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MAINTAINING ECONOMIC STABILIZATION IN INDONESIA AND SOUTH KOREA THROUGH DIGITAL FARMING

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Abstract
Digital farming is a type of digital economy that cannot be separated from essential elements, such as data availability and farmers themselves. Digital farming is found easily in many developed or agricultural countries, such as southern Europe and Brazil, nor to Indonesia and South Korea. However, Indonesia and South Korea experienced internet utilization and agricultural land area discrepancies which come to similar result, still developing sustainable agriculture. Thus, subjects of the study are Indonesia and South Korea due to their location in the Asian continent and similar history as developing countries in the past. Using farmer households and land agricultural data from Central Bureau of Statistics Indonesia and Statistics Korea, this study conducts quantitative analysis through fuzzy analysis and qualitative analysis through charts and explorative study. Based on quantitative analysis, the results are suitability maps between agricultural land area and farm households in Indonesia and South Korea due to agricultural land area, especially rice field, and farm households are the variables. Meanwhile, qualitative analysis produces charts and descriptive explanations, including internet utilization from World Bank. The rice field area is linked to land conversion, whilst farm household populations are linked to the prosperity of farmers. Indonesia has more farm households and rice field areas than South Korea, but South Korea has the technology to boost productivity and efficiency. The mutual relationship can be built by seeing food security in South Korea and digital farming implications in Indonesia. Therefore, both countries could strengthen bilateral relations beside of digital farming actualization.

Keywords: digital farming; Indonesia; South Korea; relationship; economic stabilization

1. Introduction

Internet of Things (IoT) is kind of technology innovation which is applied at all sectors, such as agriculture sector. One form of IoT is the use of machine-to-machine interaction as the core of Cyber-Physical System (CPS) and as a tool in agriculture since it relates to water resource management and weather information, thereby turning agriculture into digital farming (Bloem et al., 2014). Nevertheless, agricultural progress through technology is inseparable from the socio-population element. Digital farming as a type of digital economy also cannot be separated from essential elements, such as data availability and farmers themselves, not to mention the willingness of farmers to learn farming using technology.

Good coordination is needed between Indonesia and Korea, as well as government support to provide important components in digital farming such as data, infrastructure, outreach mechanisms, and internet. Indonesia must take a bold step by investing APBN for R&D on agricultural sector. In addition, Indonesia should provide the best agricultural products to South Korea as part of the two countries' bilateral relations. Digital farming is not scarce in many developed or agricultural countries, such as southern Europe and Brazil. Southern Europe, as developed countries, have been planting tomatoes as one of the main agricultural products. Those can be transplanted in a soilless system and harvested after 7 months only, a proof that digital farming is an effective method (Zamora-Izquierdo et al., 2019). Another country, namely Brazil, has different action for digital farming implementation. Brazil applied digital farming for agriculture and livestock, but almost investor comes to agriculture sector, especially sugarcane than livestock.

Agricultural process of sugarcane involves Global Positioning System (GPS) and Unmanned Aerial Vehicle (UAV) to execute important steps, such as planting, harvesting via telemetry to connect, observing planting failures, and analyzing the need of nitrogen fertilizer in sugarcane (Pivoto et al., 2018). The treatment of digital farming implementation towards agriculture in Brazil is different from Japan, developed country in Asia Continent. One of Japan technology firms, Fujitsu, helps the farmers to manage their crops and expenses through collecting data, such as rainfall, humidity, and soil temperatures from sensors and cameras across the country (Wolfert et al., 2017).

Japan, Brazil, and southern Europe are countries on various continents that implement digital farming regardless of the country's status. As known, Brazil is still developing country, yet Brazil ever acquired title as strategic worldwide producer in 2014 (Pivoto et al., 2018). Although Brazil has different status, Japan and southern Europe also have more barriers to evolve agriculture sector because of limited natural resources. As the countries experienced digital farming, Indonesia and South Korea are also endeavoring agriculture sector through Digital Farming.

Indonesia is developing country, whilst South Korea has procured the status as developed country. Notwithstanding, both countries used to be on the same level of development, especially on agriculture sector (Wardhana, 2016). Indonesia is richer on agricultural land than South Korea, yet the human resources quality is not prepared well to face digital farming. Although, Indonesia has large number of Internet users which is not directly proportional to agricultural land due to farmers who are still unfamiliar with technological innovations. Meanwhile, South Korea could overcome its disadvantages by increasing productivity despite limited agricultural land.

Even so, Indonesia and South Korea have its dependency by each other. South Korea still imports agricultural products, such as rice, cinnamon, and spice from Southeast Asia (Choi et al., 2016; Directorate General of National Export Development, 2018; ITPC Busan, 2016). On the other hand, Indonesia needs technology, investment, and technological products from South Korea to boost GDP through cinnamon exports, while South Korea needs natural resources, minerals, marketplaces, and labor from Indonesia (ITPC Busan, 2016). A report has been delivered on the spice trade sector, which means that cooperation in agriculture is a must.

