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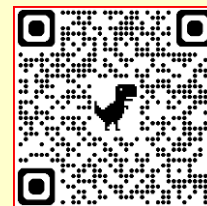
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A Preliminary Exploring Ecological Justice: Also Discussing the Potential and Challenges of Connecting with Artificial Intelligence

Jheng-Yu Yin^{1*}, Wen-Chuan Ke², Ho Yin Gary YEE³

¹ Ph D., Fu Jen Catholic University; Visiting Professor, Normal College, Hubei Polytechnic University.

² Ph D. Researcher Fellow, School of Technology Management, National Yang Ming Chiao Tung University; Adjunct Associate Professor, Department of Industrial Engineering and Management, National Taipei University of Technology; Adjunct Associate Professor, Department of Public Administration, National Open University; Visiting Professor, School of Intelligent Construction, Wuchang University of Technology.

³ Ph D., East China Normal University; Chairman, Silk Road Cultural Society.

Corresponding Author: Jheng-Yu Yin

ABSTRACT

In the context of rapid technological development, artificial intelligence (AI) is not only a product of technological innovation but also a crucial tool for solving complex social and ecological problems. The concept of ecological justice is an extension of traditional environmental ethics, deepening the connotation of justice theory. It emphasizes the intrinsic value and right to survival of all life species, advocating for the fair allocation and protection of environmental resources. True ecological justice requires a transformation of production relations, establishing a public ownership system that guarantees equality and equitable rewards for workers, and it is closely linked to the development of AI. Therefore, this paper, in addition to exploring the core theoretical perspectives of ecological justice, also connects the potential of AI in promoting ecological justice with the challenges it faces, in order to respond to the rapid development of this era.

KEY WORDS: ecological justice; multidimensional framework; data-driven; digital divide; systemic bias.

1. Introduction

Ecological justice is a complex and multi-dimensional concept that aims to address environmental damage, unfair resource allocation, and the ethical relationship between humans and nature [1]. This concept is not only an extension of traditional environmental ethics, but also deepens the connotation of justice theory, extending it from the distribution of social wealth to the ecological environment that is the premise of human survival [2][3][4]. The core of ecological justice is that it not only focuses on the interest relationship between people due to environmental resources, especially the justice of production relations [5], but also emphasizes the intrinsic value and

right to survival of all life species, advocating that different countries, groups and even species should enjoy equal rights and bear corresponding obligations in dealing with nature, ecology and environmental issues [6][7].

From a theoretical perspective, ecological justice encompasses multiple dimensions, including social justice, ecocentrism, Marxist political philosophy, and legal philosophy. It reveals how environmental harm disproportionately affects marginalized groups such as people of color and low-income communities, i.e., "environmental racism" [8][9]. At the same time, it challenges the traditional anthropocentric view and advocates ecocentrism ,

regarding it as the key path to achieving both social and ecological justice [10]. Within the framework of Marxism, the ecological crisis is regarded as an inevitable consequence of the capitalist mode of production, while true ecological justice requires the transformation of production relations and the establishment of a public ownership system that guarantees equality and equitable returns for workers [5][11][12].

In practice, the realization of ecological justice faces multiple and overlapping obstacles, such as structural marginalization, corporate power, weak legal and political systems, and exclusive public policy processes [13]. Nevertheless, the efforts of global environmental movements and local actions, such as the efforts of organizations like the Indigenous Peoples' Environmental Network (IEN), continue to advance the agenda of ecological justice [14][15]. In China, with the increasingly severe environmental problems brought about by rapid industrialization, the discussion of ecological justice has been combined with the construction of "ecological civilization" and has become a topic of widespread concern in academia and policy [3][16]. Overall, ecological justice requires us to rethink and construct a harmonious, just and sustainable world order from a holistic perspective that concerns a "community of shared future" [3].

2. Definition and Scope of Ecological Justice

Ecological justice is defined in a variety of ways, reflecting its interdisciplinary nature. In a broad sense, it is understood as fully considering the needs of the environment and ecosystems in legal, moral and policy principles in order to protect nature, promote sustainable development and ensure a fair relationship between humans and the environment [1]. It is not only about the fair distribution of environmental benefits and burdens, but also a value judgment about the premise of survival and the foundation of life [3].

