THE DEVELOPMENT OF THE BIOECONOMY CONCEPT IN UZBEKISTAN IN TERMS OF POLICY IMPLEMENTATION

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Abstract
In recent years, the bioeconomy has gained prominence as a strategic approach to addressing global challenges related to sustainable development, resource efficiency, and economic diversification. Rooted in the sustainable use of biological resources, the bioeconomy offers significant potential for balancing economic growth with environmental stewardship. Agriculture, as both a primary source of biomass and a key contributor to rural livelihoods, plays a vital role in this transition. The primary aim of this study is to analyze the current state and development prospects of the bioeconomy in Uzbekistan, with a specific focus on the agricultural sector. It seeks to evaluate national strategies aimed at fostering a green economy, assess their implementation within agriculture, and identify the key challenges and opportunities associated with advancing a sustainable bioeconomy model. Drawing on the country's predominantly agriculture-based bioeconomic structure, the study outlines the main directions for sustainable development, highlighting the role of sectoral growth in driving the bioeconomy. Findings point to positive trends in agricultural productivity and intensification across key subsectors. However, the analysis reveals that further progress is contingent on the establishment of a clearer and more coherent policy framework—one that supports the adoption of sustainable and circular practices and encourages foreign investment, particularly in value-added bioeconomic activities.
Keywords: bioeconomy, green economy, agriculture, Uzbekistan.

Introduction

There is a growing emphasis on sustainable development and environmental conservation, particularly in agriculture. While the agricultural sector is crucial for sustainable practices, it can also have negative environmental consequences, such as soil and water pollution, deforestation, and reduction of biodiversity. These issues are further compounded by global climate change, which can result in natural disasters. The concept of bioeconomy has gained global momentum as a solution to sustainable development problems. Bioeconomy involves using biological resources to meet societal needs while maintaining ecological balance and socio-economic progress. Central Asia, which is rich in natural resources and agricultural potential, could play a central role in promoting sustainable practices and transitioning to a sustainable bioeconomy in the region. The development of the bioeconomy in Central Asia is currently facing challenges due to a lack of systemic approach and institutional support and also a developing policy framework. It has been observed that many countries in the region do not have well-defined strategies and regulations for the sustainable use of biological resources. This situation has hindered the growth of bio-based industries and deterred investments. Moreover, it appears that the bioeconomy's complete potential is currently being hindered by certain infrastructure inadequacies, such as a shortage of bio-refineries and processing plants, which in turn limits the value-added potential of biological resources. Additionally, there seems to be a lack of funding available for innovation, technological advancements, and capacity-building initiatives that are necessary for the growth of this sector. Central Asia possesses substantial yet underutilised agricultural resources that could significantly contribute to the bioeconomy. However, there are certain obstacles that need to be overcome, such as insufficient knowledge transfer, limited market access, and underdeveloped value chains. To fully realise the potential of agriculture, it is important for Central Asian countries to invest in improving practices, supporting market access, and fostering innovation. Addressing these challenges effectively would require the implementation of robust policies, increased investment, capacity-building initiatives, and practices, in e.g. organic agriculture and sustainable waste management, ensuring the bioeconomy becomes a driving force for the region's sustainable development.

Materials and Methods

This paper provides a review of bioeconomy strategies and practices implemented worldwide that gives a context for analysis of the development of the bioeconomy strategy for Uzbekistan. The article also includes agriculture data analysis from the Statistics Agency of Uzbekistan and calculation of trends for selected indicators in agriculture and a SWOT analysis.

Results and Discussion

The concept of bioeconomy

Policies in general provide a structured approach to decision-making by defining goals and establishing procedures for implementation. Effective policies are designed to align with the overall vision and objectives of the entity, providing a basis for consistency, transparency, and accountability in decision-making and actions. According to the scientists of University of Eastern Finland and Fern Universitat in Hagen

(Ramcilovic-Suominen & Pulzl, 2018), the Bioeconomy policy aims to foster innovation, promote the efficient use of natural resources, and create a balance between economic growth and environmental conservation. Key elements of the bioeconomy policy include supporting research and development in biotechnology, encouraging the development of bio-based industries, promoting sustainable agricultural practices, and addressing ethical and social considerations related to biological advancements. A well-crafted bioeconomy policy contributes to job creation, technological advancement, and the overall transition towards a more sustainable and resilient economy that harnesses the potential of biological resources.

