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Final Report

Title:

Nature-Based Solutions for Climate-Neutral Neighborhoods: Scenarios for "Ex-Technological Park"

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1. Introduction

The neighborhood under study for this report is **Ex-Technological Park**, an urban area with aging infrastructure, limited green spaces, and pressing environmental challenges. The neighborhood was primarily developed during Albania's communist era, with most buildings dating back to the mid-1970s. These structures are predominantly five-story residential blocks made of prefabricated materials, many of which exhibit signs of wear, including facade deterioration and moisture issues.

The purpose of this report is to analyze the existing conditions of the neighborhood, identify key environmental and social challenges, and propose **Nature-Based Solutions (NBS)** to enhance urban resilience and sustainability. Through scenario development, we aim to assess the effectiveness of various NBS interventions in improving air quality, mitigating heat islands, managing stormwater, and fostering social inclusion. This report outlines the assessment methodology, presents design scenarios, and evaluates their environmental, economic, and social impacts, contributing to a more climate-neutral and livable neighborhood.

2. Area Profile & Observations

2.1 Neighborhood Overview

The **Ex-Technological Park** is a dense urban area developed primarily in the mid-20th century. It is characterized by a mix of residential and commercial buildings, with most structures being five-story prefabricated apartment blocks constructed in the 1970s. The neighborhood has a total of **7** buildings, primarily used for residential purposes, though some ground-floor spaces are occupied by small businesses and services.

The estimated population of the neighborhood is around **1500** residents. A significant portion of the community comprises low-income households, including a high percentage of elderly residents and children. Due to the proximity of a major highway, the area experiences high levels of pollution, particularly from vehicle emissions, contributing to poor air quality. Additionally, limited green spaces and inadequate infrastructure impact the overall livability of the neighborhood.

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2.2 Existing Conditions

Environmental Issues:

- **Air Quality:** The neighborhood suffers from high levels of air pollution, primarily from vehicle emissions due to the nearby highway. Concentrations of PM2.5 and PM10 are significantly above recommended thresholds, leading to increased respiratory illnesses among residents.
- **Urban Heat Island Effect:** Due to the lack of green spaces and vegetation, the area experiences higher temperatures compared to surrounding zones, particularly during summer. The prevalence of concrete and asphalt surfaces further intensifies heat accumulation.
- **Flooding Risks:** The absence of proper water management infrastructure results in frequent urban flooding during heavy rainfall. Poor drainage systems contribute to water stagnation, which exacerbates the degradation of roads and buildings over time.

Social and Economic Conditions:

- **Economic Hardship:** The community faces severe financial difficulties, with many residents living below the poverty line. This economic hardship limits their ability to invest in home improvements or co-finance neighborhood infrastructure upgrades.
- **Infrastructure Deterioration:** Many of the roads within the neighborhood are unpaved or in poor condition, creating significant dust pollution and mobility challenges. Waste management services are inadequate, leading to the accumulation of garbage in public spaces, further exacerbating health risks.
- **Limited Community Engagement:** Due to socio-economic struggles, community interaction and participation in local governance are minimal. Residents report feeling disconnected from municipal decision-making processes, leading to a lack of advocacy for improvements in the area.






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3. Environmental and Ecosystem Services Assessment

3.1 Environmental/Societal Demand

The environmental and ecosystem services assessment aims to evaluate the neighborhood's current environmental challenges and identify nature-based solutions that can enhance urban resilience. This section focuses on the existing demand for environmental and societal improvements and assesses how ecosystem services can be utilized to address these challenges effectively.

The following table highlights the key environmental and societal needs of the neighborhood. These challenges necessitate the implementation of nature-based solutions to improve health, economic growth, and inclusivity.

Category	Why We Need It?	Expected Improvement
Health	Poor air quality affects respiratory health.	Improved air filtration and cooling.
Economic Growth	Lack of green spaces reduces property value.	Increased attractiveness for investment.
Inclusivity	Lack of recreational areas limits community cohesion.	Creation of inclusive urban spaces.

3.2 Ecosystem Services Supply Assessment

The following table evaluates the current availability of ecosystem services in the neighborhood, analyzing their effectiveness in addressing environmental and social concerns. It provides a framework for selecting the most relevant interventions to enhance urban resilience.