2.1 Relationship with Environmental Justice

Ecological justice and environmental justice are closely related concepts and are sometimes used interchangeably [17]. However, there are subtle but important differences between the two. Environmental justice usually focuses more on addressing the unequal distribution of environmental burdens among human communities, especially due to factors such as race, income or nationality.[18][9] The US Environmental Protection Agency (EPA) defines it as "the fair treatment and meaningful participation of all people in the development, implementation and enforcement of environmental laws, regulations and policies." [18]

In contrast, the scope of ecological justice is broader. It originates from the theory of environmental justice, but extends the object of justice from humans to the entire ecosystem, namely "justice of, to, and for nature" [19]. This view argues that non-human life forms, such as animals and plants, as well as the ecosystem itself, have their intrinsic value and due rights, such as having suitable habitats [7][20]. Therefore, ecological justice not only deals with fairness between people, but also with the just relationship between humans and non-human species and the natural environment, emphasizing the interdependence of all species and the sanctity of Mother Earth [21][22][23].

3. Core Theoretical Perspective

The theoretical foundation of ecological justice is rooted in a variety of thought systems, and these perspectives together construct a rich theoretical content.

3.1 Social Justice and Human Rights

This perspective is the starting point of the ecological justice movement, emphasizing the profound connection between environmental issues and social injustice [10]. Research and action have revealed that environmentally harmful facilities such as toxic waste treatment plants and polluting industries are disproportionately concentrated in communities of color and low-income areas, a phenomenon known as "environmental racism" or "environmental discrimination" [8][24]. Ecological justice advocates that all people have equal rights to be free from the harm of environmental pollution and to enjoy environmental benefits such as clean air, water and soil equally [25][26]. The Seventeen Principles of Environmental Justice proposed at the first National Summit of NAACP Environmental Leaders in 1991 is a milestone of this movement. It explicitly calls for ending all forms of environmental injustice and affirms the ethical, balanced and responsible use of land and resources [21][27].

3.2 Ecocentrism vs. Anthropocentrism

This is a core debate in the theory of ecological justice [3].

• Anthropocentrism

Putting human interests and values first, the value of nature lies mainly in its utility to human beings. Traditional theories of social distributive justice, such as Rawls's theory, have been criticized for not paying enough attention to the ecological environment as a cost premise of wealth accumulation [3].

• Ecocentrism

In contrast to anthropocentrism , it is believed that natural ecosystems and all their components (including non-human species) have intrinsic value that is not dependent on human needs [10]. This view holds that humans are merely members of the Earth's life community and should respect the integrity and stability of nature. Many scholars argue that ecocentrism is a key path to true social and ecological justice because it fundamentally challenges the political and economic structures that lead to the exploitation of humans and nature [10].

3.3 Marxist Political Philosophy

From the perspective of Chinese academia, the Marxist perspective offers a particularly profound interpretation of ecological justice [28]. This view holds that ecological crisis and ecological injustice are not isolated environmental problems, but rather the inherent contradictions and inevitable consequences of the capitalist mode of production [3][29]. Capital's pursuit of profit maximization drives it to endlessly exploit natural resources and labor, externalize ecological costs, and transfer them to the lower classes and developing countries [3].

Therefore, from the perspective of Marxist philosophy, the essence of ecological justice is defined as "the justice of production relations between people mediated by ecological environment factors, especially ecological resources" [5][11]. The fundamental way to achieve ecological justice is:

- Establish production relations based on public ownership of the means of production [5][12].
- Guarantee the equal status and respect of workers in the production process [5].
- Ensure that workers' efforts are commensurate with their rewards [5]. This view elevates ecological justice from an ethical appeal to a political demand for fundamental changes to the socio-economic structure.

