The ethical implications of using artificial intelligence to manipulate or enhance natural ecosystems and biodiversity

Las implicaciones éticas del uso de la inteligencia artificial para manipular o mejorar los ecosistemas naturales y la biodiversidad

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ABSTRACT

In light of the grave threats posed to biodiversity and natural ecosystems by human activity, artificial intelligence (AI) emerges as a potent and promising instrument for their preservation. However, it is imperative to acknowledge the concomitant risks and uncertainties associated with AI. The integration of AI into ecological systems may potentially disrupt the intricate balance and integrity of these ecosystems, adversely impacting the rights and interests of diverse stakeholders, and resulting in unanticipated, permanent effects on the continuity of life as we know it. In this work, I discuss the ethical issues involved in utilizing AI to control or improve natural ecosystems and biodiversity by referencing five literature-based arguments. These arguments include the following: loss of authenticity, justice and equity, long-term effects, environmental impact, and ethical duty. I contend that the ethical question of using AI to manage ecosystems and conserve biodiversity is intricate and varied, necessitating a thoughtful and nuanced approach. To establish a moral framework for the responsible use of AI to improve biodiversity, the precautionary principle was investigated and its shortcomings examined. Based on Unesco's four AI integration principles, the "Ecosystem-Centric AI Ethical Framework" was developed as a potential framework to deal with these problems. According to this paradigm, AI should protect human rights and dignity as well as the rights of nature. It should also be monitored and evaluated, and there should be procedures for accountability and redress in the event of harmful effects.

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RESUMEN

Dado que la actividad humana representa un grave peligro para la biodiversidad y los ecosistemas naturales, la inteligencia artificial (IA) presenta un instrumento potente y prometedor para su preservación. Sin embargo, la IA también conlleva una gran cantidad de peligros e incertidumbre. Puede alterar el delicado equilibrio y la integridad de los ecosistemas, afectar los derechos e intereses de las diferentes partes interesadas y tener efectos imprevistos y permanentes en la continuación de la vida tal como la conocemos. En este trabajo utilizo cinco razones de la literatura para analizar algunas de las cuestiones éticas en torno a la utilización de la IA para controlar o mejorar los ecosistemas naturales y la biodiversidad. Estos argumentos incluyen los siguientes: pérdida de autenticidad, justicia y equidad, efectos a largo plazo, impacto ambiental y deber ético. Sostengo que la cuestión ética del uso de la IA para gestionar los ecosistemas y conservar la biodiversidad es compleja y variada, lo que requiere un enfoque reflexivo y matizado. Con el fin de proporcionar un marco moral para el uso responsable de la IA con el fin de mejorar la biodiversidad, investigué el principio de precaución y examiné sus deficiencias. Sobre la base de los cuatro principios de integración de la IA de la Unesco, desarrollé el "Marco ético de la IA centrado en el ecosistema" como un marco potencial para abordar estos problemas. Según este paradigma, la IA debe proteger los derechos humanos y la dignidad, así como los derechos de la naturaleza. También debe ser supervisada y evaluada, y deben existir procedimientos para la rendición de cuentas y la restitución en caso de que se produzcan efectos perjudiciales.

Palabras clave

INTRODUCTION

The field of artificial intelligence (AI) encompasses the development of systems and devices capable of learning, thinking, perceiving, making decisions, and solving problems. These tasks, which are often cognitively demanding, are typically performed by humans. The field of AI has found application in a wide range of industries, including security, entertainment, education, and medicine. Nevertheless, environmental science represents a particularly exciting yet challenging field for AI, given its capacity to enhance or modify natural ecosystems and biodiversity.

The richness, complexity and biodiversity of life on Earth, encompassing the relationships between living organisms and their natural environments, is collectively termed natural ecosystems and biodiversity. The provision of necessities such as food, water, leisure, pollination, and temperature regulation for human life is all facilitated by ecosystems. The variety of life, encompassing the diversity of genes, species, and ecosystems, is a critical metric for evaluating the health and resilience of natural systems. The resilience and adaptation of ecosystems to environmental changes, such as pollution, invasive species, and climate change, depend on biodiversity.

