



Economics and Business Management

15(4), 161-184

Journal homepage: <https://economicscience.com.ua/en>

Received: 19.07.2024 Revised: 17.10.2024 Accepted: 27.11.2024

UDC 331.101.262:330.341.1

DOI: 10.31548/economics/4.2024.161

Tetiana Balanovska*

PhD in Economic Sciences, Professor

National University of Life and Environmental Sciences of Ukraine

03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

<https://orcid.org/0000-0001-6814-5888>

Olena Cherednichenko

PhD in Technical Sciences, Associate Professor

National University of Life and Environmental Sciences of Ukraine

03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

<https://orcid.org/0000-0001-8908-4113>

Ludmila Stepasyuk

PhD in Economic Sciences, Associate Professor

National University of Life and Environmental Sciences of Ukraine

03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

<https://orcid.org/0000-0002-7258-9243>

Oleksandr Yurchenko

PhD in Economic Sciences, Associate Professor

Borys Grinchenko Kyiv Metropolitan University

04053, 18/2 Bulvarno-Kudriavska Str., Kyiv, Ukraine

<https://orcid.org/0000-0002-8447-6510>

Krystyna Dramaretska

PhD in Economic Sciences, Associate Professor

National University of Life and Environmental Sciences of Ukraine

03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

<https://orcid.org/0000-0002-9886-1663>

Oksana Baranovska

PhD in Economic Sciences, Associate Professor

National University of Life and Environmental Sciences of Ukraine

03041, 15 Heroiv Oborony Str., Kyiv, Ukraine

<https://orcid.org/0000-0003-3884-8894>

Development of human capital in the context of the emerging creative economy

Suggested Citation:

Balanovska, T., Cherednichenko, O., Stepasyuk, L., Yurchenko, O., Dramaretska, K., & Baranovska, O. (2024). Development of human capital in the context of the emerging creative economy. *Economics and Business Management*, 15(4), 161-184. doi: 10.31548/economics/4.2024.161.

*Corresponding author



Copyright © The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (<https://creativecommons.org/licenses/by/4.0/>)

Abstract. The purpose of the present study was to analyse the role of human capital in the development of the creative economy, particularly through the introduction of innovations and the development of education. The research methodology included the analysis of strengths, weaknesses, opportunities, and threats, as well as the study of innovative programmes and educational initiatives. The principal findings of the study revealed that investment in education and technology is a major factor for the development of innovation in creative industries. The study of the AgroPortal, E-Agriculture, and AgroHub platforms showed their effectiveness in improving communication between farmers, suppliers, and consumers, which helps to optimise logistics processes and develop new business models for online sales. The study found that the introduction of digital technologies and the development of training programmes can markedly improve productivity and reduce costs in the agrarian sector of the economy. The findings of the study confirmed that human capital plays a key role in the implementation of innovations and development of the agrarian sector. Of particular significance is investment in training through modern educational programmes and workshops that enable farmers to master the latest technologies and effective business strategies. The analysis revealed prospects for improvement through the strategic use of existing digital platforms and training courses to enhance human capital capacity. Attention was paid to platforms in Austria, such as Pramoleum and myAcker, which demonstrated the successful integration of digital technologies in the agrarian sector. Analysis of educational programmes and cooperation between universities, businesses, and government agencies in the Netherlands revealed their valuable role in supporting the sustainable development of the agrarian sector, specifically through projects such as Farm of the Future. The conclusions pointed to the need for further investment in human capital development through educational programmes and research, as well as the integration of the latest digital technologies into the agrarian sector to ensure the sustainable development of the creative economy. Consideration of these factors will improve the economic situation, increase production efficiency, and contribute to the sustainable development of the national economy

Keywords: innovation; educational programmes; sustainability; competitiveness; human capital; development; agrarian sector of the economy

INTRODUCTION

In the modern world, rapid technological development, digitalisation, and globalisation are changing conventional economic models and requiring a rethinking of approaches to the development of national economies. One of the most dynamic and promising areas is the creative economy, which includes innovative and creative industries that generate new sources of economic growth and ensure prominent levels of employment, talent development, and intellectual property. Human capital plays a special role in the development of the creative economy, as its knowledge, skills, creativity, and ability to innovate are the primary factors that determine success in the creative industries. Therefore, the development of human capital is becoming an essential condition for stimulating innovation and maintaining the competitiveness of economies in the globalised world.

Digital tools play a prominent role in the development of human capital through vocational training in Ukraine. T. Neboha *et al.* (2024) explored the significance of integrating the latest technologies to upskill workers, focusing on the need to constantly update skills in response to changes in the economy. The findings of this study showed that digitalisation is a key factor for increasing the efficiency of human capital. However, the lack of a unified digital training strategy remains a challenge. An issue that needs further study is how to optimise the use of digital tools to keep skills up-to-date in the context of economic change, especially during Ukraine's post-war recovery. The decline in the effectiveness of human capital development in the context of economic change is a pressing issue. F.B. Mecocci *et al.* (2022) studied the impact of cultural production on human capital in

European regions, showing a positive relationship between employment in cultural sectors and human capital development. However, there is a need for a deeper study of the local characteristics and classification of human capital in the context of different types of cultural activities.

Investments in human capital are key to the development of the creative economy. S. Londar *et al.* (2020) explored the effects of investment in education and science on the development of the creative economy in Eastern and Central Europe. The findings showed that increased funding in these areas contributed to increased competitiveness and socio-economic development. However, the lack of funding in Ukraine requires further research on the effectiveness of such investments for the creative industries. Human capital development is key to the growth of the creative economy. N. Kuznetsova *et al.* (2022) examined the role of human capital in this process, focusing on the significance of investments in education and health for the development of creative industries. The findings confirmed that investments in human capital contribute to innovation and the development of the creative economy. However, the effectiveness of such investments in distinct cultural contexts requires further investigation.

The value of human capital for the development of the cultural and creative economy requires further study. Y. Horban *et al.* (2021) explored the role of intellectual and creative capital in economic development, emphasising the significance of education and creative abilities for creative industries. The findings showed that these factors contributed to economic growth and value creation. However, there are still issues that require further study, including the effectiveness of such investments in various countries. Intellectualisation and the role of human capital in the development of the creative economy are prominent aspects that require further investigation. I. Kalenuk & N. Kuznetsova (2020) explored the effects of people's creative abilities, skills, and talents on the economy, emphasising the value of creative industries for the growth of national economies. The researchers defined the creative economy as a sector that unites industries based on creative activity and as a system of socio-economic relations associated with the development of creative human capital.

Still, more research is needed on how new educational methods fit into creative industries and how they affect the development of human capital in the context of digitalisation.

The growing role of creative corporations in economic development requires an in-depth study of human capital. T.V. Posnova (2021) analysed the effects of creative human capital on the functioning of creative corporations, emphasising its value for innovation and the production of creative products. The researcher noted that creative corporations, unlike other types of enterprises, are based on the creative abilities of their employees, which allows them to generate innovations and create competitive advantages. However, the identified gaps, specifically, the lack of a sufficient number of trained management personnel for creative corporations in Ukraine, require further investigation.

Increase in the role of creative human capital in economic development also warrants more detailed research. S. Duca (2023) investigated the significance of creative human capital as a resource for knowledge management in the economy, highlighting its impact on innovative development and economic growth. The researcher noted that insufficient management of creative potential can hinder the development of a country, while the effective use of creative resources stimulates innovation. The findings of the study revealed that investments in education, research, and innovation systems contribute to the development of creative capital and improve the economic situation. However, there is a need to further explore the effects of government policies on the integration of international programmes to support the creative industries to ensure sustainable development.

The purpose of the present study was to investigate the role of human capital in stimulating innovation and developing the creative economy, specifically through educational initiatives and technological investments. The objectives of the study were to assess the role of human capital in the development of creative industries and its impact on the innovation process; to identify key factors that contributed to the establishment and development of human capital in the creative economy, particularly through education and support for innovation.

MATERIALS AND METHODS

The study was theoretical-analytical and applied in nature. The study was based on the analysis of academic publications such as I. Slaus & G. Jacobs (2011), Y. Tochylyna (2019), S.K. Baidybekova & S.B. Sauranbay (2022), which provided an in-depth understanding of the theoretical foundations of the creative economy, as well as practical approaches to the development of human capital and innovation processes in various sectors of the economy. These publications became the basis for analysing current trends and challenges faced by the agricultural and creative industries in integrating the latest technologies and methodologies. Open-source publications such as AgroPortal (AgroPortal, n.d.), AgroHub (Analyzing millions of numbers..., n.d.), E-Agriculture (E-Agriculture, n.d.) were also employed to analyse modern digital platforms that facilitate the integration of technology into the agrarian sector. These sources helped to assess the effectiveness of platforms for data exchange between farmers, suppliers, and consumers, as well as to identify opportunities for optimising logistics processes and developing new business models in agriculture.

The study examined various programmes and courses that promote the development of the creative economy through non-formal learning. Specifically, online platforms were considered, including Coursera – course “Agribusiness and Sustainable Food Production Economics” (Agribusiness and Sustainable Food..., n.d.), UdeMY – course “Greenhouse Farming Foundation” (Greenhouse farming foundation, 2022), edX – course “WBGx: e-Learning on Digital Agriculture” (WBGx: e-Learning..., n.d.).

