AGROSAINS
Jurnal Penelitian Agronomi
pISSN: 1411-5786; eISSN: 2655-7339

Agrosains : Jurnal Penelitian Agronomi 24(1): 32-36, 2022
https://jurnal.uns.ac.id/agrosains/article/view/57919
DOI: http://dx.doi.org/10.20961/agsjpa.v24i1.59741

Preparing for Indonesian Agricultural Transformation in The Society Era 5.0

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ABSTRACT

Indonesia is an agricultural country with one of its main incomes from the agricultural sector. Indonesia's position in the equatorial region and tropical climate favors Indonesia as a country with megabiodiversity. Indonesia has a variety of regional conditions with agricultural management techniques according to the needs of farmers in the region. Agricultural technology is the key to agricultural transformation, marking changes in each era, including the era of society 5.0. Agriculture in the Society 5.0 era will blend technology with automation, where technology can play a role in replacing and complementing agricultural activities. This set of technologies will allow farmers to control agricultural commodities and their environment. Agricultural activities are carried out using IoT (Internet of Things), AI (Artificial Intelligence), Big Data, and robotic technology. Agriculture in the Society 5.0 era was based on smart agriculture with the concept of precision farming. Indonesia has a great opportunity to be ready to face agriculture in the era of Society 5.0. through 7 TTPS (7 Stages of Transformation of Agriculture Society 5.0) namely Commitment and Policy, Human resources, Research, Data management, Transition, Tools, and Cyber protection. With the right and gradual transformation process, as well as the ability to integrate and synergize across disciplines and across institutions, the transformation process will be able to run well.

Keywords: agricultural technology; farmer; globalization.

Cite this as: Yunindanova, M. B. (2022). Preparing for Indonesian Agricultural Transformation in The Society Era 5.0. *Agrosains : Jurnal Penelitian Agronomi, 24*(1), 32-36. DOI: http://dx.doi.org/10.20961/agsjpa.v24i1.59741

INTRODUCTION

Agriculture is the world's main food supplier. Agriculture has radically changed world society and energized a world society that has grown from 4 million to 7.85 billion since 10,000 BC and will continue to grow (Kremer, 1993). In Indonesia itself, agriculture is not only a food supplier, but has also become part of culture, a source of livelihood, and is now wider as a contributor to the country's foreign exchange. Indonesia has a variety of agricultural management techniques by utilizing the advantages of the natural conditions of the region (Maat, 2016).

Agriculture continues to undergo transformation as a result of changes in the global order of human life and the influence of nature. The order of human life has evolved from Society 1.0 (hunting society), Society 2.0 (agricultural society), Society 3.0 (industrial society) and Society 4.0 (information society). Currently, agriculture in Indonesia must be ready to face Society 5.0 (super smart society). Indonesia has been able to pass Society 3.0 and has begun to move to Society 4.0. Agriculture has been the root of culture for generations in Indonesia, how far is Indonesia's agricultural readiness to face the Society 5.0 era? This must be a mature thought because at this time we are in the flow of globalization with all the global demands in it. This paper will discuss how and to what extent Indonesia's agricultural readiness to face the era of Society 5.0.

DISCUSSION

Challenges of Indonesian Agriculture

Although it is still needed, in reality there are many things that make agriculture in the world and in Indonesia under pressure. Basically, this pressure arises because of 3 factors, namely 1) demographics, 2) agricultural subjects/human resources of agricultural actors, and 3) natural conditions.

Regarding demographic factors, Indonesia's population is predicted to reach 305.6 million in 2035 after previously only at 238.5 million in 2010 (Bappenas, 2013). The high population is actually two sides. On the one hand, population growth is a potential market object and a source of agricultural subjects. A high population will present a high demand for agricultural products which will have an impact on encouraging agricultural activities and increasing profits for farmers. The high number of people driven by the demographic bonus in Indonesia will present the percentage of young people who are full of energy, productive generations, and human resources in agriculture. However, on the other hand, the high population has negative impacts (Figure 1) including increasing competition in the use of natural resources and increasing "variation" in demand for agricultural products. The high population will erode fertile land into residential land (land conversion) and pollution caused by human activities, both domestic activities and industrial activities that support human needs, will threaten agricultural activities. The high population indicates the higher demand. But not only

that, the increasing number of people with diverse social strata in fact presents variations and segmentation of agricultural products that must be considered and demand more knowledge.

