# Analysis of the Economic and Social Impact Study of the Application of Artificial Intelligence in the Agricultural Sector: A Multidisciplinary Study

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**A B S T R A C T**

**Introduction:** Agriculture is an important sector in the global and national economy. Artificial intelligence (AI) has great potential to increase the efficiency and productivity of the agricultural sector. This research aims to analyze the economic and social impacts of implementing AI in the agricultural sector. **Methods:** This research uses a multidisciplinary study method, combining qualitative and quantitative approaches. Data was collected through surveys, interviews, and secondary data analysis. **Results:** The application of AI in the agricultural sector can increase efficiency and productivity. AI can help farmers in various aspects, such as land processing, fertilization, pest control, and harvesting. The application of AI can create new jobs in the agricultural sector. However, the application of AI can also have several social impacts, such as unemployment and the digital divide. **Conclusion:** The application of AI in the agricultural sector has great potential to increase efficiency, productivity, and employment. However, it is important to consider the social impacts of implementing AI and formulate appropriate policies to address it.

## 1. Introduction

In the midst of the hustle and bustle of the modern world, the agricultural sector still plays a crucial role in the global and national economy. As a source of food and industrial raw materials, this sector is the basis of life for the majority of the world's population. In Indonesia itself, the agricultural sector's contribution to the national gross domestic product (GDP) will reach 13.22% in 2023. This figure reflects the vital role of the agricultural sector in supporting the nation's food security and economic stability. More than just statistics, the agricultural sector is the lifeblood. Farmers, as the main actors in this sector, work hard to cultivate the land, plant seeds, and care for plants with full dedication. Their harvests are not only an economic commodity but also a symbol of struggle and hope for a better life.[1-3]

However, the agricultural sector is not free from various challenges. In the modern era, climate change, plant pests, and limited natural resources are obstacles that must be faced. On the other hand, technological developments present new opportunities to increase the efficiency and productivity of the agricultural sector. One promising innovative solution is the application of Artificial Intelligence (AI) in the agricultural sector. AI has great potential to help farmers in various aspects, from land processing, fertilization, and pest control to harvesting.[4-6]

AI can help farmers automate time- and labor-consuming tasks, such as watering, fertilizing, and pest control. This allows farmers to focus on other more important aspects, such as strategy development and financial management. AI can help farmers analyze data and make more informed decisions

regarding crop management, such as selecting the right crop varieties, optimal planting times, and appropriate fertilizer doses. AI can help farmers predict and overcome various risks, such as plant pests and climate change. This can help improve food security and ensure the availability of a stable food supply. Although AI offers various benefits, it is important to also consider the economic and social impacts of its application in the agricultural sector. An in-depth study of the impact of AI can help maximize its benefits and minimize potential risks.[7-9] This research aims to analyze the economic and social impacts of implementing AI in the agricultural sector.

## 2. Methods

This research uses a multidisciplinary study method, combining qualitative and quantitative approaches. This approach was chosen to gain a more comprehensive understanding of the economic and social impacts of implementing AI in the agricultural sector. Data collection was carried out by: 1. Survey: Conducted on 100 farmers in West Java and Central Java. Samples were selected randomly from the list of farmers registered with the local agricultural department. The survey instrument is a questionnaire containing questions about the use of AI in the agricultural sector (types of AI used, benefits of AI, and obstacles in using AI), Impact of AI on efficiency and productivity (changes in processing time, production costs and crop yields), Impact AI on employment (changes in the number of workers and types of work). 2. Interviews: Conducted with 20 AI experts and agricultural experts. AI experts are selected from academics, researchers, and practitioners in the field. Agricultural experts are selected from academics, researchers, and practitioners in the agricultural field. The interview guide contains questions about the potential and challenges of AI in the agricultural sector, the Economic and social impacts of implementing AI in the agricultural sector, and Policies needed to support the application of AI in the agricultural sector. 3. Secondary data analysis: Carried out to obtain information about trends in the use of AI in the agricultural sector in various countries, the impact of AI on the economy and society in other countries, and policies implemented in other countries to support the application of AI in the agricultural sector.

Data analysis was carried out using descriptive statistics and statistical tests. Interview data was analyzed using content analysis. Secondary data was analyzed using descriptive methods. Data validation was carried out using triangulating methods and data sources. The triangulation method was carried out using a combination of surveys, interviews, and secondary data analysis. Triangulation of data sources was carried out by involving AI experts and agricultural experts from various backgrounds. This research was conducted by paying attention to research ethics, where this study obtained consent from respondents before conducting surveys and interviews and maintained the confidentiality of respondent data.

## 3. Results and Discussion

Table 1 shows the impact of AI on efficiency and productivity in the agricultural sector. AI can help farmers in various aspects, from land processing, fertilization, and pest control to harvesting. AI can increase the efficiency and accuracy of land processing by mapping land, analyzing soil fertility, and selecting the right plant varieties automatically. This helps farmers save time and costs, as well as increase crop yields. AI can help farmers determine the right fertilizer dose and optimal fertilization time-based on plant and soil conditions. This helps farmers optimize fertilizer use, minimize environmental pollution, and increase crop yields. AI can help farmers detect pests and plant diseases early and determine appropriate control methods. This helps farmers control pests and plant diseases more effectively and efficiently and minimizes the use of pesticides. AI can help farmers estimate the right harvest time and harvest crops more efficiently. This helps farmers improve the quality of their crops, minimize crop losses, and increase profits.

Using drones to map land and analyze soil fertility can save time and costs by up to 50%. This helps farmers optimize land use and increase crop yields. The use of sensors to detect pests and plant diseases can increase the effectiveness of controlling pests and plant diseases by up to 80%. This helps farmers reduce the use of pesticides and improve the quality of their crops. Using robots to harvest crops can increase harvest efficiency by up to 30%. This helps farmers minimize crop losses and increase profits.

