International Journal of Environmental Impacts
Vol. 7, No. 1, March, 2024, pp. 121-131
Journal homepage: http://iieta.org/journals/ijei

Assessing the Role of Digital Technologies and E-Commercial Law in Environmental Sustainability: A Case of the Eco-Business Development in Jordan

Bassam Mustafa Abdel-Rahman Tubishat

Department of Law, Faculty of Law, Jadara University, Irbid 21110, Jordan

Corresponding Author Email: b.tubiashat@jadara.edu.jo

https://doi.org/10.18280/ijei.070114

Received: 25 January 2024
Revised: 27 February 2024
Accepted: 1 March 2024
Available online: 31 March 2024

Keywords:
digitalization, e-commerce energy efficiency, eco-business, Artificial Intelligence, environmental impact, law

ABSTRACT

The purpose of the research presented in the article is to analyze and determine the most significant factors of digital technologies and e-commerce law affecting the environment and the development of eco-business. For this purpose, we will take the environment of Jordan as the object of study. The scientific task is to determine the level of influence of digital technology factors affecting the environment and eco-business and sustainable development in Jordan. The research methodology involves the use of PESTLE analysis, a system analysis method with determination of the utility function, and a method of multicriteria selection of alternatives based on a fuzzy advantage ratio. As a result, we presented an innovative methodological approach that allows us to determine the level of influence of the four most significant factors of digital technologies affecting the environment, eco-business, and sustainable development.

1. INTRODUCTION

1.1 Trends in the development of digital technology in context environmental sustainability

Digital technologies are globally transforming our interactions with the environment, offering innovative solutions to conserve natural resources, improve energy efficiency and promote sustainable development. They open up new horizons for smart energy management, ecosystem monitoring and optimization of resource use, giving rise to new challenges, particularly in the field of e-waste management.

Thanks to smart energy systems and the Internet of Things, there is an opportunity to reduce energy consumption, optimize the production and use of renewable energy, thereby reducing the carbon footprint and promoting energy security. Artificial Intelligence algorithms for energy demand forecasting and energy management can significantly improve energy efficiency internationally.

Optimizing the use of natural resources through digitalization offers effective solutions for agriculture, ensuring precision farming and rational water use. This increases productivity and reduces environmental impact, helping to meet growing food needs while reducing waste and pollution.

In recent decades, digital technologies have become an integral part of our daily lives, transforming the way we do business, communicate, and even interact with the environment. Jordan, as an actively developing country, is experiencing the impact of the digital revolution at all levels of the economy and society, including the environmental sector. Digitalization offers unique opportunities for environmentally oriented initiatives and eco-businesses, while at the same time creating new challenges and problems.

1.2 Features of the influence of modern digital technologies and e-commerce law on ecological zones in Jordan in the context of eco-business development

One of the main trends in this context is the integration of innovative digital solutions to monitor and manage the use of natural resources, allowing Jordan to efficiently use limited water and energy resources. Digital technologies such as Artificial Intelligence and big data play a key role in predicting environmental trends and optimizing resource consumption, which contributes to sustainable development.

However, the rise of digital technology has also been accompanied by an increase in e-waste, posing significant recycling and recovery challenges for Jordan. The environmental burden from the production, use and disposal of electronics requires careful regulation and the implementation of effective environmental management strategies.

So, in Figure 1 depicts the ecological zones of Jordan from the point of view of sustainable development of eco-business.

At the same time, the revitalization of eco-business in Jordan, supported by digitalization, opens up broad prospects for the country's economy. Digital platforms enable small and medium-sized businesses to attract investment, expand markets and improve management processes, while ensuring environmental sustainability.

In the context of modern development of eco-business, e-commerce plays an important role. The development of e-commerce in Jordan opens up new prospects for environmental sustainability, in particular through the support

and development of eco-businesses. Digital technologies are facilitating the creation of innovative platforms and solutions for environmentally friendly products and services, allowing businesses to more easily reach target markets and attract conscious consumers.

At the same time, the development of e-commerce law in Jordan plays a critical role in ensuring environmental sustainability by establishing a legal framework for e-business, consumer protection, and regulation of the use of digital technologies in business processes. A regulatory framework that includes principles of environmental responsibility and sustainability encourages companies to adopt green innovations and practices, reduce waste and emissions, and consume resources more responsibly. Legal support for e-commerce is becoming an important element in promoting environmentally sustainable development of the Jordanian economy, while ensuring the protection of consumer interests and taking into account environmental requirements and standards.

However, it should be noted that the success of digital transformation in Jordan's environmental sector depends on a number of factors, in particular the availability of digital infrastructure, the level of digital literacy of the population and the relevant legislative and regulatory framework. A coordinated effort between government, the private sector and the public is needed to overcome these barriers.