In a narrower sense, bioeconomy can be defined as the 'green economy' with the underlying idea that the green economy is aimed at ensuring the wellbeing of society through the effective use of natural resources, as well as returning the end-use products to the production cycle, thus encompassing both the concepts of bioeconomy as well as circular economy. It can be also noted that this is the interpretation often associated with the term 'bioeconomy' in Uzbekistan.

The general concept of 'bioeconomy' (or bio-based economy, which is often considered as a synonym) is that of an economy based on the sustainable exploitation of biological resources (Viaggi, 2018). The concept of bioeconomy began to take shape long before this currently well-known term appeared. Birner, (2018) describes the discrepancy in definitions that have been formed over the years. The bioeconomy concept began to develop in the middle of the 20th century when scientists and economists began to pay attention to the importance of using biological resources for production and economic development. The reasons for the conscious introduction and understanding of this term came due to its potential and the possibilities of solving certain issues, namely, the solution of replacing fossil resources with bioresources and the need to increase agricultural productivity to meet future food and biomass needs. The future bioeconomy is largely determined by the visions that countries and international bodies have embedded in the policy framework (Viaggi, 2018). Currently, many countries are still in the process of building their bioeconomy strategies, while others have already well established bioeconomy strategies and goals. Table 1 demonstrates the difference in explanation and understanding of bioeconomy in selected countries that have adopted their bioeconomy strategies.

The development of a bioeconomy strategy is a way to formalise and prioritise the development of bioeconomy and particular sub-sectors and approach that the particular country sees fit to adapt.

Table 1

Definitions of the concept of 'bioeconomy' in strategies of different countries

Country	Title of the document	Definition
Latvia	Latvia Bioeconomy Strategy 2030 (2016)	Bioeconomy is a part of the national economy where renewable natural resources (plants, animals, microorganisms, etc.) are used in the production process in a sustainable and thoughtful way to produce food and feed, industrial products and energy.
Germany	National Bioeconomy Strategy (2021)	The bioeconomy encompasses the full range of economic activities and innovations based on the use of biological resources and processes. It brings together the sectors of agriculture, forestry, fish farming, food processing, bioenergy production, biotechnology, and related research and infrastructure.
Italy	Bioeconomy in Italy (2019)	The bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products, services and processes across four macro-sectors.
Norway	Familiar resources – undreamt of possibilities The Government's Bioeconomy Strategy (2016)	The concept includes sustainable, efficient and profitable production, extraction and use of renewable biological resources for food, feed, ingredients, health products, energy, materials, chemicals, paper, textiles and other products.
Japan	Bioeconomy Strategy of Japan (2022)	The bioeconomy is a collection of economic and scientific activities that relate to the production, use and trade of biotechnology products, as well as related services and infrastructure.
Singapore	Singapore Green Plan 2030 (2021)	The bioeconomy is integrated use of biological agents (microorganisms, plants, animals) and their components to create products, services and solutions that contribute to economic and social well-being.

Country	Title of the document	Definition
Austria	Bioeconomy. The strategy for Austria (2019)	Bioeconomy stands for an economic concept that aims to replace fossil resources (raw materials and energy sources) with renewable raw materials in as many areas and applications as possible. It covers all industrial and economic sectors that produce, process, handle or use biological resources.

Source: created by the authors based on the bioeconomy strategies of the selected countries.