Urban Ecosystem Service	Supply Indicator	Method & Calculation	Relevance (1-5)
Microclimate regulation	Cooling capacity of vegetation	Literature-based estimations	5
Habitat provision	Biodiversity presence	Field survey	3
Recreation	Green space per capita	Mapping & GIS analysis	4
Air purification	PM10 deposition	Urban vegetation analysis	5
CO2 sequestration	Biomass carbon storage	Carbon stock calculation	4
Runoff mitigation	Water infiltration	Soil permeability testing	5

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4. Scenario Design Process

4.1 Scenario 1 – "The Breathing Wall: Green Facades for Cleaner Air and Energy-Efficient Cities"

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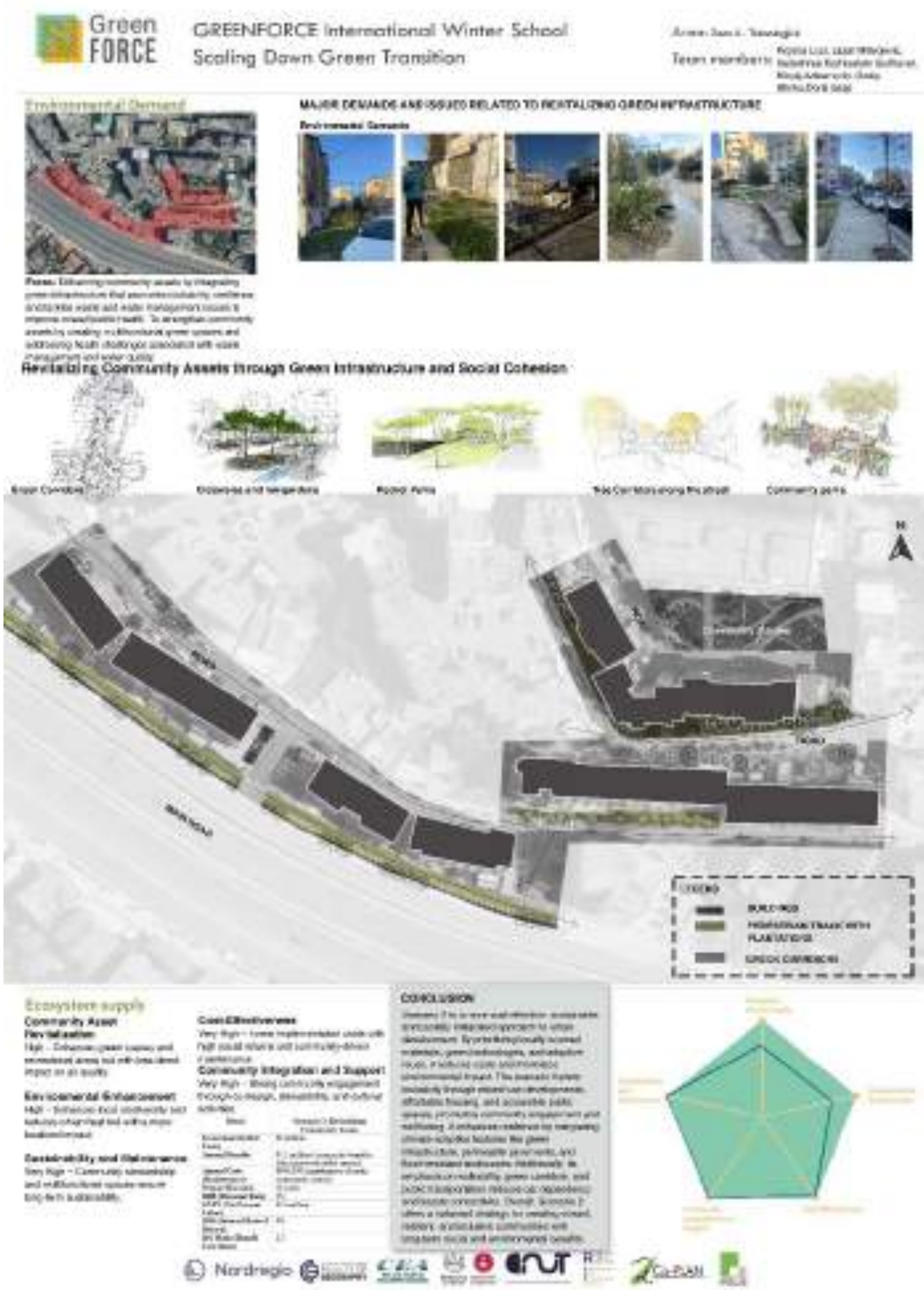
4.2 Scenario 2 – "The Heart of the Neighborhood: Urban Parks for a Greener and Happier Community"



