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Research Article

Sustainable Development and Combating Soil Pollution in the Kingdom of Saudi Arabia (A Foundational Legal Study)

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Abstract: This study explored Saudi Arabia's legal frameworks governing soil conservation and sustainable development. A qualitative legal analysis was conducted to assess the effectiveness of these legislative provisions and the challenges hindering their practical implementation. The research identified key legislative instruments, notably the Executive Regulations for Preventing and Curing Contamination of the Soil, which outline essential provisions and implementation requirements. The analysis indicated that Saudi legislative frameworks align with international standards regarding both general and site-specific environmental concerns. However, discrepancies were observed between legislative provisions and actual practice, particularly in terms of supervision and enforcement. Interventions to increase awareness of legal penalties is recommended, improving transparency in pollution-related information, and developing institutional coordination and collaborations. The study suggested that continuous legal review. Also, participatory approaches may improve the effectiveness of soil conservation efforts. It contributes to environmental legislation by an initial examination of Saudi Arabia's legal framework to conserve soil and its broader roles in sustainable development.

Keywords: Environmental Legislation, Regulatory Compliance, Conservation Policy, Legal Enforcement, Ecological Governance, Soil Protection, Saudi Law

1. Introduction

Soil contamination can cause permanent consequences for ecological activities, community well-being, and economic stabilities. Soil integrity is essential for agricultural productivity, biodiversity conservation, and groundwater preservation, such as in Saudi Arabia's arid environment [1] A quick environmental degradation, due to industrial expansion, urbanisation, and agricultural activities, necessitates urgent intervention by stringent legislative measures and effective control [2] The environmental policies and regulatory mechanisms can be enhanced by sustainable development aims informing the comprehensive using a legal frameworks to deal with soil pollution [3].

Current studies test the urbanisation effects, chemical fertilisers, and industrial effluents on soil quality; yet, the legal aspects of soil conservation, particularly in relation to pollution sources and alternative regulatory approaches, are still not explored. How effectiveness is the Saudi government legislation differs across regions, with a notable lack of in-depth research on conservation laws to protect soil. A thorough analysis of legal frameworks and their effectiveness is important [4]. The international conventions on soil protection at the national legislative level ensures effective environmental governance [5].

Weak enforcement mechanisms and inadequate monitoring undermines the soil conservation legislation effectiveness in Saudi Arabia is undermined which contributes to gaps in public awareness. No enough research on legal instruments overcome sustainability-related challenges, which making necessary to address these gaps for developing effective national policies. Growing environmental concerns have intensified the focus on soil conservation, with both national and international entities recognising stronger regulatory measures. Although pollution examinations are often show causes and solutions, very few study the conservation laws and regulatory developments [6]. Soil pollution shows crucial threats to food security, climate stability, and water resources which necessitate comprehensive policy interventions [7]. Saudi Arabia's Vision 2030 uses economic growth with environmental sustainability, and government investment in environmental studies and policy reforms show a commitment to foster sustainable activities [8].

This work examines and evaluates Saudi Arabia's legal framework for the protection of environment, with a focus on the national conservation of soil resources. One of the main features of this analysis is a comprehensive review and critical evaluation to existing legislative provisions which identify gaps and recommendations for legal reforms. Ssituating Saudi environmental policies in a broader legal context makes this research contribute to a deeper understanding of environmental governance in Saudi Arabia, in relation to Vision 2030 and its sustainable development aims. The country's legal frameworks to soil conservation, a model for sustainable growth, have significant implications for policymakers, academics, and stakeholders in environment and development.

Saudi Arabia's environmental regulations deal with industrialisation, resource depletion, and climate change and the Saudi government and the National Centre for Environmental Compliance oversee pollution controls and management of resource [9]. Yet, enforcement challenges and regulatory delays can cause concerns about their general effectiveness. Comprehensively reviewing Saudi Arabia's legislative framework win its broader environmental context is valuable into efforts for the mitigation soil pollution and promotion of sustainability [10]. An in-depth analysis of the country's environmental laws, related to soil conservation, critically assess existing legislation, identifying weaknesses, and recommendations for improving regulatory effectiveness. A thorough examination of relevant legal provisions in this study contributes to governance and sustainability by developing more robust environmental policies [11].

This study assesses whether Saudi Arabia's legal frameworks establish suitable standards for soil contamination incorporating effective monitoring mechanisms and enforcing penalties for violations. Also, according to the international standards and main principles of

sustainable development, this analysis evaluates the extent to which these frameworks agree with the recognised benchmarks. The study is a comprehensive review of Saudi government regulations [12], the Agricultural Law [13], and other relevant legislative instruments in a broader legal context. This research is important in the legal analysis of interventions aimed at soil conservation in Saudi Arabia, in relation to sustainable development. Although the previous studies have largely studied the sources and effect of soil contamination, a critical gap in research is still existing which assesses the effectiveness of legal interventions designed for the prevention and mitigation of degradation. Addressing this shortcoming contributes to the developing robust legal frameworks to conserve and protect soil and, while supporting improving management [14].

1.1. Problem Statement

Soil pollution in Saudi Arabia is a threat only to the stability of its ecosystem and public welfare and broader sustainable development efforts. Quick development, urbanisation, and agricultural expansion contribute soil contamination and degradation. Based on a report prepared for the National Centre for Environmental Compliance, more than 30% of surveyed locations has petroleum hydrocarbons and heavy metal concentrations more than the permissible limits. These show the need for effective legislative interventions and policies for mitigating soil pollution and promoting the sustainable use of land for development [15].

Despite the Saudi Arabia's commitment to environmental conservation and the sustainability objectives in Vision 2030, a comprehensive assessment of the effectiveness of current interventions to address soil pollution. There is a big gap exists in research on the apparent contradiction between determined development aims and the actual effectiveness of legislative frameworks to safeguarding soil integrity. Therefore, a critical analysis of both the effectiveness and comprehensiveness of Saudi Arabia's current legal provisions for soil conservation is essential [16].

