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Exploring the Impact of Automation on the Future of Work in the Agriculture Sector in Indonesia

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ABSTRACT

This research aims to examine the impact of automation on future work in Indonesia's agriculture sector. Internet and digital platforms have altered many aspects of life and resulted in automation in several fields, including agriculture. The emergence of new technologies is often perceived as a threat and a challenge for this sector and its workers. Using a desk study method, however, the result shows that the automation of agriculture is beneficial to Indonesia's economy. This is not only in terms of gross domestic product (GDP) but also in terms of enhancing the quality of smallholder employment and the interest of youth in working in this sector. Farmers' use of the internet and smartphones have become catalysts in adopting automation in the present and emerging. Digital technology has become an important intermediate factor that helps farmers improve their productivity. This has become the mainstream of the adoption of the technology in agriculture rather than mechanization. Job replacement due to automation will possibly not happen in Indonesia due to labour market conditions, disparity of land ownership, and the high cost of implementing automation. Furthermore, this research addresses aspects that deserve attention, including job quality, social protection, industrial relations, inequality, gender, and participation.

Keywords: *agriculture, automation, digital platforms, future of work, internet*

INTRODUCTION

This article focused on exploring the impact of automation on the future of work in Indonesia, particularly in the agriculture sector. As an agricultural country, the development of automation in this issue will have enormous consequences for Indonesia's economy. On the one hand, it could bring economic transformation to the country. According to McKinsey & Company (2018), automation has the potential to increase productivity and GDP growth in Indonesia, as well as offer greater earnings for workers and market opportunities for firms. In addition, automation could create more market opportunities for businesses. However, on the other hand, there is a risk that automation may result in inequality in the labour market due to the dynamic of the existing labour market in Indonesia.

Agriculture is one of the Indonesia central sectors of Indonesia's economy. According to data from the Indonesia Central Statistics Agency (2022), agriculture is the third largest contributor to GDP, accounting for 12.91%. In addition, the agricultural sector accounts for employment for 29 per cent of Indonesia's labour or equal to 37 million people working in this sector. Until now, the majority of employment in Indonesia has worked in agriculture despite a massive decline over the year. However,

compared to earlier generations, a smaller percentage of today's young people choose to make a living through farming. According to the National Labor Force Survey findings in 2019, only 23 per cent of the nation's 14.2 million young people between the ages of 15 and 24 were employed in the agriculture, forestry, and fishing industries. This declining trend may become constant due to automation.

According to a report by the Organisation for Economic Co-operation and Development (OECD), agricultural employment has been steadily declining for decades. This trend is anticipated to continue, making agriculture jobs the most susceptible to automation in the future (see figure 1).

