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A Procedural Framework to Identify Critical Indicators for the Protection of Environment and Ecosystem during Sustainable Urban Development in South-Western Saudi Arabia

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Abstract: This paper investigates the strategies and priorities to identify the critical indicators for the protection of the environment and ecosystem in the mountain regions of southwest Saudi Arabia, considering the natural resources, renewable energy potential, local economy, urban development issues, and compatibility with the Saudi Vision 2030. The southern region of the country is characterized as having cooler climatic conditions than the other regions of Saudi Arabia and is rich in natural resources and renewable energy potential. It also has potential in the sectors of agriculture, forests, and animal production, and the region's heritage is valuable for its tourism industry. During the past years, the region is experiencing a misbalance in its resources and population due to a quick increase in urban development. It is seen that there has been no strategy in place for the management of development. Hence, it is important to establish a framework designed to manage urban planning and sprawl that considers the topographical conditions, wildlife and forest protection, and investment in natural and renewable resources. This study employs a focus group approach to investigate these issues. Different expert panels were invited to Al-Baha University in December 2019 to discuss the sustainable development priorities of Saudi Arabia's southern regions. These included decision-makers from governmental sectors, and academics from the university's faculties of engineering, economics, sciences, and social sciences. The study highlights the issues of urban sprawl management in cities that impact the environmental conditions and wildlife habitat, concluding that the agriculture and tourism industries are the most important factors that should be targeted by developers in the southwestern regions of the country.

Keywords: urban planning; environmental protection; ecosystem; wildlife protection; forests; energy management; sustainability

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1. Introduction

In recent years, interest in energy-oriented research has increased, particularly in wildlife habitats and the natural environment [1,2]. Cities sprawl both vertically and horizontally, which means that many issues of urban development must be considered, such as the ecosystem, including the natural environment and agriculture, and the local topography and climatic conditions [3,4]. Saudi Arabia has a wide variety of different urban topographies and natural environments, as well as many local historical and urban characteristics. The country has deserts with a hot arid climate, coastal regions with a humid climate, and mountainous regions with a cooler climate, and each possesses different urban characteristics requiring local urban sprawl strategies.

Due to their climate conditions, the availability of renewable energy resources, and their suitability for agriculture, the main four factors that characterize the southwestern regions of Saudi Arabia are wildlife habitat, the potential for urban agriculture tourism, and renewable and natural resources. Agriculture, wildlife, and forests play a significant role in shaping the urban identity of local development, and the local climate conditions mean that the mountainous region is characterized by its wildlife habitat and agriculture [5]. Renewable energy resources differ from one place to another, with the potential for renewable energy production being greater in high-altitude areas than in others [6]. This should, therefore, be invested in, with local people employed in urban development that targets a green urban system and the protection of the natural environment [7,8].

It is essential to govern urban sprawl, to protect the local wildlife habitats, as well as the local urban identity. Moreover, scientists have argued that massive urban sprawl and suburban development patterns create a negative effect on habitat, air and water pollution, inequality, and social homogeneity. Urban strategies developed specifically for mountainous regions should be employed by urban planners, decision-makers and investors, and local citizens. Saudi Arabia is rich in renewable energy potential, and the southwestern region in particular has forests, wildlife, and agriculture that require specific urban development strategies. This study employs expert consultation to investigate the issues involved, and to establish a framework of urban strategies for the development of the mountainous regions of Saudi Arabia.

The local ecosystem, renewable energy, wildlife habitat, and environmental social legacy are all key issues that must be considered in the planning and management of urban development and sprawl. Saudi Arabia has a range of different topographies with distinct climatic conditions, including desert areas, as well as coastal and mountainous regions. The mountainous regions in the southwestern side of the country, as shown in Figure 1, possess unique conditions, with a cool climate, forests, and unique wildlife.

Figure 1. Saudi Arabia's Geographical Map and Provinces.

In recent decades, these areas have been affected by urban sprawl and development, with residential neighborhoods now located around the forests. The daily waste disposal of these new neighborhoods can have a considerable impact on the local ecosystem, due to their proximity to the wilder zones. Therefore, when planning urban development and managing urban sprawl in these regions of the country, it is important to consider investing in renewable energy, the protection of the local forests and wildlife habitats, and the development of the agricultural and animal production industries. It is crucial that decision-makers, such as urban planners and developers, consider these environmental issues in their planning process, and that university researchers in the southwestern regions focus their research priority on the protection of the local ecosystem and wildlife.

Urban planners and developers in the regions are responsible for managing local development, with a focus on supporting agriculture, forests, and wildlife protection, and investing in the renewable energy sector in the regions. While urban sprawl requires the allocation of areas for neighborhoods, subdivision plans should require the protection of green areas and forests to avoid imbalances in the ecosystem. Moreover, issues such as waste disposal must be managed appropriately, to avoid detrimental impacts on the local wildlife, such as the recent increase in the number of monkeys. Hence, urban planners must focus on limiting urban sprawl, and on protecting agricultural development and the local forests and wildlife, and investing in the local renewable energy sector.

2. Materials and Methods

This study is focused on identifying the specific urban strategies required for the mountainous regions of Saudi Arabia that protect their wildlife, natural resources, environment, and agriculture. The experts involved were knowledgeable about the southern regions of Saudi Arabia and the urban development challenges the regions face. To address the study's primary goal, the following research questions (RQ) were formulated:

RQ-1 What are the urban planning issues for the southwestern regions of Saudi Arabia that should be considered when addressing urban sprawl?
RQ-2 What urban development strategies should be employed for the mountainous regions of Saudi Arabia that possess a unique wildlife habitat and agricultural industry?
RQ-3 What is the likely future impact of applying these output strategies?

A focus group approach of expert discussion [9,10] was selected as the research method for this study, in which the expert panels focused on how the urban planning of Saudi Arabia's cities of the southern regions should control urban sprawl, considering both the urban development issues of the cities and wildlife protection. The study also required an assessment of the extant reports and urban plans of such cities, to assess the approach adopted by the southern cities. The focus group approach [11–13] was selected due to the specific challenges of urban sprawl and the subsequent imbalance of the local ecosystem and wildlife habitat faced by the southern regions of Saudi Arabia, as this approach is commonly employed as a qualitative method to obtain an in-depth understanding of a particular issue [14]. This approach involves the consideration of the relevant data and issues by a purposely appointed group of experts, selected using specific criteria, rather than by employing a statistically typical sample of a larger number of respondents [14]. However, this approach possesses particular ethical challenges that differ from those involved in face-to-face interviews [13].