The consequences of widespread resource scarcity extend beyond environmental concerns, and this has been seen to significantly affect food security, water access, and public health. Contaminated cultivable land may make toxic chemicals into the food with serious health risks and reducing agricultural productivity. Also, the infiltration of hazardous substances into groundwater exacerbates Saudi Arabia's already critical challenge of managing its limited water resources in an arid environment. So, addressing soil pollution is essential to develop objectives related to eradicating hunger, ensuring safe drinking water, and promoting public health [17].

Wheen there is no strong protective legislation, developing programmes risk accelerates land degradation. To reduce this, Saudi Arabia needs the integration of conservation efforts into its broader development agenda. Institutional frameworks are crucial in safeguarding natural resources and sustainable development approaches. So, this study follows the research question: To what extent can Saudi Arabia's current legislative interventions effectively combat soil contamination and support environmentally sustainable development in alignment with Vision 2030?

1.2 Study Significance

This study is theoretically and practically significant to both the Saudi government and sustainable development in the Saudi context. Theoretically, it offers a deeper understanding of the legal frameworks governing soil pollution, evaluating the extent to which these regulations confirm sustainability principles with international legal standards. Also, it is a critical shift in focus; rather identifying the root causes of pollution, it inspects the effectiveness of legal interventions designed to mitigate its impact.

The integration of sustainability principles with legal analysis fosters interdisciplinary discourse in environmental governance, policy development, and agricultural and land-use management. Moreover, a comparative analysis in this work provides a robust foundation for governance improvements by systematic identification of the strengths and weaknesses in legislation. It gives critical visions that can notify necessary legal reforms, improvement of the effectiveness of regulatory frameworks for soil conservation. Also, comparative analysis objectively assesses Saudi Arabia's legal approach to soil conservation on international best practices. Eeffective models are adapted and implemented to improve soil protection efforts. From a practical perspective, the study offers valuable insights for policymakers, legal practitioners, and environmental authorities by recommendations to strengthen legal frameworks for combating soil pollution in Saudi Arabia.

1.3 Objectives

1. Identifying the sustainable development and its objectives.
2. Determining the sustainable development aims related to soil protection.
3. Explaining the requirements and features of sustainable development.
4. Highlighting key provisions of Saudi Government for protecting soil.
5. Outline key executive orders for preventing and controlling soil pollution.
6. Outlining key documents of the study.

2. Methodology

This legal analysis of Saudi Arabia's sustainable development and soil pollution prevention used a qualitative approach in legal methodologies. The study started with critical review of the literature on both Saudi and international legal frameworks on sustainable development, soil pollution, and environmental law- an inspection of relevant international conventions and agreements. This research compares in-depth legislative documents and other legal tools to measure their effectiveness, strengths, and limitations informing recommendations to enhance legal provisions. Moreover, interviews and case studies support the study with deeper insights into the practical implementation and effectiveness of current legislative interventions.

Finally, the work examines the broader implications and results of the current legal measures for recommendations to strengthen legislation promoting sustainable development and improve compliance with legal requirements for soil pollution control and prevention in Saudi Arabia. The findings were academic publications, scholarly engagement, and documentation in policymaking.

3. Results

3.1 Sustainable Development Goals in Terms of (Definition, Objectives, Characteristics, Requirements, and a Statement of their Relationship to Soil Protection)

The Right to Development was formally incorporated into the United Nations Commission on Human Rights when, on 21 February 1977, it issued Resolution No. 4(339) which recommend the Secretary-General of the United Nations, with UNESCO and specialised agencies study the international dimensions of the right to develop a human right. By 1979, the Commission had integrated the Right to Development win the broader framework of human rights. Also, Resolution No. 41/128 on 4 December 1986 of the United Nations General Assembly issued the Declaration on the Right to Development, recognising it as a fundamental human right. The declaration is "The right to development is an inalienable human right" recognised in many international agreements and regional legal instruments as an indivisible human right [18]. It is also in the International Covenant on Civil and Political Rights and most regional human rights treaties- European Union, like the Treaty Establishing the European Community (1997) [19].

The right to development has evolved over time, particularly with the establishment of sustainable development goals in 2016. Various definitions of sustainable development have been proposed, including one from a 1987 report by the World Commission on Environment and Development, which describes it as development that meets present needs without compromising the ability of future generations to meet their own. This perspective emphasises balancing economic growth with long-term environmental and social sustainability. Sustainable development is also understood as a comprehensive transformation that integrates economic, political, and social dimensions while prioritising human development as both a means and an objective [20]. Another view highlights the importance of conserving and maintaining environmental resources to support current social and economic needs, using the best available technology to ensure their long-term viability [21; 22].

These points include the sustainable development- resource conservation, present and future needs fulfilment, technological developments in resource management, and intergenerational equity. It is as a framework to preserving natural resources to serve both current and future populations. On the environmental protection, sustainable development underpins the main environmental legal- the polluter-pays principle, environmental effect assessment, shared international responsibility, and public participation. As a legally binding, it is reinforced by more regulations governing environmental protection [23] incorporating essential principles, the development reconciliation with environmental conservation and the need to ensure fairness across generations. Moreover, they include precautionary measure and

recognise the shared humanity responsibility to address environmental challenges.

The Sustainable Development Goals (SDGs) constitute a global framework aimed at fostering a more stable, secure, and productive future for both present and future generations. The 17 SDGs address key global challenges, including poverty eradication, social and environmental equity, the transition to a low-carbon economy, and the promotion of global prosperity, with a target for achievement by 2030. These goals encompass a broad range of sectors, including eliminating poverty and hunger, ensuring access to quality healthcare and education, achieving gender equality, and securing safe water, sanitation, and energy. Additionally, they advocate for sustainable economic growth, resilient infrastructure, reduced inequalities, and urban development strategies that support long-term environmental and social well-being.

3.2 Characteristics of Sustainable Development

Sustainable development shifts towards a development model simultaneously enhancing living standards while preserving resources for the next generations. It is systemic and continuous integrating social and economic progress with environmentally responsible practices. It permanently optimises the conservation of natural resources in a manner meeting present needs—such as nutrition, healthcare, education, and essential services—safeguarding biodiversity. Environmental conservation is still the main primary concern in protecting water, air, and land resources, and establishing regulatory frameworks to mitigate pollution. Maintaining intergenerational equity and ecological balance by the reasonable use of resources is fundamental to sustainable development. After the environmental protection, sustainable development give priority to poverty eradication by fair access to essential resources. Also, it acknowledges cultural and spiritual heritage which promotes development respecting diverse traditions and customs.

