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Sustainability of Coffee: An Indigenous Agriculture toward Digital Technology Era

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Abstract
This paper deals with sustainability of coffee as indigenous farming toward digital technology. Indigenous agricultural knowledge (IAK) has long been a driving force in agricultural development. IAK is systematic and collective knowledge, practices, and beliefs about the relationship between living beings and their environment that have been passed down from generation to generation through cultural transmission. This study employed a comprehensive literature review to investigate the publisher of publications with identical titles Some of the knowledge that still exists on indigenous agriculture in communities can be a setback to agricultural progress as it has the potential to become several barriers that development strategies have neutralized over the years. Modern technology is having a growing impact on how traditional agriculture is aided. With the help of contemporary technology, farmers can now access a variety of data about what people in the world need and prepare for another challenge in the competition in the same business of agriculture. This is because they have considerable market potential and resources that can contribute to sustainable economic growth. With today's technological advancements, indigenous-based agriculture can keep up with digital technological advances in helping agriculture-dependent communities increase the productivity of arabica coffee and improve farmers' incomes. The role of digital will not eliminate the part of traditional custom-based agriculture. Still, it can maintain and preserve the custom as a cultural heritage while not forgetting the main objectives needed by people who depend on agriculture.

Keywords
Indigenous Agriculture, Digital Technology, Digital Agriculture;

1. Introduction

Advanced modern technology has great potential to support traditional industries from upstream to downstream in agriculture. The digital revolution for agribusiness helps smallholder farmers make more profit, improve food safety and nutrition knowledge, and prepare for the increasingly uncertain climate change ahead, and also encourages the involvement of women and young people to participate by integrating technological advances throughout the agricultural value chain (Tsan et al., 2019). By accelerating the provision of information to smallholder farmers or other actors in the agricultural value chain can accelerate and also improve the performance of everyone involved, such as improved systems in agricultural extension services, agricultural input traders, agribusinesses, financial service providers, and policy makers, using digital technology and channels, the digital revolution and transformation for agribusiness significantly contributes to the structural transformation of the agri-food sector (Muyiramye & Addom, 2020).

With the existence of digital technology, it can accelerate information to small farmers or other actors involved in the agricultural value chain, such as agricultural extension services, agricultural institutions, the business sector in agribusiness, financial service providers, and policymakers, with the use of technology and digital service channels, the digital revolution for agribusiness can contribute to strengthening the agricultural sector in the food sector (Tsan et al., 2019). In the past, communication tools like radios and televisions allowed farmers to get information (Wolfert et al., 2017). They were unable to consult agricultural departments and specialists to identify solutions due to the one-way communication flow, however (Lin et al., 2017)(Ma et al., 2020)].

Indigenous agricultural knowledge (IAK) has long been a driving force in agricultural development (Barrera-Bassols & Zinck, 2003). IAK is systematic and collective knowledge, practices, and beliefs about the relationship between living beings and their environment that have been passed down from generation to generation through cultural transmission. Farmers have been producing both food and plantation commodities using collective knowledge gained through field experience under various environmental conditions and seasonal variability without access to external inputs, resources or scientific knowledge, so it is inevitable that farmers are reluctant to accept developments and advances in technology that are not certain to benefit their farms. This may discourage farmers from using synthetic agrochemicals and prefer to use local techniques such as crop rotation and soil fertility restoration through closed nutrient cycling (Capra et al., 2015).

Indigenous farming practices include intercropping, terracing, mixed cropping in the hope of increasing reliance on biological fertility, and agroforestry adaptations (Tella, 2007). They can significantly reduce environmental pollution by reducing the use of modern agricultural inputs such as chemical fertilizers, insecticides, and herbicides, which can reduce carbon, nitrogen, and water footprints and be a greenhouse gas (GHG) mitigation option. Therefore, developing indigenous technologies and knowledge in modern agriculture through increased interaction among local networks and organizational arrangements will have an important impact, both in terms of technological advancements as well as approaches to maintaining traditional farming practices (Maru et al., 2019).

