

Opportunities and Challenges of Organic Agriculture in the Era of Industrial Revolution 4.0

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Agriculture in the Era of Industrial Revolution 4.0

(A Case Study at Bulukumba Regency, South Sulawesi Province)

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Abstract—The research aims to analyze: 1) farmers' understanding on organic agriculture and 2) the readiness of organic farmers in the era of industrial revolution 4.0 in Salassae Village Bulukumba Regency. The research uses constructivist paradigm with qualitative approach. Data collection is conducted using in-depth interview, observation, focused group discussion (FGD), and documentation methods. Data analysis is done through data reduction process, data presentation, and conclusion drawing. Data validity checks are carried out in four ways, i.e.: credibility level, dependency, transferability, and confirmability. The research results indicate that organic rice farmers understand organic agriculture methods from land cultivation, seedling selection, plant maintenance, organic fertilizers utilization, and product packaging. The farmers understand the main principles of organic agriculture, such as the principles of health, ecology, justice, and protection. Organic rice farmers are not ready to enter the industrial revolution 4.0 in agricultural field. The symptom is indicated by internet, robotization, and big data that are not being used in organic agricultural activities

Keywords—Farmers, Organic Agriculture, Industrial Revolution 4.0

I. INTRODUCTION

Consumer tendency in the current era is increasing indicated by their purchasing behavior that is more responsible and pays more attention on food production modes. Consumer satisfaction in food consumption highly depends on social context and institutional where the products obtained, instead of the characteristics of the product [1]-[2]. In general, consumer choice is no longer motivated exclusively by the maximisation of utility function as stated in the neoclassical theory. It covers, however, social, ethics, and environmental factors. Based on the perspective, food choices become a strong mean for the affirmation of description individually [3]-[4]-[5]. As a consequence, two main trends occur in the current consumer purchasing behavior: the growth in demand for safe products in terms of food safety and the increase in interest to high quality food products. Hence, food consumption is no longer merely satisfying basic needs but also realizing requirements related to production process sustainability from social, environmental, cultural, and ethical standpoints. In this context, several studies found positive desire to pay (TP) for different attributes related to several sustainable aspects of agricultural-food products [6]-[7]-[8]. Based on the explanation, organic agriculture holds a strategic position to seize the changing market share [9].

A research result from Brandt and Molgard in Turkey stated that a change from non-organic agriculture to organic

agriculture is a complex process with high risk and serious problems both technically and economically [10]. McEachern and Willock [11], in his research in the United States, concluded that the main cognitive process is producers' attitude and component, which is the input of behavior, and emotion as the basic potential make it difficult to study and it is also obtained from the influence of other interests as well as the existence of independent variables (perception and goal). Further, Pallegriani and Farinello [12] in Italy expressed that factors influencing consumers to buy foods from biological or natural products included one's awareness motivation of satisfaction towards the product. A research by Jinghong et. al [13] in China inferred that organic agriculture is a strategic effort that is potential for a more sustainable agricultural development. Atadi [14] in Kenya, on the other hand, concluded that leguminosae could build soil fertility. Further, Onwudike [15] in Nigeria, stated that there was no significant difference in the effect of the use of organic fertilizer on sweet potato crops to the use of non organic fertilizer.

As regard Indonesia, a research by Takagi [16] concluded that the limited factors of organic agriculture consisted of limited interaction between farmers and developer agents and between farmers and customers, limited implementation standards for organic crop products, the high cost to obtain certification for organic crops, and climate condition, especially long dry season and high rainfall during the rainy season making it difficult to control pests and diseases. Further, Samun, Rukmana dan Syam [17] concluded that most farmers unwilling to participate in the government programs, either in planning, implementation or evaluation of organic agriculture. Widiarto, Seufert et.al [18] inferred that organic agricultural practice is proven to have positive influence on farmers' economic sustainability.

According to the previous research results, it can be seen that all of them focus on how (epistemology) organic agricultural practices and its benefits (axiology). The problems examined in this study focus more on how farmers' understanding of organic farming practices and farmers' readiness in approaching the 4.0 industrial revolution in Salassae Village, Bulukumba Sub-District, Bulukumba Regency.