Agriculture sector is not the main concern to boost economic growth beside of industry and services as the others traditional macroeconomic components. Meanwhile, most of countries are moving to tertiary sector, such as services, in expectation to reduce pollution (Alam, 2015). Agricultural sector should be the main macroeconomic component since the benefits including pollution reduction as well as economic growth escalation. At this rate, digital farming is the solution for advancing agriculture sector rather than industry and services sectors.

Digital farming can be a key to upgrade bilateral relations between Indonesia and Korea, especially in economic stabilization. Previously, the relations between the two countries are most concerned on politic and economic sector. The last meeting between two countries was held when President of Indonesia, Joko Widodo went to Seoul in 2018 (ITPC Busan, 2016). Nonetheless, topic meeting is not based on agriculture sector upgrading due to low popularity of agriculture sector, especially on digital farming.

Based upon the case, maintaining economic stabilization between Indonesia and South Korea through digital farming can be an innovation. Beside of the benefits, the two countries are embodying its duty through Sustainable Development Goals (SDGs) number 2 about end hunger, food security, nutrition, and sustainable agriculture (United Nations, n.d.). Therefore, the research objective is to explore digital farming development in Indonesia and South Korea and its relevance in the lives of farmers. The results are addressed to the government as advice to upgrade bilateral relations, especially in digital farming. The rest of this paper has the following structure: methods, results and discussion, and conclusion.

2. Methods

2.1 Study Area

The study location is on two countries, Indonesia and South Korea. Although both countries are in Asia, they have different natural and social characteristics, especially on agricultural systems. The scale of the research is on the country level, whilst the smallest scale is province.

Indonesia is a tropical country located between the Australia and Asia continents, and between the Pacific and Indian oceans. Based on astronomic location, Indonesia is located at coordinates 0.7893° S and 113.9213° E. Indonesia consists of five main islands and 34 provinces. The main islands are predominantly used by the agricultural sector, which accounts for an area of 8,162,608 ha and 33,487,806 farm households (Head of Data Center and Information System of Agriculture, 2018).

South Korea, a country with four seasons, is located on the southern half of the Korean Peninsula and shares a boundary with North Korea on the north side of the island. Based on astronomic location, South Korea is located at coordinates 37° N and 127° 30 E. South Korea is surrounded by the Yellow Sea on the west, the East China Sea on the south, and the Sea of Japan on the east. Consisting of 17 provinces, South Korea also has agricultural land, which is spread at approximately 1,595,614 hectares. The total number of farm households is 2,314,982.

2.2 Data Collection

This study is aiming on two variables, farm households and agricultural land area. Since this study takes place in two countries, thus each of variables should be searched at two official websites, those are Central Bureau of Statistics Indonesia and Statistics Korea. Central Bureau of Statistics provides agricultural land area in 2017 and farm households in 2018, whilst Statistics Korea provides agricultural land area in 2018 and farm households in 2018. Agricultural land area in Indonesia has different year than the others since it has not been updated by Ministry of Agriculture Republic Indonesia.

Data of farm households and agricultural land area will be used on quantitative and qualitative analysis. According to quantitative analysis, data which are based on both variables are applied to generate map suitability in Indonesia and South Korea. Meanwhile, administrative boundary data of Indonesia and South Korea are collected from Open Street Map and Ina Geoportal Website to complement maps. On the other side, qualitative analysis uses data of both variables to generate charts. Internet utilization data of two countries are also collected from World Bank to produce chart for qualitative analysis.

2.3 Data Analysis

The study employs quantitative analysis to generate suitability maps in Indonesia and South Korea. Using agricultural land area and farm households as variables, the output maps could be generated through ArcMap 10.7 software. Agricultural land area refers to rice field because the lack of data availability. Also, the farm households refer to farmers in general regarding the same problem. Meanwhile, the function of ArcMap 10.7 is a tool of Geographic Information System (GIS) technique to analyze data spatially (Figure 1).

Agricultural land area and farm households are processed diversely. All variables must be input one by one on an attribute table in ArcMap 10.7. Agricultural land area variable is input based on rice field data which is provided by Central Bureau of Statistics Indonesia. The variable is calculated on hectares unit since wide area of agriculture sector. On the other side, farm households are input based on the number of farmers regardless various crops. The variable is calculated on person since households do not represent the real number of farmers.

South Korea experienced different data, notwithstanding the data also will be input on an attribute table in ArcMap 10.7. Both of variables are collected from Statistics Korea, adjusting the availability data in Indonesia. The important reason is South Korea has swiftness to update the data, thus year of agriculture land area and farm households is available in 2018 as the latest data. Besides, the year of agriculture land area in Indonesia is available in 2017, whilst farm households is available in 2018. Therefore, the latest data of variables and countries are employed by generalize the data without observe the year of data.

