UDC 33

IMPACTS OF THE INDUSTRIAL REVOLUTION 4.0 ON THE DEVELOPMENT OF AGRICULTURE IN THE MEKONG DELTA, VIETNAM TODAY

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Abstract. The Industrial Revolution 4.0, based on the achievements of the digital revolution, has contributed greatly in promoting the application of science and technology in production. These are favorable conditions for Mekong Delta agriculture to develop in an integrated manner, helping to improve the quality of growth, enhance competitiveness and create a favorable legal environment for businesses in production and business, in technology transfer and innovation. The impacts of Industrial Revolution 4.0 on agriculture will change the way of managing agriculture, from production, processing, exchange to consumption. Achievements of the digital revolution can be applied to all of these stages in order to save input materials, lower production costs, ensure food safety and limit environmental pollution in the Mekong Delta in the future.
Keywords: The Industrial Revolution 4.0; digital revolution; legal environment for businesses.

1. The Industrial Revolution 4.0 and agriculture in the Mekong Delta of Vietnam

1.1. Overview of the world industrial revolutions and the Industrial Revolution 4.0

Over the past 250 years, humankind has witnessed and experienced three industrial revolutions that has brought about tremendous changes. The First Industrial Revolution took place around 1784 with the use of water and steam power and production mechanization. In this revolution, production methods changed from manual to mechanical thanks to the invention of the steam engine. This revolution created higher labor productivity, even dozens, hundreds of times higher than preceding manual labor. Moreover, the First Industrial Revolution also showed the possibilities of performing many tasks which could not be done before if using just human and physical strength.

The Second Industrial Revolution took place from about 1870 to the outbreak of World War I with the use of electric power and the introduction of large-scale mass production lines (electricity, transportation, chemicals and steel production). This revolution set new premises and solid foundations for developing the industry at a higher level. Countries' economies changed rapidly thanks to the Second Industrial Revolution and labor productivity increased hundreds and thousands of times higher than small-scaled production.

Human's next breakthrough was the formation of the Third Industrial Revolution in the 1970s with the introduction of automated manufacturing based on computers, electronics and the Internet. This revolution created a relatively new production method compared to the past and labor productivity also increased dramatically. Some tasks originally done by human could be replaced by machines. Human lifestyles, habits, and cultures also changed and developed accordingly.

The Fourth Industrial Revolution (also known as the Industrial Revolution 4.0) which is being formed on the basis of the Third Industrial Revolution, began to appear in the middle of last century. This revolution is a combination of technologies to create resonance between the fields of physics, digital and biology. The Industrial Revolution 4.0 is built based on digital revolution, characterized by the Internet which is increasingly popular and mobile. It is a trend of combining real and virtual systems, Internet of

Things (IoT) and Internet systems (IoS). Nowadays, digital technologies with computer hardware, software and network systems are becoming more and more complex and integrated, thus making profound and deep change to human society. Economically, this revolution is expected to redraw the world's economic map with the strong rise of countries developing mainly based on modern technology, innovation and creativity; on the other hand, countries that rely heavily on resource exploitation will diminish their power and gradually lose the position. The Industrial Revolution 4.0 has a profound impact on production, consumption, business organization and creativity; creating state-of-the-art goods and services such as service robots, self-driving cars, drones, remote surgery..., which used to be considered to be impossible.

It can be seen that the Industrial Revolution 4.0 opens up many opportunities and also poses challenges for every country, organization and individual. In Vietnam, it has been affecting strongly and increasingly all economic sectors and social life. Recently, the Party and State of Vietnam have directed all levels and sectors to promote the application and development of science, technology and innovation, do research and improve access capacity so as to actively participate in Industry 4.0. In particular, on September 27, 2019, the Politburo issued Resolution No. 52-NQ/TW on a number of guidelines and policies to actively participate in the Fourth Industrial Revolution. The Resolution identifies that Vietnam needs to take full advantage of the opportunities brought about by the Industrial Revolution 4.0 in order to accelerate the process of renewing the growth model, restruct the economy associated with the implementation of strategic breakthroughs and nation modernization; strongly develop the digital economy; develop fast and sustainably based on science-technology, innovation and high-quality labor; improve the quality of life and welfare of the people; ensure national defense and security, protect the ecological environment.

