Article

Evaluation of Effective Factors in Achieving Ecological City in the Direction of Sustainable Development

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Abstract: Diverse ways have been presented for achieving urban balance and sustainability. The ecological city is one of these approaches. Consequently, the primary objective of this study is to identify and assess the effective variables in attaining an ecological city in the direction of sustainable development in the city of Jingzhou. Separating the effective criteria and variables for creating the ecological city and comparing the perspectives of professionals and citizens regarding the priority of these factors are additional objectives of this study. The current study has an applied objective and a descriptive data gathering strategy. In this study, a two-part questionnaire was developed in which Friedman's test was used to prioritize the effective criteria for attaining an ecological city from the people' perspective. The Analysis Hierarchy Process (AHP) was used to prioritize the aforementioned variables from the experts' perspective. The statistical population of the study consists of residents of the city of Jingzhou. A total of 384 individuals were selected as the sample. The analysis of data was performed using SPSS statistical software. According to the results, there is no substantial difference in ways in which residents and specialists prioritize the effective components for building an ecological city. Except for the sub-factors of the "physical" section (where the priorities are completely different among the groups) and the two "environmental" sections (where the priorities of the two groups are slightly different), the priority of the sub-factors is the same in the remaining sections from the perspective of both groups. According to the findings of this study, "independent and self-sufficient local economy" and "use of renewable energy" are the most beneficial components for creating an ecological city from the perspective of both inhabitants and professionals. In addition, among the indicators of Jingzhou city, the economic index is in a better position for the city to be ecological.

Keywords: ecological city; urban development; sustainable development; Jingzhou city

1. Introduction

In recent years, cities have occupied a prominent position on the global sustainability agenda [1], and sustainability has become the top priority in the laws governing urban planning. Despite covering only two percent of the earth's surface, cities have become the focal point of global sustainability efforts [2]. Their inhabitants consume 60–80% of the world's energy [3] and are responsible for more than 70% of greenhouse gas emissions [4]; however, cities are where the concept of sustainability will ultimately flourish or fail [5].

Today, ecological attitudes and practices are regarded as one of the most crucial global concerns in sustainable urban development [6], and planners have concluded that sustainable development cannot be realized without environmental management. In addition, by accelerating the development process in cities and ignoring the issue of sustainability and the requirements of sustainability in urban development, cities are accelerating toward instability. Air pollution, production of greenhouse gases, increase in the use of cars and traffic problems, excessive consumption of non-renewable energy, lack of water cycle management, reduction of per capita green space, and lack of sustainable design of urban landscapes all contribute to the deterioration of urban sustainability [7].

In addressing the challenge of unsustainable urban development, the concept of the ecological metropolis is one of the most prominent alternatives [8]. In his book *Berkeley Ecological City: Creating Cities for a Healthy Future*, Richard Register first introduced the term ecological city. Ecological city design has arisen as a response to two major global challenges, namely growing urbanization and climate change [9]. An ecological city is a city that works with its ecosystem to limit its effects and optimize its capacity to support the growth of all organisms [10].

Ecological city is the ideal urban paradigm in which nature and technology are fully integrated and human creativity and productivity are maximized. In addition, under these circumstances, the inhabitants' physical and mental health and the quality of the environment are at their peak, and their material wealth and energy consumption are effectively protected [11]. Ecological city consists of four fundamental characteristics: ecological integrity, economics, safety, quality of life, and empowerment [12]. Ecocity represents the optimal urban ecological development [13]. In his own research, White believes that the ecological city provides residents with an acceptable standard of living without harming the biological cycles upon which it depends [14].

The realization of a sustainable and healthy environment is contingent on the use of principles and criteria that can be successful in this field and guide the city in this direction; consequently, the existence of a road map and guide for the design of this route that fits the local conditions of China and its cities is regarded as a missing link. From this perspective, revising the rules governing urban planning, management, and design in accordance with global principles focusing on health, protection, and environmental sustainability is necessary for effective and forward progress. This issue is especially important in developing cities such as Jingzhou, because the unplanned and unlimited use of bio-natural resources to meet the needs and requirements of the city's residents causes the city's development to depart from the principles of sustainability as the city's population grows. Various social, environmental, physical, economic, cultural, and other variables are involved in obtaining the ecological city approach, and it appears that the conditions and potentials of cities are effective in this regard. Consequently, the primary objective of this study is to identify and assess the effective variables in attaining an ecological city in the direction of sustainable development in the city of Jingzhou. Separating the effective criteria and components for achieving an ecological city and comparing the perspectives of experts and residents of Jingzhou city regarding the prioritization of these factors are additional objectives of this study.