However, human activities, including but not limited to habitat fragmentation, overexploitation,

deforestation, and urbanization, pose a major threat to biodiversity and natural ecosystems. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has estimated that more than a million plant and animal species are at risk of becoming extinct at a rate not witnessed during any other period in human history. Furthermore, the rate of worldwide change in nature has never been as rapid in the last 50 years as it has been in the present era. The IPBES emphasizes that, in the absence of prompt and substantial measures, the depletion of biodiversity and ecosystem services will have deleterious consequences for human health, well-being, security, and culture (Brondizio et al. 2019).

This is an area in which artificial intelligence (AI) has the potential to play a significant role in the preservation and rehabilitation of biodiversity and natural ecosystems. The monitoring, modelling, forecasting, and control of the condition and dynamics of ecosystems and biodiversity represent a select number of the pressing environmental issues that AI might assist in resolving (Geary et al. 2016). Ecosystems that are more adaptable or robust to environmental changes, such as invading species, illnesses, and climate change, may be created or restored with the use of AI (Bostrom 2014). AI has the potential to enhance the social and economic benefits of ecosystems and biodiversity, including revenue generation, recreation, and food security (Jensen 2020). Furthermore, AI has the potential to enhance the productivity and profitability of specific sectors, such as forestry and agriculture, as well as the distribution and allocation of natural resources, including water, land, and energy. The ethical use of AI has the potential to empower local and indigenous populations to engage in ecosystem management and decision-making, becoming more autonomous, so long as they are involved in the co-designing of the technology, ensuring that their rights, knowledge, and values are respected (Brondizio et al. 2019). AI may also support the

search for and conservation of ecosystem services[1] and biodiversity, both of which are essential for human survival and well-being (Scheffers et al. 2016). Finally, AI may provide accountability and transparency for the players involved in AI interventions by facilitating the application of environmental proposals made in international agreements such as the Paris Agreement and the Convention on Biological Diversity (Boucher 2019). However, there are also many moral, societal and political questions and difficulties in using AI to improve or modify natural ecosystems and biodiversity.

In this article, I provide a comprehensive overview of the ethical issues associated with the utilization of artificial intelligence (AI) for the purpose of controlling or enhancing natural ecosystems and biodiversity. The following arguments are presented: loss of authenticity, equality and justice, long-term effects, environmental impact, and ethical duty. The argument is made that the utilization of AI for ecosystem management and biodiversity conservation is a complicated ethical problem with many facets that calls for a thoughtful, nuanced solution.

The analysis presented herein suggests that the utilization of AI should be confined to scenarios where the advantages outweigh the hazards, the associated uncertainties and trade-offs are transparent and acceptable, and the relevant stakeholders are informed and actively involved in the decision-making process. The Ecosystem-Centric AI Ethical Framework is proposed as a potential solution to address the detrimental effects of AI usage on biodiversity, to accomplish this goal. The shared values and goals proposed by Unesco, including human dignity, human rights, human supervision, justice, accountability, openness, and privacy, as well as the effects on

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[1] Ecosystems services refer to the advantages that humans obtain from nature, encompassing provisioning (e.g. food and water), regulating (e.g. climate regulation and flood control), cultural recreation and aesthetic appreciation), and supporting services (e.g., nutrient cycling and biodiversity). They are essential for sustaining life, maintaining biodiversity, regulating the climate, and providing economic and health benefits. Economically, they save costs in agriculture through pollination, in climate mitigation through carbon storage, and in water purification, making them crucial for long term sustainability.

society and the environment, form the foundation of this framework.

The structure of the paper is as follows: Section 2 provides a concise overview of the current state of artificial intelligence and its application in environmental research. This section focuses on a few justifications for employing AI to improve biodiversity and natural ecosystems. The subsequent section, Section 3, delves into the ethical considerations involved in utilising AI for the enhancement or modification of natural ecosystems and biodiversity. This section also encompasses a discussion of the advantages and disadvantages of employing AI in such contexts. The ethical norms and precepts that may guide and control the use of AI to ecosystem management and biodiversity conservation are examined in Section 4. Finally, in Section 5, a summation of the paper is provided, along with several suggestions for further study.