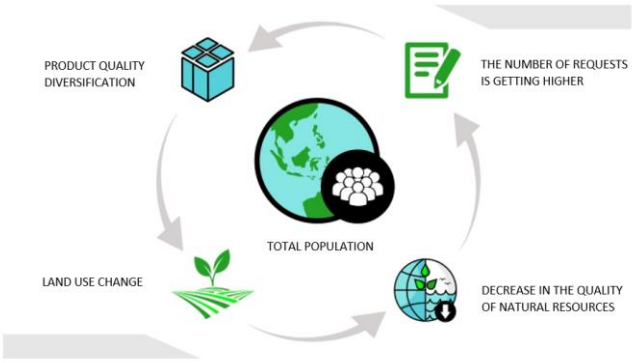

Figure 1. Agricultural challenges from a demographic perspective

The next emphasis is on the subject of agriculture/human resources of agricultural actors (Figure 2). Currently, it is undeniable that Indonesian agriculture is faced with aging farmers, a decrease in the number of farmers' resources, and a decrease in the interest of young people in the world of agriculture. This is a problem in the midst of modernization where youths see more of the practical side of a profession, see more of the less profitable side of agriculture, and think that working in an office or room is more attractive and profitable.

Figure 2. Agricultural challenges in terms of agricultural subjects/human resources of agricultural actors

The challenges of today's natural conditions are increasingly diverse (Figure 3). Globally, the earth is experiencing a decline in quality and climate change (climate change). This further increases the intensity of stress on crops and agriculture in general as a result of biotic and abiotic factors. Of course, this challenge can significantly reduce the productivity and quality of agricultural products.

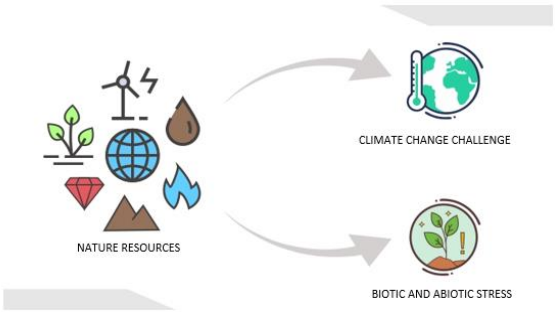

Figure 3. Agricultural challenges from a natural perspective

These three main challenges ultimately elaborated with other factors such as policies and pressure from certain parties which made Indonesia lacking in quality and quantity of some agricultural products and had not been able to realize complete food security and self-sufficiency. Other factors are the lack of protection for local products, dependence on outside suppliers, and increased imports so that in the end it becomes a vicious cycle. Vicious circle or vicious circle or endless circle means a sequence from low national income to return to low national income in a country.

Agriculture in the Era of Society 5.0

Society 5.0, which is also called the super smart society era, was introduced by Japan in 2019. Society 5.0 is a data driven society concept (Nagasaki, 2019). The form of society in the Society 5.0 era is a smart society with a combination of skills to apply findings in the Industrial Revolution 4.0 era. Community activities will be carried out on a technology basis to streamline human life, solve problems, and improve quality of life. Society 5.0 is a society where every individual becomes the center and is able to control life based on technology. The achievement of Society 5.0 with its intelligent features will enable the whole world to realize economic development along with solving social problems. This will also lead to the realization of the Sustainable Development Goals (SDGs) designed by the United Nations.

Society 5.0 in agriculture will be realized in the form of Smart Agriculture/Smart Farming based on Precision Agriculture to realize Smart Food Value Chain starting from breeding, cultivation, harvesting, storage, distribution and consumption. Agriculture in the Society 5.0 era will blend technology with automation, where technology can play a role in replacing and complementing agricultural activities. This set of technologies will allow farmers to control agricultural commodities and their environment. Agricultural activities are carried out using IoT (Internet of Things), AI (Artificial Intelligence), Big Data, and robotic technology. The agricultural system is carried out with precision (Precision Farming), which is an agricultural operating system based on data from cultivation to harvesting to optimize agricultural management and reduce adverse impacts on the environment and the environment (Nagasaki, 2019). The precision farming system is built on the basis of data on crop growth patterns, production and the environment (weather, soil, water) that have been extracted and interpreted while still prioritizing the concept of ecology in agricultural ecosystems. The data collected through this sensor becomes the basis for managing the plant cultivation process in the next period which is developed in computer systems and technology.

The agricultural system in the Society 5.0 era was developed to answer agricultural challenges (demography, agricultural subjects, and natural conditions) to ensure the quantity, quality, and continuity (3K) of agricultural products (Sims & Heney, 2017). Automation in the agricultural sector will encourage the younger generation (Permadi et al., 2021). Agriculture Society 5.0 will improve the efficiency and effectiveness of farmers' performance. The use of technology will make the practice of plant cultivation cheaper, faster, more

precise, more consistent, and more certain than human use. This makes agricultural activities more profitable in terms of economy and speed in meeting market demand for agricultural products. The orientation of agricultural production is mainly on the country's food self-sufficiency (food self-sufficiency) and subsequently increasing export capacity. Agricultural applications in the era of Society 5.0 include:

Breeding stage. Looking for genetic resources and developing plants with added value not only in terms of productivity, but also quality, and functionality as well as having resistance to biotic and abiotic stresses (smart breeding program) (Bakala et al., 2020).

