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Review

Rising significance of plant ethics: A perspective with focus on Saudi Arabia's green initiative

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Abstract: The burgeoning field of plant ethics is gaining attention as scientists, ethicists and policymakers address the complex relationships between humans and plants. Traditionally, ethical considerations in environmental contexts have focused on animals and ecosystems, often overlooking the intrinsic value and moral consideration owed to plants. This article explores the necessity of plant ethics, its importance and how some countries integrate ethical practices into their treatment of plants, with a special emphasis on Saudi Arabia's Vision 2030 and the Green Initiative. By recognising the intrinsic value of plants and incorporating ethical considerations into conservation efforts, we can promote ecological balance and sustainability. This study provides a comprehensive overview of plant ethics, its theoretical framework, and its practical implications, offering insights into global practices and Saudi Arabia's ambitious green projects.

Keywords: plant ethics, plant legislation, plant policies, Vission 2030, ethical approval

INTRODUCTION

The burgeoning field of plant ethics has garnered significant attention recently as scholars, ethicists and policymakers grapple with the intricate relationships between humans and plants. Traditionally, ethical considerations in environmental contexts have primarily centred on animals and ecosystems, often marginalising the intrinsic value and moral considerations owed to plants because plants lack autonomy. There is a growing body of evidence in the field of plant sciences that acknowledges the ability of plants to perceive, evaluate and respond to their surroundings. This ability primarily serves to create favourable conditions for their own growth. Considering these plant-centric objectives, it is inappropriate to view plants solely as tools. In the current era of

environmental challenges, understanding plant intelligence and self-governance sparks a new discussion on honouring and supporting the well-being of plants that sustain life on Earth [1].

However, amidst escalating ecological crises and an increasingly evident interconnectedness of all life forms, there is a growing recognition of the imperative to incorporate plants within ethical frameworks. Comprehending plant ethics is pivotal for fostering ecological equilibrium and sustainability. This discipline advocates the intrinsic value of plants, positing that they warrant ethical consideration not solely for their instrumental utility to humans but also for their inherent worth. This outlook is firmly rooted in biocentric and ecocentric ethics, which underscore the interconnectedness and equal importance of all living organisms within the ecosystems [2, 3]. By integrating plant ethics into conservation endeavours, a more holistic approach to environmental stewardship can be cultivated, one that bolsters biodiversity and ecological well-being [4].

DISCUSSION

Theoretical Framework of Plant Ethics

Plant ethics, a developing and significant area of study, aims to broaden ethical considerations to include plants. It critically questions human-centred and animal-centred ethical perspectives by proposing that plants, as living entities, have inherent worth and should be ethically respected. This viewpoint is based on biocentric and ecocentric ethics, emphasising the value of all living organisms and their ecological interconnectedness [3].

Throughout history, plants have often been seen as mere tools for humans without any inherent worth. This viewpoint, deeply ingrained in the philosophies of Aristotle and Descartes, proposed a hierarchy of living things that placed plants at the bottom [5]. However, the advent of modern ethical theories, influenced by the enlightened thoughts of Peter Singer, Aldo Leopold and more recently Michael Marder, has heralded a new era. They argue that plants, as vital parts of ecosystems, deserve ethical consideration not only for their usefulness to humans but also for their own sake [6, 7], offering a beacon of hope for a more balanced and just world.

Critical Concepts in Plant Ethics

- **Intrinsic Value**: This concept refers to the belief that plants possess value independently of their usefulness to humans.
- **Moral Considerability**: This crucial concept asserts that plants, as living entities, demand ethical consideration, with emphasis on the urgency of this discussion [8].
- **Interconnectedness**: This involves recognising the intricate ecological connections that link all living organisms and emphasising the importance of plants in maintaining the ecosystems [2].

Importance of Plant Ethics

Plants are fundamental to life on Earth, forming the base of food chains, producing oxygen and sequestering carbon dioxide. Additionally, they aid in preserving biodiversity, stabilising ecosystems, and providing essential resources for human health as medicinal products (Figure 1). It is ethically essential to value plants for more than just their usefulness to humans. Conserving plant life is necessary to maintain ecological balance and ensure a healthy planet for future generations. Considering the ethical implications of plants underscores their ecological importance and promotes critical conservation efforts to maintain biodiversity and ecological balance [9]. Plants hold

significant cultural, spiritual and aesthetic importance. Many cultures cherish specific plants, integrating them into their spiritual practices, art and daily lives. Acknowledging these values through plant ethics fosters respect and protection for culturally significant flora [10]. It is crucial to integrate plant ethics into environmental policies to ensure that conservation efforts are comprehensive. This approach, by encouraging sustainable practices, plays a pivotal role in safeguarding the well-being of all ecological elements including animal welfare, ecosystem health and the plants themselves [11].

