

ANALYZING THE IMPACT OF DIGITAL ECONOMIC EXPANSION ON RESOURCE UTILIZATION AND ENVIRONMENTAL SUSTAINABILITY IN UZBEKISTAN

Muhammad Eid Balbaa

Tashkent State University of Economics, m.balbaa@tsue.uz,

ORCID: 0000-0002-9924-777X

Abstract:

This study investigates the intricate relationship between digital economic expansion, resource utilization, and environmental sustainability in Uzbekistan. As the country advances its digital economy, understanding the environmental consequences of this growth becomes crucial for policy-making. The research explores how Uzbekistan's digital-driven GDP growth impacts resource consumption, particularly focusing on energy usage, water resources, and land utilization, alongside environmental degradation indicators such as CO₂ emissions and pollution levels. Employing an econometric model, the analysis assesses the extent to which economic growth, driven by non-renewable energy sources, contributes to environmental challenges, and how a transition to renewable energy can mitigate these effects. The study underscores the importance of integrating renewable energy into Uzbekistan's digital economy to ensure sustainable development.

Keywords:

Digital economy, Environmental Kuznets Curve, GDP growth, resource utilization, environmental sustainability, CO₂ emissions, renewable energy, non-renewable energy, Uzbekistan, econometric model, environmental degradation.



АНАЛИЗ ВЛИЯНИЯ ЦИФРОВОЙ ЭКОНОМИЧЕСКОЙ ЭКСПАНСИИ НА ИСПОЛЬЗОВАНИЕ РЕСУРСОВ И ЭКОЛОГИЧЕСКУЮ УСТОЙЧИВОСТЬ В УЗБЕКИСТАНЕ

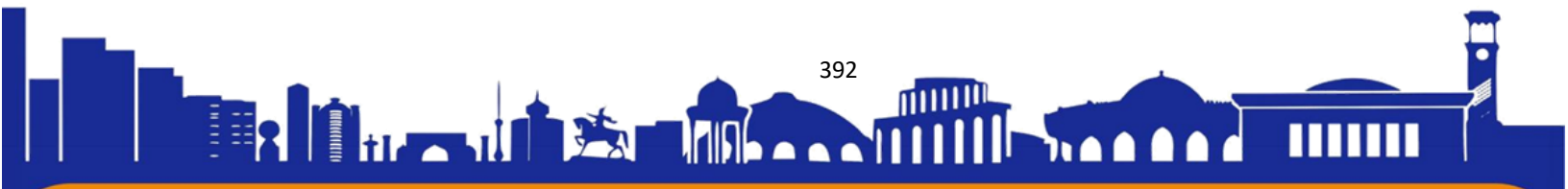
Мухаммад Эйд Балбаа

Ташкентский государственный экономический университет,
m.balbaa@tsue.uz,

ORCID: 0000-0002-9924-777X

Аннотация: В этом исследовании изучается сложная взаимосвязь между цифровой экономической экспансией, использованием ресурсов и экологической устойчивостью в Узбекистане. По мере того, как страна развивает свою цифровую экономику, понимание экологических последствий этого роста становится решающим для разработки политики. Исследование изучает, как рост ВВП Узбекистана, обусловленный цифровыми технологиями, влияет на потребление ресурсов, особенно уделяя внимание использованию энергии, водным ресурсам и использованию земель, а также показателям ухудшения состояния окружающей среды, таким как выбросы CO₂ и уровни загрязнения. Используя эконометрическую модель, анализ оценивает степень, в которой экономический рост, обусловленный невозобновляемыми источниками энергии, способствует решению экологических проблем, и как переход на возобновляемые источники энергии может смягчить эти последствия. В исследовании подчеркивается важность интеграции возобновляемых источников энергии в цифровую экономику Узбекистана для обеспечения устойчивого развития.

Ключевые слова: Цифровая экономика, рост ВВП, использование ресурсов, экологическая устойчивость, выбросы CO₂, возобновляемые источники энергии, невозобновляемые источники энергии, Узбекистан, эконометрическая модель, ухудшение состояния окружающей среды.



