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Developing human resources for modern rural construction in the period of industrial revolution 4.0

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Abstract
The construction of modern rural areas in Vietnam is facing great opportunities and challenges from the industrial revolution 4.0. This is a strategic time to restructure the rural economy, improve competitiveness, and ensure sustainable development of rural areas in the context of global integration.

Human resources are not only the core factor determining the success of rural modernization, but also the lever to promote digital transformation, apply high technology, and effectively exploit economic, cultural, and environmental potentials in the locality. With the strong development of technologies such as artificial intelligence (AI), Internet of Things (IoT), big data, rural areas not only need a large workforce but also have to meet the requirements of skills, innovative thinking, and flexible adaptability.

This document focuses on studying the current situation and proposing solutions for human resource development to build modern rural areas, ensuring the goal of rapid and sustainable development in the period of industrial revolution 4.0. The content not only aims to improve the material and spiritual life of rural people but also focuses on preserving traditional cultural values, contributing to building a sustainable agricultural economy in harmony with the environment.

Keywords: Human resources, modern countryside, industrial revolution 4.0

Introduction

Vietnam's agriculture has achieved many remarkable achievements that have been recognized and highly appreciated by the Party, State and People. Despite facing many challenges from the domestic and international economic situation such as epidemics, natural disasters, climate change, economic recession, trade wars and international conflicts, Vietnam's agriculture sector has maintained remarkable growth, affirming its important role in the economy. Agriculture has actively contributed to maintaining macroeconomic stability, controlling inflation and creating many job opportunities. Resolution 19-NQ/TW of the 5th Conference of the 13th Party Central Committee on agriculture, farmers and rural areas to 2030, with a vision to 2045, set the goal: By 2030, farmers and rural people will have higher qualifications, significantly improved material and spiritual life, and at the same time take control in the process of agricultural and rural development. Agriculture will develop rapidly, sustainably and effectively, ensuring stable national food security, expanding the scale of agricultural commodity production, protecting the ecological environment and adapting to climate change. Human resource development plays a core role in the process of building modern rural areas in the context of the 4.0 industrial revolution. This is not only to meet the requirements of the times but also a solid foundation to help rural areas develop sustainably, balancing economic growth and protecting cultural and environmental values.

Research overview

The article uses a system of methods: Theoretical research, interdisciplinary research, history - logic; abstract.

Research findings

1. The importance of human resource development for modern rural construction in the period of industrial revolution 4.0

Developing human resources in the process of building modern rural areas is an essential factor, especially in the period of the 4.0 industrial revolution. Under the impact of technology and scientific and technical advances, this development not only contributes to improving the quality of labor but also promotes the process of rural modernization.

First, improving labor productivity and applying modern technology: The 4.0 industrial revolution brings many advanced technologies such as artificial intelligence (AI), Internet of Things (IoT), and Big Data. Developing human resources helps farmers and rural workers to access, learn, and apply these technologies in production. This not only helps optimize the agricultural production process, reduce labor, but also increases productivity, improves product quality, and increases competitiveness in the market.

Second, meeting the needs of transforming the rural economic structure: In the transition from a traditional agricultural economy to a modern agricultural economy, skilled and knowledgeable human resources are an important factor to promote this process. Modern rural areas not only focus on agricultural production but also develop processing, service and trade industries. Therefore, human resource development helps meet labor needs in new fields, contributing to diversifying the rural economy.

Third, Adapting to climate change and protecting the environment: *Rural* development in the context of climate change requires people and rural workers to have knowledge and skills to apply sustainable farming methods and protect the environment. Human resources equipped with knowledge of science and technology help apply green agricultural models, save water, use organic fertilizers, thereby minimizing negative impacts on the environment and effectively dealing with climate change.

Fourth, Developing social infrastructure and improving the quality of life: Well-trained human resources contribute to the construction of modern infrastructure systems such as electricity, water, information systems and transportation. They also play an important role in improving the quality of life of the community through the construction of health, education and cultural services, helping to create a healthy living environment and sustainable development for the people.