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5. Environmental Performance & Ecosystem Service Outcomes

5.1 Assessment of Ecosystem Services – Scenario 1

The implementation of urban greening measures and sustainable infrastructure enhances environmental resilience while delivering economic benefits.

- **Planting of 6 trees**: Equivalent to **€600** in CO2 sequestration and **€100** in healthcare cost reductions due to improved air quality. These trees also contribute to biodiversity enhancement by providing shelter for urban wildlife.
- **Permeable pavements**: Reduction in surface runoff leading to **€400** in flood damage mitigation. This intervention helps prevent waterlogging and extends the lifespan of urban roads and pedestrian pathways.
- **Pocket parks and green corridors**: Increased recreational value estimated at **€600** through enhanced mental well-being and community engagement. Green spaces offer cooling effects and improve social cohesion among residents.
- **Urban gardens**: Contribution of **€300** in improved biodiversity and local cooling effects. These spaces support pollinators, increase local food production, and create opportunities for community-led initiatives.
- **Shading structures with climbing plants**: Estimated **€350** in energy savings by reducing indoor cooling demands in summer months.

Total estimated benefit: **€2,250** per year.

5.2 Assessment of Ecosystem Services – Scenario 2

Scenario 2 integrates more extensive green infrastructure and water management solutions, making a broader impact on environmental and social sustainability.

- **Rainwater harvesting system**: Estimated **€700** in water savings and flood mitigation benefits. This system captures and stores rainwater for reuse, reducing dependence on municipal water supplies.
- **Green roofs on residential buildings**: Equivalent to **€800** in cooling effects and energy savings for residents. These roofs improve insulation, reduce stormwater runoff, and enhance urban aesthetics.
- **Urban forests in vacant spaces**: Providing **€1,200** in biodiversity enhancement and CO2 sequestration. Tree coverage contributes to improved air quality, cooling effects, and stormwater regulation.
- **Enhanced tree planting in streets**: Offering **€600** in air purification and shade provision, improving thermal comfort for pedestrians and cyclists.
- **Creation of multifunctional green spaces**: Estimated **€500** in increased property value and economic activity, attracting businesses and investment in the area.

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- **Bioswales and wetland areas**: Contributing **€700** in flood prevention and groundwater recharge, addressing long-term water management challenges.

Total estimated benefit: **€4,500** per year.

5.3 Comparison Table – Ecosystem Services Achieved

The table below compares the contributions of both scenarios to key ecosystem services:

Urban Ecosystem Service	Scenario 1 Contribution	Scenario 2 Contribution
Cooling Effect	Moderate	High
CO2 Sequestration	Low	High
Air Quality Improvement	Moderate	High
Flood Mitigation	Low	High
Biodiversity Enhancement	Moderate	High
Recreational Value	High	Very High
Energy Savings	Moderate	High
Property Value Increase	Low	Moderate
Water Conservation	Low	High

Scenario 2 generally provides greater benefits due to its broader implementation of nature-based solutions. However, Scenario 1 offers quicker, cost-effective solutions that could serve as a foundation for future developments. By integrating a combination of these measures, cities can enhance urban resilience while addressing climate change adaptation and mitigation goals.

6. Social and Economic Impact Assessment

6.1 Health Benefits

Both scenarios offer significant health benefits, particularly through improved air quality, microclimate enhancements, and potential mental health gains.

- **Air Quality**: Scenario 1's tree planting and permeable pavements improve air quality by reducing pollution levels and enhancing CO2 sequestration, leading to lower respiratory and cardiovascular diseases. Scenario 2, with more extensive tree planting, green roofs, and urban forests, has a more pronounced effect, further mitigating air pollution, which directly impacts public health by reducing the risks of asthma and other air-borne diseases.