SECTION 2: CURRENT STATE OF THE ART: UNDERSTANDING HOW AI IS USED TO ENHANCE NATURAL ECOSYSTEM AND BIODIVERSITY

The research undertaken in the nascent and evolving domain of AI for the purpose of improving or altering natural ecosystems and biodiversity encompasses multiple disciplines, including computer science, environmental science, ethics, and policy. AI is described as the branch of computer science that seeks to build devices or systems capable of learning, thinking, perceiving, making decisions, and solving problems—tasks that would typically require human intellect (Russell and Norvig 2010). The intricate and dynamic relationships that exist between living things and the physical environment that support human survival and well-being, including food, water, recreation, pollination, and climate control, are known as ecosystems (Watson et al. 2019).

The IPBES (Watson et al. 2019) defines biodiversity as the measure of the diversity of life within and between ecosystems, including the diversity of genes, species, and ecosystems. Biodiversity is crucial for ecosystems' ability to adapt and remain resilient to environmental changes such as pollution, invasive species, and climate change (Watson et al. 2019). The realization of the grave and immediate risks that human activities pose to the environment and climate, as well as the need for creative and practical solutions to address these issues, is the driving force behind the use of AI to modify or improve natural ecosystems and biodiversity. According to the IPBES, around a million plant and animal species are under threat of extinction, more so than at any other time in human history. The accelerating rate of global environmental change over the past 50 years has also been unparalleled in human history. The IPBES asserts that unless prompt and substantial measures are implemented, the deterioration of biodiversity and ecosystem services will have profound and adverse consequences for human health, well-being, security, and culture (Brondizio et al. 2019).

Numerous instances exist of the use of AI to modify or improve biodiversity and natural ecosystems, including by leveraging diverse data sources and technologies, including satellite imaging, aerial photography, drone video, camera traps, acoustic sensors, and citizen science, AI systems can be employed to track and evaluate the health and trends of ecosystems and biodiversity (Geary et al. 2016). The employment of computer vision and machine learning methodologies facilitates the identification and enumeration of animal populations, including but not limited to chimpanzees, whales, and elephants. Furthermore, deep learning and natural language processing methods may be employed to recognize and categorize species, including birds, insects, and plants. Furthermore, the use of metrics such as biodiversity, ecosystem services, human well-being, and social justice enables the monitoring and as-

sessment of the effects and results of conservation interventions, including protected areas, restoration projects, and rewilding efforts.

Additionally, employing a range of techniques, including simulation, optimization, and scenario analysis, AI can be utilized to simulate and predict the consequences of environmental changes, such as pollution, land use change, or climate change, on ecosystems and biodiversity (Dietterich 2017). Agent-based models, cellular automata, and artificial neural networks are examples of the techniques through which AI can mimic the dynamics and functions of ecosystems, including the carbon and water cycles, nutrient and energy fluxes, and trophic interactions. Furthermore, employing multi-objective optimization, reinforcement learning, and genetic algorithms, AI can facilitate the optimization of ecosystem management and planning processes, including fertilization, harvesting, and irrigation. Additionally, AI can be employed to utilize game theory, decision theory, or multi-criteria analysis to examine the trade-offs and synergies between several goals, such as equity, development, or conservation.

Furthermore, for a variety of methods, such as synthetic biology, gene editing, or bioengineering, AI may also be used to develop or repair ecosystems that are more robust or adaptable to environmental changes, such as climate change, invading species, or illnesses (Bostrom 2014). AI, for instance, may be used for gene sequencing, gene synthesis, or gene editing techniques like CRISPR-Cas9 to construct artificial creatures or alter already-existing ones, such as plants, animals, or bacteria. Utilizing sensors, actuators, or feedback loops, AI can also be employed to monitor and regulate environmental factors such as temperature, precipitation, or nutrition levels. Furthermore, the integration of AI with computer graphics, virtual reality, or augmented reality holds significant potential for enhancing the aesthetic and recreational value of natural landscapes, such as parks, gardens, and woodlands.

