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Influence of Socio-economic Characteristics of Cocoa Farmers on the Use of E-agriculture in Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Author DAN conceived and designed the study, conducted field work, analysed the data and wrote original draft. Author JK supervised the study. Both authors read and approved the final manuscript.

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ABSTRACT

The emergence of modern communication technology has influenced lives of many people and businesses around the world. It has revolutionized agribusiness activities, improved communication and information access among farmers. Amid of this technophilia, many cocoa farmers are still challenged with agricultural and extension information access in Ghana. The main objective of this study was to ascertain the socio-economic factors that influerence cocoa farmers use of e-agriculture services. A multistage cluster sampling method was used to select 113 cocoa farmers' household from the Akyease cocoa district. The data obtained was analysed using SPSS software version 22. The study revealed that farmer education, household income, gender, among other factors were the main determinants of farmers' e-agriculture information access. It was therefore recommended that a comprehensive educational programme should be introduced to cocoa farmers to enhance their education and the use of e-agriculture services.

Keywords: E-agriculture; cocoa farmers; socio-economic characteristics; Ghana.

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1. INTRODUCTION

The advent of modern technologies has influenced many lives and economic activities around the world. Advanced technologies have altered the way business and household activities were carried out in our society decades ago. It has now ushered in an era of marvel, where workers can be complemented by technology (labour-augmenting technology) to increase work efficiency and labour productivity. The economic growth in many countries has been linked to the emergence of these new technologies, which have the ability to stimulate productivity growth, raise income, and consequently improve the living standard of people [1]. Technology continues to offer different range of tools and resources that provide useful information and services to augment industrial productivity. For instance, the introduction of a computer-controlled technology in valve producing companies in the United States and the United Kingdom was observed to have caused a significant increase in productivity by reducing setup time, production time and inspection time [2]. The technological influence in our world today has not only marveled humanity, but also transubstantiated the world of businesses, including the agricultural sector.

The agricultural sector as a branch of the world economy has experienced conspicuous digital revolution for the past decade, the sector has seen a great deal of agtech that is contributing immensely to innovations in production systems, work efficiency, processing and distribution of produce. Wolfert et al. [3] observed that technological advancement in agriculture has paved way for digital platforms, such as e-commerce platforms, agro-advisory applications, big data, satellite systems, computational power, and remote sensing to facilitate agriculture information sharing among producers. The technophilic in agriculture continue to unveil more tools and devices that enhance agricultural information sharing and access. Modern Information and Communication Technology (ICT) tools such as mobile phones, computers, software application, social media, among others provide the enabling environment for agricultural producers to interact with other players within the agricultural industry. ICT resources also have the potential to identify and find solutions to some of the numerous problems faced in agriculture, such as pest and disease outbreaks, prolonged drought, and high transactions costs [4]. ICT application in agriculture such as electronic agriculture (e-agriculture) is gradually changing the face of communication and information access among farmers, input dealers and agricultural technical officers. E-agriculture is a fast-developing field in agricultural sector that primarily focus on improving agricultural development through the application of information and communication technologies [5]. Many countries around the world have tapped into the e-agriculture technology and obtained varied degrees of success. For instance, in Tanzania, an electronic agricultural extension system called “UPTAKE" has been developed to provide farmers with up to date information on maize production, market information, good agricultural practices, and improved seed varieties that are susceptible to their farming areas [6]. Similarly, an e-Wallet (an electronic distribution channel) is used by the public extension services in Nigeria to provide farmers with transparent information on agriculture inputs such as fertilizers, improved seeds, pesticides and other agriculture services [7]. Also, in India, a Green Sim technology has been developed to provide timely information to farmers daily. The system offers voice-based agricultural information in regional languages to empower rural farmers. Both private and public extension organizations are investing heavily into e-agriculture services to enable their clients have direct access to timely agricultural and market information to ease the protocols involved in accessing these information from extension advisors. Before the digital age, extension officers relied on face to face (F2F) extension methods such as farmers meetings, home and farm visits, group meetings to provide information on new agricultural methods to farmers [8]. The F2F extension practices had a lower coverage ratio, and sometimes information was distorted. Presently, with the help of ICT tools, farmers have access to a wide range of e-agriculture and market information without limitations. Mawazo [9] noted that e-agriculture services offer more convenient means of delivering useful and up-to-date weather and market information to farmers than the traditional used by extension services. E-agriculture provides the platform for extension officers to cover a large number of farmers and processors at the same time without spending much money and time on transportation. Etwire et al. [10] observed that mobile phone-based extension services enable extension providers to deliver content-specific information and create extensive awareness to farmers at a very reduced cost. E-agriculture platforms have the capacity to provide current and accurate market