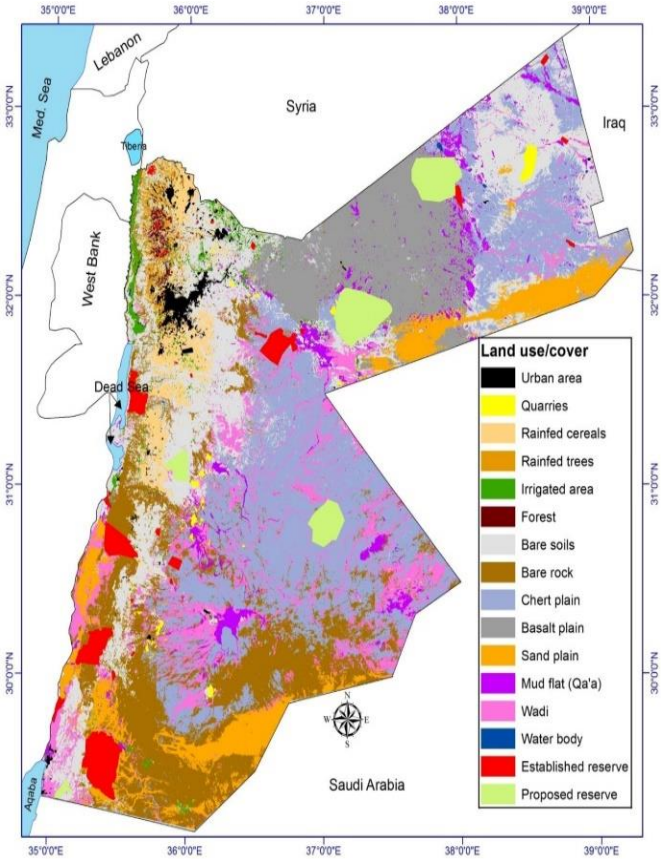

Figure 1. The ecological zones of Jordan from the point of view of sustainable development of eco-business

In the Jordanian context, digital technologies and e-commerce law have a significant impact on the social aspect of environmental sustainability, particularly through the promotion of eco-business. It also promotes innovation in the field of sustainable production and consumption, which is of great importance for the socio-economic development of the region. By providing greater transparency and consumer engagement, digital technologies help build a conscious community that supports local eco-businesses and makes environmentally responsible decisions.

On the other hand, the development of e-commerce law in Jordan creates the necessary legal framework to protect consumer rights, regulate e-commerce and promote sustainable development. Adequate legislation is key to ensuring trust between consumers and businesses, establishing environmental safety standards for goods and services, and supporting innovation in the field of eco-business. This, in turn, helps to create jobs, improve the quality of life and strengthen the social cohesion of communities that strive for sustainable development and preservation of natural resources for future generations. Thus, e-commerce law and digital technologies act as important tools to achieve social and environmental sustainability in Jordan.

In this context, special attention should be paid to the development and implementation of integrated strategies that take into account the environmental, economic and social aspects of digitalization. Strengthening collaboration between government institutions, academia, business and civil society can be the key to addressing existing challenges and maximizing the potential of digital technologies for sustainable development.

In conclusion, global trends and international experiences cannot be ignored, which can provide valuable lessons and directions for Jordan to adapt its own strategies in the context of the digital ecology. With this in mind, Jordan has a unique opportunity to not only strengthen its economy and improve its environment, but also become an example for other countries in the region in implementing digital environmental transformation.

Thus, the purpose of the research presented in the article is to analyze and determine the most significant factors of digital technologies affecting the environment and the development of eco-business. For this purpose, we will take the environment of Jordan as the object of study.

2. LITERATURE REVIEW

2.1 The current state of development of digital eco-business technologies in Jordan, their legal regulation and impact on the environment

A review of the literature in the context of the impact of digital technologies on economic and environmental performance in modern eco-business development and a deep interest in the role of digitalization in sustainable development and environmental management is critical to our research.

So, in the work of Li et al. [1] indicates that digital technologies can significantly improve the economic and environmental performance of organizations by acting as catalysts for the implementation of Industry 4.0 principles, especially when integrated with environmental management.

Adaileh and Alshawawreh [2] focus on assessing the impact of digital transformation in Jordan, offering a framework for analyzing its impact on the country's economy. While the main focus is on the economic aspect, the work also highlights the importance of digitalization for improving resource management and environmental sustainability.

Mergel et al. [3] explore the definition of digital

transformation through expert interviews, highlighting key components and mechanisms that promote sustainable development and effective environmental management at the government level.

An interesting study by Engelmann et al. [4] examines the specification of green growth and sustainable business models in the Jordanian water sector. The study notes the importance of integrating digital innovation to improve water efficiency and reduce environmental impact.

However, Qatarneh et al. [5] study focuses on analyzing the impact of climate change on water resources in the Azraq Basin in Jordan. The authors study how climate change, including changes in precipitation and temperature, affects the availability of water resources in the region. The results of the study can provide valuable information for your research assessing the role of digital technologies and e-commerce law in environmental sustainability, since understanding the impact of climate change on natural resources is critical to developing sustainable eco-business strategies, especially in vulnerable regions such as Jordan.

The study of Hammouri et al. [6] analyzes how climate change impacts surface water resources in arid and semi-arid regions, using northern Jordan as a case study. The work focuses on assessing changes in the availability and quantity of water resources due to climate change, including impacts on agricultural activities and water supplies. In the context of your topic, this resource can serve as a basis for understanding the need for digitalization and adaptation of e-commerce law to support environmental sustainability and water management in the face of climate change, especially in regions with limited access to water.

Also interesting are the studies of Alazzam et al. [7] and Alazzam et al. [8], which examine key aspects of the formation of innovative models for the development of e-commerce and business management strategies in the context of changes in commercial activity, especially focusing on the importance of economic security of business. These studies are of particular relevance to Jordan, where sustainability and sustainability are key factors for social impact and green business development. By highlighting the role of e-commerce in achieving sustainable development, the authors contribute to the understanding of how innovative models and strategies can contribute not only to economic security, but also to social sustainability and environmental well-being in Jordan, ensuring balanced growth that takes into account the needs of society and the environment.