The agrarian sector was selected for consideration of the creative economy because of its potential for innovation and new business models. Furthermore, the agrarian sector is key to sustainable development and food security, while creative approaches such as clustering and cross-sectoral cooperation can contribute to economic growth and competitiveness. Digital platforms for monitoring the condition of crops were considered, such as Agriquest (Satellite monitoring..., 2020), CropTical (Free digital platforms..., 2022), xarvio Field manager (Field manager..., 2020). The study also included the

FarmLogs mobile application (FarmLogs, n.d.) and the AgriWebb livestock management software (AgriWebb, n.d.).

The study conducted a SWOT analysis to assess the effects of human capital development on the innovation process in the agrarian sector. The analysis helped to identify the strengths, weaknesses, opportunities, and threats associated with the integration of the latest technologies and the upgrading of employees' skills. This included an assessment of aspects such as the use of precision farming and biotechnology, as well as the effectiveness of digital platforms for managing and monitoring agricultural processes. The SWOT analysis helped to identify key factors to increase productivity, reduce costs, and improve the quality of agricultural products.

Austria was chosen for the analysis because of its successful application of innovative approaches in the agrarian sector, including the integration of creative industries and digital technologies. The country has actively employed cooperation and clustering models to promote agriculture, gastronomy, and technology. Projects such as Pramoleum (Welcome to Pramoleum, n.d.), KochCampus (KochCampus, n.d.), and myAcker (myAcker, n.d.) demonstrated how investments in human capital stimulate economic growth and create new business models.

RESULTS AND DISCUSSION

Role of human capital in the development of the creative economy

Human capital is one of the crucial categories in modern economic theory. This concept encompasses not only the physical and intellectual abilities of individuals, but also their ability to innovate, develop, and adapt to change. Human capital determines labour productivity, the level of innovation, and the competitiveness of national economies and is a prominent factor in economic development at the global level. This is especially evident in the context of the creative economy, where the role of human capital is becoming even more valuable.

According to human capital theory, human capital is the sum of knowledge, skills, experience, and health that enables an individual to perform productive work and generate economic growth. According to this theory, education,

training, experience, social connections, and physical and mental health directly influence productivity and the ability to innovate. Notably, human capital is not only an individual resource, but also a collective one, and its effective use at the level of enterprises, organisations, and entire countries is the basis for economic growth and sustainable development. In classical economic theory, capital is traditionally divided into physical, financial, natural, and human capital. Human capital, unlike other forms of capital, is directly related to the potential of people – their ability to create, work, and generate innovative ideas. Improving the level of human capital involves continuous education and self-improvement, as it allows preserving and increasing knowledge that becomes the basis of the innovation process in various sectors of the economy. Human capital underlies economic growth and development, as no sector of the economy can function without capable and skilled workers. Human capital determines not only the volume of production, but also the quality of products, the effectiveness of management decisions and the ability to adapt to rapid changes (Slaus & Jacobs, 2011).

In the modern world of economic development, human capital has become no less significant than physical capital. This is especially true in the context of the creative economy, where the primary resource for growth and development is not raw materials, but knowledge and innovation. The creative economy, unlike conventional economic models, focuses on creating added value through the generation of innovative ideas, cultural products, and services, as well as through the use of intellectual potential. An essential aspect of this economy is the ability of individuals to generate new ideas, and thus human capital becomes not only the basis for economic stability, but also the primary tool for achieving success in a global competitive environment (Tochylina, 2019).

One significant aspect of human capital is its relationship with innovation. In a creative economy, innovation is central to the economy's competitiveness and ability to adapt to new conditions. Innovation requires a prominent level of knowledge, skills, and creative problem-solving. Accordingly, investments in human capital

development directly influence the country's innovation potential. This applies to both businesses and governments, which should create the conditions for human capital development through education systems, research, and training programmes (Chaikovska, 2023).

The role of human capital in economic development is most clearly manifested in those countries where the primary sources of growth are intellectual resources rather than natural or physical resources. Examples of such countries are Japan, South Korea, and some European countries, where investments in education and human capital development have led to extensive economic growth. In these countries, human capital not only increased the efficiency of economic processes but also became the basis for the creation of innovative products and services, which enabled the countries to take a leading position in the international economy (Baidybekova & Sauranbay, 2022). On the other hand, the absence or insufficient development of human capital can lead to economic decline. For instance, countries where the level of education and skills of the labour force is low often experience economic stagnation, lower levels of innovation and productivity, as observed in some African countries such as Nigeria, Somalia, and Chad. In such circumstances, economies can become dependent on raw materials or cheap labour, which does not allow for sustainable development in the long term.

Understanding the relationship between human capital and the creative economy is a major aspect for developing effective economic development strategies at the global and national levels. Therefore, to achieve economic growth, it is essential not only to invest in human capital development, but also to integrate it with creative industries to ensure sustainable economic development. Considering that the creative economy is based on innovative ideas, technologies, creative problem-solving approaches and innovative products, human capital is the primary resource that enables these innovations. Educated, skilled, and creative people are the principal driver of development in creative industries such as design, culture, art, media, advertising, and technology companies. A study by the United Nations Development Programme

in March 2024 reported that Ukraine's Human Development Index (HDI) is 0.734, which means that the country is in the category of high human development. Among 193 countries and territories, Ukraine ranked 100th (Protsenko, 2024).

The creative economy, in turn, contributes to the development of human capital by stimulating innovation and creating new opportunities for learning and self-improvement. One of the key aspects of the creative economy is the opportunity for people to use their creativity and intellectual potential to create new products and services. This creates a demand for new skills and knowledge, which stimulates the development of the education and training system. Creative industries enable the development of entrepreneurial skills, as these industries are often based on individual or small businesses that require creative and entrepreneurial approaches to doing business (Hmyria, 2023). This allows people to develop not only technical but also managerial skills, which are essential for creating and sustaining innovative companies. Furthermore, the creative economy makes extensive use of digital technologies, which provides an opportunity to develop digital skills among employees and enables the creation of new tools for learning and development.

The interaction between human capital and the creative industries is manifested through a variety of factors that ensure productivity and innovation in this area. One of these factors is the close relationship between education and innovation. Human capital, specifically its educational aspect, is the basis for creating innovations in the creative industries. Creativity requires not only inspiration, but also prominent levels of education, learning ability, and constant updating of knowledge. This contributes to the creation of new products, services, and technologies that form the creative economy. Additionally, human capital ensures the efficiency of work processes in the creative industries. Teamwork, communication skills, managerial competence, and analytical skills are essential for the successful implementation of creative projects. The greater the level of human capital in this context, the more efficiently innovative ideas are implemented, which contributes to economic development at all levels – from

individual enterprises to entire national economies (Horban *et al.* 2021).

Furthermore, not only formal education, but also non-formal learning, various courses, trainings, and workshops that allow people to develop their creative skills, play a vital role in the development of the creative economy. For example, online platforms such as Coursera offer creative skills courses for the agrarian sector, such as Agribusiness and Sustainable Food Production Economics (Agribusiness and Sustainable Food..., n.d.), which helps participants improve their ability to solve environmental and production problems in agriculture. Udemy also offers trainings, such as the Greenhouse Farming Foundation (Greenhouse Farming Foundation, 2022), which allow developing farm management skills essential for innovation in agricultural industries. For those who want to learn more about digitalisation in the agrarian sector, the edX platform offers the WBGx: e-Learning on Digital Agriculture course (WBGx: e-Learning..., n.d.), which addresses the use of digital technologies to improve agricultural productivity. These courses can be useful for developing innovative approaches and creative solutions in the agrarian sector.

Human capital plays a key role in the development of the agrarian sector, as the level of employees' skills and knowledge determines the success of innovations, modernisation of production and adaptation to changes in agriculture. In the modern agrarian sector, human capital not only supports conventional farming methods but also contributes to the active development of innovative technologies and production efficiency through digitalisation and innovative approaches.

The modernisation of the agrarian sector requires employees to be highly skilled in areas such as precision farming, hydroponics, agro-technology, robotic systems, data management, and big data analysis. Improving the level of education among farmers is also crucial, as knowledge of the latest technologies allows them to effectively apply modern methods of tillage, irrigation, and resource management. The growing role of human capital in the adoption of innovative technologies is creating a demand for specialists with digital skills who can

use drones to monitor fields, satellite images to predict yields, or even develop software to automate agricultural processes.

Digitalisation in the agrarian sector can reduce costs, optimise processes, and increase productivity, but it requires highly skilled workers who can work with new platforms and digital tools. For instance, precision farming platforms such as xarvio Field manager (Field manager..., 2020) allow farmers to manage their fields based on data collected via satellites, drones, and sensors. People who can use these technologies must have specialised skills in working with such platforms, as well as knowledge of agronomy to apply the data correctly.

Innovations and digital technologies are also linked to the development of the creative economy in the agrarian sector. Creative approaches to growing crops, vertical farms, hydroponics, and other innovative farming methods help to reduce the effects of external factors such as climate change and optimise the use of resources. In this context, human capital is the basis for the development of new business models that not only increase profitability but also ensure the sustainable development of the agrarian sector while maintaining environmental balance.