information such prices of commodities and agricultural inputs; climatic and weather information that are needed by agricultural workers in Ghana including cocoa farmers to make informed decisions on their businesses.

Ghana is the world's second-largest producer and exporter of cocoa beans after Cote d'Ivoire, with an average output of 800,000 metric tonnes (MT) annually [11]. Cocoa is currently the highest export crop earner for Ghana [12]; it accounts for about 3% of the country's Gross Domestic Product (GDP) and about 20-25% of total export receipts [13]. The sale of cocoa beans served as the primary source of income for about 250,000 households, thereby contributing to the livelihoods of 1.9 million people in Ghana representing [11,14]. The cocoa sector is primarily dominated by smallholder farmers, whose farm size ranges from 1.5 to 5 hectares [15]. Over the years, these farmers had relied on their self-taught traditional methods of producing cocoa which makes them less productive. The yield output (around 400 kilograms) from a one-hectare cocoa farm in Ghana is still considered lower compared to Cote d'Ivoire, Indonesia, and other cocoa-producing countries with an estimated yield of 500 kg to 1.4 tonnes [16]. Cocoa farmers in Ghana lack the modern technologies and skills to maximize their output. In order to enhance technological application and higher productivity in the cocoa sector, the government of Ghana created the cocoa health and extension division under COCOBOD to provide technical support to cocoa farmers through extension delivery. Unfortunately, the extension services department is understaffed. The ratio of extension officers to farmers in Ghana is considerably low (1:1500). One extension officer covers a larger operational area ranging from 15 to about 60 square kilometres occupied by about 1000 to 2000 farmers [17]. Farmers sometimes must wait for days before receiving extension service. Sometimes, farmers do not get extension visit at all due to the spatial distribution of their farms. Farming communities and farms are geographically located far apart in difficult-to-reach zones, leading to unequal extension information sharing among farmers.

Currently, there are many ICT application and resources that offer agricultural and extension information to farmers electronically in the world including Ghana, that farmers could use to complement the services received from the extension services, but still cocoa farmers' access to current agricultural and market information remain a problem. Earlier research focused on identifying the factors influencing farmers' adoption of agricultural technologies, but most of these studies centred on smallholder farmers or farmers in general and have had mixed results. Etwire et al. [10] noted that contact with agricultural extension agents and farmer-to-farmer extension services play a key role in farmers' decision to adopt mobile extension services. Donkoh et al. [18] observed that education, household size and association with a group were the most influential factors of farmers agricultural technology adoption. Also, Kante [19] asserted that the simplicity and quality of agricultural information were the main factors that determined farmers' electronic information use. Until now, there has not been any research specifically focused on cocoa farmers' access to electronic agricultural information in Ghana. Therefore, the aim of the current study is to ascertain the socio-economic factors that influence cocoa farmers use of e-agriculture service.

Specifically:

1. To identify the socio-economic characteristics of cocoa farmers, and the sources of accessing information on electronic agriculture.
2. To rank the socio-economic characteristics that affect access to information on electronic agriculture.
3. To establish the relationship between socio-economic characteristics and access to information on electronic agriculture.

1.1 Limitation

This study did not include traditional media such as Television, Radio, Print media, and so forth in its scope of study. The reason is to focus on modern interactive ICTs tools such as Smartphones, Agricultural application software, internet and so on. Also, this study is of a descriptive nature, therefore it is not possible to control possible confounding factors that may prevail.

2. MATERIALS AND METHODS

The study was conducted at Akyease cocoa district in the Birim South District of the Eastern region of Ghana. The district covers an area of about 299 square kilometres. It lies within a semi-deciduous rainforest region with a population of 119,767, male forms 49% and female forms 51% [20]. Agriculture is the

mainstay of the district's economy since it employs about 70% of the active labour force [20]. The commonly produced crops are cocoa, oil palm, citrus, maize, cassava, cocoyam, plantain and vegetable such as tomatoes, cabbage, pepper [20].

