

Assessment of Environmental Quality and Its Impact on Biodiversity in Selected Urban and Rural Ecosystems

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ABSTRACT

The present research aimed to evaluate the environmental quality and its effect on biodiversity in some urban and rural ecosystems. A descriptive and analytical research design was used with the following key environmental indicators: air quality, water quality, soil condition, waste management, land-use condition and green cover, and biodiversity indicators: species richness, species diversity, species abundance and habitat condition. The results showed the overall environmental quality and biodiversity in rural ecosystem was found to be higher than that of the urban ecosystem. The correlation analysis also revealed that there was a positive correlation between environmental quality and biodiversity and the green cover level, environmental quality level and land-use level had a significant and positive correlation with biodiversity. The study found that environmental conditions, conservation of green spaces, and sustainable land-use are significant factors in achieving eco-balance and increasing biodiversity in urban and rural environments.

Keywords: Environmental Quality, Biodiversity, Urban Ecosystems, Rural Ecosystems, Green Cover, Sustainable Land Use.

1. INTRODUCTION

Environmental quality is an integral element of ecological sustainability and is important in the health and function of ecosystems. Environment is affected by many factors including air quality, water quality, soil, waste management, uses of land and human activity. There are significant differences in population density, infrastructure, industrial activities, agricultural activities, and utilization of natural resources between urban and rural ecosystems. Such differences can cause variations in environmental conditions and pose unique ecological challenges that can impact the overall quality of the environment.

Environmental quality is closely related to biodiversity, because clean air, water, appropriate habitat, and healthy soil are essential for the life and development of various species of plants and animals. Pollution, urbanization, loss of habitats, intensive agriculture, and inappropriate waste disposal can have a negative impact on species diversity and ecosystem balance due to environmental degradation. Urban ecosystems are typically subjected to more environmental stressors such as construction, transportation and industrial development, while rural ecosystems can have environmental pressures due to agricultural expansion, resource extraction and land-use changes.

The present research concentrates on the evaluation of environmental state in certain urban and rural ecosystems and how this affects biodiversity. The study compares biodiversity patterns and environmental conditions in the ecosystems selected to gain an improved understanding of the link between ecological quality and biological diversity. The results of the study can be useful in the process of determining the major environmental issues and in developing an effective approach to the conservation of biodiversity and sustainable ecosystem management.

1.1. Research Objectives

The research objectives of the study are:

- To assess the environmental quality of selected urban and rural ecosystems.
- To examine the impact of environmental quality on biodiversity in the selected ecosystems.

2. REVIEW OF LITERATURE

Musse et al. (2018) assessed urban environmental quality by using remote sensing techniques and census data. The study assessed various environmental indicators and showed how spatial data can be used to help detect spatial variations in environmental conditions within urban areas. This finding indicated that the combination of remote sensing and socio-environmental data is a good means to evaluate urban environmental quality. The study emphasized the need of spatial analysis in the comprehension of the environmental conditions and planning of sustainable cities.

Potgieter et al. (2019) explored perceptions of the effects of IAPs in urban areas. The study examined the environmental and ecological impacts of invasive plants from different perspectives. The results identified that invasive alien plants had posed environmental problems and different perceptions to the urban communities and stakeholders. The study highlighted the need for effective management strategies and public awareness to manage and control invasive species for urban biodiversity protection.

Ronchi et al., (2020) analyzed the embedding of Green Infrastructure in spatial planning regulations in order to enhance the performances of the urban ecosystems. The study focused on the Italian context, and examined the potential of planning policies and regulations for supporting the development and protection of green infrastructure. The findings showed that the integration of green spaces in urban planning had led to the enhancement of ecological functions, environmental quality, and overall urban ecosystem sustainability. The study highlighted the need to embed Green Infrastructure in existing spatial planning processes.

Sahoo et al., (2021) studied the effects of rural activities on biodiversity and ecosystem services. The study focused on the impact of agricultural activities, land use change and other anthropogenic activities conducted in the rural areas on ecological resources and biodiversity. The results indicated that the unsustainable rural activities had had negative impacts on species diversity and ecosystem services. The study emphasized the importance of sustainable use of resources and eco-friendly management to preserve the biodiversity of rural areas and ensure ecosystem balance.

