

Empowering Traditional Farmers in Escalating Farming towards Industry 4.0-Ready

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Traditional farmers in Indonesia should be empowered to use technology to increase their capability in farming. Traditional farmers defined in this study are farmers without willingness or capabilities to perform any changes to increase their capability in farming into the era of IoT. The implication of this study could help promote Indonesia towards food self-sufficiency and could help the AEC (Asean Economic Community) program in grasping the cyber era benefits. This study is a literature research; a preliminary research needed to examine factors related to information in preparing traditional farmers to be Industry 4.0-ready using Artificial Intelligent (AI) technology. This study attempts to see the factors related to information technology derived from previous partial studies. The result of this study provides the government with necessary steps to take this research into more technical programs.

Key words: *Industry 4.0, AI, AEC, Farming, Indonesia.*

Introduction

Indonesia is yet to be food self-sufficient. What's the problem? The farmer's do not have the ability to produce such food. Traditional farmers are fundamental pillars for Indonesia in achieving the goal of food self-sufficiency. That goal is crucial to national defence. Many factors affect the ability of farmers to achieve the goal, such as:

- Low income. According to the data of average net income per month, farmers are in the lowest rank of income compare to other industries in Indonesia (BPS Statistics Indonesia, 2018, p35).
- Lack of proper education that causes the inability to calculate profit or loss, which lead to other problems, such as an inability to get a loan from a bank. Only a small percentage

(8%) of society in the low income economy could participate in higher education (BPS Statistics Indonesia, 2017)

- Difficulties in distribution chain, lack of information of real market prices, or price that is susceptible to speculation. This could lead to encourage the presence of middlemen.
- Rumours that spreads among farmers to plant one particular product with false-information that the product is in high demand and at a high level of price, leading to the over-supply of particular products and the decrease in price.
- Pests and weather that sometimes makes the harvest fail. These weather events are somewhat sophisticated to predict. However, not at all impossible to predict.

Each of the above is only a small problem, but when they are linked together form a vicious cycle. From the list above, most of these problems come from a lack of information.

The attempt to educate farmers to be digital-aware is not fully achieved; hence, the Indonesian government should try harder to grab the cyber era, to prepare the traditional farmers in entering the Industry 4.0 era of industry farming. The idea of Industry 4.0 is best implemented in the manufacture industry, to boost efficiency by reducing human mistakes involved in production, and supposedly to increase efficiency by reducing labour cost, although the cost is a relative factor, since the capital cost for establishing the computer and network facilities is not cheap either.

Since the idea is originally formulated for the manufacture or production house, to implement the idea of Industry 4.0 Revolution in the farming industry in a country scale, we must envision farming in Indonesia as one big enterprise. The idea then continues with the question of “what if farmers in this big enterprise could access the same information at the same time to make decisions that would benefit all?”

“The enterprise” should collect data from many sources in real-time, then the data should be stored in a big data warehouse, accessible to the members and up-dated by members in real-time. The data could includes many factors affecting the activity of farming, such as: weather forecast, type of soil in certain area, prices of seeds and fertilizer in a specific market, distribution channels and their cost, market price of the produce, planting, harvesting and timing of planting, etc.

Next, an Artificial Intelligent application software can process the data to come up with scenarios to help farmers in making decisions of what to plant considering the type of soil and weather forecast, how much they should plant, where to find the nearest market with the lowest price for seeds and fertilizer, where to find a soft loan they can afford, where to sell the produce, how much would the distribution cost be, what is the calculation of profit or loss estimation on every scenarios, and how to calculate the real profit or loss of their activity.

That is the idea of the Industry 4.0 revolution for the farming industry. It is not too farfetched with the current advancements of technology. It only requires small steps to form a bigger and wider progression. Determine the factors, understanding the problems, cut the vicious cycle tied to traditional farmers and provide first technical step to solve one problem then lead to the solution of others. When successfully applied in one small area, it could be and should be applied in a wider area, from West Java, Indonesia, to ASEAN countries.

Literature Review

The study gathered data from previous literature research to overview problems in farming, especially those which are related to a lack of information. This study then derived suggestions from the literature to overcome the problems.

“Traditional” Farmers

The definition of the word “traditional” in the Great Dictionary of the Indonesian Language is an attitude and a way of thinking which sticks to a norm and customs hereditary. Other definitions are that it something that is “handed down from age to age” and doing something that “adheres to past practices” (Merriem-Webster, 2019). All those definitions show one thing in common, that is the lack of willingness to change into something new and a preference to stick to the old-ways, whether it is a way of thinking or a way of doing something.