The data for this study was obtained from a survey. A probability sampling method was employed using a multistage cluster sampling. Firstly, the cocoa communities were divided into six clusters based on their sizes. The smaller communities were joined to form one cluster whiles the bigger communities were maintained as a single cluster. Secondly, a simple random sampling technique was used to select twenty (20) households from five (5) cocoa communities and thirteen (13) from one big cocoa community. A total of one hundred and thirteen (113) household heads who are cocoa farmers were interviewed using a structured formal questionnaire. The validity of the questionnaire was proved by experts' panel judgment.

The data obtained were entered into the Statistical Package for Social Sciences (SPSS 22) for analysis. A descriptive analysis was run to rank the factors that influenced farmers access to information on e-agriculture on a Likert type questions on a five-point scale, with 1= Very low; 2 = Low; 3 = Average; 4 = High; 5 = Very high. The most dominated factor was ranked 1, and the least dominated factor ranked 7. Pearson Correlation Coefficient was used to determine relationships among the dependent and independent variables.

Descriptive frequencies were employed to illustrate the demographic and other characteristics of the sample.

Independent variables	Dependent variable
Gender Age, Income, Household size, Marital status, Number of spouses Education	e-agriculture information access

Variables used for the study

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of Household Heads

Table 1 gives detailed information on the socio-economic characteristics of farmers surveyed. The table shows that majority of the cocoa farmers surveyed were males, they represented 66% of the total population while female farmers represented 34%. It implies that males head many households in the study area. The result validates FAO [21] survey report on gender inequality in rural Ghana, including Akyease, which reported that female-headed households represented 27% in the rural communities. Also in a World Cocoa Foundation [16] report on land tenure and cocoa production in Ghana. Furthermore, in Ghana, females have less access to land than their male counterparts [22], as a result, many females do not own farms, and even if they own, they mostly produce arable crops rather than plantation crops, ofwhich cocoa is among. That may explain the reason why males dominate in cocoa production than females.

Table 1 further shows that 37% of the farmers were within the age bracket of 51 to 60 years, while the age category of 41 to 50 years represented 30%. The age category of 18 to 30 years represented 5% while the age of 70 years had the least score of 3%. Summation of age 51-71 and above gives 51% of the total farmers surveyed, and it implies that more than half of the farmers fell within the aged category in Ghana. The National Youth Policy of Ghana classifies all persons between 15-35 years as youth, and from 50 years upwards as aged [23]. The interpretation of this result is that the population who are within the youthful age group in Ghana are not interested in cocoa farming, which calls for concern because of the negative implications it could have on the future of cocoa production in Ghana. Arhin [24] observed that most farmers are ageing in Ghana, with an average farmer attaining 55 years; and this situation has implications for sustaining agricultural production since they cannot channel sufficient energies and resources into production.

Furthermore, Table 1 shows that 52% of the farmers surveyed have not attained any formal education, those who attained basic education were 36% while 12% constituted those who attained senior high or vocational education. The obtained result suggests that there is lower level of literacy among cocoa farmers in the study area, and this could affect their ability to use modern technological tools to access e-agriculture information, which could help them increase productivity, and also exploring non-farming sectors to generate additional revenues. The reason for higher number of cocoa farmers

Table 1. Socio-economic characteristics of household heads

Characteristics		Frequency (n=113)	Percentage (%)
Gender	Male	75	66
	Female	38	34
Age	18-30	6	5
	31-40	16	14
	41-50	34	30
	51-60	42	37
	61-70	12	11
	71 and above	3	3
Educational levels	No formal Education	59	52
	Basic Education	41	36
	SHS/Vocational	13	12
Marital status	Single	24	21
	Married	74	66
	Widow/Widower	7	6
	Divorced/Separated	8	7
Number of Spouses	1	42	57
	2 or more	32	43
Household Size	1-3	29	25
	4-6	30	27
	7-9	42	37
	10-12	12	11

