



**Conservation of Natural Resources in Infrastructure
Development and Climate Action - Practices in the Past and
Present Scenario, and Forecast for Future**

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Abstract

Background: The conservation and utilization of natural resources in infrastructure development are crucial for achieving sustainable growth while addressing climate change challenges. The rapid expansion of infrastructure has often led to environmental degradation, necessitating a shift toward more sustainable practices. **Objective:** This study aims to examine past practices, assess the current scenario, and propose future strategies for integrating environmental sustainability into infrastructure planning and implementation. **Methods:** The



study reviews historical infrastructure development approaches, analyzes the impact of modern industrialization on natural resources, and evaluates existing sustainable infrastructure initiatives. It also explores policy frameworks, technological advancements, and community-based solutions for fostering climate-resilient infrastructure. **Findings:** Traditional infrastructure development was resource-efficient and environmentally harmonious but slow. However, rapid urbanization and industrialization, driven by heavy machinery, have led to severe environmental consequences such as deforestation, soil degradation, water depletion, and biodiversity loss. The current scenario highlights an urgent need for climate-resilient and eco-friendly infrastructure as climate change intensifies risks like extreme weather events, rising temperatures, and resource scarcity. Despite progress in adopting green technologies, weak policy enforcement and unsustainable practices persist. **Conclusion:** A transition toward sustainable infrastructure requires policy reforms, the adoption of eco-friendly construction techniques, the integration of renewable energy, and active community participation. Strengthening environmental regulations, promoting circular economy principles, and leveraging advanced technologies like Artificial Intelligence (AI) and Geographic Information Systems (GIS) can enhance climate-adaptive infrastructure planning. **Novelty:** This study provides a comprehensive analysis of past and present infrastructure development practices while proposing innovative, technology-driven, and policy-based solutions to enhance sustainability. It underscores the need for a multi-sectoral approach to balance economic growth with environmental conservation.

Keywords: Sustainable infrastructure, climate resilience, natural resource conservation, environmental policy, renewable energy, circular economy, AI in infrastructure, GIS technology, green construction

1. Introduction

Infrastructure development is a critical driver of financial growth and social well-being, yet it often comes at the cost of environmental degradation. The depletion of natural resources, loss of biodiversity, and increased carbon emissions are among the key challenges associated with large-scale infrastructure projects. In recent years, there has been a growing emphasis on integrating sustainable practices into infrastructure development to balance financial progress with environmental conservation and climate resilience (UNEP, Nature critical to infrastructure for sustainable development , 2023).

This research explores the evolution of conservation practices in infrastructure development, assessing past approaches, current trends, and future projections. By examining historical data, ongoing initiatives, and future forecasts, this study aims to highlight best practices, policy interventions, and innovative solutions that can ensure a sustainable and climate-resilient infrastructure landscape. The research also delves into the role of international frameworks, such as the Paris Agreement and the Sustainable Development Goals (SDGs), in shaping conservation-oriented infrastructure policies.



Nepal's unique topography and rich biodiversity present both opportunities and challenges in balancing infrastructure development with natural resource conservation and climate action. Historically, rapid infrastructure expansion has often led to environmental degradation, including deforestation, soil erosion, and biodiversity loss (World Bank, 2022). Recognizing these challenges in Nepal, situated at very steep young and weak geological Himalaya with temporally concentrated torrential monsoon rain, Nepal has increasingly emphasized sustainable development practices to harmonize economic growth with environmental stewardship not only to itself but also the people of Gangetic plain.

Infrastructure development in Nepal has been pivotal for economic progress and improving living standards. However, development approaches have sometimes overlooked environmental considerations, resulting in adverse ecological impacts (GON/ MOFE, 2020). In response, Nepal has adopted policies and initiatives aimed at integrating natural resource conservation and climate resilience into infrastructure planning and execution. This research examines the evolution of these practices, assessing past methodologies, current strategies, and future projections to identify effective approaches for sustainable infrastructure development in Nepal and to some extent the central Gangetic plan populated by hundreds of millions of people.

