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Strategic Programs to Release the Vision of Agriculture 5.0 in North Sulawesi, Indonesia to get much Income

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Abstract

This study aims to formulate a vision of Agriculture 5.0 in North Sulawesi, and to create strategic programs to realize the vision of Agriculture 5.0 in North Sulawesi. This research is policy research to realize the vision of Agriculture 5.0 in North Sulawesi using the Competitive Intelligence (CI) method. The results of the study indicate that the existing facilities and infrastructure in North Sulawesi Province can support the Vision of Agriculture 5.0 in North Sulawesi. The vision of Agriculture 5.0 in North Sulawesi is the use of robotic systems to increase the efficiency of agricultural businesses and take advantage of this economic growth to improve the quality of human resources and natural resources by prioritizing sustainable development. The robotic system in question uses unmanned ground vehicles for agricultural land processing, nurseries, plant planting, and plant maintenance, and unmanned aerial vehicles for soil monitoring, plant maintenance, phenotype observation, and plant health mapping. Strategic programs to realize the vision of Agriculture 5.0 are establishing an agricultural information system, farmer organization, and farmer partnership with stakeholders.

Keywords
strategic programs; agriculture 5.0; agricultural information system; farmers partnership; North Sulawesi

I. Introduction

Indonesia is entering the era of industry 4.0, while Japan is already in Society 5.0. and The European Economic Community started Industry 5.0 in 2021 with the principles of Industry 5.0. One of the principles of Industry 5.0 is the application of the principles of sustainable development in the European industry (Mazur & Walczyna, 2022). Industry 4.0 is more focused on the use of agricultural digitization with little or no attention to social and environmental problems. Some even think that the role of humans - human intelligence - in the era of industry 4.0 becomes less meaningful.

In the era of Industry 4.0, various aspects will be connected and technology will join the super intelligent society with full integration of Big Data, the Internet of Things (IoT), artificial intelligence (AI), and human services to facilitate digital and physical infrastructure for humans (Fukuyama, 2018). This new concept of Society 5.0 aims to focus on people to balance the spread of Communication and Information Technology to solve the main problems of society such as competitiveness, productivity, connection, prosperity, and sustainable development.

Indonesia has the opportunity to become a Society 5.0 because it has three potential sectors, namely agriculture, infrastructure, and information and communication technology

(ICT) (Brodjonegoro, 2021). Society 5.0 is a society that can solve social problems and challenges by utilizing various innovations born from the industrial revolution 4.0.

Society 5.0 aims to solve social problems from a new perspective. Society 5.0 seeks to create a sustainable society by giving priority to the safety and comfort of individuals based on certain cyber-physical systems (Anonimous, 2019). Society 5.0 is a society that is based on humans by utilizing human intelligence with artificial intelligence. This means that industrial progress and economic growth are used to solve social issues while still promoting sustainable development (Mazur & Walczyna, 2022). Martinelli (2019) stated that policies that only rely on economic growth are policies that limit the circulation of assets among the rich people. Despite modest progress in some countries, the post-colonial state has been unable to establish rights-based political and economic systems of governance that would facilitate consolidation of state-building and promote economic development (Monga, 2019). Particularly, whether inflation is necessary or harmful form economic growth constitutes the basis of the matter in question (Eden in Wollie, 2018).

Indonesia as an archipelagic country is currently trying to take advantage of the progress of Industry 4.0 for agricultural development. Indonesia is currently utilizing information technology to develop agricultural innovations, both in cultivation technology, product processing, and marketing of agricultural products. However, efforts to implement Society 5.0 must be made to pursue economic growth, and equitable development, and improve the quality of human resources and the quality of the environment, both the social environment and the natural environment.

In North Sulawesi, the vision to bring Society 5.0 in agriculture or Agriculture 5.0 is possible because of the support of adequate facilities and infrastructure. The condition of facilities and infrastructure that supports the implementation of Community 5.0, among others: (i) North Sulawesi's relatively high human resources, which is reflected in the Human Development Index (Badan Pusat Statistik, 2018), and (ii) the availability of an underwater fiber optic network (speeds of 40 Gbps to 10 Tbps) in North Sulawesi, including in 3T areas (marginal, outermost and isolated) (F. R. Tulungen, 2020)

The vision of Agriculture 5.0 in North Sulawesi is to increase the efficiency and quality of agricultural production and to increase farmers' income and the quality of public health while prioritizing the principles of sustainable development.

This research aims to formulate the vision of Agriculture 5.0 in North Sulawesi, and to create strategic programs that can be implemented to realize the vision of Agriculture 5.0 in North Sulawesi.