Cultivation stage. The use of automation in various agricultural activities. Planting can use an automatic transplanter (Khadatkar et al., 2018). Fertilization is done with a fertilizer applicator (Fuadi et al., 2019). Watering stage with smart irrigation system (Ogidan et al., 2019). Weed removal with a smart weeding machine (Perez-Ruiz et al., 2014; Chang&Lin, 2018). Development of Farm Management Information System (Husemann & Novkovic, 2014). Use of satellite data and Unmanned Aerial Vehicles (UAVs) to monitor plant health and the application of fertilizer, pesticide and PGR spraying on cultivated plants. The use of an Unmanned Aerial Vehicle (UAV) with a quadcopter base is able to streamline the use of chemicals and labor and increase the accuracy of agricultural activities (Santoso and Hariyanto, 2017). In addition, it can also be in the form of a smart greenhouse (Pamungkas, 2019) with various sensors that can determine and regulate environmental conditions according to plant needs.

Harvesting Stage. Use of Decission Support System Technology (Yost et al., 2011), for example determining harvest time and harvest index based on images collected by satellite based on predetermined patterns. Use of automatic harvester and combine harvester for efficient harvesting activities.

With all its advantages, agriculture in the era of Society 5.0 requires actors to be critical, innovative, and adaptive. Agricultural subjects or farmers in the Society 5.0 era are people with the ability to master technology, solve problems, social networking, negotiation skills, and multidisciplinary cooperation.

Making Society 5.0 the Driving Factor of Indonesian Agriculture

How to prepare Indonesian agriculture in the era of Society 5.0? Indonesia once triumphed as an agrarian country by achieving self-sufficiency in food in 1984 and receiving an award from the FAO in 1985. The glorious achievements in agriculture must be revived as the momentum of agricultural adaptation is inevitable in the era of Society 5.0. Indonesia will get a demographic bonus by increasing the number of productive age population. The demographic bonus must be supported by a competency bonus to increase the readiness of the agricultural sector in the era of Society 5.0. With the right stages of adaptation, in the end, Society 5.0 can become a driving factor to return to the revival of Indonesia's agricultural achievements.

Stages of Society's 5.0 Transformation in Agriculture

Society 5.0's transformation in agriculture can be realized through multi-disciplinary cooperation with careful consideration. The change instinct must consider many things, including economic, social, political environment aspects, and not only be oriented entirely from an economic point of view. Non-economic factors often have a greater impact because these factors are able to regulate economic variables (Beckford, 1973). So that the stages carried out also involve many stakeholders. The stages that can be carried out through 7 TTPS (7 Stages of Transformation of Agriculture Society 5.0) are Commitment and Policy, Human resources, Research, Data management, Transition, Tools, and Cyber protection.

Commitment and Policy. Building the commitment of the government and other stakeholders that agriculture must continue to be prioritized. This is for 3 main reasons, namely 1) agriculture as a source of food because it cannot depend entirely on imports, 2) agriculture is a source of life and employment, 3) agriculture is a source of non-oil and gas foreign exchange that contributes greatly to the economy and prosperity of the people. With a clear and targeted commitment, further supported by policies to encourage the smartization of agriculture and the food industry, this can be a fundamental factor towards the transformation of agriculture in the era of Society 5.0.

Human Resources. Ensuring human resources with competencies needed in agriculture in the era of Society 5.0. The Ministry of Agriculture has even targeted 2.5 million millennial farmers to participate in the agricultural sector (Minister of Agriculture, 2021). This process can be done through the ABGC (Academia, Business, Government, Community) involvement system. Education plays an important role in improving the quality of human resources in the Sociaty 5.0 era. Academics play a role in preparing young farmer resources (millennial farmers) with 4C abilities (Creativity, Critical Thinking, Communication, Collaboration). The education curriculum by prioritizing practices including agricultural vocational programs will be the spearhead of agricultural human resources. Business has a role as a university partner in education including the implementation of the Independent Learning Program, a provider of the real world of work, internship programs, training, and through CSR programs to facilitate research collaboration between students and companies. The government acts as the highest umbrella in making policies that support conducive education. Society is the mother of all the nation's children. Communities and community organizations can become cooperative partners that are supportive, conducive, and proactive in educational activities. Benchmarking activities and presenting experts in the fields of robotics, AI and big data can be a strategy to improve the quality of human resources in existing institutions.