Yakovenko and Komov (2021) explored the ecosystem approach to the assessment of the environmental quality of cities and management of urban development. The study highlighted the importance of ecological indicators for the assessment of environmental conditions and for sustainable urban planning. The results indicated that an ecosystem approach had given a wider picture of the correlation between urban development, environmental quality and ecological sustainability. The study found that the incorporation of ecosystem factors into urban management had helped to make better decisions and to enhance the quality of the urban environment.

3. RESEARCH METHODOLOGY

The methodology used for environmental quality assessment and its effects on biodiversity in some selected urban and rural ecosystems is presented in this chapter. This comprises of research design, study area, sampling, sources of data, variables, data collection and data analysis.

3.1. Research Design

The research uses a descriptive and analytical research design. The descriptive design will be used to evaluate the environmental state of the chosen ecosystems, while the analytical research design will help analyze the relationship between environmental quality and biodiversity.

3.2. Study Area

The experiment takes place within chosen urban and rural ecosystems. These ecosystems include diverse environmental features and other criteria which can be compared in further research.

3.3. Population and Sample of the Study

The research examines selected environmental sites and components of biodiversity in the selected urban and rural ecosystems. The right number of samples is selected for consideration of different ecological and environmental situations.

3.4. Sources of Data

Data for the research are obtained from both primary and secondary sources. All relevant data are acquired via environmental observations, documentation, publications, and any other sources of reliable information.

3.5. Variables of the Study

The major variables include:

- **Environmental Quality Variables:** Air quality, water quality, soil condition, waste management, land use, and green cover.
- **Biodiversity Variables:** Species richness, species diversity, abundance, and habitat condition.

3.6. Data Collection

Data collection is done through suitable environmental assessment techniques from the chosen urban and rural ecosystems, including field observations and other secondary sources of information. Data on biodiversity is obtained through observation of species present and the level of their diversity in the chosen environment.

3.7. Tools and Techniques for Data Analysis

Data analysis is conducted through descriptive statistics, comparative analysis, correlation analysis, and graphical representation. Comparisons between the environmental quality parameters and biodiversity parameters of the urban and rural ecosystems are made in order to determine the relationship between the two.

3.8. Ethical Considerations

The research follows the necessary codes of ethics and environmental standards while conducting data collection and analysis. Measures are taken to avoid disturbing the environment and its biodiversity. Moreover, secondary information is appropriately referenced in the research.

4. RESULTS AND DISCUSSION

This section summarizes and discusses the results of the assessment of environmental quality and biodiversity of the studied urban and rural ecosystems. It compares the major environmental and biodiversity indicators, and explores the link between the environmental and biodiversity conditions, to get an overall picture of the health of the ecosystem and ecological differences.

4.1. Comparative Assessment of Environmental Quality

Assessment of environmental quality of the chosen urban and rural ecosystems based on the following key indicators: air quality, water quality, soil condition, waste management, land-use condition and green cover. Compensatory evaluation enables differences in environmental conditions to be identified and overall understanding of the ecological quality of both ecosystems. Table 1 and Figure 1 show the environmental quality assessment of selected urban and rural ecosystems for major indicators such as air quality, water quality, soil condition, waste management, land-use condition and green cover. Both ecosystems were evaluated in terms of their environmental quality and an overview of the ecological condition of both ecosystems was given using mean scores.

Table 1: Environmental Quality Assessment in Urban and Rural Ecosystems

Environmental Indicator	Urban Ecosystem Mean Score	Rural Ecosystem Mean Score
Air Quality	3.12	4.18
Water Quality	3.28	4.05
Soil Condition	3.35	4.22

Waste Management	3.80	3.42
Land Use Condition	3.05	4.10
Green Cover	2.95	4.35
Overall Environmental Quality	3.26	4.05