II. Research Method

This research is policy research to realize the dream or vision of Agriculture 5.0 in North Sulawesi using the Competitive Intelligence (CI) method. CI is a systematic program in collecting, analyzing data and information, and understanding information in the context of making recommendations to answer research problems (H. Dou et al., 2019). CI is a circular process, as shown in Figure 1 (F. R. Tulungen, 2012) (F. R. Tulungen, 2019). Starting with the problems related to the vision of Agriculture 5.0 and then proceeding with the preparation of a data or information collection plan (F. Tulungen et al., 2021). Data or information collected is primary data and data. Primary data were obtained by observing and interviewing farmers. Primary data collection through participatory observation and interviews with several farmers in Minahasa. Secondary data collection by utilizing private libraries and by using the internet. Data collection using the internet, namely by using the Google search

engine, then search for Directory Open Access Journal (DOAJ) and from this site select further search with keywords including Society 5.0, industry 4.0, smart farming. The data or information collected is analyzed qualitatively, namely by grouping it according to themes and sub-themes and then described to get a complete understanding (F. R. Tulungen et al., 2021). The results of the analysis or information are then understood to create intelligence (Kaelan, 2012) so that conclusions and recommendations can be obtained to answer research problems (F. R. Tulungen, 2020) (H. J.-M. Dou & Manullang, 2003).,

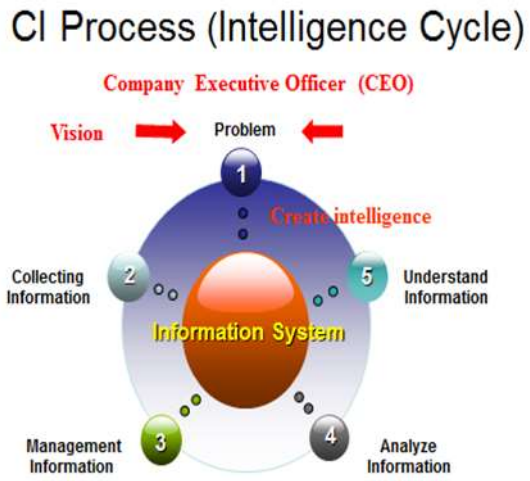

Figure 1. *Competitive Intelligence Method Process Circle*

III. Discussion

3.1 The Current State of Agriculture in North Sulawesi

Based on the results of the 2020 Population Census, it was found that the total population of Indonesia was 270,203,917 and North Sulawesi Province was 2.62 million. The population density of North Sulawesi Province is 189 people per km2 with an average population growth rate of 1.40 percent for the period 2010 - 2020 (Biro Pusat Statistik, 2021).

Based on gender, 1.34 million people (51.18 percent) are male and 1.32 million (48.82 percent) are female with a Sex Ratio of 105. Furthermore, based on age group, it shows that 72.28 percent of the population is in the productive age group (15-64 years) and the remaining 27.72 percent is in the non-productive age group (0-14 years and 64 years and over) (Biro Pusat Statistik, 2021).

The Central Statistics Agency (BPS) recorded the number of farmers as of 2019 reaching 33.4 million people. As for this number, only 8% of young farmers in Indonesia are aged 20-39 years old, or equivalent to 2.7 million people. Then, about 30.4 million people, or 91% are over 40 years old, with the majority of them approaching 50-60 years old (Alinea.id, 2022). This condition is slightly different from rural areas in Minahasa, where 23.5 % of farmers are aged between 20-39 years and 39.9% are aged between 40-65 years. That means that most of the farmers are over 40 years old.

Based on data from the Central Statistics Agency (BPS) the education level of farmers is still dominated by elementary and junior high school education levels. While college graduates and diplomas are only 0.57 %. The level of education of farmers who have never been to school is 766,954 people or about 9.65 %, not in school. Those who have not graduated from elementary school are 10,358,754 people or 26.54 %. Meanwhile, there are 15,023,269 elementary school graduates equivalent to 38.49 %, 6,330,800 junior high school

graduates equivalent to 16.22%. High school graduates as many as 332,106 people or 8.54% and graduates of Higher Education and Diploma and Bachelor's degrees as many as 223,809 people equivalent to 0.57% (Nurmansyah, 2018).

The proportion of adolescents and adults aged 15-59 years with ICT skills in information technology literacy is 69.77 (Biro Pusat Statistik, 2021) (BPS, 2020). This means that ICT skills and technology literacy have developed in the population since adolescence. Of every 10 adults who are technology literate, 7 teenagers are also technology literate.

The government partnership between farmers and industry that aims to encourage the formation of smart farmers and smart agriculture in North Sulawesi has not materialized. Universities in North Sulawesi that have agriculture faculties, such as UNSRAT, UKIT, UNPI, UNKLAB, and UNSRIT not yet have significant collaboration on smart agriculture. The developing industry in North Sulawesi which is engaged in agriculture is still limited to the coconut oil and coconut flour industry.

