Digital Farming And Local Economy: A Study On Nudira, Greenhouse Bandung

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Abstract: This study endeavors to capture the impact arising from the implementation of digital farming by farmers in Nudira Farm, Bandung. By the SWOT analysis method, it known that the strategy of applying digital farming to the object of research has had a positive impact on the economic side. This study also examines what other strategies are feasible in developing digital farming. The results can conclude that the requirement for synergy between investors and farmers facilitated by the government in increasing the productivity of the agricultural sector by utilizing advanced technology that continues to grow. The iGrow concept is considered feasible in supporting the development of digital farming in Indonesia.

Keywords: agricultural, digital farming, fintech, economic welfare, SWOT

1. INTRODUCTION

The world population is estimated to reach 9.2 billion by 2050. The United Nations Food and Agriculture Organization (FAO) estimates that farmers must produce 70 percent more to meet consumer demand. According to the OECD report (2012), water is used in agricultural activities for around 70 percent of total world water use, while, as reported by the WBCSD report (2009), excessive use of water in developing countries causes water consumption over than 90 percent. All of these advancements require producers to use a new generation of the agricultural model compared to traditional farming methods. Recently, with the development of communication technology, sectors that have insufficient relations can interact and produce high value-added. Byerlee et al. (2009) affirms that globalization affects the agricultural industry, and the situation leads to the use of new technology. They also emphasized that developing countries such as India and Brazil have high value-added agrarian products toward the market. These countries can compete with developed countries because innovation makes it possible to get products with high value-added. Transformation is considered as an essential process to achieve more with fewer resources and efforts. Juma (2015) asserts that enriching raw materials with innovation following changes in the world economy, political and ecological conditions, contributes to the processing, packaging, storage, distribution, and food security after production. The tendency to innovate in agriculture by guaranteeing production efficiency with the whole process would increase economic growth. The agricultural sector has ensued technological developments and benefited from this development. Developments in satellites, GPS (Global Positioning System), GIS (Geographic Information Systems), and other mobile communication technologies have given rise to the implementation of precision agriculture (López-Riquelme et al., 2016). Currently, the development of communication technologies such as cloud computing and the internet have been combined with other improvements like artificial intelligence, robot technology, and big data analysis that empower us to arrange digital farming (Dong et al., 2013; Tan, 2016).
As expected, the agricultural technology sector has changed merely alike other industries and is progressing. The traditional production system has changed to a modern, productive, and innovative system (Andrade-Sanchez & Heun, 2010). Managerial activities also change the new paradigm, and this circumstance requires more interaction with environmental factors (Sørensen et al., 2010). Lately, the notion of agriculture is agriculture with water-saving, intelligent agriculture, high-quality agriculture, high efficiency, and no pollution. Digital farming is the most effective and necessary strategy to realize all these transformations (Yane, 2010). Shen et al. (2010) describes digital farming as an implementation of the concept of the digital world proposed in the 90s, and the idea of precision farming emphasizes the process of agricultural production. Digital farming means the use of computers and communication technology to increase profitability and sustainability in agriculture. Digital agriculture carries new opportunities, the widespread use of high-level computer technology, and data-intensive, or what is known as the industrial revolution 4.0 in agriculture. Amidst digital farming, tools, which can be used in all farming and animal husbandry systems, are optimized, high-precision, real-time and adapted to the use of information and resource management, and creates a positive impact on agricultural productivity (Van Es et al., 2010). A report written by GIFS (2015) claims that less than 20 percent of agricultural land worldwide is managed using digital farming technology [6]. Digital farming, also known as an information-based farming model, places the process of providing processing and interpreting digital data based on agricultural production and management systems (Liang et al., 2002; Zhang, 2011). One form of digital farming that is quite successful is in the Pengalengan area, Bandung. The development of computer technology penetrated not only the industrial world but also the world of agriculture. One of them punched the tomato and cucumber farmers in the highlands, Pengalengan District, Bandung. It was Nurdira Farm who implemented it. The farmers' group in Pengalengan uses greenhouse technology and operate computers to control their agriculture. They use a greenhouse complete with supporting facilities-started from growing beef tomatoes, cherry tomatoes, and baby cucumber-is commanded by computer. The greenhouse-with a size of 2,600 m2-equipped by a regulator of