For this study, the experts concerned were recruited from various sectors to take part in workshops at the main campus of Al-Baha University. The participants, including decision-makers, were invited to share their experiences of the challenges they faced in the development of the southern regions under their authority. The Al-Baha region is one of the southwest regions of Saudi Arabia characterized as mountainous, and is known for its high energy consumption and carbon emission rates, as well as its wildlife habitat and animal and agricultural production. The region represents a typical environment in the southwest of Saudi Arabia. The methodology followed for the study is described in Table 1.

The participants in this study were invited to present the issues in their remit for discussion with their focus group peers, as follows:

Table 1. List of Focus Group Participants and their Affiliations.

Category	Sector	Number of Experts	Percentage
Decision-Makers	Ministry of Interior, Al-Baha	1	1.4%
	Ministry of Municipality, Al-Baha	1	1.4%
	Ministry of Environment, Water, and Agriculture	1	1.4%
	Saudi Electricity Company	2	2.8%
	General Directorate of Health Affairs	1	1.4%
	The General Authority for Tourism and National Heritage	1	1.4%
	Ministry of Education, Al-Baha	1	1.4%
	Ministry of commerce, Al-Baha	1	1.4%
Academic Professionals	Faculty of Engineering	13	18%
	Faculty Basic Science	14	20%
	Faculty of Medical Applied Science	5	7%
	Faculty of Arts and Humanities	4	6%
	Faculty of Medicine	4	6%
	Faculty of Business Administration	3	2%
	Faculty of Education	6	8%
Industry Professionals	Developers, Investors, and Engineers	4	6%
Al-Baha University Leaders		9	13%
Total Experts	71		
First Round of Meetings	Location: Main Campus, Al-Baha University Topic: Urban Development and Priorities for Al-Baha Province: A Case Study		
Second Round of Meetings	Location: Online Meeting Speakers: Dean of Scientific Research, Vice-Rector for Graduate Studies and Scientific Research, Mayor of Tabuk Province Topic: Urban Sprawl and its Impact on the Wildlife Environment		
Third Round of Meetings	Location: Online Meeting Speakers: Dean of Scientific Research, Mayor of Al-Baha Province Topic: The Development of the Al-Baha Region		

2.1. Decision-Makers

The decision-makers shared their knowledge and experience of urban development in the southwestern region of Saudi Arabia. The participants included the mayor of the municipality of the Al-Baha region, a representative from the Saudi electricity company branch located in Al-Baha, and representatives from the Saudi tourist board in Al-Baha and the health and education sectors in the region.

2.2. Academic Professionals

The academics shared their research and academic knowledge of establishing urban development planning frameworks. The participants were representatives from all departments of Al-Baha University's Faculty of Engineering, namely Architecture, Civil Engineering, Mechanical Engineering, Electrical Engineering, and Computer Engineering; members from all departments of the Faculty of Basic Science; and the faculties of Business Administration, Arts and Humanities, Medical Applied Science and Medicine, Pharmacy, and Computer Science and Information Technology. All these individuals had the experience of the Al-Baha region. The role of educators in the sustainable urban development of a community has been found significant. Many research articles have been published discussing the vital factors involved in the process [15–17].

2.3. Industry Professionals

The industry professionals involved in the focus group were representatives from the private sector, such as employees from engineering consultation companies, construction companies, and investors. They were invited to share their views of the challenges of urban development in the southwestern region of Saudi Arabia and to discuss these with the decision-makers and academics, to frame the project priorities for the southwestern region of Saudi Arabia, considering the issues of the ecosystem and wildlife protection, agricultural development, and renewable energy development.

2.4. Statistical Analysis

The response to all questions was compared together as well for better comparison and to rank all the factors as prioritized by the respondents by using the method of Weighted Averages (WA). The following equation was used to calculate the WA of each factor [18].

$$A_w = \frac{\sum(Q_i\, n)}{\sum Q_i} \quad (1)$$

where A_w is the Weighted Average, Q_i is the number of respondents for a specific level n of the Likert scale and the value of n ranges from 1 to 5.

3. Results

The focus group consultation approach sought to consider all the potential challenges faced in the development of the southwestern regions of Saudi Arabia, focusing on the most important aspects, such as agriculture, tourism, ecology, and environmental and wildlife protection. Each of the expert members of the panel contributed views from their realm of expertise. The consultation was conducted in three rounds, the first of which took place at the Al-Baha University campus in December 2019, before the onset of the COVID-19 pandemic, while the other two rounds were conducted online. Table 1 lists the participants involved in the study and the topics of discussion.

The analysis of the discussions addressed the main issues facing the urban development of the southwestern regions of Saudi Arabia, namely renewable energy, wildlife habitat, agriculture, tourism, and remote settlement development. Figure 2 illustrates the ranking of all the factors obtained by the experts based on the weighted percentage. Each of the factors is then discussed individually.

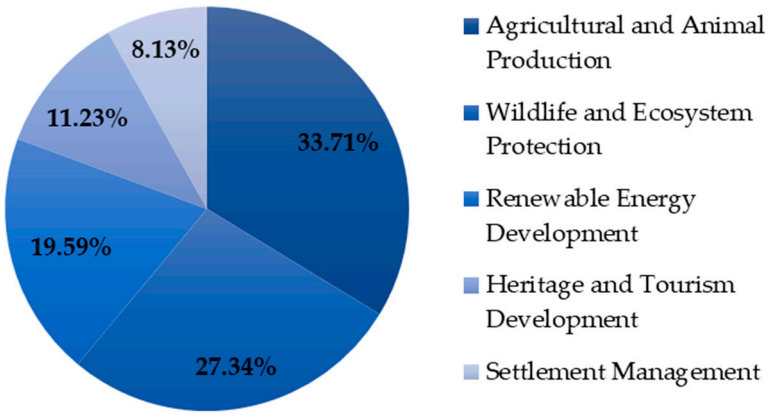

Figure 2. Ranking of Key Urban Development Factors by Experts.