The unwillingness to do something new could be influenced by many factors; difficulty because the learner could not understand the new knowledge due to the personal intelligence capability, or difficulty because the person could not afford to achieve the knowledge due to their personal welfare. Therefore, in this case, the word “unwilling” cannot be interpreted as plain as it is without considering the background of each individual.

Traditional farmers are always undertaking their activities in a traditional way. Usually, traditional farmers are the ones who do not use modern tools or modern process in farming. The Chinese government defined modern farmers as those who have access to literacy, technology, and capacity of operation (Yue, 2009).

Considering the definitions above, traditional farmers in this study are defined as ‘farmers who do not have a willingness to perform any changes to increase their capability in farming into the era of IoT’,. In this study, the word “unwilling” can be interchanged with “not capable of doing” due to more fundamental factors which prevent farmers from modernising.

Traditional Farmers and the X Theory

As per the definition in this study, the traditional farmers either cannot or would not change their ways of farming. This condition matches the assumptions from Mc Gregor's Theory X (O'Leary, p113) which stated that the X individuals are by nature resistant to change.

According to data from BPS-Statistics Indonesia (2018, p35), the average net income per month for the agriculture industry (including farmers) are the lowest in the country. For example, the manufacture industry earnings are 73.5% higher on average. In a developing country like Indonesia, this could mean that income the farmers earned can only be used to fulfil basic needs. Therefore, poverty may be the reason that farmers are unable to change. They may be willing, but due to the high cost of capital in providing high technology of facilities for farming, they cannot change.

How to overcome this condition is kind of tricky, because when we trace the problems, it usually comes back to where it starts. Poverty comes from poverty; it is a vicious cycle. The government could not magically transform poverty into wealth, but the first step should come from the government by providing the facilities.

However, to encourage traditional farmers to change, the government should understand how the X theory could work. In line with X theory, from McGregor (O'Leary, 2010, p113), when trying to induce people to do something, there should be a real benefit that they can gain. This means, when encouraging traditional farmers to change, doing something using the new technology, that technology should immediately give real benefit to the farmers.

Traditional Farmers and Government - The Agency Theory

The Agency Theory in economic (Jensen & Meckling, 1976; Ross, 1973; Spencer & Zeckhauser, 1971) describes how two parties interact with each other in an entity. One party as the principle, who provides a system and the other party is the executor who uses the system for decision making (Panda & Leepsa, 2017).

When assessing the farming industry as one big enterprise, the government plays the role of the principal who has the responsibility to provide the system to facilitate their interest (Hendriksen & Breda, 1992, 207).

However, the government probably could not rely on farmers to do the data processing, because most farmers probably do not have a sufficient level of education to do it; due to the

fact that farmers in Indonesia possess low levels of education (BPS Statistics Indonesia, 2017). We can assume that many farmers might need to be meticulously guided to move towards the enterprise's goal (O'Leary, 2010, p113).

In order to help traditional farmers to be able to take advantages of information from the internet, the government (the principle) should push the information into the traditional farmers' hands (users) and encourage them to use it (O'Leary, 2010). That is one of the government's roles in the big enterprise. And this is when the AI becomes the important tool in enabling the use of information for farmer as end users.

The Government also should prevent the condition of information asymmetry (Hendriksen & Breda, 1992) by providing needs to farmers from the information that could be beneficial for farmer, while moving towards the national ultimate goal that is food self-sufficiency.

Middlemen, Information and Pricing

It is a common knowledge that agriculture products are susceptible to price fluctuations. Many factors can cause crops price fluctuations, such as over-supply of products or the imbalance between supply and demand, market competition, future expectations, catastrophes such as dry seasons or floods, speculations, and government action (Natoras, 2013). This condition may promote middlemen. Middlemen offer price stability through payment for farmers long before harvest, but usually at lower levels of price.

Hardinawati (2010) found some middlemen violate Muslim business norms such as:

- “*ikhhtikar*”- which is the action of taking unusual profit by reducing the buying price, which could be done by piling up produce or cutting the access of distribution so that they can monopolise the trading.
- “*ba'i najasy*” – which is spreading false information to create fake demand in order to increase the price, seducing farmers to provide specific produce, that leads to the oversupply and a drop in price.
- “*Tadlis*” – which is the effort to hide information in order to cheat the quantity or quality of produce.

The research showed that a lack of information is one important factor that prevents traditional farmers from making the right decisions regarding their farming business.