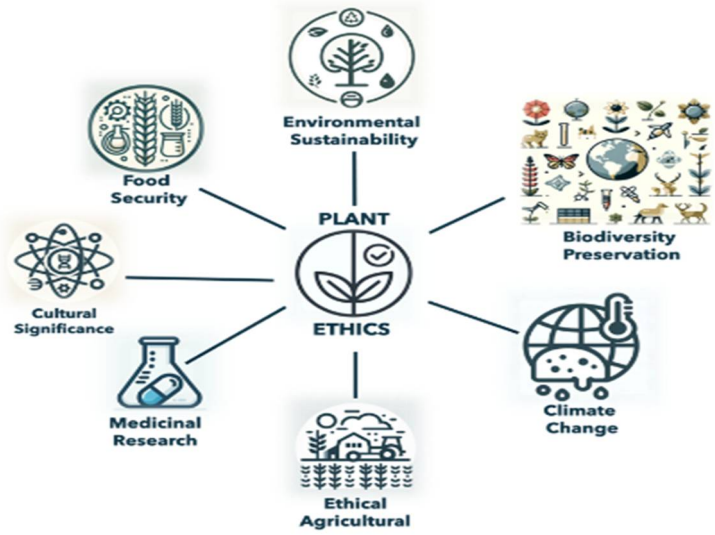

Figure 1. Interconnected overview of plant life in various aspects of anthropocentric and ecocentric value systems

Global Perspectives on Plant Ethic

Switzerland

Switzerland is at the forefront of plant ethics, with the Swiss Federal Constitution containing a provision that acknowledges the dignity of all living beings including plants. As a result, Switzerland has implemented policies aimed at safeguarding plant biodiversity and encouraging sustainable agricultural methods (Table 1) [12]. The Swiss Federal Ethics Committee on Non-human Biotechnology sparks considerable interest in the plant science community with their publication titled "The dignity of living beings with regard to plants: Moral consideration of plants for their own sake" [12] The committee, tasked with interpreting a law aimed at safeguarding 'the dignity of living beings,' employ a biocentric ethical framework as the philosophical foundation of their inquiry [1].

Germany

Germany's Federal Nature Conservation Act incorporates principles that protect plant species and their habitats. Ethical considerations guide conservation strategies, emphasising the preservation of native plant species and their ecological roles (Table 1) [13].

India

The people of India hold a profound cultural and religious respect for plants, reflected in their societal values. Sacred groves, which are forest areas set aside for deities, illustrate how the

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ethical treatment of plants is woven into cultural traditions. These groves are essential for preserving biodiversity (Table 1) [14].

Table 1. Comparative analysis of ethical legislation and practical implications for plant conservation in Switzerland, Germany and India [13, 15]

Country	Key legislation	Ethical principle	Practical Implication
Switzerland	1. Swiss Genetic Engineering Act 2. Federal Act on Protection of Nature and Cultural Heritage	- Dignity of living beings including plants - Intrinsic value and ecological significance of plants	- Strict regulations on GMOs to respect plant dignity - Encouragement of organic farming and biodiversity conservation - Ethical reviews for plant research projects
Germany	Federal Nature Conservation Act	- Biodiversity conservation - Habitat protection - Sustainable use - Public participation - Intrinsic value of plants - Ecosystem integrity - Precautionary principle	- Protection of endangered plant species - Habitat restoration projects - Sustainable forestry practices - Urban green space conservation
India	Cultural and religious reverence for plants sacred groves (no specific legislative act mentioned but traditional practices)	- Cultural and spiritual value of plants - Biodiversity conservation - Intrinsic value of sacred groves	- Traditional protection of sacred groves - Preservation of floral and faunal diversity - Maintenance of ecological functions such as hydrological cycles and soil erosion prevention

Saudi Arabia's vision for forestation and green initiative

The Vision 2030 initiative in Saudi Arabia is a bold strategy designed to diversify the economy and reduce its dependence on oil. One of the main focuses of this plan is environmental sustainability including initiatives such as large-scale tree planting and the establishment of sustainable green areas [16]. The Saudi Green Initiative (SGI) is a comprehensive strategy that aims to combat climate change, reduce carbon emissions and enhance environmental sustainability. It includes plans to plant 10 billion trees within Saudi Arabia and contribute to planting 40 billion trees across the Middle East [17].