Source: field data, 2017

lacking formal education can be linked to the general perception among Ghanaians, especially farmers, that farming involves the use of simple tools and equipment such as cutlass and hoes; therefore, one does not need a formal education as an entry requirement or special skills to operate. They believe it can be learnt from parents and other relatives. Contrary to this belief, farming in recent years deals with high levels of sophisticated equipment and agrochemicals, which have significant impact on agricultural productivity. The use of these equipment and agrochemicals require certain levels of education and knowledge. So, having a majority of farmers lacking basic education implies that they cannot use these equipment and agrochemicals appropriately, which may affect their productivity. Weir [25] reviewed that farmer education enhances farm productivity directly by improving the quality of labour, increasing the ability to adjust to disequilibria, and the propensity to successfully adopt innovations. Farmer education also helps them diversify their household income sources to reduce risk and improve economic security.

Also, the marital status among the farmers in Table 1 indicates that 66% of them were married, whereas 21% were single. Furthermore, farmers with one (1) spouse were 57% whiles those with two (2) or more spouses represented 43% of farmers surveyed. In Ghana, farmers, unlike other professionals, marry early with the notion that their partners will help them with household chores while they are on the farm. Spouses also offer a helping hand on the farm during harvesting of farm produce. There is also a belief among farmers and rural dwellers in Ghana that the more wives and children one has indicate wealth; as a result, farmers take more wives to showcase their social status in their society. And this practice is more pronounced among cocoa farmers, especially during the main cocoa season, the period where harvesting of cocoa beans is at its peak and money is available. This old practice could explain the high number of married farmers and as well as the increased number of spouses.

Finally, from Table 1, it could be observed that a higher number of the respondents had a household size of 7 to 9 members, which constituted 37% while the household with 4 to 6 members recorded 27% followed by the household with 1 to 3 members with 25% and finally household with 10 to 12 members being the least with 11%. The interpretation of this result is that cocoa farmers have large household sizes in the study area. This result agrees with Anang et al. [26] in their study of the adoption and income effects of agricultural extension in northern Ghana. Traditionally, farmers

households are influenced by socio-cultural and geographical locations. In Ghana, many people live in the external family system where uncles, nieces, grandmothers and others stay together with the nuclear family. More so, many farmers in Ghana practise the polygamy system of marriage, where the man is allowed to marry more than one woman. So, as farmers add more wives and bring forth, their household size increases. Also, in cocoa growing areas, farmers use their family as a source of labour to reduce labour cost, therefore, the larger the household size, the more family labour the person has, and the less money spent on external labour. These, among other things, could account for the larger household size among the respondents.

Table 2 summarizes details of farmers annual income. It could be observed that many of the farmers surveyed have an annual income below $1000, which represented 70.8% while a little over 16% annual income was between $1000 to $2000. Farmers with annual income between $4100 to $5000 were the least among the farmers surveyed, representing 1.8%. Cocoa farming is considered as the most profitable cash crop business in Ghana due to the structures put in place by the government to ensure ready market for cocoa beans. But the results from this analysis show that majority of the cocoa farmers' annual income is below the minimum annual income ($1900) of a civil servant in Ghana [27]. In Ghana, agricultural lands are usually owned by families, and every member of the family is entitled to a parcel of it, so after demarcation individual family members get smaller land for farming; this could account for the lower income from production. Another reason could be technology adoption. It was observed in (Table 1) that many farmers lack basic education and that could affect their ability to introduce new technologies that will help them improve their productivity as well as diversifying their income source.

3.2 Sources of Accessing E-agriculture Information

The sources farmers use to access electronic agriculture information in Table 3 shows that a larger number of cocoa farmers do not have access to electronic agriculture information. More than 90% of the farmers surveyed indicated they do not use any of the modern electronic tools to access agricultural and extension information. Also, 4.4% of the farmers indicated they obtain e-agriculture information through internet browsing while 2.7% said they access e-agriculture information through agricultural software applications. Facebook was the least source of accessing e-agriculture information by the farmers, which represented 0.9%. The lower levels of education among the farmers surveyed could be the cause of the lower use of electronic agriculture information among them. The observed result is consistent with previous research by Yaseen et al. [28], on their comparative analysis of ICT usage among Pakistanis and Chinese farmers. They found that one unit increase in the educational level of a household head increased the application of ICT in agriculture. The aging of farmers in the study area as found in (Table 1) could also account for higher number of farmers not accessing e-agriculture information. Zanu et al. [29] observed in their research on technology adoption among pig farmers in Ghana that aged farmers were the least to adopt new technologies as compared to younger famers.

