**Role of AI in Economic Development and Green Technology**

**ABSTRACT**

With the development of Artificial Intelligence (AI), the analytical power & decision-making ability of man has increased remarkably. With the help of AI, machines/computers/robots can think like humans in terms of working efficiency & performance, and can make fast & precise decisions. The study of the economic environment is not an easy process for humans as it has a number of diversified aspects at the individual level, the industrial level, the financial level, the commerce level, the rural/urban level, the state/nation level, and the international level. With the emergence of AI, it is a great help to study the economic environment. We can make easy decisions for the development of the economy of the nation, as well as the individual/industry. In understanding and processing the development of the economy, AI is playing an immeasurably important role in productivity enhancement, innovation in technology, decision-making, and skill development.

In modern days, without technology, it is not feasible to work/produce, for that energy/power is required, and this is limited by employing its resources. For technology and power, we are ignorantly wasting our precious limited resources. Therefore, we needed to use these cautiously and optimally, for this AI plays an important role by highlighting important data for the right decisions, and in doing sustainable resources management with the understanding of climate change at the right time. To be more eco-friendly in manufacturing and in technology, we can monitor the environment accurately with the help of AI.

The objective is to study the relevance of artificial intelligence in the current scenario, especially in the field of economic development.

Conclusion: In saving our environment, green technology is essential for the optimum use of resources without damaging the environment. In this manuscript, a descriptive research design based on secondary data is used.

***Keywords****: AI, economic development, green technology, sustainable, optimum, decision-making, resources management, environment, green finance*

**I. INTRODUCTION:**

A man has extraordinary power to think, to decide, to formulate on a number of subjects and processes. However, human beings have limitations in their speed, high accuracy, and in the continuity of work. Since the development of machines and software, human beings feel comfortable performing work as a manifold with high accuracy.

Artificial intelligence (AI) comprehends a varied range of proven technologies. With the availability of wide experiences, it does not lack anywhere and proves a universally agreed-upon solution as defined. However, international bodies, such as the European Parliamentary Research Service (EPRS), normally define AI is similar to a group of systems that have revelation 'human-like intellectual processes', including understanding, learning, reasoning, and interacting. In the means of all-purpose technology, AI can be evident as a fundamental infrastructure (algorithms), an essential incorporated system of production processes, or an impartial finish-user product. Unlike traditional automation, AI technologies aim to reproduce repeatedly human cognitive activities, encompassing and outspreading their applications beyond humdrum tasks and into innumerable aspects of human endeavor.

AI has been classified into five categories, which are functional, analytical, textual, interactive, and visual. Even though distinct AI techniques possess discrete scopes and applications, many prevailing technologies leverage a combination of these. Consequently, categorizing AI systems exclusively based on precise and definite types or techniques can be thought-provoking. Furthermore, the development of AI is an emergent, dynamic, self-motivating, and evolving field, constantly producing excellent, novel, and innovative forms of AI technologies. We are well aware that ChatGPT is a prime example of this persistent evolution of AI. A groundbreaking AI technology, employing profound learning, that was widespread to the public in 2022, swiftly making a significant impact and becoming popularized among people as ChatGPT, with a convenient use for all age groups as well as for a variety of professionals.

**II. OBJECTIVE:**

1. To understand artificial intelligence.
2. To learn the functioning of AI in the industries.
3. To recognize the significance of AI in economic development, green technology, and green finance.
4. To identify the continuous need for AI for human society.

**III. GAP ANALYSIS:**

Prior to the introduction of AI, the gathering of data was less, and the processing and utilization of data was limited to a certain extent, as human capabilities are certain. After the introduction of AI, data collection, data organization, and data processing have increased enormously. In the process and analysis of data, AI is replacing human resources who are less familiar with AI. Therefore, this emerging technology is creating and increasing the gap in workability and efficiency. To curtail the gap and to be more efficient for human resources, they have to understand and incorporate AI technology speedily.

**IV. LITERATURE REVIEW:**

Tong Fu et al. (2024) [9] evaluated the role of AI in decision-making at the level of industry/firm. They marked the use of AI in endogeneity analysis. They highlighted the path of environmental regulations. They analyzed the role of a green background and the digital economy. They signify that AI empowers green technological innovations and helps industries to go green.

