

Digital And Green Economy: A Pathway to Sustainable Development

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Abstract:

The digital and green economy is a transformative approach towards sustainable development in the twenty-first century. Digital technologies, together with ecologically sustainable habits, offer a great opportunity to address global concerns such as climate change, resource depletion and economic injustice. Digital breakthroughs, including artificial intelligence, the Internet of Things (IoT), big data analytics, blockchain, and smart infrastructure, boost resource efficiency, improve energy management, and accelerate the transition to low-carbon economic systems. Simultaneously, the green economic principles encourage sustainable production and consumption habits, the use of renewable energy, the minimisation of waste, and environmental conservation. The intersection of digitalisation and sustainability produces a synergistic paradigm that promotes economic growth with low environmental impact. The creative application of digital tools can help us make sound decisions, improve resource use and create smart cities, green transit systems and models of the circular economy. In addition, digital platforms may help drive innovation, strengthen governance, and offer better access to sustainable solutions across many sectors. However, the digital divide, cybersecurity issues, the high energy consumption of digital infrastructure, and unequal access to technology must be addressed to achieve inclusive and sustainable outcomes.

Keywords: *Digital Economy, Green Economy, Digital Transformation, Renewable Energy, Economy.*

I. INTRODUCTION

The twenty-first century has witnessed two major transformations: digitalisation and environmental sustainability. The digital economy has become a key driver of economic growth through the widespread adoption of information and communication technologies (ICTs). At the same time, concerns regarding climate change, environmental degradation, and resource depletion have led policymakers and businesses to embrace the concept of the green economy.

The digital economy encompasses economic activities enabled by digital technologies, including e-commerce, digital platforms, artificial intelligence, cloud computing, and data analytics. The green economy, on the other hand, aims to improve human well-being and social equity while significantly reducing environmental risks and ecological scarcities.

The convergence of these two paradigms presents new opportunities for achieving sustainable development. Digital technologies can facilitate green innovation, optimize energy use, and support environmentally friendly business models. Consequently, understanding the relationship between the digital and green economy has become a critical area of academic and policy research.

II. CONCEPTUAL FRAMEWORK

Digital Economy

The digital economy is economic activities that rely on digital technologies, digital infrastructure, and data-driven innovation, and its major components are :

- Artificial Intelligence (AI)
- Big Data Analytics
- Cloud Computing
- Internet of Things (IoT)
- Blockchain Technology
- Digital Platforms and E-commerce

Green Economy

The green economy emphasises sustainable economic growth while minimising environmental impacts. Its key principles are:

- Low-carbon development
- Efficiency in utilising resources
- Utilisation of Renewable Energy
- Sustainable production and consumption
- Protecting the Environment
- Social inclusion

Digital-Green Integration

The integration of the digital and green economies creates a framework where digital technologies support environmental sustainability through smart management systems, green innovation, and efficient resource utilisation.

III. IMPACT OF THE DIGITAL ECONOMY ON GREEN DEVELOPMENT

Enhancing Energy Efficiency

Digital technologies enable real-time monitoring and optimisation of energy consumption. Smart grids, intelligent meters, and AI-driven energy management systems reduce energy wastage and improve efficiency.

Promotion of Green Innovation

Digitalisation facilitates data exchange, collaboration and technical innovation, therefore accelerating research and development efforts. Digital technologies have huge potential for green technology, including renewable energy systems and carbon monitoring tools. Studies highlight green technological innovation as a vital pathway for digital economies to improve environmental consequences.

Sustainable Industrial Transformation

Industry 4.0 technologies (Industry 4.0, the Fourth Industrial Revolution represent the digital transformation of manufacturing and industrial processes. It integrates physical machinery with digital technologies to create "smart factories" that are highly connected, autonomous, and data-driven) enabling enterprises to optimise manufacturing processes, reduce waste, and minimise carbon emissions. Smart Factories and Digital Supply Chains for Sustainable Industrial Development.

Smart Cities and Sustainable Urbanisation

Digital technology enables smart cities through intelligent transportation infrastructure, smart waste management, and efficient public services. These advances make the cities more sustainable and lower their environmental impact.

