Utilization of Information and Communication Technology in Agriculture

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Abstract. The purpose of this study is to analyze the benefits of ICTs to support agricultural development. This study used qualitative research methods. The results of this study are, the application of ICT in the agricultural sector can reduce risk in business in agriculture. Because the presence of ICTs in the agricultural industry can make predictions more accurately, with various sources and decision support systems and expert systems that can be developed to support farmers in the decision-making process. This research was conducted to find out how influential the role of information and communication technology (ICT) is in the agricultural industry.

1. Introduction
ICTs offer several new ways to communicate and exchange information and knowledge in the last period. ICT can be widely understood as a technology that provides communication, processing, and transmission of information electronically. ICTs can be used as a means to provide precise and accurate information, information and services that are relevant for farmers to facilitate the environment to get greater results than before. The technological revolution includes many new things such as how to capture, process, store and display information, and also be able to increase productivity and competitiveness with the availability of information. The effective use of ICTs in rural areas depends on the readiness and preparedness of the community through appropriate knowledge and attitudes in using these ICTs. The use of ICT is very important as a pillar of agricultural expansion in the current state, a world that is changing very rapidly has been recognized as the basis of the process for providing information and tools as input for modern agriculture today [1]. Agriculture is the main key in the process of human development. Due to the increasing demand for food supplies, people are trying to give extra effort and special ways to produce food excessively. The use of various technologies in agriculture is one such effort. No exception from the use of scientific technology in agriculture itself, ICTs are currently being implemented in agriculture. Technologies such as sensor networks, satellite navigation, and grid computing function to enhance monitoring and decision making capabilities [2].

In most countries, farmers use traditional methods. Most farmers observe that yields and fruits have not increased, on the contrary, the yields of farmers decline from day today. More development can enable automation in agriculture. This will replace the role of humans with machines that can produce more information that includes about the agricultural environment, reduce labor intensity on agriculture, utilize agricultural resources appropriately, reduce production costs and will result in an increase in the ecological environment [3]. The agricultural industry has changed a lot, with its ability to handle the
complete life cycle of agriculture, quickly gaining recognition in agriculture to fulfill its responsibilities in overcoming food security, and becoming a basic tool for sustainable development and poverty reduction, especially developing countries like Indonesia [4]. The National Agriculture Sector (NASEP) in Kenya hopes that extension service providers and customers will increasingly implement ICTs to share information about agriculture. Frequency Modulation (FM) into radio, email, internet, web sites, and web-based applications is increasingly significant in small-scale agriculture, which aims to share and distribute agricultural information [5].

It is important to observe plant growth, the environment, and agricultural activities to increase agricultural productivity and introduce effective and efficient management. However, it is quite difficult to do so recognizing that this monitoring activity is automatic in agriculture because it requires the dissemination of specialized equipment and the development of facilities that require enormous effort, space, and costs [6]. Researchers in the field of agricultural meteorology have proposed and considered unique meteorological conditions generated from various fields to facilitate proper management of local agriculture. Air temperature mesh data in geographic information systems (GIS) can be used to evaluate meteorological conditions for each farm location [7]. Many studies suggest that ICT interventions that improve the livelihoods of poor families in rural areas are likely to have a significant impact on increasing agricultural production, marketing and post-harvest activities [8].

Policy on the Application of Information Technology in Tanzania as is the case with countries in Asia, countries in Africa have also made several innovations in the application of ICT in their 22 agricultural systems. One of the countries that made the innovation was Tanzania. Tanzania through national research and policy development (NRDP) encourages the commercialization and distribution of research results. With the role of various parties, it can help farmers in providing access to various parties, especially related to information in agriculture [9]. Computers can be used as a means for farmers to find the information they need to support their farming business activities. With the ability to access electronic information that is owned, farmers have the opportunity to be able to access the agricultural information database they want. Databases stored on hardware (hard disk) or CD media provided by information source providers can contain information such as plant species characteristics, plant and animal diseases, and methods of control, data, and formulas used to design land conservation systems and to calculate the ratio of feeding, market prices and products in various markets [10]. The purpose of this study is to analyze the benefits of ICTs to support agricultural development and see how influential and useful ICTs are in agriculture, using qualitative research methods.

