To What Extent Will Artificial Intelligence in Agriculture Benefit Vietnam's Economy?

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ABSTRACT

This paper explores the impact of artificial intelligence on Vietnam's economy when implemented in certain subsectors of agriculture. The rice, cashew nut, and coffee subsector will be analyzed to identify any problems that are already present, and what the effect of artificial intelligence will be on those specific subsectors. Artificial intelligence can be used in rice farming to help regulate salination levels, preventing any crop failure. In the cashew nut subsector, artificial intelligence can be used to grade the nuts, creating an appeal for something quantifiable and objective. In the coffee subsector, artificial intelligence can be used to monitor coffee trees and to identify defects.

INTRODUCTION

Agriculture is the practice of growing plants or raising animals. The invention of agriculture—which allows people to grow crops and raise domesticated animals to provide excesses of food—was crucial in the growth of sedentary human civilization. In this paper, the past meets the future. We will be investigating the economic impacts of the introduction of artificial intelligence in agriculture in Vietnam by studying the top agricultural sectors in the country, and analyzing the effects when artificial intelligence is implemented.

LITERATURE REVIEW

What is artificial intelligence? Over the years, the term has been defined as many different concepts, ranging from artificial neural networks, machine learning systems to prediction engines (Dick 2019). In this paper, artificial intelligence will be defined as all of the above. Artificial intelligence is now being used throughout the world because of an increase in demand for agricultural products, as established and conventional methods can no longer keep up with rising demands. With sensors and other tools built into robots and drones, artificial intelligence is utilized in agriculture for irrigation, weeding, spraying, and more (Telaviya *et al.* 2019). These technological applications help ensure final yields can be maximized. AI not only helps improve the quality of the product but also enables farmers to have more control over their crops. The integration of AI in agriculture might present more problems, but beneath those adverse effects are opportunities to reduce food waste, save time and money, and more (Telaviya *et al.* 2019; Smith 2020).

In 1990, 70 percent of Vietnam's labor force congregated in the agriculture industry. By 2008, this number had decreased dramatically, from 73 percent to 54 percent (McCaig and Pavcnik 2013). Although the employment rate for this sector has gone down, Vietnam continues to be reliant on agriculture. Agriculture contributes to approximately 21% of Vietnam's annual GDP (Nguyen *et al.* 2021). Furthermore, through analyzing the effects of Vietnam's exports in the last 25 years, Nguyen has discovered that an increase in exports in a year positively impacts the GDP growth of that year and two subsequent years (2016). Another thing that impacts the exports of Vietnam is having an affiliation with the World Trade Organization, of which Vietnam became a member in 2006. This membership facilitated Vietnam's access to international markets for its agricultural exports, leading to an increase in demand for its

products and resulting in GDP growth. With access to WTO comes economic development, which leads to an increase in GDP (Nguyen *et al.* 2021).

ANALYSIS

Vietnam is one of the biggest rice, cashew nut, and coffee exporters in the world. The country's success in the field of rice farming is attributable to higher crop intensities and irrigated area. Cropping intensity is the amount of crops a farmer produces on the same land within a specific agricultural year. For Vietnam, rice has one of the highest cropping intensities, and any rice that is not consumed domestically is sold on less-selective international markets. Along with coffee, which is widely produced at high elevations in the northern mountain regions and central highlands, Vietnam is also one of the world's top exporters of cashew nuts. More focus was placed on quality for high-value crops such as those mentioned above, in order to satisfy global consumer demands.

RICE PRODUCTION

Rice is the most important crop in Vietnam. Its cuisine is centered around rice. Every carbohydrate option in a Vietnamese meal contains either rice, rice flour, or some other derivatives of rice. As a result, there are 15 million rice farmers in Vietnam, and rice farming accounts for 82% of the total cultivated land area in Vietnam (Cultivating Rice and Sustainable Farming Practices in Vietnam, 2019). In 2019, around 6.4 million metric tons of rice was exported from Vietnam, resulting in a revenue of 2.8 billion USD (Agriculture, Natural Resources and Rural Development Sector Assessment, Strategy and Road Map, 2022). These days, rice cultivation in Vietnam has become more challenging. Rising sea levels have been disrupting farmlands all over Vietnam. Seawater has caused a considerable increase in the salination level, which lowers soil fertility. This results in rice not being able to grow in at least one-third of the 72-kilometer coastline of Soc Trang province, where the whole coastline is dedicated to rice farming. Struggling farmers have had to switch to other subsectors of agriculture, more specifically shrimp farming. Despite its many short-term benefits such as above-average cash flow, in the long run, shrimp farming will not be sustainable for the land. This is because the farmers have to dig ponds for shrimp, which excavates the uppermost layer of soil that contains all the nutrients (Cultivating Rice and Sustainable Farming Practices in Vietnam, 2019). With all the nutrients gone, the soil becomes infertile. As farmers continue to switch to shrimp farming, the land famous for its fertile soils will not be able to sustain any plant life. However, there is a solution that can enable farmers to maintain their current practices. Artificial intelligence will be used as an artificial neural network to desalinate water. Artificial intelligence-based desalination systems not only have the highest efficiency and lowest cost, but they will also free up human resources. These systems can desalinate the water either by using physical methods such as vapor compression or chemical methods such as ion exchange (Hu *et al.* 2021). The integration of desalination systems will both help to reverse the effects of the rising sea level and prevent farmers from having to adapt agricultural practices that may damage soil. Furthermore, these systems can help with regulation of saltwater as well, ensuring a perfect salination level, which will lead to higher quality rice and more exports.