Given its inherently transboundary nature, international cooperation is essential, with developed nations bearing a responsibility to assist developing countries in achieving sustainability goals. Institutional frameworks play a crucial role in enforcing environmental legislation and ensuring adherence to sustainability principles. By fostering a culture of environmental stewardship, sustainable development enhances community capacity for environmental protection at a local level. Achieving sustainability requires a commitment to the responsible utilisation of both renewable and non-renewable resources. Technological advancement and scientific innovation serve as key drivers in environmental conservation, increasing efficiency in resource use. Additionally, sustainable development seeks to improve the living standards of marginalised groups, including women, older individuals, and persons with disabilities, alongside its broader environmental objectives. Strengthening community resilience will enable societies to contribute meaningfully to global sustainability efforts. By integrating environmental, social, and economic dimensions, sustainable development provides a foundation for long-term human and environmental well-being [24].

3.3. Dimensions of Sustainable Development

The three dimensions of sustainable development encompass economic development, which pertains to growth that ensures an equitable distribution of resources; social development, which focuses on improving living standards and promoting social justice; and environmental stewardship, which involves the conservation of resources and the protection of ecosystems for future generations. In the context of this analysis, the following dimensions will be examined in detail:

3.3.1. Economic Development

Economic development encompasses the performance and position of an economy, societal well-being, and the pursuit of sustainable economic growth. It is characterised by investments in social capital, infrastructure, environmental conservation, and social policies, fostering productivity, competitiveness, and efficiency across various sectors. Two fundamental factors in supporting economic growth and development include food security and improvements in nutritional standards. Recent studies highlight Moringa oleifera as a significant contributor to food production, particularly in dairy science, due to its high nutritional value in enhancing fermented milk products. Empirical research has demonstrated that diets supplemented with Moringa oleifera exhibit increased concentrations of proteins, fats, carbohydrates, and solids, thereby improving overall nutritional value [25]. Furthermore, its therapeutic applications and efficacy in combating malnutrition further underscore its importance [26]. The incorporation of Moringa oleifera into food products, such as yoghurt, has been shown to enhance the proliferation of probiotic microorganisms, thereby promoting overall health and well-being [27]. Substantial evidence thus supports the potential of Moringa oleifera in contributing to economic development by facilitating effective food fortification and improving public health outcomes.

3.3.2. Social Development

Equitable development goes far beyond the economic progress for encompassing social, cultural, and human dimensions in strategic planning. Social development makes interpersonal relationships, access to educational resources, cultural awareness, civic participation, and knowledge of health and medical concerns easy. Social development requires equity and accessibility, requiring effective collaboration between governmental and non-governmental entities. The main features of social development are its integration with social welfare policies, in service provision, contributing to multi-dimensional social initiatives, and its effect on modern social transformations. These redefine traditional structures to evolve societal needs. So, social development fosters adaptability to social realities, makes innovative approaches, instils values of sustainable development, and networks to support aspirations and empowering community.

Empirical research highlights the role of social development in strengthening institutional frameworks and enhancing individual capabilities [28]. Studies further demonstrate its significance in advancing educational outcomes and fostering social cohesion through effective policymaking. Community initiatives, particularly youth-focused programmes, contribute to long-term social transformation by promoting participatory engagement [29]. Overall, research supports the effectiveness of social development in cultivating responsible citizenship, improving policy implementation, and reinforcing the structures underpinning social development programmes. The following definitions and constructs will be examined in detail.

3.3.3. Environmental Development

Environmental development is a specialised form of development that focuses on conserving ecological processes and natural resources in a manner that fosters balance, biodiversity, and long-term sustainability while minimising environmental disruptions. Its primary objective is to meet the needs of the present population without compromising the ability of future generations to fulfil their own requirements. The guiding principles of environmental development include sustainability, ensuring that both humanity and the environment benefit equitably; ethical stewardship, which promotes responsible management of natural assets; and the integration of social and economic progress with environmental responsibility. Additionally, environmental development encourages increased awareness of ecological concerns and facilitates systematic monitoring of environmental changes, including the preservation of cultivable land.

3.4 Uses of Soil and the Importance of Its Relationship to Sustainable Development

The relationship between soil conservation and the objective of sustainable development is well established, highlighting the necessity for effective land stewardship. Soil is fundamental in supporting many functions of human life: residential, administrative, and educational purposes, facilitating housing, governance, and schooling. Soil management of in these domains helps in effective urban planning and the development of sustainable infrastructure. Yet, unregulated urban expansion degrades soil and deplete resources[30].

In addition to structural applications, land serves as a foundation for security, recreation, and cultural activities enhance societal well-being. Dedicated spaces for security services helps in public safety, and recreational areas support physical and mental health. Also, historical and heritage sites conserve cultural identity, social cohesion, and tourism. In addition, land availability is important for religious, industrial, and leisure activities significantly affect economic productivity and community assignation. Though, unchecked expansion in these sectors delete soil with long-term environmental degradation. The medical and commercial sectors rely on land availability which underscore the necessity of its sustainable use. Healthcare facilities need stable infrastructure, and commercial spaces make economic activities and trade easy. The increase in the demand for such spaces may cause inefficient land use which exacerbates soil degradation and its environmental consequences [31].

The soil in sustainable development importance extends beyond its practical uses which encompasses ecological, economic, and social dimensions. Ecologically, soil supports food production, keeps

ecosystems as a carbon reservoir, as crucial in the mitigation of climate change [32]. In terms of economy, soil reinforces sustainable agriculture, economic growth, and preserves natural resources for long-term agricultural productivity [33]. In social perspective, soil adds to food security, community development, and the cultural heritage, so it reinforces global sustainability initiatives [34].

Because of the critical aspect of soil conservation in sustainable development, collaboration involving multiple stakeholders is important. International organisations regulate policies and agreements, although local communities use conservation strategies. Governments are central in enacting legislation and policies to protect soil resources, yet environmentalists and scientists help by technological advancements and innovative conservation methods. Consumers are supporting sustainability by environmentally responsible products and services. Also, stakeholders in ecological, industrial, and agricultural sectors engage in conservation initiatives to safeguard soil resources.