AI has the potential to enhance the productivity and profitability of specific sectors or businesses, including forestry and agriculture. Furthermore, AI can optimise the distribution and allocation of natural resources, such as water, land, and energy (Jensen 2020); and has the potential to uncover and preserve environmental services and biodiversity that are vital to human survival and well-being (Scheffers et al. 2016). However, it is important to note that the integration of AI into ecological systems may disrupt the intricate balance and integrity of these ecosystems, potentially impacting the rights and interests of various stakeholders. Furthermore, the long-term implications of AI's introduction, including the potential for irreversible changes to the continuity of life on Earth, are significant concerns and uncertainties. In the subsequent section, this discussion will be expanded to encompass six arguments from the extant literature, with a view to highlighting some of the ethical considerations that are pertinent to the use of AI in ecosystem management and biodiversity conservation.

SECTION 3: THE ETHICAL IMPLICATIONS OF USING AI TO ENHANCE BIODIVERSITY AND NATURAL ECOSYSTEMS

AI promises to advance our knowledge and ability to manage biodiversity and natural ecosystems, both of which are vital to human well-being and the health of the planet. But the use of AI also raises questions and concerns about its ethical implications that need to be addressed. These include the long-term effects of AI interventions on ecosystems and species, the loss of authenticity and connection with nature, the ethical responsibilities of AI developers and users, the environmental impact of AI systems and data, and equity and justice issues related to data access and ownership. In this section, I will explore these

ethical implications and discuss ways to mitigate or address them.

Environmental impact

The environmental impact of AI is one of the main ethical implications of using these technologies to enhance or alter natural ecosystems and biodiversity. AI interventions can have unexpected effects on ecosystems, upsetting delicate balances and potentially harming species or their habitats (Stahl 2021). Moreover, the use of AI has the potential to negatively impact the ecological diversity and stability of natural systems, for example by modifying or creating artificial species (Bostrom 2014). To modify the natural dynamics and functions of ecosystems, artificial AI could also be used to monitor and manage environmental factors such as temperature, precipitation or nutrient levels (Jensen 2020).

On the other hand, others may argue that the benefits of AI interventions may outweigh any potential harmful effects on the environment. For example, AI could be used to protect and restore ecosystems threatened by human activities such as pollution, deforestation or climate change. AI can also be used to improve the resilience and adaptability of ecosystems to environmental shocks, such as severe weather, invasive species or disease. AI can also be used to identify and conserve the environmental services and biodiversity that are essential to human life and well-being (Scheffers et al. 2016).

As a result, the question of how AI interventions affect the environment is complex and multifaceted, influenced by several variables, including the nature, scale, and goal of the intervention, as well as the context and characteristics of the ecosystem and the values and preferences of stakeholders. In addition, the data and computational resources required to develop and implement AI systems have a direct and indirect impact on the environment. As mentioned above, the training and use of AI systems generate significant amounts of greenhouse gas emissions, as they require enormous amounts of energy and natural resources such as water; and the hardware required has the potential to become electronic waste, all of which can have a negative impact on the climate and the environment (Ligozat et al. 2022).

Therefore, the ethical problem of how AI interventions affect the environment is complicated and multidimensional; and requires a systematic and comprehensive solution. It's crucial to consider the long-term and global consequences of AI interventions on ecosystems and biodiversity, as well as their immediate and local effects. The social and ethical implications of AI interventions, such as the distribution of costs and benefits, the involvement and consent of affected parties, and the preservation and protection of the inherent value and rights of nature, must be considered alongside the technical and scientific aspects (Floridi et al. 2018).

Justice and equity

The issue of justice and equity arises as another ethical consequence of using AI to enhance biodiversity and natural ecosystems. Concerns about equity, accessibility, and the potential exploitation of underprivileged groups or areas may arise over who governs and benefits from AI interventions in ecosystems.

The use of AI has the potential to optimise the distribution and allocation of natural resources such as energy, land and water, which could lead to or exacerbate inequalities and conflicts between different social groups (Bennett et al. 2016). Furthermore, the misuse of AI has the potential to negatively impact the environment and the living standards of nearby populations by increasing the productivity and profitability of certain sectors or companies, such as mining, forestry or agriculture (Lele et al. 2013).