Government fundamentally has the power to govern any commodities price, based on societal welfare consideration or political consideration. Regardless, the efforts of government to balance the supply or to interfere with the prices, is only a short term cure, not the medicine to long-term health of the economy. Further, one should remember that this kind of power to

coerce is dangerous to every business (Stigler, 1971). It is common place for the emergence of a regulation to be a politic manoeuvre. Political activity is usually driven by motivations beyond economic wealth considerations, especially in an election period. This is known as the political market (Godfrey et al, 2010:59).

Farmers and Information

According to a survey by the Indonesia Internet Service Provider Association (IISPA) in 2017, internet users in Indonesia are 54.68% of the population or equal to 143.26 million individuals, where 58.08% of it covers Java area. Based on the latest formal education, only 25% of users come from the primary school level. This means that farmers, whom mostly only achieved this level of education, are represented in the smallest proportion of users of the internet. The lowest level of the economy represents the second lowest users of the internet; only 7.39% of users. That is the level that farmers are in (IISPA, 2017). Therefore, regarding information via internet, farmers are in the most uninformed group.

The Indonesian government recently gave an opportunity to a developer to provide digital applications, which could help to improve the potency in the farming industry (Rahmayani, 2018). The government does not have the technology or it simply does not have the budget to develop it itself.

An attempt to spread information among farmers has been ongoing as a prototype project in some of area in West Java Province, Indonesia. A teleconference is now available for farmers using the software *Jarkomluhdes* (Communication network for village counselling). It was merely the digitalization of a communication activity where farmers could brainstorm about their problems and sometimes get solutions from other farmers.

The software also includes some data which is gathered from farmers, such as commodity pricing, production plans, harvest capacity, etc. (Lukihardiati, 2018). Such data was also available when they used to gather in the village-hall to discuss problems. The difference is only that now the data could be accessible for a wider range of the community. Yet, it is also merely the digitalization of partial data, and not necessarily information which could be readily used for decision making.

Another attempt is through the software system developed by PT Telkom that is the *Logtan* or *Logistik Tani* (Farmer Logistic) program. Again, this is the digitalization of data, from pre-planting, planting, harvesting, and post-harvest activity. Meaning, this is not information to support neither to simplify the decision making for farmers.

In addition, one problem raised from the use of this software is the validity of the data. It is clearly stated by *KEIN/Komite Ekonomi Industri Nasional* (National Industry Economy Committee) as the main reason why the *LogTan* was developed in the first place. The objective of this application is only to help government officers to be able to report any changes in agriculture activity (Murdianingsih, 2016). Therefore, the *LogTan* software does not offer any direct benefit for farmers, which obviously would restrain farmers from inputting data into the app, considering X Theory.

The ability of an individual to process information is limited. At one point there will be the condition called “information overload.” That is the point where data addition would not result in a better decision (Hendriksen & Breda, 1992). Therefore, the presence of a software program application to help making decision is something that would reduce the difficulties. The nature of technology is fast developing. However, humans grow differently. We cannot force farmers to keep up at the same pace at the same time. Therefore, we should focus on how the technology should do its job in making things easier for the user, for traditional farmers.

AI Farming System in the Industry 4.0

Seeing the farming industry in Indonesia as one big enterprise, there should be an Enterprise Resource Planning System (ERP System) to solve problems by integrating all aspects of the farming business. An ERP System would coordinate and manage all data, business process and all resources. It would gathered, store and process all the data to provide information needed by decision makers, in this case it could be the government at all levels (Romney & Steinbart, 2015). The ERP System consisted of specific modules that manage every activity related to the agribusiness. Every module is developed separately but has to be in the same frame, which allows the ERP System to coordinate them and facilitate the flow of information between activities.

Seen from the technological point of view, the implementation of an ERP System would need a Database Management System (DBMS). It is a software program, which manage and controls data, coordinates and connects data and connects the software programs that use the same source of data. Therefore, we also have to build a data warehouse. The problem with a data warehouse is the accuracy of the data input (Romney & Steinbart, 2015).

Business intelligence analyses bulk data to provide strategic decisions for users. Two main techniques in implementing business intelligence are the On-line Analytical Processing (OLAP) and Data Mining. The OLAP technique uses queries to make hypothetical connections between data. Taking it as the ground theory, the OLAP is not quite a high tech process, since the hypothesis is provided for the purpose. The second technique though, Data

Mining, is somewhat more advance. It is a sophisticated statistical analysis process, including the use of Artificial Intelligence, to find new connections that are not previously stated in a hypothesis (Romney & Steinbart, 2015).

Luger (2005) explains that AI is as a branch of computer science that is concern with the automation of intelligent behaviour. This AI could be used for decision making simulating the behaviour of a person, but with far more high capability in processing data and therefore the hope is more accuracy in the decision results.

