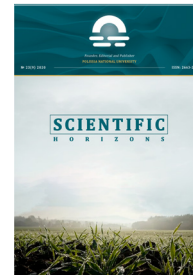


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The role of ESG in the adaptation of the agro-industrial sector to climate change

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Abstract. The purpose of this study was to investigate the role of utilising the work of agro-industrial companies in the sustainable development of Azerbaijan. Thus, the study assessed the essence of the concept of Environmental, Social, and Governance, and its role for the state and enterprises. It was concluded that in recent years, more and more attention has been paid to this kind of principles in the corporate world, as companies realise the importance of solving environmental and social problems to attract investors and develop sustainable practices. This is also consistent with the

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concept of corporate social responsibility, which emphasises the ethical obligations of business to society. The analysis of investment flows in such companies in the agricultural sector has shown that they can significantly expand the scope of their activities and accelerate the introduction of sustainable agriculture methods around the world. It was concluded that, given the benefits that investments in these companies bring to the country, it is important to include programmes aimed at increasing the investment attractiveness of such companies in the framework of national policy. In addition, targeted government support for such companies is effective. All this remains especially relevant in the realities of Azerbaijan, as a country with a transitional economy with a fairly high role for the agricultural sector (at least within the framework of food security), and the need for economic diversification. The results obtained in the framework of the study can be used to formulate a long-term development strategy for Azerbaijan in the context of combating climate change in the agro-industrial sector

Keywords: agro-industrial sector; investments; innovations; food security; ecology; sustainable development

INTRODUCTION

Sustainable development is a concept that implies striving to meet the current needs of society without compromising the ability of future generations to meet their own needs. It provides a balance between the social, economic, and environmental aspects of development, which ensures the long-term sustainability and well-being of society. This concept is developed from the principles of social justice (ensuring that all members of society have equal opportunities to meet their needs in education, health, housing, and other spheres of life), economic efficiency (strives to create a stable and prosperous economy that ensures an even distribution of benefits and resources, and fair participation in economic activities), environmental sustainability (implies conservation and protection of the environment, efficient use of natural resources, reduction of pollution and combating climate change), cultural diversity (respect for cultural identities and traditions of different communities, support for diversity of languages, customs and beliefs) and global responsibility (striving for cooperation between countries and the world community to solve global problems such as poverty, migration, climate change, and other challenges). Sustainable development in the modern conditions of the country's development plays a critical role, since it ensures a balance between economic, social, and environmental progress, while preserving the ability of future generations to meet their needs (Anarbayev *et al.*, 2024).

Agriculture, in turn, is also one of the main areas for achieving sustainable development goals (Shi *et al.*, 2022; Yap & Al-Mutairi, 2024). This is how it provides food to the population of the country, and achieving the ability to consistently and continuously create such products is an important component for the qualitative development of the country in the future. In addition, the transition to sustainable agriculture can lead to the conservation of biodiversity and ecosystem health by preventing deforestation, soil degradation, water pollution, and a decrease in the number of wild species; this sector is one of the main suppliers of greenhouse gases, but can also play a role in mitigation and adaptation to climate change. Sustainable farming methods such

as agroforestry, carbon storage in soils, and agrotechnical techniques can reduce emissions and increase resistance to abnormal climatic conditions (Bovsh *et al.*, 2024). In other words, the very essence of agriculture in the context of its impact on the lives of citizens requires special approaches in terms of methods utilised by such enterprises.

In order to ensure the qualitative development of agriculture in the country, one of the most important roles is played by the volume of investments. This is especially true for agriculture, which has a bias towards sustainable development and innovation. Without sufficient amounts of money, the latest technologies, and the appropriate level of training, it is impossible to build a company that could achieve significant success in this area (Novruzova *et al.*, 2023). In this regard, the development of different approaches to attract funds to certain industries remains relevant. Within the framework of this study, an assessment of global trends was carried out, based on which recommendations were developed to improve the situation in Azerbaijan.

The role of the Environmental, Social, and Governance (ESG) concept, for the development of the economic, social, and environmental components of a country, has been considered by a large number of researchers, among which are R.M. Visconti (2023), I.R.D. de Jesus and P.P. Nascimento (2021), M. Singhanian and N. Saini (2022a). They described the role of this component from quite different angles, but did not focus on its interaction with the investment component, which is emphasised in this study. In addition, some researchers have written that there is an interaction between the performance of enterprises and their propensity to ESG. This, in particular, was emphasised by J. Brice *et al.* (2022), M. Singhanian and N. Saini (2022b), G. Zhou *et al.* (2022). All of them came to the conclusion that ESG eventually leads the company to more effective financial results, which is why they write about the role of more active application of adherence to the concept.