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temperature, humidity, CO2, lighting, air circulation. Even nutrients for plants channeled with drip irrigation pipes, and everything, including plant development, is monitored and controlled by computers in the control room every day. The resulting product is fresh and non-pesticide. The seeds are partly produced by themselves, and some are imported from the Netherlands. These seeds produce good quality products, notwithstanding the level of brix cherry tomatoes can be adjusted according to consumer demand with a range of 9-12 brix and much sweeter than tomato beef. In addition, investment for 2,600 m2 greenhouse requires compensation of Rp 1.5 million per m2. The cost of production for these two types of tomatoes (beef and cherry) is Rp 4,200 per kg. As a result, the output reaches 12 kg per tomato beef tree and 48 kg per tomato cherry tree. The price of the farmer is Rp. 22,500 per kg, then it is far more profitable than growing ordinary tomatoes. Due to the regular tomato selling price of Rp 12,000 per kg, and the cost reaches Rp 7,000 per kg. Further, for baby cucumber, the production cost is Rp 2,100 per kg, and the selling price is Rp 22,500 per kg, it is quite efficient, and also the selling price is higher than ordinary tomatoes. Meanwhile, cucumbers sell for Rp 6,000 per kg at the expense of Rp 3,000 per kg, which means it is not very profitable. From the market side, there are no problems due to high demand, where demand reaches more than 200 tons and is only able to supply 109 tons per year. Starting from upstream, on-farm, and downstream is supported by computerization. The market has partnered with three traders and entered supermarkets, hotels, and restaurants. Therefore, patterns with this technology will become a trend and a favorite in the future. Particularly for the younger generation of millennial farmers, and their products are adjusted to the taste of the market. The availability of vegetable stock with stable quality and quantity standards for the necessities of modern retailers, hotels, and restaurants is a challenge as well as a separate opportunity. It is a challenge because agricultural business, which in general is very dependent on changes in weather and climate, directly influences agricultural output both in terms of quantity and quality. Whereas modern retailers, hotels, and restaurants necessitate this supply continuously to ensure the continuity of their services and final products. On the contrary, it becomes an opportunity if we can overcome it because by doing so, we will become a reliable supplier of high-quality vegetables. This opportunity has taken with the concept of Precision Farming, i.e., farming in a greenhouse with accurate microclimate control and nutrition. Because farming with this powerful technology method is capital intensive, thus built a conservatory that is owned by the community. In addition to community members sharing their results and risks, community members can also automatically learn along with this Precision Farming facility. The future expectation, Precision Farming projects will arise in numerous locations to provide the demands of high-quality vegetables that will increase continuously. Precision Farming is used to grow cherry tomatoes, then lettuce, and then a variety of modern vegetables that will adapt to market demands. The Greenhouse presumed to be used for ten years and will start producing results from the end of the first year. It takes about six months to make it, then 3-4 months of the first planting period, hence by the end of the first year, it is expected to have started to produce results. Revenue sharing will be given once a year during the productive greenhouse period of 10 years. During this period, it estimated that the average yield would be in the range of 12 percent per year. Based on that conditions, the researcher wants to do a SWOT analysis of Digital Farming so that this concept can be developed more widely in the future and also wants to see its impact on the local economy.

2 METHOD

This research uses explorative qualitative methods. While the data used are qualitative and quantitative. In this study, quantitative data required to analyze the numbers that researchers have obtained in the field. Whereas qualitative data used to find and discover information in actual conditions. Qualitative method is a method to explore and understand meaning by several individuals or groups of people who considered to originate from social or humanitarian problems. The qualitative research process involves meaningful efforts, such as asking questions and procedures, gathering specific and real data from participants, analyze data inductively starting from particular themes to general themes, and interpreting the meaning of data. In this method, the researchers use the Explanatory Survey approach, which is to make observations that occur, and look for factors that might be the cause through specific data. The qualitative research conducted in-depth interviews with the primary sources, namely the Coordinator of Nudira Greenhouse, Pengalengan, Bandung. Then, officers from Bank Indonesia (BI), because BI built Nudira Greenhouse, who care about digital farming and digital village. Afterward, we conducted a Focus Group Discussion with local farmers who carried out digital farming.