Objectives and goals of SGI

- **Carbon Sequestration**: The initiative aims to capture large quantities of carbon dioxide by planting billions of trees, thereby helping to combat climate change [18].
- **Biodiversity Enhancement**: The initiative concentrates on rejuvenating damaged ecosystems, fostering biodiversity and safeguarding threatened plant species [19].

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- **Water Conservation**: It focuses on sustainable water usage by employing advanced irrigation methods and choosing plants that can thrive in arid conditions [17].

Plant ethics in SGI

The SGI strongly supports the preservation of plants. It acknowledges their inherent value and advocates their preservation, not just for their environmental advantages but also for their fundamental worth. This perspective, aligned with the principles of plant ethics, guarantees that plants are safeguarded and appreciated for more than just their usefulness to humans [20]. The initiative's focus on ecological rehabilitation highlights the moral dedication to reviving original habitats and preserving plant varieties. Through prioritising indigenous species and establishing green pathways, the SGI seeks to re-establish ecological balance and enhance biodiversity [17, 19]. The cultural heritage of Saudi Arabia encompasses a strong tradition of appreciating and using indigenous plants. The SGI incorporates this cultural admiration into its initiatives by advocating the use of native flora in reforestation activities and acknowledging the cultural significance of plants [21].

CASE STUDIES

AlUla's Sharaan Nature Reserve

AlUla region is an ancient Arabic oasis city located in Medina province, north-west of Saudi Arabia. In April 2018 Saudi Arabia and France agreed to develop the AlUla region, which features prominently in the history of Islam as well as several pre-Islamic Semitic civilisations, with the goal of turning it into a cultural hub for the country. The focus was on creating a sustainable development model that respects the environment, history and local communities. The project involved using advanced techniques to promote sustainability such as cultivating native plants instead of water-consuming exotic species. Extensive field missions were conducted to identify suitable native species that can thrive in the region's natural conditions while minimising water usage [22]. The Sharaan Nature Reserve in AlUla exemplifies Saudi Arabia's commitment to incorporating plant ethics into its conservation initiative. The reserve's primary goal is to safeguard indigenous plant species and rehabilitate natural environments, highlighting the importance of plants and their ecological functions. The Reserve aims to undertake large-scale habitat restoration in order to rejuvenate the desert ecosystem, promote biodiversity and support ecotourism. This involves ceasing overgrazing by domestic animals, implementing strict bans on hunting and tree cutting, and reintroducing indigenous species to their natural habitats. Various restoration methods will be employed to revive the landscape and revert the desert environment to its original condition. The implementation of boundary fencing will prevent damage caused by camels and other livestock, promoting the recovery of native vegetation that can sustain reintroduced native species. The Reserve will place particular emphasis on protecting and restoring the local flora including various Poaceae species, e.g. *Haloxylon salicornicum* and *Retama raetam* and rare species such as *Pulicaria incisa* [23].

Urban Greening in Riyadh

Riyadh is the capital and largest city of Saudi Arabia. It covers an area of about 2,000 km^2 and is home to around eight million people. The city is situated on the Najd desert plateau in the middle of the country. Riyadh experiences a very harsh climate, with extremely hot summers and very cold winters. The urban greening initiative in Riyadh is designed to expand the city's green areas, enhance

air quality, and offer visual and leisure advantages. This will be achieved by utilising approximately 72 indigenous shade plant species that thrive in Riyadh's climate.

The key components enabling this project include the establishment of a new water treatment network capable of daily irrigating 1,000,000 m^3 of water, the development of a network of plant nurseries to supply necessary seedlings and trees, and the enhancement of urban regulations to promote afforestation in public and private projects. Furthermore, initiatives will be introduced to raise awareness and encourage voluntary participation. Moreover, the project will help in reducing ambient temperatures by 2 degrees Celsius during the summer season or by 8-15 degrees Celsius in specific densely afforested areas within the city, improving air quality by reducing CO_2 concentration by 3-6%, decreasing dust concentration in the air, and reducing annual power consumption by 650 gigawatt/hr by promoting the use of green building techniques.

Additionally, the project seeks to enhance the city's readiness to handle rainwater, reduce flood hazards, improve Riyadh's urban landscape, encourage citizens to adopt healthier lifestyles, preserve natural areas, enhance biological diversity, and ultimately improve Riyadh's overall quality of life. This initiative also aligns with the goals of the Saudi Vision 2030, aiming to achieve environmental sustainability, build a dynamic community, and enhance economic efficiency across various city sectors. Furthermore, it contributes to the National Transformation Program goals by increasing green spaces, reducing water wastage, improving flood drainage network efficiency, and maximising the utilisation of treated wastewater. These endeavours demonstrate a dedication to plant welfare by acknowledging the significance of plants in urban settings and advocating their health and growth [17]. An example of the most important suitable native plants for planting in urban areas is provided by The Ministry of Environment, Water and Agriculture through its website [18].

