IJSGS FUGUSAU VOL. 7(3), OCTOBER, 2021 WEBSITE: http://journals.fugusau.edu.ng

IJSGS

ISSN: 2488-9229
FEDERAL UNIVERSITY
GUSAU-NIGERIA

INTERNATIONAL JOURNAL OF SCIENCE FOR GLOBAL SUSTAINABILITY

Development of Automated Agricultural Information System

[1]Usman Yusuf Keana, [2]Samaila Musa, [3]Binyamin A. Ajayi, [4]Abdullahi Salihu Audu,
[5]Esther Samuel Alu and [6]Mustafa Ahmed

[1]PG Student, Nasarawa State University, Keffi.
[2]Department of Computer Science, Federal University Gusau.
[3,4,5,6] Department of Computer Science, Nasarawa State University, Keffi.

Corresponding Author's Email: samailaagp@gmail.com

Received on: August, 2021 **Revised and Accepted on:** September, 2021 **Published on:** October, 2021

ABSTRACT

Information giving out in the area of Agriculture is usually through the use of broadcast media, newspapers, magazines, pamphlet, individuals, gatherings, and seminars. Also records of farmer are collected manually using printable forms and complaints are tabled through extension workers. The challenges with these systems are unrelated of information deliver, the system does not capture all farmers, and communication is one way. The main objective of this paper is to implement the Algorithms for Agricultural Automated Information System for Computer Based Information system in Agricultural sector in Nigeria. The system was developed using Hypertext Markup Language (HTML), Hypertext Preprocessor (PhP), Java scripting Language, My SQL Server, WAMP server, cascading sheet, notepad and web browser. These results show that the problem of a lack of appropriate and easily accessible agricultural information can be solved using a system. After the development of the system, information about farmers profile who had registered, farm inputs as well as other information can be view and their locations easily identified. The portal is distributed system which various Ministries of agricultural and rural development in the country can adopt so as to have a database that contains all farmers' information and provide a platform that would provide seamless access to improved information and communication dissemination system in order to take advantage of ICT.

Keywords: Information System; broadcast media; Agricultural sector; Agricultural Automated Information System; farmers; government

1.0 INTRODUCTION

1.1 Background of the study

Every organization requires information to survive in this modern world. Information has great influence on decision making. Its values cannot be over emphasized and achievable for those who use it. Information is important resource needed to grow and develop any sector of the organization. Change in the environments and way things are carried out, make it necessary for the need to have access to vital information for efficient and effective decision making in each level of management in an organization. Information creates awareness for better understanding that can improve the means of livelihood of individual and communities at large (Adedokun and Gbaje, 2014).

The development of management information system MIS is concerned with the use of correct information that can lead to effective decision making and better results. A manager can be more effective in management if he largely depends on the existence and use effective and efficient MIS that will provide the necessary information needed to make critical decision in running day to day operation of the organization. On the other hand, information system deals with the process of collecting, manipulating, storing and disseminating fact and information and provides feedback mechanism to it users. Computer and information system are changing the way organizations carry out their function of managing information that is made for public and how to go about disseminating information that is useful to the public most especially the targeted users.

Agricultural information is an important factor that interacts with other production factors, such as land, capital, labour and other managerial ability, can be improved by relevant, reliable and useful information supplied by extension, research, education and agricultural organizations helps farmers make better decisions. Therefore, there is a need to understand the functioning of a particular agricultural information system in order to manage and improve it (Demiryurek, Erdem, Ceyhan, Atasever & Uysal, 2008).