3 RESULT AND DISCUSSION

SWOT Matrix Analysis of Digital Farming

Analysis using the SWOT matrix is a systematic identification of internal conditions that are strengths and weaknesses, as well as the external environment that presents opportunities and threats faced by digital farming in Pangalengan, Bandung. The purpose of the matching stage (SWOT matrix) is to produce feasible alternative strategies, not to choose which approach is best. Not all alternative schemes developed in the SWOT matrix will be selected and implemented. By this analysis, it assumed that a competitive strategy could be developed based on a combination of internal and external factors that have presented so that an appropriate strategy is obtained based on the position and conditions of existing digital farming. This strategy consists of SO strategy, ST strategy, WO strategy, and WT strategy. After gaining a clear picture of the strengths, weaknesses, opportunities, and threats faced, then an alternative strategy can be chosen. With the right choice of strategies, it is presumed to be able to exploit its strengths and opportunities to reduce weaknesses and deal with existing threats. Through the SWOT matrix, an alternative strategy will be collected to determine the critical decision. Internal Factors Evaluation (IFE) and External Factors Evaluation (EFE) The first stage is to design external and internal evaluation matrices. At this stage, external (opportunities and threats) and internal factors (strengths and weaknesses) that influence digital farming evaluated. Based on farmers' ideas, each item is ranked and determines the weight of each. The details can be seen in Table 1.

TABLE 1
INTERNAL FACTORS EVALUATION (IFE) AND EXTERNAL FACTORS EVALUATION (EFE)

	Internal Factors	Weight	Rank	Total
Strenghts	Good geographical condition	0.08	3	0.24
	Good technical knowledge by farmers	0.06	4	0.24
	Good watering	0.10	4	0.40
	Modern Agricultural System	0.08	3	0.24
	New technology	0.08	3	0.24
	Large Number of Workers	0.08	3	0.24
	Total	0.47		1.60
Weaknesses	High Production Costs	0.09	1	0.09
	Weaknesses in Product Value Added	0.08	2	0.16
	Resource Problems	0.08	2	0.12
	Difficulty finding reliable data and information about organic products	0.10	1	0.10
		0.08	2	0.16
	Inadequate Traditional	0.09	1	0.09
	Total	0.53		0.63
	Total of Internal Factors	1		2.23
Opportunities	A national digital farming development opportunity	0.09	3	0.27
	New Job Fields	0.08	4	0.32
	Improving Industries in the Agriculture Sector	0.08	4	0.32
	New Technology Development	0.10	3	0.30
	Policy Support by the Government regarding the Digital Farming program	0.10	4	0.28
	Amount of Start-ups	0.07	3	0.21
	Total	0.52		1.70
Threats	There is no policy framework on digital farming	0.08	2	0.16
	Weather Risks	0.09	1	0.09
	Production Risk	0.08	1	0.16
	Marketing Risks and Prices	0.08	2	0.08
	Input Price	0.07	2	0.14
	Increase the use of External Input	0.08	2	0.16
	Total	0.48		0.79
	Total of External Factors	1		2.49

Source: Authors' calculation (2019)

The Effect of Participative Leadership Style on the Teachers' Performance
Based on the results of linear regression analysis, it is known that H0 is rejected and H3 is accepted, then it can be concluded that performance can be significantly influenced by the participative leadership style. This result is in accordance with Siagian (1999) which says that the quality of leadership contained in an organization plays a very dominant role in the success of the organization in carrying out its various activities, especially seen in the performance of its employees. This can be seen from the participative leadership style applied by the school principal, so the teachers feel included in giving ideas or suggestions related to school activities so that there is a responsibility to show excellent performance.

Space Matrix
Position mapping using the space matrix is completed by calculating the average rating of each dimension. For the aspects of FS and IS, the evaluation of the axis has a positive rating. Furthermore, a factor that is approaching the primary condition is given a value of 6, while an element that does not approach a term is assigned a value of 1. As well as a dimension that is on the negative axis, a factor approaching is given a value of -1 while an element that is not close to the condition given a value of -6 by respondents. Based on the results of the weighting obtained an average of each dimension. Afterward, the average is drawn in quadrant form to find out the position in the SPACE matrix. Figure 1 shows calculations on the x-axis and y-axis.