2. Method
The research method used qualitative that aims to find out the events experienced by research subjects. Like perceptions, behaviors, actions, motivations, as a whole, by describing in the form of words and language, in a special natural context and by using various natural methods.

3. Results and Discussion
Improved information services are inseparable from the availability of information, communication institutions in each village and sub-district, and the availability of means of communication or access to information. Improving information services for farmers will speed up the process of delivering technology that has been produced by research institutions, such as the Agricultural Research and Development Agency [9]. Research institutions such as the Agency for Agricultural Research and Higher Education have produced a lot of research results, but this information has not been able to be conveyed thoroughly to farmers. To accelerate the delivery of this information can be done by changing the pattern of dissemination, from conventional to more advanced and faster by utilizing a variety of media.

Examples of website media that belong to the Agency for Agricultural Research and the Ministry of Agriculture to disseminate information to farmers (see Figure 1).
Figure 1. InaAgrimap

InaAgrimap is a web-based GIS information system that provides information in the graphical, map and tabular forms. Through this website, visitors can observe, display and learn various information about various aspects related to efforts to increase production and productivity of strategic commodities. Visitors can also display maps interactively and get agricultural information for specific locations. (See Figure 2)

Figure 2. Simforta
Simforta is one of the websites of the Ministry of Agriculture in which there are many categories in agriculture such as land and planting season, cultivation, fertilizer, and so on. This site can be easily accessed by farmers who want to find the information they need. The benefits that can be obtained from the use of ICTs in agriculture are:

1. Encourage the formation of agricultural information networks at the local and national level.
2. Open access for farmers to agricultural information to increase opportunities for increasing income and how to achieve it.
3. Improving the ability of farmers to improve their bargaining position.
4. Increasing the ability of farmers to correlate the commodities they are cultivating by entering available goods, the amount of product needed, and the ability of the market.
5. Encouraging the implementation of development activities, management, and utilization of agricultural information directly or indirectly to support agricultural development.
6. Facilitating documentation of agricultural information at the local level that can be accessed more broadly to support agricultural development.

Since the use of information and communication technology (ICT), the agricultural industry has managed to make several achievements that exceed the target. Even in terms of inflation was low and the Gross Domestic Product (GDP) increased. The intended use is agricultural machinery (alsintan) such as autonomous tractors, seed-dispersing drones, granule fertilizer spreader drones, integrated tillage harvesting machinery, and the use of planting drugs. Regarding digitalization, the Indonesian Ministry of Agriculture has done it in the form of e-catalogs, this way the price has dropped. This can be seen when accumulated annually [10]. With the existence of these savings, the government can encourage more use of Alsintan throughout Indonesia. That way, in the future farmers in remote villages, will no longer need to plant rice with the traditional ones. Calculation of planting rice using drones can save costs up to 60%, from these calculations at least the efficiency can reach 40% for tillage, 20% for the planting process and 28.6% for weeding. Also, the use of a transplanter machine using the Jajar Legowo 2: 1 planting method also greatly saves time, energy and production costs. Because this method can increase productivity up to 0.3-0.8 tons or 3.5-30.6%. Financially, this pattern has been proven to increase farmers' income by Rp 1.3 million to Rp 5 million. In other words, this method increased sharply by 19.10% to 41.23%. Examples of ICT tools that help farmers in farming activities.