Fifth, Create momentum for the digital transformation process in rural areas and improve management and leadership capacity in rural communities: Training and developing human resources not only focuses on manual labor but also on management and leadership teams in communes, villages and agricultural cooperatives. This helps improve the ability to manage, plan and operate rural development projects. Good leadership and organizational capacity will contribute to the implementation of economic, cultural and social development policies, creating sustainable development for the entire region.

Sixth, Preserve and promote traditional cultural values: The development of human resources also helps preserve and promote traditional cultural values of rural areas in the process of modernization. Understanding and combining traditional values with modern elements helps create harmony, both preserving national cultural heritage and promoting innovation. High-quality human resources will be an important bridge in transmitting these cultural values to the younger generation, helping the countryside to be both modern and rich in identity.

2. Opportunities and challenges in developing human resources for modern rural construction in the period of industrial revolution 4.0

2.1. Industrial revolution 4.0 opens up many opportunities for rural human resources

By 2026, according to the International Labor Organization (ILO), about 40% of the global workforce could be replaced by new technology due to a lack of suitable skills, and another 30% will have to change occupations to adapt to the constant changes of the market. Human resources in rural areas are mainly allocated to the fields of food and food production to serve social needs, providing raw materials for the consumer goods processing industry as well as food processing. They also play an important role in providing land and labor for the development of other economic sectors. Rural human resources have made great contributions to Vietnam's agricultural sector. Analyzing the achievements in this field will help clarify the current situation of rural human resources in the context of the linked value chain system. To promote the development of agriculture and rural areas, it is necessary to have quality human resources in rural areas to expand export markets and negotiate trade. At the same time, the agricultural sector also needs to persevere in developing domestic consumption.

Firstly, the application of digital technology and automation in agriculture brings many opportunities for rural human resources.

Technologies such as IoT (Internet of Things), drones, and smart sensors help monitor, analyze, and optimize production processes. According to a report by MarketsandMarkets, the agricultural technology market is expected to reach $22 billion by 2025, growing at an average rate of 12.1% per year, indicating a growing demand for technological solutions in agricultural production [11].

Farmers can use drones to monitor crops, thereby detecting problems such as pests or water shortages early. The result is improved crop yields, while reducing the use of pesticides and fertilizers, which benefits human health and the environment. The Food and Agriculture Organization of the United Nations (FAO) also points out that the use of IoT sensors can reduce water use by up to 30% and fertilizer use by 20% in production, thereby improving economic efficiency and protecting the environment [3].

With the adoption of technology, the demand for higher skilled workers also increases. This opens up opportunities for rural workers to participate in vocational training programs to equip them with the necessary skills. Training institutions and organizations can develop courses on information technology, smart agricultural management and technology application in production.

Rural workers will have to get acquainted with modern production processes, from production planning, progress monitoring to the use of management software. This transformation will not only help them improve their capacity but also improve their flexibility in work.

Second, the 4.0 industrial revolution creates a favorable environment for entrepreneurship and innovation in agriculture.

Technology opens up many new business models in the agricultural sector such as smart agriculture, organic production, and sustainable agriculture. According to the Ministry of Agriculture and Rural Development, high-tech agricultural models currently account for about 17% of the total agricultural land area, contributing 25% of the total output value of the industry [3]. Farmers can experiment with new models, from growing to processing products, to increase added value.

Government and NGO start-up support programs can provide farmers with funding, advice, and training. For example, one program could help farmers build an online business, from marketing their products to managing orders.

Farmers can apply technology to the production process, such as using farm management software, mobile applications to monitor prices and markets. Through this, they can increase the value of their products and increase their income. For example, the Ministry of Science and Technology's 2023 Agricultural Startup Program has supported more than 500 smart agriculture projects, enabling farmers to use technology to increase productivity and develop markets [5]. Farmers can apply technology to the production process, such as using farm management software, mobile applications to monitor prices and markets.

Through this, they can increase the value of their products and increase their income. Grow Asia pointed out that online platforms connecting farmers to markets have increased profits by up to 20% compared to traditional sales methods [13].

Third, the 4.0 Industrial Revolution promotes the development of e-commerce, creating opportunities for farmers to expand markets and connect.