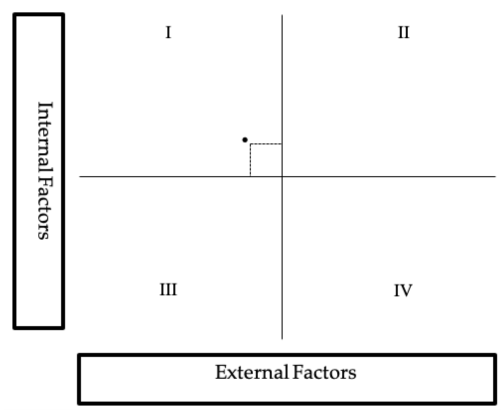

Fig 1. *Space Matrix*

TABLE 2
SWOT MATRIX

Internal Factors / External Factors	Strenght (S) S_1: Good geographical conditions S_2: Good technical knowledge by farmers S_3: Good watering S_4: Agricultural System S_5: New Technology S_6: A Large Number of Workers	Weaknesses (W) W_1: High Production Costs W_2: Weaknesses in Product Value Added W_3: Resource Problems W_4: Difficulty finding reliable data and information about organic products W_5: Inadequate Traditional Market Infrastructure
Opportunities (O) O_1: A national digital farming development opportunity O_2: New Employment O_3: Enhancing Industries in the Agriculture Sector O_4: New Technology	SO Strategies SO_1: Development of Digital Farming National Policy SO_2: Encourage Investors to invest in digital farming SO_3: Developing Digital Farming Models in other areas SO_4: Dissemination of Digital Farming to young	

Development O_5: Policy Support by the Government regarding the Digital Farming program O_6: Amount of Start-ups	people SO_5: Development of Modern Agriculture Industry	
Threats (T) T_1: There is no policy framework on digital farming yet T_2 : Weather Risk T_3 : Production Risk T_4: Marketing Risks and Prices T_5: Input Price T_6: Increase the use of External Input		Suggested Strategies

Based on the results of the discussion, an effective strategy related to digital farming in Pangalengan Bandung is SO (Strengths - Opportunities). In this case, several strategies that can be considered are digital farming national policy development, encouraging investors to invest in digital farming, developing digital farming models in other areas, socialization about digital farming to youths and development of modern agriculture industry.

The Role of Government in Digital Farming

To support the achievement of Smart Farming or Digital Farming in Bandung and throughout Indonesia, the government implemented several attempts, including building national digital infrastructure. In support of Digital Farming, the government will stimulate the development of digital infrastructure. This support including high-speed internet and digital capabilities, in collaboration with government, public, and private sectors to be able to invest in digital technologies such as cloud, data center, security management, and broadband infrastructure. The next step is the improvement of the quality of human resources (HR). HR is vital for achieving the successful implementation of Digital Farming. Indonesia projects to overhaul the education curriculum with more emphasis on STEAM (Science, Technology, Engineering, the Arts, and Mathematics), aligning the national education curriculum with future industrial demands. Indonesia will work with industry actors and foreign governments to improve the quality of vocational schools while enhancing the labor mobility program. Indonesia will also align digital standards, following global norms, to encourage collaboration between industry actors so that they can expedite digital transformation. Moreover, the government provides incentives for technology investment. Incentives have the potential to drive innovation and technology adoption. Therefore, the government will redesign the technology adoption incentive plan, such as subsidies, corporate tax breaks, and import tax exemptions for companies that are committed to implementing 4IR technology. Further, Indonesia will launch a state investment fund to support additional funding for investment activities and innovation in the field of advanced technology. Finally, the harmonization of rules and policies is also very substantial. Indonesia is committed to it for supporting industrial competitiveness and ensuring close coordination of policymakers between ministries and institutions concerned with local governments.