Support AEC to Escalate to Cyber Era

Introduction of the AEC Blueprint 2025 stated that the former blueprint is the basis to reinforce the highly integrated and cohesive economy. The next decade ASEAN will embrace the evolving digital technology as leverage to enhance trade and provide an e-based business platform. One of the visions is to foster robust productivity growth through innovation, technology and human resource development (ASEAN Economic Community Blueprint 2025;2015).

Simple application software programs could be the embryo to achieve what AEC envisions for the next 2 decades. When running well, these apps could be set not only for a province, but for a far wider area, such as in ASEAN countries. For example, one problem regarding distribution: when one domestic distribution channel is fully occupied, farmers could choose to export their crops to any other country in ASEAN to fulfil the need in other countries. They should be given privileges to export with low cost distribution and fare. Or – better – free export distribution channels provided by the ASEAN governments.

Although the apps may be simple programs, actually it is not that simple from the point of view of the willingness of every ASEAN government, the ability to cooperate among them and especially to fund the program to ensure the sustainability will be difficult to obtain.

Findings & Discussion

Findings of this study are as follows [19-21]:

1. Traditional Farmers are farmers that are reluctant to change in doing their farming activity
2. Farmers in Indonesia have low income, which indicates that they need capital support. For example, from a loan.
3. Farmers in Indonesia have low levels of education; one of the problems that rise from it is the inability to calculate proper profit and loss that ultimately leads to the inability to get a loan.
4. Middlemen could influence the pricing of produce that usually harms farmers by taking advantage of the uninformed farmers.

5. The features of farmers in Indonesia are consistent with X Theory. Therefore, they have to be induced with reward to do something.
6. Farmers are in the second lowest level of internet users. This condition is probably caused by the level of economy and education.

Traditional farmers tie their business in the circle involving middlemen. They are reluctant to shift from seeking help from middlemen because of many factors usually prevent them from doing so. They are poor, so they cannot afford a higher education, without proper education they cannot calculate proper profit or loss of their farming activity, then they could not get loans from proper institutions, therefore, they are easy prey of cheating middlemen who then easily lend them money with high return rates. The middlemen keep farmers uninformed; therefore farmers are kept tied to them and are kept poor. The Government should be able to cut this vicious cycle using technology.

The first step necessary is to enable traditional farmers to access soft loans provided by governments. This would empower traditional farmers to shift from middlemen. However, bank and other institutions should follow the regulation of healthy credit management. It means even soft loans or any programs from the government to farmers should be distributed based on clear financial information. Not all traditional farmers –if not saying most of them– could easily provide the financial information to be eligible for a credit loan. Therefore, it is important to create an app (Smartphone application software program) that could provide them with an eligible financial report for a loan application.

However, most importantly the government should be ready to receive the commodities in the market via government stores, lots of grocery stores would be better. Therefore, the farmers would not turn back to middlemen for the marketing of their products.

The next step is to build the ERP System as mentioned above. The OLAP is a more fundamental process that is needed for a simpler business intelligence system. Putting some basic data into an application could provide the information needed for decision makers. Implementing it in the farming business for traditional farmers is a sensible thing to do for a start. Encourage traditional farmers to input basic data from their daily activities into an app. Along with it, a data warehouse should be built in the cloud. Anytime farmers need specific data, the app would process the data collected from the warehouse then provides them with information they need. Later then, Data Mining would provide farmers with a set of scenarios and help them to make decisions regarding farming.

Conclusion & Recommendation

First step, in a small scale, applied in some area as prototype, the government could do the following:

1. Prepare a farming activity app. To prepare this app they would need to collaborate with a software programmer, accountant, and farmers. The app should:
 - a. be a module that could be attached to other modules (open access signature)
 - b. Be easy to use. Simple to input data.
 - c. At least be able to provide financial information of profit and loss.
2. Prepare a network that can only be accessed by the app to access into the data warehouse for free. It has to be for free, otherwise, not all farmers will be able to pay for the network, and then it will not work.
3. Prepare a data warehouse that could later on accommodate a large quantity of data, not only data from Bandung, West Java, Indonesia but also from other Asian Countries.
4. Training for trainers of the app for the first module. They should have knowledge on using the app, loan mechanisms, and financial reporting.
5. Training for users. This is to prevent inaccurate data getting into the database.

The next steps would need further research which includes many other factors that link one another. Research that is continuously carried out on the basis of modular forms, to be integrated with one another, to solve problems one step at a time.

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