Table 2

Priority areas of the above countries

	Nat. Res. (Forests)	Nat. Res. (Water)	Nat. Res. (Land)	Nat. Res. (Air)	Health	Climate	Energy	Innovation (Biotechnology)
Latvia	●		●				●	
Germany	●					●	●	
Italy	●	●	●					●
Norway		●	●					
Singapore			●			●		
Japan					●			●
Austria	●		●			●	●	

Source: created by the authors based on the bioeconomy strategies of the selected countries.

Bioeconomy has emerged as a pivotal component of sustainable development, aiming to harmonize economic growth with ecological balance. Latvia positions itself to harness its natural resources, with a focus on sustainable forestry practices and biomass utilization. The country's strategy emphasizes enhancing resource efficiency and fostering innovation in forestry and agriculture. As a global leader in the bioeconomy, Germany places a strong emphasis on sustainability and resource efficiency. Its strategy encompasses research and innovation in biotechnology, bioenergy, and bio-based materials with a concerted effort to strengthen the synergy between industry and agriculture. Germany and Japan include areas with strong industrial structures, and bioeconomy is considered in line with its innovation potential and as a potential boost for industrial use of biomaterials. The focus is mainly on replacing fossil fuels and reducing CO2 emissions to combat climate change, as well as achieving economic and technological advantages from new way of processing biomass. Other countries see the bioeconomy as a strategy to further develop their bioscience research towards strengthening their competitiveness in high-value industries (Viaggi, 2018), (Table 2). The Italian strategy is underpinned by a commitment to research and innovation, aiming to enhance the competitiveness of its burgeoning bio-based industries. Singapore's unique urban context shapes its bioeconomy strategy, emphasizing sustainable food production, waste-to-resource initiatives, and technology-driven urban solutions. The city-state aims to address urban challenges through innovative approaches, contributing to resource efficiency and environmental sustainability. Norway's bioeconomy strategy revolves around the sustainable management of biological resources, particularly in fisheries, aquaculture, and forestry. The nation strives for a delicate balance between economic growth and environmental sustainability, investing significantly in research and development. Italy charts its bioeconomy course by promoting sustainable agriculture, forestry, and the efficient utilization of resources. Japan's approach to the bioeconomy is characterized by cutting-edge technology and innovation. With a keen focus on bioenergy, bioplastics, and sustainable agriculture, Japan seeks to foster the creation of new industries and revitalize rural areas through the principles of the bioeconomy. Austria boasts a well-developed bioeconomy strategy that integrates forestry, agriculture, and industry seamlessly. The country's focus spans bioenergy, bio-based materials, and sustainable land use, with an overarching goal of promoting innovation and fostering regional development. Obtaining bioenergy and biomaterials from renewable bio-based instead of limited natural resources through waste biorefining is the fundamental principle of the bioeconomy strategy. The European bioeconomy approach provides sustainable solutions to the transition to a greener, fairer, and more responsible economy (Le Pera et al., 2022). These countries exhibit diverse bioeconomy strategies tailored to their unique socio-economic and environmental contexts. While some prioritize the sustainable use of natural resources, others place a premium on technological innovation. The common thread among these nations is a commitment to striking a balance between economic growth and environmental stewardship, illustrating the multifaceted nature of the bioeconomy on the global stage. As the bioeconomy landscape evolves, ongoing research and policy adaptations will be critical to ensure the continued success of these strategies in fostering sustainable and resilient economies.

Uzbekistan and the ability to transition to bioeconomy

In 2018, the Republic of Uzbekistan ratified the Paris Agreement accepted in Paris, on December 12, 2015, and made a quantitative commitment to a nationally determined contribution to its implementation - reducing the specific emission of greenhouse gases per unit of gross domestic product by 10% from the level of 2010 by 2030. The main goal of the Strategy is to achieve sustainable economic progress that contributes to social development, reduction of greenhouse gas emissions, climate and environmental sustainability by integrating the principles of a green economy into ongoing structural reforms.