Martínez-Peláez et al. [9] analyze the role of digital transformation in achieving sustainability, with a focus on the mediating role of stakeholders, key capabilities and technologies. They see digitalization as an important element in achieving environmental sustainability and efficient resource management.

Bertello et al. [10] explore the current state and future of open innovation, which is critical to the development of digital technologies and their impact on sustainability. This study highlights the need to integrate innovation into the business model to effectively address environmental issues.

2.2 Modern and innovative methods of managing digital technologies in context of environmental sustainability

Research examining the relationship between digital transformation, sustainability and environmental responsibility continues to gain momentum, given the growing attention to environmental challenges at the global level. The paper by Kunkel and Matthess [11] examines the impact of digital transformation on environmental sustainability in industry, with a focus on policies in Asia and Africa. The authors analyze how digitalization expectations correlate with conservation efforts, highlighting the importance of integrated strategies that combine technological development with environmental sustainability.

George and Schillebeeckx [12] expand the discussion by focusing on the role of digital transformation, continuity and mission in multinational corporations. Their research shows how digital innovation can serve as drivers for sustainable development while furthering corporate missions while taking environmental responsibility and social inclusion into account. The authors note the need to harmonize business strategies with sustainability goals to achieve significant environmental impact.

Leipold and Petit-Boix [13] explore the prospects for the circular economy and the bio-based sector, particularly through the lens of European and German stakeholders. Their work highlights how digitalization can support the transition to a circular economy by reducing waste and increasing resource efficiency. The analysis highlights the importance of innovative technologies in creating closed loops of production and consumption, which can have a significant positive environmental impact.

Taken together, these studies make important contributions to understanding the complex role of digital transformation in promoting environmental sustainability and effective environmental management. They point to the need for a balanced approach that takes into account both technological innovation and environmental responsibility to achieve sustainable development on a global scale.

Although there is a significant body of existing research highlighting the relationship between digital transformation, sustainability and environmental performance, gaps remain (Figure 2).

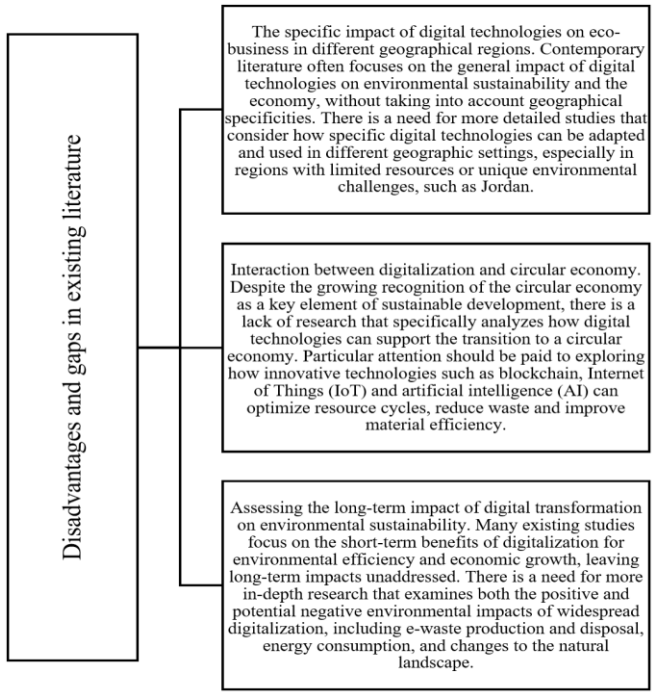

Figure 2. Disadvantages and gaps in existing literature on the topics under study

As can be seen in Figure 2, much work has focused on the overall benefits of digitalization in environmental sustainability, but less attention has been paid to the specific mechanisms through which these technologies can help reduce environmental impacts across industries and regions. In addition, more research is required on e-waste management, the integration of digital solutions into the circular economy, and the impact on biodiversity. The question also remains open of how the cultural, economic and political characteristics of different countries affect the effectiveness of the implementation of digital technologies in the environmental sphere. This highlights the need for further research to fill existing knowledge gaps and provide a deeper understanding of the dynamics between digitalization and sustainability.

So, the scientific task is to determine the level of influence of digital technology factors affecting the environment and eco-business and sustainable development in Jordan.

3. METHODOLOGY

As part of the study aimed at analyzing the impact of digital technologies on the environment and eco-business in Jordan, the methodological approach includes several key methods: PEST analysis, systems analysis method, utility function determination, and multi-criteria selection of alternatives based on fuzzy relation method advantages.

In our research, we used PESTLE analysis as a key tool for a deep understanding of the external environment in which digital technologies operate and their impact on the environment and the development of eco-business. The essence of PESTLE analysis is to systematically review and evaluate various external factors that may influence the implementation of our goals and strategies. This analysis helped us identify opportunities for development and potential threats, opening up prospects for adaptation and innovation in the context of our study. Thanks to PESTLE analysis, we were able to better understand how the outdoor environment influences the use of digital technologies in environmentally oriented businesses and what factors should be considered when planning sustainability strategies.

The method allows for in-depth external analysis, taking into account the political, economic, social, technological, legal and environmental factors affecting eco-business in Jordan. The use of PESTLE is important for assessing the macro-environment in which digital technologies and e-commerce law operate, as well as for identifying external opportunities and threats regarding environmental sustainability.