CHALLENGES AND FUTURE DIRECTIONS

Water scarcity, a significant challenge in Saudi Arabia’s forestation efforts, can be overcome by implementing innovative irrigation techniques and using drought-resistant plants. These solutions, endorsed by the Ministry of Environment, Water and Agriculture Saudi Arabia, not only address the current challenge but also hold the promise of ensuring the sustainability of green initiative [19]. It is crucial to raise public awareness about the significance of plant ethics and the contribution of plants to environmental sustainability. Engaging the community and implementing educational initiative can help people better understand and respect plants, which in turn encourages ethical treatment and conservation endeavours. Doing so can create a more sustainable and harmonious environment for all [24]. It is vital to reinforce the role of policies and laws in protecting plant species and their environments. Integrating plant ethics into environmental regulations can establish a robust foundation for sustainable conservation efforts, highlighting the significant impact of legal measures on conservation [25]. Table 2 provides a comprehensive overview of global and local laws and ethical principles that can be used as a foundation for legalising and regulating plant treatment and handling.

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Table 2. Overview of international and national legislation, ethical guidelines for plant nomenclature, and specimen handling practices

Category	Details
International Legislation	
Convention on Biological Diversity [26]	- Promotes conservation of ecosystems, species and genetic diversity - Ensures that the use of biological resources is sustainable - Facilitates fair and equitable sharing of benefits arising from genetic resources
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [27]	- Regulates international trade in specimens of wild animals and plants to ensure that it does not threaten their survival - Lists species that are threatened with extinction and regulates their trade through permits and quotas - Encourages cooperation among member countries to ensure compliance and enforcement
National Legislation	
Endangered Species Act – USA [28]	- Protects critically endangered species from extinction - Identifies and lists endangered and threatened species - Designates critical habitats necessary for the conservation of listed species - Develops and implements recovery plans
Nature Conservation Act – Australia [29]	- Provides for the conservation of nature, including plants, animals, and ecosystems - Protects native plant species and their habitats - Regulates the collection, trade, and use of native plants - Promotes biodiversity conservation through management plans and protected areas
Ethics in Plant Nomenclature and Specimen Handling	
Ethical Guidelines for Plant Nomenclature [30]	- International code of nomenclature for algae, fungi and plants sets out rules and recommendations for naming plants, algae and fungi. - Names must be unique and universally accepted. - New species names must be published with a clear description and designation of a type specimen. - Priority is given to the earliest published names (principle of priority). - Avoid naming species in ways that might be offensive or misleading. - Ensure that naming process respects indigenous knowledge and cultural heritage associated with plant species.

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Table 2. (Continued)

Ethical Handling of Plant Specimens [31, 32]	- Obtain proper permits and permissions before collecting plant specimens. - Ensure that collection does not harm the population or ecosystem from which specimens are taken. - Properly document all collected specimens including location, date and habitat information. - Store specimens in well-maintained herbaria or botanical gardens, ensuring their preservation for future research. - Use non-destructive methods whenever possible to study plants. - Share data and specimens with broader scientific community to promote collaboration and conservation efforts.
Example	- The Global Strategy for Plant Conservation outlines objectives and targets for plant conservation, including ethical collection and documentation of plant specimens [31, 32].

CONCLUSIONS

Recognising the importance of plant ethics is crucial in addressing the environmental challenges of the 21st century. By acknowledging the inherent value of plants and integrating ethical aspects into conservation efforts, we can support ecological balance and long-term sustainability. This approach not only ensures the preservation of plant biodiversity but also contributes to the health and well-being of other species including humans. Nations such as Switzerland, Germany and India offer valuable models for integrating plant ethics into policies and cultural norms. Saudi Arabia's ambitious Green Initiative illustrates a dedication to these principles, intending to transform the landscape and advance environmental sustainability through ethical plant treatment, which is briefly cited in Law of Ethics of Research on Living Things under Royal Decree no. M/59 on 24th August 2010, article 39: "Plants may not be used in research that upsets environmental balance and distribution of vegetation. Endangered plant species may not be subject to negative use. Moving forward, broadening the scope of ethical considerations to encompass all living beings is essential, ensuring a comprehensive and sustainable approach to environmental stewardship. Finally, each country needs to develop its own plant ethics regulations or adopt an international standard to preserve plant communities and approach a sustainable environment. These ethical guidelines should be followed when handling and conducting research on plants.

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