The Role of The Internet of Things In Improving Farmers' Skills

Alya Apriliani[1], Fandi Ahmad[2]
STIA LAN Bandung Polytechnics, Jl. Hayam Wuruk No.34-38, Kota Bandung, Jawa Barat

{19110285@poltek.stialanbandung.ac.id }

Abstract. Indonesia is an agrarian country, ironically Indonesia still imports food needs from abroad, therefore at this time it is necessary to improve the management of agricultural land which is based on the use of technology and is supported by competent human resources. This study uses a qualitative descriptive approach where the researcher conducts field observations that focus on the Tricipta farmer group located in Cimenyan village. Then the researchers tried to identify the increase in the competence of farmers by using the concept of competence from McClelland and coupled with a literacy study. Therefore, the application of the smart farming model with an element of competence is something that should be implemented in the context of reforming the agricultural system in Indonesia.

Keywords: Competence Upgrade; Smart Farming; Digital Village

1 Introduction

Indonesia is an agricultural country that has abundant natural resources. Who can use the fertile land to support the country's economy, especially in the agricultural sector? However, in recent years the role of the agricultural sector in economic development has slowed compared to previous years. This can be seen from the relatively high number of Indonesian food imports, then the Covid-19 Pandemic, which resulted in the hampered food supply, decreased demand for agricultural products, and restrictions on food exports globally so that it became a threat to a food crisis in Indonesia.

In addition, there are several other factors, such as the lack of agricultural infrastructure and the difficulty of controlling crops, which currently depend on a climate that tends to change, so agricultural yields decline [1].

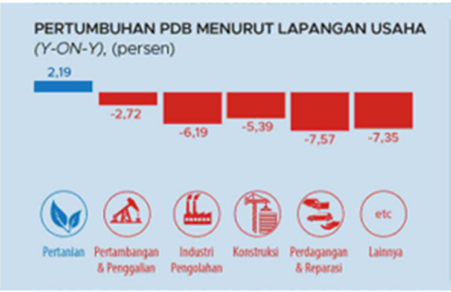

Fig 1. GDP Growth by Business Sector (Source: BPS)

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Even though, based on data from the Central Statistics Agency (BPS) [2], when compared to other sectors, only the agricultural sector continued to experience growth while other sectors experienced a decline. From the description above, we can assume that the Indonesian agricultural sector has advantages over other sectors. However, improvement measures are still needed so that our various potentials can be managed optimally—one of the steps that need to be considered in agriculture human resources. The fact in the field is that many farmers are at the poverty line, resulting in a generation of farmers crisis; farming is considered an outdated, dirty, and less promising job because the income earned is not proportional to the energy expended. So far, almost 99% of the agricultural sector has relied on human labor, resulting in young people preferring to work as staff rather than continuing the farming business passed down for generations. For this reason, contributions and innovations are needed to transform the agricultural sector into modern agriculture.

Talking about human resources in agricultural development, competent farmers are the primary key to the successful transformation of modern agriculture. It is assumed that agricultural human resources must have the competence to become "competent" to carry out innovations in the agricultural sector. Competence is formed from the intersection of the set of knowledge, skills, and attitude. According to Setiana L, Nuskhi, and Hidayat S [3], [4] competence is the ability and authority to act owned by a person to do a job based on knowledge, skills, and attitudes following the performance applied. If the competencies contained in farmers are further developed by the context of the needs in their field of work, they will achieve optimal performance.

Given that the agricultural industry is one of the critical aspects of a country's economic growth, the government continues to strive to support the development of agricultural competence as carried out by the Agency for Extension and Development of Agricultural Human Resources (BPPSDMP), which launched the National Occupational Map for the agricultural sector which contains the competency needs of the world of work in the agricultural sector. This occupational map can be used as a reference for preparing curriculum for education and training institutions. With the competency standards that are mastered, a person will be able to do a task or job skillfully, organize work that is carried out carefully, be able to act when deviations occur, and use their abilities to solve problems or carry out tasks with different conditions [3],[4].