Agricultural ownership and exploitation in North Sulawesi are carried out on a small scale. The average agricultural ownership and exploitation by farmers is less than one hectare. This is a challenge and a problem in preparing farmers to enter Society or Agriculture 5.0.

Currently, farmers in North Sulawesi are not ready for Technology 4.0 and Society 5.0. This can be seen from the way farmers have not utilized Artificial Intelligence (AI), technology Big Data and the Internet of Things. Farmers are still trying to farm conventionally.

The use of technology 4.0 is only limited to online shopping for clothing and food needs and other supporting needs while online marketing has not been going well. Online shopping for agricultural needs, such as seeds, fertilizers, and other supporting tools has not yet started. Only for products that are not available in Manado and its surroundings that are purchased through online shopping.

Sustainable agriculture has not been implemented and economic growth has not fully resolved social and environmental issues. This can be shown from the behavior of farmers who use inorganic fertilizers and pesticides excessively to increase production without considering the negative impact on consumers and the natural environment.

Inorganic fertilization is very massively used by farmers for food crops and vegetables to pursue high production with the smallest sacrifices. In addition, the use of pesticides that tend to be excessive (and not following the instructions) for vegetable crops to maintain the quantity of products has resulted in the contamination of agricultural products.

There are still many farmers who do not understand the negative impact of excessive use of inorganic fertilizers and pesticides on human health and the environment. Cancer and soil and water damage are examples of this impacts.

Concerning the development of strategic superior products in North Sulawesi, namely Coconut, Cloves, Nutmeg, Flowers, and Salak, no information system has become a think tank and provides all information that supports innovation in these commodities. Besides that, there is no adequate cooperation between industry, farmers, government, and universities as well as the media (Penta Helix) to develop agricultural products to prepare farmers to enter Society 5.0.

The existing Unicorn and Dekacorn are mostly to serve the marketing of transportation, trade, and services. Meanwhile, the agricultural sector has not made significant use of this advance in information technology.

In Indonesia, we can see several startup unicorns, such as Tokopedia, Bukalapak, Traveloka, OVO, J&T, and Online Taxes. The six startups are still growing and have a pretty guaranteed future. We are proud because Indonesia has a decacorn startup, namely Grab.

The application of this technology will later transform the way humans interact to the most basic level to increase efficiency and competitiveness. The agriculture, food, and plantation sector are currently conducting experiments to support the industrial revolution 4.0 by developing new business models and innovations such as precision agriculture, vertical farming, and smart farming.

Greenhouse farming in North Sulawesi has been carried out by farmers for flower cultivation. Meanwhile, hydroponic farming has been widely practiced by farmers in urban communities for vegetable cultivation. Both of these technologies have used applications to control temperature and humidity using an Android mobile phone that can be operated alone. However, greenhouse and hydroponics farming has not utilized IoT, AI, and BD integrated into an autonomous farming production system for temperature and humidity control, pests and diseases, and production management (Bersani et al., 2022), and also It has not been applied to a large-scale (Velazquez-Gonzalez et al., 2022).

The development of greenhouse and hydroponic agriculture for North Sulawesi has not had a significant effect on production because it only involves a small number of farmers. Besides that, the challenge of changing the seasons is very small because in Indonesia any crop or commodity can be grown throughout the year.

The condition of farmers, the majority of whom are in junior high school or equivalent education and aged over 40 years with relatively narrow land ownership and control (about 1 hectare), it is necessary to implement policies that can encourage farmers to work on a more efficient business scale. Besides, there needs to be an effort to increase the skills of farmers so that they can work following technological advances and increase farmers' knowledge so that they can produce quality agricultural products while still paying attention to environmental sustainability.

Based on the availability of existing facilities and infrastructure in North Sulawesi Province, North Sulawesi can take a role in utilizing ICT advances in the era of Industry 5.0 to realize the Vision of Agricultural 5.0 in North Sulawesi.

3.2 The Vision of Agriculture 5.0 in North Sulawesi

The Revolution of Industry 5.0 (Industry 5.0) has been called for by the European Commission in 2021. This is done as a critique of Industry 4.0 focusing less on the principles of social justice and sustainability but focusing more on digitization and artificial intelligence (AI) based technologies to increase efficiency and flexibility (Xu et al., 2021).

Agriculture 5.0 is an extension of agriculture 4.0, by adding and emphasizing humans as the subject and object of development (Wang, 2022) and the availability of healthy and affordable food for the world community and ensuring that the ecosystem in which we live must be preserved (Saiz-Rubio & Rovira-Más, 2020). Agriculture 5.0 focuses more on providing food products that are healthy and competitive (superior) so that they can be purchased by the wider community (high flexibility) while still paying attention to environmental sustainability.