2. Practices in the Past

a. Early Infrastructure Development (Pre-1950s)

Before the 1950s, Nepal had minimal infrastructure due to its geographical constraints and isolation policies. Politically it prohibits foreigner from entering into and geologically it was walled by the in-penetrable high Himalayan Mountains in the north and climatically hostile plains infested with malaria and big rivers flowing north to south slicing the country. Thus it was very much isolated and with virtually no large scale infrastructures. The transportation network was rudimentary, relying on foot trails and mule paths. There was little environmental impact as infrastructure development was limited to palace construction, irrigation canals, and stone-paved trails (IAAS, 2024).

b. Expansion of Infrastructure (1950s–1990s)

After Nepal opened up to the world in the 1950s, infrastructure development gained momentum, particularly in road construction, hydropower, and urbanization. Major projects such as the Tribhuvan Highway (1956) connecting to India, Arniko Highway (1967) connecting to Tibet, Prithvi Highway (1974) connecting major cities, and East West Highway (1961~2000) were developed, connecting east to west borders of Nepal. However, this expansion triggered significant environmental impacts as follows:

- **Deforestation:** Large-scale road construction required clearing forests and facilitating the logging and log transportation, leading to deforestation, wild habitat dissection and loss etc.
- **Soil Erosion and Landslides:** Poor engineering mainly storm-water flow disturbances and concentration at steep terrain made not only the roads but the whole mountains vulnerable to landslides, river bed rising exacerbating soil degradation.



- **Loss of Biodiversity:** Infrastructure expansion disrupted wildlife corridors and natural ecosystems.

In the 1980s and 1990s, hydropower development, such as the Kulekhani Hydropower Project (1982), increased energy production but also caused deforestation and river ecosystem disturbances (World Bank, 2022). This project diverted the water from one basin (Bagmati) to another basin (Rapti).

Malaria eradication and high population growth triggered the mass migration to the southern plain and thus rapid road and building concentration boomed. Also population growth in Kathmandu Valley and other regional cities led to unplanned settlements, pollution, and increased water scarcity.

c. Infrastructure Boom (2000s–Present)

With increased foreign investment and government initiatives, Nepal witnessed rapid infrastructure growth, including:

- **Hydropower Development:** Projects like the Upper Tamakoshi Hydropower Plant (456 MW) have boosted energy supply but affected river ecosystems and fish migration.
- **Expansion of Road Networks:** The Mid-Hill Highway (started 2064 BS) improved connectivity but led to deforestation and soil erosion.
- **Urban Expansion:** Cities like Kathmandu, Pokhara, and Chitwan have seen unplanned growth, increasing air and water pollution in these areas.

Environmental consequences include:

- **Increased Air Pollution:** Construction dust and vehicle emissions have worsened air quality, particularly in Kathmandu Valley especially during the winter gloomy days where the temperature inversion cause the pollution within the surrounding hills.
- **Water Scarcity and Pollution:** Over-extraction of groundwater and pollution from sewers and the construction waste has degraded water quality of rivers.
- **Disaster Vulnerability:** Poorly planned roads that cut the near collapsing slopes dump the cut soil in the valleys that kills the visitations that trigger the mass erosion, disturbs and disposes the storm water in inappropriate sites and have intensified the occurrences of landslides, particularly in hilly regions and flooding in southern plains due to siltation.

d. Conservation Efforts and Sustainable Practices

Recognizing these challenges, Nepal has adopted policies and programs for sustainable infrastructure development (Mahaseth H., Hilali S., 2021), such as:

- **Environmental Impact Assessment (EIA) Regulations (1997):** Mandating environmental considerations in major projects.
- **Sustainable Hydropower Development Policy (2018):** Emphasizing river conservation and social responsibility.
- **Green Roads Approach:** Integrating eco-friendly road construction techniques to minimize deforestation and soil erosion.