Some might counter that appropriate governance; and regulation can address the issue of equity and

justice in relation to AI interventions in ecosystems, and that this need not always be a bad thing. For example, AI could be used to empower and enable local and indigenous peoples to participate in ecosystem management and decision-making, while upholding their rights, knowledge and values (Brondizio et al. 2019). To ensure accountability and transparency of the parties involved in AI interventions, as suggested by Philip Boucher (2019), AI should also be used to monitor and enforce compliance with environmental laws and standards, such as the Paris Agreement or the Convention on Biological Diversity. And, as suggested by Unesco, the use of AI systems must be subject to impact assessments and human-in-the-loop approaches to ensure that biases and potential unintended consequences are mitigated.

The nature, scale and objective of the intervention, the context and characteristics of the ecosystem, the values and preferences of stakeholders and other factors all play a role in determining the equity and justice of AI interventions in ecosystems. As a result, this is not a clear-cut or simple issue. Furthermore, the question of equity and justice of AI interventions in ecosystems is influenced not only by the direct effects of the intervention, but also by the indirect effects of historical and global factors such as colonialism, imperialism and neoliberalism that have shaped the distribution of wealth and power between nations and regions (Jin et al. 2023).

Therefore, the ethical problem of equity and justice of AI interventions in ecosystems is complicated and multidimensional, requiring a critical and contextual approach. The social and political aspects of AI interventions, such as the recognition and representation of diverse voices and perspectives, the defense and promotion of human rights and dignity, and the avoidance and resolution of conflicts and grievances, should be considered alongside the technical and economic aspects (Floridi et al. 2018).

Long-term repercussions

The question of long-term impacts arises when AI is used to modify or enhance biodiversity and natural ecosystems. As noted above, AI has the potential to permanently alter ecosystems, which could affect how future generations interact with and benefit from the natural environment. AI has the potential to improve the resilience or adaptability of ecosystems to environmental changes, such as the effects of climate change, which could benefit the sustainability and well-being of both current and future generations (Scheffers et al. 2016). However, unethical applications of AI have the potential to damage the inherent value and diversity of natural systems by restoring or creating ecosystems that are more lucrative or attractive to humans (Palmer 2019).

Nonetheless, others would counter that proper monitoring, and assessment could mitigate the problem of AI interventions in ecosystems having long-term harmful effects. For example, using indicators such as biodiversity, ecosystem services, human well-being and social equity, AI could be used to monitor and assess the impacts and consequences of AI interventions in ecosystems (Boucher 2019). According to Floridi et al. (2018), AI has the potential to enable adaptive management and continuous improvement of AI systems and practices by providing feedback and learning mechanisms for AI interventions in ecosystems. On the other hand, this feedback loop between AI systems is inherently risky. Basically, if one AI system relies on another AI system for feedback, this can exacerbate errors or misunderstandings if the models used are not sufficiently validated or diverse. Because ecosystems are so fragile and interdependent, even small errors in intervention can have long-term negative effects on the environment that AI may not be able to fully predict. Therefore, while AI can improve environmental management, an autonomous feedback loop between AI systems could be dangerous unless rigorous human oversight is implemented.

As a result, the question of the long-term effects of AI interventions in ecosystems is not easily answered or clear-cut, but depends on a number of variables, including the nature, scale and goal of the intervention, the context and characteristics of the ecosystem, and the values and preferences of stakeholders. Furthermore, the question of the long-term effects of AI interventions in ecosystems is influenced not only by the direct effects of the intervention, but also by the indirect effects of historical and global factors such as population growth, economic development, technological innovation and cultural shifts that will shape life on Earth in the future (Jin et al. 2023).

As a result, the question of the long-term effects of AI interventions on ecosystems is a complex and multifaceted ethical issue that requires care and forethought. It is crucial to consider the long-term and global consequences of AI interventions on ecosystems and biodiversity, in addition to their immediate and local effects. The ethical and moral implications of AI interventions, such as the accountability and responsibility of actors, the rights and interests of affected parties, and the preservation and respect of the inherent value and rights of nature, must be considered alongside the technical and scientific aspects (Floridi et al. 2018).

Loss of authenticity

The issue of loss of authenticity is another ethical concern in the use of AI to enhance or modify natural ecosystems and biodiversity. The manipulation of ecosystems by AI may reduce the inherent value and authenticity of natural areas, which could affect people's relationship with the environment and cultural heritage. AI has the potential to enhance or create natural landscapes, such as parks, gardens or forests, in terms of their aesthetic or recreational value (Cristian 2024). This could enhance human visitors' enjoyment and appreciation of nature (Gobster et al. 2007). But artificial AI could also be used to improve and inform the development of

man-made features such as buildings, roads or monuments in naturally occurring landscapes, which would diminish the naturalness and distinctiveness of the environment for human visitors (Elliot 2008).