In this context, the following parameters should be discussed:

1. Limitation. May not take into account the internal specifics of an organization or industry, focusing only on the external macroenvironment and environmental stability.

2. Assumption. Digital drivers are assumed to have the same impact on all eco-businesses, which may not reflect specific challenges or opportunities for specific businesses.

The systems analysis method is used to study the relationships between different components of a system, in this case between digital technologies, environmental sustainability and eco-business. This method helps to identify the key elements of a system and their impact on the environment, showing both direct and indirect interactions. The advantage of the system analysis method is an integrated approach to studying the problem, but the disadvantage may be its high complexity and the need for significant resources for collecting and processing data.

The approach allows to effectively analyze and select among various eco-business development strategies, taking into account multidimensional and often ambiguous criteria. Fuzzy logic provides flexibility in the evaluation of alternatives, allowing better consideration of the ambiguity and subjectivity in the evaluation of criteria inherent in the evaluation of environmental and technological innovations.

In this context, the following parameters should be discussed:

1. Limitation. Requires a detailed understanding of evaluation criteria and their importance, which can be difficult when evaluating new or rapidly changing technologies. It can also be difficult to interpret the results, especially for non-experts.

2. Assumption. It implies the presence of sufficient information to form fuzzy sets and determine the degree of membership for each criterion. It is also based on the assumption that various aspects affecting environmental sustainability can be adequately measured and compared due to fuzzy logic modeling.

Determining the utility function allows to assess the degree of influence of various factors on the objectives of the study, in particular, on environmental efficiency and eco-business development. A utility function in economics is a mathematical representation used to describe the order of a person's preferences over a set of alternatives. It assigns a numerical value to each alternative such that higher values correspond to preferred outcomes, resulting in a rational decision-making process based on utility maximization. On the other hand, the fuzzy benefit ratio method is used in decision-making processes when the criteria are not strictly defined or when one has to deal with imprecise data. It involves comparing alternatives by establishing a relationship that reflects the extent to which one alternative is better than another, using fuzzy logic to handle uncertainty. This method allows decision makers to evaluate and rank options under conditions of uncertainty and incomplete information, providing a more nuanced approach to assessing preferences and making decisions in complex scenarios.

A multi-criteria alternative selection method based on a fuzzy advantage relationship is used to evaluate and compare different digital technology-enabled scenarios or strategies with respect to their impact on the environment and eco-business. Fuzzy logic allows you to take into account uncertainty and subjectivity in estimates, which is a significant advantage when working with complex and poorly defined data. However, the use of this method can be difficult due to the need for specialized software and highly qualified researchers for the correct analysis of fuzzy data.

Taken together, these methods form an integrated approach to analyzing the impact of digital technologies on environmental sustainability and eco-business development in Jordan, allowing us to take into account both quantitative and qualitative aspects of the problem.

4. RESULTS OF RESEARCH

Digital technologies have revolutionized the modern world, penetrating every aspect of our lives and changing the way we

interact with our environment. From Artificial Intelligence optimizing energy consumption to Internet of Things systems monitoring air pollution, digitalization offers the potential to improve environmental efficiency and promote sustainable development. However, this impact is twofold, since the growth of electronic waste and the increasing energy consumption of information and communication technologies also pose new environmental challenges to society. Understanding this impact requires deep analysis and the development of strategies that balance the opportunities offered by digitalization with the need to preserve our planet for future generations.

In the context of our research, we plan to conduct a PESTLE analysis to better understand the impact of external factors on the integration of digital technologies in the field of ecology and eco-business development in Jordan (Table 1). This analysis will allow us to systematically assess the political, economic, social, technological, legal and environmental aspects influencing the implementation of digital innovation in the country's environmental sector. Through this, we will be able to identify key challenges and opportunities facing Jordan on its path to sustainable development and develop evidence-based recommendations for optimizing the use of digital technologies to protect the environment.

Table 1. PESTLE analysis results

PESTLE Analysis Results	
Political Factors	**Economic Factors**
The Jordanian government's policies and initiatives are aimed at preserving the environment and promoting the use of renewable energy sources. International cooperation and compliance with international environmental agreements. Regulation and standardization in the field of water and waste management.	Dependence of the Jordanian economy on energy imports and the need for diversification of energy sources. Investments in green technologies and sustainable development. Financial incentives for eco-business and innovation in the renewable energy sector.
Social Factors	**Technological Factors**
Increasing environmental awareness and demand for environmentally friendly products and services among the population. Educational initiatives and programs to raise environmental awareness. Demographic changes and urbanization affecting resource use and environmental pressures.	Development and implementation of innovative technologies in the field of renewable energy. Application of digital solutions for monitoring and management of water resources. Digitalization of processes in eco-business in the context of giving preference to e-commerce to increase efficiency and reduce environmental impact.
Legal Factors	**Environmental Factors**
National legislation in the field of environmental protection and use of natural resources. Legal framework for regulating eco-business and implementing green initiatives. Legal support for modern methods and mechanisms of e-commerce in the context of eco-business development	Problems of water supply and water resources management in Jordan. Impact of climate change on the region, including deserts and loss of biodiversity. The need to reduce greenhouse gas emissions and combat environmental pollution.