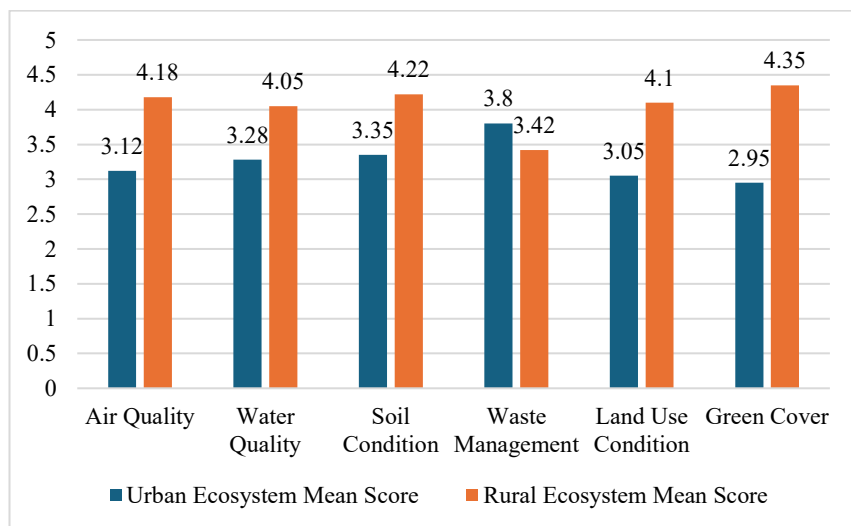


Figure 1: Graphically Representation of Environmental Quality Assessment in Urban and Rural Ecosystems

The results indicated that the mean score for the whole ecosystem for the rural ecosystem is 4.05, which is higher than the mean score of the urban ecosystem of 3.26. In the air quality, water quality, soil condition, land-use condition and green cover, the scores were higher for the rural ecosystem as compared with the urban ecosystem, while in the waste management, the score was higher for the urban ecosystem (3.80) than the score for the rural ecosystem (3.42). The result thus showed a relatively better overall environmental condition in rural areas, while the urban condition had a high environmental pressure especially regarding green cover and land use conditions.

4.2. Assessment of Biodiversity

Biodiversity of the selected urban and rural ecosystems based on species richness, species diversity, species abundance and habitat condition. The comparative assessment gives an insight into the differences in the number of species and ecological conditions in both ecosystems. Table 2 compares the biodiversity indicators for selected urban and rural ecosystems. Species richness, species diversity index, species abundance and habitat condition score are assessed. These indicators will help to understand the biodiversity level and condition in the two ecosystems and enable a comparative analysis of their ecological properties.

Table 2: Comparison of Biodiversity Indicators

Biodiversity Indicator	Urban Ecosystem	Rural Ecosystem
Species Richness	42	68
Species Diversity Index	2.85	3.72
Species Abundance	315	562
Habitat Condition Score	3.10	4.28
Overall Biodiversity Status	Moderate	High

The outcomes demonstrated that the rural ecosystem condition is better than that of the urban ecosystem, in all important aspects, regarding the biodiversity conditions. The number of species was also higher in the rural ecosystem (68 species) than in the urban ecosystem (42 species). The species diversity index, species abundance and habitat condition score of the rural ecosystem were also higher at 3.72, 562 and 4.28, respectively, than those of the urban ecosystem of 2.85, 315 and 3.10, respectively. In general, it was observed that the rural ecosystem had a higher biodiversity status, whereas the urban ecosystem had a moderate biodiversity status, meaning that the former had better habitat conditions and environmental quality than the latter.

4.3. Relationship Between Environmental Quality and Biodiversity

The relationship between environmental quality and biodiversity in the selected urban and rural ecosystems. It emphasizes the relationship between the diversity of living organisms and the quality of air and water, the condition of soil, waste management system, land-use condition and green cover. Table 3 shows the correlations between the environmental quality indicators and the biodiversity in the selected ecosystem and these are presented graphically in Figure 2. The analysis encompasses air quality and water quality, soil quality, waste management, land-use quality, green cover and overall environmental condition. Correlation values provide a direction and strength of the correlation between each environmental quality indicator and biodiversity.