Agriculture 5.0 is an extension of agriculture 4.0 by adding the principles of industry 5.0 to produce healthy and affordable food for the community on the one hand and ensuring that the ecosystem on which life depends is sustainable in the sense of avoiding environmental degradation on other hand Agriculture 5.0 focuses more on providing food products that are healthy and competitive (superior) so that they can be purchased by the wider community (high flexibility) while still paying attention to environmental sustainability.

Agriculture 5.0 can be presented in North Sulawesi by integrating information and communication technology (ICT) with human intelligence. The ICTs that can be integrated into Agriculture 5.0 in North Sulawesi are (i) internet of things (IoT), (ii) wireless sensor

networks (WSN), (iii) cloud computing (CC), (iv) edge/fog computing, (v). autonomous robot systems (ARS), (vi). big data and analytics (BDA), (vii) artificial intelligence (AI), (viii). decision support systems (DSS), (x) cyber-physical systems (CPS), and (xi) digital twins (DT) (Abbasi et al., 2022).

The vision of Agriculture 5.0 in North Sulawesi is the use of robotic systems to increase the efficiency of agricultural businesses and take advantage of this economic growth to improve the quality of human resources (mainly education and health) and natural resources by prioritizing sustainable development.

3.3 Agricultural Autonomous Robot System

Agricultural Autonomous Robot System (AARS) in intelligent agriculture serves to replace almost all human tasks in farming or plantations, such as clove and coconut farming. AARS is an intelligent machine capable of performing tasks, making decisions, and acting in real-time, with a high degree of autonomy. Interest in AARS has increased significantly in recent years due to its ability to replace farmers' duties in farming both indoors and outdoors (in the field).

AARS uses a combination of developing technologies, such as computer vision, WSN, satellite navigation system (GPS), AI, CC, and IoT, making it easier for farmers to increase productivity and quality of agricultural products. AARS can be divided into two categories, namely (i) agricultural unmanned ground vehicle (AUGV) and (ii) agricultural unmanned aerial vehicle (AUAV) (Abbasi et al., 2022)

a. Agricultural Unmanned Ground Vehicles

Agricultural unmanned aerial vehicle (AUGV) is a land-operated agricultural robot that is remotely controlled by an operator or without a human operator, based on artificial intelligence technology. UGV must meet certain requirements such as small size, maneuverability, durability, efficiency, ease to operate and safe for users (Abbasi et al., 2022).

The main components of the AUGV are: platforms for locomotive and manipulator apparatus, sensors for navigation, surveillance control systems, communication links for exchanging information between devices, and system architecture for integration between hardware and software (Gonzalez-De-Santos et al., 2020).

AUGV can be able to map or inspect specific agricultural areas and make decisions regarding smart farming enterprises. The ability of this AUGV to perform tasks according to the state of the surrounding environment is based on an artificial intelligence algorithm (Beloev et al., 2021). One example of AUGV is AgROS (a robotic system based on an emulation tool for Agricultural Robots) which helps farmers in controlling the plan before it is carried out (ex-ante) and evaluation after the implementation of smart farming [25]. Robot can make decision making base on artificial intelligence

AUGV can be used for agricultural land processing, nurseries, crop planting, plant maintenance (watering, spraying, weeding, fertilizing, eradicating pests and diseases), crop yields, and product processing. In North Sulawesi, AUGV for coconut and clove harvesting can be developed to reduce production costs. Harvesting costs reach 50% of total production costs (F. R. Tulungen et al., 2020).

b. Agricultural Unmanned Aerial Vehicles

Agricultural unmanned aerial vehicle (AUAV) or aerial robot is an aircraft without a human pilot on board. The most popular type of AUAV technology in agriculture is drones. Drones are equipped with appropriate sensors, such as sight, infrared, multispectral, and hyper-spectral cameras, to enable farmers to obtain plant data, including vegetation, leaf area,

and reflectance index. Based on data obtained through drones, farmers or other experts analyze to obtain conclusions and recommendations related to plant diseases, nutritional deficiencies, water levels, and other plant parameters (Chapman et al., 2014). With this information, farmers can plan appropriate solutions related to irrigation, fertilization, weed control, and so on.

The AUAV Drone is suitable for use in North Sulawesi because coconut and clove plants are plants that have tall trees so it is difficult to monitor and maintain the top of the plant. The task of maintaining and controlling pests and diseases as well as monitoring soil and plants will be able and easy to do with Drones.