Accordingly, an Agricultural Information System (AIS) consists of subsystems, information related processes, interfaces, networks, control and management. Agricultural information is considered as an essential input to agricultural education, research and development and extension activities. There is a strong need for AIS to influence agricultural activity in several ways. It can bring about the needed information which farmers would make decisions regarding farming activities and management. Agricultural activities can be improved upon through efficient, consistent, and useful information and knowledge dissemination in the sector. AIS help in disseminating information to farmers so that farmers can make decision in order to take advantage of their productivities.

de Araujo, da Silva & Albini (2020) proposed a work that aims at reviewing the state-of-the art of smart agriculture security, particularly in open-field agriculture, discussing its architecture, describing security issues, presenting the major challenges and future directions. Strang, Vajjhala & Bitrus (2019) examined what factors impacted the Agricultural Information System (AIS) electronic software adoption by rural farmers in central Nigeria. They collected a moderately large sample of responses from rural farmers and examined the generally accepted factors that were found in the literature. The results should generalize to other rural farm decision makers in Nigeria and the paper should be of interest to other researchers in this field.

Tegegne and Alemu, (2019) present a design and evaluation of an SMS-based agricultural information system that serves as a platform where rural farmers and extension officers can share agricultural information. Development of the system followed a Rapid Application Development (RAD) methodology. The system was evaluated for usability, accuracy, performance, and significance. The performance of the system was analyzed by gathering data for the amount of time it took to process the messages and send responses based on a user's request. Based on feedback from 20 participants using the SUS, the system, with the score ranging from 0 to 100, scored 87.63. The mean average response system time was 3.34 seconds. These results show that the problem of a lack of appropriate and easily accessible agricultural information can be solved using a system.

Information dissemination in the Agricultural sector is done through broadcast media (Television and Radio), newspapers, magazines, pamphlet, individuals, gatherings, and seminars. Also records of farmer are collected manually using printable forms and complaints are tabled through extension workers. Various agricultural information systems were developed to provide crop information to farmer (Adeyemo, 2013) developed national e-agriculture that provides relevant information about varieties of crops and other requirement such as temperature soil type, rain fall, temperature, type and quantity of fertilizer, time of planting, time of maturity, market price etc. all this agricultural information system provide pre-farming and post farming information to the Farming to take decision about his farming activities.

The various agricultural information system highlighted does not have functionality for storing information of the farmers, farmer cannot interact with the institution concerned, whenever in difficulties. Information dissemination in the Agricultural sector is usually done through broadcast media (Television and Radio), newspapers, magazines, pamphlet, individuals, gatherings, and seminars. Also records of farmer are collected manually using printable forms and complaints are tabled through extension workers. The challenges with the current system are irrelevant of information deliver, the system does not capture all farmers, and communication is one way.

The aim of this study is to show how framework, algorithm designed and developed database for storing, managing, and disseminating information in the Agricultural sector can be implemented.

1.2 Related Works

Application of Information and Communication Technology (ICT) in agriculture is increasingly important (Saha, Sakib, Saquib & Hussain, 2010). Agricultural information involves the conceptualization, design, development, evaluation and application of innovative ways to use ICT in rural domain, with a primary focus on agriculture. ICT can play a significant role in maintaining properties of information as it consists of three main technologies (Mahant, Shukla, Dixit, & Patel, 2012). Adhiguru, Birthal & Kumar (2009) present an agricultural information flow which

revealed that only 40 per cent farm households access information from one or the other source. The popular information sources among farmers have been reported to be fellow progressive farmers and input dealers, followed by mass media. The public extension system has been found to be accessed by only 5.7 per cent households. Only 4.8 per cent of the small farmers have access to public extension workers as compared to 12.4 per cent of large farmers. Regarding adoption of information by farmers, input dealers and other progressive farmers have depicted greater influence mainly due to easy and convenient access to these sources. The researchers suggested promotion of farmers-led extension and strengthening of public extension services to improve coverage and efficiency of agricultural information delivery systems.

Tiago, Marco, Vítor, Otávio and André (2014); Kumar and Babu (2016); Weiguo, Zhengwei, Liping, Richard (2012); Zhu, Zhang and Sun (2009); Wilson (2000) have demonstrated and implemented web-GIS based information systems for agriculture using traditional GIS tools and technologies. These technologies are often insufficient to provide a complete picture of analytics in a geographic context.