Seed dispersal drones have the advantage of being able to spread one hectare of seed in a single hour with a capacity of 50-60 kg/ha (See Figure 3). This seed spreader drone can work independently according to a pattern or path that has been set on an android device and guided by GPS. The drone is capable of carrying out further operations so that operations that were previously delayed can be resumed, so there is no overlap and is done automatically. With a battery life that can operate for 20 minutes with a maximum carrying capacity of 6 kg of rice seeds.
The autonomous tractor is a tractor equipped with four wheels that functions to process the ground with a steering system automatically (autonomous tractor) or unmanned (See Figure 4). This autonomous tractor can do land management according to the planning map with an accuracy of 5-25 cm. The navigation system used is a global positioning system (GPS) based on Real-Time Kinematics (RTK). The control system on the tractor consists of steering, gas, gear, brake and clutch control. As for the land management application, the tractor implements and power take-off (PTO) controls are used.
4. Conclusion
An effective relationship between ICTs and agriculture will lead to sustainable agriculture, through the preparation of timely and relevant agricultural information, which can provide farmers with the right information in the decision-making process to increase their productivity. ICTs can improve farmers’ accessibility quickly to market information, production inputs, consumer trends, which positively impact the quality and quantity of farmers’ production. Marketing information, new crop management practices, diseases and pests, transportation availability, market opportunity information and market prices of agricultural inputs and outputs are very important for economic production efficiency. In addition to the usefulness of ICTS in terms of information for farmers, ICTs are also able to help farmers’ performance with a variety of innovative tools to assist farmers in carrying out their farming activities, such as seed-dispersing drones, so that effective and efficient agriculture can occur. The application of ICTs in the agricultural sector can reduce risk in business in agriculture. Because the presence of ICTs in the agricultural industry can make predictions more accurately, with various sources and decision support systems and expert systems that can be developed to support farmers in the decision-making process.

References
[1] Raghuprasad, K. P., Devaraja, S. C., & Gopala, Y. M. 2012. Attitude of Farmers towards Utilization of Information Communication Technology (ICT) Tools in Farm Communication. Research Journal of Agricultural Sciences, 3(5), pp. 1035-1037.
[2] Abbasi, A. Z., Islam, N., & Shaikh, Z. A. 2014. A review of wireless sensors and networks’ applications in agriculture. Computer Standards & Interfaces, 36(2), pp.263-270.
[3] Sarkar, P. J., & Chanagala, S. 2016. A survey on iot based digital agriculture monitoring system and their impact on optimal utilization of resources. Journal of Electronics and Communication Engineering (IOSR-JECE), 11(1), pp.1-4.
[4] Golhani, K., Rao, A. S., & Dagar, J. C. 2015. Utilization of open-source Web GIS to strengthen climate change informatics for agriculture. In Climate change modelling, planning and policy for agriculture, pp. 87-91. Springer, New Delhi.
[5] Mwombe, S. O., Mugivane, F. I., Adolwa, I. S., & Nderitu, J. H. 2014. Evaluation of information and communication technology utilization by small holder banana farmers in Gatanga district, Kenya. The Journal of Agricultural Education and Extension, 20(2), pp.247-261.
[6] Kim, I., Lee, K. S., Kim, K., Kim, K., Chae, H. S., & Kim, H. C. 2020. Implementation of a real-time fall detection system for elderly Korean farmers using an insole-integrated sensing device. Instrumentation Science & Technology, 48(1), pp.22-42.
[7] Ueyama, H. 2012. Practical utilization of high-resolution air temperature data as geographical information for local agriculture. Japan Agricultural Research Quarterly: JARQ, 46(2), pp.139-144.
[8] Mugwisi, T., Mostert, J., & Ocholla, D. N. 2015. Access to and utilization of information and communication technologies by agricultural researchers and extension workers in Zimbabwe. Information Technology for Development, 21(1), pp.67-84.
[9] Cáceres, D. M., & Gras, C. 2020. A tipping point for agricultural expansion? Technological changes and capital accumulation in Argentina’s rural sector. Journal of Agrarian Change, 20(1), pp.79-97.
[10] Rue, B. D., Eastwood, C. R., Edwards, J. P., & Cuthbert, S. 2020. New Zealand dairy farmers preference investments in automation technology over decision-support technology. Animal Production Science, 60(1), pp.133-137.