RAQAMLI IQTISODIY KENGAYISHNING O‘ZBEKISTONDA RESURSLARDAN FOYDALANISH VA EKOLOGIK BARQARORLIKKA TA‘SIRINI TAHLIL QILISH

Muhammad Eid Balbaa

Toshkent davlat iqtisodiyot universiteti, m.balbaa@tsue.uz,

ORCID: 0000-0002-9924-777X

Annotatsiya: Ushbu tadqiqot O‘zbekistonda raqamli iqtisodiy kengayish, resurslardan foydalanish va ekologik barqarorlik o‘rtasidagi murakkab bog‘liqlikni o‘rganadi. Mamlakat raqamli iqtisodiyotni rivojlantirar ekan, bu o‘shishning ekologik oqibatlarini tushunish siyosatni ishlab chiqish uchun hal qiluvchi ahamiyatga ega bo‘ladi. Tadqiqot O‘zbekistonda raqamli yalpi ichki mahsulotning o‘shishi resurslar iste‘moliga qanday ta‘sir qilishini o‘rganadi, xususan, energiyadan foydalanish, suv resurslari va yerdan foydalanish, shuningdek, CO2 emissiyasi va ifloslanish darajasi kabi atrof-muhitning degradatsiyasi ko‘rsatkichlari. Ekonometrik modeldan foydalangan holda, tahlil qayta tiklanmaydigan energiya manbalari hisobiga iqtisodiy o‘shish ekologik muammolarga qanchalik hissa qo‘shishi va qayta tiklanadigan energiyaga o‘tish bu ta‘sirlarni qanday kamaytirishi mumkinligini baholaydi. Tadqiqot barqaror rivojlanishni ta‘minlash uchun qayta tiklanadigan energiya manbalarini O‘zbekistonning raqamli iqtisodiyotiga integratsiya qilish muhimligini ta‘kidlaydi.

Kalit so‘zlar: Raqamli iqtisodiyot, Ekologik Kuznets egri chizig‘i, YaIM o‘shishi, resurslardan foydalanish, ekologik barqarorlik, CO2 emissiyasi, qayta tiklanadigan energiya, qayta tiklanmaydigan energiya, O‘zbekiston, ekonometrik model, atrof-muhitning degradatsiyasi.

Introduction:

The relationship between digital economic growth and resource consumption is increasingly critical for nations like Uzbekistan, which are experiencing rapid

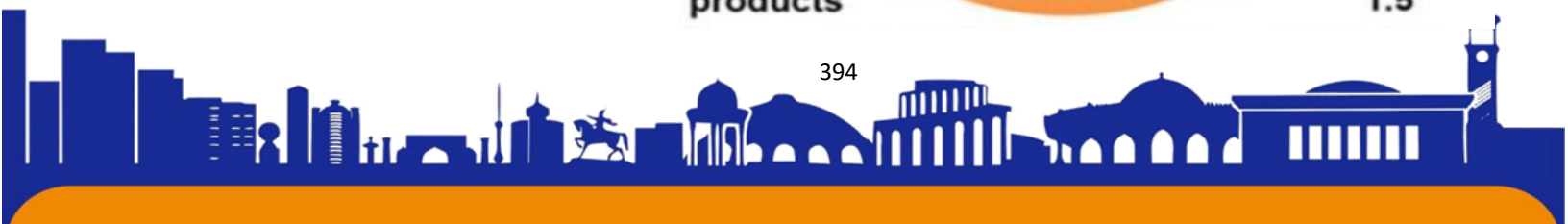
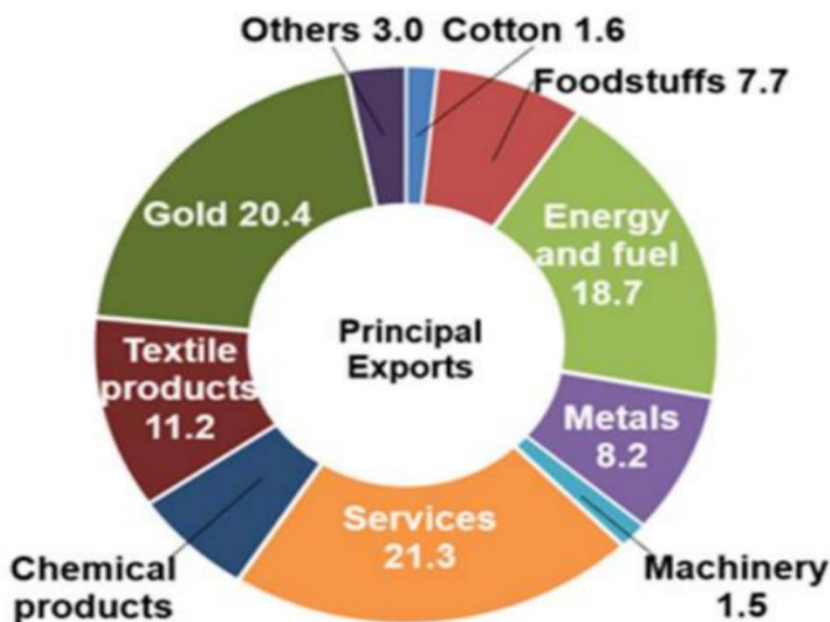