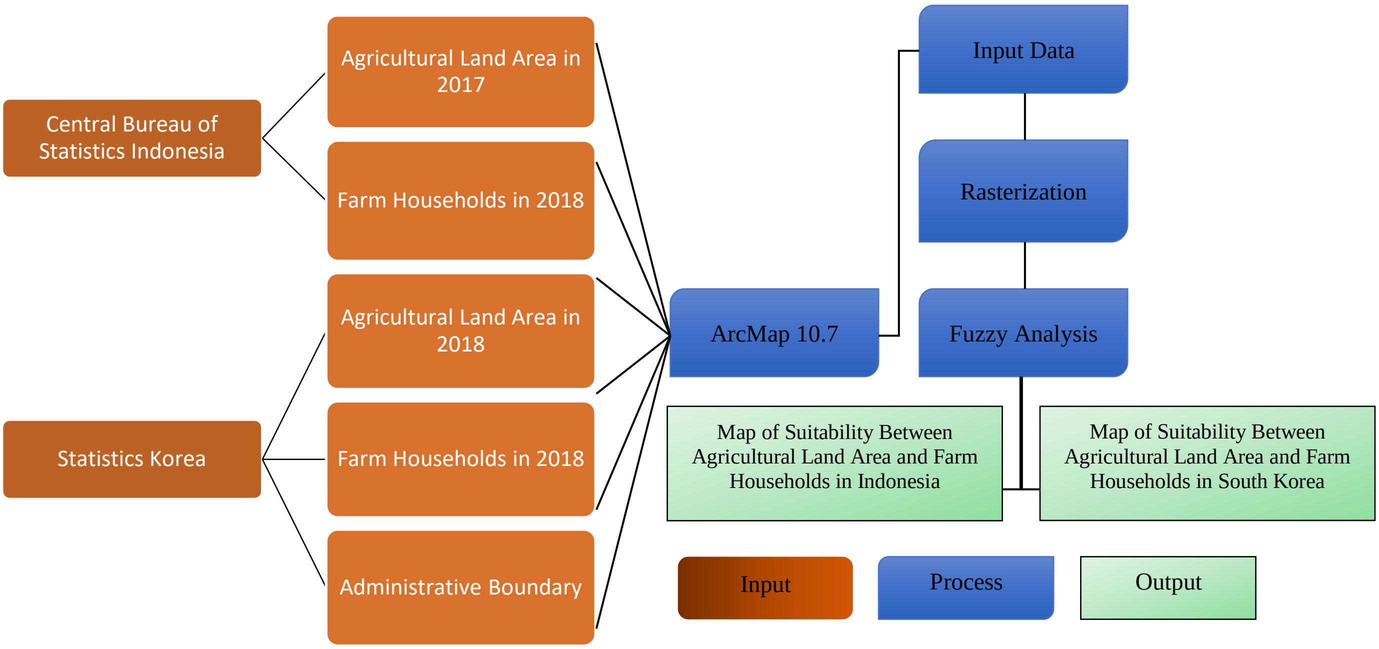

Figure 1. Flowchart of quantitative analysis

If the data are ready and prepared well, rasterization is the next step of data processing. The variables are converted to fuzzy membership before stepping into fuzzy overlay. Fuzzy membership is a tool used in spatial analysis in ArcMap 10.7 to transform data in person and hectares into a 0-to-1 scale as integer data (Esri, n.d.-a, 2019). Fuzzy overlay cannot be used if input data are not on integer scale.

Type of fuzzy membership applied is fuzzy MS small. It is similar to fuzzy small, also as default type because of the wide scope to huddle up the smallest value to be a member of the set (Esri, n.d.-b, 2019). Fuzzy MS small is based on mean and standard deviation at specific values, as shown in Figure 2.

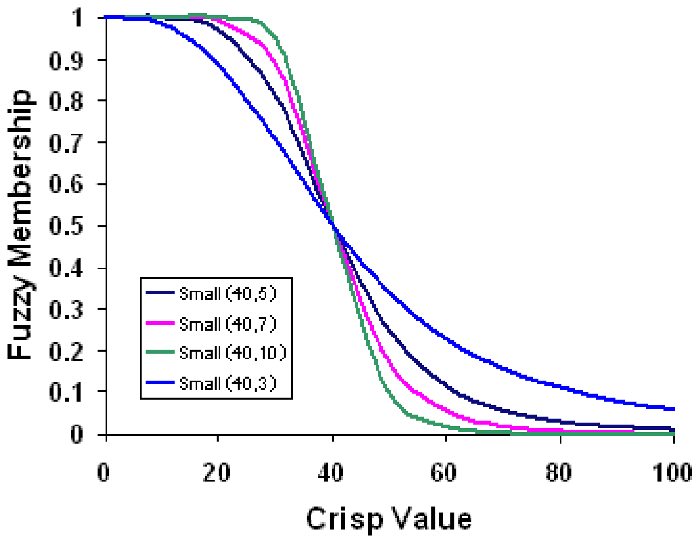

Figure 2. Graph of fuzzy MS small
(Source: Esri, n.d.-b, 2019)

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Aside from fuzzy membership, fuzzy overlay aims to combine raster data together to produce a relationship between farm households and agricultural land areas in Indonesia and South Korea. The overlay type is fuzzy gamma, an algebraic product of fuzzy sum and fuzzy product (Esri, n.d.-c, 2019). Therefore, the range of values is between the fuzzy sum and fuzzy product, as shown on following equation:

$$\mu(x) = (FuzzySum)^{\gamma} * (FuzzyProduct)^{1-\gamma} \quad \text{..............................(1)}$$

Fuzzy overlay has various functions aside from combining raster data. It can perform multi-criteria decision analysis through the possibility of a phenomenon belonging to multiple sets. This method can also analyze the relationship between the membership of each multiple set (Papadopoulou & Hatzichristos, 2019). The output is suitability maps between agricultural land area and farm households in Indonesia and South Korea.