Yakhshiboyev R.E. and Ermetov E.Ya. (2024) [3] highlighted in their research article that AI is a transformative force in today’s concerned economics. They explored AI's dual impact on economic expansion and job creation. They also focused on the encounters faced by AI, such as challenges to the job, and emphasized the necessity to reskill the workforce.

Muhammad Zubair Chishti et al. (2024) [17] introduce AI as a critical player in ascertaining economic cycles. They elaborated the effects of green finance in diminishing the economic cycle. They state that AI is a new driving tool of the economic cycle, and it has an energetic & changeable role. AI influences the economic cycle in the short run, and in the long run, it contributes to economic stability.

Lei Chang et al. (2023) [5] assessed the impact and importance of AI on the use of natural resources. They stated that carbon intensity varies between industries and development. The paper highlights that AI is significantly reducing carbon intensity.

Julius Tan Gonzales (2023) [7] states that applications of AI warrant the process and various aspects of research in economic considerability. The contribution of AI in production, supply chain, marketing, acquisition, etc., makes a great favorable change for the industries as well as for the customers. This paper highlighted the optimistic relationship between AI and economic development, which is better than previous ones and continues.

Yong Quin et al. (2021) [1] said in their paper that there is a rapid rise of AI in today’s environment. They highlighted that it is doubtful for the environment, that AI is beneficial. They discussed sustainability in their article. They noted five planes of intellectual decision-framing, social governance, labour & capital, Industry-4.0, and remarkable innovation.

Kedong Yin et al. (2020) [11] specified that the rapid development of AI leads to green technology innovations. They highlighted the development of industrial robots and their applications the advanced use of AI, and it is increasing continuously.

**V. RESEARCH METHODOLOGY**

A primary challenge in collecting and analyzing the data for this study is the procurement of data from the different streams of various specialization fields at cross-country, which can accurately observe, measure, and ascertain the AI development. For this, we can obtain help from the papers/articles published in various journals and publications of different organizations and governments that have become widely recognized as a key indicator of technological innovation. This study utilizes AI-published data as a prime method of data collection as secondary data, which is used for AI development, advancement, and flourishing everywhere, i.e., in each country and in every field of commerce, science, and technology. This research article is descriptive in nature and consists of various aspects of green finance and green technology.

**VI. FINDINGS / DISCUSSION:**

**VI.1 The Development of Industry 4.0 and AI**

Industry 4.0, driven by disruptive technologies, aims to effortlessly integrate the abiotic, biotic, and numeric-computerized, worlds. This revolution envisions an exceedingly flexible and customized production archetype, breaking down traditional industry restrictions and reframing the manufacturing value chain. Publications, Journals, articles, and industry reports uninterruptedly magnify the critical role of Artificial Intelligence (AI) in realizing the vision of Industry 4.0. AI is widely accepted and familiar as a significant technology driving this 4th industrial revolution, with its integration seen as essential for competitiveness. Continuous research signifies the need for intellectual and automated solutions, predominantly AI-driven frameworks, to boost and develop industrial processes. This has prompted significant research on integrating AI into the manufacturing value chain. For example, the interpretation of the research and studies has proposed ‘hybrid-adaptive-neuro-fuzzy-inference-systems’ and ‘artificial-neural-networks’ for optimizing manufacturing processes.

The applications of AI in Industry 4.0 are diverse, ‘encircling-extrapolative-analytics’, ‘predictive-preservation’, ‘industrial-robotics’, ‘inventory-management’, and ‘computer-vision’. From an industrial perspective, AI empowers systems with heightened competencies, sensing their environment, processing data, addressing complex tasks, and learning from experience to improve performance. While autonomy is a key trend and feature of Industry 4.0, the value of the intelligence of a human being in guiding, administering, and managing AI-powered systems should not be undervalued and misjudged. Varied levels of autonomy will likely be un-conditional on the maximum suitability for the specific needs of various factories.