Within the framework of this study, more attention is paid to the use of this concept in the agricultural sector. As for the analysis of the situation in Azerbaijan,

E.A. Ibraghimov (2022) emphasised the shift in the focus of states from simply ensuring economic competitiveness to achieving a balance of sustainable development. He also noted the strong interdependence between innovation, competitiveness, and sustainable development within the current global economic system. In the framework of this study, in turn, the emphasis is slightly shifted and the main attention is paid specifically to the issues of this component in the agricultural sector. Nevertheless, little attention is paid to the issues of investing in sustainable projects in Azerbaijan. M. Mammadli (2022), in turn, partially considered the features of sustainable development in Azerbaijan, but did not consider investing in this area.

In this regard, a more detailed analysis of this component is relevant in the framework of the study. Thus, the purpose of this study was to assess the role of investments in companies in the agricultural sector, whose activities are aimed at sustainable development.

MATERIALS AND METHODS

The study analysed data on “green” investments in individual companies. The analysis included Indigo Ag (Thomas, 2023), Bowery Farming (Bowery Farming secures..., 2022), BrightFarms (BrightFarms extends its..., 2021), Kaiima Agro-Biotech Ltd. (2024), TruLeaf Sustainable Agriculture Ltd. (\$150-million investment..., 2022), GoodLeaf Community Farms Ltd. (Sokic, 2023), Rigoni di Asiago Srl. (Palazzolo, 2019), Agricool (2024), InvertiGro (2024), WayCool (Ramasubramanian, 2023) and DBN Group (DBN Group makes..., 2024). The reason for mentioning such a list of companies is that they have attracted quite large amounts of investment at various times to create sustainable development technologies in the agricultural sector.

To outline the principles of the ESG concept, a model was built that describes in detail all its components. Thus, ESG inherently consists of three components, namely: external environment (environmental), government (governance), and social (social). However, each of them includes many other components, which were depicted within the framework of the model. These include: pollution and waste, resources and land use, climate change, ecological footprint and biodiversity for the environment; leadership and corporate governance, anti-corruption and bribery, risk management, tax transparency and business ethics for public administration; health and safety, product and consumer responsibility, community impact, diversity and inclusivity, labour standards and human rights for a component of society. It is worth noting, however, that, in fact, a much larger number of them can be produced, since each of the components of ESG is quite multifaceted.

Information from individual legislative documents was also evaluated, in particular, the Order of the President of the Republic of Azerbaijan “On Approval of the National Priorities of Socio-Economic Development:

Azerbaijan 2030” (2021). At its core, this document covers a wide range of aspects of the country’s economic and social development for the future up to 2030. This strategy is focused on achieving stable and sustainable economic growth, improving the standard of living of the population, developing human capital, reducing poverty, and modernising the economy. Its main components are: economic diversification, human capital development, social protection, environmental sustainability, and others. Within the framework of the study, this document was mentioned as one of the main ones in the framework of the analysis of the ESG concept in the country.

In addition, information from the Law of the Azerbaijan Republic No. 759-IG “On Food Stuffs” (1999) was evaluated. This is the main regulatory act governing the production, turnover and quality of food products in the country. It establishes food safety and quality standards, and rules and requirements for their production, storage, transportation, and sale. The Order of the President of the Azerbaijan Republic No. 3004 “On Approval of the “State programme for reliable provision of food products to the population in the Azerbaijan Republic for 2008-2015” (2008) was also mentioned, the main objective of which is to stimulate the growth of agricultural output and increase food supplies through local production.

RESULTS

Environmental, Social, and Governance (ESG) is a concept that is used to assess the social responsibility and sustainability of companies (Barrymore & Sampson, 2021; Broadstock *et al.*, 2021). This approach considers three main aspects: environmental (assessment of the impact of the company’s activities on the environment; this may include emission management, energy and resource use, waste management, and impacts on biodiversity and climate), social (assessment of the company’s relations with its stakeholders such as employees, customers, suppliers, society as a whole. Important aspects include labour standards (employee rights, diversity and inclusion, and contributions to the local community) and managerial standards (assessment of company management systems and practices, which includes corporate governance structure, independence of the supervisory board, ethical standards, corporate transparency, anti-corruption) (Cakranegara & Sidjabat, 2021; Fang *et al.*, 2023).