The development of e-commerce platforms makes it easier for farmers to access a larger market. They can sell their products directly to consumers without going through intermediaries. This not only reduces costs but also increases profits. According to Statista, revenue from the global agricultural e-commerce industry is estimated to reach 50 billion USD by 2024, with an average growth rate of 9%/year. In Vietnam, e-commerce platforms such as Voso.vn and Postmart.vn have helped millions of farmers sell their products directly to consumers, significantly reducing intermediary costs and increasing profits.

Developing new skills in marketing, farmers need to equip themselves with new skills, especially in the field of digital marketing. They need to understand how to use social networks to promote products, build personal brands and build trust with customers.

Connecting with customers does not stop at selling but also includes collecting and analyzing customer data. Thanks to this data, farmers can better understand the needs and consumption habits of customers, thereby adjusting their products and services accordingly.

The 4.0 industrial revolution not only poses challenges but also opens up many opportunities for rural human resources. Applying technology in production, developing new business models, and expanding markets through e-commerce will create conditions for farmers to improve their capacity, improve income and contribute to the sustainable development of Vietnam's agriculture. To make the most of these opportunities, support from government, training institutions and communities is essential.

2.2. The 4.0 industrial revolution creates many big challenges for rural human resources

First, the quality of human resources in rural areas

Industry 4.0 focuses on high technology such as artificial intelligence, Internet of Things (IoT), Big Data, automation and robotics. This requires the workforce to have the knowledge and technical skills to operate, manage and apply these technologies. However, in rural areas, most workers only receive basic training, with little access to in-depth technology training programs. In rural areas, access to education is limited, and many workers are not properly trained. This creates a gap in the ability to absorb and apply new technology between rural and urban areas, leading to difficulties in the transition from traditional labor to high-skilled labor.

Currently, the quality of human resources in rural areas of our country is still low. Although the population is mainly concentrated in rural areas, in reality, the young, healthy, and qualified human resources of this area migrate freely to big cities and industrial parks. According to the General Statistics Office, in 2023, the labor force in rural areas will be 32.9 million people, accounting for 62.7%. The number of employed workers in 2023 will reach 51.3 million people, of which 32.3 million will be employed in rural areas. The number of employed workers in the agriculture, forestry and fishery sector will be 13.8 million people, accounting for 42.7% of the total number of employed workers in rural areas. However, in terms of qualifications, in 2023, the trained workforce with degrees and certificates is estimated to be 14.1 million people, accounting for 27.0% (General Statistics Office, 2024). This rate has increased by 0.6 percentage points compared to 2022 but is still low compared to the set target. The rate of trained workers in rural areas is often lower than that in urban areas (General Statistics Office, 2022). Therefore, in Conclusion No. 54-KL/TW dated August 7, 2019 of the Politburo on continuing to implement Resolution 7 of the 10th Central Committee on agriculture, farmers, and rural areas, it was recognized that the process of urbanization and industrialization will attract and compete strongly with rural agriculture for resources in the areas of land, water resources, trained young labor resources, capital resources, etc. The remaining human resources in rural areas are mainly people above or below working age, in poor health or still in school. Therefore, another important factor to assess the quality of human resources is the number of trained people.

Second, Regarding the structure of human resources in rural areas

Regarding the structure of human resources in rural areas, our Party has also clearly stated: "Accelerate the restructuring of the agricultural sector, build an ecological agriculture that comprehensively develops agriculture, forestry and fishery in a modern and sustainable direction, on the basis of promoting comparative advantages and reorganizing production, promoting the extensive application of science and technology, especially biotechnology and information technology in agricultural production and management, and accelerating the industrialization and modernization of rural agriculture to increase productivity, quality, efficiency and competitiveness, firmly ensuring national food security in both the short and long term; improve farmers' income and life" (Communist Party of Vietnam, 2016, vol. 1, p. 92) [8]. Currently, the population size of the whole country is 100.3 million people (in 2023). The labor force aged 15 and over is 52.4 million people, of which the labor force in urban areas is 19.5 million people (accounting for 37.3%), the labor force in rural areas is 32.9 million people (accounting for 62.7%); the female labor force is 24.5 million people (accounting for 46.7%), the male labor force is 27.9 million people (accounting for 53.3%). The labor force participation rate is 68.9%, of which the labor force participation rate of men is 75.2% and that of women is 62.9%. Vocational training for rural workers in the past has not met practical requirements, there are still limitations and weaknesses. Some set targets have not been achieved; rural workers are mainly trained at the elementary level and under 3 months, the training quality is still low, especially in remote areas, remote areas, and ethnic minority areas. Conditions to ensure the quality of vocational training are still inadequate. Activities to support people after vocational training have not been effectively implemented.