Governments are pivotal role in soil conservation by the development and enforce legal frameworks. Legislation has proven effective in soil assets and promoting long-term sustainability [35]. Moreover, water resource management is crucial for soil conservation, which make an integral component of Saudi Arabia's agricultural planning. Pesticide residues in soil prompts efforts to use stricter regulations on agrochemical use and safeguard groundwater resources. According to Saudi Arabia's commitment to legal soil protection, this study critically analyses and evaluates the policies used in the country for ensuring soil sustainability [36].

3.5 Legal Protection of Soil from Pollution in the Kingdom of Saudi Arabia

The certain tools for environmental protection include raising public awareness on environment, helping in the training skilled and qualified engineers in the enactment of legislation to safeguard the environment, with incentives for environmental conservation, and used measures to prevent environmental contamination.

3.5.1. Mountains Ecosystems

The conservation of healthy soil in mountainous regions are crucial to promote sustainable development, preserve biodiversity, and regulate climatic processes. Consequently, the formulation of policies governing land use, soil conservation, and environmental protection is of paramount importance. In Saudi Arabia, governance frameworks have been established to encourage responsible land use in alignment with international conventions. Conservation initiatives in rural and mountainous areas, such as those implemented in the Al-Ahsa Oasis, demonstrate their effectiveness in promoting ecosystem sustainability [37]. Additionally, ecologically sensitive regions like Al-Baha have adopted efficient waste management practices—one of the key strategies for resource conservation—thereby preventing soil degradation [38]. Overall, such interventions, supported by robust policy frameworks, significantly contribute to long-term environmental sustainability.

3.5.2. The Desert Ecosystem

The Kingdom of Saudi Arabia possesses extensive natural pastures, covering approximately 171 million hectares across various regions, though their distribution varies significantly. Areas receiving an annual average rainfall of less than 200 mm predominantly support woody pastures. The majority of the Kingdom's rangelands are concentrated in the northern, eastern, central, and southern regions, extending across sandy deserts, gravel plains, and rocky highlands. Notably, over two-thirds of these pastures are situated in areas where annual rainfall falls below 100 mm. So, the Kingdom's contemporary pastures include isolated desert grasses and sparsely distributed shrubs, showing low ground coverage and limited capacity for livestock. They fluctuate considerably according to annual rainfall patterns and regional climatic conditions, with pastoral activities confined to rainy times.

For safeguarding natural resources, Saudi Arabia has made a comprehensive legislative and regulatory frameworks focusing on environmental conservation. The main principles are pollution mitigation, addressing the adverse effects of human activities like urban development, agricultural expansion, and industry. The protection of subsurface resources, groundwater reserves and mineral deposits, is also a priority. Sustainable land management strategies optimise the use of agricultural land developing and constructing projects do not compromise environmental integrity. Moreover, attempts to prevent soil degradation, combating erosion and deterioration, in line with broader national aims for environmental sustainability. Agricultural productivity enhancement initiatives further contribute to preserving soil health and supporting sustainable land use.

Environmental conservation efforts in Saudi Arabia are coordinated through several specialised entities. The National Centre for Environmental Compliance, National Centre for Meteorology, National Centre for Soil Quality, and the Ministry of Environment oversee policies related to environmental protection and soil conservation. The National Centre for Waste Management regulates waste disposal to prevent environmental degradation, while the National Centre for Wildlife Development focuses on biodiversity conservation and habitat protection. Additionally, the National Centre for Vegetation Cover Development and Desertification Combating is responsible for reforestation initiatives and restoring degraded landscapes. Collectively, these institutions play a crucial role in shaping legislative frameworks, ensuring regulatory compliance, and fostering sustainable development across the Kingdom.

Saudi Arabia has used many legislative frameworks for safeguarding the environment, with a strong emphasis on soil conservation. Notable laws are the Saudi Government's environmental policies, the Agriculture Law, and the Water Law. The government applies events for preventing soil contamination by strict regulations. The Agriculture Law endorses sustainable farming for protecting soil, and the Water Law highlights groundwater conservation and prevents soil degradation by poor water management. Together, these laws are a solid foundation for environmental and soil protection which supports long-term ecological sustainability and responsible resource uses.

The Kingdom has offered legislation for the regulation of pollution, ensure sustainable resource uses, and presentation environmental degradation. Environmental laws reduce contamination from industries, agriculture, and construction and protecting groundwater and minerals. The prevention of soil degradation mitigates erosion and deterioration, ensure agricultural productivity and land preservation. Productivity policies enhance resource efficiency maintaining long-term sustainability. These collectively support Saudi Arabia's commitment to environmental protection and ecological balances.

Multiple agencies supervise environmental and soil conservation in Saudi Arabia, adhering regulations. The Ministry of Environment advances policies and the National Centre for Meteorology monitors soil conditions. The National Centre for Environmental Compliance applies legislation, and the National Centre for Waste Management grows sustainable waste disposal approaches. The National Centre for Wildlife Development emphases on biodiversity conservation, and the National Centre for Vegetation Cover Development and Desertification Combat encourages afforestation contributing to environmental stewardship and sustainability.

Key legislative frameworks, Saudi Government policies, the Agriculture Law, and the Water Law, are crucial in environmental protection. Government policies emphasize pollution control and ecosystem conservation. The Agriculture Law controls land use and endorses sustainable farming practices, and the Water Law confirms groundwater conservation and stops water source contamination. These laws make a comprehensive framework for environmental conservation, with Saudi Arabia's commitment to ecological sustainability and responsible resource management.

3.6 The Saudi Government Prohibits

Saudi Arabia's legal framework applies stringent controls on activities contributing to environmental pollution in many ecosystems, including terrestrial, atmospheric, aquatic, and marine habitats in its territorial borders. Emission-generation are subject to environmental laws which require permits and incessant monitoring for ensuring compliance. Legislative mandates necessitate environmental rehabilitation programmes, periodic evaluations, systematically removing of toxic chemicals, and adhering operational permit requirements for pollutant-emission (Articles 6, 7, 8, 10 of the Saudi Environmental Law).