In conclusion, this study will address the issues raised by the ecological city's principles and components. In addition, the following question is considered: In what dimensions are these issues addressed, and what local elements constitute the ecological city in Jingzhou?

In addition, a review of previous scientific sources reveals that less attention has been paid to the role of citizen participation and attention to the odor pattern of the ecological city; consequently, the distinction and originality of the current study is its focus on this issue.

2. Theoretical Foundations and Research Background

The complex issues that arise from the interplay of climate change, water, and the modern city are a significant challenge [15]. Between 1890 and 1925, Patrick Geddes researched and theorized primarily on the concepts of urban ecology. During this time, he examined the theories relating to the coordination and dependence between "city and district" in the city, as well as the utilization of urban land. Patrick Geddes's ideas on the "necessity of coordination of social activity in cities" drew the attention of urban theorists, and various aspects of urban ecology gained credibility. Representative researchers in this discipline, such as Mark Jefferson, Patrick Abercrombie, and Louise Mumford, continue the sequence of Patrick Geddes' studies and illuminate new avenues in urban studies and urban ecology. Urban ecology is a prerequisite for cities to be able to provide a suitable environment for the lives of their citizens, and technological advancements can only serve the city in conjunction with ecology. Currently, in the world's largest and wealthiest cities,

which are able to cover their costs, eco-friendly technologies have been tested and proven to be effective and many have been put into effect [16].

Ecological city is an important trend for resolving our critical environmental concerns and issues. Ecological city development is predicated on the establishment of a sustainable equilibrium and interaction between social, economic, and environmental factors. The term "ecological city" derives from the core objective of sustainability and the use of environmental principles in urban planning, architecture, and management [17]. The ecological city, according to Harry Hess, is a city that interacts with nature and whose built-in human habitat and environment are interconnected with the life of urban systems [10]. The building of Husi ecological cities, according to Tai Chi Wong, is neither ephemeral nor transient; rather, it is essential to the continuation of our species [18]. As a theorist with a pragmatic approach, along with the formulation of the ecological city, he employs its concepts in a variety of projects, recommends comprehensive ecological planning, deems it the planning method of the future, and places particular focus on it. It is founded on the principle that science and technology must be in perfect harmony with the environment [19]. In conclusion, it may be stated that the ecological city represents a new model of good urban government in harmony with environment [20]. According to the 2012 United Nations Environment Program, the ecological city concept is the key to achieving sustainability. What distinguishes an ecological city from other cities is the quality of the urban environment and the ability to live there, which has the following characteristics: dense development; mixed use; low consumption of transportation; and production of renewable energy with a reduced overall environmental impact [21].

In 2014, the United Nations predicted that by 2050, the urban population would increase from 3.9 billion to 6.4 billion. Thus, the urban population will comprise between 54 and 64 percent of the total global population [22]. Human activity in fact governs the global ecosystem. Urbanization is a significant contributor to this change. Today, the world requires cities that are planned and constructed in harmony with the environment and in accordance with environmental resources. By doing so, human societies would take steps towards the restoration of natural resources so that the ecocities can be utilized for economic, social, and biological purposes of their citizen. Degradation of environmental quality and the resulting pollution directly contribute to deterioration of living conditions and quality of life, as well as a decline in the diversity of urban environments. Although natural spaces are constructed artificially in urban planning today, they serve no ecological function. In actuality, preserving the ecological nature of the urban environment signifies that the city will continue to exist in harmony with nature.

Numerous studies have been undertaken on the ecological city model [23–26]; ecocity (ecological cities) is a relatively new name, although it is based on decades-old notions. In 1869, the German biologist Ernst Haeckel coined the term ecology to describe a new branch of study in biology. Ecology, according to his definition, is the study of the mutual interaction between living creatures and their environment. Richard Register founded urban ecology in 1975 in California as a non-profit organization for nature-centered urban revitalization [27]. The desire to live in harmony with nature is not a new issue in human history; philosophers and intellectuals from both Western and Eastern civilizations have considered it in the past [28].

Kenworthy [29], in the course of his research, identified 10 fundamental aspects in the field of ecological city and presented them in the form of a conceptual model. These ten elements include compact urban form, mixed use, and a focus on public transportation. This concept demonstrated that the foundation of an ecological city is sustainable city and transportation. In their book *Dimensions of Sustainable City*, Jenks and Jones [30] examined the relationship between urban form and variables including traffic, environment, social acceptability, energy consumption, and economic survival. According to McCarty and Kaza's [31] research, there is a correlation between the spatial development pattern of a city and its level of pollution and air quality, and the dispersed form contributes to poor

air quality. In a study, Wang et al. [32] highlighted the impact of city layout, as well as the social and economic characteristics of the inhabitants, on carbon dioxide emissions.