1.2. An overview of the Mekong Delta and agricultural sector in the Mekong Delta

Overview of the Mekong Delta

The Mekong Delta is a large delta, rich in ecology and fertile alluvial soils, with mountains, forests, and numerous rivers. The boundary of the Mekong Delta is delimited by: the North borders Cambodia; the East borders Vam Co River, Ho Chi Minh City; the South borders the East Sea; and the West borders the Gulf of Thailand. It is located in the end part of the Mekong river basin and is the southernmost point of Vietnam. The Mekong Delta consists of Can Tho City and 12 provinces: Long An, Dong Thap, Tien Giang, Vinh Long, Tra Vinh, An Giang, Bac Lieu, Ca Mau, Kien Giang, Soc Trang, Ben Tre and Hau Giang.

Provinces and cities in the Mekong Delta are home to many ethnic groups, including 4 main groups: Kinh, Hoa, Khmer and Cham. Therefore, the culture here is very diverse and plentiful, expressing Vietnamese cultural identity and showing the culture integration at once. Apart from religions introduced from the outside such as Buddhism, Catholicism, Islam, Protestantism, in the Mekong Delta, there are other religions appearing only in areas with obvious local nuances such as Buu Son Ky Huong, Tu An Hieu Nghia, Cao Dai, Hoa Hao.

According to the General Statistics Office, the population of the Mekong Delta is currently about 16.2 million people (accounting for 23 % of the national population), with 82 % of the population living in rural areas and 18 % in urban areas. The economic structure of the Mekong Delta shifts towards agriculture – industry and services sectors, with a tendency of increasing proportion of industry and services and reducing proportion of agriculture. Over the past time, the economic structure in the whole region has changed but still focuses mainly on agriculture while industry and services account for only a small proportion with a slow upward trend.

Agriculture in the Mekong Delta

Firstly, the agricultural economy of the Mekong Delta ranks first in the country in terms of area, output and value. Currently, the Mekong Delta provinces have the leading agricultural land area in the country, with 2,606.5 thousand hectares (equivalent to 25.53 % of the whole country). The agricultural production value of the region accounts for 33.3 % (in 2011) of the national agricultural value, 1.91 times higher than that of the Red River Delta; 2.28 times higher than that of the North Central and South Central Coast region; 3.24 times higher than that of the Northern Midland and Mountainous area and 3.19 times higher than that of the Southeast region ...

Secondly, the Mekong Delta is the largest orchard of the country with many popular specialties. Provinces in the Mekong Delta have an area of nearly 300,000 ha, with a total production of over 3 million tons of fruits per year. Fruit exports in the Mekong Delta are well-developed with the expansion of export markets across many continents. Currently, there are over 30 kinds of specialty fruits with high economic value such as: Hoa Loc mango, green pomelo, Nam Roi pomelo, dragon fruit, durian, longan, Mac Bac sapodilla, banana, pineapple, citrus fruits... that are grown following VietGAP and GlobalGAP standards. In the coming time, the development of fruit trees in the Mekong Delta is associated with the focus on developing processing industry and consumption market. At the same time, the selection of key fruit trees with high productivities and competitiveness is also paid attention with a favorable investment policy to develop specialized cultivation areas and build brand for each product.

Thirdly, the fishing economy is a key sector of the region. Fishery production of the Mekong Delta provinces currently accounts for more than 56.62 % of the country's total fishery production, capture fishery production accounts for 39.97 %, and aquaculture area accounts for 72.00 %. The fishing economy contributes 30–35 % to the GDP of the agriculture-forestry-fishing sector, with the growth rate of production value reaching 8–10 % per year. Fishing export turnover reaches 8–9 billion USD. The total fishery products reaches 6.5–7 million tons, of which aquaculture accounts for 65–70 % of total production. With this advantage, the fisheries of the Mekong Delta is a key economic sector with mass and highly competitive products, a large export turnover, capable of self-investing and developing, contributing significantly to the socio-economic development of the region.

Fourthly, the agricultural economy of the Mekong Delta region is facing climate change. Coastal forest ecosystem in the Mekong Delta plays a very important role in protecting the coast, the environment and supplying woods. It is also the living and production place of a part of coastal people. However, the ecosystem here is directly affected by climate change with severe consequences. Every year, coastal erosion in the region takes place at a relatively high speed (over 40m). The system of sea dykes and river estuary dykes is not strong enough to withstand the threat of natural disasters. The area and quality of the coastal mangrove belts is not guaranteed to protect the sea dyke system and prevent natural disasters. In addition, the mangrove deforestation for cultivation, aquaculture, forest exploitation and land use has not been controlled and is even increasing, significantly reducing the area and quality of mangroves. As a result, salinity intrusion occurs earlier and negatively affects the life and rice production activities of people, especially in coastal areas.