Some of the knowledge that still exists on indigenous agriculture in communities can be a setback to agricultural progress as it has the potential to become a number of barriers that have been neutralized by development strategies over the years (Degaga, J and Angasu, 2017). Although indigenous agricultural knowledge is certain to erode and disappear as technology develops, especially in agriculture, it is hoped that the development of knowledge about agricultural progress can be obtained and documented to fill the loss of at least traditional agriculture, with the aim of closing the intergenerational information gap and increasing agricultural resilience in the future (Arunrat et al., 2022). Using community-based and collectively organized IAK can provide valuable insights, can also help in complementing scientific data, and result in global changes in agricultural productivity. It is clear that there is a need to document and educate younger generations on the value of IAK in line with modern agricultural knowledge. IAK is in line with modern agricultural knowledge. IAK should not only be part of historical knowledge archives, but documentation of such knowledge in a contemporary form is now necessary to ensure proper utilization and attribution (Ha et al., 2008).

Sustainable agriculture is becoming a benchmark in the form of environmentally friendly measures of durability and sustainability of food grains. Sustainable agriculture also has a positive impact in promoting agricultural practices and approaches that help farmers and

resources to last (Srisruthi et al., 2017). It provides benefits in terms of economic viability, maintaining soil quality, reducing soil degradation, conserving water, increasing land biodiversity, and ensuring a natural and healthy environment (Navulur et al., 2017). Sustainable agriculture makes a potential contribution to the conservation of natural resources, preservation of biodiversity and reduction of greenhouse gas emissions. Sustainable agriculture is a method of preserving nature without jeopardizing the basic needs of future generations, while improving agricultural efficiency and also the sustainability of future generations of farmers (Shelef et al., 2018).

Crop rotation, nutrient deficiency control in crops, pest and disease control, recycling, and water harvesting are the primary accomplishments of smart farming in terms of sustainable agriculture, resulting in a safer environment overall (Scherban', 2021). Living organisms rely on biodiversity and are contaminated by waste emissions, fertilizer and pesticide use, degraded dead plants, and other factors. The emission of greenhouse gases has an impact on plants, animals, humans, and the environment, necessitating a better environment for living things (Reddy & Dutta, 2018).

Agriculture has long been an important part of the Indonesian economy. The vast agricultural landscape contributes significantly to national GDP and employment (Khairiyakh et al., 2016). Food and beverage manufacturing and distribution are also significant contributors to national GDP, serving one of the region's largest domestic consumer markets. Mapping the economic footprint of Indonesia's agrifood sector and its recent development. The COVID-19 pandemic's impact on the sector's performance in 2020, and what it means for the future. All values are quoted in USD and have been adjusted to maintain exchange rates and prices at 2020 levels. This ensures consistency across years and markets studied in this analysis (Change et al., 2021).

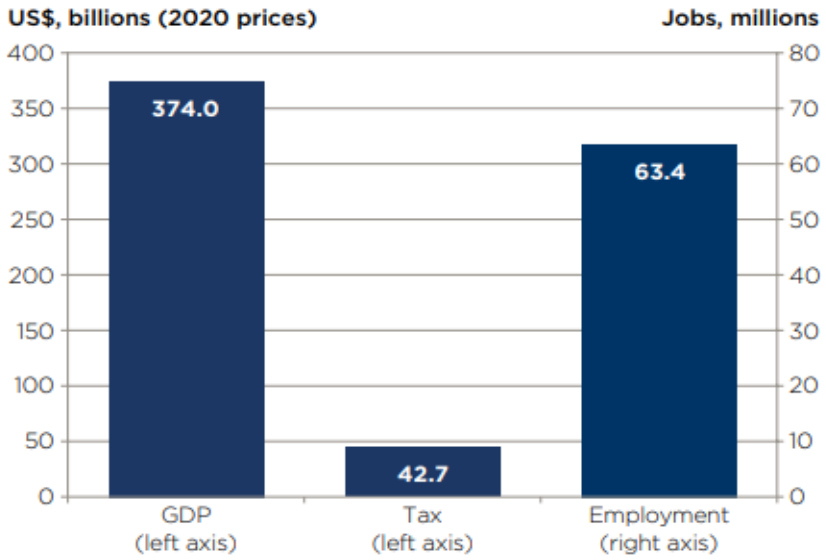

Figure 1. Total economic contribution of agri-food sector in Indonesia (2019)