The Impact of Digital Farming on the Local Economy

Pangalengan is one of the districts in Bandung Regency, which is an agricultural center. The agricultural sector contributes the largest of the total Gross Regional Domestic Product (GDP) in Pangalengan Subdistrict even to the district level, the third-largest contributor after the Industrial Sector (Without Oil and Gas) and Mining and Mining (Oil and Gas). Based on the existing potential, the agricultural sector is a sector that deserves more attention, both from the regional government and the farming community itself. Several types of food crops cultivated in the Pangalengan District include rice, corn, cassava, sweet potatoes, long beans, and kidney beans. The highest production and area of food crops is 6,267 tons of paddy rice, with a harvest area of 1,481 hectares, while the second highest is 5,886 tons of corn, 393 hectares of harvested area. Thus, affected the level of productivity of rice plants to 42.32 q/Ha in 2017 was an increase in the previous year. For rice and secondary crops (known as palawija), the production of rice is still inferior. This situation can be understood because the area for rice plants is quite small when compared to the area planted with horticultural plants. The land area of 2159.50 Ha is used for potato plants with a productivity of 42,889 tons. Whereas 1,214.60 Ha of cabbage plants production of 30,634.00 tons, and chili plants 345.69 Ha production of 4,094 tons. Others like shallot plant 374.83 Ha production of 20,358 tons, carrot plant 806.00 Ha production of 18,520.80 tons, tomato plant 665.85 Ha producing 15,494 tons, chayote 12.00 Ha production of 55,650.50 tons, and 791.00 Ha mustard plant production 18,054 tons while other food crops and Horticulture ranges from 1 to 56 Ha. For all plants in 2017, there was fluctuation in the previous year due to the main thing is the uncertain weather factor. Horticultural plants are excellent in Pangalengan District compared to other food plants. Horticulture plants that have superior plants such as potatoes, cabbage, Chinese cabbage, mustard greens, carrots, tomatoes, pumpkin Siam, onions, chilies, and followed by fruit plants, namely oranges, avocados, and bananas. For plantation crops such as tea and coffee, strawberries, which also cultivated in the District of Pangalengan. According to Beckie et al. (2012), there are certain factors that limit the role of farmers' markets within food systems: the scale (the number of markets accessed and the products), the scope (variety of products), accessibility and convenience (location, timetable), physical infrastructures (storage and processing) and organizational capacity are just some of them. It is clear that the economic dimension of markets is linked to their ability to attract both producers and consumers. Therefore, digital farming can be one of solution to thus problems. The application of Digital Farming is not just about applying technology. Nonetheless, what is critical in digital farming is measured data, what is needed by plants to achieve optimal production results and what must be done by farmers. Before Digital Farming implemented, there are challenges and opportunities related to climate change and weather, where these conditions will directly affect agricultural products in terms of both quantity and quality. Whereas modern retailers, hotels, and restaurants need this supply on an ongoing basis to ensure the continuity of their services and final products. Specifically, this can be an opportunity if they can overcome it because then they will become a reliable supplier of high-quality vegetables. This opportunity is taken with the concept of Precision Farming - namely farming in a greenhouse with accurate microclimate control and nutrition. Because farming with this technology-intensive method is capital intensive, thus iGrow will build in a greenhouse that is owned by the community. Community members can sponsor their construction starting from 1 unit, which is 1 m^2, which is then managed by iGrow mutually with experienced operator partners in this field. Aside from sharing results and risks, community members can also automatically learn together with the Precision Farming facility. In the future, Precision Farming projects expected will emerge in numerous locations to supply the needs of high-quality vegetables that will continue to increase. For the first time, this Precision Farming will be used to grow cherry tomatoes, then lettuce, and then various modern vegetables that will adapt to market demands. Furthermore, based on the results of in-depth interviews conducted, the investment for 2,600 m2 greenhouse costs Rp 1.5 million per m2. The cost of production for these two types of tomatoes (beef and cherry) is Rp 4,200 per kg with production is 12 kg per tomato beef tree and 48 kg per tomato cherry tree. Meanwhile, the price for the farmers is Rp. 22,500 per kg, which is much more profitable than growing ordinary tomatoes. Then for baby cucumber, production costs are Rp 2,100 per kg, and the selling price is Rp 22,500 per kg. The forms of investment that can be constructed and created a job opportunity to improve the local economy can be seen in Figure 2.