Advanced, autonomous or adaptive designs that respond to changes in the environment or visitor behavior will be made possible by integrating AI into the creation or enhancement of man-made features in natural environments. This raises significant ethical and aesthetic issues, as AI-driven adaptations may integrate more seamlessly or, conversely, provide more intrusive interventions that damage the perceived authenticity of the landscape. Therefore, the unique influence of AI on design and interaction needs to be carefully considered, as it can both incrementally alter and potentially undermine the natural features that make these spaces valuable to human visitors.

Some might argue that appropriate ethical and aesthetic standards can offset the problem of AI interventions in ecosystems losing their authenticity, which is not always a bad thing. For example, AI could be used in conjunction with other technologies to develop or repair ecosystems that preserve the original characteristics and functions of natural systems while remaining compatible with the ecological and historical context (Palmer 2019). To avoid misleading and manipulating human perceptions of nature, AI could also be used to develop or repair ecosystems that are open and truthful about their artificial or modified origins (Floridi et al. 2018).

As a result, the problem of AI interventions affecting the authenticity of ecosystems is not easily or simply resolved, as it involves the nature, scope and goals of the intervention, as well as the context and characteristics of the ecosystem and the values and preferences of stakeholders. Furthermore, the question of whether AI interventions in ecosystems lose their authenticity is influenced not only by the direct effects of the intervention, but also by the

indirect effects of the intervention on human and social factors - such as culture, religion or philosophy - that influence how people interpret and value nature (Jin et al. 2023).

For this reason, the ethical problem of ecosystems losing their authenticity because of AI intervention is complicated and multidimensional, requiring a philosophical and artistic solution. The ethical and artistic aspects of AI interventions should be considered alongside the technical and scientific ones. These include the expression and communication of the values and emotions of AI creators and users, the evaluation and appreciation of the harmony and beauty of natural and artificial systems, and the preservation and protection of the identity and integrity of nature (Floridi et al. 2018).

Ethical responsibility

The issue of ethical responsibility arises when AI is used to alter or enhance biodiversity and the natural environment. The question centres on whether humans have the right to use AI to intervene in natural systems, given our past involvement in extinction events and environmental damage. Some argue that it is morally required for humans to use AI to undo the damage we have done to the environment and to prevent or mitigate future environmental catastrophes (Jamieson 2014). Others argue that it is morally wrong for humans to interfere with or manipulate nature, and that we should instead respect, preserve and maintain the integrity and autonomy of the natural world (Rolston 2012).

Some might counter that there is room for interpretation, and that the question of whether AI interventions in ecosystems are ethically responsible can be resolved by applying the appropriate moral standards. For example, AI, together with human oversight, could be used to implement the precautionary principle, which emphasizes the need for comprehensive risk assessments and ethical reviews, and states that where there is uncertainty and potential harm, caution and careful consideration should be applied before AI interventions in ecosystems are deployed (Boucher 2019). AI, together with human oversight, has the potential to adhere to the principle of beneficence. This concept dictates that interventions in ecosystems, including AI, should prioritize benefits and minimize harms to humans and the environment, considering the values and interests of all stakeholders (Floridi et al. 2018).

Therefore, the question of whether AI interventions in ecosystems are ethically responsible is not clear. Furthermore, the question of the ethical responsibility of AI interventions in ecosystems is influenced not only by the direct effects of the intervention, but also by the indirect effects of the intervention on the moral and legal frameworks - such as environmental laws, ethical codes of conduct and human rights - that regulate the use and development of AI (Jin et al. 2023).

As a result, the moral responsibility of AI interventions in ecosystems is a complicated and multidimensional ethical problem that requires a legal and normative framework. In addition to the technical and scientific aspects of AI interventions, it is crucial to consider the ethical and moral aspects. These include the motivations and justifications of actors, the assessment and validation of impacts and outcomes, and the preservation and protection of both human and natural rights and duties (Floridi et al. 2018).