2. The role and impact of Industry Revolution 4.0 on the development of agriculture in the Mekong Delta, Vietnam at present

2.1. The role of technology 4.0 application in the development of agricultural products in the Mekong Delta, Vietnam at present

With the adverse events caused by climate change and environmental pollution, the agricultural industry in the Mekong Delta is facing a great challenge, forcing the region to change its ways of thinking and acting. In the new context, the region's agricultural production must be based on the application of technology, especially the high and the latest technology of the Industrial Revolution 4.0. The application of Industry 4.0 technology plays a huge role in the development of agricultural products in the Mekong Delta at present.

Firstly, increase productivity, output, quality and cost of agricultural products. The application of digital technology will assist the process of planning, calculating seasonal cost and sales, collecting, analyzing environmental information, and controlling equipment to keep the agricultural production environment follow the set procedure. Currently, the Mekong Delta has built cluster factories to process food, vegetables, catfish, shrimp... and promoted cooperation in developing systems of processing, drying and storage at the same time. The region also gives priority to investment and financial support for research, the transfer and application of modern and mechanized technologies; investment in research and processing by-products from farming and agricultural products. Local authorities have invested over VND 1,600 billion to support the implementation of more than 7,000 production models, contributing to improving production efficiency by 15–20 % [6].

Secondly, replace human labor and speed up some production stages, perform the functions of production, processing, transportation and market supply. This is the direct effect of science and technology in the role of application and replacing human labor. Industrial Revolution 4.0 contributes to applications in transporting agricultural products. Currently, although Vietnam is a major manufacturer and supplier of agricultural products in the world, about 40 % of the products are damaged during transportation, causing great waste for the economy. The successful application of Industry Revolution 4.0 will help to better control the transportation process, limit the damage rate of agricultural products, especially fruits and vegetables, aquatic products during transport .

Thirdly, create plant varieties and animal breeds with high quality and productivity. In recent years, the application of technology has helped create some high-yielding rice varieties such as Jasmine 85, OM4218, OM 6976 and OM 4900, fruit trees, some shrimp varieties with high yield and quality such as whiteleg shrimp, tiger prawn... In addition, Industry 4.0 creates technologies to prevent and eradicate diseases, clean technologies, preservation technologies to help increase the price of agricultural products when supplying to the market. The development of gene technology and biotechnology from the achievements of the Industrial Revolution 4.0 allows the Mekong Delta to create, build and form plant and animal breeds suitable for the intended use.

2.2. The impact of Industrial Revolution 4.0 on the development of agriculture in the Mekong Delta, Vietnam at present

Science and technology is considered as a breakthrough solution to develop a green and high value-added agriculture. In the process of applying science and technology in agriculture, the Industrial Revolution 4.0 creates valuable opportunity and new potentials for application for the Mekong Delta. However, the region is also facing many challenges.

Positive impacts:

Firstly, on process innovation.

Reality shows that the application of cloud computing in transporting agricultural products is very necessary. It helps control the truck temperature, prevent vegetables and seafood from being damaged during transportation. In addition, new innovations in the information technology can increase farmers' adaptability to changes by increasing access to weather and market information.

It is very essential for the Mekong Delta to apply Industry 4.0 technology achievements in serving the development of e-

government and smart cities, as well as solving relevant issues in dealing with climate change, increasing production and export agro-fishery products.... The application of smart technology has helped to exchange, connect and provide information from manufacturers, businesses to the researchers and to the places with available technology to help agriculture and fisheries be smarter and more efficient, develop sustainably.

In the development of agriculture, the Mekong Delta is a major source of food, fruit and fisheries, playing an important role in the nation's food security and export strategy for rice and aquatic products. Annually, the Mekong Delta provides 95 % of rice export and 60 % of fisheries exports. It is also one of the largest specialty fruit growing areas for domestic and export demand [7]. In the past time, specialty rice varieties has been introduced for cultivation, a part of traditional rice area has been replaced with high-value vegetables, fruit trees. The Mekong Delta also promotes the "four linkages" strategy to syndicate agricultural products by expanding links with processing centers in the region and across the country, contributing to improving the value of agricultural products. The linkage is one of the important solutions to build a comprehensive and sustainable commodity agriculture in the Mekong Delta.