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- **Microclimate Improvements**: The cooling effects of urban greening measures in both scenarios reduce the urban heat island effect. Scenario 1's pocket parks and shading structures provide localized cooling, while Scenario 2's larger-scale green infrastructure (green roofs, urban forests) results in more widespread temperature regulation, contributing to reduced heat stress.
- **Mental Health Benefits**: Green spaces in both scenarios offer opportunities for physical activity and recreation, enhancing residents' mental well-being. Scenario 1's smaller interventions (e.g., pocket parks) foster a sense of community, while Scenario 2's multifunctional green spaces and urban forests promote greater social interaction and improve the psychological benefits derived from nature.

6.2 Economic Benefits and Costs

Both scenarios yield significant economic advantages, including cost savings and the creation of new economic opportunities.

- **Energy and Water Savings**: Scenario 1's shading structures and permeable pavements reduce the need for air conditioning and water management systems, leading to energy savings and lower water bills. Scenario 2's green roofs, rainwater harvesting, and bioswales provide larger savings, especially in energy costs for cooling and water conservation, benefiting both households and municipal budgets.
- **Green Jobs**: Scenario 2, with its extensive green infrastructure and maintenance needs, offers more opportunities for green jobs, such as landscaping, horticulture, and green construction. Scenario 1 also creates jobs in urban greening and maintenance, but on a smaller scale.
- **Costs**: Scenario 1 has a lower initial investment, with an estimated cost of implementation around €5,000 per year, while Scenario 2's broader interventions require a higher initial investment but provide higher long-term returns, with an estimated cost of €10,000 per year. The costs are offset by the environmental, social, and economic benefits they generate.

6.3 Inclusivity Benefits

Both scenarios significantly contribute to social inclusion, accessibility, and community engagement.

- **Accessibility**: Scenario 1's pocket parks and green corridors increase accessibility to public green spaces, promoting social integration among diverse groups. Scenario 2's multifunctional green spaces and urban forests offer even greater access, ensuring that

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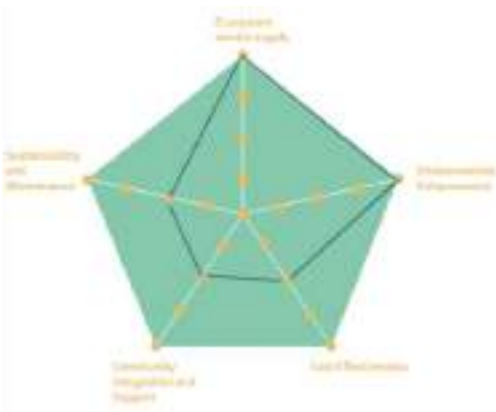
residents, including those with limited mobility, can enjoy nature and engage in recreational activities.

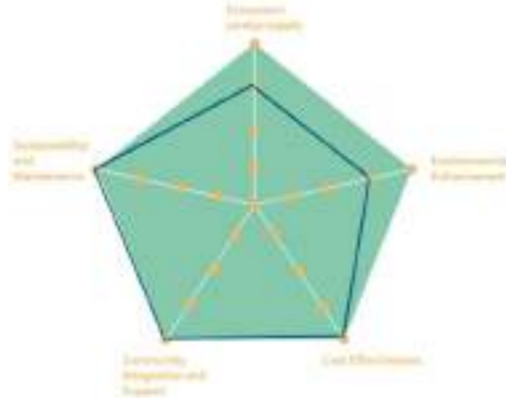
- **Social Cohesion**: Both scenarios foster social cohesion by providing spaces for residents to interact and engage in community activities. Scenario 1’s smaller interventions, like community gardens, create intimate spaces for local gatherings, while Scenario 2’s larger green spaces bring together different groups, promoting collaboration and reducing social isolation.
- **Community Engagement**: Scenario 2, with its more extensive interventions, encourages greater community participation through initiatives such as urban farming, environmental education, and local stewardship of green spaces. Scenario 1, while offering smaller-scale involvement, still supports community engagement through accessible green spaces that promote collective ownership and care.

7. Star Tool Evaluation

Scenario 1:



Scenario 2:



SC1 is an environmentally superior solution but may be costly and difficult to integrate into the community. On the other hand, SC2 provides a more practical and balanced approach, ensuring cost efficiency, sustainability, and better community adoption, while still delivering environmental benefits.
If the primary goal is to maximize environmental impact, SC1 would be the preferred choice. However, if the objective is to implement a sustainable, cost-effective, and community-friendly solution.