CASHEW NUT PRODUCTION

The cashew subsector, previously one of Vietnam's most profitable industries, is now seeing a steady decline. In 2019, the country exported 455,563 metric tons of cashew nuts and gained 3.3 billion USD in revenue (Agriculture, Natural Resources and Rural Development Sector Assessment, Strategy and Road Map, 2022). Within the first five months of 2022, cashew nut's export saw a decrease both in volume and price, dropping by 7.81% and 6.81%, respectively. This is due to a variety of reasons, including pests, diseases, and climate change, which raised the cost of processing raw cashews (Cashew Industry Faces Huge Challenges, 2022). Since the processing of cashews in Vietnam is already

autonomous, there are very few possible ways to implement artificial intelligence to reverse this declining market. One attempt would be to introduce an autonomous cashew grading machine. This machine uses image recognition to classify cashews into one of 26 international export quality grades (Aran *et al.* 2016; Shyna and George 2017). This will increase customer demand because of the objective grading scale, which, at the most, might compel countries to buy more cashews because of Vietnam's excellent export quantity and quality. The implementation of artificial intelligence may not be the one-stop solution to Vietnam's cashew crisis, but it will certainly help mitigate the decline.

COFFEE PRODUCTION

Vietnam is the world's second largest producer of coffee, contributing to around 20% of the world's coffee production (Shahbandeh 2022). The country exported 1.7 million metric tons in 2019 alone. This resulted in a massive revenue of 2.9 billion USD (Agriculture, Natural Resources and Rural Development Sector Assessment, Strategy and Road Map, 2022). Given the industry's importance to Vietnam's economic growth, it certainly needs further improvements to remain competitive in the global market. A way to increase revenue in the coffee subsector is automation. Precision agriculture is a type of automation that helps provide farmers with accurate data on their crops. They can then use this data to make the decisions that will help maximize profits. This type of precision agriculture presents itself in the form of Unmanned Aerial Vehicles (UAVs). These UAVs have sensors that are controlled by artificial intelligence to report many different types of information about coffee fruits. The information can include: harvestability, weight, maturation, and yield (Liakos *et al.* 2018; Barbosa *et al.* 2021). Another type of application of artificial intelligence is real-time classification. This machine uses image recognition to identify defects in coffee beans. There are several vision sorting systems on the market right now. These methods mostly employ color to discern defects in green coffee beans. For these systems, which need a robotic arm to pick out the beans, a range of colors must be established, making it ineffective. For the system using artificial intelligence, a high-resolution IP camera uses an artificial neural network to identify green coffee beans with defects as they travel through the conveyor belt. An air gun is then used to separate the normal beans from the defects, making this system completely autonomous (Huang *et al.* 2020). Not only are the aforementioned applications cheap and effective, but they are completely autonomous. Automation is crucial in agriculture because it provides higher quality and healthier crops, and a higher production rate. All these factors contribute to lowering the cost and maximizing revenue, which leads to a higher return on investment. A higher revenue also means that Vietnam's GDP will have risen, improving the economy.

CONCLUSION

This paper looks into the current Vietnamese agriculture sector, and how artificial intelligence will impact the Vietnamese economy. We have found that, in the three crops that were investigated, two will benefit from the introduction of artificial intelligence. Rice farming can be saved by inhibiting saltwater contamination in the ricefields, and decreasing the risk of the spreading of infertile soil. This would lead to the improvement of the export of rice because of better quality control. The cashew nut subsector was already in a steady decline economically, and when artificial intelligence is applied, it might save the subsector marginally. Without the integration of artificial intelligence in the cashew nut subsector, it might decline even more. Coffee exports will increase with the introduction of artificial intelligence because automation improves quality and quantity while keeping costs low. Artificial intelligence should be implemented in the agriculture sector in Vietnam not only because of its economic benefits, but it would revolutionize Vietnam's view on the agriculture that has been the backbone of the country for decades.

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