economic and digital expansion. With the rise of the digital economy, Uzbekistan faces the challenge of balancing Gross Domestic Product (GDP) growth driven by digital transformation with sustainable resource utilization. While digitalization offers significant opportunities for enhancing productivity and economic efficiency, it also drives higher demand for natural resources such as energy, water, and minerals to support the infrastructure needed for digital technologies, data centers, and communication networks [1]. This increased demand can exacerbate resource extraction and consumption, leading to potential environmental degradation, including deforestation, pollution, and biodiversity loss, if not managed sustainably [2].

Uzbekistan’s economic growth has historically been driven by natural resource extraction industries. However, the digital economy is rapidly becoming a key sector that places additional pressure on the country’s natural resources. The energy demands of expanding digital infrastructure, such as data centers and internet service providers, have increased significantly, leading to higher consumption of fossil fuels, which are Uzbekistan’s primary energy source [3]. Furthermore, the rapid digital transformation and urbanization in recent years have intensified these environmental challenges, underscoring the need for innovative strategies that can promote both economic and environmental sustainability.

Figure 1: Uzbekistan Principal Exports (% , 2018)

Source: state statistics committee of Uzbekistan, stat.uz.





This research aims to fill this gap by investigating the impact of digital economic growth on key natural resources such as energy, water, and land. Additionally, it explores how the expansion of the digital economy correlates with environmental degradation, including increased CO2 emissions, pollution levels, and resource depletion. A comprehensive analysis of these relationships is crucial for shaping policies that can enable Uzbekistan to capitalize on its digital economy while minimizing its environmental footprint.

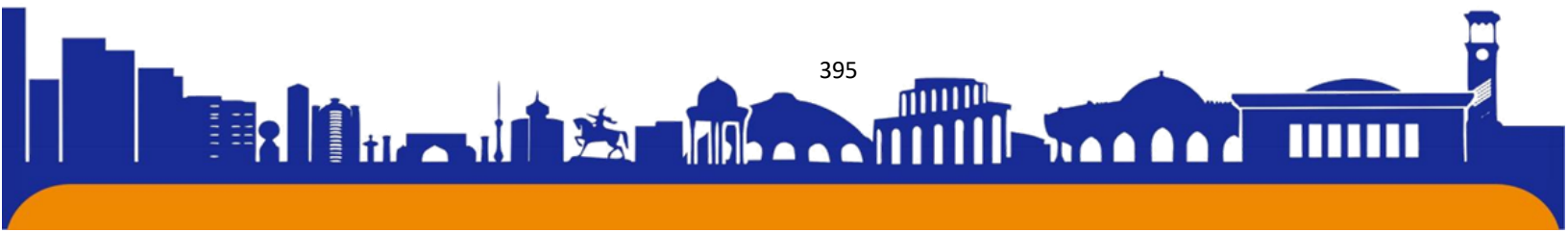
Table 1: Approved volume of water resources for Uzbekistan, km3