Mastery of technology is one of the factors needed in developing HR competencies because the times have brought us to digital-based industries, computer science, the internet of things (IoT), and extensive data analysis. Currently, many entrepreneurs are starting to switch to start adopting technology, especially in every business process. So, the same thing can be applied to the agricultural sector by carrying out agricultural development based on technology. Considering that most of the farmers in our country are using traditional farming methods, they should have started to switch using modern farming methods. This means that all agricultural processes originally done manually are slowly starting to apply Internet of Things (IoT) technology.

According to Gunawan at al [5] states that the use of new technology on increasing productivity is unquestionable. For example, productivity increases with the rapid adoption of seeds. Thus, automation in agriculture is considered to increase crop yields and help the country's economic development. The application of automation in agriculture leads to plant monitoring that can be done anywhere and anytime without human intervention in the field using internet objects. Internet objects are networks in which sensors, software, and electronic components are embedded, such as microcontrollers, because sensors and microcontrollers cannot connect to the internet directly [6].

One area that is well known to have great potential as barns Indonesia one of which is the area of West Java, such as Bandung Raya region as an area that plays an important role as a producer of agricultural food raw materials. With an area of more than 70%, which has the potential for the agricultural sector, this becomes an essential responsibility for the surrounding residents to maintain optimal land productivity, primarily to support the food security program that the government has launched. Therefore, the biggest challenge is improving the competence of agricultural, human resources to increase the productivity of agricultural products with land that continues to decrease because development begins to erode and land-use changes.

Furthermore, talking about increasing land productivity, current Internet of Things (IoT) technology can be the best solution to minimize threats that arise when managing agricultural land. Advances, especially in land management technology, are expected to provide new insights to farmers, such as the use of plant sensors and the use of easily accessible internet networks. The smart farm concept can realize technology-based agricultural management with the hope of higher agricultural production levels. Because it is more focused on encouraging innovation, especially in the agricultural sector, smart farming is the answer to what farmers have experienced. And the whole process can be done using integrated mobile phones and IoT devices [7] . Many examples of how IoT technology can increase land productivity, the use of IoT technology can also make it easier for farmers to collect data to increase their agricultural yields.

Based on several previous studies, it is known that there are advantages and benefits when farmers use technology in land management and have a positive impact on production results and farmers' welfare. Therefore, this study aims to determine the extent of the impact of IoT on the development of shallot agricultural products, particularly in Bandung Raya, and to try to identify more deeply the efforts made by farmers to utilize IoT for agricultural land management. Various efforts made by farmers will be more optimal if they are based on the competence of each individual.

Therefore, the researcher tries to use the concept of competence from McClelland. to find out what suggestions can be made to uniform the ability of each farmer so that it is expected to be a source of information when other farmer groups want to try use technology in managing their agricultural land.

2 Method

This type of researcher uses a qualitative descriptive approach where field observations are made by conducting interviews with the Head of the Tricipta Farmers Group to find natural phenomena in the field. Next, the researchers tried to increase the competence of farmers using the concept of competence from McClelland and supplemented with literacy studies for researchers' knowledge. Focusing on the Tricipta farmer group located in Cimenyan village, Bandung Regency, the researchers tried to find out proposals for efforts that could be made to improve the competence of farmers. Especially in the use of technology, including the obstacles faced when implementing the IoT system in managing land.

3 Result and Discussion

The Tricipta Farmer Group is one of the farmer groups in Mekarmanik Village, Cimenyan District, Bandung Regency, West Java Province. Mr. Oden Suganda parks this farmer group

with 32 members and 100 assisted people. It focuses on agricultural commodities such as shallots, potatoes, chilies, and cabbage with an arable area of about 500 hectares. In 2016 when there was a fluctuation in the price of shallots in the market, which reached 80 thousand rupiahs, even in the capital it reached 120 thousand rupiahs, the Tricipta farmer group was given the mandate by the government to assist government programs, especially in controlling the price of shallots.