Empirical studies show that robust legal frameworks and heightened public awareness significantly improve environmental risk mitigation efforts promoting sustainability [39]. Strict environmental disclosure laws enhance corporate accountability and environmentally responsible business [40]. Also, policy-driven strategies support infrastructure development for reducing sustainability and pollution, in large-scale industrial operations. Saudi environmental law imposes strict prohibitions for safeguarding natural resources. The discharge of treated or untreated wastewater into groundwater or any environmental medium with no permit is prevented. The same is with encroachment, expansion, or transfer of ownership of protected areas, forests, pastures, national parks, and geological reserves. Actions- vegetated lands require permits, and afforestation or cultivation are licensed. Also, inappropriate waste disposal, ecological balance disruption, and fires in unauthorised areas are restricted. Extracting materials, sand, gravel, rocks, or clay needs official authorisation (Article 14, Saudi Environmental Law) [41].

These regulations show that Saudi Arabia's is dedicated to conserve the environment and sustainable resource management. Studies have shown the importance of legal frameworks in environmental protection, with ongoing revisions for addressing regulatory challenges and strengthen accountability. Under regulatory provisions, reclamation of agricultural or vegetation-covered lands and levelling them require official licensing (Article 15, Saudi Environmental Law). Licensed operators integrate environmental issues into their activities managing land in vegetated areas responsibly (Article 17, Saudi Environmental Law). Compliance events ensure economic activities with conservation efforts. In environmental crises or disasters, legal protections are supported by Articles 33 and 34 of the Saudi Environmental Law which safeguard agency personnel from liability for unintentional errors countering pollution, except in proven carelessness. Yet, affected people keep the right to legal recourse upholding operational efficiency and accountability during emergencies.

The Minister authority can use the necessary interventions in response to environmental emergencies, disasters, or forthcoming environmental threats. Consulting relevant agencies prevent more environmental degradation. Legislation improves disaster management by precautionary and preventive approaches, reinforcing Saudi Arabia's commitment to environmental sustainability and reducing risks. Legal frameworks give priorities to proactive emergency response mechanisms for minimising ecological damage ensuring regulatory compliance. Research highlights the nation's emphasis on disaster resilience by incorporating sustainability principles into key sectors such as healthcare [42]. These initiatives align with Saudi Arabia's broader environmental protection strategies.

Articles 35 and 36 of the Saudi Environmental Law regulate violations, including unauthorised pollutant discharge into groundwater, environmental media, or exposed rock layers. Maritime activities such as the disposal of ballast water, cargo residues, and hazardous waste in marine environments are also prohibited. Violations extend to improper hazardous waste disposal, illicit trading, hunting, and the extermination of endangered species. Regulatory authorities conduct inspections to identify and document these infractions, with officials acting under the authority of the relevant governing body or Minister. Facility inspections require coordination with the overseeing entity, and obstructing inspectors is expressly forbidden. Official documentation of enforcement actions is mandated, ensuring compliance with legislative requirements. Research underscores the necessity of aligning legislative structures with enforcement practices to achieve regulatory compliance [43].

The Ministry of Interior, in coordination with relevant authorities, oversees compliance with environmental legislation through supervision, monitoring violations, and supporting inspectors during investigations (Article 37, Saudi Environmental Law). Articles 38 to 44 of the Saudi Environmental Law outline penalties for infractions, detailing the committees responsible for imposing sanctions, their composition and authority, and the administration of appeals within the courts of administration. The Public Prosecution and the environment minister oversee the enforcement of preventive measures. Saudi Arabia's environmental legislative framework is robust, prioritising pollution prevention and the conservation of natural resources. Article 45 mandates financial institutions to integrate sustainability considerations into financing approved projects. Article 46 establishes Environmental Law as the default in cases where specific legislative provisions are absent, reinforcing sustainability mandates. These provisions align with Saudi Arabia's commitment to international agreements and the policies of the Cooperation Council for the Arab States of the Gulf. Empirical research underscores effective governance and accountability as critical to enhancing sustainability initiatives, with studies highlighting the importance of resolving legal challenges to strengthen environmental conservation.

The Saudi government has established general bans for preventing soil pollution: (1) a ban on activities compromising soil integrity and values, (2) a requirement for prevention against contamination, (3) strategies to control and reduce pollution at its source, (4) compliance with legislation for rehabilitation of contaminated soil, and (5) reporting individual and collective pollution incidents to the National Centre for Environmental Compliance. The Saudi government structured process for the detection of the violations and penalties: (1) determining fines according to the severity of environmental damage, site significance, affected area, and socio-economic effect, (2) delegation of penalty valuations to a specialised expert committee, and (3) categorising serious violations causing major environmental degradation, harm to sensitive ecosystems, or breaches explicitly in the law. These ensure soil conservation through accountability and compliance with legal standards. Empirical studies highlight the significance of these frameworks in preventing long-term environmental degradation, particularly in relation to soil pollution from effluents and landfill disposal. Moreover, studies underscore the dangers of heavy metal contamination in agricultural lands which reinforce compliance for maintaining soil quality and securing food production [44].

Several laws protect Saudi Arabia's territorial lands, the Law of Desert Lands Distribution [43], the Law of Fertilisers and Soil Additives in Member States of the Cooperation Council for the Arab States of the Gulf [45], the Quarantine in Agriculture Law, the Pesticides Law, the Agriculture Law, and the Water Law. These show the Kingdom's sustainable development with Vision 2030. The Ministry of Environment, Water, and Agriculture gives high attention to environmental sustainability, resource management, water access, and national security, in relation to food security.

Studies are crucial to agricultural policies in the promotion of sustainability and protecting arid lands from excessive pesticide uses [46]. Environmental conservation is in the Saudi legislation by government support, legal penalties for violations, and executive regulations for soil contamination prevention and remediation. The government has institutions to land protection, anti-pollution legislation, and a national framework for assessing land. These regulations show the individuals' responsibilities, prohibiting activities degrading soil quality, and enforcing mechanisms for detecting and penalising violations. Studies show the need for legal enforcement and accountability in closing regulatory gaps in Saudi Arabia's environmental protection policies. These are with Saudi Arabia's international environmental commitments. The Kingdom actively engages in regional and global agreements on environmental and soil conservation, ensuring domestic laws conform to international legal frameworks. Saudi regulations are designed to uphold the Kingdom's obligations under Gulf Cooperation Council agreements and international treaties.