The use of drones in various tasks, including in agriculture, is increasingly being carried out by the community. One of the contributing factors is that operating drones has become a hobby for some people. With the increasing use of drones that are controlled directly by humans, more and more young people or parents are using drones to support agriculture 5.0 (Abbasi et al., 2022).

Agriculture 5.0 in North Sulawesi can be realized with the use of AUAV Drones. Drones equipped with bio-inspired cameras (Xu et al., 2021) and GPS such as the Pheno-Copter, a type of drone, remote sensing robots at low altitudes will be very useful in plant cultivation and plant breeding.

The use of drones is something that can be applied in the development of Agriculture 5.0 (super smart farming) in North Sulawesi. This is because drones carry multispectral sensors that can detect up to five discrete spectral bands of light reflected by plants. The ability to detect certain types of light reflected by plants allows farmers to identify nutrient deficiencies and even detect disease early before it becomes problematic enough. Healthy vegetation reflects more of certain types of light than unhealthy vegetation. This difference cannot be detected with the naked eye, except with the help of a drone. In addition to these detection capabilities, drones, equipped with precision GPS and thermal camera sensors, assist farmers in tasks such as phenotyping, plant health mapping, water pressure analysis, leak monitoring, fertilizer management, zone mapping, and so on. In addition, drones can also be used directly for pest and disease control and plant maintenance, agricultural logistics transportation, and marketing of agricultural products.

3.4 Strategic Programs to Realize Agriculture 5.0

To realize the vision of Agriculture 5.0, strategic programs that can be implemented are establishing Agricultural Information System, organizing farmers, and forming a farmer's partnership with universities, local government, and industries.

a. Development of Agricultural Information System

The agricultural information system as far as possible can integrate the following systems, namely: (i) internet of things (IoT), (ii) wireless sensor networks (WSN), (iii) cloud computing (CC), (iv) edge/fog computing, (v). autonomous robot systems (ARS), (vi). big data and analytics (BDA), (vii) artificial intelligence (AA), (viii). decision support systems (DSS), (x) cyber-physical systems (CPS), and (xi) digital twins (DT) (Abbasi et al., 2022). An agricultural information system that integrates several systems will allow for designing future smart farming systems. It is hoped that this information system will have a positive impact on research around Agricultural systems 4.0 and 5.0, which provide clear concepts and guidelines to assist actors in a successful transition to the digitization of the agricultural sector (Araújo et al., 2021).

The agricultural information system can be divided into several parts, such as internal data collection, external information collection, data and information processing, planning, and report generation. The collection and processing of data is an automated monitoring

system, while the reports and plans subsystem must be initiated by the farm manager. The external repository contains information about standards, rules, all kinds of guidelines for agricultural activities, etc. (Srensen et al., 2010). Through this information system, activity reporting can be done semi-automatically so that it will be easier for managers to make reports in the context of business continuity and efficiency improvements.

The agricultural information system will function as a database for storing data obtained from (i) results of fertility surveys, (ii) results of soil mapping surveys based on land suitability, (iii) results of observations of plant growth and development, (iv) observations of plant pests and diseases and (v) information and technology related to the plant itself, starting from seeds, cultivation, fertilizer, harvesting, post-harvest, processing of products, and product marketing.

The agricultural information system will also provide a common working space for researchers and stakeholders to discuss problems faced by farmers and to make studies related to Agriculture 5.0. The studies are based on available information, both from within the system and from the broad agricultural information system to create intelligence (innovation) as input and as a basis for decision-making to increase competitiveness, while still paying attention to the preservation of the natural environment and social environment. In addition, this agricultural information system can also be used to evaluate programs and plan overall programs to be better, and more competitive in the future (Crane et al., 2022).

The agricultural information system is very important to support the logistics system in smart Agriculture 5.0 (Jafari et al., 2022). However, the need for agricultural business facilities and infrastructure to support Agriculture 5.0 will be more efficient if it can be provided through an agricultural information system.

Developing agricultural information systems can enable sustainable agricultural development and increase food security for the world's population. One application model to help with this is the application of Digital Twins technology (Singh et al., 2022). The potential applications of DT in various fields in agriculture, such as al (i) crop storage, agricultural equipment/machinery, (ii) identification of pests or diseases in crops, (iii) production plant management and optimization, and (iv) and evaluation of the cost-effectiveness of management maintenance plants along with tracking engines in real-time.

This agricultural information system through the help of human expertise and artificial expertise will be able to process all available information for the benefit of, among others: (i) plant health analysis, (ii) plant growth analysis, (iii) fertilization analysis, (iv) pest and disease control, (v) water pressure analysis, (vi) leakage surveillance, and (vii) zone mapping. Besides that, it can assist farmers in agricultural cultivation, harvesting, processing of produce, marketing of produce, and logistical detection of agricultural products in real-time

b. Social Technology

1. Farmer Organizing

Organizing farmers is important to make efficient and effective management and exploitation of agriculture. Organizing farmers is aimed at facilitating the guidance and training of farmers. Besides, it will facilitate the unification or integration of human resources, financial resources, and natural resources.