Indonesia's agriculture and food sector Indonesia maintained a strong trade surplus between 2015 and 2019. This was driven mainly by the output of unprocessed goods from its large agricultural sector, demonstrating the size and importance of this primary sector to the national economy (Change et al., 2021).

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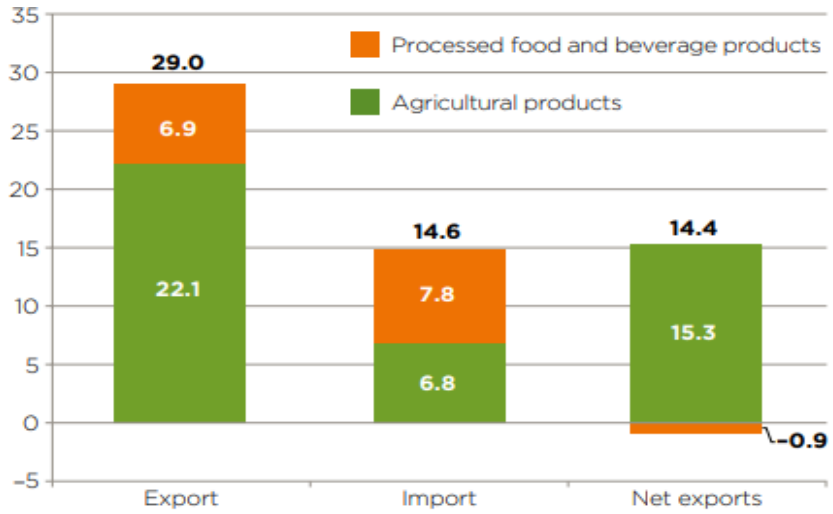

Figure 2. Trade in agri-food products, 2019

However, in recent years, Indonesia's agricultural trade surplus has dwindled. This is due in part to the weakening of Indonesia's currency relative to the US dollar, which has reduced the value of Indonesia's exports in US dollars. However, the declining trade surplus indicates that domestic demand for these products is increasing in the Indonesian economy. The Indonesian economy is expanding as a result of the country's brisk growth in food and beverage manufacturing and a growing domestic market. The domestic market is expanding (Contreras-medina et al., 2022). As Industry 5.0 has evolved, various technologies have been implemented. For In Industry 1.0, for example, the transition from agriculture to industrialization using fossil fuels increased output (Nahavandi, 2019). Other examples include mechanical devices from Industry 2.0, electronic tools from Industry 3.0, the Internet of Things from Industry 4.0, and robots and intelligent systems from Industry 5.0 (Nahavandi, 2019). However, introducing these technologies into the primary stage of the food production system is difficult for farmers and indigenous peoples who have spent centuries managing their crops by hand or with the help of animals (Yin et al., 2018). Because Industry 5.0 is a human-centered concept, it is critical to understand these groups' specific needs and preserve their indigenous practices by directing digital resource technologies to their communities (Nag & Gite, 2020). This paper deals with sustainability of coffee toward digital technology era.

2. Materials and Methods

This study employs a comprehensive literature review methodology to investigate the publisher of publications with identical titles. The articles were obtained from digital databases available on the websites of Google Scholar, ResearchGate, ScienceDirect, Springer, MDPI, Taylor & Francis, and other providers of online journal subscription services. Abstracts, introductions, and conclusions provide the foundation for literature reviews, which are then examined and summarized using descriptive methodologies (Widiasih, 2017). Make recommendations for determining the sustainability of arabica coffee farming in the supply chain, including an assessment of existing experience and documentation (database of research results).