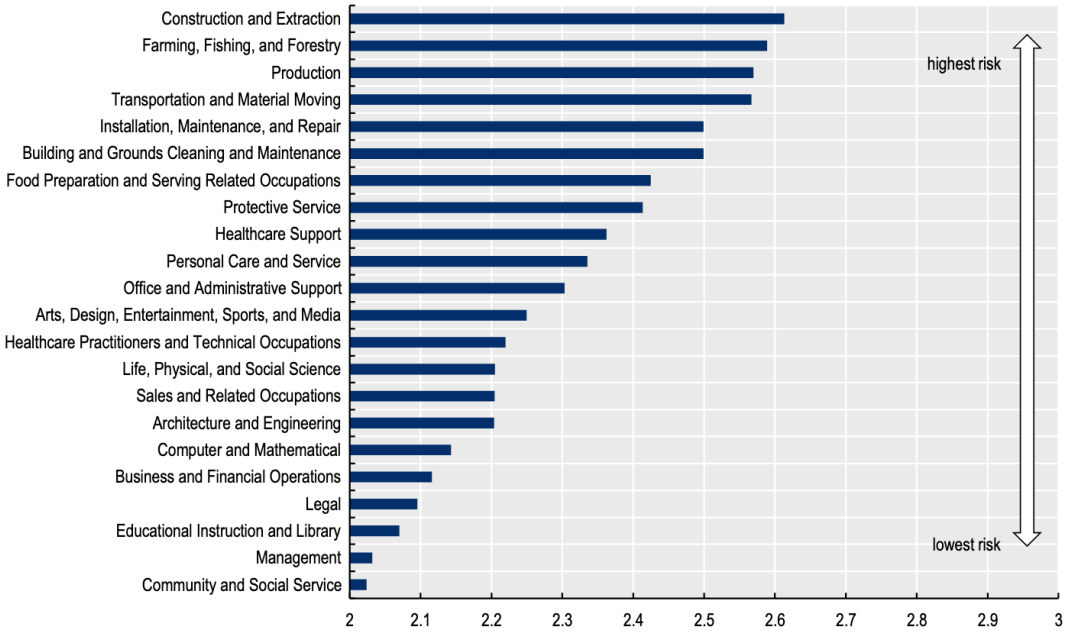

Figure 1: Jobs and risk of automation
Source: OECD Social, Employment and Migration Working Papers (2018).

It is essential to underline that this data is based on the context of developed countries which different characteristics in terms of demography, economy and technology. Many farmlands in developed countries (such as Australia) are corporation ownership rather than smallholder. Therefore, adopting the technology will be easier since they have capital and a strong technological ecosystem. Different political economy also plays a significant role in shifting their policy. In contrast, one of the different characteristics of Indonesia's agriculture is most of the workforce who work in this sector is dominated by smallholders or small farmers. At this point, the idea of automation has become quite challenging to adopt automation technology. As a result, the adoption and the effect of automation will differ.

Despite the differences, technology, indeed, will help farmers to boost their productivity. For instance, digital technology can increase farmers' technical knowledge, allow for more efficient calculations of the use of fertilizers, seeds, and other agricultural inputs, and improve farmers' decision-making by providing data on weather, crop management, market conditions, and livestock (World Bank, 2020). Unfortunately, only a small number of farmers can enjoy these benefits. The vast majority of digital agricultural technologies have under 10,000 users. Therefore, millions of farmers need access to digital agricultural technology. This is due to the fact that there are still many fundamental obstacles preventing farmers from using the most advanced digital agricultural technology. Currently, the government and the private sector are trying to adopt technology in the agriculture sector. Increasing access to the internet becomes fundamental as starting point toward automation and the implementation of machine learning in farms. In the past five years, some start-ups have emerged that focus on agriculture technology, from

online consultation to cutting-edge sensor technology. Before exploring the current transformation due to automation, the section below will focus on explaining the characteristic of the agricultural economy of Indonesia in order to identify the opportunities and challenges.

LITERATURE REVIEW

Automation and the Future of Work

Automation and the future of work are intertwined topics that have been discussed a lot lately. Automation can be defined as converting and altering a work process, procedure, and equipment to automatic rather than human control (Gerovitch, 2003). Gerovitch (2003) elaborates this definition by saying that automation does not solely move human functions to machines or computers but affects the organization of the work process. In the recent era, automation is frequently associated with the future of work as digital platforms have influenced how people work and run their activities. Stoepfgeshoff (2018) and Santana and Cobo (2020) explain that scholars have concluded that there is no exact and precise definition of the future of work. Scholars often describe the future of work by referring to other aspects; for example, Balliester and Elsheiki (2018) link the future of work to recent trends such as technology, climate change, globalization, and the demographic impact on work. More specifically, the aspects of work include the future of jobs, the quality of jobs, wage and income inequality, social protection system, and social dialogue and industrial relations (Balliester & Elsheiki, 2018). Another scholar, Mitchell (2022), explains the future of work by categorizing it into four key aspects, including workplace relations, workplace change, diversity, and personal skills. In sum, Gartner (2022) defines the future of work as the changes in how work will be done, implemented, and regulated in the future, affected by generational, technological, and social shifts. The impact of automation on future work is a prevalent topic that regularly appears in the news, non-academic outlets, and academic papers (Petersen et al., 2023). The discussions on automation and the future of work generate two views or predictions. Utopian or optimistic discourses view that automation will improve the quality of work, increase productivity, raise the standard of living, and generate significant wealth (Steinhoff, 2024; Blit et al., 2018). However, automation has also been seen as a concerning issue that will hinder people, especially low and middle classes, from having a decent life. Dystopian or pessimistic discourses perceive automation will replace human positions in the workforce and make them more susceptible (Kolhatkar, 2017). Furthermore, for the pessimistic ones, automation may reinforce social inequalities and worsen the conditions of existing jobs (Smith, 2020; Frey, 2019). In the Indonesian context, Hibrida and Sunarni (2023) argue that automation should be responded to by reskill and upskill initiatives to enter the workforce. Policymakers, businesses, and individuals must collaborate to ensure productivity and well-being (Hibrida & Sunarni, 2023). According to the research conducted by Ing and Zhang (2022), automation in Indonesia has brought benefits in terms of firm productivity, quality, and employment. In the public sector, automation, mainly caused by the use of AI, will change the future employment structure (Silitonga & Isbah, 2023). However, each sector's changes and implementation will vary (Silitonga & Isbah, 2023).