II. RESEARCH METHODS

The village was selected purposively since the research location was one of villages in South Sulawesi where the majority of its population practicing organic agriculture. Various organic agricultural commodities developed, such as

rice, cloves, and cacao grow on the village land area of 32 km².

Primary data of the research gained directly from several respondents. Primary data collection technique used were in-depth interview, limited participative observation, documentation as well as Focused Group Discussion (FGD) [19]. Main interview technique used was in-depth interview. Researcher also used informal conversational interview, which is a free and spontaneous interview technique [20]. Meanwhile, the secondary data gained from related institutions such as government and custom institutions, as well as written data from various sources such as books, journal, and researches.

Data analysis done in three stages; *first*, data reduction process focused on selection, simplification, abstraction, and transformation of rough data from field records. In this process, data were sorted into those that relevant to the research focus, and those that do not meet the exclusion-inclusion criteria. The second stage was data serving, which involved compiling information into statements that will enable conclusion drawing. Data served in narrative text form, which initially spread and separated on various information sources, then classified according to the mean d analysis needs. The third stage was conclusion drawing based on data reduction and serving. Conclusion drawing executed in stages from general conclusion at the data reduction stage, and then become more specific at data serving stage, and become even more specific at the actual conclusion drawing stage. These process chains showed that qualitative data analysis in the research was interactive in nature, start from data reduction, data serving, and conclusion drawing stage over and over again in cyclical way [21]. Examination on data validity refers to [22] view that includes four ways, i.e: *credibility, transferability, dependability, and confirmability*.

III. RESULTS AND DISCUSSION

The success of organic agriculture in the village resided in *Komunitas Swabina Petani Salassae* (KSPS) (self-developed community of Salassae farmers). Since its establishment in November 2011, its members were active in developing organic agriculture in their own yards and fields. Three years after its establishment, KSPS members had increased to 76 people from only 20 people.

The application of organic agriculture is a new method application in agricultural field called SRI (*System of Rice Intensification*) method. SRI is organic plantation without chemical, synthesis fertilizer and pesticides. Its principle is improving plant roots by arranging irrigation, applying single crop plantation, early planting time, and improving soil quality; thus, reducing the use of water and seeds requirements. Several farmer groups and respondents at the research location indicated great enthusiasm to apply the SRI plantation system; therefore, the number and area (farmer and plantation) were gradually increasing. However, concern on risks was the most essential factor, especially on how to apply the suggested SRI components. Moreover, the system required more organic materials. As a consequence, the development of farming area by each farmer was relatively limited to part of their land without adoption of SRI components in stages. It seemed, adjustment was required that indirectly became a learning process for farmers in adopting SRI technology. Regarding the risks, there were

farmers in the research location who did not interest in the SRI pattern.

The *Komunitas Swabina Petani Salassae* (KSPS) was not a common farmer community. Through hardwork principle held by each member, organic agriculture succeeded to be developed in the village located at Bulukumba Regency. According to Armin Salassa, it required 3 (three) months for farmers in Salassae Village to shift from old way of farming to organic. They admitted that the result was more profitable, financially as well as in terms of commodity. The condition of organic plant and non-organic farming in the village was different. Organic processed products were usually taller and greener. In addition, the organic rice yield was larger.

Farmers at the village expressed that the use of fertilizer was more efficient with organic farming. Fertilizer utilization using a mixture of sugar and fruits would only require approximately Rp. 80.000 for 1 ha field. Therefore, it was not surprising that organic farming became the choice among KSPS farmers. In addition, farmers also stated that organic rice tasted better and the market price was twice of that ordinary rice.

Despite the superiorities of organic agriculture in Salassae Village, the change in old farming to organic farming was not entirely smooth. Like other changes, it required time and encountered many challenges from the surrounding environment, including family. It was revealed by Awaluddin, one of KSPS initiators. He claimed that he had a memorable experience during his two years of shifting to organic farming from conventional farming. According to him, his family initially opposed his decision to do organic farming; his mother even cried and begged him to use pesticides and chemical fertilizers, a method that had been used for years. However, he was determined and he eventually succeeded in persuading his family to do organic farming after they found out the promising result. Other members also had similar experience as Awaludin.