In their research, Hu et al. [33] analyzed the lessons learned from three ecological cities in Asia. The findings indicate that the variables influencing the development of the Asian ecological city include the application of a local policy and strategy, the ongoing involvement of local inhabitants, and the utilization of national capacities and economic capabilities. Li et al. [34] examined environmental and ecological influencing factors in an article titled "Environmental analysis of Chinese cities from an ecological perspective using climatic indicators." Climate change has been a significant factor in the ecological transformation of Chinese cities, according to the findings of this study.

In addition, Chen et al. [13] used the entropy and TOPSIS model to assess the ecological level of the city in a study dubbed ecological city evaluation. Lin [35], in a study titled "Ecological Urbanism in East Asia", assessed two ecological cities in Japan and China. Using a dynamic spatial panel model, Yu [36] investigated the ecological effects of a new form of urbanization on pollutant emissions and energy efficiency. The results demonstrated that the construction of an ecological civilization in China is the most crucial strategic direction and driving force for the promotion of a new form of urbanization. Dana et al. [37], during research, studied the role of digital technologies in smart cities. Boeing et al. [38] studied the development of spatial indicators and transportation characteristics to achieve healthy and sustainable cities. Bottero et al. [39] conducted research on the potentials and limitations of sustainable cities in Europe. Flynn et al. [40] investigated eco-cities, governance, and sustainable lifestyles in the ecotourism city of Tianjin, Singapore.

Reviewing and summarizing the research presented in the papers reveals that in places and countries where the ecological city has been or is being implemented, it has had a good impact on the recovery, ecological efficiency and sustainability.

3. Materials and Methods

3.1. The Study Area

Jingzhou is a central city in the People's Republic of China, located in Hubei. Its total residential population was 5,231,180 based on the 2020 census. Of Jingzhou's residential population, 50.94 percent were males while 49.06 percent were females. On 29 September 1994, Jiangling County and Shashi City were merged to create the prefecture-level city of Jingsha. On 20 November 1996, Jingsha was renamed to Jingzhou. Figure 1 shows the geographic location of the study area.
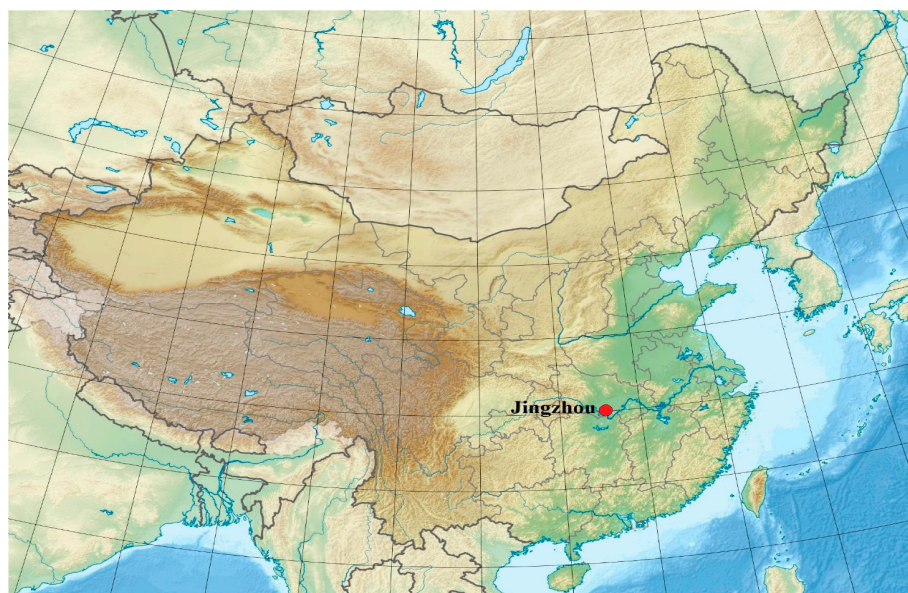

Figure 1. Geographical location of the study area in China.

3.2. Research Methodology

This study is descriptive, applied and cross-sectional. The questionnaire (Supplementary Materials) and interview were selected as the primary research instruments for the current study. According to the questionnaire, the effective variables in establishing an ecological city in the direction of sustainable development in the city of Jingzhou have been analyzed from the perspective of both specialists and inhabitants.