3.1. Agricultural and Animal Production

In urban planning, agriculture and animal production play a significant role in the development of the local economy, in terms of their impact on landform and topography, as well as the level of underground water required for the industry. Hence, it is essential to protect these aspects when considering land use in city urban planning [19,20]. In general, the southwestern region (Provinces) of Saudi Arabia is suitable for the agricultural industry and animal production, and the availability of natural resources and underground water means that many locals engage in farming on agricultural terraces. Therefore, the urban planning of the cities in the region must support the development of the local agricultural industry, incorporating agricultural zones based on the landform character and underground water reserves [19]. While the industry is one of the main local economic factors of the region, including agricultural production, the forestry sector, and animal and livestock production, this study focused on seasonal fruit and vegetable production. The availability of natural water resources for these farms is vital for improving the local economy of the region. The discussion of sustainable agricultural development, establishing a clear agricultural vision for increasing the volume of agricultural investments, supporting farmers, and highlighting the role of farmers in the economy of the region included the following:

- Organic farming in Saudi Arabia, especially in the Al-Baha region and other southern regions;
- Seasonal cultivation and agricultural production using natural and artificial techniques;
- Cereal crops, including mainland wheat, barley, millet, sorghum, yellow corn, lentils, sesame, and fenugreek;
- Vegetable and fruit gardens, mainly olives, pomegranates, almonds, grapes, figs, apricots, peaches, guava, apples, berries, quince, plums, olives, and mangoes;
- Aromatic plants such as mint, basil, and caddy.

In addition, medicinal plants have been used globally in traditional medicine for hundreds of years, as such plants synthesize many chemical compounds that can be useful for medicinal practice, including defense against insects, fungi, and diseases. There has been a resurgence in the popularity of medicinal plant usage and herbal remedies in recent years, for improving both physical and mental well-being. Such plants are used widely in non-industrialized societies, mainly because they are readily available and often cheaper than modern medicines. However, decisions must be made about the production and use of these herbs alongside more traditional medicinal approaches. In Saudi Arabia, and particularly in both the urban and rural areas of the southwestern regions of the country, the traditional use of medicinal plants for the treatment of many clinical conditions is common.

Although the southwestern regions offer a great variety of medicinal plants, studies of these plants are limited, and the popular medicinal practices of the regions should, therefore, be the subject of more scientific study. For this purpose, it will be necessary to create a database of the key medicinal plants used in the treatment of different illnesses in the region. Due to the range of agricultural and animal production practices in the southwest of Saudi Arabia, specific farms should be allocated by urban planners, as presented in Table 2. The percentage response for Agricultural and Animal Production is shown in Figure 3.

Table 2. Weighted Averages for the Strategies on Agriculture and Animal Production.

Sr. No.	Title	Short Description	Weighted Average
Strategy I	Organic Farms	Allocate specific areas for these types of farms in the master plan of the city. Motivate farmers to invest in the industry.	4.0
Strategy II	Seasonal Cultivation Farms		4.33
Strategy III	Vegetable and Fruit Gardens		4.33
Strategy IV	Cereal Crop Farms		4.33
Strategy V	Aromatic Plant Farms		4.33

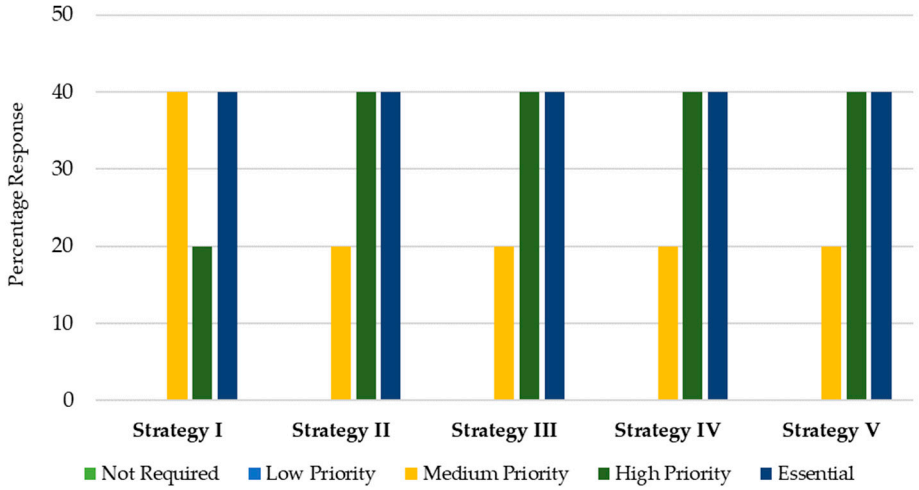

Figure 3. Response Percentages on the Proposed Strategies for Agricultural and Animal Production.

3.2. Wildlife and Ecosystem Protection

There are significant links between urban planning, landform, and wildlife habitat, and it is, therefore, essential to maintain the balance of the wildlife and plant environment when allocating residential zones in the master plan of urban development. This matter was discussed under two main strategies, as illustrated in Table 3 and Figure 4, and discussed further below.

Table 3. Weighted Averages for the Strategies for Wildlife and Ecosystem Protection.