Research. Streamlining research institutions, promoting applicable research, and formulating appropriate research strategies in agriculture in the Sociaty 5.0 era. This is because innovation is the main keyword. The research needed includes the development of effective

agricultural technology by considering emerging barriers such as biotic and abiotic stress and land limitations while still considering local wisdom and collaborating with technology (community based-precission farming) (Shibusawa, 2003). Another thing is research related to the development of superior varieties based on local genetic resources (smart breeding system). In addition, research related to policy analysis, social expectations, domestic, and global trends is also needed. Research involves various fields of science and multi-institutions including the private sector.

Data management. Agriculture in the Society 5.0 era uses Big Data, data driven innovative technology and data collaboration plantforms. Data management is very important starting from data mining, data integration, institutions, and human resources in it.

Transition. The transition process must be carried out appropriately and gradually. Technology transition cannot be done without a mind set transition. Mind set transition must be done at the beginning and continued with technology transition. The technology transition is carried out through on farm demonstration trials of smart agiculture, technology dissemination through community service programs by universities, and CSR programs with the involvement of private companies. Given that the awareness of our farmers is still low, agricultural extension workers and academics must have communication skills and the right approach to conventional farmers.

Tools. It is necessary to develop smart agriculture and infrastructure supporting tools that are affordable and accessible to many parties, including the role of private companies. It is also necessary for companies that are able to provide information and communication technology services accompanied by the provision of a good business atmosphere by the government.

Cyber Security. Data security guarantees from illegal access are required as well as the protection of organizations and users' assets. Cyber security requires comprehensive thinking (Ardianti, 2014).

Indonesia's Current State of Agriculture Towards Society 5.0

Indonesia's preparations for Society 5.0 in the agricultural world have actually begun, although not massively. Currently, agriculture in Indonesia is in the process of elaborating the Industrial Revolution 4.0 in the context of initiating agricultural transformation in the Society 5.0 era. The use of automation technology in agriculture has been carried out in research institutions, educational institutions, pilot projects, the agricultural industry with high capital, and even start-ups in the field of smart farming.

Smart farming technology 4.0 includes blockchain to facilitate monitoring of the supply chain of agricultural products on modern off farms, drone surveillance (UAV land mapping), agri drone sprayer (UAV spraying pesticides and liquid fertilizers), soil and weather sensors, smart irrigation systems, Agriculture War Room (AWR), siscrop 1.0 (information system) has been applied in several areas. The Ministry of Agriculture has made smart farming innovations by using satellite data imagery to increase crop productivity. The Ministry of Villages, PDT and Transmigration has built a smart farming pilot project in several areas in Indonesia (Rachmawati, 2021). There is an agricultural technology company created by the nation's children that is able to produce the ENCOMOTIONTM smart irrigation system using two tools named SiJamoorTM and SiRamotTM (Ananda, 2021). There have been start-up agritech companies such as Eragano and agricultural support companies such as TanuHub, Crowde, and LimaKilo.

Problems in Agriculture in the Era of Society 5.0 in Indonesia and the Solutions

The technology used will increase the interest of the younger generation. But on the other hand, the existence of smart agriculture in the era of Society 5.0 will change the demand for the job market. There will be a reduction in human resources in the agricultural sector which will allow the creation of unemployment for unskilled farmers.

The thing to remember is that "technology is created by humans, technology is not the enemy of humans, and technology is not to get rid of humans". The implementation of Society 5.0 in Indonesian agriculture must be done wisely while still prioritizing the concept of humans as the technology owner. It must be emphasized that technology is created to increase the efficiency of human performance. Technology will indeed change the nature of the work. So what must be done is to change the concept that reducing human resources in agriculture is not a reduction but a transfer. Transfer means that existing human resources will be utilized for things that are more important, profitable, and cannot be replaced by machines.

The step that needs to be done is "Characterizing the type of work". By determining which types of work are more efficiently carried out by machines or vice versa, we can begin to describe which jobs require a large human role, the skills needed, and the extent to which technology will help complete the work. Technology can replace repetitive agricultural activities. Technology can replace routine cognitive work and routine manual work (OECD, 2012). Meanwhile, humans have a role in determining the rules for the use of agricultural technology, control, and maintenance of technology that has been designed for specific agricultural jobs. So that the main things that cannot be replaced by machines/technology are 1) jobs that require expert thinking and 2) jobs that require complex communication (OECD, 2012).

CONCLUSION

Agriculture in the Society 5.0 era was based on smart agriculture with the concept of precision farming. Indonesia has a great opportunity to be ready to face agriculture in the era of Society 5.0. through 7 TTPS (7 Stages of Transformation of Agriculture Society 5.0) namely Commitment and Policy, Human resources, Research, Data management, Transition, Tools, and Cyber protection. With the right and gradual transformation process, as well as the ability to integrate and synergize across disciplines and across institutions, the transformation process will be able to run well.

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