- **Community Forest Programs:** Empowering local communities to use protect and manage forests affected by infrastructure expansion.

Nepal's infrastructure development has significantly improved connectivity and economic opportunities, but it has also contributed to deforestation, biodiversity loss, and environmental degradation. Moving forward, adopting climate-resilient and eco-friendly infrastructure practices will be crucial for sustainable development.

3. Present Scenario

Nepal is currently experiencing a significant surge in infrastructure development, encompassing road expansion, hydropower projects, urbanization, and industrialization. While these initiatives aim to bolster economic growth and improve living standards, they have elicited substantial environmental concerns.

a. Road and Air Transport Infrastructure

The government has prioritized enhancing connectivity through projects such as the Mugling-Pokhara Road Expansion, Kathmandu-Terai Fast Track, and the Mid-Hill Highway. Additionally, new international airports are construction in Pokhara, Bhairahawa, and Nijgadh.

Environmental Impacts:

- **Deforestation and Habitat Loss:** The proposed Nijgadh International Airport project has faced criticism for its environmental implications, particularly concerning deforestation and biodiversity loss. The project area is heavily forested, and the Environmental Impact Assessment indicated that more than 2 million trees are expected to be cut down. This deforestation threatens wildlife habitats and corridors, especially given the area's proximity to Parsa National Park, home to endangered species like the Bengal Tiger and Asiatic Elephant (Wikipedia, 2025).
- **Landslides and Soil Erosion:** Un-planned road construction in Nepal's frazil hilly regions has led to increased landslides and soil erosion, exacerbating environmental degradation (Intpolicydigest, 2021).
- **Air Pollution:** Dust from construction activities and increased vehicular emissions have deteriorated air quality, particularly in urban centers like Kathmandu (IFC, 2022).

b. Hydropower Development

Nepal aims to harness its hydropower potential with projects like the Upper Tamakoshi (456 MW) and Madhya Bhotekoshi (102 MW). Agreements with neighboring countries for electricity trade have further spurred investments in this sector. In last five years the electricity generation has gone from 4476 GWh (2019) to 12,071 GWh (2024).

Environmental Impacts:

- **River Ecosystem Disruptions:** The diversion of water reduces the flow discharge from intake to out fall through power plants and even serious is the inert basin diversion like Kulekhani, Koshi Marin and Vheri Babai, negatively affecting riverine ecosystems, fish migration, and downstream communities that depend on the rivers. A compromise is necessary between national energy demands, environmental health, and the needs of local communities (CGIAR, 2024).



- **Landslides and Seismic Risks:** Large-scale hydropower projects in Nepal's fragile mountain regions increase the risk of landslides and seismic activities, posing threats to both the environment and local communities (Tiwari A., Dhakal S., 2023).
- **Community Displacement:** Hydropower reservoirs often submerge villages, forcing local communities to relocate and disrupting their livelihoods (IAAS, 2024). Reservoirs also generate huge amount of Methane that is about 24 times more harmful compared to CO₂ from the Climate Change perspective.

c. Urbanization and Industrialization

Rapid urban growth in cities like Kathmandu, Pokhara, Bharatpur and Butwal has led to unplanned settlements and sprawls increasing pressure on infrastructure. The establishment of Special Economic Zones (SEZs) in Bhairahawa and Simara aims to promote industrial growth.

Environmental Impacts:

- **Water Crisis:** Over-extraction of groundwater in urban areas has led to shortages and contamination, affecting both human health and the environment (IFC, 2022).
- **Air and Water Pollution:** Industrial waste, emissions from factories and disposing untreated waste water without treatment from settlements contribute significantly to air and water pollution, with negative impacts on health and productivity (IFC, 2022).

d. Tourism Infrastructure Development

To boost eco-tourism, infrastructure projects are underway in regions like Everest, Annapurna, and Rara National Park, including new trekking routes and accommodations.