4. Discussion

Sustainable development has become a core principle of international law, recognised as a fundamental human right through United Nations resolutions and integrated into global human rights frameworks. In theory, sustainable development has evolved into a set of ambitious objectives, formally adopted in 2016, aiming to conserve natural resources, meet the needs of present and future generations, and leverage scientific and technological advancements for efficient resource use [47]. The SDGs encompass multiple sectors, linking soil conservation with poverty eradication, food security, water conservation, and responsible consumption and production. In practice, sustainable development necessitates addressing environmental degradation, ensuring intergenerational equity, and balancing economic growth with social welfare. Key principles include long-term sustainability, the establishment of legislative frameworks, poverty reduction, technological advancement, and global cooperation.

Saudi Arabia's legislative framework for environmental and soil protection comprises various legal measures focused on pollution prevention, conservation, and sustainable land use. Key legislation includes the Saudi Government Law, Agriculture Law, and Water Law, which serve as fundamental tools for environmental protection [48]. The Executive Regulations for the Prevention and Treatment of Land Contamination mark a significant step in strengthening environmentally responsible governance. Saudi Arabia's commitment to sustainable development is exemplified by its Vision 2030, which prioritises resource management, conservation, and urban sustainability. In alignment with international agreements, the Kingdom aims to enhance its environmental governance to meet global standards, ensuring a resilient and sustainable future.

5. Conclusion

This research underscores the vital role of a robust legal framework in advancing Saudi Arabia's sustainable development while safeguarding its territorial lands. By examining legislative enactments such as the Saudi Government Law, Agriculture Law, Water Law, and the Anti-Pollution and Land Contamination Act, it highlights key provisions on pollution prevention, resource conservation, sustainable land use, and land degradation prevention. The study emphasises the need for continuous legal evaluation, increased awareness, and systematic documentation to enhance environmental governance. It provides actionable recommendations to strengthen Saudi Arabia's legal system, promote sustainable practices, and align national policies with global sustainability goals, ensuring long-term environmental protection and resource equity for future generations.

5.1 Recommendations

The findings of the first study underscore the necessity of enhancing awareness regarding sustainable development, Saudi Vision 2030, and the vital significance of soil conservation. It advocates for comprehensive education across all sectors on the adverse impacts of soil degradation, depletion, and pollution while ensuring transparency through public access to data on pollution levels, degradation, and conservation efforts. Legislative frameworks must be periodically revised to align with sustainability objectives, and organisations engaged in activities affecting soil should play a proactive role in promoting awareness of relevant regulations. The implementation of structured conservation programmes is essential for strengthening food security, fostering regional development, and safeguarding the environment, thereby promoting long-term stewardship and sustainable practices.

5.2. Study Implications and Directions for the Future

The findings of this study have significant implications for Saudi Arabian legislation and sustainable development policies. By prioritising the formulation and enhancement of environmental legislation, this research establishes a foundation for future policy development and legislative restructuring. Key recommendations, such as raising awareness of existing laws, updating legal frameworks, and improving access to pollution-related information, provide valuable insights for environmental agencies and policymakers, particularly in soil conservation. The study highlights the importance of transdisciplinary approaches in environmental, agricultural, and socioeconomic research, paving the way for future investigations. Future studies should assess the impact of interventions on soil health, evaluate enforcement effectiveness, and explore participatory conservation strategies for long-term agricultural sustainability. These insights will enable policymakers and researchers to develop more effective legal frameworks, ensuring the sustainable use of Saudi Arabia's land resources.

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References

[1] Badran, DMI, Alammari, KS, & Abdelhady, MA. The Legal Challenges in Environmental Protection and Accountability: A Study in Saudi Law. Revista de Gestão Social e Ambiental. 2024;18(9):e6536.doi: https://doi.org/10.24857/rgsa.v18n9-060

[2] Alhogbi, BG, Al-Ansari, SA, & El-Shahawi, MS. A Comparative Study on the Bioavailability and Soil-to-Plant Transfer Factors of Potentially Toxic Element Contamination in Agricultural Soils and Their Impacts: A Case Study of Dense Farmland in the Western Region of Saudi Arabia. Processes. 2023;11(9):2515.doi: https://doi.org/10.3390/pr11092515

[3] El-Sorogy, AS, & Khathlan, MHA. Assessment of potentially toxic elements and health risks of agricultural soil in Southwest Riyadh, Saudi Arabia. Open Chemistry. 2024;22(1).doi: https://doi.org/10.1515/chem-2024-0017

[4] Li, C, Jiang, X, Jiang, H, Sha, Q, Li, X, Jia, G, Cheng, J, & Zheng, J. Environmental Controls to Soil Heavy Metal Pollution Vary at Multiple Scales in a Highly Urbanizing Region in Southern China. Sensors. 2022;22(12):4496.doi: https://doi.org/10.3390/s22124496

[5] Vasconcelos, AA, Len, T, de Oliveira, AdN, Costa, AAFd, Souza, ARdS, Costa, CEFd, Luque, R, Rocha Filho, GNd, Noronha, RCR, & Nascimento, LASd. Zeolites: A Theoretical and Practical Approach with Uses in (Bio)Chemical Processes. Applied Sciences. 2023;13(3):1897.doi: https://doi.org/10.3390/app13031897

[6] Wang, X, Zhao, X, & McNamara, N. Environmental Public Interest Litigation in China: Springer; 2023. doi: https://doi.org/10.1007/978-3-031-26526-6

[7] Iqbal, J, Khan, MJ, Hafeez, M, Siddiqui, JA, Fahad, M, Ali, B, Imran, M, Ahmad, A, & Fahad, S. Impact of cement waste on soil fertility and crop productivity: a serious concern for food security. Environmental Science and Pollution Research. 2024;31(29):41775-41790.doi: https://doi.org/10.1007/s11356-024-33696-x