Table 3: Correlation Between Environmental Quality and Biodiversity Indicators

Environmental Quality Indicator	Correlation with Biodiversity	Relationship
Air Quality	0.62	Positive
Water Quality	0.58	Positive
Soil Condition	0.65	Positive
Waste Management	0.41	Moderate Positive
Land Use Condition	0.69	Strong Positive
Green Cover	0.74	Strong Positive
Overall Environmental Quality	0.71	Strong Positive

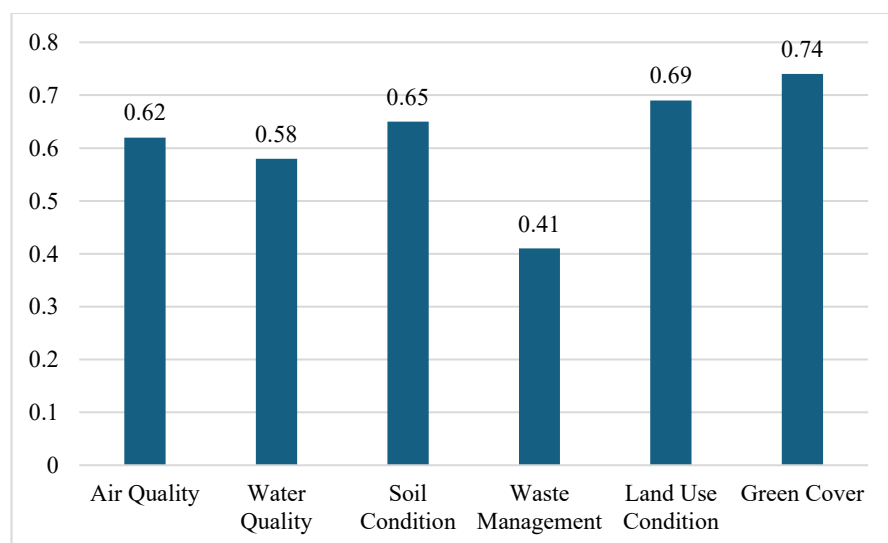


Figure 2: Graphically Representation of Correlation Between Environmental Quality and Biodiversity Indicators

The outcomes revealed a positive correlation between all environmental quality indicators and the biodiversity. Overall environmental quality ($r = 0.71$), green cover ($r = 0.74$) and land-use condition ($r = 0.69$) showed the highest correlation with biodiversity. There were also positive correlations for soil condition ($r = 0.65$), air quality ($r = 0.62$) and water

quality ($r = 0.58$) and a moderate positive correlation for waste management ($r = 0.41$). Results overall showed that the increase in biodiversity were associated with the improved environmental conditions, especially by green cover and proper land-use.

4.4. Discussion of Findings

The findings of the study demonstrated that there is a high correlation between the environmental quality and biodiversity of the selected urban and rural ecosystems. The overall environmental quality and biodiversity in the rural ecosystem were higher reflecting species richness, diversity, abundance and habitat condition. The natural vegetation (green cover) and land-use condition had the highest positive correlation with biodiversity, emphasizing the importance of natural vegetation and appropriate habitat for biodiversity. The quality of the environment and the biodiversity were comparatively low in the urban ecosystem, while the rural one was comparatively high, this could be correlated with increased human activities in the rural area, increased land use change and decreased green spaces in the urban area. The overall results showed that improved environmental conditions, maintaining green cover and sustainable land use would be important to consider in protecting and improving biodiversity in urban and rural areas.

5. CONCLUSION

The study results revealed significant positive correlations between environmental quality and biodiversity at the selected ecosystems in the city and countryside. The outcome showed that the environmental quality of rural ecosystem was better than the urban ecosystem in respect of species richness, species diversity, species abundance and habitat condition. The highest positive correlation with biodiversity was the green cover and land use conditions which highlights the importance of nature's vegetation and suitable habitats in achieving ecological balance. The urban ecosystem was doing better in waste management but had relatively more press regarding environmental deterioration in the form of decrease in green cover and land use changes. The study emphasized the need for environmental quality improvement, green spaces, preservation of natural habitats and encouraging sustainable land use to support biodiversity and sustainability in urban/rural areas.

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