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Investigating the environmental condition of Isfahan metropolis based on the DPSIR model

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Extended Abstract

Introduction:

Urban environments across the world face critical environmental challenges resulting from industrialization, rapid population growth, and unplanned urban expansion. These issues disturb the natural balance of ecosystems and impose serious social, economic, and health consequences on human societies. Isfahan, one of Iran's largest and most industrialized metropolitan areas, provides a clear example of these problems. The city's intense industrial activities, population concentration, and environmental pressures make it an ideal case study for sustainable urban policy analysis.

This study aims to assess the environmental condition of Isfahan metropolis using the DPSIR model — a conceptual framework developed by the European Environment Agency to describe the cause-and-effect relationships between human activities and the environment. The model includes five key components: Driving forces, Pressures, State, Impacts, and Responses. By analyzing these components, this study seeks to identify the main environmental challenges of Isfahan and propose management strategies aligned with sustainable urban development.

Methodology:

The research was conducted in 2022 using a mixed qualitative and quantitative approach. Data were collected through library studies, environmental status reports, expert questionnaires, and semi-structured interviews. The gathered information was then categorized under the five elements of the DPSIR framework, enabling a causal and systematic analysis.

In this framework:

- Driving forces (D) represent the fundamental socio-economic factors that trigger environmental change (e.g., population growth, industrial

development).

- Pressures (P) refer to direct human or natural factors affecting environmental quality, such as pollution or land-use change.
- State (S) describes the condition of environmental resources like air, water, and soil.
- Impacts (I) are the resulting consequences on ecosystems and human health.
- Responses (R) denote the management actions and policy measures aimed at mitigating negative effects.

Findings:

Based on the review of reports and expert evaluations, seven major driving forces were identified for Isfahan's environmental degradation. The most significant are population growth and industrial expansion.

1. Driving Forces

- Rapid population growth has intensified urbanization, housing demand, and consumption of resources.
- Industrialization, particularly steel, petrochemical, and energy sectors, has amplified emissions and waste generation.
- Migration and suburbanization have led to uncontrolled settlement expansion, often lacking infrastructure.
- Transportation growth has contributed to high levels of air and noise pollution.
- Construction projects and land-use changes have reduced green spaces and increased soil erosion.
- Groundwater exploitation has accelerated land subsidence.
- Increased waste generation has strained urban management systems.

2. Pressures

The identified driving forces have produced severe pressures, including:

- Air and water pollution, due to industrial emissions and vehicular traffic.
- Depletion of groundwater resources through over-extraction.
- Deforestation and destruction of vegetation cover.
- Waste accumulation and contamination from leachate.
- Soil degradation caused by excessive construction and land conversion.

3. State

As a result, Isfahan's environmental state is characterized by:

- Deteriorating air quality, with only 3% of days classified as clean.
- Decreased groundwater levels and worsening water quality.
- Decline in biodiversity and urban green cover.
- Expansion of slum and peripheral districts with poor living conditions.

4. Impacts

These environmental and social changes have led to multiple adverse effects:

- Increased respiratory and cardiovascular diseases.
- Mental stress and reduced quality of life among residents.

- Economic losses due to health expenditures and damage to infrastructure.
- Loss of aesthetic and ecological value of urban areas.
- Rising inequality between central and peripheral regions of the city.

5. Responses

To mitigate these problems, the study proposes several management and policy strategies:

1. Integrate human and social dimensions of urbanization into planning frameworks.
2. Develop green spaces using drought-resistant plant species.
3. Encourage waste separation at source and promote composting programs.
4. Enhance public awareness about air pollution and sustainable lifestyles.
5. Expand public transportation networks and improve fuel quality.
6. Relocate polluting industries and enforce emission standards.
7. Implement groundwater protection zones and monitoring systems (GPS/GIS).
8. Support rural livelihoods to prevent excessive rural-to-urban migration.

Discussion and Conclusion:

The DPSIR model offers a comprehensive framework for linking human development with environmental consequences. In the case of Isfahan, it demonstrates that rapid population growth, unregulated industrialization, and inadequate urban management have jointly produced multiple environmental crises.

To move toward sustainable urban policy, the city must adopt integrated management strategies focusing on:

- Population control and social equity,
- Industrial regulation and technological innovation,
- Efficient water and waste management, and
- Enhanced public participation in decision-making.

The study emphasizes that long-term success depends on aligning local and national policies, investing in environmental education, and fostering collaboration among government, private sector, and citizens. Only through such coordinated responses can Isfahan transform from a highly polluted industrial hub into a model of sustainable urban resilience in Iran.

Keywords: Isfahan metropolis, Policy, Environment, DPSIR model.,

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