The prospects for human capital development in the context of the creative economy are closely linked to the development of innovations, technologies, and educational initiatives. To succeed in this area, it is necessary to integrate curricula and educational processes with the real needs of the creative economy, actively attract talent, and create conditions for their development and implementation. The creative economy requires employees to have not only technical and specialised knowledge, but also the ability to adapt, creativity, and the ability to work in an unstable environment. Considering the rapid changes in the technological environment, human capital should be focused on continuous development and improvement, which allows it to adapt to new economic realities and support the innovation process.

The present study and the study by A.M. Ausat *et al.* (2023) emphasised the significance of human capital as a key factor in economic development, particularly in the context of modern challenges and transformations. The

researchers emphasised that human capital development was necessary to ensure innovative development, increased productivity, and overall economic growth. Both studies focused on the significance of human capital for economic development, but the present study was more focused on the specifics of the Ukrainian economy and its adaptation to modern requirements, while A.M. Ausat *et al.* provided a general view of the role of human capital in the global context, considering different types of capital (intellectual, cultural, social). The present study and the study by S. Malisiova & S. Kostopoulou (2024) also shared a focus on the role of social capital and networks in the development of cultural and creative industries (CCI), particularly in peripheral areas. Both studies highlighted the value of social and cultural resources in supporting innovation and economic development in such regions. Key shared features were in that both approaches emphasised the significance of social networks and their effects on the development of CCIs. The distinction, however, was that S. Malisiova & S. Kostopoulou focused more on cross-sectoral networks and informal ties in local communities, while A.M. Ausat *et al.* (2023) focused on intellectual, social, and cultural capital as the foundations for the development of the creative economy.

The present study and the study by M.F. Carrillo (2024) had shared aspects, specifically, the researchers emphasised the significance of human capital for economic development. Both studies recognised that investments in education, training, and technology contributed to increased labour efficiency and innovation. The present study focused on the development of human capital through digitalisation and the latest technologies in Ukraine, particularly in the agrarian sector and creative industries. On the other hand, M.F. Carrillo addressed the influence of human capital on long-term economic growth through innovation and technological change in a global context.

The paper by H.S.H. Wijoyo *et al.* (2024) and the present study both focused on human capital development for economic development, but the approaches were distinct. The present study focused on the development of human capital in the agrarian sector and its effects on the creative

economy in Ukraine through innovation, education, and technology. It emphasised the significance of investing in human capital to increase the competitiveness of agricultural enterprises. H.S.H. Wijoyo *et al.* focused more on social capital and networks, as well as the role of governments and access to finance for the development of creative industries, particularly in peripheral regions. The difference was that the present study addressed technological innovation in Ukraine, while H.S.H. Wijoyo *et al.* were more focused on social and cultural aspects at the global level. Both studies recognised the value of human capital, but with different emphasis.

Human capital is an indispensable element of economic development, as its potential determines labour productivity, the level of innovation, and the ability to adapt to change. Investments in education, science, training, and the development of intellectual and cultural capabilities of human capital are essential for increasing competitiveness and economic growth, especially in the context of the creative economy.

Mechanisms of human capital development in the creative economy

Mechanisms for the development of human capital in the creative economy are a major part of the success of modern economies, as human capital provides innovation potential and increases production efficiency in the face of dynamic change. Human capital includes knowledge, skills, adaptability and innovation, as well as motivation and creativity. In the creative economy, where innovation, culture, and creativity are the key drivers, human capital is an essential resource that ensures economic growth through the creation of new ideas, products, and services.

Education is a key factor in the development of human capital. Education systems play a key role in shaping the basis for the development of knowledge, skills, and intellectual potential. In the context of the creative economy, education should be focused not only on the transfer of theoretical knowledge, but also on the development of practical skills that allow people to successfully adapt to changing conditions and continuously improve. It is essential to create educational platforms that foster creativity, critical thinking,

and innovative approaches to problem solving. These skills are crucial for working in the creative industries, where the ability to generate fresh ideas and solve non-standard problems is essential (Vorzhakova & Revtiuk, 2021).

Investment in research and development (R&D) is another prominent factor in the development of human capital. R&D enables the creation of the latest technologies and innovative products, which promotes growth in the creative industries. Investments in R&D activities ensure the development of highly qualified personnel capable of implementing complex innovative projects. Furthermore, R&D contributes to the creation of new knowledge that can be used to develop innovative technologies, products, or services, thereby supporting the development of the creative economy (OECD, 2021).

Alongside technology and innovation, cultural and social institutions that shape values and behavioural norms play an essential role in the development of human capital. Culture and social institutions, such as family, community, and media, influence the development of individuals' creativity, motivation, and ability to fulfil themselves. In the creative economy, cultural institutions not only preserve traditions but also promote the development of new forms of creativity that meet modern market requirements. Cultural values transmitted through social institutions have a pronounced effect on the development of creative ideas and products in various sectors of the economy. Motivation is another valuable factor contributing to the development of human capital in the creative economy. A strong level of motivation is essential for achieving high performance, especially in innovative fields where constant adaptation to change and the search for new ideas are required. Motivation provides individuals with the energy to achieve their goals, fosters creativity, and maintains a solid level of productivity. In the creative economy, where the primary resource is not physical labour but intellectual and creative activity, motivation is the driving force that allows achieving best results and implementing innovative projects (OECD, 2021).

Social networks and communications also play a major role in the development of human capital. Interaction between people, the

exchange of ideas and experiences is a valuable aspect of developing creativity and innovation. Communities that support ideas and innovation provide opportunities for the development of human capital through mutual support and knowledge sharing. Social networks also

provide opportunities for finding new opportunities for self-fulfilment and development, which is essential for the development of the creative economy. Table 1 presents the key factors contributing to the development of human capital in the creative economy.

Table 1. Examples of initiatives and methods that promote human capital development in the creative economy

Human capital development factor	Concrete initiatives and methods
Education systems	Implementation of study programmes in agribusiness, precision agriculture, and biotechnology in higher education institutions. For example, the National University of Life and Environmental Sciences of Ukraine is the innovative higher education institution in Ukraine that implements a dual form of education, cooperating with research institutions and enterprises of agrarian sector.
Research and development activities (R&D)	Joint research between universities and businesses to create new products. Kernel's Open AgriTech University offers 3-5 year students and graduates the opportunity to study in the agri-tech business. The programme includes hands-on training at the company's assets, paid internships, online meetings with experts, and scholarships for the best students.
Technology and innovation	Use of online education platforms and digital technologies to develop new ideas. For example, the Agronomy e-Learning Academy (Purdue University) offers courses such as Agronomy Essentials, Precision Agriculture and Nutrient Management. It provides knowledge on agronomy, precision agriculture, and nutrient management, helping professionals adapt to modern challenges in agriculture.
Cultural and social institutions	Support of cultural initiatives for the development of agricultural regions, such as AGRO-2025, the largest agro-industrial exhibition in Ukraine, which promotes the development of local agricultural producers and culture.
Motivation and entrepreneurship	Start-up support programmes and incubators for young entrepreneurs. For example, AgTech Farm is the largest specialised fund in Ukraine that has invested over \$1 million in agri-tech projects.

Source: compiled by the authors of this study based on data from Open agritech university (n.d.), What's happening to agri- and foodtech startups..., (2023)

The Table 1 provided examples of concrete initiatives and methods contributing to the development of human capital in the creative economy. Each factor, be it education, R&D, technology, cultural institutions or entrepreneurship, has its specifics and implementation methods. These initiatives and programmes not only support the development of human capital but also contribute to the development of the creative economy as a whole, ensuring innovative and sustainable economic advancement.

In the context of modern economic transformations, the agrarian sector is one of the key industries affected by innovative technologies. The introduction of innovative technologies in the agrarian sector not only improves the efficiency of production processes but also contributes to maintaining environmental balance and ensuring food security. However, the development of human capital plays a vital role in the

successful implementation of innovations, as the knowledge, qualifications, and skills of employees are the basis for the effective implementation of the latest technologies in production.

Human capital includes not only the physical workforce, but also the intellectual potential required to adapt to a rapidly changing technological environment. In the agrarian sector sector, this means the need for continuous training and professional development of employees, as well as the ability to adopt the latest farming methods. The development of human capital in the agrarian sector is linked to the formation of key competencies, such as mastery of the latest technologies, creative thinking, the ability to work with big data and other skills that can increase the productivity and sustainability of agricultural production. The primary areas of innovation and the latest technologies in the agrarian sector cover several crucial

areas, including automation and mechanisation of agricultural production, precision farming to improve resource efficiency, development of biotechnology to improve crop varieties and pest control, and digitalisation of agricultural management processes to optimise costs and increase transparency. Precision farming is also one of these areas, using advanced technologies such as the Global Positioning System (GPS), soil moisture sensors, drones, and satellite imagery. These tools allow significantly optimising the use of resources such as water, fertilisers, and pesticides, which not only reduces costs but also increases yields. The use of precision agriculture contributes to a more rational use of land resources and improved soil conditions, which is a major factor for the sustainable development of the agrarian sector (Ranjan *et al.*, 2024).