Mtega & Msungu (2013) assessed how ICTs can enhance access to agricultural information needed for fostering agricultural production and agribusiness in Tanzania. Specifically, the research determined the role of specific ICTs in agricultural production and agribusiness and assessed the effectiveness of the commonly used ICTs in the creation and sharing of agricultural knowledge and information services. The researchers used a mixed approach in collecting data, relying on a structured questionnaire, interviews, content analysis and observations during the data collection. The results show that radio, mobile phones, television, computers and internet have potentials to transform the sector if they are used effectively. Mobile phones and radio were preferred as communication channel among farmers while researchers and extension staff mentioned to prefer using computers and internet. From the research findings it is recommended that internet and mobile service providers should widen their infrastructure and reduce tariffs associated with usage of their services so as to increase the number of users of their services.

The developments in ICT and the Internet in particular have revolutionized the entire agriculture field. It has generated new markets, changed the structure of the Agriculture distribution channels and re-engineered all processes. Different technology used from the perspective of agricultural research, extension, product processing and marketing. The findings reveal potential growth of the agriculture sector. The impact of information and communication technology (ICT) on access for rural farmers on agricultural information was analyzed by (Armstrong, Gandhi, & Lanjekar, 2012) reveal that farmers were most interested in obtaining market price information without putting into consideration the need to have modern knowledge about farming and farming related activities. Examining of the relationship between use of ICT tools and co factors such as age, qualifications and income indicated that only income was a determining factor of using ICT tools. Armstrong, Diepeveen and Gandhi (2011) explain the grains value chains in agriculture, and identify the importance in developing strategies which could better secure food production. The study integrates ICTs in agricultural supply and value chains. The development of strategies to integrate these ICTs into the supply chain was proposed.

Saidu, Clarkson, Adamu, Mohammed & Jibo (2017) reviewed the influence of Information and Communication Technology in agriculture in respect of opportunities and trials. It was found that improvement of market activities, exchange of relevant information, profit gain, networking agricultural sector globally, conducting research and strategizing economic growth for self-reliance are among the possible benefits of ICT in agricultural sector. Likewise, the review identified inadequate ICT facilities, lack of personnel, insufficient infrastructure, harmonization of knowledge and language, power supply and farmers' perception are some of the challenges and issues that obstruct successful implementation of ICT in agricultural growth. Saidu et al, (2017) concluded that more research need be conducted in order to draw relevant ideas and suggestions that will enhance fruitful implementation of ICT to develop agriculture.

Islam, Haque, Afrad, Abdullah and Hoque (2017) conducted a study on 110 SAAOs (Sub Assistant Agriculture Officer) of Manikganj district to investigate the use of different ICT tools for

official purpose and found that about 94% of the respondents highly used mobile phone followed by smart phone (8%) and digital camera (6%). Rest of the tools had very limited use. It was a major concern that only 3% and 1% respondents highly used internet and computer respectively. There is no alternative to increase and apply the use of GIS in the coming years to sustain agricultural production. A GIS based soil mapping system at the union level can analyze data and provide information relating to crop suitability, land zoning, nutrient status and fertilizer dosage. Satellite based data will help to define flooding by its characteristics (river flood, flash flood, tidal flood, rain fed flood) and duration of inundation. This system can also be applied to assess drought, salinity and cold stresses for each soil map unit.

Birke (2021) presented a work that aims to provide evidence on the implementation process of ICT initiatives in agriculture extension organizations and their use. The researcher provides empirical evidence on the complex interaction of social and technical actors and their assemblage to set up an ICT-based initiatives called Agricultural Knowledge Centers (AKCs); to provide empirical evidence on experts' perceptions and their use of ICTs in agriculture extension offices; and to bring insights on organizational characteristics that facilitate or hinder the learning of an organization for successfully applying ICTs in agriculture extension services. The work analyzes the innovation process of ICT-based initiatives in agriculture extension by building on the definition of innovation as an alignment of hardware (technical devices, bodily skills), software (mode of thinking, discourse, perceptions).