Through hard work and unyielding spirit, they could prove themselves as a model farmer. Organic farming could bring more profit. Four years after its establishment, KPPS now become independent with its Division of Microfinance Institution (*Lembaga Keuangan Mikro/LKM*), which is the backbone of the organization. Every member could issue special stock of Rp. 100 thousand per stock for capital of cattle breeding business. Up to 2014, KSPS had been able to have 14 cows. KSPS independence also reflected in the use of fertilizer. They could produce compost called Mikroba 3 (M3) independently. The production house distributed from the yard to field.

Farmers applied organic agriculture if they received knowledge and information from mass media containing the success of farmers who applied organic agriculture. Adoption could be defined as the process of receiving innovation or a change in behavior in form of knowledge or skill [23]. Adoption could also an acceptance of something offered or attempted by another party.

Farmers in Salassae Village already had knowledge related to organic agriculture principles. The principle of health stated that organic agriculture should conserve and improve the health of soil, plant, animal, human and earth as a unity and inseparable.

The principle implied that each individual and community is inseparable from the health of ecosystem; healthy soil would result in healthy plants that could support animal and human health. Health is an inseparable part of life system. Being health is not only being free from any diseases but also maintaining physical, mental, social, and ecological welfare. Body endurance, cheerful, and self-renewal are the basic things to be healthy. The role of organic agriculture in production, processing, distribution, and consumption is intended to conserve and improve the health of ecosystem and organism, from the smallest organisms located in the soil to human being. Especially, organic agriculture is aimed to produce high quality and nutritious foods that supports health and prosperity. Therefore, the use of fertilizer, pesticides, drugs for animals and other food additives that have detrimental effects for health should be avoided.

Organic agriculture ecological principle should be based on life ecological system and cycle through work, imitating, and maintaining the life ecological system and cycle. The ecological principle put organic agriculture in the life ecological system. The principle states that production is based on ecological process and recycles [24]-[25]. Food and prosperity gained through ecology of a specific production environment. For example, plants require fertile soil, animals need livestock ecosystem, fish and marine organisms demand aquatic environment. Agricultural cultivation, livestock and organic wild product harvesting must be in accordance with ecological cycle and balance in the nature.

The cycles are universal in nature yet its operation is specific-local. Organic management must be adjusted to the local condition, ecology, culture, and scale. Intake materials should be reduced through reuse, recycle and efficient materials and energy management to maintain natural resources, improve the quality of natural resources, and protect natural resources. Organic agriculture could achieve ecological balance through agricultural system patterns, habitat development, and genetics and agricultural diversity maintenance. Those who produce, process, market or consume the organic products must protect and provide benefits for the environment in general, including soil, climate, habitat, biodiversity, air and water[26].

The principle of justice. Organic agriculture must build a relationship that able to guarantee justice related to environment and chance to live together. Justice is characterized by equality, respect each other, be fair, and world joint management, either between human being or in its relationship with other organisms. The principle emphasizes that those who involve in organic agriculture should build a humane relationship to ensure the existence of justice for all parties in all levels; such as farmers, workers, processors, distributors, traders, and consumers. Organic agriculture must provide better life quality for everyone involved, contribute to food sovereignty and poverty reduction [27]-[28]. Organic agriculture aims to produce sufficiency and availability in foods as well as other products in better quality. The principle of justice also stresses that livestock must be kept in a condition and habitat suitable to the physical and natural properties and their welfare must be guaranteed. Natural resources and environment used for production and consumption have to be managed in a fair way socially as well as ecologically and is maintained for future generations. Justice requires production, distribution,

and trading systems that is open, fair, and considers the real social and environmental cost.