In the field of cultivation, the structure of plants and crops shifted strongly towards commodity production suitable to each region's advantages and adapt to climate change. In the restructuring of crop production, the basic trend is to diversify crops to gradually reduce the monoculture situation, especially rice; gradually increase the proportion of other crops with economic efficiency, especially industrial crops, fruit trees, specialty plants, vegetables, beans, onions, garlic, ornamental plants of high economic value. The structure of rice crop in the Mekong Delta region has changed in the direction of increasing the area of Winter – Spring crop, reducing the area of Summer – Autumn crop, increasing productivity and quality of rice, increasing economical efficiency of rice cultivation area. Local long-day rice varieties adapted to deep water such as VND 404, VND 95-19, MTL 250, MTL 392, MTL 449, OM 4498, OM 2395, OM 1257, OM 3405, Nang thom, Nang Huong are fairly widely used. The transfer and application of rice production process following VietGAP standards has significantly improved product quality in the market to meet the requirements of food hygiene and safety. Many localities have signed contracts with scientists from the Mekong Delta Rice Institute, Can Tho University to provide rice seeds and many other crop varieties suitable to each soil region, ensuring high productivity and good quality.

Secondly, on agricultural technical innovation.

The development of biotechnology allows to select and create new plant varieties and animal breeds which are more suitable for the intended use. This has a strong impact on the productivity and the quality of crops and animals, thereby increasing the added value in each agricultural product. A typical example is the application of breeding giant river prawn in An Giang province. This is the technology of breeding all male giant river prawn, originated in Israel. Male giant river prawns weigh about 200–300 grams heavier than females and the growth of males is faster than females. In the past, all-male prawn farming was usually done manually by separating the males from mixed populations. However, this method is relatively time consuming with high labor cost while shrimp quality is not guaranteed. Applying effective biotechnology to produce all-male prawns in fact can increase income by up to 60 % for the farm. The application of new scientific and technological achievements in rice production has also brought significant achievements. Currently, 100 % of the rice production area in the Mekong Delta has been mechanized in tillage stage; rice area applying sowing seeds by row accounts for about 20 % of the total rice production area.

The rice area harvested by combined harvester is 95–98 %, contributing to improving the rice quality and reducing post-harvest losses significantly.

Rural areas in Mekong Delta is flourishing with many innovations. Many key agricultural economic regions have been formed such as the Long Xuyen Quadrangle focusing on developing agriculture – forestry, building materials industry and tourism; the western region of Hau river forms a high-quality rice production region; U Minh Thuong area has developed the model of shrimp-rice rotation and aquaculture; coastal areas focus on ecotourism, aquaculture and offshore fishing... As of June 2019, the whole region had 528 communes meeting new rural standards (accounting for 40.6 %), 2,7 times higher than 2015. In addition, irrigation systems and disaster prevention are initially innovated to meet climate-change adaptive agriculture. Activities to handle urgent erosion of river banks and coasts have been implemented, 36 urgent treatment projects have been prioritized with a total budget of VND 2,500 billion [8]. These results have contributed to rural economic restructuring and income generation. The per capita income in rural areas in 2018 of the Mekong Delta reached about 36.7 million VND (2.4 times higher than in 2010 and 1.1 times higher than in 2016), higher than the national average (35.88 million) [9].

Thirdly, on the production organization method.

Access to technology has helped the agricultural economy change its traditionally small-scale and self-sufficient production organization method. A typical instance is the "Best rice cultivation" model of My Dong Cooperative (Dong Thap province) collaborating with Rynan Smart Fertilizers Company to cultivate Jasmine variety using intelligent cultivation (slow-fertilizing and spraying bioproducts once, using a solar sensor to regulate the water level). This model has helped to achieve a yield of 7 tons of rice per ha, while reducing the variety from 200 kg/ha to 60–80kg/ha, reducing fertilizer, reducing the number of pesticide sprays from 5 to 3 times, pests are reduced and labor is saved.

Along with cultivation, the animal husbandry industry has also changed from small-scale and scattered husbandry to the form of large-scale farms focusing on industrial and semi-public methods. The whole region has formed a number of large-scale breeding models, gradually increasing according to the farm economy model. With the implementation of developing breeding and leaning pig herds program, Ca Mau province has over 5,000 foreign breed pigs with fast weight gain, high lean rate, low feed cost and shorten breeding time. Breeding of crossbred Sindhi cow has also been expanded, many provinces have strongly developed animal husbandry under the farm economy model.

Negative impact:

Firstly, the region's agriculture is mainly based on natural resources and cheap labor, thus facing many difficulties due to limited capacity in absorbing technology and innovation, low labor productivity. In fact, although the Mekong Delta has many potentials and strengths, its development is still not commensurate with its potential. In particular, Industry 4.0 technology has not been systematically and effectively applied, the region has not exploited all resources and strengths. The product competitiveness is quite low. Products are exported mainly in unprocessed form, resulting in low economic efficiency. Regarding macroeconomic management, there are still significant limitations for exports, such as lack of synchronous planning, lack of long-term and sustainable development strategies while the processes of production, processing, consumption and export still lack uniformity and logic.