Third, challenges in accessing and applying technology and the risk of job loss and changes in labor structure

In many rural areas, telecommunications and Internet infrastructure is weak, reducing access to modern

technologies. According to a report by the Ministry of Information and Communications of Vietnam in 2022, only about 75% of households in rural areas have access to broadband Internet, compared to 96% in urban areas. This disparity leads to major limitations in access to digital technologies, especially in the Northern mountainous provinces and the Central Highlands [4].This limits the application of digital technologies in agricultural production, reducing competitiveness and production efficiency. Applying Industry 4.0 technologies to agriculture requires large investments in equipment, software and management systems. For rural households and small businesses, this investment is a financial burden, especially when the ability to borrow capital and access to financial support sources is limited. According to a report by the State Bank, only 30% of farmers have access to formal loans due to lack of collateral and complicated approval processes [10].

The application of machinery and automation in agricultural production can replace many traditional jobs. According to the International Labor Organization (ILO), in Vietnam, nearly 70% of agricultural workers do jobs that are at high risk of being replaced by automated machines within the next 10 years. Jobs such as planting, harvesting, and raising animals are all being heavily automated [12]. This is particularly true for unskilled rural workers, who are predominantly engaged in manual and unskilled work. The change in production methods requires rural workers to move to more technical jobs or new occupations that are not directly related to agriculture. This transition is not easy due to the lack of appropriate vocational training programs, as well as limited information and career guidance. According to statistics from the General Department of Vocational Education (2022), only 12% of rural workers have participated in technical vocational training courses in the past 5 years. Many training programs are not yet linked to real needs, making career transition difficult.

Fourth, Difficulty in changing thinking and perception and social and psychological impact

Rural workers are often accustomed to traditional production methods. Changing to modern and digital production methods requires a change in mindset and working methods. According to a survey by the National Agricultural Extension Center (2022), only 35% of farmers appreciate the role of modern technology in improving productivity and income, while 50% still believe in traditional methods. This is a big challenge because changing long-standing habits often takes a lot of time and effort. Many farmers are not fully aware of the benefits of applying new technology, due to lack of information or incomplete information. This leads to hesitation in applying advanced production methods, thereby slowing down the modernization of agricultural production.

The Fourth Industrial Revolution not only affects production methods but also changes the labor market, creating greater competitive pressure on rural workers. They face competition not only domestically but also from high-tech agricultural products from abroad. According to a report by the Food and Agriculture Organization of the United Nations (FAO), Vietnam has to compete with high-tech agricultural products from Thailand, China and Japan. This makes rural workers vulnerable due to their lack of ability to produce high value-added products. As technology develops rapidly, many rural workers feel insecure about their career future. This can lead to concerns about job loss, unstable income and uncertainty about their ability to adapt to changes. A survey by the Vietnam Institute of Sociology (2023) showed that 60% of rural workers feel insecure about their career future and 45% said they are not ready for changes in production methods.

3. Some solutions for developing human resources for modern rural construction in the period of industrial revolution 4.0

One, Strengthen the role of the local political system in human resource development

Promoting the role of socio-political organizations: Mobilizing the participation of organizations such as the Farmers' Association and the Youth Union in organizing training activities and skills development for rural workers.

Creating favorable conditions for people to participate in the decision-making process: Ensuring people's participation in planning and implementing human resource training programs, thereby creating consensus and commitment in the implementation process.