[8] Munday, M, Reynolds, L, & Roberts, A. Re-appraising 'in-process' benefits of strategic infrastructure improvements: Capturing the unexpected socio-economic impacts for lagging regions. Transport Policy. 2023;134:119-127.doi: https://doi.org/10.1016/j.tranpol.2023.02.012

[9] Alnuwaiser, MA, Rabia, M, & Elsayed, AM. Bismuthyl chloride/poly(m-toluidine) nanocomposite seeded on poly-1H pyrrole: Photocathode for green hydrogen generation. Open Physics. 2024;22(1).doi: https://doi.org/10.1515/phys-2024-0111

[10] ALHaithloul, H. Comparative studies of the biochemical and molecular responses of haloxylon ammodendron grown on heavy metal polluted soil in al-jouf region of saudia arabia. Applied Ecology & Environmental Research. 2023;21(6).doi: https://doi.org/10.15666/aeer/2106_53695387

[11] Rolón-Cárdenas, GA, & Hernández-Morales, A. Phytoremediation of Lead Present in Environment: A Review. In: N. Kumar & A. K. Jha, editors. Lead Toxicity Mitigation: Sustainable Nexus Approaches. Cham: Springer Nature Switzerland; 2024. p. 149-168. https://doi.org/10.1007/978-3-031-46146-0_7

[12] El Behairy, RA, El Baroudy, AA, Ibrahim, MM, Mohamed, ES, Rebouh, NY, & Shokr, MS. Combination of GIS and Multivariate Analysis to Assess the Soil Heavy Metal Contamination in Some Arid Zones. Agronomy. 2022;12(11):2871.doi: https://doi.org/10.3390/agronomy12112871

[13] Akhoirshieda, MS, Khalif, KMNK, & Awang, S. Artificial intelligence in the United Arab Emirates public sector: a systematic literature review. IAES International Journal of Artificial Intelligence (IJ-AI). 2024;13(3).doi: https://doi.org/10.11591/ijai.v13.i3.pp2472-2481

[14] Siabi, WK, Owusu-Ansah, ED-J, Essandoh, HMK, & Asiedu, NY. Modelling the adsorption of iron and manganese by activated carbon from teak and shea charcoal for continuous low flow. Water-Energy Nexus. 2021;4:88-94.doi: https://doi.org/10.1016/j.wen.2021.02.001

[15] Faraj, TK, EL-Saeid, MH, Najim, MMM, & Chieb, M. The Impact of Pesticide Residues on Soil Health for Sustainable Vegetable Production in Arid Areas. Separations. 2024;11(2):46.doi: https://doi.org/10.3390/separations11020046

[16] Abuzaid, AS, & Jahin, HS. Combinations of multivariate statistical analysis and analytical hierarchical process for indexing surface water quality under arid conditions. Journal of Contaminant Hydrology. 2022;248:104005.doi: https://doi.org/https://doi.org/10.1016/j.jconhyd.2022.104005

[17] Yogafanny, E, Triatmadja, R, Nurrochmad, F, & Supraba, I. The leaching behavior of pervious mortar used as water filter in rural areas. GEOMATE Journal. 2023;25(110):159-166.doi: https://doi.org/10.21660/2023.110.3942

[18] Huali Fu, YB. Research on the Right to Development from the Perspective of International Human Rights. Journal of Humanities, Arts and Social Scienc. 2024;8(2):486-490.doi: https://doi.org/10.26855/jhass.2024.02.032

[19] Graibeh, AMA, Khan, S, Al-Majeed, S, & Zhang, S. Capability Assessment Framework for Artificial Intelligence and Blockchain Adoption in Public Sector of United Arab Emirates (UAE). International Journal of Advanced Computer Science and Applications. 2024;15(6):50-56.doi: https://doi.org/10.14569/ijacsa.2024.0150607

[20] Sumartini, S, & Setiady, T. Harmonizing international and national legal systems through the principles of sustainable development in the modern state. Cepalo. 2024;8(1):17-30.doi: https://doi.org/10.25041/cepalo.v8no1.3248

[21] Al-Ajlouni, MM, & Saad, MA. The impact of entrepreneurship on economic and social development: a study on entrepreneurial projects in Saudi Arabia. Access Journal. 2024;5(3):562-578.doi: https://doi.org/10.46656/access.2023.5.3(11)

[22] Alshamsi, SASA, Hussain, TPRS, & Ali, SSS. The Role of Artificial Intelligence on the Public Energy Sector Performance in the United Arab Emirates: The Mediation Role of Organizational Agility. Journal of Law and Sustainable Development. 2024;12(1):e2808.doi: https://doi.org/10.55908/sdgs.v12i1.2808

[23] Albat, FMA, Alsaman, MAA, & Albakjaji, M. The Role of Saudi Environmental Laws and Regulations in Protecting the Environment, and Achieving the goals of sustainability: The Case of Hail City. Journal of Ecohumanism. 2024;3(8):2647– 2654.doi: https://doi.org/10.62754/joe.v3i8.4912

[24] Kayal, G. Sustainable entrepreneurship in the Kingdom of Saudi Arabia: a systematic evaluation of extant research. Entrepreneurship and Sustainability Issues. 2024;11(3):85-98.doi: https://doi.org/10.9770/jesi.2024.11.3(6)

[25] Adepoju, FO, Selezneva, IS, & Okpala, OR. Yoghurt fortification with Moringa oleifera: nutritional and production aspects. Mljekarstvo: časopis za unaprjeđenje proizvodnje i prerade mlijeka. 2024;74(1):3-21.doi: https://doi.org/10.15567/mljekarstvo.2024.0101

[26] Sokhela, H, Govender, L, & Siwela, M. Complementary Feeding Practices and Childhood Malnutrition in South Africa: The Potential of Moringa Oleifera Leaf Powder as a Fortificant: A Narrative