This farmer group is trying to deliver 150 tons of harvested produce directly to the market and sell it at a much cheaper price than the market price in the hope of lowering the price of shallots. Although on the way, several members protested because they felt they had been harmed, after being given an understanding and avoiding imported onion products from entering Indonesia, they finally supported the program. It is proven that after the market operation directly made the price of shallots drop and became the Ministry's flagship shallot barn.

Furthermore, for the development of farmer groups, the government tries to help by providing some counseling assisted by the relevant agencies and ministries where each farmer group member is given knowledge about managing shallots. Besides that, the government also helps in building infrastructure such as road repairs and post-harvest buildings in the form of warehouses to be able to be used as a means of storing and drying shallot production materials, because in 2017, during the main harvest, many farmers still felt overwhelmed, mainly to store their shallot harvest.

This success has resulted in complete trust and support from both the government and the private sector, who work together to implement corporate social responsibility (CSR) programs. Habibi Garden, in collaboration with West Java DISKOMINFO, JABAR Digital services, and the West Java Province Food Crops and Horticulture Service, to create the first digital village concept. In West Java, focusing on onion-based agricultural centers and integrated technology, it can also be called smart farming.

The first step that can be done is to adjust and calibrate the application to suit the characteristics of the shallot plant and then install a synchronized monitoring and irrigation system on the computer-based automatic irrigation system panel. The next step is to arrange a tower installation that is useful as a water reserve with a capacity of 2000 liters. After the water tank is installed, proceed with installing an electric faucet that functions as a barrier to the irrigation zone, then installing the HBB Ground sensor to help monitor soil conditions on agricultural land.

After that, installing a hose as the main irrigation line, making a hole as a sprinkler connection that is useful for spreading water, and adding bamboo sticks to hold the sprinkler every 7 meters. Furthermore, installing a smart camera to monitor crop conditions in real-time, coupled with the installation of AWS HBB, which is helpful as a weather reader for prediction of disease and pest outbreaks, and installing automatic irrigation installations for water and fertilizer distribution. And the last step is to install an application on the farmer's cellphone to monitor the condition of the garden from the mobile application.

Then next is the use of the Habibi Garden application by farmers, which is used for land monitoring; through this application, farmers can find out information about humidity levels, light intensity, and nutritional conditions in plants. The way these application works helps farmers focus more on taking care of their plants. For example, when there is a lack of nutrients in the soil, a notification will automatically appear on the farmer's cellphone to immediately provide fertilizer to the plants. Automatic irrigation installation systems for water and fertilizer distribution are beneficial for farmers.

So far, farmers have struggled with irrigation system problems, especially during the dry season, so this automatic system is beneficial for farmers, especially in their daily activities.

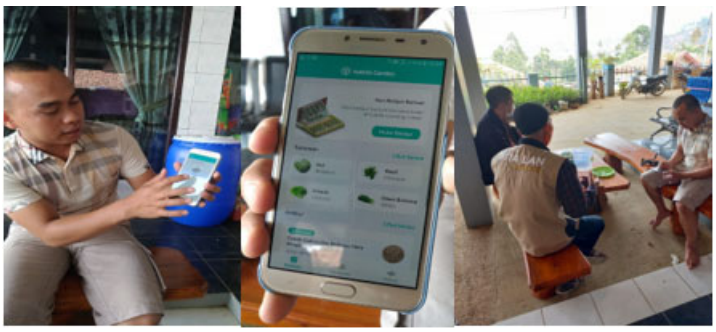

Fig 2. The use of the Habibi garden application for monitoring agricultural land

From the description above, it can be seen that there are efforts from various parties to develop the competence of farmers, especially in the Tricipta Farmer Group. This effort is made so that they are competent in their field of work, namely agriculture. The meaning of "competent" is a person or people whose work is based on competence with an optimal level of application to achieve a quality level of performance [8].