3. Results and Discussions

3.1. Sustainability of Coffee

Production building blocks focused on increasing output volume while adhering to Building blocks for production aimed at improving output produced while adhering to sustainability standards and guidelines, such as growing total output while reducing chemical inputs and

deforestation. Arabica and Robusta appeared to have different strategies for increasing production volume. Aside from increasing productivity, Arabica faced the challenge of expanding the plantation area. A potential strategy for increasing Arabica plantations was identified as moving production from Robusta to Arabica at specific elevations. Arabica grows at elevations ranging from 1000 to 1500 meters, whereas Robusta grows at 500 to 1100 meters. An area that appeared to be suitable for Arabica cultivation (altitude between 800-1100 meters) is now used to cultivate Robusta. At elevations higher than 800 feet above sea level, the productivity of the Robusta plant was low (Siti Khairani Elhakim, 2020). As a result, the appropriate areas needed to be identified, and efforts needed to be made to persuade farmers to switch from Robusta to Arabica production in order to maximize output based on their land's potential. Arabica required wet processing, which was more detailed and required more knowledge and skills than Robusta dry processing (Anwarudin & Dayat, 2019).

However, the environment in Indonesia did not support the development of the coffee sector adequately (Coffee Lens, 2021). The concerns relating staple foods in their agricultural programs (such as rice and secondary crops). As a result, there were fewer proactive policies (such as extension services) and less investment in coffee cultivation and industry (e.g. rural infrastructure and facility). Another issue encountered was the farmer's low productivity and coffee quality. Farmers' lack of professionalism in production, processing, and marketing could be the source of this issue (Braistorming et al., 2019). This problem, along with their reliance on wholesalers, was exacerbated by a lack of capital, poor input, and remote locations. The institutional improvement must be the focus of the enabling environment suggest that the structure. Access to finance and inputs, rural facilities and infrastructure, well-functioning farmer organizations, training and workshops, and extension services could all be improved. In order to address the issue of finance and input, efforts had to be directed toward administrative issues in order to obtain adequate input and capital. Farmers were apprehensive about dealing with the supervision of lending money to banks or other private lenders.

Furthermore, before lending credits, banks or lending agencies are required to provide collateral (land or a building). The farmer was discouraged from dealing with financial providers as a result of this situation. These issues are interconnected, and efforts to address them require a strong commitment from the government in the form of policies and regulations. Given the limited national budget for the coffee sector, the government should have expanded partnerships with the private sector to address all farmer issues and develop proper facilities and infrastructure in rural areas. It was found that 4.50 million farmers use the internet, per the 2018 Inter-Census Agricultural Survey (Sutas). To reduce price fluctuations caused by information supply and demand gaps, the internet can be used as a productive medium (as opposed to a consumptive medium as an entertainment medium). The rapid development of information and communication technology is expected to be adopted as one of the most important tools to improve the quality of farming in the industrial revolution era of industrial revolution 4.0. One of the initiatives is to develop an e-commerce-based agricultural trading system. It was demonstrated to be capable of increasing farmers' income during the COVID-19 pandemic, which required farmers to be technologically literate and capable of using information technology. where customers can place online food orders (also known as e-commerce). Meanwhile, the Indonesian industrial revolution 4.0 has been ineffective, particularly in the agricultural sector.