Corresponding ratings are available to assess the level of commitment to ESG principles (Klinger *et al.*, 2022). They are based on an assessment of companies’ management of environmental, social, and managerial issues that are crucial for sustainable investments: they are used by investors to make informed decisions, assessing the long-term viability of companies and their impact on society, and therefore, they play a very important role in the investment decision-making process (Lankford, 2022). In turn, companies are interested in paying more attention to solving such

issues to attract more investors (Rosegrant *et al.*, 2022; Prasad *et al.*, 2023). This motivates them to more actively introduce innovative technologies into production and management processes, and improve the quality of their approach to personnel management and influence society as a whole. This concept is quite close to corporate social responsibility. Both concepts relate to

business social responsibility; they are closely linked and complement each other in creating sustainable and socially responsible business practices that consider environmental, social, and managerial aspects. In this regard, they are often considered and assessed together.

In general, the principles of ESG can be described using the model shown in Figure 1.

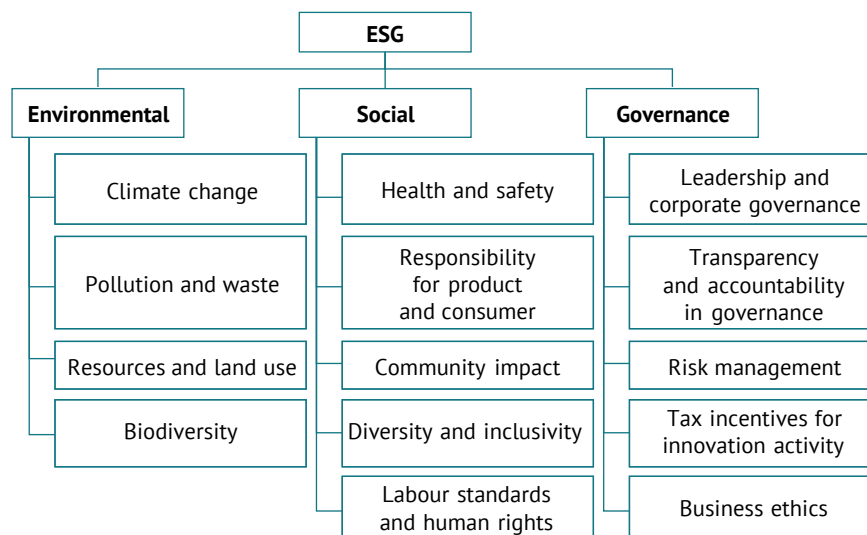


Figure 1. The concept of ESG

Source: compiled by the authors

As can be seen from Figure 1, ESG consists of three main components, which have already been mentioned above, however, they include a fairly large number of other introductory ones. They, in turn, should be considered during the development of national policy in this area, including in the agricultural sector.

To assess the role of ESG in adapting the agro-industrial sector to climate change, it is worth considering the situation in individual companies, and how investments in them have affected the ability of these enterprises to develop business. So for a start, it is worth considering Indigo Ag (USA), which has received more than USD 250 million in funding to expand its sustainable agriculture programmes and improve the quality of service to its customers (Thomas, 2023). The company itself offers products and services aimed at improving the sustainability and productivity of agriculture: its seed treatment methods increase the yield of the sector's products in a variety of conditions, including drought. Indigo Ag also facilitates communication between producers and buyers by helping with crop logistics. They have signed contracts for significant areas and initiated projects such as creating carbon credits by measuring soil carbon levels, appealing to companies seeking to reduce their carbon footprint. Internationally, Indigo Ag is working in Brazil, introducing microbial processing of soybean seeds, which significantly increases yields, and in Europe is working on the

creation of a carbon credit programme in collaboration with companies such as Beiselen.

Both existing and new investors participate in the financing round. In particular, such players as Flagship Pioneering (a biotech company), pension funds of the state of Michigan, and Lingotto Investment Management were featured. Lingotto Managing Partner James Anderson stressed the importance of supporting innovative companies such as Indigo Ag in solving climate problems. Indigo Ag has shown significant growth rates in 2022, while actively cooperating with other large companies to meet the goals of reducing emissions into the atmosphere. With the funds received, the company plans to expand the range of biologically pure products that it produces, and expand geographically. Given the significant growth rates of the company, it is worth expecting a high return on invested funds, while providing significant benefits to the country in environmental and social implications.