The study does not only use quantitative analysis, but also qualitative analysis. Qualitative analysis is far different to quantitative analysis since it does not employ fuzzy analysis, neither to ArcMap 10.7 software. However, basic data for qualitative analysis are also collected from Central Bureau of Statistics Indonesia and Statistics Korea, as explained on data collection section. Internet utilization data is also explored in World Bank official website to complete the qualitative analysis. The charts (as the results of data above) are described with explorative study simultaneously. The charts represent the rice field areas in Indonesia and South Korea by year, also Internet utilization percentage in both countries from 1994 until 2018. Thus, a comparison of digital farming development between Indonesia and South Korea can be analyzed.

3. Results and Discussion

3.1 Digital Farming as an Essential Component of Digital Economy

Indonesia and Korea are two countries with bilateral relations in several fields. The cooperation between these two countries covers economics, trade, and investment. Some examples include the Joint Commission Meeting attended by the Ministers of Foreign Affairs of Indonesia and South Korea on December 18, 2015 and Indonesia–Korea Business Summit Forum in Jakarta on March 14, 2017 (Hidriyah, 2017).

The growth of Industry 4.0 has triggered the presence of the digital economy and influenced an alteration in economic strategy between Indonesia and South Korea. The effect of digital economy in Indonesia is a significant growth of e-commerce with a total transaction value of USD 3.56 billion in 2015, which rose to USD 8 billion in 2017. Large e-commerce companies, such as Bukalapak and Tokopedia, account for USD 5 billion (CNN Indonesia, 2019; APJII and Puskakom UI, 2015 in Tangkary, 2016). Due to massive transactions in e-commerce, the Indonesian economy grew by 4.71% in the first quarter of 2015 and 5.04% in the fourth quarter of 2015 (Wirabrata, 2016).

Indonesia experienced rapid development on digital economy in 2019. The value of e-commerce transactions, which reached USD 8 billion in 2018, is inseparable from the digital economic growth that reached 90% from 2015 to 2017, where the main actors are micro, small, and medium enterprises (CNN Indonesia, 2019). Moreover, the presence of Indonesian "unicorns" or companies with recorded valuations above USD 1 billion is making good strides through Industry 4.0. Four of the eight unicorns in Southeast Asia, namely, Go-Jek, Traveloka, Bukalapak, and Tokopedia, are from Indonesia (Sugiarto, 2019).

South Korea was 9th in 2013, and then moved up to 7th in the ranking of global digital economies (Chakravorti et al., 2014; Sil, 2017). The impact of the digital economy on economic growth was approximately 4% between 2003 and 2007. Thus, South Korea joined the trillion-dollar group in the world economy in 2004. The discrepancy between the two countries is not only in the economic sector but also in ICT, which affects the agricultural sector.

At present, agricultural sector across the world is experiencing a revolution known as digital farming, which is characterized by the integration of farming and advanced technologies. Digital farming is a system that covers many forms of technology, such as IoT, big data analytics, visualization capabilities, and industry knowledge and farm management, to promote high productivity and adaptability to climate change (Accenture, 2017; Heath, 2018; Trendov et al., 2019). Digital farming has not been adapted entirely in developing countries because of many factors, including the slow pace of adopting digital technologies, enhancement of mid-level white collar jobs, business regulations, skills development systems, and even public sector governance (Deichmann et al., 2016).

Digital farming is being implemented not only in developed countries but also in developing ones, such as those in Africa. Aker shows that African farmers can reduce time and cost through ICT for extension services, while in South Europe, tomatoes can be planted on a soil-less system and climate sensors can be used with a humidifier module, thereby reducing the gap between planting and harvesting to approximately seven months (Deichmann et al., 2016; Zamora-Izquierdo et al., 2019). However, the technology has not given digital farming an important role in upgrading the economy in Africa. Although digital farming can penetrate all types of country, thus effective implementation is necessary.

3.2 Agricultural Development in Indonesia and South Korea

Indonesia and Korea are two countries with vast landscapes. Korea has mountains that can be used for agriculture even though the country has four seasons. Meanwhile, Indonesia's climate is tropical, which allows the community to farm.

The ability of Indonesian people to farm is not the only reason for being an agrarian country. Indonesia has a land area of approximately 190 million ha, of which 55 million are agricultural lands consisting of 24 million ha of arable land, with 20 million ha being land with permanent crops (Quince, 2015). The other 7 million ha are irrigated agricultural lands.

Agricultural land can generate numerous products, such as tomatoes, paprika, watermelon, and rice. In Indonesia, rice is the main agricultural product because of high demand. As shown on Figure 3, the largest rice field areas are on Java Island. However, the land area has decreased over the years. Nevertheless, the land area for rice field in other islands is unstable since it does not show increment nor reduction.