Table 2. Farmers Annual income in USD

Income	Frequency	Percentage
Below 1000	80	70.8
1000-2000	19	16.8
2100-3000	7	6.2
3100-4000	5	4.4
4100-5000	2	1.8

Source: field data, 2017

Table 3. Sources of accessing e-agriculture information

Sources	Frequency	Percentage
Internet	5	4.4
WhatsApp.	2	1.8
Facebook	1	0.9
Agric. software Apps	3	2.7
None.	102	90.3

Source: field data, 2017

3.3 Socio-economic Characteristics Influencing E-agriculture Access among Cocoa Farmers

Table 4 displays socio-economic characteristics impacting on electronic agriculture information access among cocoa farmers in the study area. The most dominated factor recorded the highest mean value, which was ranked one (1), with the least dominated factor obtaining the least mean value, which was ranked seven (7). Among the factors, education was the highest ranked factor influencing farmers' e-agriculture information access. It had a mean value of 4.965 while

income follows closely as the second highest factor with a mean value of 3.965. Marital status on the other hand had the least influential factor, with a mean value of 1.390. The obtained result could be interpreted that among cocoa farmers in the study area, education and income were the most socio-economic characteristics that determined their e-agriculture information access. This confirms a finding by Donkoh et al. [17] that farmer education, age of farmer and family size were the most factors influencing farmers technology adoption in Ghana. Similarly, Ali [30] found that education, income, and social category of farmers were the most important socio-demographic factors affecting the adoption of ICT-based information systems by Indian farmers. Also, Asante et al. [31] noted that education, age and gender were among the most factors that influenced farmers' adoption of the yam mini-sett technology in Ghana. It implies that to improve the access of e-agriculture by cocoa farmers in the study area, their education, gender, and income levels should be taken into consideration.

3.4 Correlation Analysis of Farmers' Socio-economic Characteristics with E-agriculture Access

The test of farmers socio-economic variable with e-agriculture access in Table 5 shows that there was a positive and significant relationship between gender, age, household size, marital status and e-agriculture access. It means that in terms of gender, male farmers are likely to use e-agriculture more than female farmers. Also, younger farmers are likely to access e-agriculture information more than older farmers. Education, on the other hand showed a negative but significant relationship between e-agriculture access, and this could be as a result of fewer farmers attaining higher education (refer to Table 1). The implication of this is that cocoa farmers with higher educational attainments are more likely to use e-agriculture information than those without. This result is consistent with the finding of Asiedu-Darko [32] that educated farmers are more inclined to using modern agricultural production technologies and could even serve as agents to educate relatives and friends to adopt these technologies. Number of spouses on the other hand have limited relationship and it is not a determinant of e-agriculture access by cocoa farmers. Furthermore, there was a significant relationship between income and smartphone use among farmers. That means that farmers with higher income are more likely to use smartphones than farmers with lower income. It was revealed during the study that the use of smartphone was a social status among farmers in the area. Meaning smartphone defines farmers' wealth in their communities, but not necessarily using them to access e-agriculture information.

Table 4. Socio-economic characteristics influencing e-agriculture access among cocoa farmers

Characteristics	Mean	Standard deviation	Rank
Education	4.965	4.965	1st
Income	3.965	0.325	2nd
Gender	1.814	0.851	3rd
Age.	1.743.	0.563	4th
Household size	1.726	0.723	5th
Number of spouses	1.434	0.498	6th
Marital status	1.390	0.523	7th

Means were calculated on a scale of 1= Very low; 2 = Low; 3 = Average; 4 = High; 5 = Very high

Table 5. Correlation analysis of farmers' socio-economic characteristics with e-agriculture access

Social character	E-agriculture info access	Correlation coeff.	Sig.
Gender		0.234*	0.013
Age		0.259**	0.006
Education		-0.496**	0.000
Income		-0.066**	0.000
Marital status		0.258 **	0.006
Household size		0.207 *	0.028
Number of spouses		0.088	0.356
Income		-0.608**	0.000