River	River Trunk	Small Rivers	Total	Groundwater	Collector drainage flow	Total
Syrdarya	10.49	9.42 1	19.91	1.59	2.60	24.10
Amudarya	22.08	10.41	32.49	0.30	2.31	35.10
Total	32.57	19.84	52.41	1.89	4.91	59.20

Source: state committee of statistics, Uzbekistan

This study is guided by the following research question: *How does digital economic growth in Uzbekistan affect resource utilization and environmental sustainability?* Specifically, the research will examine the extent to which digital transformation and GDP growth influence the consumption of key natural resources such as energy, water, and minerals, and how these trends correlate with environmental challenges, including pollution, resource depletion, and CO2 emissions.

The study provides a framework for future research on the relationship between digital economic growth and environmental sustainability in other Central Asian economies. As these countries are also undergoing significant digital transformations, the insights from this research can serve as a comparative benchmark for analyzing how digital policies and growth strategies impact resource utilization and environmental outcomes across the region.



In summary, this study seeks to provide a comprehensive understanding of the relationship between digital economic growth, resource utilization, and environmental sustainability in Uzbekistan. By addressing a critical gap in the literature and offering policy recommendations, this research has the potential to contribute to Uzbekistan's long-term digital, economic, and environmental well-being.

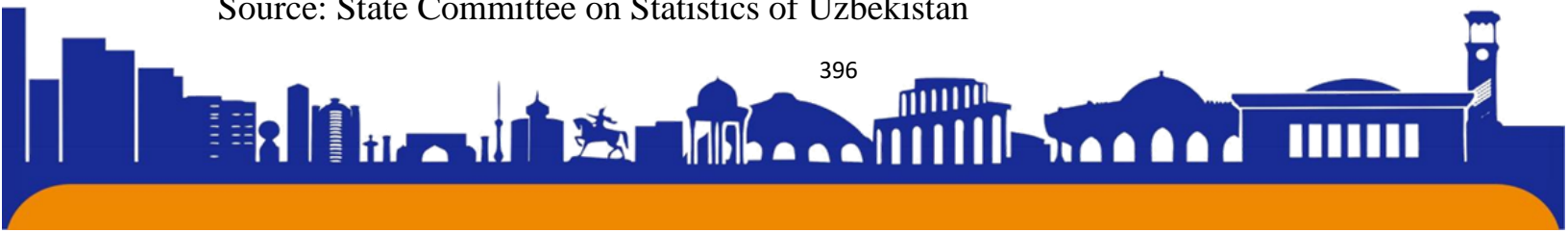
Economic Growth and Resource Utilization

Economic growth in Uzbekistan has been marked by a steady rise in GDP, but this growth comes at a cost in terms of resource utilization and environmental degradation. In recent years, Uzbekistan has implemented various reforms to balance economic development with sustainability.

Table 2: Land use categories of Uzbekistan

No	Land use categories	Total area	
		Thousand ha	%
1	Agricultural purpose	20481,1	46,1
2	Settlements	214,1	0,5
3	Industry, transport, communication, defence	914,5	2,1
4	Environmental, health and recreational purposes	75,9	0,2
5	Historical and cultural purposes	6,2	0
6	Forest fund	9636,9	21,7
7	Water fund	831,4	1,9
8	Reserve land	12250,2	27,6
Total		44410,3	100,0

Source: State Committee on Statistics of Uzbekistan





Uzbekistan’s GDP has grown significantly, reaching approximately USD 80.4 billion in 2022, with an annual growth rate of 5-6%. This growth has largely been fueled by non-renewable energy resources such as natural gas, coal, and oil, which make up a considerable portion of the country's energy consumption. As indicated in the Uzbekistan Energy Profile, the country produced around 60.4 billion cubic meters of natural gas in 2019, making it one of the world's largest producers.

