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Green Belt Development: A key pathway to a sustainable and carbon-neutral future

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Abstract:

A green belt is an area of natural or agricultural land that is preserved around urban regions, encompassing open spaces such as parks, farms, ranches, and wildlands. Greenbelts play a crucial role as natural buffers in times of wildfires, while also providing essential ecosystem services like water and air quality improvement, groundwater replenishment during droughts, and carbon sequestration. Beyond these environmental benefits, green belts help prevent the merging of neighboring urban areas, protect rural areas from urban encroachment, and preserve the cultural identity of historic towns. Moreover, they contribute to urban regeneration by promoting the recycling of underused urban land. Green belts, designated as policy areas for land use, are typically protected from being developed, although this doesn't imply that no buildings can be erected within their boundaries. Green belt policies aim to address urban sprawl and ensure ecological sustainability by preventing unregulated urbanization. However, green belt policies are not without criticism, and there is often a lack of clarity regarding contentious issues in their implementation. This chapter examines the environmental and socioeconomic roles of green belts and explores the potential strategies for their preservation, including prohibiting residential development within green belt areas and utilizing brownfields for urban housing. The history of green belt development is also explored, from its origins at the end of the 19th century to the present day, with an analysis of its evolution, functions, and debates regarding its future viability in urban and regional landscapes.

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Introduction

As the world faces mounting challenges due to climate change, rapid urbanization, and environmental degradation, sustainable development has become a global priority. Urban areas contribute to nearly 70% of global carbon emissions and consume a significant portion of the world's energy (UN-Habitat 2020). These growing urban areas often encroach on natural ecosystems, leading to the loss of arable land and disruption of wildlife habitats. Between 2001 and 2020, global tree cover loss amounted to approximately 411 million hectares, contributing to annual CO2 emissions of approximately 8.41Gt (Global Forest Watch 2021). Urbanization exacerbates the heat island effect, significantly raising temperatures in cities compared to surrounding rural areas due to the replacement of vegetation with impervious surfaces. In regions like South Asia and sub-Saharan Africa, urban expansion amplifies the risks associated with heat waves and deteriorating air quality, severely affecting millions of people each year (IPCC 2022).

Uncontrolled urban sprawl has resulted in numerous environmental and social problems. From 1990 to 2018, the global urban population increased by nearly 78%, driving a parallel rise in demand for housing, transportation, and infrastructure (World Bank 2019). Green belt development presents a strategic solution to mitigate the negative impacts of urban sprawl, improving ecological resilience and fostering sustainability. Studies suggest that forests in green belts can sequester an average of 2.6Gt of CO2 annually, accounting for approximately 30% of global anthropogenic emissions (FAO 2020). Similarly, green belts, such as those in India's National Capital Region (NCR), help reduce air pollution by filtering particulate matter and lowering urban temperatures.

Green belts also enhance the quality of life in urban areas, providing recreational spaces, improving public health, and strengthening social ties. Research indicates that access to green

spaces can reduce stress by 30% and increase physical activity by up to 50%, significantly boosting overall well-being (WHO 2017).

History of Greenbelt Development

The concept of green belts has ancient roots, embedded in various cultural and environmental practices:

1. **Biblical Origins:** The Old Testament proposed green belts around Levite towns in ancient Israel, later interpreted by Moses Maimonides as applicable to all towns in Israel (Wenham 1999).
2. **Islamic Tradition:** In the 7th century, Muhammad established a green belt around Medina by prohibiting tree removal within a 12-mile radius.
3. **Elizabethan Policy:** In 1580, Elizabeth I of England banned new construction within a 3-mile radius of London to curb the spread of the plague (Tussay 2021).
4. **Modern Green Belt Policies:** The United Kingdom pioneered modern green belt planning. Proposals emerged in the late 19th century, with the 1919 London Society plan advocating a continuous belt to limit urban sprawl.
5. **Global Sustainable Development:** Today, green belts are integral to sustainable development, with many countries adopting "Green Structure Planning" to align urban development with environmental protection (Forshaw 1943).

Objectives and Principles

The primary goal of green belt policy is to protect natural and semi-natural environments. In addition to improving air quality in urban areas, green belts ensure that residents have access to landscapes that provide recreational and educational opportunities. Furthermore, green belts safeguard rural communities from urban encroachment.

Green belts also contribute to employment generation and community participation in environmental protection. Carbon sequestration in green belts plays a vital role in mitigating climate change by absorbing atmospheric CO2, storing it in plants, soil, or engineered storage sites (Vernet et al. 1898).

Approaches for Greenbelts

The primary approaches for green belt development focus on reducing pollution, enhancing environmental benefits, and boosting the aesthetic value of the land:

2.1 Climate and Environmental Suitability

Local and indigenous fast-growing tree species should be evaluated for green belt development. Trees should be planted in appropriate rows in areas where vegetation was previously absent. Unpalatable shrub species should be selected during tree species selection (Anake et al. 2023).

2.2 Location and Accessibility

The location of the green belt plays a crucial role in reducing pollution, enhancing biodiversity, and providing recreational spaces. An ideally located green belt offers benefits like air purification, noise reduction, habitat restoration, and recreational areas (Obi et al. 2021).

2.3 Plant Species Suitable for Greenbelt Development

Choosing climate-resilient tree species is essential to adapt to and mitigate urban climate change and pollution. These species should be selected for their ability to improve biodiversity and provide ecosystem services like carbon sequestration and soil stabilization (Singh 2024; Mondal et al. 2011).

Greenbelts in the 21st Century: A Debate

Green belts, once considered crucial for ecosystem conservation and urban sprawl mitigation, are now at the center of debates due to rapid urbanization, climate change, and land-use conflicts. Key questions include:

- Does green belt policy encourage urban renewal and conservation, or does it restrict housing development?
- How effective is land regulation in the urban periphery through green belt policies?

Case Factors and Greenbelt Implementation:

1. **Environmental Advantages**: Green belts improve air quality, reduce urban heat islands, and promote biodiversity. Projects like the "Aravalli Green Wall" in India aim to combat land degradation (Dhrishti IAS, 2023).
2. **Mitigating Climate Change**: Green belts play a significant role in carbon sequestration and regulating local climates. For instance, the Miyawaki forest initiative in Chennai helps offset carbon emissions (Uchiyama et al., 2023).
3. **Preventing Urban Sprawl**: Green belts limit unchecked urban growth, promoting compact urban planning. The Bangalore planning authority's green belt has controlled urban expansion since 1984 (Xie et al., 2020).
4. **Enhancing Quality of Life**: Urban green belts provide recreational spaces that improve mental health and add aesthetic value (Wang et al., 2019).

Conclusion

In the 21st century, green belts are essential for urban sustainability. However, their role must evolve to address modern challenges such as rapid urbanization, economic pressures, and climate change. By adopting innovative and resilient strategies, societies can ensure that green

belts continue to serve as vital ecological buffers while meeting the needs of a growing population

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