Another example is Bowery Farming, founded in 2015 also in the United States of America (Bowery Farming secures..., 2022). Its goal is to improve access to high-quality, local, safe, and sustainable products by creating "smart" farms near urban areas, the company produces fresher, protected, pesticide-free products with a rich taste all year round in precisely controlled conditions. The centrepiece of each farm is the patented BoweryOS, an integrated system that organises

and automates operations using software, hardware, sensors, artificial intelligence, computer vision, machine learning, and robotics. This approach minimises waste and significantly reduces the use of water and land compared to traditional agriculture. The company recently received USD 472 million in financing from well-known investors such as Fidelity Management & Research Company LLC, Temasek, GV (formerly Google Ventures), General Catalyst, GGV Capital, First Round Capital, and some well-known persons. It is expected that due to such an investment, the company will be able to significantly expand its capabilities for introducing innovations into the industry, developing its own technology platform, expanding its customer base, and attracting more qualified experts.

Another company worth mentioning is BrightFarms (BrightFarms extends its..., 2021). It is engaged in indoor agriculture; the company specialises in growing and supplying supermarkets with local salad greens that do not contain genetically modified organisms (GMO) and pesticides. The company received a loan of USD 150 million from the global investment company KKR for the purpose of accelerating growth. As a result, the company's total funding has exceeded USD 647 million, including a USD 325 million Series C stock investment round in 2021, which is the largest private fundraiser in history for an indoor farming company. The main area of their investments is to increase the efficiency of the process of growing such products both in the technological part and in terms of reducing transportation costs, energy. BrightFarms stands out in the closed farming market due to an expanding network of high-tech and environmentally friendly hydroponic farms. They prioritise research, development, and operational excellence to deliver fresh, locally grown products year-round. With ambitious expansion plans, including the creation of new farms and the strengthening of expertise in various fields, BrightFarms is ready to meet the growing demand for products grown indoors. Through the use of funds raised from investments, the company plans to expand production capabilities.

Another example is Kaiima Agro-Biotech Ltd. (2024), an Israeli agricultural technology company. Founded in 2006, Kaiima specialises in the development and commercialisation of innovative technologies to increase crop yields and sustainability. One of the main activities of Kaiima is to improve the genetics of crops using non-GMO products. They use a patented technology platform called Enhanced Ploidy Induction and Cultivation (EPIC), which allows the creation of new varieties of crops with improved characteristics such as yield, resistance to environmental stresses and nutritional value. Kaiima technology works by inducing polyploidy in plants, a process that increases the number of sets of chromosomes in a plant cell. This can lead to significant changes in the characteristics of the installation, which will potentially lead to increased productivity.

It is important to note that Kaiima's approach avoids the use of genetic modification techniques, which may be subject to regulatory restrictions in some markets. The company cooperates with agricultural partners, research institutes and seed companies around the world to further develop and commercialise its technologies. Kaiima aims to address global challenges in agriculture, such as providing food to a growing population, adapting to climate change, and reducing the environmental impact of farming practices.

Recently, Embrapa and the Israeli company Kaiima Seeds signed a cooperation agreement on the breeding of new castor oil varieties in Brazil (Santos, 2023). The purpose of this interaction is to improve the cultivation of castor oil by creating varieties with high productivity, adaptability to various conditions, and distinctive characteristics such as oil composition and disease resistance. In general, cooperation and interaction between this company and other potential partners can increase opportunities for the future development and implementation of the latest technologies.

It is also worth mentioning a company such as TruLeaf Sustainable Agriculture Ltd (\$150-million investment..., 2022). It is a Canadian company that specialises in vertical and sustainable agriculture. Vertical farming is a farming method in which plants are grown in vertical structures such as buildings, shelving or special towers. This approach allows efficient use of limited space, as cultivation takes place upwards, in several levels, instead of the traditional horizontal distribution in the field. Vertical agriculture is usually based on hydroponics or aeroponics technologies that allow plants to obtain essential nutrients through water without using soil (Kobayashi *et al.*, 2022; Oh & Lu, 2023). The method itself has several advantages, including more efficient use of water and land areas, increased yields compared to conventional methods, and the ability to grow products closer to the place of consumption, which reduces time and transportation costs. In addition, vertical agriculture can be more resilient to climate change and ensure stable production all year round in all climatic conditions. The company was established in 2011, and its main goals remain: to ensure a higher level of food security, better indicators of environmental sustainability, and to introduce innovative farming methods. They use a plant growing system called TruLeaf, which uses vertical farming techniques to grow leafy greens and grasses. This approach allows year-round production regardless of climatic conditions, reduces water consumption compared to traditional farming methods, and minimises the need for pesticides and herbicides. The company's indoor agricultural premises are designed to optimise the use of space and resources, using modern LED lighting, automated nutrient supply systems, and climate control technologies to create ideal conditions for growing plants. TruLeaf also pays great attention to sustainable development, using renewable energy

sources and implementing recycling and waste reduction measures in its activities. The company is also engaged in the promotion of research developments in this field, is constantly in the process of creating new technologies to increase the level of sustainability of agriculture.