3.4 Legal Philosophy Perspective

From the perspective of legal philosophy, ecological justice requires that the needs of the environment and ecosystems be incorporated into legal and moral principles [1]. This means that the law must not only regulate the relationship between people, but also the relationship between people and nature to ensure sustainable development [1]. Its core lies in procedural fairness and fairness of participation, that is, everyone should be treated fairly and be able to participate effectively in the formulation, implementation and supervision of environmental laws, regulations and policies [11].

4. A Multidimensional Framework for Ecological Justice

In order to understand and practice ecological justice more comprehensively, scholars have proposed a multi-dimensional analytical framework. This framework usually includes several core aspects, which are interconnected and together constitute a complete justice system [19].

Table 1. A Multidimensional Framework of Ecological Justice

Dimension	Core connotation	Specific Manifestations
Distributive Justice	Fairly distribute the benefits (such as parks and clean air) and burdens (such as pollution and waste) of the environment.	Focus on equality of environmental rights and obligations among different countries, regions or groups [6]. Oppose the behavior of disproportionately transferring environmental harm to vulnerable communities [30].
Procedural Justice	Ensure that all affected communities can meaningfully participate in the environmental decision-making process.	Emphasis is placed on transparency, openness and inclusiveness in the decision-making process, and the public's right to know, participate and supervise are guaranteed [18 [11]].
Recognition of Justice	Acknowledge and respect the cultures, values, knowledge systems, and intrinsic value of different communities and non-human species.	Challenge the notion that certain communities (such as indigenous peoples) or nature itself are secondary or merely instrumental, and promote the integration of cultural diversity and ecological knowledge [19].

Capabilities Approach	Focus on enhancing the overall capacity of the socio-ecosystem to maintain health, resilience, and prosperity.	It is not just about allocating resources, but also about building the capacity of communities and ecosystems to sustain and develop themselves, for example through community participation, capacity building and ecological knowledge education [19].
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Source: This article is compiled from various sources.

5. Practice and Challenges

Ecological justice is not only a theoretical concept, but also a global social movement and an arduous practical task [31].

5.1 Global Movement and Local Action

The ecological justice movement is characterized by alliances and an “inside-out” action [15]. It consists of numerous grassroots organizations, non-governmental organizations (NGOs) and community actors. For example:

- **Indigenous Environmental Network (IEN)** : founded by Native Americans, dedicated to addressing environmental and economic injustices in Native American communities [14].
- **Women on Earth and Climate Action Network (WECAN)** : Mobilizing women worldwide to participate in policy advocacy, local projects and direct action on climate justice [14].
- **The Pan-Africa Climate Justice Alliance** is comprised of more than 1,000 organizations from 48 African countries that work together to address the challenges posed by climate change. These organizations promote the ecological justice agenda through a variety of means, including documentaries, reports, legal action and community organizations [14].

5.2 Obstacles to Achieving Ecological Justice

Despite tremendous efforts, the realization of ecological justice still faces deep-rooted obstacles. A study of global activists and scholars found that these obstacles are multi-layered, interconnected and overlapping [13], with the main obstacles including:

- **Structural marginalization** : Structural factors such as historical and contemporary violence, racism and colonialism are the root causes of injustice [10 [13]].
- **Institutional barriers** : a weak legal framework, a corrupt political system and regulatory agencies that are captivated by corporate interests make it extremely difficult to hold people accountable [13].
- **Exclusive public policy** : The decision-making process often ignores or suppresses the voices of victim communities and social justice, and lacks effective public participation mechanisms [13].
- **Bureaucratic culture and internal strategic dilemmas** : The movement itself also faces the challenges of bureaucracy and internal strategic dilemmas [13].

5.3 China's Context and Development

Since the reform and opening up, China has faced severe environmental pollution and ecological imbalance problems while undergoing rapid industrialization and urbanization, which has led to many mass environmental incidents [16] , making the discussion on ecological justice in China increasingly important [32][16]. Most Chinese scholars start from Marxist political philosophy and link ecological justice with the construction of "socialist ecological civilization values with Chinese characteristics" [3] , focusing their research on:

- Define the standards of justice under different social and ecological environments [32].
- Identify the roles and demands of different stakeholders in ecosystem service management [32].
- Explore how to fairly share ecological costs while pursuing economic development, and achieve a just distribution of social production, living and ecological space [33][3].