Table 2. The key components that underlie the modern system of interaction between digitalization and the environment

The Component	**Component Entity**
Eco-business	Focuses on the importance of integrating digital technologies into business models focused on environmental sustainability
Sustainable development	Emphasizes the role of digitalization in solving local environmental problems, supporting local economies and promoting social well-being, including the creation of environmentally oriented jobs and support for environmental initiatives
Renewable energy development	Focuses on using digital innovation to optimize the production, distribution and consumption of renewable energy, reducing dependence on fossil fuels and facilitating the transition to a low-carbon economy

Table 3. The digital technologies influencing based on the key components of the modern system of interaction between digitalization and the environment

Digital Technology	**Symbolic Designation**
Artificial Intelligence and big data	a_j
E-commerce	b_j
Blockchain	c_j
Smart grids	d_j

The involvement of experts allowed us to identify three key components that underlie the modern system of interaction between digitalization and the environment, which are crucial for achieving sustainable development and positive environmental impact (Table 2).

These components interact with each other, forming an integrated approach to implementing digital transformation with maximum benefits for the environment.

Analyzing all these components - the functioning of eco-business, the sustainable development of the region and the development of renewable energy sources, the need for an in-depth study of key digital technologies and their specific level of influence on each of these components becomes obvious. The importance of this study is to determine how digital transformation can optimize eco-business processes, promote environmentally sustainable development at the regional level, and effectively use and integrate renewable energy sources into the energy system. Understanding the specifics and scale of influence of these technologies will allow not only to identify the most effective tools for achieving sustainable development goals, but also to identify potential risks and challenges associated with their implementation and operation.

Using the expert research method, we identified four main digital technologies that are key to influencing the selected components: the functioning of eco-business, sustainable development of the region and the development of renewable energy sources (Table 3).

Let's take a closer look at each technology:

Artificial Intelligence and big data are playing a key role in transforming green businesses by providing the tools for in-depth analysis and intelligent decision-making. AI can forecast demand for resources, optimize supply chains and minimize waste through predictive service, while big data can collect and analyze information about consumer habits and the efficiency of resource use. Together, these technologies help companies implement established practices, making them more competitive and environmentally responsible.

E-commerce has a significant impact on the development of environmentally oriented business, contributing not only to the increased efficiency and availability of "green" products, but also by introducing changes to the regulatory framework of e-commerce law. On the one hand, online platforms allow eco-brands to reach a wider audience, promote sustainable production practices and increase consumer consciousness on environmental issues. On the other hand, the development of e-commerce law, including regulations on e-commerce, data and consumer protection, encourages businesses to implement more transparent and responsible practices that have a positive impact on the environment. This includes using environmentally friendly materials for packaging and optimizing logistics to reduce CO_2 emissions. Thus, e-commerce becomes an important tool in ensuring sustainable development of eco-businesses, while increasing environmental awareness and encouraging environmentally responsible behavior on the part of both businesses and consumers.

Blockchain offers unique opportunities for the development of renewable energy sources by providing transparency, security and efficiency in energy data management. This technology makes it possible to reliably certify the origin of green energy, simplifying the trade in energy certificates and ensuring mutual settlements between producers and consumers. The use of blockchain has the potential to revolutionize the renewable energy market by making it more accessible, efficient and reliable.

Smart Grids are an embedded network that uses information and communication technologies to optimize energy production, distribution and consumption. This technology helps improve the flexibility and reliability of power systems, allowing for efficient integration of renewable energy sources, reducing grid losses and improving response to demand fluctuations. Smart grids are key to the transition to a low-carbon economy, ensuring sustainability, efficiency and reducing the environmental footprint of the energy sector. Smart grids play a critical role in the region's sustainable development, especially due to its social impact in strengthening social communities, improving quality of life and promoting social inclusion. They enable residents to gain more reliable and efficient access to essential services such as energy, water and internet, while adapting to consumer needs in real time. This reduces the gap in access to services between different social groups, promoting social equality.

Table 4. Levels of influence of digital technologies that underlie the key components of the modern system of interaction between digitalization and the environment

Levels of Influence	Digital Technology			
	a_j	b_j	c_j	d_j
Minimum	a_1	b_1	c_1	d_1
Sufficient	a_2	b_2	c_2	d_2
Maximum	a_3	b_3	c_3	d_3

Table 5. Scale of relative importance of comparison objects

Entity	Assessment Score
Comparison elements are equivalent to each other	1
The influence of one element is slightly greater than the other	3
The influence of one element is greater than the other	5
The influence of one element is significantly greater than the other	7
The influence of one element is absolutely greater than the other	9
Intermediate assessment values	2,4,6,8

Table 6. Scales of the levels of influence of digital technologies underlying the key components of the modern system of interaction between digitalization and the environment

a_j	a_1	a_2	a_3
s_i	0.07	0.27	0.66
b_j	b_1	b_2	b_3
s_i	0.07	0.28	0.65
c_j	c_1	c_2	c_3
s_i	0.11	0.40	0.48
d_j	d_1	d_2	d_3
s_i	0.05	0.29	0.65

To objectify the final results, we will determine separate levels of impact of each digital technology (Table 4). The definition of each level is important in the context of using the research methods we have chosen: the method of system analysis and multi-criteria selection of alternatives based on a fuzzy advantage ratio.

To determine the weight of comparison objects, a special scale of relative importance of objects was used (Table 5). For two levels of influence of digital technologies that underlie the key components of the modern system of interaction between digitalization and the environment, which are compared with each other depending on their degree of impact on the process, we will evaluate the importance that constitutes the corresponding element of the paired comparison matrix in position (a_j, a_m).