IV. IV REVIEW OF LITERATURE

Fan, D. & Li, M. (2024). Addressing the discord between economic growth and ecological sustainability is essential in the shift from conventional economic development to a sustainable green economy. The super-NSBM model was utilised to assess the efficiency of research and development in green innovation technologies. Furthermore, it was utilised to assess the efficacy of the transition of green innovation achievements throughout 30 Chinese provinces. The evaluation was performed from 2011 to 2021, employing a two-stage innovation value chain framework. The entropy approach was employed to thoroughly compute the digital economy development index, and the influence of digital economy advancement on the two-stage green innovation effect was empirically investigated utilising SDM. The results disclosed the subsequent information: Initially, both two-stage green innovation efficiency and the rise of the digital economy demonstrated notable spatial characteristics. Furthermore, the advancement of the internet economy positively influenced the efficiency of two-stage green innovation, both locally and in adjacent regions. This finding persisted following a series of robustness assessments. Thirdly, regarding regional heterogeneity, the eastern region and non-resource-based areas had larger benefits from digital economy development compared to the central, western, and resource-based regions; thus, the impact on two-stage green innovation efficiency was more pronounced. Ultimately, both intellectual property protection and data factor endowment positively moderated the impact of the digital economy on two-stage green innovation efficiency. This research's conclusions offer theoretical support and empirical evidence for the mechanism of digital economy development and its influence on two-stage green innovation efficiency. These findings imply policy consequences, including the enhancement of digitalisation, the formulation of targeted legislation, and the cultivation of a supportive external environment for technological innovation.

Liu, T. & Imran, A. (2024). The overexploitation of natural resources, alongside economic and social advancement, has engendered numerous ecological problems. This study investigates the impacts of globalisation (GLZN), digitalisation (DGTZ), economic development (ECDV), natural resource utilisation (NRRS), and

technical innovation (TCIN) on ecological footprints (EFPR) in G10 economies from 2000 to 2021. We analysed cross-sectional dependence, slope homogeneity, stationarity properties via the CIPS unit root test, and panel co-integration among the variables using the Westerlund test. We subsequently employed the pooled mean group autoregressive distributed lag method to analyse both long-term and short-term relationships, corroborated by the Hausman test. The empirical results indicate that DGTZ and TCIN enhance environmental quality by reducing EFPR. In G10 economies, ECDV, GLZN, and NRRS diminish environmental quality by amplifying the effect of EFPR on the environment. The absence of sustainable methods in the production and consumption of natural resources results in an elevated EFPR, signifying increased environmental stress. Furthermore, the findings suggest that TCIN and DGTZ are essential for environmental conservation in the G10; hence, we should advocate for their use to uphold ecological sustainability in these countries.

Wang, C. et al. (2024). In recent years, the digital economy and the green economy have become essential components of China's economy. The Chinese government has been vigorously augmenting its assistance for the advancement of these sectors. Nonetheless, numerous impediments continue to obstruct the advancement of the digital economy and the green economy in China. The aim of this study is to investigate the influence mechanism of the digital economy on the green economy. This research innovatively incorporates industrial structure and technology innovation into the impact process. We clarify the important functions of these two mediating variables. Concurrently, we utilise the bidirectional fixed effect model, baseline regression, and robustness testing to examine data from 31 provinces in China spanning 2012 to 2021. The advancement of China's digital economy enhances the quality of the green economy. The digital economy significantly impacts the green economy through the enhancement of industrial structure and technical innovation. The influence of the digital economy on the green economy differs among various locations in China. This study elucidates the influence mechanism of the digital economy on the advancement of the green economy through the factors of industrial structure and technological innovation. It enhances the research substance in this domain and broadens the applicability of associated research methodologies. The conclusions offer significant insights for advancing the digital economy and the green economy in China.

Imansyah, M.H. et al. (2023). This article seeks to ascertain the influence of the digital economy, specifically the Information and Communication Technology (ICT) sectors, on output growth, CO₂ emissions, and income distribution in Indonesia. These metrics are referred to as green economy indicators. The analysis of the production and value-added multiplier of the ICT industries, as well as their effects on CO₂ emissions and income distribution, is grounded in input-output analysis. The analysis will employ the multiplier, elasticity, and Miyazawa income distribution methods. The ICT sectors exhibit substantial output and value-added multipliers. This situation indicates that any alteration in final demand, such as investment in these sectors, will significantly affect output and value-added. The ICT industries generally contribute to lower CO₂ emissions and are predominantly considered insensitive to such emissions, with the exception of three areas that exhibit elasticity above the average. The influence of the ICT development sectors may exacerbate income inequality. Policy measures must account for the implications of ICT development as a pivotal industry that could exacerbate income inequality. Consequently, it is recommended that the government promote ICT industries with an increased emphasis on social inclusion to attain a green economy.