The Characteristics of Indonesia Agriculture

In order to understand the impact of automation in Indonesia, it is essential to address the specific context of Indonesia, which is known as an agricultural country due to the vast land of its agriculture. As agricultural countries, this not simply means the landscape of Indonesia itself but is also related to the social and cultural characteristics of the country. As a result, automation will not only transform the way people manage their land.

As stated earlier, agriculture is the key to Indonesia's macroeconomy. According to World Bank (2021), 14 per cent of Indonesia's gross domestic product is generated from the agriculture sector, which is dominated by smallholder farmers (93%). During the pandemic, the agricultural sector absorbs more

labour due to the loss of the manufacturing and other commercial sectors, which attracts more individuals to become farmers in rural areas. As a result, as of February 2021, the agriculture sector successfully maintained a labour absorption rate of 29.5%, a rise of 0.36 percentage points from the previous year (Ministry of Investment, 2021).

Most of Indonesia's farmers live in rural areas and have limited access to land, which is one of the most prominent demographic differences between Indonesian agriculture and developed countries. According to The World Bank (2022), over 43 per cent of the population lives in rural areas, while approximately 29 per cent of the labour force is employed in the agricultural sector. In this regard, around 39 million people work as a farmer, either with low or high skills. It is also essential to address that small households dominate most of the land for agriculture.

In terms of farmers' economic condition, the standard of living for its farmers has not altered significantly from one year to the next. In 2019, the Farmer's Exchange Rate (NTP) was 104.46, representing a modest increase of 1.25% from the previous year. However, the low wages paid to agricultural labourers, limited land ownership, and agricultural goods' selling prices do not benefit the farmers, making the farmers' well-being even lower than it already is (Setiariti, 2021). As a result, the number of young people is decreasing over the year (see figure 2).