We will place the set of importance assessments as a result of comparing the levels of support in a matrix of paired comparisons and the method of multi-criteria selection of alternatives based on a fuzzy advantage ratio; we will derive weights of the levels of influence of digital technologies that underlie the key components of the modern system of interaction between digitalization and the environment. All calculations were performed through software and to facilitate understanding and reduce the accumulation of large amounts of mathematical data. Table 6 summarizes the final results of these calculations.

Now we will determine the options for the levels of influence of digital technologies that underlie the key components of the modern system of interaction between digitalization and the environment by using paired comparisons based on the options. To do this, we will evaluate alternatives to the level of influence of digital technologies that underlie the key components of the modern system of interaction between digitalization and the environment (Table 7).

Table 7. Designation of distribution alternatives of digital technologies influencing based on the key components of the modern system of interaction between digitalization and the environment

The Component	Digital Technology			
	Artificial Intelligence and big data	E-commerce	Blockchain	Smart grids
Eco-business	*A*	*D*	*G*	*K*
Sustainable development	*B*	*E*	*H*	*L*
Renewable energy development	*C*	*F*	*I*	*M*

Table 8. Utility function determining the levels of influence of Artificial Intelligence and big data on the key components of the modern system of interaction between digitalization and the environment

u_{ij}	u_{i1}	u_{i2}	u_{i3}
u_{1j}	0.13	0.23	0.62
u_{2j}	0.09	0.21	0.69
u_{3j}	0.06	0.19	0.73

For example, let's consider determining the level of impact of one of the technologies on the three key components that underlie the modern system of interaction between digitalization and the environment by the utility function, which are crucial for achieving sustainable development and positive environmental impact (Table 8).

Calculation of the utility function values of the levels of impact of Artificial Intelligence and big data on the key components of the modern system of interaction between digitalization and the environment according to a certain distribution will occur in accordance with the following Eq. (1):

$$\begin{aligned} U_1 &= s_1u_{11} + s_2u_{21} + s_3u_{31} \\ U_2 &= s_1u_{12} + s_2u_{22} + s_3u_{32} \\ U_3 &= s_1u_{13} + s_2u_{23} + s_3u_{33} \end{aligned} \quad (1)$$

Substituting into the system of Eq. (1) the obtained values of the weights of the selected digital technologies at different levels of their impact si and the value of the utility function for each component, we obtain the following numerical values:

$$\begin{aligned} U_1 &= 0.07 \times 0.13 + 0.27 \times 0.09 + 0.67 \times 0.06 = 0.1 \\ U_2 &= 0.07 \times 0.23 + 0.27 \times 0.21 + 0.19 \times 0.69 = 0.2 \\ U_3 &= 0.07 \times 0.62 + 0.27 \times 0.69 + 0.67 \times 0.73 = 0.7 \end{aligned}$$

The results of the summary calculations will be placed in Table 9.

Table 9. Results of utility function calculations

U_i	U_1	U_2	U_3
Results	0.08	0.21	0.71

So, as we see, the greatest utility function for this type of digital technology was in the case of U_3, which indicates the greatest influence. Similar calculations were made for all other digital technologies and levels. All results were summarized in Figure 3.

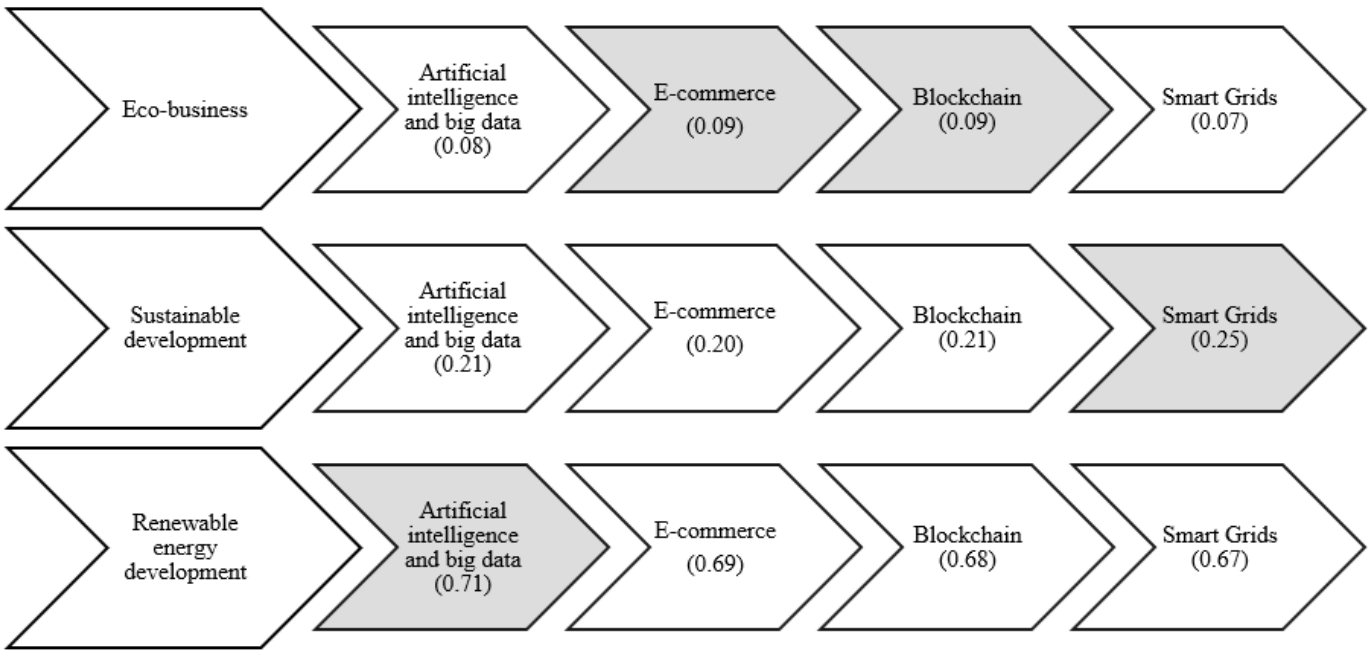

Figure 3. Results of assessing alternative impact levels digital technologies influencing based on the key components of the modern system of interaction between digitalization and the environment