By organizing farmers in the villages into farmer group groups, farmer groups form farmer groups at the sub-district level, and farmer groups at the sub-district level form farmer unions at the district level. Grouping of farmers can be done according to domicile (place of residence) and according to the expanse of agricultural land.

The grouping of farmers according to the expanse of agricultural land will allow the merging of business lands so that farming management becomes more efficient. More

efficient in land management, crop planting, plant maintenance, pest and plant disease control, harvesting, post-harvest, processing, and marketing of produce.

With the existence of farmer organizers, the use of drones can be applied to farmers, for example, mapping soil according to fertility, mapping commodities, and controlling pests and plant diseases. Considering the condition of land ownership and exploitation in North Sulawesi which is narrow on average, which is around 1 ha, it is necessary to hold a land merger to facilitate the implementation of all activities ranging from land cultivation, planting, maintenance, harvesting, product processing, and product marketing.

By organizing farmers, farmers will be stronger and easier to implement innovations in agriculture. Organizing farmers will make it easier to collaborate and partner with other stakeholders. Besides that, it will make it easier to use the agricultural information system that will be provided. Organizing farmers as social technology needs to be developed to support agricultural information systems on the one hand and dissemination and application of technology on the other. Organizational innovation is human intelligence which is a prerequisite for the development of agricultural information systems and the realization of Agriculture 5.0 in North Sulawesi.

2. Farmer Partnership

Farmer partnership is one of human intelligence apart from farmer organization. The partnership is an important thing that must be done to realize Agriculture 5.0. Farmers need to partner with other parties to realize an agricultural information system. By collaborating with other parties, the functions of this information system can be realized, starting from establishing the information system itself, mapping agricultural land, monitoring plants, developing agricultural innovations, logistics systems, product marketing, and so on.

A partnership is a business organization in which two or more parties work together and combine resources to advance their common interests. Each party, referred to as a business partner, agrees to share the risks, responsibilities, profits, and losses. They can be individuals, businesses, or other organizations (Pique et al., 2018).

A partnership is a process of working together to combine the advantages of two or more parties to generate ideas or solve problems faced so that a common vision can be achieved. The partnership that needs to be built to realize the dream of Agriculture 5.0 is a minimal collaboration between farmers, government, industry, and universities (F. R. Tulungen, 2020).

Partnerships allow owners to share profits, liabilities, and management. It is also possible to combine each other's qualities and expertise by collaborating and working together. In preparing smart farmers and smart agriculture in North Sulawesi, partnerships between farmers, universities, industry, government, and social media can be built.

IV. Conclusion

4.1 Conclusion

Based on the existing facilities and infrastructure in North Sulawesi Province, North Sulawesi can take a role in utilizing ICT advances in the era of industry 5.0 to realize the the vision of Agriculture 5.0 in North Sulawesi. The vision of Agriculture 5.0 in North Sulawesi is the use of robotic systems to increase the efficiency of agricultural businesses and take advantage of this economic growth to improve the quality of human resources (mainly education and health) and natural resources by prioritizing sustainable development.

Unmanned Ground Vehicles can be used for processing agricultural land, nurseries, planting crops, maintaining plants (watering, spraying, weeding, fertilizing, eradicating pests and diseases), harvesting products, and processing products and Unmanned Aerial Vehicles

can be used for soil monitoring (fertility and land suitability), plant maintenance (watering, spraying, fertilizing, pest and disease eradication), phenotype observation, plant health mapping, water pressure analysis, leak surveillance, fertilizer management, zone mapping, and harvesting.

The agricultural information system through the support of human intelligence and artificial intelligence will be able to process all available information for the benefit of, among others: (i) plant health analysis, (ii) plant growth analysis, (iii) fertilization analysis, (iv) pest control and disease, (v) water pressure analysis. Besides, it can assist farmers in agricultural cultivation, harvesting, processing of produce, marketing of produce, and detection of required logistics and distribution of agricultural products in real-time.

Human intelligence, including social technology (organizing farmers), really needs to be developed to support agricultural information systems on the one hand and the dissemination and application of technology on the other. Organizational innovation is human intelligence which is a prerequisite for the development of agricultural information systems and the realization of Agriculture 5.0 in North Sulawesi. Through the partnership, all problems encountered by farmers can be solved. The more partners with farmers, the better the system will be. With the Penta helix partnership, namely, farmers, universities, government, and industry will be able to facilitate the achievement of the dream or vision of Agriculture 5.0 in North Sulawesi

4.2 Recommendation

Strategic programs that can be taken to realize the vision of Agriculture 5.0 in North Sulawesi are:

(i) Building an Agricultural Information System that will accommodate information not only from within the agricultural business itself but also from outside the agricultural business itself. Besides that, it will become a think tank and a means of supporting the digital production and marketing of farm products.