Chowhan & Ghosh (2020) performed a thorough review of secondary data sources; i.e. overlook of literatures from web, online published articles, reports, news etc. on some selective districts of Bangladesh to study the current features of ICT, its exercise and future prospects in the context of agriculture information and communication. The results showed that the majority of the farming group and thereby involved extension workers (SAAO) have limited access, usage, knowledge and capacity on the use of ICT tools and media. But the researchers do not consider collecting, storing, managing, and disseminating information in the Agricultural sector.

Shah, Hiremath & Chaudhary (2017) propose a spark-based information management system for agriculture and intend to reduce the technological gap between agro users and information. The work was proposed to collect, query, analyze, and visualize heterogeneous and distributed data including Geo-spatial data at scale using open source. The analytical results are explored through interactive maps and Restful adhoc Application Programming Interfaces.

Dourte, Fraisse & Uryasev (2014) developed a tool that provides a system-specific water footprint accounting that responds to changes in location, time, soil, and management. Modifications to an existing crop growth model were made in order to separate consumptive use of green and blue water; that is water from rainfall and water from a groundwater or surface water resource, respectively. This separation is an important distinction of water foot printing that allows for more direct assessments of impacts on water resources. The tool also provides a local water stress index, based on regional water use and available supplies, and it displays time series and cumulative rainfall during the period of crop production.

ICT in agriculture field focusing on the enhancement of agricultural and rural development involves innovative applications using ICT in the rural domain (Singhal and Shukla, 2011) the advancement of ICT can be utilized for providing accurate and timely relevant information and services to the farmers, thereby facilitating an environment for remunerative agriculture.

2.0 RESEARCH METHODOLOGY

The proposed system will be accessed by the users using a web browser such as Mozilla, Opera, and Chrome or internet explorer. The system will feature a security subsystem that will be used to authenticate user requesting access into the system. It has four different types of interfaces for interacting with the database each of which grants specific access right to the operations the users can perform. The following are the list of interfaces.

i. Farmer's interface: This interface will be used by the farmers to upload and their information and also gain quick access to all the necessary forms and information they need to know.
ii. Research interface: This interface will be used by the individual department to register/upload and received complaints of the farmers.

iii. Government interface: This interface will be used by the individual institutions to upload vital information concerning government policies and programs.
iv. Complaint interface: this interface allows the farmer to lay their various complaints.

3.0 IMPLEMENTATION OF THE NEW SYSTEM

The new system was develop using java programing language and hypertext makeup language, Cascading style sheets, for user Interface, my structural query language for data-based query while hyper processor was use for application development.

3.1 Input Forms

This design describes the input to the system. The first is the user interface forms. These were designed using PHP programming language with Macromedia Dreamweaver as editor. Different forms/screen were developed. As shows in Figure 3.1 to Figure 3.6.

The Home page

This form allows farmers and research institution and the Admin to register, Log-In into the application. The interface form is shows in Figure 3.1.

Figure 3. 1: The Home Page

Log-In Interface Form for Farmer

This form allows farmers register and also Log-In into the application to use it after registration. The interface form is shows in Figure 3.2.

Figure 3.2. Farmer Log in Page

Research Institution Log-In Interface Form
This form allows Research institution register and also Log-In into the application to use it after registration. The interface form is shows in Figure 3.3..