As we can see, for Eco-business, the E-commerce and Blockchain have the greatest impact. While for sustainable development, smart grids have the greatest impact. For renewable energy development. Artificial Intelligence and big data have the greatest impact in the context of ensuring environmental safety.

Having determined the impact distributions for each component, we provided a number of recommendations for optimizing this impact.

1. To optimize the development of e-commerce and the

legal framework in the context of eco-business, it is important to integrate digital technologies that promote environmental sustainability, such as the use of Artificial Intelligence to analyze data on consumer environmental preferences and optimize logistics. E-commerce law also needs to be updated to promote environmental responsibility for online businesses, including introducing green certifications and reducing waste. Creating an enabling environment through tax incentives for eco-businesses and investments in green technologies can support environmentally sustainable development while ensuring long-term economic growth in the digital economy.

2. In terms of sustainability, the use of smart grids is proving critical for improving energy efficiency and integrating renewable energy sources. It is recommended that policies and initiatives be developed to support the deployment of smart grids at national and regional levels, enabling adaptive energy management. This includes investing in modern technologies to monitor and manage energy consumption, which can significantly reduce the carbon footprint and improve the overall environmental security of the region. This approach not only promotes sustainable development, but strengthens energy security and independence. Smart grids also support educational development and professional growth in the region by providing access to digital educational resources and e-learning platforms. This opens up new learning and skills development opportunities, especially in remote or low-income communities where access to quality education has traditionally been limited.

Overall, smart networks make a significant contribution to the social dimension of sustainable development, providing the basis for a fairer, more accessible and better-quality life for all members of the community, as well as contributing to the development of a socially responsible and environmentally sustainable society.

3. In the context of renewable energy development, Artificial Intelligence and big data offer powerful tools for optimizing energy production and distribution. We recommend developing algorithms and platforms that can analyze large volumes of data to predict energy demand and optimize renewable energy generation. This will not only maximize the efficiency of renewable sources, but also reduce environmental impact, providing a more stable and environmentally friendly energy supply. The introduction of such technologies could fundamentally change the renewable energy sector, making it more adaptive to climate change and environmental needs.

This study not only highlights the potential of digitalization to address environmental challenges, but also points to ways to effectively integrate innovative technologies into sustainable development strategies, providing valuable insights for businesses, policymakers and scientists.

5. DISCUSSIONS

Comparing our research with other scientific works is a critical aspect of scientific work, allowing us to not only determine the uniqueness and novelty of our findings, but also to establish their place in the broader context of existing research. This comparison contributes to a better understanding of the impact of digital technologies on the environment and eco-business, particularly in the Jordanian context, identifying common trends, differences and potential directions for further research. Such a comparison not only enriches academic discourse, but also provides valuable insights for developing more effective strategies for using technology to achieve sustainable development.

Thus, in a study by Schöggl et al. [14] focuses on analyzing two decades of research into sustainability and the circular economy. The authors examined how persistence and circular economy narratives have evolved over time, identifying key themes and trends in the academic literature. Our study is distinguished by its specific geographic focus on Jordan and its emphasis on digital technologies as catalysts for eco-business and sustainable development, complementing Schöggl et al.'s broad review with specific insights into the impact of technology.

Tavoni et al. [15] explores the importance of technology and its evolution towards a low-carbon economy, focusing on the potential of technological progress to minimize our carbon footprint. In the context of our study, we detail this aspect by focusing on digital technologies, their impact on environmental sustainability and the specific context in Jordan, which allows us to more accurately determine the level and mechanisms of these impacts.

A study by Fu et al. [16] highlights the importance of ecological wisdom in urban landscape planning and design. Our research extends this perspective by focusing on digital technologies as a tool for realizing environmental wisdom in the context of eco-business, providing a new dimension to understanding how technological innovation can be used for sustainable development.

At the same time, Bauer [17] examines biorefinery innovation narratives in the context of the bioeconomy, highlighting conflicts, consensus and confusion in the discourse. Our research complements this analysis by focusing on digital technologies and their specific impact on eco-business and environmental sustainability, providing a clearer understanding of the potential and challenges of digital transformation.

Li and Ji [18] conducted an empirical analysis of the relationship between institutional pressures, environmental strategy, and corporate environmental performance. In contrast, our study focuses on the role of digital technologies in shaping environmental strategies of eco-businesses in Jordan, providing insights into the specific mechanisms through which technologies can influence environmental performance and sustainability.

A study by Singh et al. [19] assesses global sustainable development, environmental sustainability, economic development and social development index in selected economies. The authors use a comprehensive approach to analyze the relationship between these aspects at the macroeconomic level. Our study is distinctive in its specific focus on the impact of digital technologies in the Jordanian context, with particular attention to eco-business and sustainable development, complementing Singh and colleagues' broad-based analysis with concrete examples of digitalization implementation.