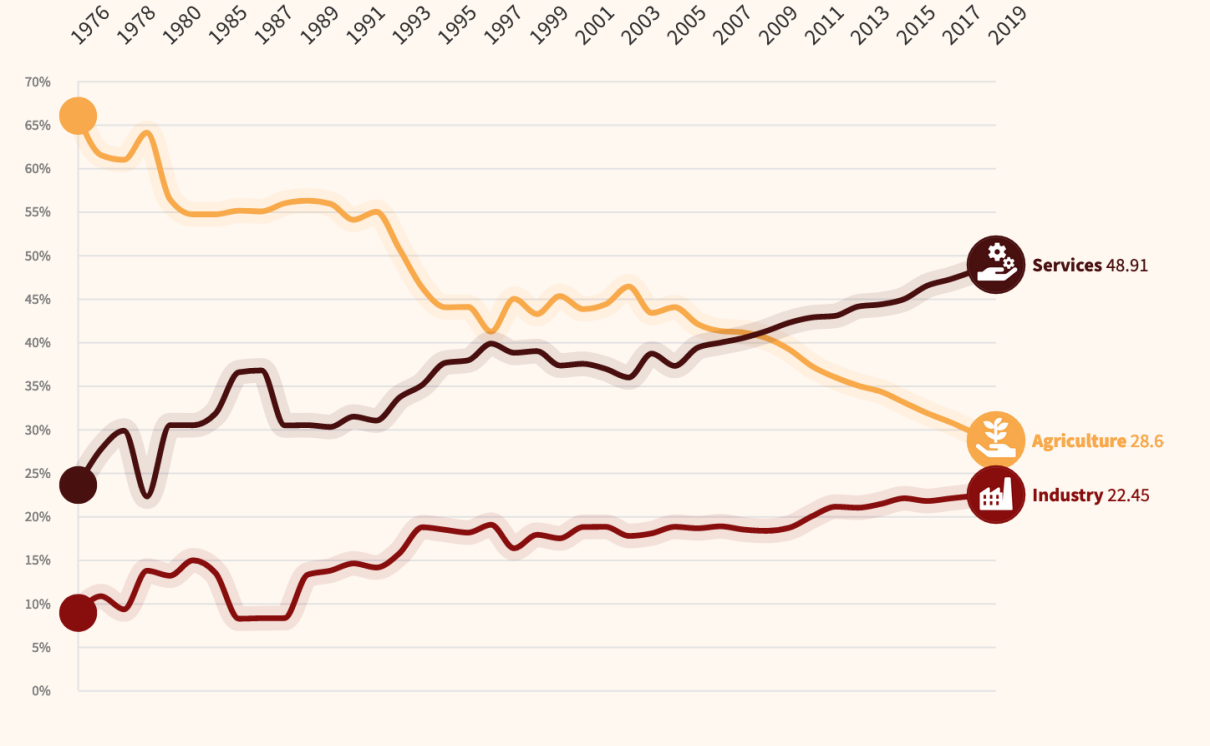

Figure 2: Types of employment in Indonesia
Source: The Jakarta Post (2021), Indonesia Central Statistics Agency (2021)

According to the Indonesia Central Statistics Agency (BPS), 55.8 per cent of young people work in the service industry. Compared to 45.93% a decade earlier, this percentage has grown by 9.87%. In the meantime, the percentage of young people employed in the agricultural industry was only 19.18%. In comparison, the number reached in 2011, which was 29.18%, has reduced by 10%. This number even could be even bigger due to urbanization, not to mention automation. This results from most of the people working in this sector being dominated by the older population. According to Susilowati (2014) analysis of

the results of the Census of Agriculture in 2013, the proportion of farmers between the ages of 40 and 54 makes up the biggest share or 41%. Old farmers make up 27% of the population in the age group over 55 years old, whereas only 11% of the population in the age group less than 35 years old is considered to be part of the younger generation. The Agricultural Census of 2003 also shows that the majority of farmers are in the age group of 25–44 years, which accounts for 44.7% of all farmers. This is followed by the age group of 45–60 years, which accounts for 23.2% of all farmers. The proportion of workers in the elderly group (> 60 years) accounts for approximately 13.8%, and the proportion of workers in the young group (24 years) accounts for only 9.2%.

Various reasons cause the decline in the interest of young workers in the agricultural sector, especially the image of the agricultural sector, which is less prestigious and less able to deliver adequate income due to relatively low land ownership. Another reason is that the perspective and way of life for young workers have changed in the era of the development of postmodern societies. For young people in rural areas, The agricultural sector is increasingly losing traction. Not just because of the economic sector agriculture increasingly unpromising, however, young people's reluctance to farm is influenced by subcultures' new developments in the digital era such as now. The crisis of young farmers in the agricultural sector and the dominance of old farmers have consequences for the sector development of sustainable agriculture, in particular agricultural productivity, market competitiveness, rural economic capacity, and more. It will threaten the food security and sustainability of the agricultural sector.

METHODS

This research uses a qualitative approach, mainly secondary data with a desk study method. The desk study method collects information relevant to answering the research question and feasible to the research topic (Genske, 2003). This research uses reports, documents, and publications to be gathered and concluded to answer the research question (Bassot, 2022). After compiling the data, we have undertaken the reflective process, which examines and explores the issues and experiences related to automation and the future of work in Indonesian agriculture. We have observed and read relevant sources and employ those sources to analyze the topic raised in this research.

RESULTS AND DISCUSSION

Unlocking The Future-Agriculture Through Internet

Despite numerous obstacles, the development of automation in Indonesia is advancing. Increasing internet connectivity and a flourishing digital economy in Indonesia make the adoption of automation in agriculture possible. Internet penetration is one of the factors contributing to the rise of automation. Approximately two-thirds of farmers use smartphones and are active on social media, frequently in farmer-specific groups (The Jakarta Post, 2021). Indonesia is well-positioned to capitalize on these developments. The vast majority of farmers have access to Internet connectivity and utilize it regularly.

Internet connection is more than just having access to the world wide web; it also entails having access to information, connecting farmers with large industries, and functioning as the primary tools for creating a digital ecosystem. In addition to providing microcredit to farmers and promoting the adoption of technology, the present government initiative is close to incorporating the internet into farming. Goh (2019) argues that emerging countries such as Indonesia are establishing a dynamic and robust AgriTech ecosystem in five primary business models, including farmers consulting, peer-to-peer financing, traceability, digital marketplaces, and mechanization.