Another prominent area is innovations in agronomy, specifically biotechnology, which enables the creation of new crop varieties that are resistant to various diseases and climate change. This ensures the stability and sustainable development of agricultural production, as new varieties are more productive and less vulnerable to adverse environmental impacts. The use of biotechnology can improve production efficiency and reduce dependence on chemical pest and disease control agents, which positively influences the environment. Automation of production is another major area that can markedly reduce labour costs and improve the accuracy of agrotechnical measures. The use of robotic technologies for harvesting, irrigation, and soil cultivation enables farmers to reduce labour costs extensively and ensure more efficient processes. Robotic technologies are revolutionising the agricultural industry by increasing efficiency and productivity in harvesting, irrigation, and tillage. Autonomous harvesters and tractors are used for harvesting crops, which can be operated without human intervention. Robots are also used for selective fruit picking, equipped with computer vision to distinguish between ripe and unripe fruit. Drones with multispectral sensors are used to assess the condition of crops and determine the best time for harvesting. Furthermore, robotic manipulators are used for delicate fruit harvesting and processing (Hands-free crop harvested by robots..., 2017). In the field

of irrigation, smart irrigation robots use a network of soil moisture sensors and meteorological data to make real-time irrigation decisions. Autonomous irrigation systems adapt irrigation strategies to particular crop types and growth stages. Precision water application robots prevent waterlogging of the soil, while remote irrigation monitoring systems allow controlling the process through mobile applications (Ghodke *et al.*, 2023). In soil cultivation, lightweight autonomous tractors for spraying, sowing, and rolling minimise soil compaction, which ensures sustainable plant development. Robots are also available to selectively apply pesticides to plants that need them, and drones and ground scouting robots are used to collect data on soil and crop conditions. Robotic systems for precision fertilisation are used based on an analysis of the needs of concrete areas of the field (Robotics applications in agriculture, 2022). These technologies help optimise resource use, increase yields, and reduce environmental impact. They also help solve the problem of labour shortages in the agrarian sector (Zaika *et al.*, 2023). Automation helps to increase the speed and accuracy of work, reducing the probability of errors and increasing overall production efficiency.

Digitalisation is giving rise to new specialisations. For instance, professions such as precision farming specialist or agricultural data analyst are becoming more in demand. Such specialists need to be able to analyse large amounts of data obtained from sensors, drones and satellites and use this data to optimise agricultural processes. Another new profession, the agrobot operator, is emerging in connection with the automation of harvesting and soil cultivation. Robots and autonomous field processing systems are becoming a prominent part of the agricultural infrastructure, and therefore specialists who maintain these systems are in high demand as well. Digitalisation is changing not only skills requirements but also cultural and organisational aspects of the agrarian sector. For example, farmers need to become more open to the adoption of innovative technologies as they require new ways of farming and managing resources. Furthermore, farmers need to be capable of learning and adapting quickly as digital technologies are constantly improving and changing.

Digitalisation is also becoming a significant area of development in the agrarian sector, as the introduction of digital platforms for monitoring crops offers accurate control over the condition of plants, which facilitates prompt response to changes in environmental conditions. One of these platforms is Agriquest (Satellite monitoring..., 2020), a free weather data analysis platform that allows farmers to receive up-to-date information on weather conditions and their impact on yields. Another prominent platform is Coptical (Free digital platforms..., 2022), which uses satellite monitoring to analyse field conditions and provide farmers with data for decision-making. Coptical already covers over 500,000 hectares in Ukraine. For precision agriculture, xarvio Field manager (Field manager..., 2020), a global digital platform that helps farmers manage their fields from sowing to harvesting, is widely used and supports more than 39,000 farmers in 17 countries. Another notable platform is FarmLogs (FarmLogs, n.d.), a mobile application that allows farmers to keep records of all aspects of their operations, such as planting, watering, and harvesting, which greatly simplifies farm management and increases decision-making. For livestock management, AgriWebb (AgriWebb, n.d.) is used, a platform that allows farmers to keep track of livestock, plan feeding, and monitor animal health in real time. These platforms allow farmers to manage their farms more efficiently, reduce costs, and increase productivity by using modern digital technologies.

Several agri-startups are being successfully implemented in Ukraine, actively attracting human capital through the introduction of innovative technologies such as agrodrones, vertical farms, and hydroponics. These start-ups not only contribute to the development of the agrarian sector but also change the structure of jobs by creating new professions that require particular skills and qualifications. Human capital underlies successful operation of such start-ups, as it is the knowledge and experience of specialists that allows them to develop and implement innovative technologies that greatly increase the efficiency of agricultural production.

One successful example is the startup DroneUa (Ukraine became the world..., 2022),

which specialises in using drones to monitor crops, cultivate fields, and collect data on plant health. This startup involved agronomy, engineering, and IT specialists who developed software to analyse the data. As a result, farmers can reduce the cost of cultivating their fields by up to 30% and increase yields by 15-20%. In this case, human capital in the form of highly qualified specialists became the basis for the startup's development, as the effective implementation of such technologies requires knowledge of both agronomy and information technology.

Another example is Vertical Farm Ukraine (Ukrainian innovative vertical farm..., 2022), a project that implements the concept of vertical farming in urban environments using hydroponics and aeroponics. This startup actively engages agronomists and engineers to develop and implement innovative plant growing technologies. Human capital, including agronomy and engineering specialists, has helped to create effective business models for growing fresh vegetables and herbs throughout the year. This reduces transportation and storage costs, which is essential to ensure a steady supply of produce to urban areas.

These cases demonstrate how agri-startups in Ukraine are using the latest technologies to improve agricultural efficiency while investing in human capital through training and development of employees. Human capital plays a crucial role in creating successful agri-start-ups, as it is the knowledge, skills, and experience of professionals that form the basis for the implementation of innovative technologies. Skilled personnel provide the necessary knowledge to develop and implement innovative technologies such as agrodrones, vertical farms, and hydroponics. Furthermore, innovative thinking, which is developed through training and practical experience, allows generating fresh ideas and solutions that greatly improve production efficiency.

Thus, the success of agri-start-ups in Ukraine directly depends on human capital, which underlies the development of technologies and the creation of new business models in the agrarian sector. Education, specialised courses, and practical experience help to improve the skills of employees, which in turn increases the efficiency of agribusiness, helps to

adapt to market changes and ensures the sustainable development of the agricultural industry. Automation of accounting and management systems at enterprises can markedly reduce the cost of management functions and increase the efficiency of agricultural enterprises. This includes the use of software to manage yields,

plan crops, control resource turnover and forecast economic outcomes, which allows for optimisation of production processes and increase the overall efficiency of enterprises. Table 2 presents a SWOT analysis that reflects the key factors that influence human capital development and innovation in agriculture.

Table 2. SWOT-analysis of the introduction of innovations and innovative technologies in the agrarian sector of the economy

Strengths	Weaknesses
1. Increased potential for productivity improvement through the latest technologies (precision farming, automation). 2. Optimisation of the use of resources, such as water, fertilisers, and pesticides, through the application of the latest technologies that reduce costs and increase production efficiency. 3. Improvement of environmental sustainability and conservation of natural resources through the introduction of technologies that reduce the use of chemicals and minimise adverse environmental impact. 4. Increased competitiveness of agricultural enterprises in the international market through optimisation of production processes and export of innovative products.	1. Insufficient dissemination of information about the latest technologies among some farmers. 2. Excessive initial costs of implementing innovations. 3. Lack of adequate training of personnel to work with the latest technologies. 4. Technical and organisational challenges in integrating innovative technologies into conventional production processes.
Features	Threats
1. Growing demand for environmentally friendly products, which drives innovation. 2. Development of international partnerships and cooperation in the agrarian sector of the economy, which facilitates the transfer of technology and knowledge. 3. Improved access to finance for investment in innovative technologies through public and private support programmes. 4. Increased access to advanced digital platforms and tools for data analysis and monitoring of production processes in the agrarian sector of the economy, which enables improved efficiency and cost reduction, including through external initiatives and international partnerships.	1. Risk of losing conventional jobs to automation and robotics. 2. Dependence on external technology and parts suppliers. 3. Potential market volatility and uncertainty over investment returns. 4. Elevated level of risk if technology is not applied correctly (poor integration or underestimation of impact).

Source: compiled by the authors of this study based on data from S. Zaika *et al.* (2023), A. Ranjan *et al.* (2024)

Overall, the introduction of innovations and the latest technologies into the agrarian sector through human capital development is a key element for ensuring the sustainable development of the sector. The SWOT analysis revealed that while there are significant opportunities for increasing the productivity and environmental sustainability of agricultural production, proper education and training is a crucial precondition for the successful fulfilment of these opportunities. It is necessary to ensure that workers develop the adequate skills to implement the latest technologies and innovations effectively, which will minimise risks and maximise the potential for growth in the agrarian sector.

Education and digital technologies substantially affect farm productivity and income,

as evidenced by studies from various regions. The effects of education on farm productivity are evident. M. Reimers & S. Klasen (2011) found that each additional year of farmer education increases agricultural productivity by 2-5% in high-income countries. The greatest effect was observed for primary and secondary education, while tertiary education had no significant effect on productivity. This demonstrated the value of basic knowledge for farmers who can effectively innovate and adopt modern farming practices. Additionally, a study in the Offinso Municipality of Ghana found that farmers with secondary education had 15-20% greater yields than those with only primary education. Furthermore, access to extended services such as extension can increase productivity by 25%, although the coverage of such services continues

to be low. This underscores the significance of education not only in formal training, but also in access to practical knowledge and advice that can greatly improve farm efficiency.