According to McCleland [9], competency can be learned and developed over time. This means that competency is not brought in since humans are born but can be obtained by learning and developing within a specific time in life. Then the researchers tried to identify the concept of competence, according to McClelland, to find out what things are needed. So, that farmer groups are competent in implementing IoT as an effort to realize smart farming. There are three essential components of incompetence, namely knowledge, skills, and attitudes. As stated by McClelland [9] that competency consists of knowledge, skills, and attitudes.

3.1 Knowledge

Knowledge can be used as the basis for developing human resources, especially when implementing something new. This can be seen when the effort to apply the technology known in the Tricipta Farmers Group. In this effort, regardless of the role of several parties, both the government and the private sector. As in this case, Habibi Garden, as a private sector, conducts agricultural extension by utilizing open forums to introduce technology. In this activity, each farmer member included in the Tricipta farmer group is given guidance in land management by utilizing the Habibi Garden application to focus more on maintaining plants. Then the farmers also give freedom to express their opinions and views when trying to apply this technology.

The approach taken during the mentoring and counseling process utilizes the discussion method and direct assistance to farmers. There are direct discussions and practices regarding the technical application of the IoT system in agricultural land and how this system works. The knowledge provided is how nutrients are dissolved in water pipes and then sprinkled on agricultural land, then deepening planting methods by utilizing arable meetings between group members, which are carried out before starting the seed planting process every two months. This is in accordance with the function of farmer groups proposed by Swastika and Nuryanti [5] that the function of farmer groups is as a learning forum, a vehicle for cooperation, and a production unit for farming [5] .

In addition, the Tricipta farmer group also often participates in meetings and training from private agencies, ministries, and visits from academia. So, that farmers can find their solutions

if problems arise. Armed with the knowledge obtained, members of this tricipta farmer group managed to foster six youths in their village and three farmers in other villages, to switch professions as farmers. In addition, members of this group are acting as resource persons in various places at the sub-district, district, provincial levels, and even outside West Java, such as South Kalimantan and East Kalimantan.

With participants from farmers, officers (Agricultural Extension, Vocational Teachers, etc.), vocational students, and students from various universities in West Java. From the description above, it is known that knowledge plays a vital role in shaping a person's competence. Furthermore, knowledge can be shared through the process of social interaction from individual to individual, individual to a group, or between groups for better implementation and creation of new knowledge. Davenport and Prusak [10] stated that knowledge sharing is voluntary dissemination of expertise and experience required by the organization as a whole.

3.2 Skill

The results of the transfer of knowledge can improve the ability of individuals, and this can be seen from how the individual performs the entire task of his work as can be seen in the context of IoT-based agricultural development where every individual in the Tricipta Farmer Group is required to be skilled in using technology.

This can be seen when farmers gain knowledge from extension activities, training, and discussions with various parties, so farmers gain new skills, especially in managing agricultural land. Like when members of the tricipta farmer group use the Habibi Garden application on their smartphones to monitor and manage agricultural land, this is a form of upskilling embodiment from individuals. At first, most farmers still used traditional patterns and tended to be manual to take a long time to manage agricultural land, but this seems to be reversed when farmers use information technology.

This application is considered easy to understand and provides several conveniences such as farmers can still water their plants even though the distance between farmers and the land is in far apart locations so that the agricultural process becomes more organized. With this, it can directly provide the effect of using resources more effectively and efficiently than the traditional way, with a higher output of agricultural products than the previous method. However, the open application of this technology still cannot be done because the cost required for the installation of this technology reaches 80 million rupiahs, even though the application manager has provided relief in the form of a payment policy that can be paid in installments after the harvest.

From the description above, we can see that skills cannot stand alone but must be supported by high and robust knowledge and attitudes because someone is said to have become skilled if the power of knowledge and attitudes supports them. Someone must be willing to learn to gain knowledge with an open attitude to produce new skills that are useful to improve their performance at work.

3.3 Attitude

In essence, attitudes contain biased and ambivalent meanings; attitudes can be in the form of a person's positive, negative, or neutral view of something [8]. This was stated by Rakhmat in Soemantrie [8] that the use of the word attitude must be followed by the word 'towards' or 'on the object of attitude, so that if someone says 'my attitude is positive' we must ask 'attitude towards what or who?'. The journey to becoming the first digital village in West Java was not without obstacles.