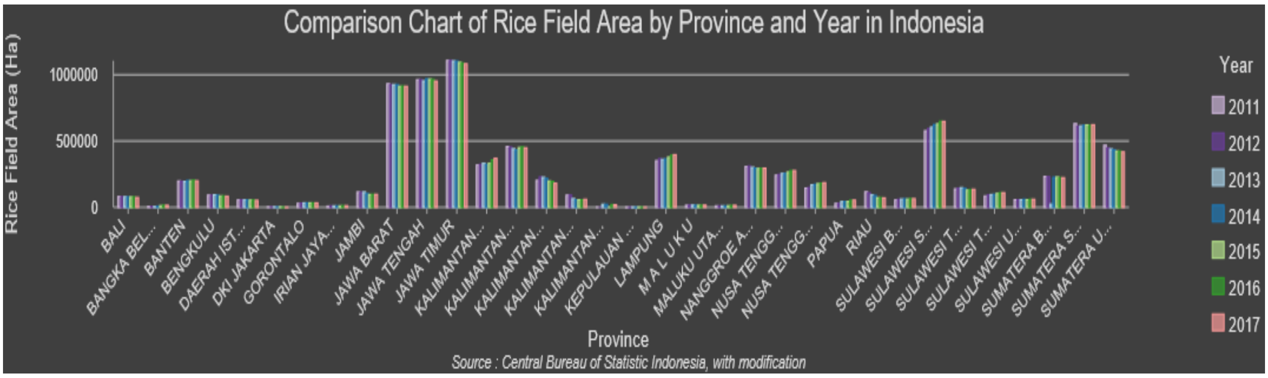

Figure 3. Comparison chart of rice field area by province and year in Indonesia

Land conversion threatens food security because the rice field areas continue to decrease in some provinces (Engel et al., 2017; Virianita et al., 2019). If land use planning and management are an issue for the government sector, the threat is not only in the agricultural sector but also in forestry. An increase in rice field areas outside Java might occupy forest lands, such as those in Kalimantan, Sulawesi, and Sumatera. Deforestation to support agricultural activities is the only livelihood option for farmers, and conversion of agricultural lands, especially rice field areas to built-up areas is the result of complex socioeconomic processes (Angelsen, 1999; Purnamasari, 2010; Virianita et al., 2019).

Meanwhile, South Korea has limited water and land resources, as shown on Figure 6. The limited land resources bring the rice field area to only 1,000,000 ha. Most of the provinces in South Korea have been experiencing land conversion, as shown in Figure 4. Even Jeollanam-do, the province with the largest rice field area, also shows land conversion, so the graphic pattern persistently declining from 2011 to 2017.

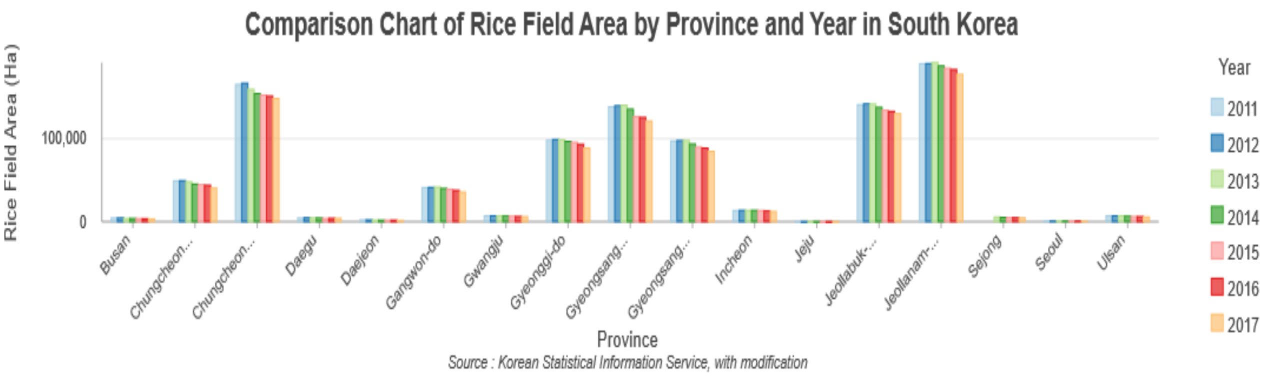

Figure 4. Comparison chart of rice field area by province and year in South Korea

The interesting point is the similarity between the rice field area of Jeju and Seoul. Data represent that Jeju province only has rice field area under 100 ha in all years, whereas the rice field area of Seoul province is 300–1000 ha in all years. Although Seoul has experienced a reduction in rice field area to 200 ha for 7 years, the two provinces are totally different in terms of status and regional development.

Seoul is a capital city with a population of approximately 10 million or 20% of the total population of South Korea (Kim & Baik, 2005). As the most densely populated province in the world, Seoul's largest land use type is built-up area. Unlike Seoul, Jeju Special Self-Governing Province has dry-farming field areas, topography of steep slope 5°, and 232,141 households (Jeju Special Self-Governing Province, 2013). The problem in Jeju is its barren land with abundant volcanic ash soils and rocks; strong winds are also common, thereby affecting farming conditions (Jeju Special Self-Governing Province, 2013).