Digital technologies also markedly affect farmers' incomes. A 2014 study of 676 farmers in Guangdong province, China, found that the use of digital technologies such as the Internet of Things (IoT) and data analytics increased incomes from agricultural production and sales by 12-18%, especially for highly skilled farmers. Digital technologies also reduced the negative impact of distance to market by 30%, allowing farmers to get their products to end users faster and cheaper (Oduro-Ofori *et al.* 2014). Platforms such as Farm Pass (India, Africa) enabled farmers to increase their income by 20-35% through direct access to buyers, digital payments, and the ability to obtain loans based on financial history. For example, farmers in India receive payment on the day of sale, which reduces losses from delays and improves the financial stability of farms (True prosperity will be found..., 2023).

In Ukraine, education and the adoption of digital technologies greatly influence farm productivity and income. 66% of farmers in Ukraine have a university degree, which positively affects their productivity. Farmers with higher education demonstrate 20-30% higher productivity compared to those with only secondary or vocational education. The study also showed that farmers who take advanced training courses can increase their productivity by 15-25% through the introduction of innovative technologies and farming methods. In Ukraine, there are online education platforms such as AgroPortal and AgroHub that help farmers acquire new knowledge and skills that can improve their efficiency (Varchenko, 2019).

Overall, the key findings were that education is most effective in a context of rapid technological advancement, when farmers can adapt innovations more quickly and increase their productivity. Digital technologies not only increase incomes, but also simplify access to financial services, reducing dependence on conventional intermediaries. Expanding educational programmes and digital infrastructure in rural areas is key to the sustainable development of the agrarian sector, as it creates favourable

conditions for innovation and improves the economic efficiency of farms.

The present study and the study by M.Y. Darsyah *et al.* (2024) shared a focus on the development of human capital for the creative economy, but their approaches differed. Both studies stressed the significance of investing in education, training, and the latest technologies for the development of creative industries. At the same time, the present study focused on particular industries, such as the agrarian sector of the economy in Ukraine, and the value of integrating digital technologies and precision farming to increase productivity. M.Y. Darsyah *et al.*, on the other hand, focused on general approaches to developing the creative economy through infrastructure, digital platforms, and education, without focusing on concrete sectors.

The present study focused on the development of human capital in the agrarian sector, emphasising the role of education, innovation, and technology in increasing the productivity and competitiveness of agricultural enterprises through the introduction of the latest technologies such as precision agriculture and digital platforms. J.D. Snowball & R. Haines (2024) focused more on the global aspects of supporting creative industries, while the present study focused on particular innovations and technologies in the agrarian sector. The findings of D. Divianto *et al.* (2024) and of the present study had a shared focus on the value of human capital for the development of the creative economy. Both studies emphasised the significance of investments in human capital and government support for the development of creative industries. Furthermore, they highlighted the role of social capital and infrastructure as factors influencing the development of this sector. However, D. Divianto *et al.* paid more attention to intellectual capital, specifically human capital and its influence on the financial success of SMEs in the creative economy, using quantitative methods.

The paper by B. Fotuhi Mehrabani *et al.* (2022) and the present study had a shared theme in terms of the significance of human capital for economic development, specifically, for the creative economy. Both studies emphasised the role of investment in human capital to stimulate innovation and economic growth and recognised

the significance of government initiatives. The present study focused on the adoption of technology in the agrarian sector, namely precision agriculture and digital platforms, while the B. Fotuhi Mehrabani *et al.* investigated the spatial distribution of creative capital in Iranian metropolises and its impact on economic growth.

Human capital is a critical factor in economic development in the creative economy. Its value lies not only in knowledge and skills, but also in the ability to innovate, adapt, and solve problems creatively. In a creative economy, human capital ensures the creation of innovative ideas, products, and services, which forms the basis for economic growth.

Use of human capital potential to develop the creative economy in the agrarian sector

The agrarian sector of the economy is one of the oldest and crucial areas of economic activity, but it has undergone major transformations over time due to the introduction of innovations and creative approaches. Creative approaches in the agrarian sector include a variety of strategies to help adapt to global challenges, such as climate change, growing demand for environmentally friendly products, the need to increase resource efficiency, and sustainable development. These approaches help farmers to optimise their processes, reduce costs, improve product quality, and ensure sustainable development at the local level.

Creative approaches to cooperation and clustering have been the basis for many agricultural initiatives. In some countries, farmers unite to form cooperatives or clusters, enabling them to exchange knowledge, improve efficiency, and reduce costs. In Austria, Pramoleum has created a unique model of cooperation by bringing together farms to grow pumpkins and produce pumpkin seed oil (Rural and high-tech..., 2021). This cooperation not only reduced production costs but also expanded the range of products and created new jobs for local residents. Furthermore, this approach has contributed to the development of the regional economy by creating new business models and increasing demand for pumpkin seed oil on the local market. Another example is the KochCampus Association,

which brings together chefs, restaurateurs, and farmers to jointly develop new products and test new crops in the catering industry (Rural and high-tech..., 2021). This approach not only supports local producers, but also promotes gastronomic tourism, which is a major part of the economy in many Austrian regions. The project also serves as an excellent example of how the agrarian sector can be integrated with other economic sectors to create added value. The introduction of digital technologies in the agrarian sector can reduce costs, increase the efficiency of production processes, and ensure sustainable development. One example is the Austrian myAcker project, which allows consumers to rent beds online and monitor the cultivation of vegetables via smartphone or tablet (Rural and high-tech..., 2021). This allows for a new model of interaction between the consumer and the producer, where everyone can become part of the agricultural process, observe the growth of their products, and even take part in choosing what to grow. This approach helps to engage people in agricultural production, raise awareness of agriculture and encourage sustainable consumption.

The use of human capital for the development of the creative economy in the agrarian sector is one of the key factors contributing to the modernisation of agriculture, increasing its efficiency and environmental sustainability. The Netherlands is a prime example of how human capital can drive innovation and create new opportunities for the agrarian sector, specifically through the introduction of advanced technologies, the development of digital initiatives and the implementation of sustainable agricultural practices. A highly educated workforce, research, and effective collaboration between universities, businesses, and farmers are leading to prominent results in agriculture.

The role of human capital in the creative agrarian economy in the Netherlands is invaluable. Highly skilled people, such as specialists in agronomy, engineering, and the IT sector, contribute to the development of innovative technologies such as precision farming, robotics, hydroponics, vertical farms, and sustainable agricultural practices. Collaboration between

academic institutions, government, and the private sector in the Netherlands actively promotes innovation. For instance, partnerships between universities and agricultural enterprises have led to breakthroughs in the development of new crops, improved water management systems, and the introduction of innovative technologies in greenhouse farming. Such innovations can reduce water costs, preserve biodiversity and markedly increase yields (OECD, 2015).

One of the most prominent examples of innovation in the Netherlands is the Wageningen University Farm of the Future concept, which focuses on sustainable farming systems using zero fossil fuels. Within the framework of this project, eight different crops are being experimented with, which helps to increase biodiversity, soil health, and yield efficiency. Innovative drainage systems are also being introduced to store excess water underground for reuse during dry periods. This can greatly reduce dependence on conventional irrigation methods and improve water use efficiency (OECD, 2015).

Another successful example is innovation in greenhouses, where Dutch farmers use ultra-modern technology such as automated climate control systems and LED lighting to grow vegetables and flowers year-round. This maximises the productivity of the land while minimising energy consumption, which is essential for the sustainable development of the agricultural industry. Thanks to such initiatives, farmers can ensure sustainable production with minimal environmental impact. Furthermore, the CAP Strategic Plan (2023-2027) in the Netherlands supports farmers in their transition to sustainable agriculture. This is achieved through individualised regional strategies that ensure not only a fair distribution of income, but also food security and environmental sustainability. This strategy allows farmers to adapt to new conditions, use resources efficiently, and reduce their environmental impact (Netherlands – CAP Strategic Plan..., n.d.).

Human capital also contributes to the development of an export-oriented agri-food economy in the Netherlands. The country is the second largest exporter of agricultural goods in the world, with exports worth over EUR 100 billion annually. Creative approaches in logistics, pack-

aging, and innovation contribute significantly to this achievement. The Netherlands has successfully integrated human capital into the development of new packaging, logistics and delivery methods, making its products high quality and competitive on global markets.

Lessons from the Dutch experience show that human capital is a crucial factor for the development of a creative economy in the agrarian sector. Highly skilled personnel, innovative approaches and effective cooperation between research institutions, government and business allow the Netherlands to stay a leader in agriculture. Educational programmes and investments in human capital development ensure the sustainable development of the agrarian sector, addressing environmental issues and creating new business models that contribute to increased productivity and environmental sustainability in agrarian sphere.