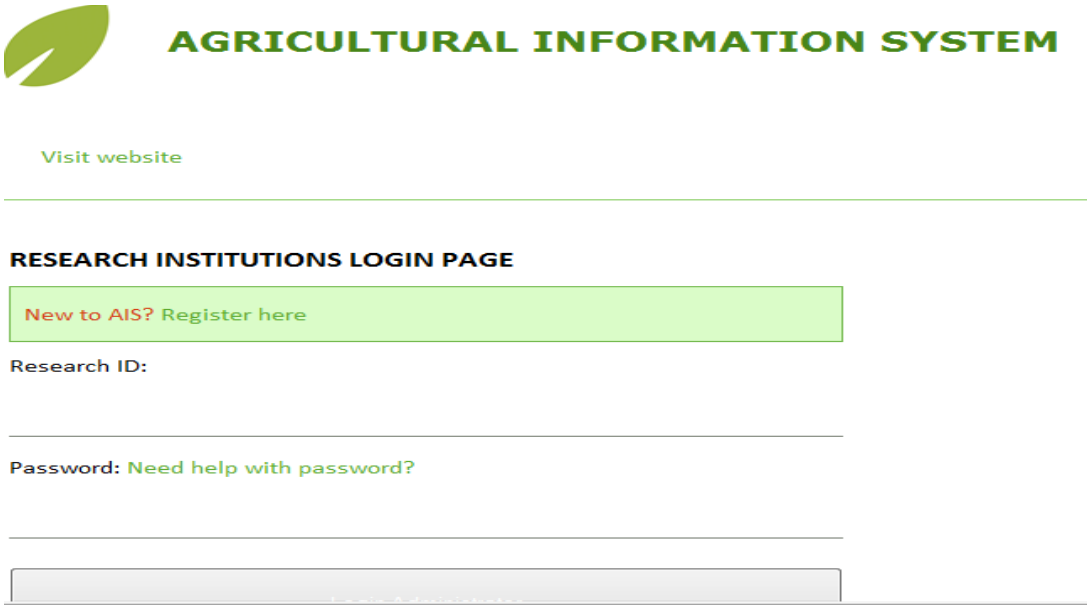

Figure 3.3. Research Institution Log in Page

Research Institute Registration Form
This form allows Research institution registers their organization Name, Address, and research interest. The interface form is shows in Figure 3.4**.**

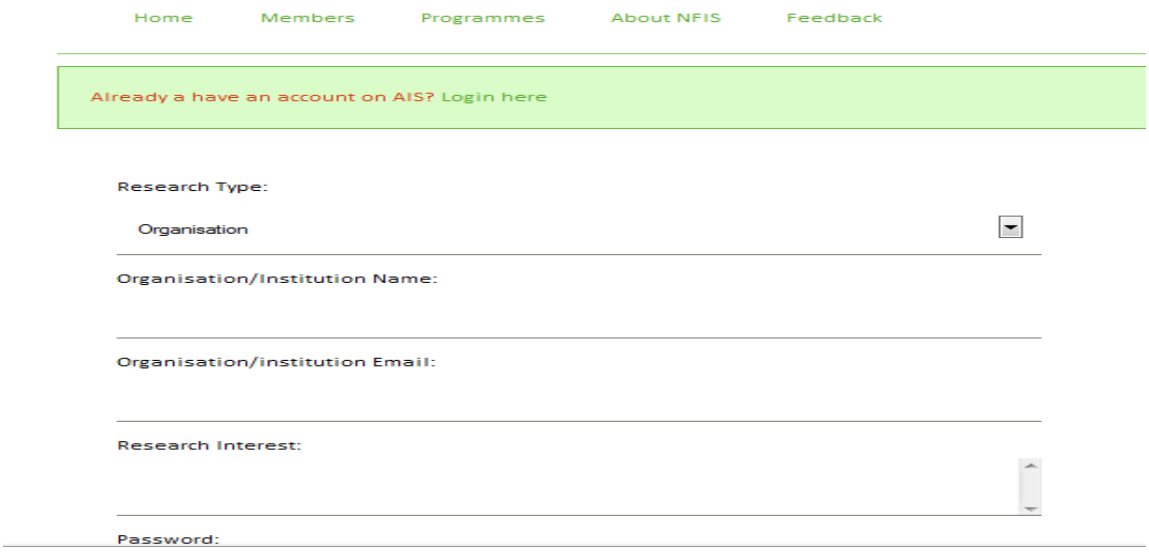

Figure 3.4. Research Institute Registration Page

Complaint Form
This form allows farmers to make their compliant whenever they have issues or difficulties in the farming activities. The interface form is shows in Figure 3.5.