Farm households in the two countries show different results, as shown on Figure 7. The largest farm household population in Indonesia is 6,290,107 people, whereas South Korea only has 376,562 people. The disparity may have negative and positive implications.

In South Korea, the negative implication is that laborers tend to work outside the agricultural sector because of the mindset that attaches a low social status to agricultural work. Thus, the difference between the farm households in both countries are quite far. In South Korea, the number of active workers in the agricultural sector has diminished from 60% in 1949 to 5.7% in 2015 (Neszmelyi, 2016). Indeed, all countries have experienced a reduction in the number of active agricultural workers due to massive migration from rural areas to cities in search of a better life (Neszmelyi, 2016).

Indonesia also experienced reduction of active agricultural workers, although the number is still high among the large farm households in Java Island. According to Figure 5, Papua and some parts of Sumatera, Kalimantan, and Sulawesi Island are classified as low since the scarcity of rice field areas.

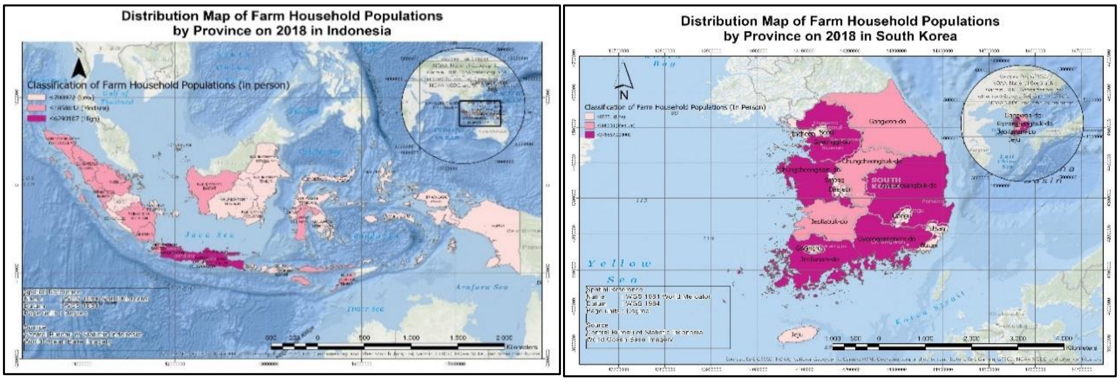

Figure 5(a). Distribution map of farm household populations by province in 2018 in Indonesia; (b). Distribution map of farm household populations by province in 2018 in South Korea

(Source: Central Bureau of Statistics Indonesia and Statistics Korea, 2018)

A possible factor is that land use is dominated by forests. However, deforestation is occurring as land is turned into plantation and mine. In addition, soil types and geomorphological landscapes may not be suitable for farming. For example, Singkep Island in Riau Islands Province has experienced farming on vast land. According to land survey, the rice fields did not produce any paddy because of the suitability to land and environment.

Mining activities are found conveniently in Singkep Island. Due to high mining activities, agriculture activities are not prioritized. Even though, the inhabitants also eat rice as staple food, so the development of rice field areas draws the attention. Furthermore, the development is still getting bad results because of pests and different soil types. As a post-mining land, Singkep Island is dominated with podzolic and hydomorfic soil type, which most of them including sand and poor nutrient (Sjahbudinef, 1995 in Harahap & Siagian, 2004). Therefore, the suitability to land and environment to produce paddy needs more research.

In terms of positive implications, the data show that South Korea is more advanced than Indonesia. The smaller number of farm households in South Korea is due to technology, which ensures high productivity and requires few active workers. This finding means that South Korea has already been implementing digital farming. Another consideration is that Indonesia has a vast landscape and large population. Thus, discrepancy occurs in the distribution of farm household populations between the two countries.

The combination of farm households and rice field areas produce new results, as shown on Figure 6. According to fuzzy analysis, the provinces in Java Island and Gyeongsangbuk-do Province have low classification, which means that the relationship between farm households and agricultural land area is inversely proportional. It means that those provinces have high farm households as well as narrow rice fields area. Narrow rice fields are caused by land use conversion, which commonly occurs in urban locations (Kim & Baik, 2005).