However, the state has not yet adopted a bioeconomy strategy, which can play an important role in implementation of the Strategy, becoming one of the key tools for the transition to a green economy. Thus, the transition to the green economy as well as fully unlocking the potential of the Uzbekistan natural resources and adaptation of more sustainable practices in agriculture, bio-based industry and waste-management is work in progress. According to Kardung et al. (2021), the interactions between the concepts of bioeconomy, bio-based economy, circular economy, and green economy are all interconnected and share similar goals of promoting sustainability, resource efficiency, and reduction of environmental impact. The bio-based economy is seen as a part of the bioeconomy and relates to the conversion of biological resources into products and materials. This is also referred to as bio-based production. The authors have found that in some definitions of the bio-based economy, an emphasis is put on innovative bio-based products such as biopolymers and bioplastics, while in others, traditional bio-based products such as bio-based textiles, wood products, pulp, and paper are explicitly included as well. Recently, the term circular bioeconomy that has been introduced by the European Commission, among others, to intertwine the bioeconomy and circular economy concepts and emphasize the use of a circular approach in bioeconomy, also shows its limitations and overlap. In turn, green economy is a concept of economic development aimed at ensuring sustainability and environmental safety. It seeks to minimize the negative impact of human activity on nature and maximize the use of renewable resources.

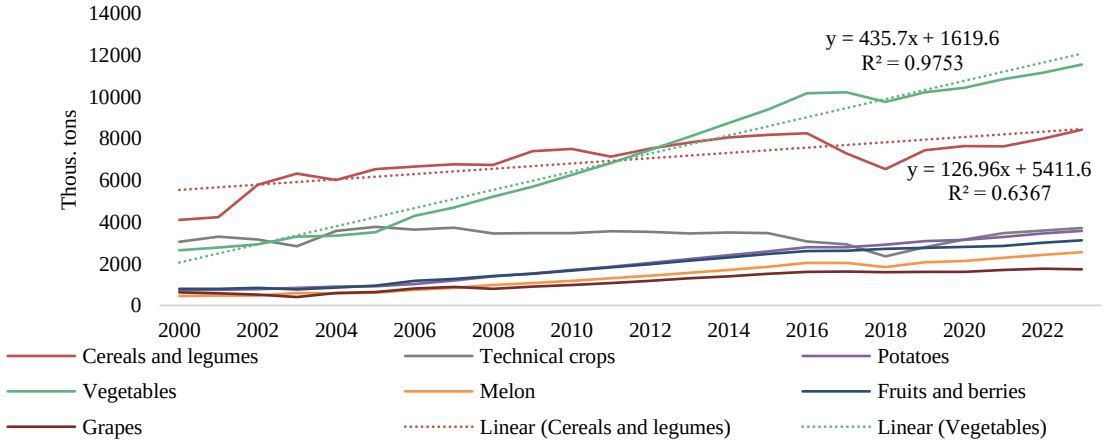
Bioeconomy in Uzbekistan

The current structure of bioeconomy in Uzbekistan is dominated by agriculture amounting to 404.6 trillion soums. Forestry and fisheries contribute to a much smaller rate – 10.4 and 4.3 trillion soums accordingly (Socio-economic situation…, 2024). The whole agriculture sector is divided almost in two halves, namely, livestock and crop production. In 2023, the crop production amounted to 50.1% of the whole agriculture sector (2.02 trillion soums) and the livestock production – 49.9% (2.01 billion soums) respectively (Socio-economic situation …, 2024).

Within the crop production sector ‘Figure 1’, the main cultures grown are vegetables (mainly carrots, tomatoes and onions), which also has the highest growth rate among other cultures, and thus this sector has had a rather steady increase during the last two decades. A trendline with a linear equation can be used to reflect the direction of this sector (R^2_{veg}=0.9753), and thus this equation could be used to assess further development of the vegetable production. It is followed by cereals and legumes – a sector that has seen an overall increase in the produced volumes over the last few years; however, there has also been a rather sharp decline in the production in 2017-2019 due to low harvests in those years. Low harvests had also affected the group of technical crops, which is predominantly cotton in Uzbekistan; fortunately, the harvest of this crop is recovering in the recent years.