Sr. No.	Title	Short Description	Weighted Average
Strategy I	Protection of Forests	The identity and the ecosystem of the forests and the natural environment between settlements should be protected in urban development master plans.	4.32
Strategy II	Waste Disposal Planning	The waste disposal from residential areas should be managed, due to the potential impact on local wildlife, such as the increase in the number of monkeys.	4.36

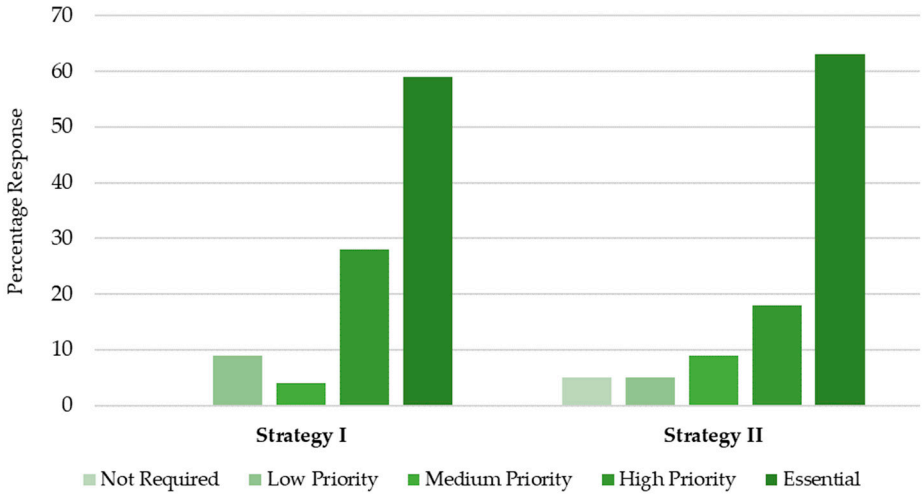

Figure 4. Response Percentages on the Proposed Strategies for Wildlife and Ecosystem Protection.

Protection of Forests: The southern regions of Saudi Arabia are widely forested, and these forests constitute a rich wildlife habitat and natural environment. Therefore, the forests should be protected in urban development planning, and roles created to manage them in a way that avoids the cutting down of trees or otherwise adversely impacting the local flora and fauna. Cities and other settlements should be extended in a way that avoids having a detrimental impact on the forests and wider environmental identity.

Waste Disposal Planning: In recent years, there has been a dramatic increase in the number of monkeys across the southwestern regions of Saudi Arabia, due to an imbalance in the ecosystem, and the loss of natural predators. The loss of these predators was in part the result of urban sprawl since they could not live alongside humans. The increase in the number of monkeys was also due to the daily production of waste from homes providing an alternative food source. The monkey population explosion has caused damage to both the natural plant life and farms, and it is, therefore, important to allocate waste disposal facilities in urban plans that are located at a distance from cities and other settlements, to protect the local natural environment and agricultural production.

3.3. Renewable Energy Development

There should be a focus on sustainable energy production, and on new and renewable energy sources, with a research priority on the study of the potential of energy generation in the southwestern regions of Saudi Arabia, including a particular focus on sustainable and renewable methods of energy production, incorporating both on-site and off-site energy resources. Since the field of energy, studies are currently in early stages in Saudi Arabia in general, and in the southwestern regions in particular, this research will provide an understanding of the current usage, practices, availability, governing policies, and energy economics of the sector that will constitute the foundation of future comprehension of the potential generation of renewable energy, the environmental impact of this generation, and the future of such energy industries.

In the focus group discussions, two members presented the advantages of the southwestern regions of Saudi Arabia for reducing energy demand and enhancing renewable energy generation in the form of electricity, focusing on certain renewable energy generation approaches that are suitable for use in the Al-Baha region, and in other similar provinces in Saudi Arabia. The group members then discussed five main renewable energy approaches, as illustrated in Table 4. Figure 5 shows the percentage response for Renewable Energy Development.

Table 4. Weighted Averages for the Strategies on Renewable Energy Development.

Sr. No.	Title	Short Description	Weighted Average
Strategy I	Solar Energy Investment	Allocate solar radiation areas for energy generation on the southern foothills of the mountains.	3.75
Strategy II	Wind Energy Investment	Allocate wind energy generation fields for turbines on top of mountains.	3.54
Strategy III	Biomass Energy Generation	Exploit appropriate forests for renewable energy, and provide energy for the surrounding settlements.	3.04
Strategy IV	Hydroelectricity Generation	Exploit appropriate valleys and construct dams for generating energy via hydroelectrical strategies.	3.75
Strategy V	Geothermal Energy	Use geothermal strategies for energy generation, due to the mountain landform topography.	3.04

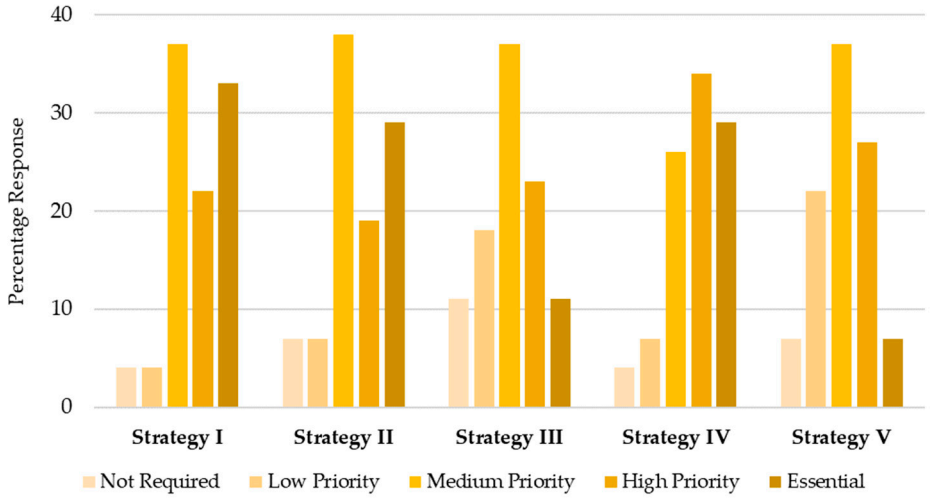

Figure 5. Response Percentages on the Proposed Strategies for Renewable Energy Development.

The approaches outlined in Table 4 should be applied according to the availability of the relevant natural resources in the southwestern regions of Saudi Arabia, and the challenges it faces, as follows:

Solar Energy Investment: Solar radiation is rapidly becoming one of the fastest-growing renewable resources worldwide. Solar energy is harnessed by transforming natural light from the sun into clean energy for the domestic sector and other services [21] through the use of photovoltaic (PV) panels. The introduction of an architectural code of practice that mandates the compulsory application of onsite renewable energy tools to generate electricity via solar radiation for each home can reduce the energy demand from burning fossil fuels and engender a reduction in the carbon dioxide (CO_2) emission rate [22]. Every house in the southern regions of Saudi Arabia has a low energy demand coupled with a high availability of solar radiation that can be used for the operation of domestic buildings. In addition, many locations in the southern regions of the country have rugged landforms that are not suitable for construction but are appropriate for investment in energy generation using PV fields to generate energy in the form of electricity and to export this energy to remote settlements. The number of fields developed should be compatible with the requirements of urban sprawl and future energy demand.