The principle of protection. Organic agriculture should be managed carefully and in responsible way to protect health and prosperity of the present and future generations as well as the environment. Organic agriculture is a life and dynamic system that answers the internal and external demand and condition. Organic agriculture actors are encouraged to increase efficiency and productivity yet without endangering their own health and prosperity. Hence, new technology and the existing methods need to be examined and reviewed. Thus, an effort should be done to address the incomplete ecosystem and agricultural understanding. The principle suggests that prevention and responsibility are the foundation of technology management, development, and selection in organic agriculture. Sciences are a necessity to guarantee that organic agriculture is healthy, safe, and environmentally friendly. Sciences, however, are not enough. Overtime, practical experiences integrated with virtue and traditional wisdom is the right solution. Organic agriculture must be able to prevent adverse risks by applying appropriate technologies and reject those technologies with unpredictable consequences, such as genetics engineering. Every decision should give consideration on values and requirements from all aspects that are likely affected through transparent and participative processes.

Organic agriculture practice in Salassae Village Bulukumba Regency encountered various obstacles in the field, especially in the process of its application. For example, farmer groups in Salassae Village were unable to produce organic seeds. Therefore, the available seeds were merely conditioned to be adaptive to chemical fertilizers, chemical pesticides, and other cultivation treatment. It was suggested, however, that farmers used local or hybrid seeds that had been adapted to the surrounding natural. Local seed have several advantages, namely low cost and easy to obtain; farmers even give it themselves. In addition, local seeds have clear origin and suitable to the surrounding natural condition [29].

Farmers' minimum technical knowledge in managing agriculture became the main factor in the application. One of activities in organic agriculture is marketing process. Farmers had their own collector. The relationship between farmers and the collectors was the result of collective decision between them, although it was unwritten. The decision was mutually agreed and implemented or through community consensus in a social system.

Agricultural era in industrial revolution 4.0 requires modern telecommunication infrastructure in rural areas [30]-[31]. In addition, the ability to implement data along the agricultural supply chain is also a necessity towards agriculture of industrial revolution 4.0. Facts in the field suggested that despite the entry of internet in Salassae Village Bulukumba Sub-district, Bulukumba Regency, its utilization was limited to searching for information related to market information and organic agricultural activity in other areas. The condition experienced by only 12% farmers who were young (17-35 years), whereas 88% of farmers (36-75 years) were not internet literate. The condition indicated that the use of internet of things could not be implemented entirely by farmers. There were, however, some farmers who were able to market their produces through online marketing.

Organic agricultural activities at the village only utilized agricultural machines in land cultivation activity. Other activities were conducted using methods which were not reflecting industrial revolution 4.0. The linkage between industrial revolution and organic agricultural sector is a big opportunity to consider variability and uncertainty involving food-agricultural production chain [32]. Agricultural machines became smarter, more efficient, safer, and environmentally friendly due to the combination and integration of technology and production devices, information system and communication as well as data and service in network infrastructure. Smart Agriculture must be able to independently adapt to those changes to be competitive in the market [33]. One of main requirements must be met is constant communication between market and production, and in the business itself. Methodology used to effectively connect all actors from continue and rich data communication is virtualization. Farmers' readiness in the use of robotic in agricultural activities was not applied in the Bulukumba Regency.

Industrial of Things Internet is an increase in technology connectivity in agricultural world. Integration and connectivity in agriculture sector and other sectors create a brand new relationship between human and computer, and set different ways of working with innovative working position for all sectors [34]. Types of work mostly needed are those in engineering and management sectors and data analysis.

The use of big data in organic agricultural practice was limited to information search regarding organic farmer activities in other places. Whereas, the ability to collect data in large number and analyze it in a faster and smarter way could open a road for transformation of understanding, production, selling and so on. The use of big data in the industrial revolution 4.0 is absolute. Some organic farmers in Bulukumba actually had the ability to read and analyze data; however, they had not practiced the use of big data in organic agriculture.

The organic farmers in Salassae Village, Bulukumba Sub-district, Bulukumba Regency had not used data of things in their organic agriculture practice. They relied on local knowledge and knowledge obtained from agricultural extension.

IV. CONCLUSION

Organic rice farmers understood the organic agricultural methods from land cultivation, seedling selection, plant maintenance, organic fertilizer utilization, and product packaging. They also understood the organic agricultural principles, such as the principle of health, ecology, justice, and protection.

They were, however, not ready to enter the industrial revolution 4.0 in agricultural sector. Only a small proportion of the farmers who were able to use internet to access market development, whereas robotization, and big data were not used in the organic agriculture activities

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