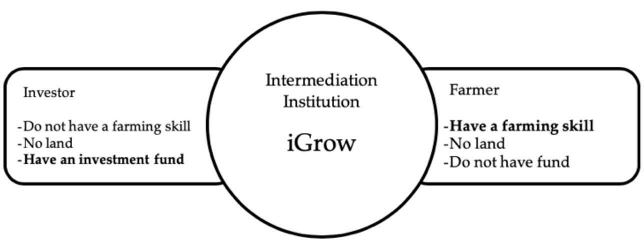

***Fig 2**. Investment Model between Overfunding and Farmers*
Source: Adaptation from iGrow.asia.com

Similar other intermediary institutions, iGrow, in this case, facilitates the parties with excess funds to invest in the modern agricultural sector with good prospects. Furthermore, to making a job opportunity, this model will benefit the two parties between investors and farmers. Additionally, the results of an interview with Nursyamsu, owner of Nudira Farm, added that cultivation using greenhouses is an example of technology-based farming 4.0. A computer controls the production process. Good business and market prospects, besides the domestic market, the export market is also in high demand. Starting from upstream, on-farm, and downstream supported by computerization. The market has partnered with three traders and entered supermarkets, hotels, and restaurants. The patterns with this technology will become a trend and a favorite in the future, especially for the younger generation of millennial farmers. Its products accustomed to market tastes. Likely with Zaldua et al. (2018) alternative agri-food networks present other factors, not just economic, that add value for both producers and consumers, as well as for the local economy. Eventhought, digital traceability and provenance systems are becoming increasingly important in maintaning and developing new high-value markets, and providing confidence for end users (and consumers) in relation to product safety and quality (Heath, 2018).

The Support system Financial Technology through Digital Farming Funding

The development and challenges of technology in agriculture have progressed. Seen from the many young people who care about the fate of farmers and many agro-technology-based companies began to be present in Indonesia, such as in Pangalengan, Bandung. Challenges faced in the next 20 to 30 years, the world must produce 70 percent more food than now. This circumstance is due to an increase in population, agricultural land is narrow, and labor in agriculture is reducing. The challenge going forward is how humans save natural resources and reduce environmental pollution. Financial Technology (Fintech) is a breakthrough in technology that connects the financial sector with users or the general public. Fintech has the potential to be one of the solutions to overcome problems that are currently in the community, especially people who live far from the city center or for people classified as unbanked. Fintech interpreted as utilizing the development of information technology to improve services in the financial industry. Community needs, encourage commercial service players to continue to innovate and transform traditional transactions into digital form, with a shorter, more accessible, and more affordable process with the existence of a digital platform. In this context, the Financial Services Authority (Otoristas Jasa Keuangan - OJK) issued OJK Regulation No.13/POJK.02/2018 regarding Digital Financial Innovation in the Financial Services Sector. This regulation as a provision that oversees the supervision and management of the Financial Technology (Fintech) industry, which had previously issued OJK Regulation Number 77/POJK.01/2016 concerning Information Technology-Based Money Lending and Borrowing Services. OJK reminded the rapid advancement of technology in the digital financial industry that cannot be ignored and needs to maintain in order to provide maximum benefits for the benefit of the community. Digital financial innovations need to directed to produce digital financial innovations that are responsible, safe, prioritizing consumer protection, and have well-managed risks. This regulation also issued as an effort to support financial services that are innovative, fast, cheap, easy, and broad and to increase financial inclusion, investment, financing, and other financial services.

4 CONCLUSION

This study concluded that there are several advantages to implementing digital farming that can contribute to increasing agricultural productivity. Various concrete strategies require to be performed by the government both in terms of policy support and infrastructure as well as financial to realize optimal digital farming. The iGrow scheme can also be applied and developed according to the context in each region in improving the quality and quantity of agricultural products. There has been a positive benefaction to the local economy with the implementation of digital farming, which can be a benchmark for the process of duplicating in different locations. The development of fintech in supporting digital farming activities is mandatory because it is a breakthrough in technology that is a link between the financial sector and other sectors such as agriculture. Digital transformation is a big step forward that induces a very cumbersome process of cultural change. Eventually, the digital agricultural revolution continues to be the focus. Digitalization in agriculture expects to be able to help farmers to take advantage of opportunities presented digitally. Furthermore, the monitoring of digitalization in the agricultural sector needs to be continued, especially digital farming. The aim is to encourage digitization efforts and overcome the digital divide. Modernization of agriculture is imperative to achieve the target of sustainable food self-sufficiency. Agricultural development strategies related to the policy direction include the expansion of the adoption of agricultural technology, as well as increased agrarian innovation and also economic improvement of agricultural products. It is also necessary to design a model of the application of digital farming, from the results of multi-disciplinary studies that can be applied in all regions in Indonesia to provide benefits for development.

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