Secondly, an economy with a high level of automation and creativity requires labors to adapt quickly to changes in production, otherwise there will be labor redundancy, causing job disruption and unemployment. At present, the 4.0 technology has only been applied at some stages of the agricultural production chain such as seeding, tending, preliminary processing and preserving. In-

vestment in developing high-tech agriculture and applying science and technology in post-harvest processing is still limited, leading to low quality of agricultural products and market competitiveness. The number of agricultural cooperatives strong enough to associate with enterprises in the production and consumption of agricultural products is still low. Many businesses still have to negotiate and sign contracts directly with farmers. For instance, An Giang Plant Protection Joint Stock Company had to sign a contract with more than 20,000 farmer households to produce a large field model. With direct partners such as farmer households, the Company has a lot of difficulties to expand production links.

Thirdly, Industry 4.0 technology could expand the gap between rich and poor in society because knowledge plays a more important part in production than capital. At present, agricultural production of the region is still small, incomplete and difficult to connect to domestic and foreign markets. The labor force level is still low, focus mainly on traditional agricultural production, the production scale is still small and seasonal. Many farmer households tend to follow the crowd, do not follow production planning as well as market strategically. Therefore, they often change the structure and type of plants and livestock whenever the effectiveness is not high. Therefore, the situation of good harvest, bad price and good price, bad crops occur frequently.

3. Solutions to apply achievements of Industry 4.0 to agricultural development in the Mekong Delta region

Firstly, restruct agriculture sector towards a high-tech agriculture.

In the context of deep international integration, it is necessary to renovate agricultural production models and build synchronous infrastructure in order to create favorable conditions for the application of scientific and technological achievements in manufacturing. Besides, the ability to prevent and mitigate natural disaster needs to be improved to respond effectively to climate change; protect and use efficiently and sustainably natural resources and the environment. It is also necessary to increase investment capital for agricultural extension programs and the transfer of scientific and technological advances. Encourage and create link between farmers and enterprises, ensure output for products. At the same time, it is necessary to have strategies to train and improve the qualifications for extension officers and allocate appropriate staffing, contributing to improving the quality and efficiency of the transfer and application of science and technology into agricultural production.

Secondly, promote linkage development in agricultural production with various effective types of links.

Strengthen links in the value chain, associate production with the processing and consumption of agricultural products on the basis of divesifying forms of cooperation and links between farming households, cooperatives and businesses. This could improve the efficiency of production and business activities, ensuring the interests of participating entities. Encourage linkage between farming households and credit institutions, science and technology organizations and enterprises. In the long term, agricultural cooperatives need to be more proactive and flexible in production and business activities. To do that, it is necessary to pay attention to building and developing a contingent of managing officers with appropriate qualifications and capacity, contributing to stable and sustainable development, creating jobs and output for agricultural products and actively building new rural areas.

Thirdly, re-plan agricultural production by region and regional scale on the basis of linking market supply and demand with the goal of improving the efficiency, quality and value of agricultural products. Localities need to create a favorable environment to establish and strengthen the links between businesses and businesses, between businesses and people, between people and people to create a close link between production, pro-

cessing and syndicating products. At the same time, it is necessary to pilot the construction of hi-tech agricultural parks based on new scientific and technological advances, especially biotechnology and information technology. Create linkage and management models according to modern criteria. On that basis, it could create a breakthrough change in agricultural production in the Mekong Delta.

Fourthly, perfect mechanisms and policies for developing science and technology for agriculture, especially high-tech agriculture.

Adopt mechanisms and policies to encourage scientific and technological research and application, especially biotechnology and information technology in production and management. Focus on measures and policies with long-term goals to improve the quality of agricultural products. Form strong agricultural value chains in concentrated cultivation areas. Encourage the signing of contracts between scientific, technical and technological agencies with agricultural subjects. Adopt adequate financial and credit mechanisms to promote the application of the achievements of the Industrial Revolution 4.0 into agricultural development in general and the Mekong Delta in particular.

Fifthly, improve the quality of science and technology activities for agricultural development.

Strengthen scientific research activities, transfer advanced technology and apply scientific and technological achievements to agricultural production. Pay attention to all stages of the production process, from the creation of new plant varieties and animal breeds, to the development of tools, means, new cultivating methods and techniques, promote agricultural mechanization to serve the process of planting, harvesting, drying, packaging and preserving post-harvest and processing products.

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