A thoughtful and nuanced strategy is needed to address the complex and diverse ethical issues of using AI in ecosystem management and biodiversity conservation. The environment and society may face both opportunities and difficulties because of artificial intelligence, and there are no simple or universal solutions to the ethical issues it raises. Developing appropriate and responsible ways to

use AI for the benefit of nature and humanity, as well as exploring the ethical implications of AI in different contexts and scenarios, depends on critical and constructive dialogue between different disciplines, sectors and stakeholders.

SECTION 4: ETHICAL STANDARDS AND PRINCIPLES FOR AI AND ECOSYSTEMS

Given the complexity and diversity of ethical issues and challenges raised using AI to manipulate or enhance natural ecosystems and biodiversity, a thorough and robust framework of ethical principles and guidelines is needed to guide the design, development, deployment and use of AI systems and applications in this area. Such a framework must be based on the recognition and defence of the inherent value and rights of nature, as well as the respect and defence of human dignity and rights. It should also seek to promote the common good and sustainable growth of both humanity and the environment, while ensuring the accountability, transparency, fairness and accountability of AI systems and applications.

The precautionary principle is one of the ethical principles that could guide the use of AI in environmental management and biodiversity protection. The precautionary principle highlights the need for extensive risk assessment and ethical evaluation and emphasizes that caution and careful consideration should be used when deploying AI solutions in ecosystems in situations of ambiguity and potential harm (Boucher 2019). The precautionary principle seeks to protect the rights and interests of both humans and nature, while preventing or reducing the harmful effects of AI interventions on ecosystems and biodiversity (Floridi et al. 2018).

However, the precautionary principle is not without its difficulties and critics, and it may have some limitations. Below are some potential refutations of

the precautionary principle for AI interventions in ecosystems: Innovation and progress may be hampered by the precautionary principle. By highlighting the potential dangers and negative impacts of AI interventions, the precautionary principle could impede or delay the development and implementation of AI solutions that could offer significant environmental and societal benefits and opportunities (Sunstein 2009). Additionally, the precautionary principle could impose unjustified or burdensome regulatory constraints and hurdles on AI researchers and organizations, hindering their ability to innovate and compete (see Portuese & Pillot 2018).

The precautionary principle may be ambiguous and personal. The precautionary principle does not provide precise or objective criteria for identifying or quantifying the degree of uncertainty and danger associated with AI interventions, nor does it specify the appropriate degree of care and caution. The views and preferences of different stakeholders may also influence the precautionary principle, leading to disputes or inconsistent implementation and interpretation of the concept (Sunstein 2007).

It is possible that the precautionary principle is unfair and biased. Precautionary principles can work against change and new opportunities in favor of the status quo and current interests. The opportunity costs and trade-offs of not pursuing AI solutions, as well as the potential dangers and negative effects of pursuing other interventions, may also be disregarded or overlooked by the precautionary principle. The precautionary principle may potentially fail to consider or compromise the agency and autonomy of affected parties and actors in AI interventions, including ecosystem managers, local and indigenous groups, and AI developers (Sandin 1999).

As a result, the precautionary principle of AI interventions in ecosystems is a complex idea that requires a thoughtful, nuanced approach. It is crucial to consider both the potential benefits and advantages of AI interventions, as well as any potential hazards

or negative impacts. It's crucial to consider the evidence and understanding of AI treatments alongside the ambiguities and harms. It's crucial to consider not only the care and caution, but also the progress and creativity of AI interventions (Floridi et al. 2018).

Several organizations and initiatives have proposed or adopted ethical principles and guidelines for AI in general, or for specific AI domains or applications. Examples include the Unesco Recommendation on the Ethics of Artificial Intelligence, the IEEE Ethically Aligned Design, the European Commission Ethics Guidelines for Trustworthy AI, the OECD Principles on AI, the Asilomar AI Principles, the Dubai AI Principles, and the Montreal Declaration for the Responsible Development of AI. These principles and norms share a common set of values and goals, including human rights, human dignity, human oversight, justice, accountability, openness and privacy, as well as impact on society and the environment. I will go on to provide an ethical framework to guide the use of AI to enhance natural ecosystems and biodiversity, based on the criteria proposed by Unesco.