Wind Energy Investment: Many previous studies found that the use of natural resources for energy production, specifically wind energy, is more successful on high mountainous landforms than in cities [22,23], and there should, therefore, be an investment in wind energy in the mountainous regions of Saudi Arabia to provide energy to remote settlements and other areas. Each wind turbine can generate energy for many dwellings, so investment in the development of many turbines in the mountains will serve thousands of homes, both rurally and across the cities. Furthermore, energy demand in the domestic sector of the southern regions of the county is lower than elsewhere, due to the climate conditions and lifestyle that require less energy than in other provinces of Saudi Arabia. By connecting to the grid, the wind turbines have the potential to provide clean electricity with a zero-carbon emission rate, using 100% renewable energy.

Biomass Energy Generation: The southern regions of Saudi Arabia, particularly the southwest of the country, are widely forested, with a huge variety of plants and other wildlife that can be harnessed in the production of renewable energy. Biomass is a renewable organic material produced by animals and plants [24] that stores chemical energy from solar radiation that possesses huge potential energy production capability. This is especially available in areas that possess wildlife, forests, and a high rate of solar radiation [25], such as the southwest of Saudi Arabia. Since investment in all available renewable resources is important and should be targeted in the development of cities in southwest Saudi

Arabia, developers should harness the natural energy available from the forests to produce electricity for remote settlements, exporting the surplus energy to the surrounding regions.

Hydroelectricity Generation: The southwestern regions of Saudi Arabia have a higher annual rainfall in the many valleys among mountains than other regions of the country, an advantage that can be exploited in the building of dams for the creation of hydroelectricity, another form of renewable energy. Many forms of water can be employed to generate energy by constructing a dam that directs the water flow through a pipe to a turbine, then ejecting it on the other side. The force of the water traveling through the pipe spins the turbines and generates energy in the form of electricity. This form of energy generation is highly suited to the southern regions of Saudi Arabia, due to the many valleys, and should, therefore, be invested in by allocating locations for hydroelectricity systems in the planning of cities. This form of energy production has a low degree of carbon emissions annually [26], and energy generation from hydroelectricity can dispatch electricity to the grid and provide an essential backup form of energy generation during major electricity emergencies.

Geothermal Energy: The southwestern regions of Saudi Arabia have high mountains that can be used as locations for energy generation, as holes bored deep in the earth can produce heat in the form of steam that can be employed for renewable energy [27] through the use of a 'chimney' through which the steam is funneled to a turbine, rotating it and generating energy [28,29]. The benefit of this technique in the Al-Baha region, and all southern regions of Saudi Arabia, is its ability to generate sufficient energy to serve remote settlements with a zero-carbon emission rate. Moreover, the nature of the southwestern regions of Saudi Arabia, with their mountains and cool climate, has the potential to generate sufficient clean energy for other regions of the country, considerably reducing the country's carbon emission rate and reliance on fossil fuels for energy production.

3.4. Heritage and Tourism Development

The heritage of a region reflects the local urban and architectural identity and can play a significant role in historic preservation, as well as stimulating the local culture [30,31]. Heritage locations in villages can be developed as a form of investment in the tourism industry and for conserving local traditions through their preservation [32]. The focus group members discussed how the wealth of heritage in the villages and historical locations in the southwest of Saudi Arabia, such as castles, palaces, and mosques, can be promoted by using local construction materials to reflect the vernacular architecture. Strategies for the conservation and promotion of the region's heritage to develop tourism were discussed under three areas, as outlined in Table 5 and Figure 6.

Table 5. Weighted Averages for the Strategies on Heritage and Tourism Development.

Sr. No.	Title	Short Description	Weighted Average
Strategy I	Accommodation Facilities	Allocate and develop tourist accommodation facilities with options for different visitor budgets.	4.18
Strategy II	Local Farm Development	Allocate certain local farms for tourism purposes to showcase the local seasonal agricultural products.	4.0
Strategy III	Rehabilitation of Heritage Villages	Select particular heritage villages and designate attractive elements, such as hotels and/or shops, for development and restoration.	4.25
Strategy IV	Restoration and Accessibility	Designate certain heritage villages and historical facilities for restoration and protection.	3.89

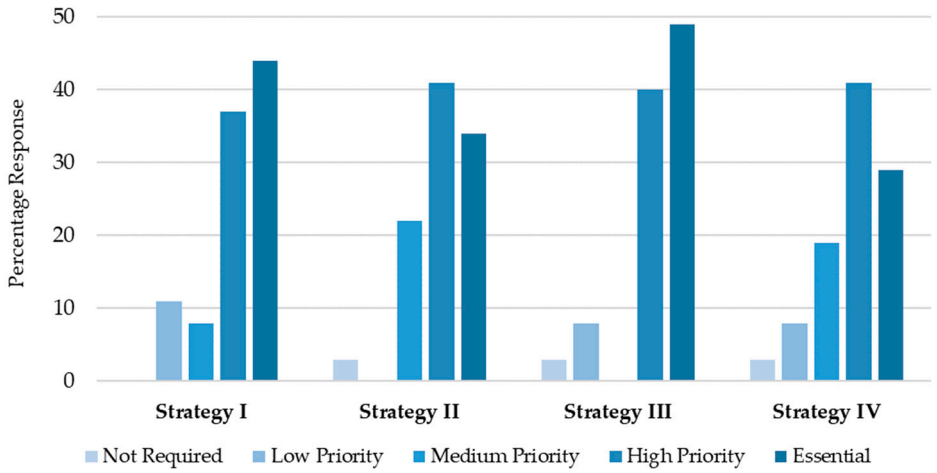

Figure 6. Response Percentages on the Proposed Strategies for Heritage and Tourism Development.