(ii) Organizing farmers according to the commodity will make it easier for the farmers to establish the agriculture information system. Besides that, partnerships with universities, government, industry, and other stakeholders are needed to establish the agricultural information system to create intelligence or innovation in agriculture and realize the vision of Agriculture 5.0 in North Sulawesi.

References

Abbasi, R., Martinez, P., & Ahmad, R. (2022). The digitization of agricultural industry – a systematic literature review on agriculture 4.0. Smart Agricultural Technology, 2(January), 100042. https://doi.org/10.1016/j.atech.2022.100042

Alinea.id. (2022). Jumlah Petani Indonesia. Alinea.Id. https://data.alinea.id/jumlah-petani-di-indonesia-b2cCd9Bp9c

Anonimous. (2019). Mengenal Visi Jepang Society 5. tekno.tempo.co. https://tekno.tempo.co/read/1170120/mengenal-visi-jepang-society-5-0-integrasi-ruang-maya-dan-fisik/full&view=ok

Araújo, S. O., Peres, R. S., Barata, J., Lidon, F., & Ramalho, J. C. (2021). Characterising the agriculture 4.0 landscape emerging trends, challenges and opportunities. Agronomy, 11(4), 1–37. https://doi.org/10.3390/agronomy11040667

Badan Pusat Statistik. (2018). Indeks Pembangunan Manusia (IPM) Sulawesi Utara tahun 2018 (Issue 34).

Beloev, I., Kinaneva, D., Georgiev, G., Hristov, G., & Zahariev, P. (2021). Artificial intelligence-driven autonomous robot for precision agriculture. Acta Technologica Agriculturae, 24(1), 48–54. https://doi.org/10.2478/ata-2021-0008

Bersani, C., Ruggiero, C., Sacile, R., Soussi, A., & Zero, E. (2022). Internet of Things Approaches for Monitoring and Control of Smart Greenhouses in Industry 4.0. Energies, 15(10), 3834. https://doi.org/10.3390/en15103834

Biro Pusat Statistik. (2021). Sensus Penduduk 2020.

Brodjonegoro, B. (2021). No Title. Antaranews.Com, 1. https://www.antaranews.com/berita/2472473/indonesia-optimistis-memasuki-masyarakat-50

Chapman, S. C., Merz, T., Chan, A., Jackway, P., Hrabar, S., Dreccer, M. F., Holland, E., Zheng, B., Ling, T. J., & Jimenez-Berni, J. (2014). Pheno-copter: A low-altitude, autonomous remote-sensing robotic helicopter for high-throughput field-based phenotyping. Agronomy, 4(2), 279–301. https://doi.org/10.3390/agronomy4020279

Crane, D. S., Tammi, K., Autiosalo, J., Ala-laurinaho, R., Mattila, J., & Salminen, P. (2022). applied sciences Extended Reality Application Framework for a.

Dou, H. J.-M., & Manullang, S. D. (2003). Competitive Intelligence, Technology Wath and Regional Development. MUC Publishing.

Dou, H., Juillet, A., & Clerc, P. (2019). Strategic Intelligence for the Future 1. ISTE Ltd, London and John Wiley & Sons.

Fukuyama, M. (2018). Society 5.0: Aiming for a New Human-centered Society. Japan SPOTLIGHT, 27(Society 5.0), 47–50. https://www.jef.or.jp/journal/pdf/220th_Special_Article_02.pdf

Gonzalez-De-Santos, P., Fernández, R., Sepúlveda, D., Navas, E., & Armada, M. (2020). Unmanned Ground Vehicles for Smart Farms. In Agronomy (pp. 1–13). Intech. http://dx.doi.org/10.1039/C7RA00172J%0Ahttps://www.intechopen.com/books/advanced-biometric-technologies/liveness-detection-in-biometrics%0Ahttp://dx.doi.org/10.1016/j.colsurfa.2011.12.014

Jafari, N., Azarian, M., & Yu, H. (2022). Moving from Industry 4.0 to Industry 5.0: What Are the Implications for Smart Logistics? Logistics, 6(2), 26. https://doi.org/10.3390/logistics6020026

Kaelan. (2012). Metode Penelitian Kualitatif. Paradigma.