6. Potential

6.1 Resource Management and Environmental Monitoring

AI plays a key role in resource management and environmental monitoring. Through machine learning algorithms, AI can analyze a large amount of environmental data, predict pollution sources and monitor the health of ecosystems. For example, the San Francisco air quality monitoring system uses AI to analyze data from multiple sensors to provide real-time pollution forecasts, which not only helps in the formulation of public health policies, but also promotes social attention to environmental issues [1].

6.2 Data - Driven Decision Making

AI can process and analyze massive datasets, which is of great value in solving environmental problems. Through in-depth analysis of data, AI can reveal the root causes of environmental injustice and provide targeted solutions. For example, some studies have used AI technology to analyze water resource allocation issues and found that some communities are in a water shortage predicament due to improper resource management. These results help policymakers understand the root causes of the problem and prompt them to formulate more effective water resource management policies [2].

6.3 Social Participation and Transparency

AI technology can significantly improve social participation and allow more people to participate in the environmental decision-making process. By using AI platforms to collect public opinions, policymakers can better understand the needs and concerns of the public. In addition, AI can enhance the transparency of policies, make the decision-making process more open, and thus enhance public trust in policies [3].

6.4 Continuous Monitoring and Early Warning System

AI can be used to establish a continuous monitoring and early warning system, which is especially important in the face of climate change and environmental disasters. Through real-time data analysis, AI can detect environmental problems in a timely manner and give warnings to relevant departments, which is crucial for protecting the environmental rights of marginalized communities. For example, AI systems in some areas are used for flood warnings, which can predict the possibility of floods in advance by analyzing meteorological data and topographic data, and issue timely warnings to communities [4].

7. Challenges and Risks

7.1 The Widening Digital Divide

Despite the potential of AI in promoting ecological justice, there are also risks that cannot be ignored. First, the development of AI technology may exacerbate the digital divide, making it impossible for some communities to access relevant resources and technologies. In particular, in developing countries, the lack of technological resources may lead to the loss of advantages for these communities in environmental protection and resource management, further widening social inequality [5].

7.2 AI System Bias and Opacity

Secondly, biases and lack of transparency in AI systems can lead to unjust decision-making. If biased data is used in the design and training of AI technology, it may ultimately produce discriminatory results, marginalizing certain vulnerable groups in policy-making. Therefore, to mitigate these risks, we need to establish more transparent and equitable mechanisms in the development and application of AI to ensure that all social groups benefit from these technologies.

8. Conclusion

8.1 The Issues of Our Time

Ecological justice is a profound and urgent issue of our time. It transcends the scope of traditional environmental protection and closely links ecological integrity with social fairness and justice. It requires us to recognize that the root of environmental problems is often deeply rooted in unequal social structures, exploitative economic models, and the value concept of instrumentalizing nature [3].

8.2 Practical Orientation

This article shows that ecological justice has multiple theoretical dimensions and complex practical aspects. Whether from the perspective of social human rights, ecocentrism, Marxist production relations, or legal philosophy, they all ultimately point to a common goal: to establish an ecosystem in which all human communities and non-human species can coexist healthily, fairly, and with dignity [10][34].

To achieve the aforementioned goals, a holistic and multi-pronged approach must be adopted. This requires not only patchwork policy adjustments, but also a fundamental reflection and reconstruction of the existing political, economic and cultural systems. This means challenging the power structures that create injustice, empowering marginalized communities, and establishing respect and responsibility for nature in law and ethics [10][131]. Ultimately, the pursuit of ecological justice is a shared future aimed at building a truly harmonious, just and sustainable global community of shared future [3].

8.3 Connecting AI Development

The connection between artificial intelligence and ecological justice is a complex and important issue, possessing both potential and facing many challenges. To achieve true ecological justice, we must fully consider social equity, environmental sustainability, and respect for all life in the development and application of AI. This requires the broad participation and support of policymakers, technology developers, and all sectors of society, collaborating to ensure that AI technology serves broader social justice goals and promotes the realization of ecological justice.

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