Figure 1

Crop production of the Republic of Uzbekistan, 2000-2023, thou. tonnes

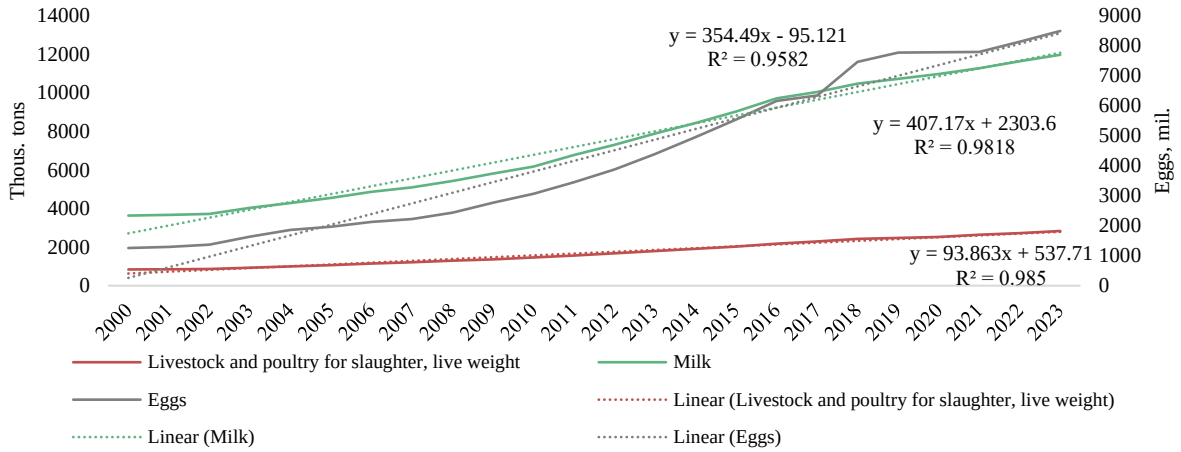


Source: calculation by the authors using the data of the Statistics Agency of Uzbekistan, 2024.

Livestock production sector is also experiencing a steady increase in production volumes, especially regarding milk and eggs, also meat - the increase is steady for meat but much slower due to the rapid

growths of production of dairy and eggs. All three of the goods reflected in 'Figure 2' exhibit a very close correspondence with a linear trend, showing an upward trajectory with R^2_{milk}=0.9582; R^2_{eggs}=0.9818; $R^2_{livestock}$=0.985, thus they can be used in developing a future outlook for the production of these goods.

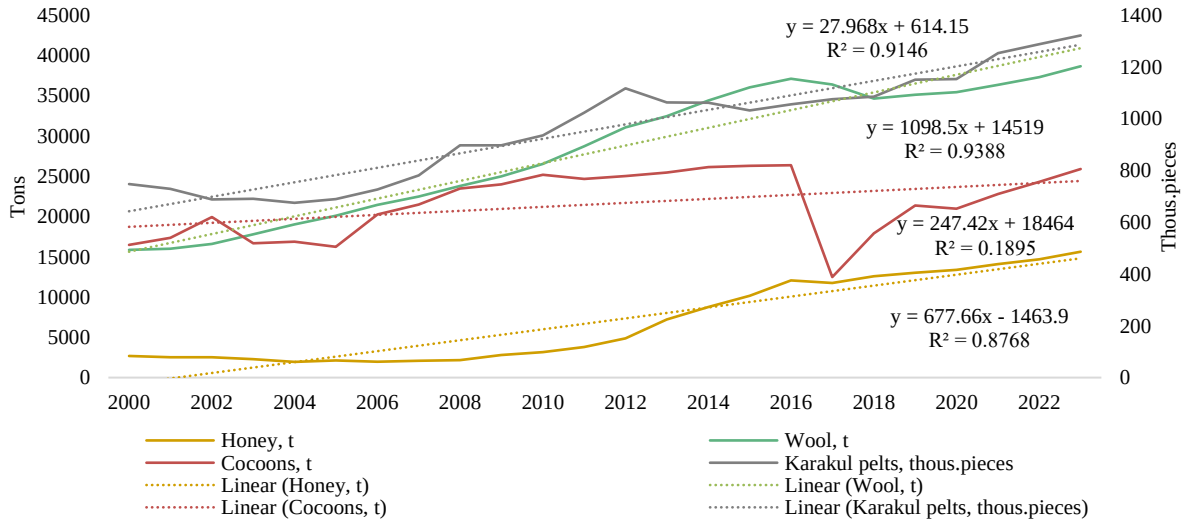
Figure 2
Livestock production of the Republic of Uzbekistan, 2000-2023, thou. tonnes; mil. eggs (secondary axis)