Significant at the 0.05 level, Significant at 0.01 level***

4. CONCLUSION

The study primarily sought to ascertain the socio-economic factors that determine cocoa farmers access to e-agriculture. The general conclusion from this study is that farmers levels of education, household income, and gender were the most determinants of electronic agriculture information access. Also, the use of e-agriculture among Cocoa farmers was found to be very low. Furthermore, the study found majority of the cocoa farmers being lacking formal education. They have never attained any formal education. The internet, Facebook, WhatsApp and agricultural apps were found to be the modern electronic tools that fewer farmers use to obtain agricultural information. Therefore, any effort to improve cocoa farmers' access to e-agriculture services such as e-extension service, e-weather information, e-commence and so on in the area should first of all consider their educational levels, income and gender. Based on the findings from this research, it is recommended that;

Educational policy should be designed for cocoa farmers. COCOBOD, which is the main body in charge of cocoa activities in Ghana should liaise with the non-formal education unit in Ghana and design and implement adult education programme in cocoa growing areas to give farmers basic education that could enhance their ability to read and write. It will help the farmers to learn how to use basic electronic devices that can provide them with valuable information on cocoa production. It is also recommended that this study should be replicated to cover more cocoa districts and farmers, as well as other factors such as farm group, farm size, availability of extension officer and so forth.

Farmers should also diversify their income source to increase their household income by investing in non-traditional farming such as beekeeping, rearing of grasscutter etc. in addition to the cocoa farming.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Piketty T. About Capital in the Twenty-First Century. American Economic Review. 2015;105(5):48-53.
   DOI: 10.1257/aer.p20151060
2. World Cocoa Foundation. Report on Land Tenure & Cocoa Production in Ghana. A CRIG/WCF Collaborative Survey; 2017.
3. Wolfert S, Lan G, Verdouw C, Bogaardt M. Big data in small farming-a review. Agric. Sys. 2017;153:69–80.
4. Gerber N, Alisher M. Benefits of action and costs of inaction: Drought mitigation and preparedness – A Literature Review (Geneva & Stockholm: World Meteorological Organization & Global Water Partnership, 2017) Integrated Drought Management Programme Working Paper. 2017;1.
5. FAO. E-agriculture promising practice UPTAKE: driving adoption of agri-technologies through information and communication technologies (ICT). Food and Agriculture Organization of the United Nations; 2018.
   Available:http://www.fao.org/3/I9142EN/i9142en.pdf
6. FAO, ITU. E-Agriculture Strategy Guide: A summary. FAO and International Telecommunication Union (ITU) Bangkok; 2017.
   Available:http://www.fao.org/3/a-i6909e.pdf
7. Agwu EA, Nwokorie UM. Challenges and opportunities for ICT adoption in agricultural extension. ICT update Newsletter; 2019.
   Available:https://ictupdate.cta.int/en/article/challenges-and-opportunities-for-ict-adoption-in-agricultural-extension-sid03b7c751a-f2db-48c7-a5ed-40344e00e00a
   Accessed on 20/11/2019
8. FAOSTAT. Food and Agriculture Organization of the United Nations, 2010. 2016. Roma, Italy.
9. Mawazo MM. Linking rural farmers to markets using ICTs. The Technical Centre for Agricultural and Rural Cooperation (CTA) working paper 15/12. Wageningen, The Netherlands; 2015.
10. Etwire PM, Buah S, Ouédraogo M, Zougmoré R, Partey ST, Martey E, Dayamba SD, Bayala J. An assessment of

mobile phone-based dissemination of weather and market information in the Upper West Region of Ghana. Agric. Food Sec. 2017;6(1):8.