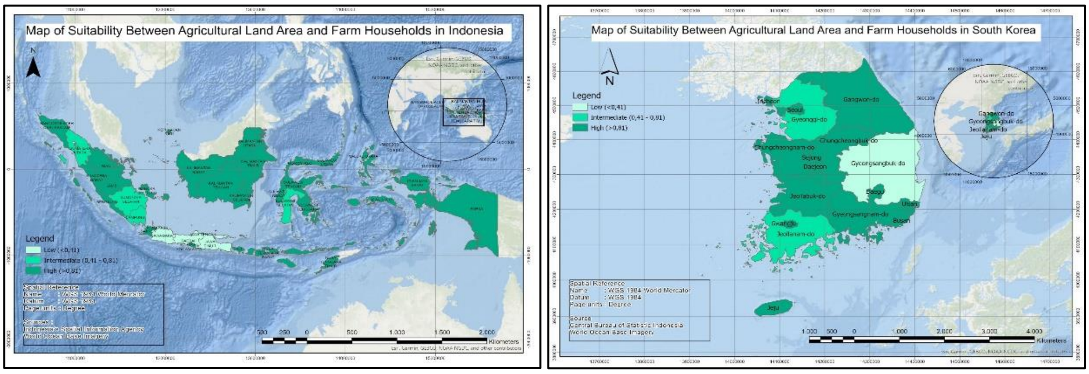

Figure 6(a). Map of suitability between agricultural land area and farm households in Indonesia; (b). Map of suitability between agricultural land area and farm households in South Korea
(Source: Central Bureau of Statistics Indonesia and Statistics Korea with modification, 2018)

Another possibility is that low farm households live in provinces with vast rice fields. This usually does not happen because land use conversion is dynamic. Most of Indonesia's population still work in agriculture, forestry, and fisheries (38,700,530 of the 127,067,835 national population) (Head of Data Center and Information System of Agriculture, 2018). Meanwhile, the percentage of informal workers in Indonesia's agricultural sector was stable from 2015 to 2018, where the percentage in 2018 was 88.27% (Central Bureau of Statistics Indonesia, 2018).

The problem in Indonesian agriculture is the disintegration of farming systems, which causes farmers to live in poverty. Farmers are the poorest population group by jobs in Central Java at 55.95%, although poor households in some regions still depend on agriculture due to lack of economic diversification (Gunawan, 2017; World Bank, 2003). The lack of government support for agriculture in Indonesia is reflected by APBN allocation for the agricultural sector at only 2%–3% and the overall bank credit allocation at only 5.4% (Sudiro, 2017; Gunawan, 2017).

Injustice toward farmers is one of the causes of disintegrating farming systems. The Indonesian economy is going through a liberal economic pattern in which small farmers face the risk of being set aside due to their weak bargaining position and being isolated from access to information and markets (Andri, 2017). The difficulty experienced by farmers in interacting with markets and their low capability to bargain can be addressed by a partnership system so that an ideal market commitment occurs. Import control, as well as the presence and integration of traders, processors, and producers in a self-regulated system, can prevent farmers from living below the poverty line (Suseno & Suyatna, 2007; World Bank, 2003)

3.3 Adaptation of Digital Farming from South Korea to Indonesia

South Korea is one of the developed countries with high-speed Internet access. As shown on Figure 7, discrepancy of internet utilization between Indonesia and South Korea is quite big. As of 2018, South Korea has achieved nearly 100% Internet access for its population. The capability of applying Internet technology to digital farming is important; thus, farmers are expected to develop technological literacy.

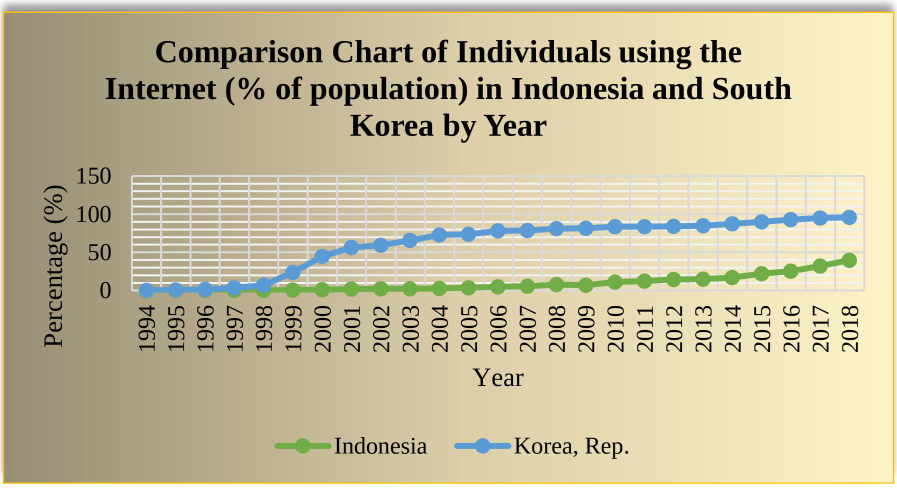

Figure 7. Comparison chart of individuals using the internet (% of population) in Indonesia and South Korea by year
(Source: World Bank, 2019)

Previously, farmers in South Korea could not produce crops efficiently because of old technologies. However, the government promoted the standardization and localization of ICT equipment and materials, as well as the development of growth and management technologies (Lee, 2019; Neszmelyi, 2016). Encouragement to invest on agriculture sector are seen by increasing the R&D budget from 5.4 billion won in 2014 to 33.6 billion won in 2018 (Lee, 2019). Therefore, the expectancy can be shown through achieving higher productivity on agricultural sector.

South Korea has been developing its agricultural system to create an integrated farming system from production process to end consumer. The system consists of production and distribution to generate an agricultural information system called Okdab, as shown on Figure 10. The first step is production that considers farming calendar and the agricultural weather, including temperature, rainfall, humidity, wind, and regional real-time climate service (Sanghun, 2017).