Accommodation Facilities: The tourism industry is an important element for the region that should be considered in the urban planning of the southwest of Saudi Arabia. There are a range of aspects that should be included, such as (a) providing and developing tourist accommodation facilities, (b) offering social and tourism programs appropriate to the local landforms and topography, (c) providing tourist resorts and sports activities, and (d) building shops and other tourist facilities. The tourism industry of the southwestern regions can play a significant role in the local economy and can be attractive to investors due to the region's landforms and cooler climate, which is preferred by tourists in the Middle East for their vacations.

Local Farm Development: The southwestern regions of Saudi Arabia are characterized by certain seasonal fruit-vegetable produce. Some of the farms involved in this production should be developed as tourist destinations, so visitors can experience their cultivation. This will attract visitors to the regions and boost the local economy.

Rehabilitation of Heritage Villages: Heritage villages should be restored and conserved using the original local materials, to protect their unique identity. The restoration process should be managed and allocated as a priority, due to the high number of heritage facilities and different locations, and their distance from urban agglomerations. Access from and into heritage villages should be an essential part of the transport system. Since some of the high numbers of potential heritage villages are located near the main highways of the southern regions, they should be prioritized in the development, as they can easily be connected to the transport system, providing flexible access, and making them attractive heritage locations.

Restoration and Accessibility: It is essential to allocate hotels and social facilities around and within heritage villages, to encourage investors to invest in the heritage and thereby participate in the local economy. Heritage buildings can be used as museums, marketplaces for traditional products, traditional restaurants, and hotels.

3.5. Settlement Management

Southern regions of Saudi Arabia have many settlements, the population of which has often largely relocated to the central cities, causing an increase in the urban sprawl of these cities, and the shrinking of the remote settlements while disregarding the impact on the local landform and forests around the cities. Therefore, it is important to focus on developing these smaller settlements and minimizing city sprawl to protect the wildlife habitats and plant environments.

Remote Settlement Management: The southwestern regions of Saudi Arabia were originally constituted of a plethora of villages, with the governmental sectors located in the main village that subsequently sprawled and became a town. Each such settlement is surrounded by forests and other wildlife habitats that should be protected by controlling

the urban sprawl of the main towns, redirecting the urban sprawl to the smaller settlements, and distributing service facilities among the remote villages to conserve and protect the natural habitats around the cities. In the focus groups, the experts discussed how the local settlements, rather than the main cities, might be developed in a way that is sympathetic to the needs of the surrounding natural habitats. Such sympathetic development might be achieved by dividing these settlements villages into three main categories: settlements with a population of higher than 40,000, settlements with a population of between 20,000 and 40,000, and settlements with a population of less than 20,000. It was proposed that a strategic plan should be instigated for the development of the settlements with a population of between 20,000 and 40,000, allocating to them attractive factors, such as certain governmental sectors, university branches, or malls, that will encourage the population to remain, rather than relocating to the urban sprawl of larger locations, and thereby playing a significant role in protecting the surrounding forests and other wildlife habitats. The three main factors involved in the development of remote settlements are presented in Table 6 and Figure 7.

Table 6. Weighted Averages for the Strategies on Settlement Management.

Sr. No.	Title	Short Description	Weighted Average
Strategy I	Remote Settlement Management	Move development from the main town to the settlements with a population of between 20,000 to 40,000, to prevent urban sprawl in settlements with a population of 50,000+. Allocate attractive factors to the smaller settlements, such as university branches or certain governmental sectors, shops, hotels, and similar features.	3.54
Strategy II	Urban Settlement Management	Allocate new subdivision plans for locals to motivate the development of smaller settlements.	3.75

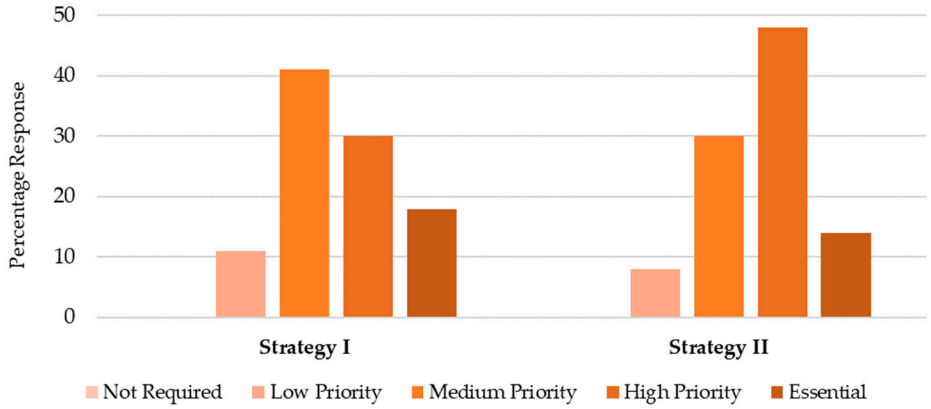

Figure 7. Response Percentages on the Proposed Strategies for Settlement Management.

Urban Settlement Management: In the discussion of an urban development framework for the mountain landform regions of Saudi Arabia, the focus groups highlighted certain main cities that have some surrounding smaller settlements, for which this framework would be suitable.

4. Discussion

The proposed urban framework should be employed by developers and urban planners involved in the planning of future towns in Saudi Arabia that are characterized as possessing a mountainous landform, with forests and cold climate conditions. The expert members of the focus groups detailed the urban strategies with the potential to play a significant role in developing such regions and their settlements in sympathy with the local natural resources and wildlife habitats. This framework is shown in Figure 8.