Iskajyan et al. [20] examine the importance of the information environment in assessing the country's economic security in the context of the digital economy. This study focuses on the importance of information technology and its impact on economic sustainability. Our research expands this perspective by focusing on specific digital technologies and their impact on environmental sustainability and eco-business development, showing how digitalization can contribute not only to economic but also to environmental security.

Phan and Baird [21] focus on examining the impact of institutional pressures on the comprehensiveness of environmental management systems and their impact on environmental performance. This study demonstrates how external demands and expectations influence corporate environmental strategies. Our research complements this work by emphasizing how digitization can be used as a means to achieve better environmental outcomes in response to these pressures, with a shifted focus on innovative technologies.

Our study focuses on identifying the impact of digital technologies and e-commerce law on eco-business and sustainable development in Jordan using innovative methodological approaches, while the studies of Kronivets et al. [22] and Sylkin et al. [23] focus on the use of Artificial Intelligence in educational processes and the assessment of various types of security in engineering enterprises as prerequisites for the application of crisis management, respectively. At the same time, they do not specify the specific features of business activities in different countries. Our work offers a specific analysis of the impact of technological and legal aspects on environmental sustainability, focusing on the Jordanian context.

In comparison with the studies of Alazzam et al. [24] and Yesimov and Borovikova [25] and Sylkin et al. [26], who examine the development of information models for e-commerce platforms in the context of global digitalization and legal compliance and the administrative-legal implementation of the rights of business entities, our study offers specific value by focusing on the environmental aspects of digitalization and legal regulation in the context of eco-business. Particularly valuable is your approach to analyzing factors affecting the environment and sustainability, which helps identify key areas for improving environmental sustainability and social impact in Jordan.

Our research focuses on analyzing the impact of digital technologies and e-commerce law on environmental sustainability and eco-business development in Jordan using PESTLE and fuzzy benefit-based multi-criteria selection techniques. It is complemented by the work of Sylkin et al. [26], which examines the impact of international tourism on sustainable development from a methodological perspective. Both studies identify the importance of integrated strategies to support sustainable development, but our study is unique in that it specifically focuses on digitalization and legal aspects as drivers of environmental and social well-being in Jordan.

Zeleňáková and Zvijáková [27] investigate the ecological impact of flood protection facilities based on rural risk analysis. Their approach reveals the specific environmental risks associated with water management projects. Our research brings a digital transformation perspective to this discussion, demonstrating how digital technologies can be used to optimize environmental planning and risk management, providing new tools to minimize negative environmental impacts.

Comparison of our research with other works in the field of digital transformation, environmental sustainability and eco-business development showed that our research is highly relevant and brings significant scientific novelty to this discipline. By focusing on specific aspects of digital technology in the Jordanian context, we have uncovered new perspectives on the impact of technology on environmental sustainability and the promotion of eco-business. This focus not only helps fill existing gaps in the literature, but also provides practical recommendations for stakeholders, highlighting the importance and innovativeness of our approach in exploring the interactions between technological progress, economic development, and environmental challenges.

6. CONCLUSIONS

The study, which focuses on analyzing the impact of digital technologies on the environment and eco-business development in Jordan, has important implications in the context of global sustainable development efforts. This study not only highlights the specific factors shaping environmental and economic reality in the region, but also offers an innovative approach to assessing their impact. The use of a set of methods, including PEST analysis, systems analysis method, utility function determination and multi-criteria selection of alternatives based on a fuzzy advantage relationship, provided a deep and multifaceted understanding of the impact of digitalization.

This study identified four key digital technology drivers that have a critical impact on environmental sustainability and eco-business development in Jordan. This opens the door to developing strategies that can maximize the positive environmental and economic impacts of technology while minimizing possible negative impacts. The central conclusion of the study is the need for a focused and responsible approach to the introduction and application of digital technologies in the context of sustainable development.

However, recognition of the geographical limitations of the study and potential issues with data availability and quality highlights the importance of further work in this area. The recommendation to expand the geographic scope of the study and include more diverse data sources highlights the need for a more comprehensive approach to studying this issue. Also, the use of additional data collection methods, such as expert surveys or case studies, can significantly increase the level of reliability and validity of the results obtained.

This study also points to the significant potential of digital technologies as a tool for achieving sustainable development. However, to realize this potential, the complex impacts of these technologies, including their environmental, economic and social aspects, must be taken into account. Developing targeted policies and initiatives based on a deep understanding of these impacts is critical to ensuring a sustainable future.

The importance of an interdisciplinary approach cannot be overstated in the context of the study. Integrating knowledge from different fields will help develop a deeper and more comprehensive understanding of the interactions between digital technologies, environmental sustainability and economic development. This approach will help develop effective solutions that take into account a wide range of influences and interests.

In conclusion, the study highlights the need to continue and expand research in this important area. Future research should focus on identifying new opportunities for using digital technologies to promote environmental sustainability and eco-business development, and addressing the challenges to achieving these goals. This requires a constant focus on innovation, adaptation and integration of new knowledge and technologies to create a sustainable and prosperous future.

One possible limitation of the presented study is its geographic focus on Jordan, which may limit the generality of the findings. To overcome this limitation, it is recommended

that the research base be expanded to include data from other regions with similar environmental challenges and economic conditions to make the findings more generalizable.

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