Digitalisation of the agrarian sector is an important stage of development in Ukraine. Involving young people in the development of digital technologies is a major step towards increasing the efficiency of production and marketing. Various platforms for data exchange between farmers, suppliers, and consumers are actively developing in Ukraine, such as AgroPortal (AgroPortal, n.d.), AgroHub (Analysing millions of numbers..., n.d.), E-Agriculture (E-Agriculture, n.d.), which allows for better management decisions and reduced costs (Creative approaches, 2021). Each of these platforms has its own impact on the work of enterprises in the agrarian sector, helping to improve communication, management processes, and reduce costs. AgroPortal is one of the leading information exchange platforms in the Ukrainian agrarian sector. It enables farmers to receive up-to-date information on product prices, industry news, and government support programmes. Using AgroPortal helps to improve management decisions, as farmers can quickly respond to changes in the market. Furthermore, the platform helps to reduce costs by providing access to up-to-date data, which allows farmers to plan input purchases and sales more efficiently. AgroHub is another platform that actively supports farmers in Ukraine. It is focused on creating an ecosystem for the

exchange of knowledge and experience among farmers. AgroHub allows farmers to upgrade their skills through online courses and trainings, which improves their farm management skills. The platform also facilitates communication between farmers, suppliers, and consumers, which reduces transport and logistics costs through more accurate and prompt orders. E-Agriculture is a platform that supports farmers in using digital technologies to manage their farms efficiently. It allows farmers to access online resources, tools for monitoring and analysing data, which is essential for making informed management decisions. The use of this platform improves agricultural communication and reduces costs, as the platform provides accurate monitoring of resources and allows for optimisation of the processes of growing, harvesting, and processing agricultural products. Overall, these platforms help farmers improve market access, optimise management processes, and reduce costs, as well as improve farmers' skills and facilitate communication between agricultural market participants. They enable farmers to adapt to market changes more quickly, increase efficiency and reduce financial risks, which is critical in times of economic instability. Climate change and global environmental issues are forcing the agrarian sector to adapt to new conditions. The use of environmental technologies to reduce the adverse impact that agricultural production has on the environment is one of the most significant creative approaches in this area.

One such example in Ukraine is the creation of biogas complexes for processing agricultural waste. These facilities can process organic waste such as manure, haylage, and other biological materials into energy that can be used for farmers' needs. Such complexes also reduce the amount of waste in landfills and contribute to soil conservation, as the residues after processing can be used as organic fertiliser (Rural and high-tech..., 2021).

Another example is the development of climate-smart agriculture in Ukraine. Adapting the agrarian sector to climate change is becoming increasingly significant for food security. This includes the use of drought-tolerant crops, water, and energy conservation methods,

and the application of the latest agricultural technologies to increase productivity in an unstable climate. Climate-smart approaches can markedly reduce crop losses and make agriculture more resilient to extreme weather conditions. Technologies such as precision farming and no-till farming methods reduce CO₂ emissions, increase soil resilience to climate challenges and guarantee sustainable agricultural development. These technologies can reduce tillage costs, reduce the risk of erosion, and improve soil structure. This is an important part of maintaining food security in the face of climate change (Prospects for the development..., 2024).

Proactive approaches that can increase productivity and help adapt to new economic, environmental, and social challenges are a powerful tool for sustainable development of the agrarian sector. Innovations, such as innovative technologies, digitalisation, cooperation, and eco-friendly methods, allow the agrarian sector to become more competitive and ensure sustainable development at all stages of the production cycle. Considering the current trends, the agrarian sector has a massive potential for development if creative and innovative solutions are implemented.

The present study and the study by Y. Ionin & A. Prysich (2024) had a shared focus on the significance of digital technologies for economic development and improving the efficiency of management processes. Both studies emphasised the role of digital tools in optimising business processes and increasing the competitiveness of enterprises. However, the difference between them was that the present study focused on the development of human capital and its relationship with the creative economy, while Y. Ionin & A. Prysich focused more on digital technologies and their influence on management structures.

The study by C. Chaiboonsri (2024) and the present focused on the value of human capital for economic development, but with different emphases. Both studies emphasised the need to invest in education, innovation, and technology. C. Chaiboonsri emphasised the role of cultural industries, which contribute to economic growth through creativity and new jobs. The present study, on the other hand, focused on the

development of human capital in the agrarian sector, specifically through precision agriculture and digital technologies to increase productivity. Both studies recognised the value of investment in R&D, but C. Chaiboonsri focused more on cultural and social capital, while the present study underscored technological innovation in the agrarian sector.

The current study and the study by D. Kalfas *et al.* (2024) converged in their emphasis on the role of cultural and creative industries for economic development and social cohesion. Both studies emphasised their significance for job creation and entrepreneurship. D. Kalfas *et al.* focused on the social and cultural aspects of urban regeneration in Europe. This study and the study by L.J.S. Baiyegunhi (2024) shared a focus on the significance of human capital for economic development. Both studies highlighted the value of investing in education, research, and innovation to increase productivity and stimulate economic growth. The present study focused more on the cultural and creative industries, exploring their role in regional development and recovery through an analysis of sectoral impacts on the economy. At the same time, L.J.S. Baiyegunhi's study focused on the agrarian sector and focused on human capital development through training of farmers to increase their productivity and resilience to change.

The present study and the study by W.-J. Yan & S.-T. Liu (2023) had a shared focus on the development of the creative economy, particularly through innovation and human capital. However, the approaches differed: the present study focused on the development of human capital through education and technological innovation to stimulate the creative economy, while the study by W.-J. Yan & S.-T. Liu focused on cultural aspects and the management of the creative economy through cultural policies. Both approaches recognised the significance of innovation, but from different standpoints – through human capital and cultural governance.

This paper and the study by Y.F. Yoga *et al.* (2023) both addressed the development of the creative economy through investment in human capital and entrepreneurship support, emphasising the significance of public policy and infrastructure. Both studies examined the role

of human capital and innovation in supporting economic growth in the creative industries. However, Y.F. Yoga *et al.* focused on infrastructure initiatives and government programmes in specific regions of Indonesia, while the present study focused more on the agrarian sector and technological innovations, such as digitalisation and precision agriculture, to stimulate the development of the creative economy.

Investments in education and research are essential for the development of human capital in the agrarian sector in the context of the creative economy. Programmes aimed at developing creativity, innovation, and entrepreneurial skills should be available at all levels of education, including at agricultural universities and specialised training institutions for agricultural professionals. For example, courses in agribusiness, precision farming, agronomy, ecology, and sustainability can prepare students for the challenges of the modern agricultural market. This will enable young professionals not only to work effectively with the latest technologies, but also to run a successful business in the agrarian sector.

Furthermore, it is vital to stimulate research and development activities in the field of agricultural technology and innovation. An example is investment in biotechnology research, particularly in genetic modification of crops, which enables the development of varieties that are more resistant to climate change. It is also worth paying attention to the development of agri-platforms for monitoring soil health, which allows farmers to obtain accurate information to increase productivity and reduce costs.

The creation of effective educational platforms for the development of specialised skills is a prominent aspect for the agrarian sector. Such platforms can include courses and trainings on the use of precision agriculture, automation of agricultural processes, and the development of sustainable production methods. For instance, platforms that teach farmers how to use drones to monitor crops or soil data collection systems can help young farmers to implement innovative technologies in their operations, markedly reducing costs and increasing efficiency. Supporting cultural and social initiatives in the agrarian sector should be a priority in human capital development policy. It is vital to stimulate

the development of cultural and social projects in agricultural regions, such as the organisation of agritourism festivals, agricultural exhibitions or the creation of rural cultural centres. Such initiatives foster creativity in communities and can become a new source of employment, which will also improve social stability in the regions.

Engaging young people in creative agricultural industries is essential for innovation and sustainable economic growth. Programmes that foster the development of young talent in areas such as digital agriculture, food processing or agribusiness can help to create a new generation of entrepreneurs and innovators. For example, programmes to support agri-innovation start-ups can help young farmers create competitive products and services that meet global market demands. To ensure the sustainable development of the agrarian sector, it is necessary to introduce innovative technologies such as precision farming, automation of agricultural production processes, biotechnology and renewable energy sources. For example, farmers who use monitoring systems to determine water and fertiliser requirements can significantly reduce input costs and increase yields. It is also worth addressing the development of biofuels and renewable energy-oriented agricultural enterprises, which helps to reduce the environmental impact of agriculture.

Integration of international practices is a valuable condition for the development of human capital in the agrarian sector. Involvement in international support, training and cooperation programmes will allow Ukrainian farmers to gain access to advanced technologies and best practices. For example, participation in international projects on precision agriculture or organic production will allow adapting these technologies to Ukrainian conditions, increasing competitiveness in the global market and ensuring sustainable development of the agrarian sector.

CONCLUSIONS

The development of human capital is the basis for increasing the competitiveness of national economies, specifically in the context of globalisation, rapid technological change, and the challenges posed by climate change and

economic instability. A creative economy based on intellectual and creative resources requires the development of human capital capable of generating innovative ideas, products, and services. This allows not only to increase production efficiency, but also to adapt to new market requirements, increase innovation and ensure sustainable development. Investments in human capital, including in education, research and development, and the latest technologies, are essential to foster the development of the creative economy, particularly in industries such as information technology, media, design, culture, and the arts.

The study demonstrated that countries that actively invest in human capital development, such as Austria and the Netherlands, achieve prominent economic growth rates and have competitive advantages in the global market. In the context of constant change and competition at the global level, human capital is becoming one of the key factors determining the success of enterprises, especially in the creative industries. An essential aspect is the integration of education and innovative approaches into the practical activities of enterprises, which allows them to create new products, technologies and services that meet international standards.

Ukraine is gradually moving closer to integrating the latest technologies and digital platforms into the agrarian sector. The use of platforms such as AgroPortal, AgroHub and E-Agriculture helps to improve communication between farmers, suppliers and consumers, as well as optimise management processes. It is also important to develop education for farmers, which includes not only traditional courses but also online learning using modern technologies, allowing farmers to gain relevant knowledge and improve their skills. Training programmes such as AgriAcademy help farmers to effectively use new digital tools and techniques, which leads to increased productivity and reduced costs.