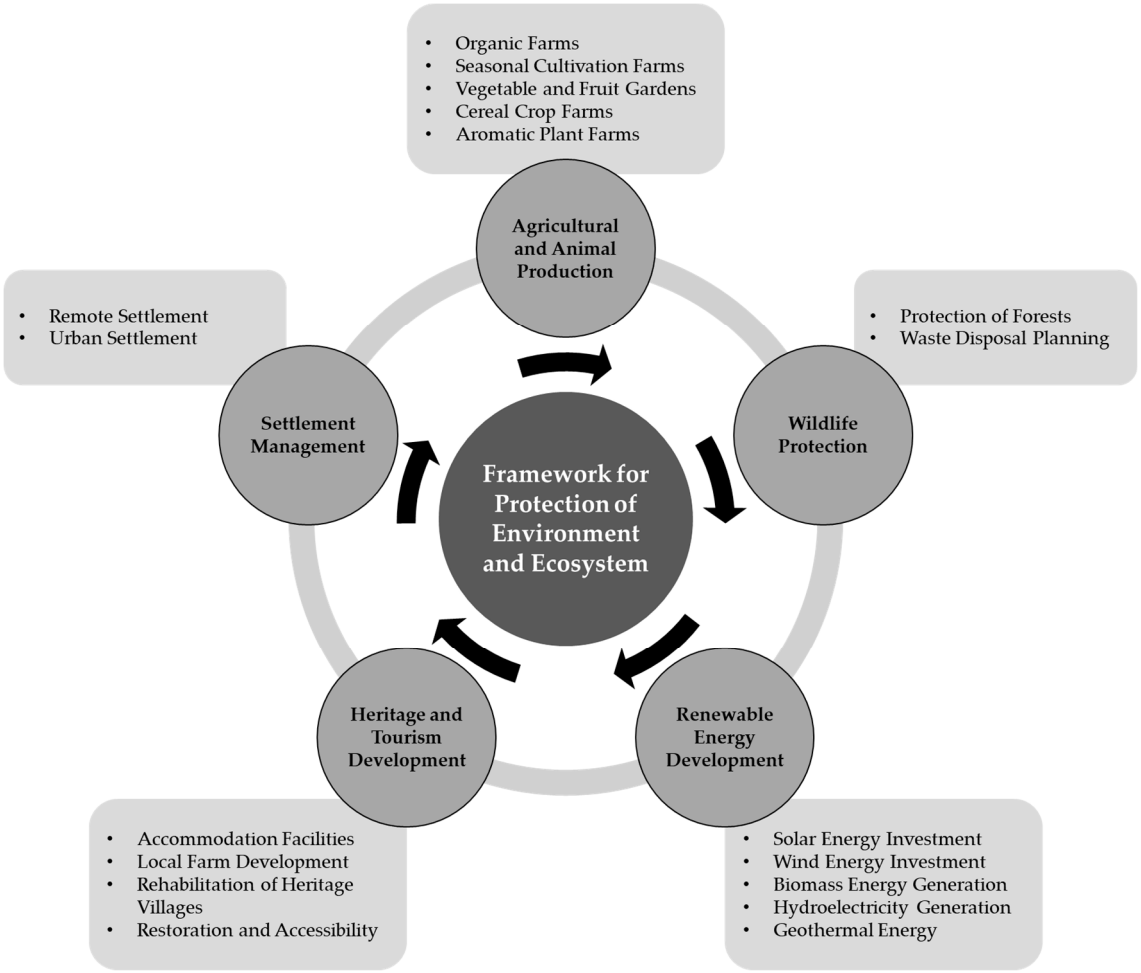

Figure 8. Proposed Regional Planning Framework for Protection of the Environment and Ecosystem of South-Western Saudi Arabia.

The strategies within the framework shown in Figure 8 were discussed and agreed upon by 70 different experts as being suitable for locations that share a similar landform topography, both in the Middle East and worldwide. The framework includes (a) the protection of the local wildlife habitats, (b) consideration of environmental responsibilities, (c) consideration of the uncertainties of the local economy, and (d) the role of rural development within the socio-urban structure.

There is a relationship between urban sprawl, wildlife, and the wider ecosystem, and the protection of wildlife habitats on a macro scale, such as in cities and towns, particularly for species that are 'urban avoiders'; this requires the modification of urban identity, and the restoration, or preservation, of suitable areas of key habitats [33]. Indeed, many previous studies highlighted the fact that the impact on the natural world of urban sprawl, and the dramatic increase in urbanization, means that it is crucial to introduce measures to protect the local wildlife and ecosystem [34]. The needs of humans, along with the nature of human culture and behavior have shaped and modified towns and cities and the surrounding natural habitat. One reason why this is of concern is the fact that many human diseases are 'zoonotic', originating in wild animals, and rodents play a significant role in the spread of human pathogens [35].

Numerous previous studies explored a range of issues related to the types and locations of wildlife across the Arabian Peninsula. For instance, Soares et al. (2015) investigated the reasons for the mortality of the rare Arabian gazelle, using the necropsy reports of 1218 captive animals at the King Khalid Wildlife Research Centre in Saudi Arabia, between 1988 and 2011 [36].

The wildlife habitat is a part of an urban system that should be considered when developing an environment [37,38]; indeed, there are many benefits of protecting urban ecosystems that impact the local wildlife, including the flora, fauna, and microbiology. The range of different topographies and climate conditions in Saudi Arabia means that the southern region is characterized as an agricultural area that is rich in wildlife. The urban development of this region should, therefore, focus on identifying a suitable area for construction, considering the needs of both human life and the ecosystem, to ensure a balance between them. Since an ecosystem is interconnected, this will ensure that the microbiology of the wider ecosystem is also kept in check. In addition, protecting the natural ecosystem will also benefit the agricultural and animal production industry [39], both of which are important aspects of the local economy in the mountainous regions of Saudi Arabia.

4.1. Environmental Responsibilities

During the economic boom in Saudi Arabia between the 1950s and 2013, the country witnessed urbanization on a massive scale, with older cities experiencing growth and new cities being founded [40]. This caused rapid growth in the number and size of roads linking these cities, with a three-fold expansion of urbanization from 1992 to 2013 [40]. This impacted the country's biodiversity, affecting the ecosystem by changing the natural habitat [41]. Both the country's flora and fauna suffered, and there has been a dramatic reduction in biodiversity since the late 1970s. Numerous previous studies investigated the relationship between CO_2 emissions and urban sprawl, highlighting the need for urban planners to reduce carbon emissions and address future energy needs [42] by considering aspects such as transportation development, water management, infrastructure, and housing, addressing the needs of both the environment and human impact on the climate and the environment [43]. Examples of these environmental responsibilities include exploiting natural resources for renewable energy production, to reduce carbon emission rates [44,45]. As discussed in more depth previously, the southwestern regions of Saudi Arabia are rich in natural resources that can be used to produce renewable energy, reducing the reliance on fossil fuels and addressing the need to reduce CO_2 emissions, providing a clean, green environment. Moreover, the protection of the local ecosystem should be addressed by urban planners and architects, to safeguard the local natural identity.