Source: calculation by the authors using the data of the Statistics Agency of Uzbekistan, 2024.

Apart from the production of the main goods of the livestock sector (milk, meat and eggs), other goods include honey, wool, cocoons and karakul pelt. The volumes of all of these goods show an overall upward tendency although it can be noticed that production of silkworm cocoons fluctuates strongly and had a sharp decline in 2017, but has been restoring the production volumes in the recent years 'Figure 3'.

Figure 3
Production of other goods within the livestock sector of the Republic of Uzbekistan, 2000-2023, tonnes; thou. pieces (secondary axis)



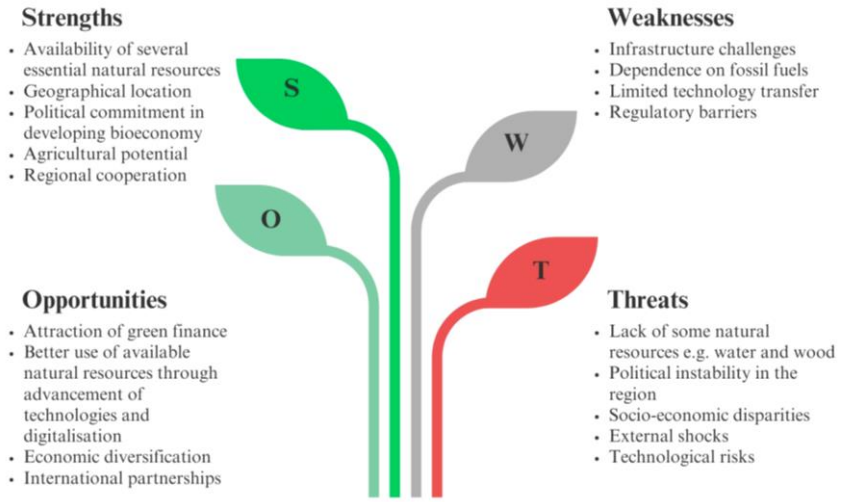
Source: calculation by the authors using the data of the Statistics Agency of Uzbekistan, 2024.

Uzbekistan's transition to a green economy can be analysed through a SWOT perspective in 'Figure 4'. The country has significant strengths, particularly in its availability of several essential renewable energy resources, e.g. arable land. Furthermore, the government commitment to green initiatives and investment in renewable energy projects provides a strong foundation for further development of sustainable bioeconomy. Uzbekistan's agricultural sector also presents opportunities for sustainable practices, contributing to the green economy and is important provider of agricultural products in the region. However, it is important to consider notable weaknesses. Infrastructure challenges, particularly in management of water resources, waste management and renewable energy production and distribution, may impede progress. Economic and technological dependence on

fossil fuels poses a significant obstacle, along with limited access to advanced green technologies and bureaucratic barriers. Also, lack of experience in the development and implementation of green technologies may pose an obstacle to the implementation of the strategy. The growing interest in green technologies and sustainable practices creates opportunities to attract investment and develop new industries (Raimjanova & Popluga, 2023).

Cooperation with other countries can provide access to technology and expertise. The need for significant investments for the introduction of green technologies may face limitations in the country's financial resources and price fluctuations for traditional energy resources may affect the economic feasibility of green investments (Meyer, 2017).