Internet, at this point, allows the government to assist farmers through online counselling, including the cyber extension programme. As a result of this programme, various changes have occurred in the social structure and culture of farming communities, according to Prayoga (2018). Regarding peer-to-peer

financing, the internet enables farmers to obtain funds via mobile phones. KoltiPay is a digital wallet designed specifically for farmers. This financial platform offers funding, agricultural inputs, guidance, insurance, and access to the market. In addition, these digital apps allow e-wallets for cash safekeeping. It is necessary to address the fact that many people in a developing country lack access to bank accounts. Internet and smartphones now enable them to access their finances through their smartphones.

The digital marketplace is also thriving in Indonesia, for instance Tanihub, is a marketplace that specifically sells agricultural products. The goal is to break the distribution chain so that consumers can buy food at low prices and farmers still get big profits. Interestingly, Nisa & Samputra (2021) found that Tanihub has a good impact on young people's interest in farming. Indeed, the internet did not change how farming plants seeds, but now it has changed how people sell and buy the product. All these aspects could be implemented since it does not require much money compared to the adoption of technology, such as the internet of things (IoT) and agro-technology, which requires much money. The current infrastructure is also not fully compatible with current Indonesian agriculture. As a result, automation in terms of mechanization is will not be fully implemented in the near future.

"The Future of Work" in Farming

Due to the advancement of agriculture technology mostly based on the internet, implementing "the future of work" in this sector would focus on utilizing smartphones rather than using smart machines on land farms. Thus, the current trend of innovation in agriculture highly relies on smartphones and artificial intelligence for various purposes, such as accessing information, marketing, and conducting transactions. Other than that, such technology is less costly and more affordable, which could enable smaller-scaled farmers in Indonesia to implement this feature. This is shown by an increasing number of agriculture start-ups starting to provide services on smartphone-based apps, reflecting high market demand and profitable business in this sector. According to Soegoto & Faridh (2020). There are three types of agro-start up in Indonesia: e- Agriculture, m-Agriculture, and telle-agriculture. E-Agriculture is an agricultural service that is developed utilizing information and communication technology, which is required to access this service via computers and the internet. M-Agriculture, on the other hand, is a subset of e- Agriculture that provides services via cell phones and other cellular-based technology. Finally, tele-Agriculture refers to agriculture-related services offered with agronomic participation via electronic communication.

In the level of implementation, this technology can help farmers to get early-warning weather information, digital credit, and market to sell their products. In addition, personalized advising services on demand can be provided via mobile phones. One of the best examples of the "early" adoption of automation is a start-up called Habibi Garden. This start-up assists farmers with digital platforms and the Internet of Things. Habibi Garden can assist farmers in remotely monitoring and maintaining their fields and crops by connecting sensors and irrigation systems in farms to the internet and delivering data based on machine learning. This will reduce the time farmers spend on their land. As it is a common practice in Indonesia that traditional farmers work from morning until night, it is highly likely to change in the future. With automation, farmers could efficiently automatize a big proportion of their work, such as planting, fertilizing, herding, etc. As a result, the time spent on farming would be shorter, and farmers would have more freedom to allocate their time to non-work-related matters, which could improve their quality of life. Two other transformations affected by automation in agriculture are harvesting and marketing. For the harvest, one of the notable examples of improvements due to automated systems is irrigation.

The automated irrigation system enables farmers to analyse data on weather, humidity, etc., to generate recommended schedules of time and amount of irrigation depending on the crop types and growths in real-time. In Indonesia, this feature is beneficial for farmers to find information on suitable times (weather conditions) before starting to plant. Moreover, in determining the amount and the time of irrigation, low-cost microprocessor and infrared sensor systems automatically measure water delivered and farming chemicals used to control and optimize the irrigation process and fertilization. Due to its

integrated nature, automation could effectively reduce farmers' workload and improve data-based optimization in productivity (for instance, to adapt crops' needs and monitor and forecast their growth) throughout the farming processes.

Moreover, automation could also enhance marketing processes for farmers to promote and sell their products. This is done by connecting producers (farmers) to distributors (suppliers, wholesalers, agents, and retailers) and customers. For example, Indonesian agri-apps, Sayurbox, provides an online-based grocery platform for consumers to select their fresh produce, which is then procured directly from nearby producers and delivered to the customers' doorsteps. Other than its practical benefits and convenience, this technology could also be advantageous in reducing ineffective marketing strategies like long chains of mediators. It is because customers are able to select and purchase the products of their choice directly from the producers. That way, consumers could avoid paying additional costs from distributors for transportation, maintenance, and others.