Initially, the company attracted USD 8.5 million in investments, due to which they were able to develop their technology and begin to implement it at enterprises. In 2022, its subsidiary GoodLeaf Community Farms Ltd received funding for another USD 150 million to expand the company and create new farms in Calgary and Montreal (Sokic, 2023). GoodLeaf aims to solve the problem of long transportation routes and food spoilage by supplying Canadian consumers across the country with types of agricultural products that are traditionally imported into Canada. Considering GoodLeaf Community Farms Ltd in more detail, a big investor in it was McCain Foods Ltd among others investing more than USD 65 million as of 2021 (Sokic, 2023). Using vertical farming technology, GoodLeaf grows greens such as young spinach and micro-broccoli in a controlled indoor environment, which ensures faster growth compared to traditional farming methods in the field. The company's new 96,000-square-foot facility in Calgary, which was already mentioned above and is estimated to cost USD 56 million, will initially operate at half capacity, which will create 70 new jobs in the city. The greens grown by GoodLeaf are expected to be available at major Calgary grocery stores, and the company plans to expand further as demand increases. Considering the features of vertical cultivation technology, it is worth expecting in the future both an improvement in the company's business opportunities in the future and prospects regarding the impact on the environment.

The next company to be evaluated is Rigoni di Asiago Srl (Palazzolo, 2019). It is an Italian group of food industry companies headquartered in Asiago, Italy, known for the production of honey and sweets. Its history begins with Eliza Antonini, who initiated the production of honey after the First World War. In 1979, the district began processing and commercialising various types of honey, rapidly expanding its activities. The company's headquarters are located in Asiago, the production complex is in Fos, and the logistics centre is in Albaredo d'Adige. The company is also present in Bulgaria, where it has been producing organic fruits since 1993. In 2019, the company received EUR 50 million of loan funds from UniCredit and Banco BPM with the support of SACE SIMEST (CDP Group) to promote its growth in international markets (Palazzolo, 2019). Currently, foreign trade turnover accounts for 24% of Rigoni di Asiago's revenue, and the company is striving to expand its presence in Europe and in America. Recently, the company acquired 100% of the shares of Saveurs&Nature, a French enterprise for the production of organic chocolate: the company employs 70 people, including

32 master chocolatiers, and the annual turnover of the company is about EUR 12 million (Moore, 2022). Chocolate production, in turn, is no less important than any other type of organic products, since it also includes sustainable practices, namely organic farming, the use of environmentally friendly ingredients.

Agricool (2024) is a French agrotechnological start-up specialising in the cultivation of fresh products indoors, after entering into receivership, it began searching for a buyer. The company, founded by Guillaume Fourdinier in 2015, uses recycled shipping containers to grow herbs, leafy greens, and strawberries under controlled conditions. Agricool's innovative systems consume 90% less water and nutrients compared to traditional farming methods and run on fully renewable energy sources. Despite investments from major players such as Danone, which participated in a USD 28 million funding round in 2020, Agricool has faced financial problems due to the capital-intensive nature of indoor agriculture. In 2023, the company emerged from bankruptcy proceedings, and its assets were bought by Grosvenor Food & AgTech and Doha Venture Capital (Harvey, 2023). With the new management component of the company, it is worth expecting an improvement in the overall situation in the company and the subsequent development of this technology.

Considering the situation in Australia, it is necessary to mention InvertiGro (2024). It is located in Sydney and specialises in indoor farming technologies, offering modular vertical farming systems that can be adapted to different scales, providing flexibility in deployment and integration with existing operations. As for India, there are also start-ups in the country that attract investments. For example, WayCool Foods from Chennai is negotiating to raise USD 40 million through the issue of rights, and Lightrock is acting as the main investor. WayCool, founded in 2015, initially focused on agricultural supply chain services and later expanded into consumer products with brands such as Madhuram, Kitchenji, and Freshey's (Ramasubramanian, 2023). The company has restructured its operations over the past 18 months to improve profitability, and is optimistic about breaking even by the target date. Despite recent losses, the company aims to significantly expand its activities to other markets and increase the efficiency of its own operation. Its impact is expected to spread to more than 800 cities in India through this round of investments. In China, such an example is DBN Group (2022), a well-known high-tech agricultural enterprise that plans to become a major player in the field of agriculture through investments, paying special attention to strengthening its international influence, brand awareness, and attracting the best specialists around the world.