Review. Nutrients. 2023;15(8):2011.doi: https://doi.org/10.3390/nu15082011
[27] Salihu, F, Salihu, M, & Nyadar, P. Proximate Analysis and Nutritional Content of Moringa Oleifera Leaves Collected From Horticultural Garden in Gwagwalada, Federal Capital Territory, Abuja, Nigeria. Journal of Applied Sciences and Environmental Management. 2024;28(4):1267-1272.doi: https://doi.org/10.4314/jasem.v28i4.27
[28] Midgley, J. Social Development, Change, and Progress. Social Development Issues. 2024;46(2).doi: https://doi.org/10.3998/sdi.5982
[29] Sutton, SE. A social justice perspective on youth and community development: Theorizing the processes and outcomes of participation. Children, youth and environments. 2007;17(2):616-645.doi: https://doi.org/10.1353/cye.2007.0055
[30] Mikhailova, EA, Zurqani, HA, Lin, L, Hao, Z, Post, CJ, Schlautman, MA, & Shepherd, GB. Opportunities for Monitoring Soil and Land Development to Support United Nations (UN) Sustainable Development Goals (SDGs): A Case Study of the United States of America (USA). Land. 2023;12(10):1853.doi: https://doi.org/10.3390/land12101853
[31] Thinojah, T, & Ketheesan, B. Iron removal from groundwater using granular activated carbon filters by oxidation coupled with the adsorption process. Journal of Water and Climate Change. 2022;13(5):1985-1994.doi: https://doi.org/10.2166/wcc.2022.126
[32] Sanjay, MA, Rai, S, Patil, AA, Nengparmoi, T, Devi, KB, Dora, HSV, & Sharma, Y. Environmental Sustainability through Soil Conservation: An Imperative for Future Generations. International Journal of Environment and Climate Change. 2023;13(10):1700-1707.doi: https://doi.org/10.9734/ijecc/2023/v13i102826
[33] Telo da Gama, J. The Role of Soils in Sustainability, Climate Change, and Ecosystem Services: Challenges and Opportunities. Ecologies. 2023;4(3):552-567.doi: https://doi.org/10.3390/ecologies4030036
[34] Singer, MN, Hamouda, MA, El-Hassan, H, & Hinge, G. Permeable Pavement Systems for Effective Management of Stormwater Quantity and Quality: A Bibliometric Analysis and Highlights of Recent Advancements. Sustainability. 2022;14(20):13061.doi: https://doi.org/10.3390/su142013061
[35] Sarabdeen, J. The Role of Government in Driving Sustainability: A Public Policy Perceptive. Emerging Science Journal. 2024;8(3):1184-1200.doi: https://doi.org/10.28991/esj-2024-08-03-023
[36] Aldegheishem, A. Assessing progress towards smart governance in Saudi Arabia. Humanities and Social Sciences Communications. 2024;11(1):759.doi: https://doi.org/10.1057/s41599-024-03235-7
[37] University, UAE. The United Arab Emirates University Discusses Artificial Intelligence Role in Promoting Organizational Efficiency and Reducing Bureaucracy 2025 [Retrieved from: https://www.uaeu.ac.ae/en/news/2025/january/uaeu-discusses-artificial-intelligence-role-in-promoting-organizational-efficiency-and-reducing-bureaucracy.shtml
[38] Mohamed, MT, Aldossary, NA, Alzahrani, AA, & Alghamdi, JK. Waste management as a tool to preserve the sensetive ecosystem of the al-baha region in saudi arabia. Journal of Al-Azhar University Engineering Sector. 2023;18(68):580-607.doi: https://doi.org/10.21608/auej.2023.310341
[39] Farag, AOK. The Role of Saudi Universities in Achieving Aspects Of Sustainability in Light of the Saudi Green Initiative. Journal of Educational and Human Sciences-Taiz University. 2023(33):59-92 https://doi.org/10.55074/hesj.vi33.804
[40] Firmansyah, EA, Umar, UH, & Jibril, RS. Investigating the effect of ESG disclosure on firm performance: The case of Saudi Arabian listed firms. Cogent Economics & Finance. 2023;11(2):2287923.doi: https://doi.org/10.1080/23322039.2023.2287923
[41] Vernocchi, V, Abd El, E, Brunoldi, M, Danelli, SG, Gatta, E, Isolabella, T, Mazzei, F, Parodi, F, Prati, P, & Massabò, D. Airborne bacteria viability and air quality: a protocol to quantitatively investigate the possible correlation by an atmospheric simulation chamber. Atmos. Meas. Tech. 2023;16(22):5479-5493.doi: https://doi.org/10.5194/amt-16-5479-2023
[42] AlDulijand, NA, Al-Wathinani, AM, Abahussain, MA, Alhallaf, MA, Farhat, H, & Goniewicz, K. Sustainable Healthcare Resilience: Disaster Preparedness in Saudi Arabia's Eastern Province Hospitals. Sustainability. 2024;16(1):198.doi: https://doi.org/10.3390/su16010198
[43] Alqaisi, A. Assessing the Gap between Environmental Legislation and Effective Implementation: A Study and Guidelines for Enhancing the Implementation Performance of Environmental Laws. Journal of Electrical Systems. 2024;20:937-947.doi: https://doi.org/10.52783/jes.3469
[44] Madaras, M, Krejčí, R, & Mayerová, M. Assessing soil aggregate stability by measuring light transmission decrease during aggregate disintegration. Soil & Water Research. 2024;19(1).doi: https://doi.org/10.17221/78/2023-swr
[45] Duarte, M, Caeiro, SS, Farinha, CS, Moreira, A, Santos-Reis, M, Rigueiro, C, & Simão, J. Integration of sustainability in the curricula of public higher education institutions in Portugal: do strategic plans and self-report align? International Journal of Sustainability in Higher Education. 2023;24(9):299-317.doi: https://doi.org/10.1108/IJSHE-01-2023-0001
[46] Senila, M. Metal and metalloid monitoring in water by passive sampling – A review. Reviews in Analytical Chemistry. 2023;42(1).doi: https://doi.org/10.1515/revac-2023-0065
[47] Benlaria, A, Sadaoui, N, Almawishir, NFS, & Benlaria, H. Navigating the Oil-environment Nexus: Saudi Arabia's Challenge in Sustainable Development. International Journal of Energy Economics and Policy. 2024;14(5):292-300.doi: https://doi.org/10.32479/ijeep.16647
[48] Mazzetto, S. Urban Heritage Conservation in Saudi Arabia Toward Sustainable Reuses. Advances in Science and Technology. 2024;137:79-86.doi: https://doi.org/10.4028/p-umK0gc