Yin, S. et al. (2023). Amid rising anti-globalisation sentiments, sustainable economic growth has emerged as an essential and viable approach to reconcile the escalating conflicts among social, environmental, and economic dimensions. It seeks to attain equilibrium among the demands of the economy, society, and the environment, facilitating long-term sustainable growth. This article is grounded in the context of intense worldwide disputes among the environment, economy, and society. This essay examines the crucial influence of digitalisation, environmentally sustainable practices, and innovation on promoting sustainable economic development through the synthesis and analysis of extensive literature. This essay highlights the interrelation and cooperative essence of digital empowerment, green leadership, and innovation-orientated strategies in fostering a healthy relationship between humans and nature, while also enabling sustainable economic growth. This paper elucidates the advantages gained from the combination of digital, sustainable, and innovative strategies, as evidenced by the "Taipao e-Agricultural Insurance" case study, offering essential recommendations for organisations and industries pursuing transformation and growth. This article presents feasible ideas for integrating digital empowerment, sustainable practices, and innovation-driven development. It provides a thorough study that enhances the current research on these subjects and establishes a basis for future extensive investigation. The conclusions of this paper include both theoretical and practical importance, providing useful insights and methodologies for attaining sustainable development across multiple industries.

Alsmadi, A.A. & Alzoubi, M. (2022). Amid heightened efforts and emphasis on sustainable development and climate change, literature has increasingly concentrated on the green economy. However, experts have not yet reached a complete consensus on the definition of this phenomenon. The analysis outlined in the article offers a comprehensive summary of developments in green economy research from 1990 to 2020. The research employs a bibliometric analysis to delineate the developmental trends and current situation of the

green economy. The objective is to furnish the reader with direction and a robust conceptual framework for subsequent inquiry.

Zhang, Z. et al. (2022). In light of the substantial benefits derived from the robust advancement of the digital economy, China urgently necessitates a significant strategic shift from extensive development to sustainable development. The 14th five-year plan period necessitates that China's green development establishes distinct advantages in the advancement of the digital economy. This study employs a panel data model to examine the influence of the digital economy on the green economy, utilising data from 30 Chinese provinces from 2015 to 2020. Research findings indicate that the digital economy facilitates the progression of the green economy, with the Eastern region exerting a more significant influence than the Central region, which, in turn, has a higher impact than the Western region. The industrial structure and technology innovation are crucial avenues via which the digital economy fosters green development. In light of the aforementioned result, we submit the following recommendation: China ought to proactively promote the digital economy, foster regional collaboration in development, consistently enhance the industrial framework, and stimulate technological innovation.

Bhattacharya, S. & Sachdev, B.K. (2021). The green economy is regarded as a potent instrument capable of addressing the trifecta of crises in food, fuel, and finance. India possesses significant potential and opportunities for a green economy due to its geographic and climatic circumstances, as well as its undeveloped resources. India is the foremost producer of solar energy globally, benefiting from almost 300 days of sunshine annually. Sikkim is the first state in the world to be designated as an organic state, located in India. In recent years, tiny states, particularly those in North-East India, have excelled in the green economy by advocating for organic farming and minimising plastic bag usage, serving as exemplary models for the nation. There has been a swift increase in the utilisation of renewable energy, with South and West India being the leading producers. Digital India is significantly contributing to the advancement of a digital green economy. All nations are advancing towards a green economy to achieve their sustainable development objectives and address climate change and environmental degradation. The primary objective of a green economy is to diminish carbon emissions, enhance resource efficiency, and promote social inclusivity by fostering an environmentally friendly lifestyle.

Baruah, P. (2020). The notion of a "green economy" has emerged as a subject of increasing discourse due to the environmental catastrophe. The world economy is following an unsustainable trajectory. Since the Industrial Revolution, global economic growth has occurred at the detriment of the environment. Natural resources have been overexploited without permitting stock regeneration, contaminants have amassed in the biosphere, ecosystems have been significantly degraded, and biodiversity has diminished at an alarming pace. The principal challenge confronting developing nations such as India is how to harmonise environmental objectives with economic growth, poverty alleviation, and other critical issues, including water and food supply crises, fluctuations in energy and food prices, escalating greenhouse gas emissions, income inequality, persistent fiscal deficits, and terrorism. This study aims to examine the concept of a green economy in the context of India and how the country is pioneering progress in this area.