Starting from 2016, several members objected and felt disadvantaged because the tricipta farmer group had to voluntarily sell 150 tons of shallots they harvested at half the market price

to prevent imported onions from entering Indonesia. And this step produced positive results. At that time, the price of shallots immediately fell and became the Ministry's flagship shallot barn to date.

The same thing happened when IoT was applied on agricultural land, especially in the Tricipta Farmer Group, because some farmers initially still had a negative view of this system. They worry that the system approach will result in additional costs and the inability to operate the system. Such as additional costs for electricity sources, internet credit, and worry about difficulties in learning the system.

However, with counseling and support for infrastructure development such as road access improvements carried out by the government, coupled with corporate social responsibility (CSR) program support in the form of tools, sensors, and systems from Habibi Garden, these problems can be resolved. After gaining the trust of all members, and they are willing to learn, there are no obstacles for the digital farming learning method process, this is because farmers are actively involved, especially during the process of applying technology such as pipe installation, sensors, water storage containers, and several other components in the field.

Fig 3. The First Digital Village Program in West Java

This agricultural development effort forms a new view that farmers are millennial jobs because they are assisted by using the IoT system, so that it is hoped that it can spur the younger generation to want to go down to become the next generation of farmers. Another thing that is felt by farmers with the concept of agricultural land management using IoT makes savings in terms of energy spent and time required. Such as when watering plants or fertilizing, which was previously done manually which took a long time and was limited to a maximum of two times a day due to land area and limited human resources available, after utilizing the land management system with the help of this IoT, farmers can water their plants more often and easily. applying fertilizers according to the needs of the land, and this has implications for the results of higher crop productivity on the land with high plant quality. Therefore, with this system, it is hoped that it can encourage every resource, especially human resources, in the village so that it no longer depends on the big cities around it and the village can progress and develop into an independent village.

From the description above, it can be seen that attitude is one of the main things to support competency improvement. This can be seen from the efforts of farmer groups in providing understanding when selling agricultural products below market prices because it is more concerned with broader interests. This study aims to determine the extent of the role of IoT in improving the competence of agricultural, human resources and understanding an integrated

system to facilitate the farming process. Furthermore, this research is expected to be a role model for implementing new trends in IoT competency-based agriculture in West Java.

This study also follows several previous studies conducted by Somatrie [8] which explained the importance of competence for human life to achieve optimal performance, then in research conducted by Nuryanti and Swastika [5], which explained the role of farmer groups in the application of agricultural technology, Furthermore Sugiono [11] which states that the application of IoT can increase the effectiveness of resource use and facilitate the work of farmers, this is in line with the research conducted Naveen Balaji [6] which in his research also discusses the application of IoT-based crop monitoring so that farmers can connect with their fields anytime and anywhere.

4 Conclusion

The urgency of competence is an important thing to have, especially when a person or group is trying to increase productivity to win the competition; from the results of the study, it can be seen that three components play an essential role in supporting the formation of competence, namely knowledge, skills, and attitudes. To apply technology to their agricultural land, the Tricipta farmer group gains knowledge through counseling, coaching, and continuing to attend training organized by various parties. These efforts and activities eventually resulted in a new skill for farmers. This can be seen when the tricipta farmer group members tried to start using the Habibi Garden application to monitor and manage their agricultural land.

To achieve the title as the first digital village in West Java, this journey is not without problems. Whereat first, some group members objected to selling their agricultural products at prices far from the market. Then, when implementing IoT on their agricultural land, many farmers still have a negative view of this system, especially in terms of costs. However, after being given understanding through counseling and infrastructure support from various parties, finally, they were willing to participate in the smart farmer's program.