Figure 4
SWOT analysis of Uzbekistan's strategy for the transition to a green economy



Despite these challenges, there are promising opportunities for Uzbekistan. International partnerships and funding can accelerate the transition to green industries, creating jobs and attracting investment. Investing in green infrastructure and a better use of advanced and digital technologies (Zeverte-Rivza et al., 2023) can also enhance climate resilience and enhance a more effective use of available natural resources. Also, diversification of economic activities can improve the resilience of the businesses affected by climate threats, e.g. drought and development of local food consumption in the unprocessed food, locally specific and prosocial value food segments. As concluded in previous studies in these segments, demand is inelastic, creating a relative advantage of local food in competition with global food products (Naglis-Liepa et al., 2022).

However, there are potential threats that must be addressed. Political instability in the region could disrupt long-term sustainability efforts, and socio-economic disparities may widen during the transition. External factors such as fluctuating energy prices and technological risks pose additional challenges. Also, lack of some much needed resources as, for example, water resources and wood should be taken into account. Meyer in 'Bioeconomy Strategies' (2017) explores challenges in implementing the strategy, citing potential goal discrepancies due to insufficient communication with other industries. The lack of coordination between ministries may further impede strategy execution.

The literature review indicates that the transformation of the economy into a bioeconomy involves adopting strategies that harness biological resources, promote sustainability, and drive innovation in biotechnology; and it can be done through: 1) development of biotechnologies; 2) transitioning from fossil fuels to renewable energy; 3) sustainable agriculture: involves developing methods that minimize environmental impact and maximize biological resource utilization, including transitioning to organic farming and alternative soil cultivation methods; 4) development of biodiversity: emphasizes protecting and restoring life diversity in ecosystems through nature reserves, protected areas, and species restoration programs; 5) development of ecological tourism: focuses on tourism designed to preserve the natural environment, mitigating environmental impacts and generating income for local populations.

Conclusions

1. The bioeconomy in Uzbekistan is predominately dominated by agriculture accounting for 96.5% of Uzbekistan's bioeconomy among the primary sectors of agriculture forestry and fisheries with a growing tendency in almost all subsectors of agriculture with the fastest growth in vegetable, milk and egg production.
2. Clear and transparent regulatory frameworks would facilitate the growth of bioeconomy industries in Uzbekistan, ensuring attraction of investments and developing circular and sustainable practices.

3. Facilitating collaborations between bioeconomy producers and potential end-users, such as industries utilizing biomass-based products or renewable energy sources, is essential. Creating awareness among consumers about the benefits of bio-based products is equally important for sustainable development.
4. International collaboration should be strengthened by forming partnerships with global organizations, allied nations, and investors.
5. Establishing a robust monitoring and evaluation framework is crucial for regularly assessing the progress of bioeconomy policies. Collecting data on key performance indicators and making necessary adjustments will ensure continuous improvement.

References

Birner, R. (2018). Bioeconomy concepts. In: Lewandowski I. (Eds.) *Bioeconomy* (pp. 17-38), Springer, https://doi.org/10.1007/978-3-319-68152-8_3

Bioeconomy in Italy. (2019). *A new Bioeconomy strategy for a sustainable Italy*. https://cnbbsv.palazzochigi.it/media/1903/bit_ii_en_2019_final.pdf

Bioeconomy strategy. (2022). *Outline of Japanese Bioeconomy Strategy*. https://biock.jp/wp-biock/wp-content/uploads/2022/10/BioJapan2022_watanabe_20221012.pdf

Federal Ministry of Agriculture, Forestry, Climate and Environmental Protection, Regions and Water Management of Republic of Austria. (2019). *Bioeconomy. The strategy for Austria.* https://www.bmluk.gv.at/dam/jcr:69bdc92b-83fe-468a-9ec04d29295a505b/Oe_Biooekonomie_Strategie_ en.pdf