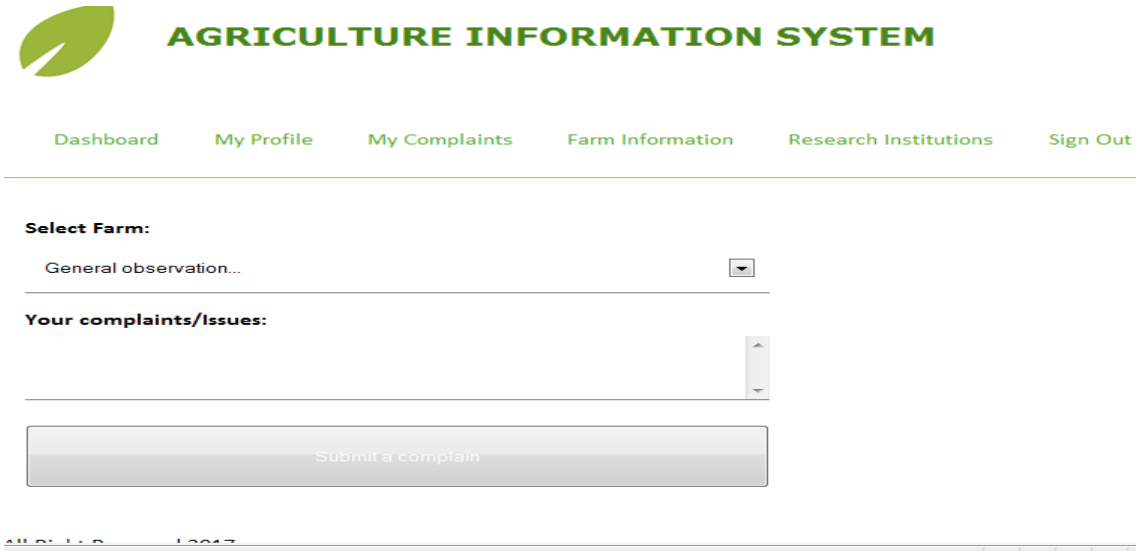

Figure 3.5. Complaint Page

4.0 DATA ANALYSIS AND RESULT

The outputs from the system include view of advice from research report, viewing of policies and programs. The goal of the output design is to present information to the user of the application so that they can accurately understand it with the least effort. Outputs of this system (Agricultural information system) are the reports that the system produces. This is as shown in Figure 4.1 and Figure 4.2.

Report form

This form allows the user (farmer) to view the suggestion given to him by a research institution. The interface form is shows in Figure 4.1.

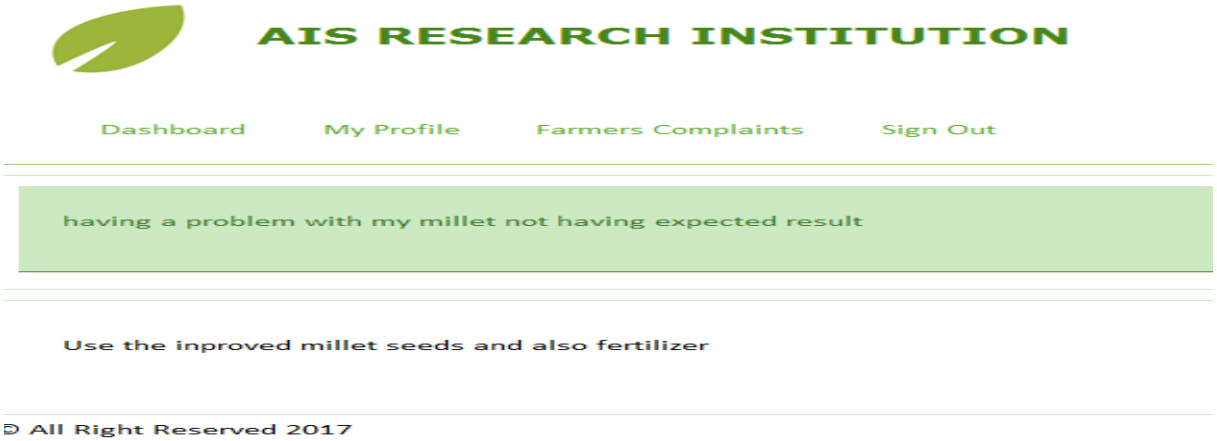

Figure 4.1. Advice Given to a Farmer

List of Research Institutions

This form allows the user to view all research institutions (and their research) that have registered. The interface form is shows in Figure 4.2.