In this study, in order to determine the criteria and indicators that are effective in establishing an ecological city, an initial list of relevant indicators and criteria for each of the sector variables was compiled following a review of numerous domestic and international studies. In addition, due to the fact that some of the employed indicators and criteria were developed for national levels or distinct geographical regions, certain modifications and corrections were performed during the initial list's creation. It is important to note that these modifications and corrections were introduced after consulting urban management specialists. Then, in order to create the final list of indicators, the semi-structured interview method and the Delphi method were employed to solicit the opinions of thirteen experts in the field of urban management.

SPSS software was used to implement Friedman's test in order to prioritize the effective components in establishing an ecological city in the direction of sustainable development in Jingzhou city from the perspective of the residents. This test prioritizes elements based on the acquired score. In addition, Expert Choice software uses the hierarchical analysis technique in order to rank the aforementioned criteria according to the opinions of experts. To this end, the questionnaire requested that the experts analyze the criteria and indicators associated with each criterion in pairs. Thus, it was possible to identify the relative weight or significance of each criterion and the most pertinent indications for evaluating each criterion. To conduct a pairwise comparison, numerical scales ranging from 1 to 9 were employed, with each scale indicating the degree of preference of one indication over another.

This study's statistical population consisted of two groups: specialists and residents of the city of Jingzhou. The statistical population of this research comprised of experts and specialists in the field of urban management. Using the AHP approach, the opinions of twenty-three experts were solicited in this study. Jingzhou city residents comprised the statistical population of this research in order to emphasize beneficial aspects in building an ecological city. Cochran's formula (Equation (1)) was used to estimate the sample size in this study.

$$n = \frac{\frac{t^2 pq}{d^2}}{1 + \frac{1}{N}\left(\frac{t^2 pq}{d^2} - 1\right)}, \tag{1}$$

where n is the sample size; p is the probability of the trait, q is the probability of absence of attribute, N is the total population, d^2 is the desired feasible accuracy and t is the number of standard errors required to obtain an acceptable confidence factor at the 95% level, which is 1.96.

In this study, samples were chosen using a basic random procedure and depending on people's desire to collaborate. For the purpose of validating the questionnaire, a logical validity study was conducted, which was reviewed and validated by a panel of experts. In order to determine the reliability of the current research questionnaire, Cronbach's alpha was used in such a way that the first questionnaire was distributed at random to 10 experts, then the collected data were analyzed and Cronbach's alpha was used to calculate the questionnaire's reliability (Equation (2)).

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{S_t^2}{\sum S_i^2}\right), \tag{2}$$

where α is the alpha coefficient of Cronbach, k is the number of items, St is the standard deviation of the scale, and Si is the standard deviation of questions or items.

In this study, eventually, multi-criteria decision-making procedures were utilized to rank the indicators most successful in establishing an ecological city (Equation (3)). After obtaining the weight of each indicator in regard to each criterion in the previous phase, the weight of each criterion was similarly calculated in relation to the target, and the ultimate weight of each criterion was determined as follows:

$$A^* = \sum_{j=1}^{n} w_{ij} \times v_j \tag{3}$$

where W_{ij} represents the weight of the indicator *i* relative to criterion *j*, and V_j represents the weight of criterion *j*. On this basis, the weight of each criterion was determined, and the final ranking of the criteria was determined using these weights.

4. Results

According to the objectives of the research, 26 indicators were selected in the form of five environmental, physical, economic, managerial and social criteria. Cronbach's alpha coefficient was used to measure the reliability of the questionnaire. Cronbach's alpha for all indicators is above 0.7, and it shows the correlation and internal consistency of the indicators and the reliability of the items to measure the concept of the research, whose values are presented in Table 1. In addition, in Table 2, the list of indicators for achieving the ecological city is presented.

Table 1. The reliability of the studied indicators.

Row	Criterion	Cronbach's Alpha
1	Environmental	0.73
2	Physical	0.81
3	Economic	0.77
4	Managerial	0.75
5	Social	0.79

Table 2. List of indicators for achieving the ecological city.

Criterion	Indicator	Source
Environmental	Prevent the spread of various types of pollution	Gunawansa [41]; An [42]; Flynn et al. [40]; Downton [43]; White [14]
	Revival of vegetation	
	Use of renewable energy	
	Production of renewable and carbon-free energy	
	Protection of environmental resources and basic resources	
	Protection and strengthening of biological and natural corridors	
Physical	Preventing excessive and unconventional urban growth	Regiser [44]; Gaffron et al. [45]; Ma [11]; An [42]; Kenworthy [29]
	Use of public transportation and clean energy	
	Reuse of brownfields and existing buildings	
	Recovery and improvement of damaged biological areas	
	Taking advantage of a legible, diverse and human-oriented urban structure	
Economic	Independent and self-sufficient local economy	Bibri and Krogstie [23]; An [42];
	The existence of local markets for farmers	
	Job opportunities appropriate to the cultural and local environment	
	Promoting simple living and reducing resource consumption	