Kardung, M., Cingiz, K., Costenoble, O., Delahaye, R., Heijman, W., Lovrić, M., …, & Zhu, B. X. (2021). Development of the circular bioeconomy: Drivers and indicators. *Sustainability*, *13*(1), 413. https://doi.org/10.3390/su13010413

Le Pera, A., Sellaro, M., Bencivenni, E., & D'Amico, F. (2022). Environmental sustainability of an integrate anaerobic digestion-composting treatment of food waste: Analysis of an Italian plant in the circular bioeconomy strategy. *Waste Management*, 139, 341-351. https://doi.org/10.1016/j.wasman.2021.12.042

Meyer, R. (2017). Bioeconomy strategies: Contexts, visions, guiding implementation principles and resulting debates. *Sustainability*, *9*(6), 1031. https://doi.org/10.3390/su9061031

Ministry of Agriculture of Republic of Latvia. (2016). *Latvia Bioeconomy Strategy 2030*. https://tap.mk.gov.lv/mk/tap/?pid=40433525

Ministry of Industry and Fisheries of Norway. (2016). *Familiar resources – undreamt of possibilities. The governments bioeconomy strategy.* https://www.sureaqua.no/Sureaqua/library/ Norwegian%20Bioeconomy%20Strategy%20-%20English%20summary%20.pdf

Ministry of Sustainability and the Environment. (2021). *Singapore Green Plan 2030*. https://www.greenplan.gov.sg/overview/

Naglis-Liepa, K., Paula, L., Janmere, L., Kaufmane, D., & Proskina, L. (2022). Local Food Development Perspectives in Latvia: A Value-Oriented View. *Sustainability*, *14*(5), 2589. https://doi.org/10.3390/su14052589

Norwegian Ministry of Trade, Industry and Fisheries. (2017). *Familiar resources – undreamt of possibilities. The Government's Bioeconomy Strategy.* Ministry of Trade, Industry and Fisheries https://www.regjeringen.no/contentassets/32160cf211df4d3c8f3ab794f885d5be/biookonomi-eng-kortversjon_uu.pdf

Raimjanova, M. & Popluga, D. (2023, January). Bioeconomy concept and possibilities of its implementation in Uzbekistan agriculture for making it more attractive for investments. In *Economic Science for Rural Development Conference Proceedings*, 57. https://doi.org/10.22616/ESRD.2023.57.059

Ramcilovic-Suominen, S. & Pulzl, H. (2018). Sustainable development–a 'selling point' of the emerging EU bioeconomy policy framework? *Journal of cleaner production*, 172, 4170-4180. https://doi.org/10.1016/j.jclepro.2016.12.157

LEXUZ. (2019). *Resolution president of the Republic of Uzbekistan on approval of the strategy for the transition of the Republic of Uzbekistan to a 'green' economy for the period 2019 – 2030.* https://lex.uz/en/docs/-4539502

Statistics agency under the president of the Republic of Uzbekistan. (2024). *Socio-economic situation of the Republic of Uzbekistan.* https://stat.uz/images/uploads/reliz-2023/talil-2023-jil-yanvar-mart-angl-19_04_2023.pdf

The Federal Government of Germany. (2021). *National Bioeconomy Strategy.* https://www.bmbf.de/bmbf/shareddocs/downloads/files/bmbf_bioeconomy-strategy_summary_en.pdf?__ blob=publicationFile&v=1

Viaggi, D. (2018). *The bioeconomy: delivering sustainable green growth*. CABI.

Statistics agency under the president of the Republic of Uzbekistan. (2024). *Volume of products (services) of agriculture, forestry and fisheries by region.* https://api.stat.uz/api/v1.0/data/hududlar-kesimida-qishloq-ormon-va-baliqchilik?lang=en&format=pdf

Zeverte-Rivza, S., Girdziute, L., Parlinska, A., Rivza, P., Novikova, A., & Gudele, I. (2023). Digitalisation in Bioeconomy in the Baltic States and Poland. *Sustainability*, *15*(17), 13237. https://doi.org/10.3390/su151713237