**VI.2 The Economic Development and AI:**

In the economic transactions of an economy, automating repetitive tasks is compulsory and disruptive. AI systems smooth the tasks and enhance efficiency, reduce labor costs, and increase output. For example, AI-powered robotics and quality control systems streamline manufacturing processes, while the assistance of chatbots and the use of virtual assistants improve customer service efficiency in the service sector. AI analytics tools enable businesses to process vast datasets, extracting valuable insights for optimized decision-making and resource allocation. These productivity gains contribute significantly to economic growth and development.

AI incorporates innovation by enabling the fast, distinct, and improved development of innovative products, amenities, and business models. AI’s ability to analyze data and expose un-repetitive patterns accelerates research and development across sectors, from healthcare (drug discovery) to finance (personalized products) and technology. AI made it possible to produce novel business models, such as platform-based economies and subscription services, that leverage data analytics and machine learning. This AI-enabled unremitting innovation not only inspires economic growth but also strengthens global competitiveness.

The impact of AI adoption varies across sectors. The banking, non-banking and financial services industry utilizes AI is used for the detection of fraud, managing the risk, and trading of algorithms, enhancing of efficiency & security. Healthcare has benefited from AI-powered diagnostics, personalized medicine, and improved patient care. Retail and logistics have also undergone transformations, optimizing supply chains and enhancing customer service. All the sectors have not only experienced increased efficiency and reduced costs but have also essentially restructured their business models and service delivery mechanisms due to AI adoption. This leads to economic growth and development secured and sped with the help of AI.

**VI.3 Green Finance and AI:**

Green financing intends to direct increased financial resources from the public, private, and not-for-profit sources towards justifiable developmental goals. This encompasses effectively managing environmental and social risks, identifying and capitalizing on opportunities that execute both monetary returns and ecological benefits while ensuring greater accountability in monetary decision-making. The promotion of green financing necessitates a multi-dimensional methodology that has many directions, for elaboration, adjusting national regulations to foster green investment, right positioning of public financial-incentives to encourage green practices, increasing green financing contributions from diverse sectors (public, private, non-profit), positioning public-sector monetary decisions with the environmental-dimensions of the ‘Sustainable-Development-Goals’, enhancing investment in clean and green technologies, supporting maintainable & continued natural resource-based green economies, and climate-smart blue economies, and increasing the issuance and utilization of green bonds. All the above-mentioned multidimensional functions are possible through AI technology.

Green Finance involves encompassing financial resources towards the projects and initiatives that have optimistic environmental effects, such as renewable energy projects (solar projects, wind projects, and hydro-power projects), energy efficient upgrades, sustainable transportation, pollution prevention & control, and conservation & restoration of natural resources. The Main themes of green finance are:

**VI.3.1 Green finance and environmental sustainability:**

Green finance enhances the development of ecologically approachable technologies and projects by providing vital capital. This quickens the evolution to a reduced-carbon economy and assistances in vindicating climate change. By making green investments more tempting, green finance induced businesses and common person to implement sustainable working practices, such as reducing their carbon footprint and conserving resources. Moreover, green finance supports internalizing the environmental costs of economic activities. For instance, carbon pricing mechanisms incentivize businesses to reduce their emissions. Investing in green projects also creates new jobs in sectors corresponding renewable energy, environmental technology, and environmentally conscious agriculture.

**VI.3.2 Green finance and investments:**

Green finance encompasses the practice of guiding monetary resources towards projects and initiatives that have optimistic environmental and social influences. Key financial instruments used in green finance are green bonds (debt securities dispensed to monetary environmentally approachable projects), resources-efficient investment funds (funds that invest in corporations with positive environmental, social, and governance performance), impact investing (investments centralized on producing & delivering both monetary returns and positive social and environmental influence), and green loans (precisely intended to finance ecologically sustainable projects).

**VI.3.3 Green finance and innovation:**

Green finance signifies a significant role in funding research & development, developing new materials, improving existing technologies, creating new technologies, incentivizing Innovation, creating new markets, and addressing environmental challenges.

**V.3.4 Green finance policy/green credit guidelines:**

Green finance policies and credit guidelines are crucial for directing financial flows towards sustainable development. These policies are intended to foster a cooperative environment for green investments, encouraging together to the public and private sectors to adopt environmentally sustainable practices. These are Regulatory Frameworks, Credit Guidelines for Financial Institutions, Promotion of Green Financial Instruments, and International Cooperation.