Second, improving digital technology skills and qualifications for rural workers

Digital technology skills training: Organizing short-term courses on digital skills such as using smart devices, data management, internet access, and software applications in agriculture. This helps rural workers get acquainted with new technology, contributing to improving productivity and efficiency in production.

Cooperate with universities and research institutes: Connect universities, research institutes and technology organizations to train and coach farmers and rural cadres on new technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and big data management.

Build smart agriculture models: Create practical models in smart agriculture, helping farmers access and directly experience technology applications in production. This not only helps people better understand the benefits of technology but also makes them see clearly the development potential of modern agricultural production.

Third, Develop policies to encourage vocational training and technical education for farmers

Develop specialized vocational training programs: Focus on training in highly specialized skills such as animal husbandry, high-tech cultivation, operating modern machinery and equipment, and applying science and technology to production.

Innovate training methods: Combine theory and practice through practical on-site models, helping learners to apply immediately to production. In particular, it is necessary to promote on-site training, direct instruction in fields, factories or farms.

Financial support policies: There should be incentive policies such as exempting or reducing tuition fees, providing scholarships and subsidies for vocational training courses. This helps rural workers easily access new skills courses and improve their capacity.

Fourth, Build a knowledge and technology transfer system between rural areas and research centers

Strengthen the electronic agricultural extension network: Use digital platforms to provide information on

techniques, market prices, weather information and disease forecasts to farmers. This helps farmers access new knowledge and technology quickly.

Promote technical support and innovation centers in rural areas. Build local support centers that can provide consulting services, transfer technology, and organize practical training activities. This will be a bridge between scientists and farmers, helping to improve the quality of human resources.

Fifth, Promote the start-up and innovation movement in rural areas

Encourage technology-based start-ups: Support young farmers and start-ups in building agricultural production models that apply new technologies such as greenhouses, automatic irrigation systems, and sensor-based management.

Establish start-up and innovation support funds: These funds will help finance creative ideas in agriculture, while creating conditions for start-up projects to access funding and investment capital from the private sector and non-governmental organizations.

Sixth, Develop a policy for sustainable human resource development associated with rural environmental protection

Training on sustainable agriculture and circular economy: Organize courses on organic agriculture, sustainable farming, and agricultural waste treatment to raise awareness and skills of workers in environmental protection.

Encourage the use of renewable energy: Support farmers in switching to renewable energy such as solar, wind, and biogas in the production process. This not only helps save production costs but also contributes to environmental protection.

Seventh, Strengthen international cooperation and learn from experiences of developed countries

Expand cooperation with international organizations: Strengthen cooperation with international organizations such as FAO, UNDP, and countries with developed agriculture to receive technical, financial support and experience in human resource development.

International exchange program: Send cadres and rural workers to study and intern in advanced countries, thereby bringing back valuable experiences to apply to the actual situation in Vietnam.

Participate in international forums and seminars: This helps rural workers have the opportunity to learn and access the latest trends in global agriculture, thereby orienting development in accordance with conditions local conditions. The above solutions will help create a high-quality human resource, meeting the requirements of modern agriculture in the period of industrial revolution 4.0. This not only contributes to improving the lives of rural people but also promotes the sustainable development of rural areas in the future.

Conclusion

Developing human resources in modern rural construction in the period of Industrial Revolution 4.0 is an urgent and strategic task. Industrial Revolution 4.0 brings many opportunities but also many challenges for rural areas, especially the requirement for a workforce with skills, knowledge and the ability to apply high technology. To meet these requirements, it is necessary to focus on training, fostering skills, and improving professional qualifications for rural workers. In addition, building policies to encourage, support, and facilitate farmers' access to new science and technology is a key factor. Human resource development must be closely linked to local socio-economic development practices, ensuring sustainability, while strengthening the connection between farmers, businesses and training and research institutions. Only when human resources are improved in quality, can the countryside transform strongly, becoming a solid foundation for a modern, competitive and sustainable agriculture in the period of global integration. This not only contributes to improving the lives of rural people but also promotes the socio-economic development of the country, towards the goal of sustainable development and building a fair and prosperous society.

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