Figure 4.2. List of Some Research Institution

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Based on the research work carried out at the course of the study, the work come out with system that is more usable and reliable compared to the old system of storing and disseminating information in the Agricultural sector, the system was design using PHP and MYSQL which make the system flexible and robust. However, the system is designed to minimize the problem with the old system in terms of storing and disseminating information, the new system has the ability to create, store and update information, make inquiry, and disseminating of advanced technological findings, policies and program of ministry of agricultural and rural development.

5.2 Conclusion

Automated agricultural information system if adopted will help in having a database that contains precise and accurate information concerning each and individual farmer his location, state of residence, and the type of farming he/she is into. Accurate information can be disseminated in due course reaching the targeted audience which is the farmer at the right time. Many farmers didn't have access to most of the required information to improve in their performance of crop productions. Therefore, Agricultural information system as a platform will help to address some of these issues because they now have a platform to make direct inquiring. Government interventions could be monitored and ensure that it get to the farmers, such in the area of fertilizer and seed distribution in so doing it will increase productivities and also encourage others to embrace farming as a means of livelihood which at the end will contribute to the economy at large. This study was able to come up with a framework for which farmer can interact with the research institution and extension institution that provide the farmer with the techniques for modern farming. Also, algorithm was designed in other to show the flow of information in the agricultural sector. The framework and the algorithm were developed and implemented to achieve the objectives of the research work of having a system that sored, help in retrieving and disseminating information in the agricultural sector.

5.3 Recommendations

Based on the advantages to be derived from the ICT in this modern age, this research is recommended to various Ministry of agricultural and rural development in the country, so as to have a database that contains all farmers' information and provide a platform that would provide seamless access to improved information and communication dissemination system in order to take advantage of ICT.

5.4 Limitation of the Study

The researcher faced some constraints in carrying out this research which are as follows; it has a very wide attribute that need to be clearly understood. The population size is very large as it involves almost every farmer in the country. There is issue of Internet connectivity in the local areas. Therefore, the need for government to connect every rural area with dedicated Internet for the easy access to the portal by the farmers.

5.5 Future work

New agricultural information systems can be designed considering major or minor problems that might have been measured during the study. Areas such as smart agricultural video conference, between farmers, extension and research institutions can be considered. Agricultural Information System (AIS) using local languages that would also accommodate major languages in the country are hereby recommended for future work.

REFERENCES

Adedokun, O. A., & Gbaje, E. S. (2016). *MIS channels for effective information provision to managers of agricultural extension programme*s. International Journal of Library and Information Science, 8(3), 19-26.

Adeyemo, B. A. (2013). An E-farming framework for sustainable agricultural development in Nigeria, *Journal of Internet and Information System*.

Adhiguru, P., Birthal, P. S., & Kumar, B. G. (2009). Strengthening pluralistic agricultural information delivery systems in India. Agricultural Economics Research Review, 22(1), 71-79.

Armstrong, L. J., Diepeveen, D. A. and N. Gandhi, (2011). "Effective ICTs in agricultural value chains to improve food security: An international perspective. *World Congress on Information and Communication Technologies*, Mumbai.

Armstrong, L. J., Gandhi, N., & Lanjekar, K. (2012). Use of Information and Communication Technology (ICT) Tools by Rural Farmers in Ratnagiri District of Maharastra, India. *International Conference on Communication Systems and Network Technologies*, Rajkot, doi: 10.1109/CSNT.2012.202.

Birke, F. M. (2021). Public agriculture extension and information and communication technologies: a case study in South Wollo, Ethiopia.