Human capital development also greatly influences social responsibility and environmental sustainability. Improving the education and skills of employees allows for more efficient resource management, cost reduction and the introduction of sustainable technologies in production, which helps to preserve the

environment and increase the competitiveness of enterprises. Educated employees are also better equipped to adapt to climate change, which is a crucial aspect of sustainable development in the face of global environmental challenges.

Human capital is an integral part of the transformation of the agrarian sector in these countries. Investments in education, research and development, and the introduction of the latest technologies contribute to increasing the efficiency of agricultural production, promoting innovation, and ensuring sustainable economic development. Training programmes, cooperation between universities and businesses, and the introduction of digital platforms are the basis for the successful modernisation of the

agrarian sector in these countries, and the experience of the Netherlands, Austria and Ukraine can become a scientific and practical model for other countries seeking to achieve sustainable development in the agrarian sphere. Prospects for further research include the investigation of the effects of human capital on the introduction of innovative technologies and sustainable development of the agrarian sector, particularly through digitalisation and innovation.

ACKNOWLEDGEMENTS

None.

CONFLICT OF INTEREST

None.

REFERENCES

- [1] Agribusiness and Sustainable Food Production Economics. (n.d.). Retrieved from <https://www.coursera.org/specializations/agribusiness-and-sustainable-food-production-economics>.
- [2] AgriWebb. (n.d.). Retrieved from <https://www.agriwebb.com/>.
- [3] AgroPortal. (n.d.). Retrieved from <https://agroportal.ua/news>.
- [4] Analyzing millions of numbers to help you earn millions of dollars. (n.d.). Retrieved from <https://agrohubs.com/en/about/>.
- [5] Ausat, A.M., Al Bana, T., & Gadzali, S.S. (2023). Basic capital of creative economy: The role of intellectual, social, cultural, and institutional capital. *Journal of Tourism and Business*, 1(2), 42-54. doi: 10.58905/apollo.v1i2.21.
- [6] Baidybekova, S.K., & Sauranbay, S.B. (2022). The role of human capital in the economic development of countries. *The Economy Strategy and Practice*, 17(2), 111-125. doi: 10.51176/1997-9967-2022-2-111-125.
- [7] Baiyegunhi, L.J.S. (2024). Examining the impact of human capital and innovation on farm productivity in the KwaZulu-Natal North Coast, South Africa. *Agrekon*, 63(1-2), 51-64. doi: 10.1080/03031853.2024.2357072.
- [8] Carillo, M.F. (2024). Human capital composition and long-run economic growth. *Economic Modelling*, 137, article number 106760. doi: 10.1016/j.econmod.2024.106760.
- [9] Chaiboonsri, C. (2024). The potential analytical impact of significant sectoral creative economy on thailand's economy: A case study of the IRS-CGE Model vs. the CRS-CGE Model for both the national and provincial economies. *Economies*, 12(2), 44. doi: 10.3390/economies12020044.
- [10] Chaikovska, I. (2023). Human capital as a factor of innovative development of the national economy. *Scientific Journal "Modeling the Development of the Economic Systems"*, 2, 229-234. doi: 10.31891/mdes/2023-8-31.
- [11] Creative approaches of young people to the future development of the Ukrainian agro-industrial complex. (2021). Retrieved from <https://nubip.edu.ua/node/91325>.
- [12] Darsyah, M.Y., Akbar, S., Widjanarko, W., & Al-Amin, A. (2024). [Optimising the role of creative economy in society through literature review: Empowerment strategies and sustainable development models](#). *Journal of Community Dedication*, 4(3), 529-544.
- [13] Divianto, D., Kamaludin, K., Santi, F., & Saiful, S. (2024). Impact of intellectual capital on business efficiency and financial success in creative SMEs. *International Journal of Financial Accounting and Management*, 6(3), 361-383. doi: 10.35912/ijfam.v6i3.2512.

- [14] Duca, S. (2023). The resource of creativity and creative human capital for the management of knowledge economy: Implications for the Republic of Moldova. *E3S Web of Conferences*, 409, article number 05015. doi: [10.1051/e3sconf/202340905015](https://doi.org/10.1051/e3sconf/202340905015).
- [15] E-Agriculture. (n.d.). Retrieved from <https://www.fao.org/e-agriculture/>.
- [16] FarmLogs. (n.d.). Retrieved from <https://m.farms.com/agriculture-apps/crops/farmlogs>.
- [17] Field Manager – a digital platform for agriculture. (2020). Retrieved from <https://aggeek.net/ru-blog/field-manager--tsifrova-platforma-dlya-silskogo-gospodarstva>.
- [18] Fotuhi Mehrabani, B., Ziari, K., Pourahmad, A., & Zanganeh, S. (2022). Explaining the spatial distribution of creative capital as a driver of economic growth in Iranian Metropolises. *Urban Economics and Planning*, 3(3), 37-51. doi: [10.22034/uep.2022.344994.1241](https://doi.org/10.22034/uep.2022.344994.1241).
- [19] Free digital platforms for farmers. (2022). Retrieved from <https://surli.li/ncqeco>.
- [20] Ghodke, S.P., Godase, S.M., Jadhav, S.R., Hiranwale, S.B., & Sapre, N.R. (2023). *SMART irrigation robot*. *International Journal of Advance Research and Innovative Ideas in Education*, 9(6), 139-145.
- [21] Greenhouse farming foundation. (2022). Retrieved from <https://www.udemy.com/course/greenhouse-farming-foundation/?couponCode=ST17MT31325G1>.
- [22] Hands-free crop harvested by robots in world-first trial. (2017). Retrieved from <https://surli.cc/ixxlpz>.
- [23] Hmyria, V.P. (2023). Creative industries and their contribution to the country's economic development. *Economics*, 4(68), 109-115. doi: [10.15276/ETR.04.2023.12](https://doi.org/10.15276/ETR.04.2023.12).
- [24] Horban, Y., Dolbenko, T., Yaroshenko, T., Sokol, O., & Miatenko, N. (2021). Human capital as a development factor for cultural and creative industries. *International Journal of Computer Science & Network Security*, 21(12), 604-610. doi: [10.22937/IJCSNS.2021.21.12.83](https://doi.org/10.22937/IJCSNS.2021.21.12.83).
- [25] Ionin, Y., & Prysich, A. (2024). Digital transformation in company management: Ukraine on the way to competitiveness. *Economic Analysis*, 34(34(3)), 429-437. doi: [10.35774/econa2024.03.429](https://doi.org/10.35774/econa2024.03.429).
- [26] Ismayilov, V., & Karimova, V. (2023). Development of an integrated model of intellectual capital based on various approaches to «human capital». *Management and Business*, 1(2), 12-24.
- [27] Kalenuk, I., & Kuznetsova, N. (2020). Human capital development in the conditions of creative economy. *Central Ukrainian Scientific Bulletin. Economic Sciences*, 4(37). doi: [10.32515/2663-1636.2020.4\(37\).77-85](https://doi.org/10.32515/2663-1636.2020.4(37).77-85).
- [28] Kalfas, D., Kalogiannidis, S., Ambas, V., & Chatzitheodoridis, F. (2024). Contribution of the cultural and creative industries to regional development and revitalization: A European perspective. *Urban Science*, 8(2), 39. doi: [10.3390/urbansci8020039](https://doi.org/10.3390/urbansci8020039).
- [29] KochCampus. (n.d.). Retrieved from <https://www.kochcampus.com/blank-7>.
- [30] Kuznetsova, N., Tkachuk, V., Obikhod, S., & Vlasenko, T. (2022). Development and preservation of human capital under the conditions of the creative economy. *PROOF*, 2, 123-129. doi: [10.37394/232020.2022.2.15](https://doi.org/10.37394/232020.2022.2.15).
- [31] Londar, S., Lytvynchuk, A., Versal, N., Posnova, T., & Tereshchenko, H. (2020). Investment in human capital within the creative economy formation: Case of the Eastern and Central Europe countries. *Comparative Economic Research. Central and Eastern Europe*, 23(4), 129-148. doi: [10.18778/1508-2008.23.31](https://doi.org/10.18778/1508-2008.23.31).
- [32] Malisiova, S., & Kostopoulou, S. (2024). Synergies of cultural – creative industries and development in peripheral areas: Networking, social capital, and place. *Heritage*, 7(8), 4500-4519. doi: [10.3390/heritage7080212](https://doi.org/10.3390/heritage7080212).
- [33] Mecocci, F.B., Maghssudipour, A., & Bellandi, M. (2022). The effect of cultural and creative production on human capital: Evidence from European regions. *Papers in Regional Science*, 101(6). doi: [10.1111/pirs.12702](https://doi.org/10.1111/pirs.12702).
- [34] myAcker. (n.d.). Retrieved from <https://myacker.com/>.
- [35] Neboha, T., Zapsha, H., Kuznetsova, M., Golikova, O., & Striy, L. (2024). Development of the human capital in the context of corporate personnel training digitalization. *E3S Web of Conferences*, 558, article number 01020. doi: [10.1051/e3sconf/202455801020](https://doi.org/10.1051/e3sconf/202455801020).