Thus, the above examples of companies such as Indigo Ag, Bowery Farming, BrightFarms, Kaiima Agro-Biotech, TruLeaf Sustainable Agriculture and others

emphasise the important role of investments for the subsequent development of companies in the agricultural sector, the purpose of which is to have a positive impact on the environmental and economic component. These companies use sustainable practices, innovative technologies, and strategic investments to address climate change, improve food security, and promote environmental sustainability. For most companies, attracting investments is an approach to expanding the sales market and increasing production capacity. Thus, this allows for more active promotion of innovative practices in the world, and therefore, leads to more effective results in this area as a whole. This also indicates that the public authorities should pay much more attention to increasing the investment attractiveness of companies of this kind.

Azerbaijan is currently on the path of developing the basic principles of ESG. The country is facing a number of environmental problems, including air, water, and soil pollution caused by industrial and oil and gas operations, and therefore, significant efforts are being made to pay attention to improving the environmental situation in the country. In particular, special attention is paid to the sectors of the oil and gas industry and transport, and to reducing the negative impact on the environment. All this is happening within the framework of the Order of the President of the Republic of Azerbaijan "On Approval of the National Priorities of Socio-Economic Development: Azerbaijan 2030" (2021). Social aspects include issues such as social justice, human rights, working conditions, and access to education and health care: public authorities are working to improve their social sphere, including the development of education and health care, and the provision of jobs and social protection. Transparency and accountability of the work of the public administration system is considered as one of the important achievements. The government is taking steps to improve aspects of governance, such as creating conditions for more open and transparent governance, consolidating the legal system, and fighting corruption. Many developed countries also have problems of this kind, which they are trying to solve using certain concepts with varying success. Considering all the observed problems, it is not surprising that in recent years Azerbaijan has begun to pay more attention to ESG initiatives, especially in the context of attracting investments and improving its business climate. Due to the assistance from government authorities, many companies and organisations in the country are beginning to implement sustainable development practices in their activities, including social responsibility and environmental programmes.

As for the development of agriculture, this area includes the development and implementation of methods for the sustainable use of natural resources such as land, water, and energy to minimise the negative impact on the environment. Programmes and projects

are aimed at protecting the quality of soil and water resources, including the prevention of pollution from agricultural chemicals and other industrial processes; measures to create jobs, improve access to education, health, and social services in rural areas to reduce the gap between urban and rural areas. The initiatives are aimed at ensuring fair working conditions, including the protection of the rights of agricultural workers, including on issues of wages, and workplace safety. In addition, measures are being taken to encourage the participation of agricultural enterprises in social responsibility programmes and environmental protection initiatives, and the introduction of certification systems that guarantee compliance with ESG standards in agricultural production is supported. An important component of this policy is the legislative framework, which, among other things, is aimed at ensuring food security. For this purpose, there are certain norms that are recorded in the Order of the President of the Azerbaijan Republic No. 3004 "On Approval of the 'State programme for reliable provision of food products to the population in the Azerbaijan Republic for 2008-2015'" (2008), Law of the Azerbaijan Republic No. 759-IG "On Food Stuffs" (1999). Activities are also underway to improve this legislative framework. First of all, this is done to increase the investment attractiveness of the country for such investments, both in agriculture and other sectors such as transport, energy. At the moment, it is difficult to say for sure about the effectiveness of this policy, but it is worth assuming that if it is effectively implemented, the state can get really good results in terms of achieving the sustainable development goals.

Thus, to achieve the best results, it is worth increasing efforts in this area. The country should give priority to initiatives aimed at reducing environmental impacts, especially in key sectors such as oil, gas, and transport. Public authorities should promote sustainable farming practices by promoting methods of efficient use of natural resources such as land, water, and energy. Support programmes aimed at preserving soil and water to prevent pollution from agricultural chemicals will be effective in solving environmental difficulties. This also applies to the training of educated personnel who would be able to manage such developed enterprises. It is necessary to implement such programmes through private organisations, thereby encouraging entrepreneurship in the country, along with innovative development. The support of such enterprises can also help solve some social difficulties. In addition, special attention should be paid to the possibility of attracting investments to the country, showing its focus on achieving sustainable development goals. In this context, cooperation with international organisations, whose attention can be attracted both at international meetings and at personal meetings, should also be effective.