Table 2. *Cont.*

Criterion	Indicator	Source
Managerial	Restoration of the damaged and destroyed environment	Downton [43]; Gunawansa [41]; Bibri and Krogstie [23]
	Development of green technologies and services	
	Preparation and compilation of ecological laws and regulations	
	Improving the state of waste and garbage and urban sewage	
	Using effective and powerful workforce instead of consuming resources, energy and materials	
Social	A sense of belonging to a place of residence	White [14]; Yang [46]; An [42]
	Community empowerment in terms of participation and decision making	
	Social order and adaptability to environmental changes	
	Increasing public awareness in the field of environmental sustainability	
	Appreciating the respect for nature	
	Education and culture development to produce less waste and save resources	

4.1. Prioritization of Effective Factors in Achieving an Ecological City from the Perspective of Citizens Based on Friedman's Test

Using the Friedman's test, this section ranks the effective components in achieving the ecological city from the perspective of the citizens (Table 3). From the perspective of this group of inhabitants, "Economic" and "Environmental" criteria are more significant than other variables in building an ecological city. Table 3 displays, with a confidence level of 99% (Sig = 0.000), the ranking of the most important components and sub-factors for attaining the ecological city from the perspective of the people.

Table 3. Ranking of effective criteria and sub-criteria in achieving ecological city from citizens' point of view by Friedman's method.

Criterion	Average Score	Indicator	Average Score
Environmental	4.10	Prevent the spread of various types of pollution	3.80
		Revival of vegetation	3.11
		Use of renewable energy	3.61
		Production of renewable and carbon-free energy	3.19
		Protection of environmental resources and basic resources	3.46
		Protection and strengthening of biological and natural corridors	3.14
Physical	3.72	Preventing excessive and unconventional urban growth	3.15
		Use of public transportation and clean energy	3.39
		Reuse of brownfields and existing buildings	2.99
		Recovery and improvement of damaged biological areas	2.82
		Taking advantage of a legible, diverse and human-oriented urban structure	2.65
Economic	4.36	Independent and self-sufficient local economy	3.16
		The existence of local markets for farmers	2.32
		Job opportunities appropriate to the cultural and local environment	2.69
		Promoting simple living and reducing resource consumption	2.47

Table 3. *Cont.*

Criterion	Average Score	Indicator	Average Score
Managerial	3.85	Restoration of the damaged and destroyed environment	2.97
		Development of green technologies and services	4.19
		Preparation and compilation of ecological laws and regulations	4.21
		Improving the state of waste and garbage and urban sewage	3.52
		Using effective and powerful workforce instead of consuming resources, energy and materials	4.04
Social	4.00	A sense of belonging to a place of residence	3.44
		Community empowerment in terms of participation and decision making	3.25
		Social order and adaptability to environmental changes	3.18
		Increasing public awareness in the field of environmental sustainability	4.03
		Appreciating the respect for nature	3.30
		Education and culture development to produce less waste and save resources	3.82

Table 4 presents the ranking results of several factors affecting in establishing an ecological city from the viewpoint of index ranking. According to Table 4, the "Independent and self-sufficient local economy" "Prevent the spread of various types of pollution" and "Job opportunities appropriate to the cultural and local environment" indicators are ranked first, second, and third, respectively, and have been introduced as the most effective indicators.

Table 4. Prioritizing various indicators that are effective in achieving an ecological city from the perspective of citizens.

Criterion	Ranking	Indicator	Ranking
Environmental	2	Prevent the spread of various types of pollution	1
		Revival of vegetation	6
		Use of renewable energy	2
		Production of renewable and carbon-free energy	4
		Protection of environmental resources and basic resources	3
		Protection and strengthening of biological and natural corridors	5
Physical	5	Preventing excessive and unconventional urban growth	2
		Use of public transportation and clean energy	1
		Reuse of brown fields and existing buildings	3
		Recovery and improvement of damaged biological areas	4
		Taking advantage of a legible, diverse and human-oriented urban structure	5
Economic	1	Independent and self-sufficient local economy	1
		The existence of local markets for farmers	4
		Job opportunities appropriate to the cultural and local environment	2
		Promoting simple living and reducing resource consumption	3
Managerial	4	Restoration of the damaged and destroyed environment	5
		Development of green technologies and services	2
		Preparation and compilation of ecological laws and regulations	1
		Improving the state of waste and garbage and urban sewage	4
		Using effective and powerful workforce instead of consuming resources, energy and materials	3