Table 3: Uzbekistan electricity consumption by sector, 2019

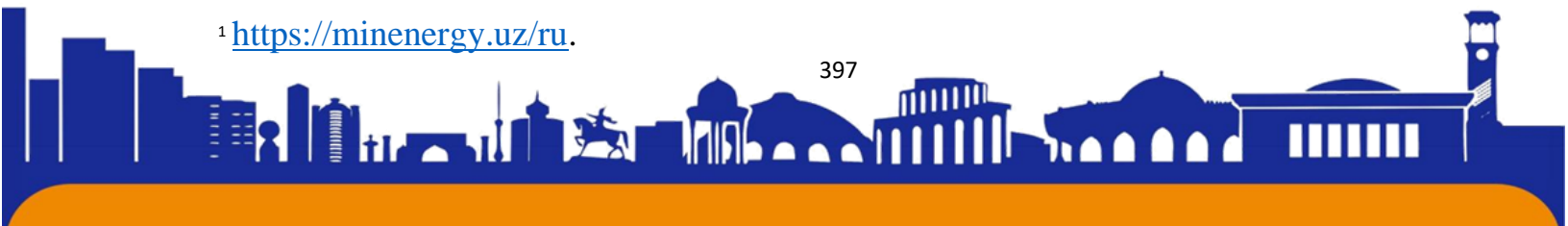
Sectors	Electricity consumption
Industry	40%
Population	23%
Agriculture	20%
Utility	13%
Transport	3%
Construction	1%

Source: Uzbekistan Ministry of Energy¹.

Literature Review

Digital economic expansion has increasingly become a significant factor influencing resource consumption and environmental sustainability. Several studies have explored the relationship between economic growth and environmental degradation, most notably in the context of developing economies like Uzbekistan. The literature highlights both opportunities and challenges in managing the environmental impacts of digitalization.

¹ <https://minenergy.uz/ru>.



FDI and Environmental Sustainability

A recent study by Apergis et al. (2023) found that FDI inflows in Uzbekistan contributed to increased CO₂ emissions due to investments in resource-heavy industries [12]. This suggests that while FDI can support economic development, it may also exacerbate environmental degradation if appropriate environmental safeguards are not in place. This is particularly relevant for Uzbekistan, where the digital economy is growing rapidly, but energy consumption remains heavily dependent on fossil fuels.

Renewable vs. Non-Renewable Energy in the Digital Economy

The transition from non-renewable to renewable energy is a critical component of achieving environmental sustainability in the digital age. Studies such as those by Saidmamatov et al. (2023) highlight the potential for Central Asian economies to leverage renewable energy resources to reduce their environmental footprints [13]. In Uzbekistan, the adoption of renewable energy sources such as solar and wind power has been slow, but recent policy initiatives suggest that the government is beginning to recognize the importance of green energy for sustainable digital growth.

The literature on digital economic growth, resource utilization, and environmental sustainability highlights the complex interplay between economic development and environmental outcomes. While digitalization offers opportunities for enhancing economic efficiency and reducing waste, it also poses significant environmental challenges, particularly in resource-dependent countries like Uzbekistan. The Environmental Kuznets Curve (EKC) hypothesis provides a useful framework for understanding the relationship between economic growth and environmental degradation, but its applicability to Uzbekistan's digital economy remains to be fully explored. Moreover, the role of FDI in promoting sustainable digital growth is contingent on the country's ability to implement effective environmental policies and transition to renewable energy sources. As Uzbekistan continues its digital transformation, future research should focus on developing resource-efficient growth models and exploring the potential for renewable energy to mitigate the environmental impacts of digital economic expansion.