Chowhan, S., & Ghosh, S. R. (2020). Role of ICT on Agriculture and Its Future Scope in Bangladesh. Journal of Scientific Research and Reports, 20-35.

De Araujo Zanella, A. R., Da Silva, E., & Albini, L. C. P. (2020). Security challenges to Smart Agriculture: Current State, Key Issues, and Future Directions. *Array*, 100048.

Demiryurek, K., Erdem, H., Ceyhan, V, Atasever, S., & Uysal, O. (2008). Agricultural information systems and application networks: the case of dairy farmers in Samsun province of Turkey. *Information Research*, 13(2) Retrieved from http://InformationR.net/ir/13-2/paper343.html

Dourte, D. R., Fraisse, C. W., & Uryasev, O. (2014). WaterFootprint on AgroClimate: A dynamic, web-based tool for comparing agricultural systems. Agricultural Systems, 125, 33-41.

Islam MS, Haque ME, Afrad MSI, Abdullah HM, Hoque MZ. Utilization of ICTs in agricultural extension services of Bangladesh. Asian J Agr Extn Econ Soc. 2017;16(1):1-11.

Kumar SK, Babu SDB (2016) A Web GIS Based Decision Support System for Agriculture Crop Monitoring System-A Case Study from Part of Medak District. J Remote Sensing & GIS 5:177. doi:10.4172/2469-4134.1000177.

Mahant, M., Shukla, A., Dixit, S., & Patel, D. (2012). Uses of ICT in agriculture. *International Journal of Advanced Computer Research*. 2. P 2249-7277.

Mtega, W. P., & Msungu, A. C. (2013). Using information and communication technologies for enhancing the accessibility of agricultural information for improved agricultural production in Tanzania. The Electronic Journal of Information Systems in Developing Countries, 56(1), 1-14.

Saha A., Sakib S.R., Saquib N., & Hussain M, (2010) *Required IT infrastructure, Technical Design, and Total Admin Assessment to Establish an "Agro Call Center"*. Retrieve from coursehero.com

Saidu, A., Clarkson, A. M., Adamu, S. H., Mohammed, M., & Jibo, I. (2017). Application of ICT in agriculture: Opportunities and challenges in developing countries. International Journal of Computer Science and Mathematical Theory, 3(1), 8-18.

Shah, P., Hiremath, D., & Chaudhary, S. (2017, December). Towards development of spark based agricultural information system including geo-spatial data. In 2017 IEEE International Conference on Big Data (Big Data) (pp. 3476-3481). IEEE.

Strang, K. D., Vajjhala, N. R., & Bitrus, N. S. (2019). Examining e-Adoption of Agricultural Systems by Farmers in Central Nigeria. *International Journal of E-Adoption (IJEA)*. 11(2), 31-40.

Tegegne, A. K., & Alemu, T. A. (2019). SMS-Based Agricultural Information System for Rural Farmers in Ethiopia. *Journal of Usability Studies*, 15(1).

Tiago H. Moreira de Oliveira, Marco Painho, Vítor Santos, Otávio Sian, André Barriguinha, Development of an Agricultural Management Information System based on Open-source Solutions, Procedia Technology, Volume 16, 2014, Pages 342-354, ISSN 2212-0173, http://dx.doi.org/10.1016/j.protcy.2014.10.100.

Weiguo Han, Zhengwei Yang, Liping Di, Richard Mueller, CropScape: A Web service based application for exploring and disseminating US conterminous geospatial cropland data products for decision support, Computers and Electronics in Agriculture, Volume 84, June 2012, Pages 111-123, ISSN 0168-1699, https://doi.org/10.1016/j.compag.2012.03.005.

Wilson, T.D. (2000). Human Information Behavior. *Informing Science*, 3(2), 49-55.

Zhu, Z., Zhang, R. and J. Sun, "Research on GIS-Based Agriculture Expert System," *2009 WRI World Congress on Software Engineering*, Xiamen, 2009, pp. 252-255. doi:10.1109/WCSE.2009.104.