- [36] Netherlands – CAP Strategic Plan. (n.d.). Retrieved from https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/netherlands_en.
- [37] Oduro-Ofori, E., Aboagye Anokye, P., & Acquaye, N.A.E. (2014). *Effects of education on the agricultural productivity of farmers in the Offinso Municipality*. *International Journal of Development Research*, 4(9), 1951-1960.
- [38] OECD. (2015). *Innovation, agricultural productivity and sustainability in the Netherlands*, OECD food and agricultural reviews. Paris: OECD Publishing. doi: 10.1787/9789264238473-en.
- [39] OECD. (2021). *The role of innovation and human capital for the productivity of industries*. OECD science, technology and industry policy papers. Paris: OECD Publishing.
- [40] Open agritech university. (n.d.). Retrieved from <https://oau.kernel.ua/>.
- [41] Posnova, T.V. (2021). Creative human capital as a basis for the functioning of creative corporations. *Mechanism of Economic Regulation*, 3, 38-45. doi: 10.21272/mer.2021.93.03.
- [42] Prospects for the development of Ukraine's agricultural sector in the context of climate change. (2024). Retrieved from <https://niss.gov.ua/news/novyny-nisd/perspektyvy-rozvytku-aharnoho-sektoru-ukrayiny-v-umovakh-klimatychnykh-zmin>.
- [43] Protsenko, V. (2024). *How to preserve and strengthen Ukraine's human capital*. Retrieved from <https://surl.li/kqfsbt>.
- [44] Ranjan, A., Pathak, S., & Singh, S. (2024). *Precision farming: Uses drones, satellite imagery, and other technologies to increase efficiency and resource utilization*. In *Fields of tomorrow: Advancements in modern agriculture* (pp. 21-34). Bilaspur: Astitva Prakashan.
- [45] Reimers, M., & Klasen, S. (2011). *Revisiting the role of education for agricultural productivity*. Göttingen: Georg-August-Universität Göttingen, Ibero-America Institute for Economic Research (IAI).
- [46] Robotics applications in agriculture. (2022). Retrieved from <https://robotnik.eu/robotics-applications-in-agriculture/>.
- [47] Rural and high-tech: How farmers manage in the 21st century. (2021). Retrieved from <https://surl.li/qdhsrn>.
- [48] Satellite monitoring for farmers: A list of free platforms. (2020). Retrieved from <https://www.agrilab.ua/suputnykovyj-monitoryng-dlya-agrariyiv-perelik-bezkoshtovnyh-platform/>.
- [49] Slaus, I., & Jacobs, G. (2011). Human capital and sustainability. *Sustainability*, 3(1), 97-154. doi: 0.3390/su3010097.
- [50] Snowball, J.D., & Haines R. (2024). The creative economy in Africa: The focus and scope of the African Journal of Creative Economy. *African Journal of Creative Economy*, 1(1). doi: 10.4102/ajce.v1i1.3.
- [51] Tochylyna, Y. (2019). *The role of human capital in innovation development of the national economy*. *Scientific Bulletin of Uzhhorod National University*, 26(2), 88-91.
- [52] True prosperity will be found in the embrace of the digital economy. These farmers prove it. (2023). Retrieved from <https://www.weforum.org/stories/2023/01/embrace-digital-economy-farmers-africa-davos-2023/>.
- [53] Ukraine became the world leader in the growth of drones for agriculture. (2022). Retrieved from <https://odessa-journal.com/public/ukraine-became-the-world-leader-in-the-growth-of-drones-for-agriculture>.
- [54] Ukrainian innovative vertical farm Green Wave Organic produces 1 500 kg of vegetables and herbs a day. (2022). Retrieved from <https://surl.li/ybmpwx>.
- [55] Varchenko, O.M. (2019). *Organisational and economic aspects of farm development in Ukraine*. Bila Tserkva: Bila Tserkva National Agrarian University.
- [56] Vorzhakova, Yu., & Revtiuk, Ye. (2021). *Influence of the quality of the education system on the efficiency of investing in human capital (on the example of Ukraine)*. In *II international scientific and practical conference "Business, innovations, management: Issues and perspectives"* (pp. 138-139). Kyiv: National Technical University of Ukraine 'Igor Sikorsky Kyiv Polytechnic Institute.

- [57] WBGx: E-Learning on Digital Agriculture. (n.d.). Retrieved from <https://www.edx.org/learn/agriculture/world-bank-group-e-learning-on-digital-agriculture>.
- [58] Welcome to Pramoleum. (n.d.). Retrieved from <https://www.pramoleum.eu/>.
- [59] What's happening to agri- and foodtech startups and where to look for money during the war - a brief overview from an investor. (2023). Retrieved from <https://aggeek.net/ru-blog/otkuda-vzyalis-takie-tseny-6-faktorov-kotorye-vliyayut-na-stoimost-zernovyh>.
- [60] Wijoyo, H.S.H., Mujanah, S., & Susanti, N. (2024). Building a sustainable creative economy: The influence of capital access and government programs. *Edelweiss Applied Science and Technology*, 8(6), 3081-3099. doi: [10.55214/25768484.v8i6.2658](https://doi.org/10.55214/25768484.v8i6.2658).
- [61] Yan, W.-J., & Liu, S.-T. (2023). Creative economy and sustainable development: Shaping flexible cultural governance model for creativity. *Sustainability*, 15(5), article number 4353. doi: [10.3390/su15054353](https://doi.org/10.3390/su15054353).
- [62] Yoga, Y.F., Sadana, K., & Prianto, B. (2023). Increasing industrial competitiveness through the quality of human resources. *International Journal of Research in Social Science and Humanities (IJRSS)*, 4(8), 1-10. doi: [10.47505/IJRSS.2023.V4.8.1](https://doi.org/10.47505/IJRSS.2023.V4.8.1).
- [63] Zaika, S., Hridin, O., & Zaika, O. (2023). Innovations in sustainable agricultural development: Trends, issues, perspectives. *Economy and Society*, 52. doi: [10.32782/2524-0072/2023-52-69](https://doi.org/10.32782/2524-0072/2023-52-69).

Тетяна Балановська

Кандидат економічних наук, професор
 Національний університет біоресурсів і природокористування України
 03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0001-6814-5888>

Олена Чередніченко

Кандидат технічних наук, доцент
 Національний університет біоресурсів і природокористування України
 03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0001-8908-4113>

Людмила Степасюк

Кандидат економічних наук, доцент
 Національний університет біоресурсів і природокористування України
 03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0002-7258-9243>

Олександр Юрченко

Кандидат економічних наук, доцент
 Київський столичний університет імені Бориса Грінченка
 04053, вул. Бульварно-Кудрявська, 18/2, м. Київ, Україна
<https://orcid.org/0000-0002-8447-6510>

Кристина Драмарецька

Кандидат економічних наук, доцент
 Національний університет біоресурсів і природокористування України
 03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0002-9886-1663>

Оксана Барановська

Кандидат економічних наук, доцент
 Національний університет біоресурсів і природокористування України
 03041, вул. Героїв Оборони, 15, м. Київ, Україна
<https://orcid.org/0000-0003-3884-8894>

Розвиток людського капіталу в умовах становлення креативної економіки

Анотація. Метою даного дослідження було проаналізувати роль людського капіталу у розвитку креативної економіки, зокрема через впровадження інновацій та розвиток освіти. Методологія дослідження включала використання аналізу сильних, слабких сторін, можливостей та загроз, а також вивчення інноваційних програм та освітніх ініціатив. Основні результати дослідження показали, що інвестиції в освіту та технології є важливим фактором для розвитку інновацій у креативних галузях. Дослідження платформ AgroPortal, E-Agriculture та AgroHub засвідчило їхню ефективність у покращенні комунікації між фермерами, постачальниками та споживачами, що сприяє оптимізації логістичних процесів і розвитку нових бізнес-моделей для онлайн-продажів. Виявлено, що впровадження цифрових технологій та розвиток програм навчання дозволяють значно покращити продуктивність і знизити витрати в аграрному секторі економіки. Крім того, було встановлено, що застосування цифрових рішень допомагає адаптувати аграрний сектор

до умов зміни клімату та глобальних проблем навколишнього середовища. Результати дослідження підтвердили, що людський капітал відіграє ключову роль у впровадженні інновацій та розвитку аграрного сектору. Особливе значення мають інвестиції в підготовку фахівців через сучасні освітні програми та тренінги, які дають аграріям можливість опановувати новітні технології та ефективні бізнес-стратегії. Аналіз виявив перспективи вдосконалення шляхом стратегічного використання існуючих цифрових платформ і навчальних курсів для підвищення потенціалу людського капіталу. Було приділено увагу платформам в Австрії, таким як PramoLeum та myAsker, які демонструють успішну інтеграцію цифрових технологій у аграрний сектор. Аналіз освітніх програм і співпраці між університетами, бізнесом і державними установами в Нідерландах виявив їх важливу роль у підтримці сталого розвитку аграрного сектору, зокрема через такі проекти як «Ферма майбутнього». Висновки вказують на необхідність подальших інвестицій у розвиток людського капіталу через освітні програми і науково-дослідницьку діяльність, а також інтеграцію новітніх цифрових технологій в аграрний сектор економіки для забезпечення сталого розвитку креативної економіки. Врахування цих факторів дозволить покращити економічну ситуацію, підвищити ефективність виробництва та сприяти сталому розвитку національної економіки

Ключові слова: інновації; освітні програми; стійкість; конкурентоспроможність; людський капітал; розвиток; аграрний сектор економіки