**VI.3.5 Green finance and economy:**

Green finance optimizes a significant role in orienting a transition towards a sustainable economy. It fosters economic growth while minimizing environmental harm. It helps in Job Creation, Economic Growth, Improved Resource Efficiency, Enhanced Competitiveness, and Reduced Environmental Risks.

**VI.3.6 Green finance and corporate social responsibility:**

Green finance provides the capital necessary for companies to implement CSR initiatives for ecological protection, social obligations, and Ethical business practices.

**VI.3.7. Trends/challenges/barriers/awareness of green finance:**

Trends in Green Finance are growing demand for sustainable investments, the rise of impact investing, technological advancements, the incorporation of ESG factors into mainstream finance, also the growing role of green bonds. Challenges and Barriers are a lack of standardized metrics, Risk perception, data availability and quality, Greenwashing, and a lack of awareness & understanding.

**VII. CONCLUSION:**

Green technology and green finance are distinctive tools that enable economic development at a faster pace with reliability and accuracy, i.e., minimized error while performing a variety of tasks in the manufacturing sector, marketing sector, services sector, research & development sector, banking/finance sector. Because of the strong machine thinking and decision-making power, AI has made a number of operations (which were very difficult or beyond the skills & capabilities of a human) feasible, operable, customized, and convenient for human beings, which assures the economic development at an individual level, industrial level, national level, and international level. For customized satisfaction at the customer level as well as the supplier level, AI has proven its significance, which is admirable to all.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that no generative AI technologies, ChatGPT, or COPILOT, etc., have been used during the writing or editing of this manuscript.

**VIII. REFERENCES:**

1. Yong Quin, et. al., “Artificial Intelligence and Economic Development: An Evolutionary Investigation and Systematic Review”, Journal of the Knowledge Economy (2024) 15:1736–1770, 24 June 2021
2. <https://link.springer.com/article/10.1007/s13132-023-01183-2>
3. Yakhshiboyev R.E. and Ermetov E.Ya., “THE IMPACT OF AI ON ECONOMIC GROWTH AND JOB CREATION”, Innovations in Science and Technologies, September 2024
4. https://innoist.uz/index.php/ist/article/view/465/465
5. Lei Chang, et al. “Role of AI in Green Economic Development: Joint Determinants of Natural Resources and Green Total Factor Productivity”, Science Direct.com Elsevier, May 2023
6. https://www.sciencedirect.com/science/article/abs/pii/S0301420723002167
7. Julius Tan Gonzales, “Implications of AI innovation on economic growth”, Journal of Economic Structures, 2023
8. https://link.springer.com/article/10.1186/s40008-023-00307-w
9. Tong Fu et al., “The impact of artificial intelligence on green technology cycles”, Technology Forecasting and Social Change, December 2024
10. https://www.sciencedirect.com/science/article/abs/pii/S004016252400619X
11. Kedong Yin et al., “How Does Artificial Intelligence Development Affect Green Technology Innovations in China” November 2020
12. https://link.springer.com/article/10.1007/s11356-022-24088-0
13. Gloria Cicerone et al., “Regional artificial intelligence and the geography of environmental technologies”, August 2022
14. https://www.tandfonline.com/doi/full/10.1080/00343404.2022.2092610#abstract
15. Tan Yigitcanlar et al., “Green Artificial Intelligence: Towards an Efficient, Sustainable and Equitable Technology for Smart Cities and Futures”, Sustainability 2021
16. https://www.mdpi.com/2071-1050/13/16/8952
17. Muhammad Zubair Chishti et al., “Can artificial intelligence and green finance affect economic cycles”, Technological Forecasting and Social Change, December 2024
18. https://www.sciencedirect.com/science/article/abs/pii/S0040162524005389
19. D. Hemanand et al., “Applications of Intelligent Model to Analyze the Green Finance for Environmental Development in the Context of Artificial Intelligence”, Computational Intelligence & Neuroscience, July 2022
20. https://onlinelibrary.wiley.com/doi/full/10.1155/2022/2977824
21. Xiaoyun Yang, “Role of green finance and investment in sustainable resource development in China”, Resources Policy, October 2023
22. https://www.sciencedirect.com/science/article/abs/pii/S0301420723009303