DISCUSSION

Thus, the paper considered the ESG concept and its application in assessing the sustainability and social responsibility of companies, especially in the agricultural sector. The reviewed examples have shown that companies that are aimed at spreading sustainable technologies and are committed to the principles of ESG have the opportunity to attract investments quite successfully. This is how examples of companies such as Indigo Ag, Bowery Farming, BrightFarms, Kaiima Agro-Biotech, TruLeaf Sustainable Agriculture, were considered. It was also concluded that it is important to attract investments for the development of such technologies, and the efforts on the part of the state in this area to increase the attractiveness of such enterprises.

Within the framework of this study, it was noted that investments in enterprises related to the technologies related to sustainable development are very important for the comprehensive development of the country. In addition, the connection between green finance, environmental degradation, and sustainable development was established by A.I. Hunjra *et al.* (2023). They noted that there is a positive and statistically significant relationship between green finance and the level of sustainable development. In this regard, researchers consider it important to pay sufficient attention to the development of opportunities for attracting investment in the sector to enhance the potential for sustainable development. Similar conclusions have been obtained by M.A. Nyasapoh *et al.* (2022). They concluded that investments remain a very important component for the development of renewable energy in Ghana, which means that their maximum active involvement should remain an important part of the country's public policy. All this also agrees with the fact that the development of innovations in the context of sustainable development is a very important component for the development of any country, including Kyrgyzstan, which should pay special attention to this in modern conditions (Amanova *et al.*, 2020).

Within the framework of the study, individual enterprises were noted that had the opportunity to receive significant investments by developing technologies aimed at ensuring the sustainability of agriculture (Kryvenko, 2024). The influence of the ESG-based management method on companies' results has been investigated by L. Zeng and X. Jiang (2023). They noted that companies with higher ESG ratings tend to achieve higher levels of corporate efficiency. This indicates that such companies not only succeed economically, but also achieve better results in terms of achieving the economic and social goals of sustainable development. Thus, such an effect can be calculated as a "win-win situation" for the company and the state. The study highlights that social and managerial indicators have a greater impact on improving corporate performance than environmental ones, which also shows that

government policy, market conditions, and the composition of managers influence the relationship between ESG and corporate performance. Based on this, researchers develop recommendations that companies should increase the macroeconomic role of ESG in their activities, and government authorities, in turn, should also pay more attention to it.

The dependence of ESG commitment in terms of company size was investigated by M.W. Rosegrant *et al.* (2022). They noted that in modern conditions, large companies actively adhere to these principles, which cannot be said about small and medium-sized ones. In this regard, the researchers concluded on the role of supporting small and medium-sized agricultural companies for the development of corporate social responsibility initiatives, and the implementation of sustainable resource management approaches. Researchers also noted that the application of measures related to ESG, in general, has a positive effect on the activities of companies, but not always, in connection with which they write about the role of assessing the characteristics of each of the companies to apply appropriate measures to regulate the characteristics of their activities in case of problems. And although this study did not pay much attention to the current situation in Azerbaijan, it is worth noting that the development of ESG among small and medium-sized enterprises is a higher priority than among large ones. This is conditioned by many aspects, but in general – due to the role of such companies for the welfare of the country in principle (Tkachenko *et al.*, 2023).

Within the framework of this study, it was noted that the development of human capital is an important component for the development and implementation of sustainable development technologies. The impact of aspects of the environment, social sphere and management, and the characteristics of human capital on the financial performance of state-owned agricultural companies was assessed by M.G. Pirtea *et al.* (2021). The study highlights the importance of corporate social responsibility and sustainability in the agricultural sector to increase profitability, especially against the backdrop of climate change challenges. It emphasises the need for managers of agricultural companies to prioritise such measures, especially in environmental aspects, and devote more time to staff training to improve financial performance in the future. In addition, researchers have proposed some strategies to improve the efficiency of enterprises through measures of corporate social responsibility. Thus, it can be concluded that in Azerbaijan, increasing attention to the development of better approaches to personnel training in the context of sustainable development is an important component.

The impact of the disclosure of information on sustainable development on the efficiency of agricultural companies in Europe was considered by P. Mititean (2023). The researcher wrote that the increasing

relevance of the ESG concept in recent years has led to a gradual tightening of monitoring of companies' activities in this area. The results showed that companies with a higher level of disclosure of information about sustainable development tend to achieve better operational, financial and market performance, which is also combined with past estimates. This study did not pay much attention to the development of information on sustainable development from companies in general, but it is worth noting that this is an important component of promoting this concept.