Martinelli, I., Harahap, A., and Zainuddin. (2019). Community Economic Development Prospect Based on Wakaf Funds. Budapest International Research and Critics Institute-Journal (BIRCI-Journal) Vol 2 (4): 409-423.

Mazur, B., & Walczyna, A. (2022). Sustainable Development Competences of Engineering Students in Light of the Industry 5.0 Concept. Sustainability, 14(7233), 2–17. https://doi.org/https://doi.org/10.3390/su14127233

Monga, M., Dzvimbo, M., and Mashizha, T. (2019). The Dynamics of Gender: A Grassroots Perspective on Economic Resilience and Empowerment of the Tonga People in Kariba. Budapest International Research and Critics Institute-Journal (BIRCI-Journal) Vol 2 (4): 115-124.

Nurmansyah, A. (2018). Tingkat Pendidikan Petani Indonesia Masih Minim. Akurat. https://akurat.co/tingkat-pendidikan-petani-indonesia-masih-minim

Pique, J. M., Berbegal-Mirabent, J., & Etzkowitz, H. (2018). Triple Helix and the evolution of ecosystems of innovation: the case of Silicon Valley. In Triple Helix (Vol. 5, Issue 1). https://doi.org/10.1186/s40604-018-0060-x

Saiz-Rubio, V., & Rovira-Más, F. (2020). From smart farming towards agriculture 5.0: A review on crop data management. Agronomy, 10(2). https://doi.org/10.3390/agronomy10020207

Singh, M., Srivastava, R., Fuenmayor, E., Kuts, V., Qiao, Y., Murray, N., & Devine, D. (2022). applied sciences Applications of Digital Twin across Industries: A Review.

Tulungen, F., Batmetan, J. R., Komansilan, T., & Kumajas, S. (2021). Competitive intelligence approach for developing an e- tourism strategy post COVID-19. Journal of Intelligence Studies in Business, 11(1), 48–58. https://ojs.hh.se/index.php/JISIB/article/view/JISIB Vol 11 Nr 1 2021

Tulungen, F. R. (2012). Competitive Intelligence for the Regional Development in Imbonesia, Strategy for the Development of Clove Small Entreprises in Minahasa, North Sulawesi. LAMBERT Akademic Publishing.

Tulungen, F. R. (2019). Cengkeh Dan Manfaatnya Bagi Kesehatan Manusia Melalui Pendekatan Competitive Intelligence. Jurnal Boifarmasetikal Tropis, 2(2), 158–169. https://journal.fmipaukit.ac.id/index.php/jbt/article/view/128/93

Tulungen, F. R. (2020). Pertanian Cerdas Cengkeh Sulawesi Utara di Era Industri 4.0 dan Masyarakat 5.0. DeePublish. https://books.google.co.id/books?id=Rhr3DwAAQBAJ&printsec=frontcover&dq=pertanian&hl=id&sa=X&ved=2ahUKEwjAobHC-tDrAhWL6XMBHbTtAPg4PBDoATAEegQIBRAC#v=onepage&q=pertanian&f=false

Tulungen, F. R., Lengkong, J., Karuntu, R. P., Oping, M. J., & Rumondor, F. S. (2020). Program Strategi untuk Meningkatan Keuntungan Usahatani Cengkeh Berdasarkan Analisis Struktur Biaya di Minahasa, Sulawesi Utara. Jurnal Frontiers, 3(1), 19–25. http://ejournal.unima.ac.id/index.php/efrontiers/article/view/2132

Tulungen, F. R., Maarisit, W., & Rompas, P. T. D. (2021). Competitive intelligence application: The case of geothermal power plant development in rural Tompaso, North Sulawesi, Indonesia. Journal of Intelligence Studies in Business, 11(2), 43–52. https://ojs.hh.se/index.php/JISIB/article/view/JISIB Vol 11 Nr 2 2021

Velazquez-Gonzalez, R. S., Garcia-Garcia, A. L., Ventura-Zapata, E., Barceinas-Sanchez, J. D. O., & Sosa-Savedra, J. C. (2022). A Review on Hydroponics and the Technologies Associated for Medium-and Small-Scale Operations. Agriculture (Switzerland), 12(5), 1–21. https://doi.org/10.3390/agriculture12050646

Wang, L. (2022). A futuristic perspective on human-centric assembly. Journal of Manufacturing Systems, 62(December 2021), 199–201. https://doi.org/10.1016/j.jmsy.2021.11.001

Wollie, G. (2018). The Relationship between Inflation and Economic Growth in Ethiopia. Budapest International Research and Critics Institute-Journal (BIRCI-Journal) Vol I (3): 264-271.

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. Journal of Manufacturing Systems, 61(October), 530–535. https://doi.org/10.1016/j.jmsy.2021.10.006