Table 4. *Cont.*

Criterion	Ranking	Indicator	Ranking
Social	3	A sense of belonging to a place of residence	3
		Community empowerment in terms of participation and decision making	5
		Social order and adaptability to environmental changes	6
		Increasing public awareness in the field of environmental sustainability	1
		Appreciating the respect for nature	4
		Education and culture development to produce less waste and save resources	2

In the index ranking section, from the perspective of citizens, and in the environmental factors section, the sub-factors "Prevent the spread of various types of pollution", "Use of renewable energy", and "Protection of environmental resources and basic resources" are the most important. Physically, "Use of public transportation and clean energy", "Preventing excessive and unconventional urban growth", and "Reuse of brownfields and existing buildings" were more crucial to establishing an ecological city. In addition, in terms of economic criteria, the results revealed that the "Independent and self-sufficient local economy" is the most important sub-factor in this industry, according to the respondents. The "Preparation and compilation of ecological laws and regulations" index played a unique function in the administrative sector from the perspective of the general public. Following that, "Development of green technologies and services" and "Using effective and powerful workforce instead of consuming resources, energy and materials" were increasingly significant. In terms of social criteria, inhabitants consider "Increasing public awareness in the field of environmental sustainability" and "Education and culture development to produce less waste and save resources" to be their top and second objectives, respectively.

4.2. Prioritization of Effective Factors in Achieving the Ecological City from the Point of View of Experts Based on the AHP Model

In this section, the effective factors and sub-factors for achieving an ecological city have been ranked based on the opinions of experts and the importance coefficient acquired. Experts have determined that the "Economic" factor with a significance rating of 0.263 is the most important factor. Additionally, "Managerial" and "Environmental" variables were placed in the following categories. In this regard, the "Physical" component was rated last with a significance coefficient of 0.116 (Table 5).

Table 5. Calculation of the final weights of research options (indices).

Criterion	Weight	Indicator	Weight	Final Score
Environmental	0.219	Prevent the spread of various types of pollution	0.212	0.046
		Revival of vegetation	0.087	0.019
		Use of renewable energy	0.238	0.052
		Production of renewable and carbon-free energy	0.183	0.04
		Protection of environmental resources and basic resources	0.151	0.033
		Protection and strengthening of biological and natural corridors	0.129	0.028
Physical	0.116	Preventing excessive and unconventional urban growth	0.277	0.032
		Use of public transportation and clean energy	0.235	0.027
		Reuse of brownfields and existing buildings	0.195	0.023
		Recovery and improvement of damaged biological areas	0.132	0.015
		Taking advantage of a legible, diverse and human-oriented urban structure	0.159	0.018

Table 5. *Cont.*

Criterion	Weight	Indicator	Weight	Final Score
Economic	0.263	Independent and self-sufficient local economy	0.345	0.091
		The existence of local markets for farmers	0.155	0.041
		Job opportunities appropriate to the cultural and local environment	0.218	0.057
		Promoting simple living and reducing resource consumption	0.282	0.074
Managerial	0.230	Restoration of the damaged and destroyed environment	0.217	0.050
		Development of green technologies and services	0.253	0.058
		Preparation and compilation of ecological laws and regulations	0.268	0.062
		Improving the state of waste and garbage and urban sewage	0.155	0.036
		Using effective and powerful workforce instead of consuming resources, energy and materials	0.107	0.025
Social	0.171	A sense of belonging to a place of residence	0.139	0.024
		Community empowerment in terms of participation and decision making	0.163	0.028
		Social order and adaptability to environmental changes	0.088	0.015
		Increasing public awareness in the field of environmental sustainability	0.272	0.047
		Appreciating the respect for nature	0.116	0.02
		Education and culture development to produce less waste and save resources	0.221	0.038

In order to produce valid results in the real world, a certain amount of inconsistency is required when ranking items and actions according to the criteria. Using the consistency ratio, AHP determines the overall inconsistency of judgments. This consistency indicates the degree to which the preferences of the group members or the preferences of the combination tables may be relied upon. The consistency of the comparisons can be accepted if the consistency ratio (C.R.) is less than 0.10; otherwise, the comparisons must be performed again [47]. The analysis revealed that the compatibility rate for all comparisons is less than 0.10, hence the comparisons can be recognized as compatible.

Table 6 presents the ranking results of several factors affecting in establishing an ecological city from the two viewpoints of index ranking and overall ranking. According to Table 6, the "Independent and self-sufficient local economy" "Promoting simple living and reducing resource consumption" and "Preparation and compilation of ecological laws and regulations" indicators are ranked first, second, and third, respectively, and have been introduced as the most effective indicators.