Considerable attention was paid, among other things, to education issues. Thus, improving the quality of education will lead to better work of enterprises, more effective work of researchers on theoretical and practical projects. This was partially mentioned by P. Dmuchowski *et al.* (2023), although their study has specialised in the evolution of sustainable investments in the context of major global events in general. Researchers noted that events such as the 2008 financial crisis and the COVID-19 pandemic accelerated the adoption of an environmental, social, and governance model, especially in the financial sector. Although there is a positive correlation between ESG factors and financial performance, problems persist due to vague definitions of responsible investments and data quality issues. In addition, the researchers analysed the situation in Poland, noting the need to significantly expand the markets for sustainable financing. However, the main recommendation in this area was to work on the quality of education in this area in the country. Among other things, this study highlighted the positive impact of ESG on their investment attractiveness, which ultimately is one of the important factors of their financial condition.

CONCLUSIONS

Thus, the ESG concept has become a vital basis for assessing the sustainability and social responsibility of companies. In recent years, the corporate world has been paying increasing attention to the principles of this concept, as companies realise the importance of solving environmental and social problems to attract investors and develop sustainable practices. It is closely consistent with the concept of corporate social responsibility, which emphasises the ethical obligations

of business to society. Both of these concepts create a framework that allows enterprises to integrate environmental, social, and managerial aspects into their activities, which ultimately contributes to sustainable and socially responsible practices.

The study also showed examples of how companies in various sectors, including agriculture, apply ESG principles to stimulate innovation and solve pressing environmental and social problems. From sustainable agriculture programmes to vertical farming technologies, these companies are attracting investments to develop solutions that enhance food security, mitigate the effects of climate change, and promote environmental sustainability. The described examples of companies have shown how innovative farming methods can achieve better results in terms of achieving sustainable development goals. In this regard, the development of national programmes aimed at attracting investments in such companies should become a very important component of the national policy.

In the agricultural sector, the introduction of sustainable practices is of paramount importance to address environmental degradation, ensure food security, and promote rural development. By promoting sustainable land use, water conservation and the introduction of renewable energy sources, countries can mitigate the adverse effects of climate change and contribute to the creation of sustainable agricultural systems. It is also worth noting that the ESG principles are an integral part of shaping a sustainable future for both business and society. By taking measures to protect the environment, social responsibility, and good governance, companies can achieve positive changes and create value for all parties, both for the companies themselves in the context of increasing profitability, and for enterprises and society. An assessment of the possibilities of attracting investments in sustainable agriculture in Azerbaijan is relevant for further research. In particular, in this context, it remains important to investigate foreign experience, especially in developed countries.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Роль ESG в адаптації агропромислового сектору до зміни клімату

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Анотація. Це дослідження було спрямоване на оцінку ролі використання роботи агропромислових компаній у сталому розвитку Азербайджану. Таким чином, у рамках дослідження було оцінено суть концепції Environmental, Social, and Governance, її роль для держави та підприємств. Було зроблено висновок, що останніми роками в корпоративному світі дедалі більше уваги приділяють подібним принципам, оскільки компанії усвідомлюють важливість розв'язання екологічних і соціальних проблем для залучення інвесторів і розвитку стійких практик. Це також узгоджується і з концепцією корпоративної соціальної відповідальності, яка підкреслює етичні зобов'язання бізнесу перед суспільством. Проведена аналітика потоків інвестицій у такого роду компанії аграрного сектору засвідчила, що вони дають змогу значно розширити сферу своєї діяльності та прискорюють впровадження методів сталого сільського господарства в усьому світі. Було зроблено висновок, що, з огляду на таку користь, що приносять інвестиції в ці компанії для країни, важливо включати в рамки національної політики програми, спрямовані на збільшення інвестиційної привабливості такого роду компаній. Крім того, ефективною є цілеспрямована підтримка таких компаній з боку держави. Усе це залишається особливо актуальним у реаліях Азербайджану, як країни з перехідною економікою з досить високою роллю аграрного сектору (щонайменше, в рамках продовольчої безпеки), а також потребою для диверсифікації економіки. Результати, отримані в рамках дослідження, можуть бути використані для формування довгострокової стратегії розвитку Азербайджану в контексті боротьби зі зміною клімату в агропромисловому секторі

Ключові слова: агропромисловий сектор; інвестиції; інновації; продовольча безпека; екологія; продовольча безпека; сталий розвиток