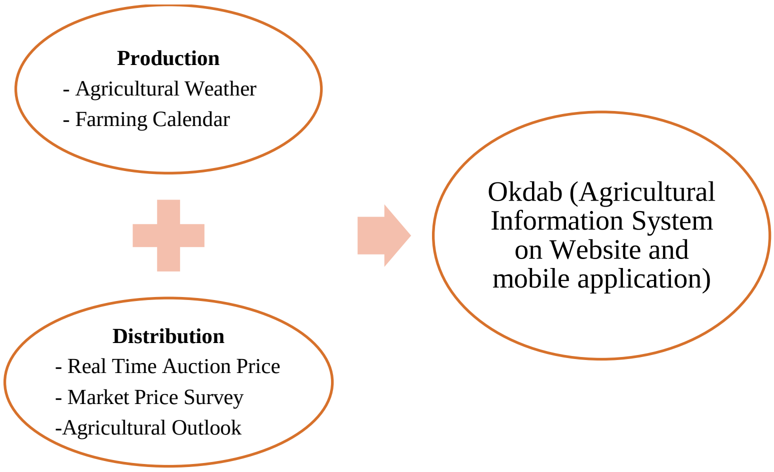

Figure 8. Flowchart of integrated farming system in South Korea
(Source: Sanghun, 2017)

The farming calendar prioritizes five main vegetables and related publication services. This calendar also employs technologies, such as automated air circulation, environmental monitoring (humidity, temperature, and carbon dioxide), and nutrition supply using a computer or mobile application to create the ideal environment (Sanghun, 2017). Distribution encompasses real-time auction price, market price survey, and agricultural outlook.

Bidding information, price, and price analysis are included in the real-time auction price, whereas market price survey covers import, retail, and wholesale prices. At the same time, agricultural outlook involves the cultivation, crop condition, until harvest approximation (Sanghun, 2017). The output is Okdab, a publication and agricultural information system for public use.

The integrated farming system in South Korea can be applied in Indonesia, but the setting of the tools and detailed steps must be suitable for the Indonesian situation. By contrast, South Korea benefits from cooperation in the commerce sector through agricultural trade. Indonesia is an exporter of spices and cinnamon to South Korea but has not been able to export rice as Thailand does (Choi et al., 2016; Directorate General of National Export Development, 2018; ITPC Busan, 2016).

Rice is the most important food in South Korea since its status as staple food, also chief crops for the farm (Choi et al., 2016). The rice consumption in South Korea also rises rapidly, so the balance between consumption and production should get more attention. Even though Korean Government has been attempting to reduce rice consumption, whilst they have been impelling the productivity by digital farming application (Choi et al., 2016).

By applying integrated farming technologies from South Korea, the expectations for Indonesia should be meet SDGs number 2. According to SDGs goals number 2 about sustainable agriculture, Indonesia is also supposed to double agricultural productivity and incomes, especially for farmers, strengthen capacity adaption to disaster and climate change, and increase investment to boost economic growth and reduce poverty for farmers (United Nations, n.d.). On the other side, data availability should be integrated to agricultural research, technology development, or official website, thus government could monitor the agricultural development and make right decisions.

The relations between Indonesia and South Korea could deliver another benefit, such as food security. Food security is important for both countries to guarantee the consumption of the community. South Korea could not hide from their severity of food insecurity (Lee, 2019). Therefore, digital farming on crops, especially rice, could be the opportunity for Indonesia to strengthen bilateral relations and build mutual relationship of each countries. If digital farming can be implemented in Indonesia, then the country may obtain funding and investment, while South Korea can gain a reliable supply of quality agricultural products.

4. Conclusion

Economic relations between Indonesia and South Korea can be strengthened through digital farming as an essential component of the digital economy. Digital farming can penetrate all types of countries, but the implementation needs to be carried out effectively. Indonesia is an agrarian country with vast agricultural lands where most of the residents work as farmers, while South Korea has the opposite situation.

The cause of different suitability maps between rice fields and farm households, as a result of fuzzy analysis, are complex socioeconomic processes such as migration, government policy, and injustice to farmers. Both countries experienced them. Indonesia faces greater difficulty because of poor technological literacy. Thus, the integrated farming system in South Korea should be applied in Indonesia.

The benefits for South Korea are stronger bilateral relations through agricultural trade and cheaper price for agricultural products. Else, food security and rice stock of South Korea achieve sustainability. Meanwhile, Indonesia gets more benefits through technology literacy, double agricultural productivity and incomes, capacity adaptation to disasters, and investment which impacts to poverty reduction and economic growth. Therefore, the study is aimed to government in order the policy could be created well.

Good coordination is needed between Indonesia and Korea, as well as government support to provide important components in digital farming such as data, infrastructure, outreach mechanisms, and internet. Indonesia must take a bold step by investing APBN for R&D on agricultural sector. In addition, Indonesia should provide the best agricultural products to South Korea as part of the two countries' bilateral relations.

Author Contributions

Aprillia Christianawati as author are fully handling the whole article

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