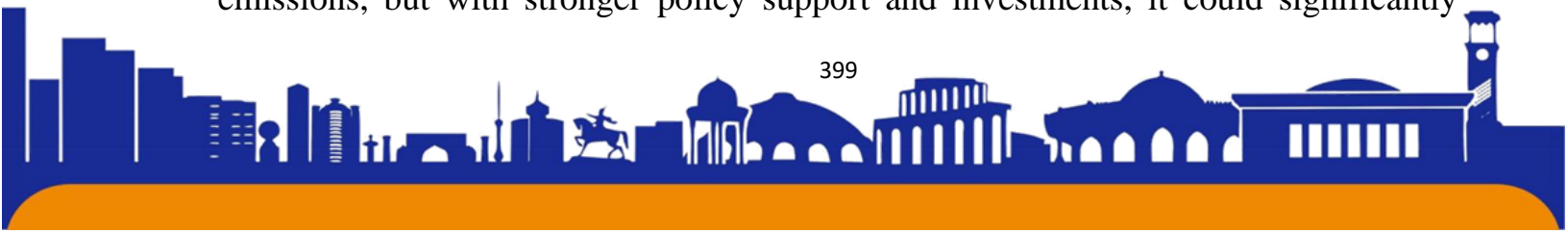
Discussion

The findings reveal that Uzbekistan's digital economic growth has contributed to a significant increase in resource consumption, particularly in the energy sector. This aligns with studies suggesting that rapid economic expansion, particularly in digital industries, tends to drive higher energy demand, primarily due to the energy-intensive nature of digital infrastructure such as data centers, telecommunications, and cloud services [1]. While digitalization can bring about efficiency gains in various sectors, the initial stages of digital economic growth are often characterized by increased reliance on non-renewable energy sources. This is evident in Uzbekistan's case, where non-renewable energy consumption shows a strong positive correlation with GDP growth, as illustrated in the correlation analysis and regression results.

Uzbekistan's reliance on fossil fuels, particularly natural gas, to power its digital infrastructure presents significant environmental challenges. The increase in CO₂ emissions, which correlates with both economic growth and energy consumption, highlights the environmental costs associated with non-renewable energy dependency [2]. These findings are consistent with other studies on energy consumption in rapidly growing economies, which suggest that energy transition efforts must be prioritized to mitigate the environmental impact of economic growth [3]. While the country has made some efforts to integrate renewable energy into its energy mix, as indicated by the correlation between renewable energy consumption and CO₂ emissions, these efforts are insufficient to offset the environmental degradation caused by non-renewable energy use.

2. Policy Implications and Sustainable Development

The findings of this study have important implications for Uzbekistan's policymakers. To ensure that the country's digital economic growth is sustainable, it is crucial to accelerate the transition towards renewable energy sources. As the results show, renewable energy consumption currently plays a limited role in reducing CO₂ emissions, but with stronger policy support and investments, it could significantly



contribute to environmental sustainability. Increasing the share of renewable energy in Uzbekistan's energy mix will not only help reduce emissions but also ensure that the country's growth is aligned with global sustainability goals [7].

Additionally, the results underscore the need for Uzbekistan to implement stronger environmental regulations that incentivize cleaner production practices and energy efficiency. Given the positive relationship between GDP growth and CO₂ emissions, policymakers should consider adopting policies that promote resource efficiency and reduce the environmental footprint of digital economic activities. For instance, incentivizing the development of energy-efficient digital infrastructure and encouraging the use of green technologies in sectors such as agriculture and manufacturing could mitigate the negative environmental impacts of economic growth [8].

3. Limitations and Future Research

While this study provides valuable insights into the relationship between digital economic growth and environmental sustainability in Uzbekistan, there are several limitations that should be acknowledged. First, the analysis primarily focuses on energy consumption and CO₂ emissions as indicators of environmental degradation. Future research should explore additional environmental indicators, such as water pollution, deforestation, and biodiversity loss, to provide a more comprehensive understanding of the environmental impacts of digital economic growth [10].

Second, the study's time frame is limited to the period from 2005 to 2020. Given that digital economic growth is a relatively recent phenomenon in Uzbekistan, future research could benefit from extending the analysis to capture more recent data and trends. Additionally, investigating the potential role of technological innovation and digital policies in mitigating environmental degradation could offer valuable insights for policymakers seeking to promote sustainable growth.