Vijayan, A. (2019). Countries that adopt technology for the advantage of their inhabitants have experienced significant transformations across all sectors, resulting in GDP growth and elevated national and per capita income. The government is obligated to enhance the living conditions of citizens by introducing programmes that drive economic growth. The digitalisation was driven by the impetus of technology, which was a pivotal component of the Digital India programme. India has evolved as a nation where the government has begun a development programme to boost economic growth and offer jobs for the younger generations. The primary purpose was to offer all services to every citizen via web portals or electronically to facilitate smooth and transparent transactions. The government is investing more in technology to eradicate black money and corruption from public life. India has commenced its digital transformation, albeit it will require time to fully realise the effects of this development. This project will enable India to attain the United Nations Sustainable Development Goals by 2030. This research elucidates the influence of Digital India on the economy, assesses the extent of goal fulfilment, and aims to build a model for attaining sustainable development goals in conjunction with the principles of Digital India.

V. IMPORTANCE OF THE DIGITAL AND GREEN ECONOMY FOR SUSTAINABLE DEVELOPMENT

The purpose of Sustainable development is to meet present requirements without compromising the ability of future generations to fulfil their requirements. Both the **digital economy** and the **green economy** play a significant role in achieving this goal by promoting economic growth, social inclusion, and environmental protection.

1. Significance of the Digital Economy

The digital economy refers to economic activities driven by digital technologies like the internet, artificial intelligence, cloud computing, and digital platforms.

a) Enhances Economic Growth

- Increases productivity and efficiency throughout the industries.

- Helps to establish new business models and employment opportunities in society.
- Facilitates innovation and entrepreneurship in our country.

b) Improves Access to several Societal Services

- Expands access to education through e-learning.
- Supports telemedicine and digital healthcare services provided by the healthcare Industry.
- Promotes financial inclusion through digital banking and mobile payment services to the people.

c) Strengthens Governance

- Enables e-governance and transparent public services, which are essential for economic growth.
- Improves data-driven decision-making.
- Reduces corruption (which usually happens in Paper-based systems) through digital record-keeping.

d) Supports Sustainable Resource Management

- Smart technologies help in monitoring energy use, water consumption, and waste management.
- Digital tools improve agricultural productivity, simultaneously reducing resource wastage.

2. Significance of the Green Economy

A green economy is an economic system that improves human well-being, simultaneously reducing environmental risks and ecological degradation.

a) Environmental Protection

- Reduces greenhouse gas emissions.
- Promotes renewable energy sources like solar and wind power.
- Conserves natural resources and biodiversity.

b) Sustainable Economic Growth

- Encouraging investment in clean technologies.
- Creates green jobs in renewable energy, recycling, and sustainable agriculture.
- Reduces dependence on fossil fuels.

c) Improves Public Health

- Reduces air and water pollution.
- Leads to healthier living conditions.
- Lowers healthcare costs associated with environmental diseases.

d) Enhances Climate Resilience

- Supports adaptation to climate change.
- Promotes sustainable infrastructure and resource-efficient production.

3. Combined Role of Digital and Green Economies

The integration of digital and green economies accelerates sustainable development in the following ways:

- Enabling smart grids for efficient energy distribution.
- Supporting precision agriculture that minimises resource use.
- Improving environmental monitoring through sensors and data analytics.
- Facilitating economic practices through digital platforms.
- Encouraging sustainable consumption and production patterns.

VI. FUTURE PROSPECTS

The future of sustainable development lies in the synergy between digital transformation and environmental sustainability. Emerging technologies such as artificial intelligence, blockchain, digital twins, and advanced analytics are expected to play increasingly significant roles in achieving carbon neutrality and resource efficiency. Governments and businesses worldwide have recognised that digitalisation and green development are complementary strategies rather than separate objectives.

VII. CONCLUSION

The digital economy and green economy represent two transformative forces shaping contemporary economic development. Their integration offers significant opportunities to enhance productivity, promote innovation, and achieve environmental sustainability. Digital technologies can support green development by improving energy efficiency, enabling smart resource management, and fostering green innovation. Nevertheless, challenges such as energy-intensive digital infrastructure, e-waste generation, and digital inequality require careful policy attention. A balanced and coordinated approach that combines technological advancement with environmental responsibility is essential for achieving sustainable and inclusive economic growth.

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