Future of Work Implication in Future Indonesia Agriculture

The effects of automation may be slow at the macro level. However, they may be relatively swift at the mid or micro level, especially for companies with more significant capital to invest in technology. Smaller firms will struggle to compete in the future unless the government makes a clear commitment to "mainstreaming the use of technology" and provides more funds. Otherwise, they can make use of so-called automation. As a result, it may widen the social divide, accelerate urbanization, and cause other issues.

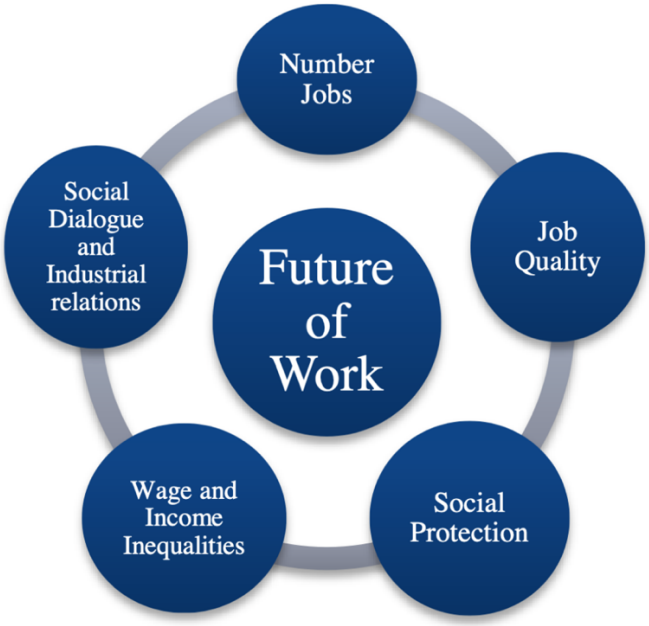

Figure 3: The Future of Work Implication
Source: Balliester & Elsheikhi (2018)

Balliester & Elsheikhi (2018) provide a framework to address the impact of automation in agriculture. This article employs five aspects (see Figure 1): the future of jobs, their quality, wage and income inequality, social safety systems, and social dialogue and industrial relations. The future of jobs relates to job creation, job destruction, or the future labour force composition. In contrast, the future of

job quality is concerned with topics such as future working conditions and the long-term viability of social protection programmes. Wage and income inequality discussions are concerned with both the average rise of wages and earnings - as well as their future distribution among families. Finally, the future of social dialogue and industrial relations refers to how organized labour institutions may evolve in the next years in the face of such change drivers.

a) Number of Jobs

Despite the many challenges of adopting automation in the agriculture sector, Indonesia is already on track to embrace the future of work. Contrary to popular belief, which puts the farming sector at the highest risk of losing jobs, adopting technology will improve the number of jobs in the country. Currently, most of the jobs in the agriculture sector are done manually, which does not require a lot of skills and is less competitive, making the jobs in this sector remain the same or even decrease. If automation could be implemented, it would create new typed jobs that can be done outside the farming area. Using machines, for instance, will generate jobs from maintenance to nurturing artificial intelligence. Indeed, specific skills are required to do this kind of job, resulting in a more polarised job in the future. According to McKinsey (2019), the growth in demand for work will outnumber the jobs lost due to automation. Automation even will lead to the expansion of many sectors. However, the gained benefits are not without loss. Although the number of jobs in agriculture will increase, or at least remain stable, policymakers and institutions must ensure that those jobs will let either men or women participate equally. Women have pivotal roles in maintaining and preserving the agriculture sector in Indonesia. Therefore, the increasing number of jobs should be followed by the equal participation of women and men.

b) Job Quality

As mentioned earlier, it is clear that automation technology brings many benefits, including improving job quality and the nature of the farmer's work. Automation may reduce working tasks, increase effectiveness, and thus improve the quality of work (McGuinness et al., 2019; Klenert et al., 2023). Farmers could improve their well-being while maintaining their land. In short, technology will increase labour market productivity and enhance farmers' opportunities to maintain a healthy balance between their personal and professional lives. In the long run, this will also improve the human development index in Indonesia. However, highly automatable jobs will likely have lower levels of job satisfaction and health (Liu, 2022). Therefore, it is important not to be 'blinded' by the advantages only but rather to make the most of technologies while improving and acquiring more skills simultaneously. In addition, a high job quality should also consider the best qualities for all workers despite their background and identity differences.