Table 6. Prioritization of various indicators effective in achieving an ecological city from the point of view of experts.

Criterion	Indicator	Index Ranking	Overall Ranking
Environmental	Prevent the spread of various types of pollution	2	9
	Revival of vegetation	6	22
	Use of renewable energy	1	6
	Production of renewable and carbon-free energy	3	11
	Protection of environmental resources and basic resources	4	14
	Protection and strengthening of biological and natural corridors	5	16
Physical	Preventing excessive and unconventional urban growth	1	15
	Use of public transportation and clean energy	2	17
	Reuse of brownfields and existing buildings	3	20
	Recovery and improvement of damaged biological areas	5	24
	Taking advantage of a legible, diverse and human-oriented urban structure	4	23

Table 6. *Cont.*

Criterion	Indicator	Index Ranking	Overall Ranking
Economic	Independent and self-sufficient local economy	1	1
	The existence of local markets for farmers	4	10
	Job opportunities appropriate to the cultural and local environment	3	5
	Promoting simple living and reducing resource consumption	2	2
Managerial	Restoration of the damaged and destroyed environment	3	7
	Development of green technologies and services	2	4
	Preparation and compilation of ecological laws and regulations	1	3
	Improving the state of waste and garbage and urban sewage	4	13
	Using effective and powerful workforce instead of consuming resources, energy and materials	5	18
Social	A sense of belonging to a place of residence	4	19
	Community empowerment in terms of participation and decision making	3	16
	Social order and adaptability to environmental changes	6	24
	Increasing public awareness in the field of environmental sustainability	1	8
	Appreciating the respect for nature	5	21
	Education and culture development to produce less waste and save resources	2	12

In the sub-factor rating section in the environmental section, "Use of renewable energy" has been selected by experts as the most crucial aspect in creating an ecological city. "Prevent the spread of various types of pollution" and "Production of renewable and carbon-free energy" were also placed in the following list of priorities. In ranking the physical factors, "Preventing excessive and unconventional urban growth" was placed first while "Use of public transportation and clean energy" and "Reuse of brownfields and existing buildings" were assigned to the following ranks. The "Independent and self-sufficient local economy", "Promoting simple living and reducing resource consumption", and "Job opportunities appropriate to the cultural and local environment" indices ranked first, second, and third, respectively, by the specialists in the economic sector. According to analysts, "Increasing public awareness in the field of environmental sustainability" with a significance coefficient of 0.272 is the most significant subfactor in the social sector. Then, "Education and culture development to produce less waste and save resources" with an importance coefficient of 0.221 and "Community empowerment in terms of participation and decision making" with an importance coefficient of 0.163 were rated second and third, respectively, in terms of importance. Experts identified the "Preparation and compilation of ecological laws and regulations" and "Development of green technologies and services" indicators as the most essential sub-criteria in the management sector, assigning them a higher priority than other aspects. Additionally, "Using effective and powerful workforce instead of consuming resources, energy and materials" was less significant than the other sub-criteria in this area.

4.3. Comparing the Ranking of Effective Factors in Achieving an Ecological City from the Point of View of Citizens and Experts

The ranking of the successful factors in building an ecological city, as determined by inhabitants and professionals, is presented in Table 7. On this basis, "Economic" and "Environmental" from the perspective of the inhabitants and "Economic" and "Managerial" from the perspective of the professionals were identified as the most essential aspects in attaining the ecological city.

Table 7. Comparing the rank of effective criteria and sub-criteria in achieving ecological city from the point of view of citizens and experts.

Criterion	Ranking of Experts	Ranking of Citizens	Indicator	Ranking of Experts	Ranking of Citizens
Environmental	3	2	Prevent the spread of various types of pollution	2	1
			Revival of vegetation	6	6
			Use of renewable energy	1	2
			Production of renewable and carbon-free energy	3	4
			Protection of environmental resources and basic resources	4	3
			Protection and strengthening of biological and natural corridors	5	5
Physical	5	5	Preventing excessive and unconventional urban growth	1	2
			Use of public transportation and clean energy	2	1
			Reuse of brownfields and existing buildings	3	3
			Recovery and improvement of damaged biological areas	5	4
			Taking advantage of a legible, diverse and human-oriented urban structure	4	5
Economic	1	1	Independent and self-sufficient local economy	1	1
			The existence of local markets for farmers	4	4
			Job opportunities appropriate to the cultural and local environment	3	2
			Promoting simple living and reducing resource consumption	2	3
Managerial	2	4	Restoration of the damaged and destroyed environment	3	5
			Development of green technologies and services	2	2
			Preparation and compilation of ecological laws and regulations	1	1
			Improving the state of waste and garbage and urban sewage	4	4
			Using effective and powerful workforce instead of consuming resources, energy and materials	5	3
Social	4	3	A sense of belonging to a place of residence	4	3
			Community empowerment in terms of participation and decision making	3	5
			Social order and adaptability to environmental changes	6	6
			Increasing public awareness in the field of environmental sustainability	1	1
			Appreciating the respect for nature	5	4
			Education and culture development to produce less waste and save resources	2	2