A broad ethical framework is needed to guide the development and use of AI to enhance natural ecosystems and biodiversity. The resulting framework incorporates important ethical factors such as justice, accountability, transparency, accountability, the inherent value and rights of nature, respect for human rights and dignity, and the common good and sustainable development. I propose to navigate the ethical implications of using AI to enhance natural ecosystems by using the "Ecosystem-Centric AI Ethical Framework". The four principles recommended by Unesco serve as the basis for this framework.

They are first and foremost, AI systems must be developed and used in a way that respects the fundamental rights and dignity of all people affected by their use. This includes ensuring that the rights of disadvantaged or marginalized groups are not violated or disproportionately harmed by AI applications. For example, AI systems must not be used

to oppress, discriminate against, or take advantage of individuals based on their gender, skin color, ethnicity, religion, or any other identity or status (Rawls 1971). Individuals' privacy and autonomy should be respected by AI systems, which should also protect users from harmful or illegal frameworks for data processing, sharing and collection.

Second, AI technology must recognize and respect the inherent value of all living things, including ecosystems and other habitats. To minimize ecological damage and promote the protection of biodiversity, this means upholding the rights of nature, including the right to exist, thrive and develop, and incorporating these ideas into decision-making processes. For example, AI systems must not be used in ways that endanger, degrade or disturb species, natural habitats or natural resources (Leopold 1986). AI systems should respect the needs and interests of non-human creatures and plants and contribute to the enhancement and restoration of ecosystems.

Third, the common good and sustainable development: AI solutions should prioritize the long-term well-being of current and future generations and support sustainable development goals. AI algorithms and applications need to be optimized to combat climate change, promote equitable access to natural resources and increase ecological resilience. For example, AI systems need to be used to model, monitor and manage environmental problems such as pollution, deforestation and water scarcity (United Nations 2015). In addition, AI systems must help facilitate the transition to renewable energy sources and promote the wise and equitable use of environmental resources.

Finally, fairness, openness, accountability and explainability: These four guiding principles must be followed in the design and implementation of AI systems. This requires ensuring the objectivity and fairness of AI algorithms, disclosing the data sources and decision-making processes that underpin

AI-driven interventions, establishing procedures for accountability and redress in the event of harm, and providing stakeholders with clear explanations of AI-generated outcomes. According to Jobin et al. (2019), AI systems should not generate or perpetuate unfair or biased outcomes, such as marginalizing or undervaluing certain groups or people. To enable stakeholders to understand and challenge the data, processes and assumptions used by AI systems, they should also be visible and auditable.

Furthermore, AI systems need to be accountable and responsible, which means that they should comply with all applicable rules, laws and moral principles, and be subject to scrutiny and evaluation. Furthermore, explainable and understandable AI systems are those that express their limitations and uncertainties, as well as relevant and understandable information about their inputs, outputs and processes.

Some may argue that putting this theory into practice will stifle economic expansion and technological progress by placing onerous restrictions and moral concerns on the development of AI. Fostering innovation and economic growth is important, but it shouldn't come at the expense of social fairness, environmental integrity or human rights. By incorporating ethical concepts into the development of AI, we can design technology that not only promotes creativity, but also social justice, environmental sustainability and responsible governance.

In addition, respecting moral principles can increase public trust in AI systems, leading to their wider use and acceptance. Moreover, as AI systems can be used to solve social and environmental problems and create value for people and nature, putting this theory into practice can potentially open new avenues for innovation and development.

CONCLUSION

This paper has presented some ethical implications of using AI to enhance biodiversity and natural ecosystems. As argued, using AI to manage ecosystems and conserve biodiversity is a complicated ethical issue that requires a nuanced and thoughtful approach. As noted above, AI should only be used in situations where the benefits outweigh the risks, the trade-offs and uncertainties are clear and acceptable, and stakeholders are informed and actively involved in the decision-making process. In addition, AI systems should be evaluated and monitored, and procedures should be in place to hold parties accountable and seek redress when adverse outcomes occur. To develop appropriate and responsible ways to use AI for the benefit of nature and humanity, different disciplines, sectors and stakeholders need to engage in critical and constructive dialogue.

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