c) Social Protection

Currently, social protection schemes are predominantly related to the formal labour sector, while small farmers are often not included in any scheme. This happens because most small farmers are self-employed and have limited access to health insurance. If the farmer's welfare could be improved through automation, it would also mean improving the farmer's contribution to existing social security. Moreover, this will also increase government revenue from taxes. In short, the improvement of small farmers' lives could be a catalyst for future social security in Indonesia. Additionally, the gender perspective or framework should be included in the social protection discussion. As Asriani and Ramdlaningrum (2019) highlight, women play significant roles in Indonesian agriculture. However, women working in agriculture are often not protected with legal protection and do not have access to welfare and social security, resulting in exploitation and lack of support (Asriani & Ramdlaningrum, 2019). Integrating the gender perspective into social policies will help farmers from various backgrounds survive in this transformational era.

d) Wage and Income Inequality

The farmer's disparity of education and skills will be determinant factors that influence their income. Farmers with high education and financial capacities will quickly adopt technology in the process, while small farmers with small resources will find it hard to complete. The development gap between East and West Indonesia will have a more negative impact on this sector. As a result, if the government does not have adequate support for the small farmer, especially in the undeveloped region, it may lead to wage and income inequality. The inequality arising from automation needs institutional changes and interventions (Willcocks, 2024). This issue also reminds us of the need to solve the problems of the digital divide and digital literacy. Internet and digital platforms have been seen as opportunities to remove space and time and connect to each other. However, Indonesia is still facing a digital divide until now, and not all areas have the same access and facilities. Furthermore, people still need digital literacy skills, encompassing critical and functional skills. As mentioned above, both issues will prevent framers from getting decent wages and incomes. In addition, this inequality should also be viewed from the intersectional lens to take into aspects such as income levels, gender, race, class, and other visible minorities (Petersen et al., 2022; Croucher et al., 2018). Intersectionality acknowledges the complexities and differences of each individual or group. Automation and the future of work are affecting groups and individuals as Indonesia itself still depends on the agriculture sector. Therefore, it is necessary to include an intersectional lens in dealing with wage and income inequality.

e) Social Dialogue and Industrial Relations

As mentioned earlier, agriculture in Indonesia is dominated by small farming, making the future of work and the adoption of automation will be quite different compared to affluent countries. Due to the current development of technological information in Indonesia, it could bring more cooperative relations between small farmers and corporations. The government also focuses on implementing automation in the private sector to help farmers. Collaboration seems to be a new norm due to the digital age. The collaboration should adjust the current circumstances in order to respond to automation and the future of work in agriculture. Still, the chance for big fish to eat small fish is still possible in the future. This condition may lead to injustice; thus, ethics, principles of inclusiveness, equity, and humanity should apply. Current and future policies must benefit not only the government and corporations but also farmers or people from the lower middle classes who work in farming or agriculture. Civil society also can play roles in following the changes and dynamics, and in advocating the needs of farmers and small farming.

CONCLUSION

In a nutshell, agriculture remains the backbone of Indonesia's economy despite the number of people who are willing to work in this sector declining. Automation or machine seems to be not replacing human labour in this sector due to the current demography of Indonesia, which is dominated by productive age**.** Not to mention, the wage is still low and seems to be a better investment in certain contexts rather than fully adopting automation technology. The agriculture sector will not entirely adopt automation in the near future, especially in mechanization. There are several factors affecting this, namely expensive cost, people's high reliance, the smallholder-dominated farming sector, and big implementation challenges. The use of technology is more inclined as the 'partner' role rather than the substitute of human labour. However, it is important for the government to increase the interest of young people in this sector because of its high possibility of being overtaken by machines or robots. Despite Indonesia's slow adoption on agriculture automation. The current state of automation has changed the nature of the farmer's work. Especially in terms of working time and selling product. This is a result of Indonesia's thriving digital economy during the past decade. In long term, the technology not only helps farmers enhance their productivity but also their well-being, which is a win-win for everyone involved. This may lead to better

social protection, social dialogue, and industrial relation along with the other following issues such as number of jobs, the quality of those jobs, equal participation, and decent wage or income.

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