Table 1. Impact of AI on agricultural sector efficiency and productivity.

| Aspect | Impact of AI | Information |
|--------|-------------|-------------|
| Land processing | Increase efficiency and accuracy | AI can map land, analyze soil fertility, and choose the right crop varieties automatically. |
| Fertilization | Increasing efficiency and optimizing fertilizer use | AI can determine the right fertilizer dose and optimal fertilization time based on plant and soil conditions. |
| Pest control | Increase the effectiveness and efficiency of pest control | AI can detect plant pests and diseases early and determine appropriate control methods. |
| Harvest | Increase efficiency and crop yields | AI can estimate the right harvest time and harvest crops more efficiently. |

The application of AI in the agricultural sector not only increases efficiency and productivity but also opens up new opportunities for job creation. Table 2 shows several examples of employment types impacted by AI in the agricultural sector. The development of AI in the agricultural sector requires experts to develop, implement, and maintain it. This opens up new opportunities for professionals in the fields of information technology, computer science, and robotics. Although AI can automate some tasks in the agricultural sector, the role of farmers will not be completely replaced. AI actually helps farmers become more efficient and productive so they can focus on other, more important aspects of crop management. AI can help optimize logistics and agricultural supply chains. This increases the demand for workers in the logistics sector, such as truck drivers, warehouse operators, and logistics experts. AI can help increase the efficiency of processing agricultural products and create new products with high-added value. This opens up new opportunities in the field of agricultural product processing, such as the development of functional food products and nutraceuticals. Developing an AI platform to help farmers manage crops requires AI experts to design and develop AI algorithms, build and maintain the AI platform, and provide training and support to farmers in the use of the AI platform. Using robots to harvest crops can help farmers save time and effort so they can focus on controlling crop pests and diseases, fertilizing and watering crops, and marketing crops. The use of AI to optimize supply chain logistics can help reduce costs and increase the efficiency of agricultural delivery, improving the visibility and traceability of agricultural products. The use of AI to develop new products, such as functional foods and nutraceuticals, can increase the added value of agricultural produce and meet the growing market demand for health and wellness products.

Table 2. Application of AI and its impact on employment in the agricultural sector.

| Type of workplace | Impact of AI | Information |
|-------------------|-------------|-------------|
| AI experts | Increase demand | AI requires experts to develop, implement, and maintain it. |
| Farmer | Increase efficiency and productivity | AI can help farmers automate time- and labor-consuming tasks so they can focus on other, more important aspects. |
| Logistics | Improve supply chain efficiency | AI can help optimize logistics and agricultural supply chains. |
| Processing of agricultural products | Increase efficiency and added value | AI can help increase the efficiency of processing agricultural products and create new products with high-added value. |

The application of AI in the agricultural sector not only brings benefits but can also have several social impacts that need to be considered. Table 3 shows several examples of social impacts that can occur as a result of implementing AI in the agricultural sector. AI has the potential to replace several jobs that have been done by humans, especially routine and repetitive jobs. For example, the use of robots to harvest crops can cause job losses for farmers who have been harvesting crops manually. This can increase unemployment rates and worsen poverty problems in rural areas. The application of AI could widen the gap between farmers who have access to AI technology and farmers who do not. Farmers who have access to AI technology, such as AI platforms for crop management and harvesting robots, can increase their crop yields and profits. Meanwhile, farmers who do not have access are left behind in this regard and are increasingly falling behind the competition. This can worsen social inequality in the agricultural sector. Large companies' use of AI could increase the concentration of power in the agricultural sector. Large companies that have access to AI technology can dominate the market and make it difficult for small farmers to compete. This can threaten food security and hinder rural economic development. Some people may not trust AI and fear its impact on their work and lives. Farmers may fear that AI will take over their jobs and make them lose their livelihood. This distrust and fear could hinder the adoption of AI in the agricultural sector and slow technological progress.

Table 3. Social impact of implementing AI in the agricultural sector.

| Social impact | Description | Example |
|---|---|---|
| Unemployment | AI can replace some of the jobs that humans have done. | The use of robots to harvest crops can cause job losses for farmers who have been harvesting crops manually. |
| Digital divide | The application of AI could widen the gap between farmers who have access to AI technology and farmers who do not. | Farmers who have access to AI technology can increase their yields and profits, while farmers who do not have access are left behind in this regard. |
| Concentration of power | Large companies' use of AI could increase the concentration of power in the agricultural sector. | Large companies that have access to AI technology can dominate the market and make it difficult for small farmers to compete. |
| Distrust and fear | Some people may not trust AI and fear its impact on their work and lives. | Farmers may fear that AI will take over their jobs and make them lose their livelihood. |

The research results show that the application of AI in the agricultural sector has great potential to increase efficiency, productivity, and employment. This finding is in line with several previous studies that have been conducted in various countries. AI can help farmers automate various tasks, such as land cultivation, fertilization, pest control, and harvesting. This can increase efficiency and save production time and costs. AI can help farmers improve crop yields and product quality in a more precise and measurable way. For example, AI can help farmers determine the right planting and harvest times, as well as optimal fertilizer and pesticide doses. The application of AI in the agricultural sector can create new jobs in the field of AI technology development. AI can increase the economic value of the global agricultural sector by up to $950 billion by 2030. AI can help increase crop yields in developing countries by up to 20%. AI could create up to 10 million new jobs in the global agricultural sector by 2030.[10-15]

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## 4. Conclusion

The application of AI in the agricultural sector has great potential to increase efficiency and productivity. However, it is important to consider its social impact and formulate appropriate policies to address it.

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