3.2. Toward Digital Farming

Communication and information technology can help rural cooperatives and other agricultural institutions improve their effectiveness and long-term viability. (Ekpe et al., 2015) The

performance of an organization can be defined as the extent to which tasks are carried out in fulfilling the goals, objectives, mission, and vision of the organization and its business. The organizational performance also shows how each public organization serves the public and how its performance can be measured using existing performance indicators to determine how well the organization's operations and work processes have been carried out, as well as the achievement of its goals. It is crucial to generate new ideas, especially as we enter the fourth industrial revolution, where technology is expected to improve the performance and sustainability of coffee cooperatives so that they can compete and survive in an increasingly competitive business environment. Agricultural and rural institutions must address social, economic, environmental, and political factors, including food, infrastructure, communication, and poverty (Anwarudin & Dayat, 2019) regards agricultural and rural institutions as supporting subsystems in the agribusiness system. Agribusiness supporting institutions which include political policies on national agriculture, as well as the role of banking institutions, agronomy guidance institutions, educational and research institutions (including universities), non-governmental organizations (NGOs), cooperatives, farmer groups, and so on. Farmer cooperatives, including coffee farmer cooperatives, are emerging rural agricultural institutions. Cooperatives are business entities whose members are people or entities. Its operations are based on the principles of economy and cooperation.

Cooperatives strive to improve their members' well-being and to build a more innovative, just, and successful society (Anwarudin & Dayat, 2019). This is consistent with Indonesia's constitution. Cooperatives are expected to have a positive impact on citizens who need cooperative societies as mediators to sustain their activities by creating and making use of the resources available in the surrounding area. Businesses, especially those in remote areas, face a variety of challenges, including capital, marketing, and production techniques. As a result, in addition to capital assistance, cooperatives are expected to provide marketing and production strategies so that the products produced benefit the companies and actors who run them.

The ability of a cooperative to operationalizing in its strategic environment by responding creatively to the dynamics of the surrounding strategic environment is referred to as cooperative sustainability. Indicators of the concept of sustainable development are multidisciplinary because many development sectors must be considered. Ecological, economic, socio-cultural, and economic sectors are all factors to consider for sustainable development. Indicators are one method for assessing and promoting the long-term viability of a manufacturing business. Indicators are also useful variables because they show how far a dimension has progressed. Before establishing indicators, it is necessary to first comprehend the concept of sustainable production and then identify the requirements that need to be fulfilled in order to achieve sustainability (Haryanto et al., 2020). Cooperatives are considered to be sustainable if they meet three criteria: (1) they can recover some of their costs or even finance themselves, (2) they provide a consistent stream of benefits, and (3) they persist over time (Krajnc & Glavic, 2003). With the Covid-19 pandemic, it can change some people's views to quickly make adaptations in order to survive in the face of economic competition, especially in the agricultural economic. With this momentum, it is hoped that the role of communication and digitalization will be able to make Indonesian agriculture more developed and be able to facilitate the community in accessing the various needs they need in doing agriculture, so that agricultural sustainability can continue in the future.

4. Conclusion

In their agricultural programs, the government prioritized staple foods (such as rice and secondary crops). This resulted in fewer proactive policies (extension services) and low

investment in coffee cultivation and industry (e.g. rural infrastructure and facility). Another problem encountered was the farmer's low productivity and quality of coffee. This problem could be caused by farmers' lack of professionalism: shared knowledge and skills in production, processing, and marketing. This issue and their high reliance on wholesalers were exacerbated by limited access to capital, poor input, and remote locations. The enabling environment development block must focus on institutional improvement. Finance and input access, rural facility and infrastructure, well-functioning farmer organizations, access to training or workshops, and extension services could all be improved. To address the issue of finance and input, efforts had to be directed toward administrative matters in order to obtain proper information and capital. Farmers hesitated to deal with the administrative requirements of lending money to banks or other lending institutions. Some lingering knowledge of indigenous agriculture in communities can be a setback to agricultural progress as it potentially becomes a number of barriers that have been neutralized by development strategies so far. With today's technological advancements, indigenous-based agriculture can keep up with digital technological advancements in helping agriculture-dependent communities increase the productivity of arabica coffee and improve farmers' incomes as well. The role of digital will not eliminate the role of traditional custom-based agriculture, but can maintain and preserve the custom as a cultural heritage, while not forgetting the main objectives needed by people who depend on agriculture.

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