In conclusion, this study demonstrates that while digital economic growth has contributed to Uzbekistan's economic development, it has also led to increased resource consumption and environmental degradation. The country's reliance on non-renewable

energy sources is a key driver of CO₂ emissions, highlighting the need for a more sustainable approach to digitalization. To achieve long-term sustainability, Uzbekistan must prioritize investments in renewable energy, implement stronger environmental regulations, and integrate environmental considerations into its digital economic strategy. Further research is needed to explore additional environmental indicators and to assess the role of technological innovation in promoting resource-efficient economic growth.

Conclusion

This study has examined the intricate relationship between digital economic growth, resource utilization, and environmental sustainability in Uzbekistan. The results highlight that while digital economic expansion contributes positively to Uzbekistan's GDP, it also exacerbates resource consumption, particularly in terms of energy use, and leads to significant environmental degradation, as evidenced by rising CO₂ emissions. The findings underscore the need for Uzbekistan to prioritize its energy transition toward renewable sources in order to mitigate the adverse environmental impacts associated with non-renewable energy consumption.

To ensure that Uzbekistan's digital economic growth is aligned with sustainable development goals, the country must focus on three key areas:

1. **Energy Transition:** Uzbekistan should accelerate its shift from fossil fuel dependence to renewable energy. This will not only help in reducing CO₂ emissions but will also enhance the sustainability of the country's digital economy.
2. **Environmental Policy and Regulation:** Stronger environmental regulations are required to manage the environmental impacts of digitalization. Policymakers should promote energy efficiency, invest in green technologies, and adopt policies that encourage industries to reduce their environmental footprint.
3. **Sustainable Digitalization:** As Uzbekistan continues to digitalize, it is essential to adopt an integrated approach that balances economic growth with environmental sustainability. This requires incorporating environmental

considerations into digital economic strategies and ensuring that technological advancements support rather than hinder environmental goals.

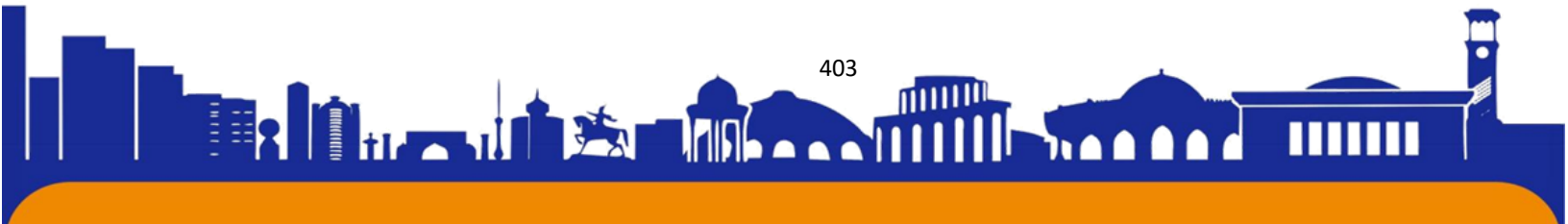
By addressing these areas, Uzbekistan can chart a path toward sustainable digital economic growth, ensuring that its economic development contributes not only to improved living standards but also to long-term environmental health. The findings of this study provide a foundation for future research and policy formulation, aimed at fostering a more sustainable and resilient economy.

References:

1. Astanakulov Olim Tashtemirovich, Muhammad Eid Balbaa, Foziljonov Ibrohimjon, Nilufar Batirova. (2024). Investigating the Impact of Artificial Intelligence on Digital Marketing Tactics Strategies Using Neutrosophic Set. *International Journal of Neutrosophic Science*, 23 (3), 175-183.
2. B. Kuziboev, P Vysusilova, R. Salahodjaev, A. Rajabov, T. Rakhimov. The Volatility Assessment of CO2 Emissions in Uzbekistan: ARCH/GARCH Models. *International Journal of Energy Economics and Policy*, 13(5), 1-7 (2023). doi: 10.32479/ijeep.14487
3. Balbaa, M. E. (2024). Socio-Economic Indicators and their Impact on Sustainable Economic Development: An In-depth Analysis of Egypt. *International Journal of Economics and Financial Issues*, 14(2), 136–145. <https://doi.org/10.32479/ijefi.16016>
4. Ch. Hsu, F. Chien. The impact of high economic growth and technology advancement on extensive energy production in China: evidence using NARDL model, *Environmental Science and Pollution Research*, 30, 1656–1671 (2023) <https://doi.org/10.1007/s11356-022-22205-7>
5. E. Akhmetshin, S. Zhiltsov, A. Dmitrieva, A. Plotnikov, A. Kolomeytseva. The formation of the contemporary renewable energy sector and its role in the industry development. *International Journal of Energy Economics and Policy*, 9(6), 373-378 (2019). doi:10.32479/ijeep.8229
6. I. Mateia. Is there a Link between Renewable Energy Consumption and Economic Growth? A Dynamic Panel Investigation for the OECD Countries,



- Dans Revue d'économie politique, 127, 985 à 1012 (2017). Éditions Dalloz
ISSN 0373-2630 DOI10.3917/redp.276.0985
7. IEA (International Energy Agency). Uzbekistan 2022: Energy Policy Review, 95-98 (2022). <https://www.iea.org/reports/uzbekistan-2022>
 8. J. Behera, A.K. Mishra. Renewable and non-renewable energy consumption and economic growth in G7 countries: evidence from panel autoregressive distributed lag (PARDL) model (2020). IEEP 17(1): 241–258
 9. Kuldasheva, Zebo and Ismailova, Nilufar and Balbaa, Muhammad, Evaluating the Factors Affecting Consumer's Online Shopping Behavior: The Case of Uzbekistan, 2022, isbn 9781450387347, Association for Computing Machinery, New York, NY, USA, <https://doi.org/10.1145/3508072.3508126>, ICFNDS 2021 pages 328–333.
 10. M.H. Zrelli. Renewable energy, non-renewable energy, carbon dioxide emissions and economic growth in selected Mediterranean countries, Environ Econ Policy Stud. 19, 691–709 (2017). DOI 10.1007/s10018-016-0170-5
 11. Muhammad Eid Balbaa, Astanakulov O. Tashtemirovich. (2023). Fusion-Based Econometric Analysis: Assessing Investment Project Efficacy and Business Decision Making. Fusion: Practice and Applications, 13 (2), 145-155. <https://doi.org/10.54216/FPA.130213>
 12. N. Apergis, B. Kuziboev, I. Abdullaev, A. Rajabov. Investigating the association among CO2 emissions, renewable and non-renewable energy consumption in Uzbekistan: An ARDL approach. Environmental Science and Pollution Research, 30(14), 39666-39679 (2023). doi:10.1007/s11356-022-25023-z
 13. O. Saidmamatov, N. Tetreault, D. Bekjanov, E. Khodjanizoyev, E. Ibadullaev, Y. Sobirov, L. R. Adrianto. The nexus between agriculture, water, energy and environmental degradation in central Asia—Empirical evidence using panel data models. Energies, 16(7) (2023). doi:10.3390/en16073206
 14. Olim, A., Balbaa, M. E., Mukhabbatkhon, B., Batirova, N., & Dadabaev, U. (2024). Enhancing Housing Finance for Socio-Economic Stability in



ISSN (E): 2181-4570 RESEARCHBIB IMPACT FACTOR: 6,4 / 2023 SJIF 2024 = 5.073

VOLUME-2, ISSUE-11

Uzbekistan. International Journal of Economics and Financial Issues, 14(3), 140–148. <https://doi.org/10.32479/ijefi.16269>

15.S. Chindo, A. Abdulrahim, S.I. Waziri, W.M. Huong, A.A. Ahmad. Energy consumption, CO2emissions and GDP in Nigeria, GeoJournal, 80, 315–322 (2015) DOI 10.1007/s10708-014-9558-6