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8. Community Simulation Game Outcomes

In the Community Simulation Game, various target groups—including policymakers, urban planners, environmental activists, business owners, and residents—participated in shaping their neighborhood using two sustainability strategies: SC1 (high environmental impact, high cost, low community integration) and SC2 (balanced sustainability, cost-effectiveness, and community engagement).
While both strategies had their strengths and weaknesses, SC2 emerged as the more widely accepted choice across most groups. The long-term economic stability, strong community integration, and lower initial costs made it the preferred strategy, especially for residents and businesses. SC1, though highly effective environmentally, required significant financial resilience and strong institutional backing, making it less popular among those without substantial governmental support.
The simulation highlighted a key takeaway: extreme sustainability measures can bring impressive results but often require top-down enforcement and financial sacrifice. On the other hand, a balanced, community-led approach, though slower in producing environmental benefits, fosters long-term sustainability and public trust. The game concluded with an understanding that true sustainability must not only prioritize the environment but also economic feasibility and social cohesion.

Ultimately, the groups left with valuable insights into urban sustainability—choosing between rapid, high-impact solutions and steady, community-driven progress. The debate will continue, but one thing became clear: sustainability is as much about people as it is about the environment.

9. Conclusion & Recommendations

The analysis of both scenarios demonstrates the considerable potential of Nature-Based Solutions (NBS) in transforming urban neighborhoods into more sustainable and resilient environments. Key findings include:

- **Environmental Benefits**: Scenario 2, which integrates larger-scale green infrastructure, provides more comprehensive benefits in terms of cooling, CO_2 sequestration, flood mitigation, and biodiversity enhancement compared to Scenario 1. Both scenarios, however, contribute significantly to improving air quality and mitigating the urban heat island effect.
- **Social and Health Benefits**: Both scenarios improve mental and physical health by offering green spaces that promote recreation, relaxation, and social interaction.

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Scenario 2's broader range of interventions leads to even greater health benefits due to its cooling effects and larger green spaces.

- **Economic Benefits**: Scenario 2 offers higher long-term economic returns, such as greater energy and water savings, increased property values, and more green job opportunities. While Scenario 1 presents lower initial costs, it still delivers substantial economic benefits in the form of energy savings and community cohesion.
- **Inclusivity**: Both scenarios enhance accessibility and inclusivity by providing spaces for social interaction and improving the quality of life for marginalized groups, though Scenario 2's interventions offer more extensive opportunities for community engagement and accessibility.

Recommendations for Future Steps and Scalability

- **Future Steps**:
    1. **Pilot Implementation**: A phased approach should be considered, beginning with Scenario 1 as a cost-effective way to address immediate issues, followed by scaling up to Scenario 2 for more substantial environmental and social benefits.
    2. **Stakeholder Engagement**: Continuous engagement with local residents, municipal authorities, and other stakeholders is essential to ensure the success of the interventions and build a sense of ownership and participation.
    3. **Monitoring and Evaluation**: Establish a robust monitoring system to track the effectiveness of the implemented NBS, focusing on environmental, social, and economic metrics. This will help fine-tune the interventions for better impact.
- **Scalability**: The proposed NBS are scalable to other urban neighborhoods facing similar challenges. While Scenario 2's extensive interventions may require more resources, the lessons learned from this report can be applied to larger city-wide projects, especially when dealing with urban heat islands, stormwater management, and social cohesion.

Lessons Learned from the Process

Integration of Solutions: Combining green infrastructure with traditional urban planning tools (such as water management systems) can enhance the effectiveness of NBS. A multidisciplinary approach involving environmental, urban planning, and engineering expertise is crucial for success.
Cost-Benefit Analysis: Initial costs of NBS can be high, but the long-term benefits—particularly in terms of energy savings, health improvements, and flood mitigation—far outweigh these costs. Future projects should prioritize comprehensive cost-benefit analyses to demonstrate the full range of benefits.
Community Involvement: Residents should be actively involved in the design and implementation of NBS to ensure that the solutions meet local needs and enhance social

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cohesion. NBS are most successful when communities feel ownership over the green spaces created.