From the results of this study, it is known that farmers can more easily cultivate their agricultural land when utilizing a technological approach and collaborated with the values of the competence concept of McClelland contained in every farmer in the organization to make program implementation run smoothly, this can be seen from the fact that the harvest obtained almost doubled even with limited land. Therefore, the application of the smart farming model assisted by the concept of competence should be implemented in the context of reforming the agricultural system in Indonesia.

References

[1] S. Suci et al., “Bina Darma Conference on Computer Science PALEMBANG Bina Darma Conference on Computer Science,” vol. 9, pp. 904–918, 2019.

[2] BPS, “Pertumbuhan Ekonomi Indonesia Triwulan IV-2020,” Www.Bps.Go.Id, no. 13, p. 12, 2021, [Online]. Available: https://www.bps.go.id/pressrelease/2021/02/05/1811/ekonomi-indonesia-2020-turun-sebesar-2-07-persen--c-to-c-.html.

[3] L. Setiana, M. Nuskhi, and S. Hidayat, “Kompetensi penyuluh pertanian dalam revolusi industri 4.0 menuju pertanian modern,” Pros. Semin. Teknol. dan Agribisnis Peternak. VIII-Webinar, no. 16, pp. 602–607, 2021.

[4] N. Kartikasari, B. Subroto, and A. F. Rahman, “Perbedaan Tujuan Auditor Atas Tingkat Overconfidence Pertimbangan Auditor (Studi Eksperimental),” EKUITAS (Jurnal Ekon. dan Keuangan), vol. 17, no. 2, p. 234, 2017, doi: 10.24034/j25485024.y2013.v17.i2.2251.
[5] S. Nuryanti and D. K. S. Swastika, “Peran Kelompok Tani dalam Penerapan Teknologi Pertanian,” Forum Penelit. Agro Ekon., vol. 29, no. 2, p. 115, 2016, doi: 10.21082/fae.v29n2.2011.115-128.
[6] G. Naveen Balaji, V. Nandhini, S. Mithra, N. Priya, and R. Naveena, “IOT Based Smart Crop Monitoring in Farm Land,” Imp. J. Interdiscip. Res. Peer Rev. J., vol. 4, no. January, pp. 88–92, 2018, [Online]. Available: https://www.researchgate.net/publication/322508245.
[7] V. N. Malavade and P. K. Akulwar, “13.Z56-57.pdf,” Natl. Conf. "Changing Technol. Rural Dev., pp. 56–57, 2016.
[8] H. Somantrie, “‘Kompetensi’ Sebagai Landasan Konseptual Kebijakan Kurikulum Sekolah di Indonesia,” J. Pendidik. dan Kebud., vol. 16, no. 6, p. 684, 2010, doi: 10.24832/jpnk.v16i6.497.
[9] B. D. C. Mcclelland, “1244321.Pdf,” vol. 9, no. 5, pp. 331–339, 1998.
[10] and L. P. Davenport, Thomas H., Working knowledge: How organizations manage what they know, vol. 35, no. 09. 1998.
[11] Sugiono, T. Indriyani, and M. Ruswiansari, “Kontrol Jarak Jauh Sistem Irigasi Sawah Berbasis Internet Of Things (IoT),” INTEGER J. Inf. Technol., vol. 2, no. 2, pp. 41–48, 2017.
[12] Gantino, R. (2016). Pengaruh corporate social responsibility terhadap kinerja keuangan perusahaan manufaktur yang terdaftar di bursa efek Indonesia periode 2008-2014. Jurnal Dinamika Akuntansi Dan Bisnis, 3(2), 19-32.
[13] Setiawan, T., & Purwanti, A. (2017). Piramida Carroll Pada Perusahaaan di Indonesia: Studi Pada 3 Perusahaan Pemenang Csr Award 2016. JMB: Jurnal Manajemen dan Bisnis, 6(1).
[14] Yohana, N., Rasyid, A., Lubis, E. E., & Rimayanti, N. (2019). Communication of Community Participation in Implementation of Policy in Child-Friendly Regency (Kla) in Siak District. International Journal of Research in Social Sciences, 33(1), 2307-227X.