11. Asante-Poku A, Angelucci F. Analysis of incentives and disincentives for Cocoa in Ghana. Technical notes series, MAFAP. FAO, Rome; 2016.
12. Abbadi S, Senadza B, Lieuw-Kie-Song M, Abebe H. Assessing the employment effects of processing Cocoa in Ghana. International Labour organization, Geneva, Switzerland; 2019.
    ISSN:1999-2947
13. GSS. Population and Housing Census: District Analytical report. Ghana Statistical Service; 2010, Accra.
14. Schulte-Herbrüggen B. The importance of bushmeat in the livelihoods of cocoa farmers living in a wildlife depleted farm-forest landscape, SW Ghana. (doctoral thesis) Department of Anthropology, University College London; 2011.
15. COCOBOD. Report of the Committee on Application of High Technology Method on Cocoa Production in Ghana. Ghana Cocoa Board; 2002. Accra, Ghana.
16. World Cocoa Foundation. Report on Land Tenure & Cocoa Production in Ghana. A CRIG/WCF Collaborative Survey; 2017.
    Available:https://www.worldcocoafoundation.org/wpcontent/uploads/files_mf/1492612620CRIGLandTenureSurveyFinal41217.pdf
17. Lamontagne-Godwin J, Williams F, Bandara WM, Appiah-Kubi Z. Quality of extension advice: A gendered case study from Ghana and Sri Lanka. The J. Agric. Edu. & Ext. 2017;23(1):7–22.
    DOI:10.1080/1389224X.2016.1230069
18. Donkoh SA, Azumah S, Awuni JA. Adoption of improved agricultural Technologies among Rice Farmers in Ghana: A Multivariate Probit Approach. Ghana J. Dev. Stud. 2019;3(16):46.
19. Kante M, Oboko R, Chepken C. Influence of perception and quality of ICT-based agricultural input information on use of ICTs by farmers in developing countries: Case of Sikasso in Mali. Electron J. Inf. Syst. Dev. Ctries. 2017;83(1):1-21.
    DOI:10.1002/j.1681-4835.2017.tb00617.x
20. MOFA. The districts in Eastern region.
    Available:http://mofa.gov.gh/site/?page_id=1508. Accessed on 15/04/2016
21. FAO. FAO report on gender inequality in rural employment in Ghana Overview. Research and Extension, FAO; 2012. Rome, Italy.
22. Higgins T, Fenrich J. Legal Pluralism, Gender, and Access to Land in Ghana. Fordham Environmental Law Review. 2012;7-21.
23. GSS. 2010 Population and Housing Census Report: Children, Adolescents and Young people in Ghana; 2013.
24. Arhin BG. Ghana Agricultural News Digest – February 8, 2016: Ghana Strategy Support Program, International Food.
25. Weir S. The effects on education on farmer productivity in rural Ethiopia. Working Paper CSAE WPS99-7. Centre for the Study of African Economies, University of Oxford; 1999.
    Available:https://www.worldcocoafoundation.org/wp-content/uploads/files_mf/1492612620CRIGLandTenureSurveyFinal41217.pdf
26. Anang BT, Backman S, Sipilainen. Adoption and income effects of agricultural extension in northern Ghana. J. Sci. Afr. 2020;77:1-11.
    DOI:https://doi.org/10.1016/j.sciaf.2019.e00219
27. Paylab Ghana. Salaries in category: Education, Science & Research; 2017.
    Available:https://www.paylab.com/gh/salaryinfo/education-science-research. Accessed 08/02/2018
28. Yaseen M, Xu S, Wen Y. Factors inhabiting ICTs usage among farmers: A comparative analysis from Pakistan and China. Open J. Soc. Sci. 2016;4:287–294.
29. Zanu HK, Antwiwaa A, Agyemang CT. Factors influencing technology adoption among pig farmers in Ashanti region of Ghana. J. Agric. Tech. 2012;8(1):81-92.
30. Ali J. Factors affecting the adoption of Information and Communication Technologies (ICTs) for farming decisions. J Agric Food Inf. 2012;13(1):78–96.
    DOI:10.1080/10496505.2012.636980
31. Asante BO, Villano RA, Battese GE. The effect of the adoption of yam minisett technology on the technical efficiency of yam farmers in the forest-savannah

transition zone of Ghana Afr. J. Agric. Res. Econ. 2014;9(2):75-90.

32. Asiedu-Darko E. Effects of gender, education and age on the adoption of agricultural technologies in Ashanti, Northern and Eastern regions of Ghana. J. Appl. Sci. & Res. 2014;2(1):112:118-67.

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