Cultural Sensitivity: Understanding the social dynamics of the neighborhood is essential. Projects should be tailored to the unique characteristics of the community to foster inclusivity and ensure that no group is left behind.

Collaboration and Coordination: Effective governance requires collaboration between local authorities, environmental experts, and community representatives. Transparent communication and coordination across sectors are key to successful NBS projects.

Sustainability: Ensuring the sustainability of NBS requires long-term planning, adequate funding, and institutional support. Projects should be designed with maintenance and future adaptation in mind to ensure continued benefits.

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10. Annexes

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Google Earth


Area 2- Ex-Technological park
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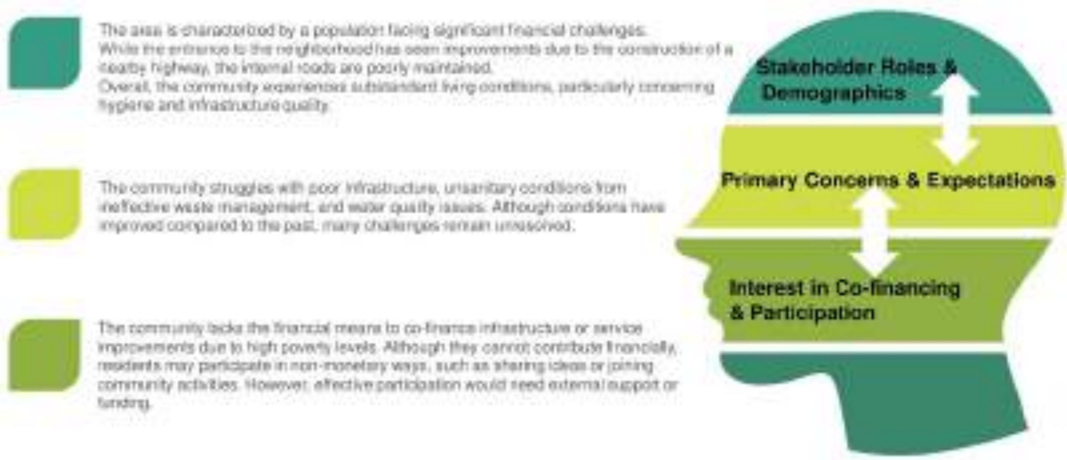
Community interactions & Interviews



PROBLEM (Problems and solutions we are going to tackle)	SOLUTION (Innovative Solutions can be provided to tackle)	STAKEHOLDERS (Some of the stakeholders who can support)
Air quality Health issues Waste Management Water Management Community assests	Green Infrastructure Permeable Pavements Pocket Parks & Urban Forests Street Trees & Green Corridors Sustainable Water Management Greywater Recycling Community Gardens Cooling Spaces Rainwater harvesting	Government Agencies Local Business Community Organizations NGO's Public Private Organisations