4.2. Uncertainty of Local Economy

Urban planning strategies play a significant role in shaping the local economy, affecting its sustainability [46,47]. The local industry generally exploits local materials and the urban features of the cities in a region; therefore, urban planning and investment in the southwestern regions of Saudi Arabia should focus on agriculture, tourism, and traditional and heritage villages, with the companies attracted to invest in these areas playing a significant role in the local economy. Such investors should be flexible in their approach, for example, establishing factories to manufacture products related to extant local industries in locations where the employees are also able to engage in other local businesses. In addition, it is possible to both protect and invest in heritage villages concurrently by engaging in restoration activities [48] to attract visitors and thereby play a role in the local economy and tourism industry [49].

4.3. Role of Rural Development in Socio-Urban Structure

As there are many urban suburbs across the southwestern regions of Saudi Arabia, the development of rural settlements and the balancing of services to control urban sprawl is an important function of decision-makers, as it will contribute to protecting the local wildlife and forests with the application of software tools such as geographic information system GIS [50]. Saudi Arabia is a country with a wide range of different climatic conditions, including deserts, coastal and mountainous areas, and an equally wide range of climatic conditions, including hot and arid conditions [51]. Due to these differing topographical

and climatic conditions, some of which can be challenging for agricultural production, food security is an important issue for the country, and several programs have been introduced to address the related services and farm input, as well as water supply, for the farming communities to develop the agricultural industry and increase the production of food and other agricultural products [51].

Al-Baha is considered to be a newly established city, only appearing on maps of Saudi Arabia since 1974, as it was merely a village before that date. While it is now a city by definition of its population size and administrative function, Al-Baha is a group of villages that merged to form a larger urban settlement. This inevitably impacted the nearby agricultural land that constituted the primary source of income for much of the population. During the economic boom of 1970 to 1980, the cities of Saudi Arabia witnessed rapid urban growth, with many, including Al-Baha city, doubling in size, in terms of their area and population. The cities' inhabitants became employed in commercial and economic activities, due to the new range of income sources that improved the standard of living. Due to the subsequent increase in the per capita consumption rate, the demand for residential land increased, and some began investing in real estate.

The land around the city of Al-Baha includes mountains with an uninhabitable topography; therefore, due to the longitudinal nature of urban dispersal, the city's population encroached on the surrounding flat agricultural lands, due to poor coordination between the central regulatory agencies and the executive sectors. In addition, the lack of technical competencies to manage and rationalize urban growth directly impacted this fragmentation. However, the emergence of modern means of transportation and advanced technological equipment aided in developing the more mountainous areas for habitation, cutting terraces into steep slopes and altering their topography through the processes of backfilling, mowing, and often complete removal. Support obtained from the Ministry of Municipal and Rural Affairs and the Ministry of Agriculture played a significant role in changing the local land use from agricultural to residential, engendering urban sprawl on agricultural areas and into the forests at the expense of the natural environment.

Several extant strategies highlighted the importance of suburban and rural development and urbanization [52], as well as the importance of sustainable development both economically and environmentally [53], seeking to control urban development and future land use by protecting forests and other vital aspects of the environment in the planning of urban development [54], including the creation of the related infrastructure [55], particularly in mountainous and forested areas, and other such wildlife havens. These strategies reflected the importance of employing specific approaches to rural development that avoid urban sprawl, protecting vital aspects of the natural environment.

5. Future Work and Extension of Research

It is intended that future work will explore the impact of urban expansion on the biodiversity of the Al-Baha region, considering the history of urban development in the region and allocating several sites for observation and monitoring. These sites will be studied in terms of habitat change, biodiversity change, foreign species introduction, human population growth, human interaction with wildlife, and pollution levels generated by urban expansion. These factors are direct indicators of the effect of urbanization on an ecosystem and its biodiversity, providing an understanding of the impact of human expansion on the natural habitat of the mountainous regions of Saudi Arabia. Future research may investigate the following:

- The origin and development of the city of Al-Baha;
- The geographical location of the study area, and its spatial relationships;
- The historical development of the horizontal urban growth of Al-Baha city between 2006 and 2021;
- Time-dependent implementation of the proposed framework;
- Urban growth trends;
- The promoters of urban growth in the city;

- The determinants of urban growth in the city;
- Application of the proposed framework to other regions of Saudi Arabia.

6. Conclusions

This study investigated a framework of urban planning suitable for developing the mountainous, forested regions of Saudi Arabia with particular climatic and topographical conditions. The proposed framework included a consideration of the natural environment of these regions, along with the development of heritage facilities. The strategy was developed by a focus group of relevant experts who were invited to attend Al-Baha University on 5 December 2019 to discuss the advantages and challenges embodied in the mountainous regions of Saudi Arabia. The focus group members included decision-makers based in the southwestern region of the country, academics from Al-Baha University, and relevant investors. This paper established urban planning framework strategies that address the barriers represented by the topographical and climatic conditions concerned, discussing the advantages of these regions, including their agricultural and tourism industries, and ways to encourage sustainable investment that protects the local wildlife habitat. The study highlighted the potential environmental, economic, and rural developmental impacts of employing the framework. This study recommends the following:

1. Support future research that addresses the restoration and rehabilitation of heritage villages, to identify the related challenges and the impact on the tourism industry;
2. Investigate specific urban projects for each specific southwestern region of Saudi Arabia;
3. Allocate qualified and specialized companies to produce and manufacture local construction materials, to reduce carbon emissions and protect the local urban and architectural identity;
4. Conduct feasibility studies for allocating agriculture farms, and establish associated companies, highlighting the impact on the local economy;
5. Raise awareness of the need to protect the natural habitat, to safeguard the region's ecosystem.

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