5. Discussion

The objective of an ecological city is to remove carbon waste, generate energy from renewable sources, and cultivate an environment within the city. Instead of physical characteristics, social, economic, and environmental elements are the most important in the ecological city. Considering the multiple difficulties of urbanization and the need to achieve sustainable development objectives, concepts such as the ecological city are regarded as necessary for the future development plan of cities. The city of Jingzhou faces increasing urbanization and urban development concerns. In contrast, taking into account the advantages of the climatic and environmental potentials and the need to improve the social dimensions of the city due to its diverse settlements, it appears that the ecological city approach is the appropriate alternative for Jingzhou's future plans which can move the city closer to sustainable development.

The research of numerous sources, theories, and global experiences in the field of ecological city revealed that environmental, economic, managerial, social, and physical aspects, among others, are effective in achieving the ecological city. Consideration of local and climatic variables, as well as the identification of city-specific concerns, can be a means of achieving a successful outcome and execution of an approach. Prior to taking any action, it is crucial to raise awareness of the most significant and effective concerns in the city of Jingzhou. Expert interviews with individuals who have significant expertise and understanding of the difficulties and peculiarities of Jingzhou city and are conversant with the science of planning, management, and urban design assisted us in achieving this goal. Consequently, 26 effective environmental, economic, social, managerial, and physical components for the localization of the ecological city approach were determined. The factors and sub-factors were then prioritized and rated from the perspective of citizens using Friedman's test, and from the perspective of professionals using the AHP approach. The results indicated that, from the inhabitants' perspective, "Independent and self-sufficient local economy", "Prevent the spread of various types of pollution", and "Job opportunities appropriate to the cultural and local environment" were the top three objectives for achieving an ecological city. In addition, according to experts, "Independent and self-sufficient local economy" "Promoting simple living and reducing resource consumption" and "Preparation and compilation of ecological laws and regulations" were the most influential aspects in achieving the ecological city. Importantly, there is no substantial difference between resident and professional prioritization of the effective components for building an ecological city. For instance, the first priority of both groups for attaining an ecological city (economic) and the last priorities of both groups (physical) are identical with differences in ordering only.

Except for the sub-factors of the physical sector (where the priorities of the two groups are fully different) and the Environmental sector (where the priorities of the two groups are slightly different), the sub-factors in the remaining sectors are considered from the perspective of both groups, so that the top two priorities of the groups (Preparation and compilation of ecological laws and regulations and Development of green technologies and services) within the management section are nearly identical. In the economic sector, "Independent and self-sufficient local economy" is both groups' top priority for achieving the ecological city.

6. Conclusions

The relative influence of these parameters indicates that sustainable development focuses not only on the environmental and physical aspects, but also on its social and economic aspects. This is demonstrated by the dominance of the index of "Increasing public awareness in the field of environmental sustainability" and "Education and culture development to produce less waste and save resources" over the index of "Recovery and improvement of damaged biological areas". To accomplish development in accordance with the ecological city concept in the city of Jingzhou, efforts should be made to enhance and prioritize this index. Sustainability is a dynamic, equitable process that, in addition to

contributing to the ecological sustainability of a city, may also improve the economic and social standing of its residents.

On Limitations and Future Research Directions

Given that the majority of factors are related to physical, managerial, social, and environmental dimensions, it is likely that the current difficulties and issues of Jingzhou city are in the direction of achieving sustainability and an ecological city approach in this area. In this way, these factors can serve as a guide for decision-making and planning the future development of the city of Jingzhou, as well as be utilized in related research. Obviously, it is important to note that due to the constraints of the current research, it appears that the final conclusion and the identified factors require further examination and completion. In order to conduct specialized interviews, there were not a large number of university graduates with scientific degrees in the relevant sector. The following are ideas for future research in order to complete and improve the current study's findings:

(1) Investigation of the position and role of urban management in the creation of ecological cities;

(2) Investigation of the role of education and environmental behavior of residents in the implementation of the ecological city strategy.

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