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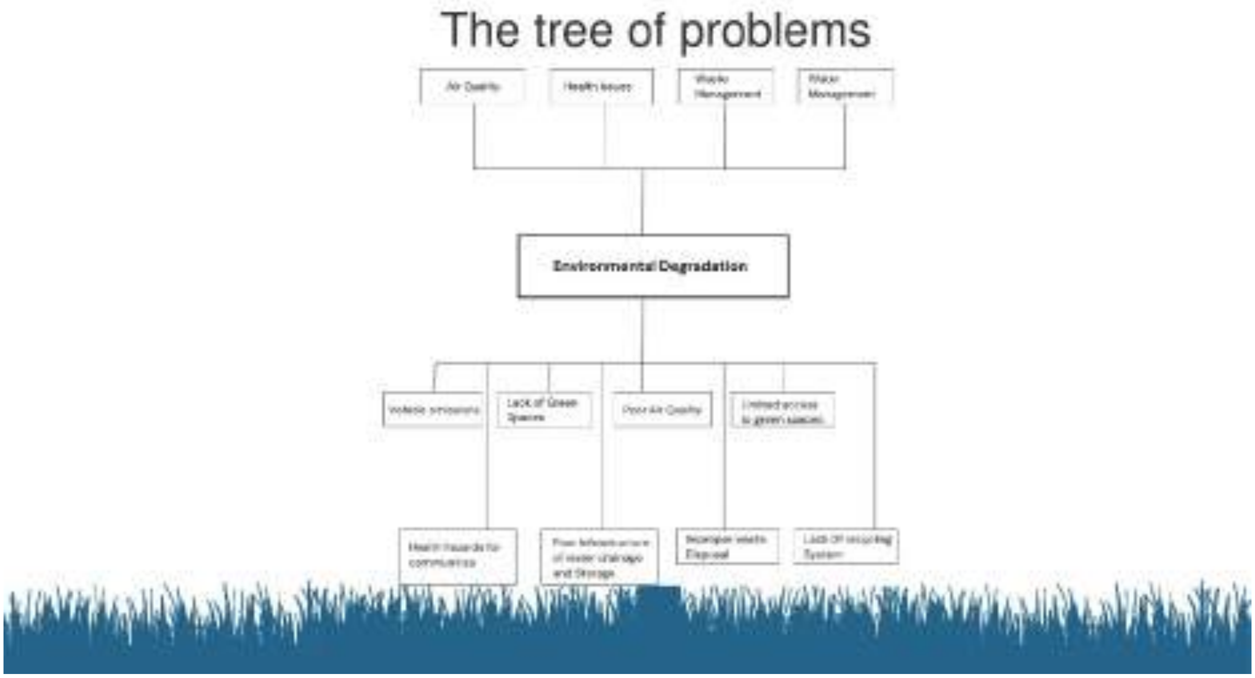

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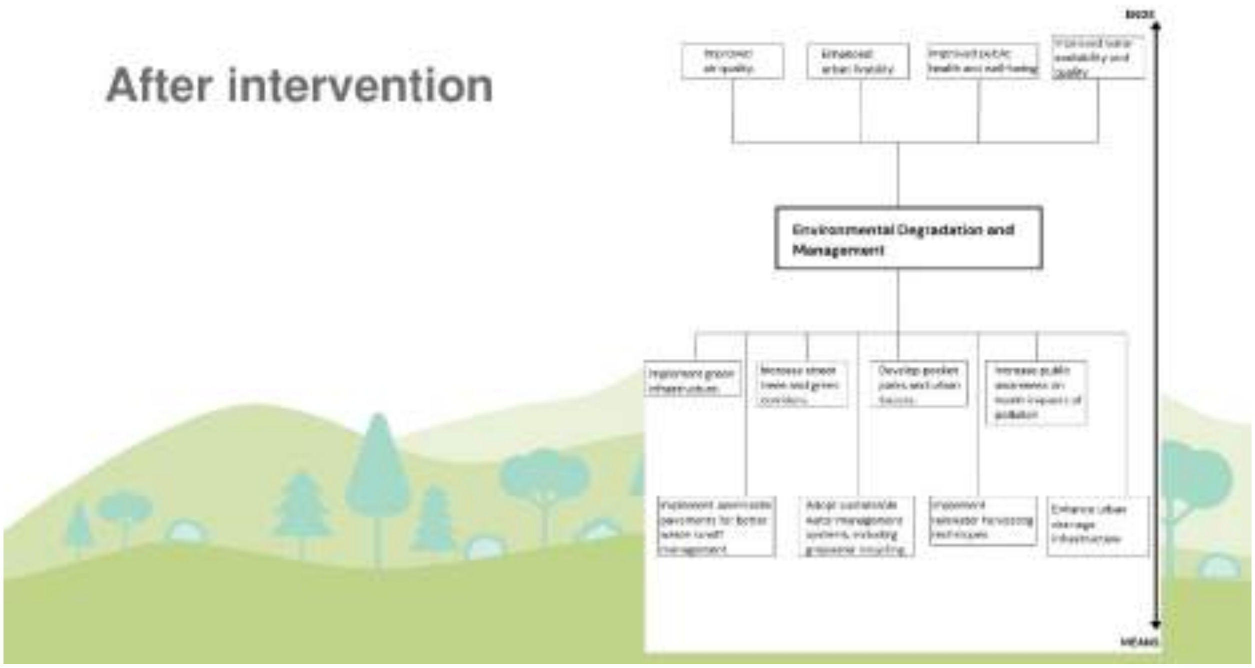

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