Environmental Impacts:

- **Waste Management Issues:** Increased tourism generates more waste, particularly plastics, in fragile ecosystems, posing challenges for waste management (IAAS, 2024).
- **Glacier Retreat:** Higher footfall in mountainous areas can accelerate the impact of climate change, contributing to glacier retreat and associated environmental consequences (Tiwari A., Dhakal S., 2023).

e. Government Initiatives and Sustainable Practices

Recognizing these challenges, Nepal has implemented several measures:

- **Environmental Impact Assessment (EIA):** The Environmental Protection Rules 1997 mandate EIAs for major projects. However, the effectiveness of EIAs has been questioned due to issues in implementation and enforcement (Joshi A. R., 2022).
- **Green Infrastructure Initiatives:** The government is investing in green infrastructure, emphasizing the need to consider carbon social costs and climate change impacts in development projects (NIS, 2024).
- **Wildlife-Friendly Linear Infrastructure Guidelines (2022):** These guidelines require the incorporation of wildlife corridors in major infrastructure projects to mitigate impacts on biodiversity (Das P., 2019).

While infrastructure development is vital for Nepal's economic progress, it presents significant environmental challenges. Development with environmental conservation requires robust implementation of environmental regulations, investment in sustainable practices, and active



engagement with local communities to ensure that progress does not cause bigger harm to the nation's rich natural heritage which is the only livelihood of many Nepalese mainly poor.

4. Forecasting of Future Situation

Nepal's current infrastructure development is characterized by rapid expansion in road networks, hydropower projects, urbanization, and industrial growth. However, this progress has often come at the cost of environmental degradation, deforestation and climate vulnerabilities. Looking ahead, the future of infrastructure development in Nepal will likely shift towards more sustainable, climate-resilient, and environmentally friendly approaches, driven by global trends, policy reforms, and technological advancements.

Comparison of Present and forecasting of Future Infrastructure Development

Aspect	Present Scenario	Future Forecast
Environmental Regulations & Compliance	Weak enforcement of Environmental Impact Assessments (EIA), leading to deforestation, habitat loss, and pollution.	Stricter enforcement of EIA, Strategic Environmental Assessments (SEA), and green building standards.
Sustainable Road Construction	Unplanned and haphazard road expansion leading to landslides, deforestation, and erosion.	Adoption of bioengineering techniques, eco-friendly roads, and better urban transport planning.
Hydropower Development	Large-scale dam projects disrupt river ecosystems, cause landslides, and displace communities.	Shift towards run-of-river hydropower and hybrid renewable energy solutions.
Urban Planning & Industrialization	Rapid urbanization with inadequate waste management, air pollution, and loss of agricultural land.	Smart cities with green buildings, circular economy principles, and strict emission regulations.
Climate-Resilient Infrastructure	Limited climate resilience measures, leading to damages from floods, landslides, and extreme weather events.	Infrastructure designed for climate adaptation, incorporating flood-resistant roads, landslide prevention, and disaster risk reduction.
Public Transport & Mobility	Over-reliance on fossil fuel-based transport, leading to congestion and high emissions.	Expansion of electric buses, metro rail systems, and non-motorized transport (cycling, walking).
Biodiversity Conservation in Infrastructure	Infrastructure projects often ignore wildlife corridors and protected areas.	Mandatory integration of wildlife-friendly infrastructure and ecological restoration projects.
Energy Transition	Hydropower-dominated energy sector with minimal use of solar and wind power.	Diversification into solar, wind, and energy-efficient solutions to reduce hydropower dependency.

Source: Nepal Policy Review Journal (2024); (World Bank, 2024); (IAAS, 2024).

Future Trends towards Infrastructure Development

a. Adoption of Green and Climate-Resilient Infrastructure



Nepal is expected to transition towards climate-resilient and green infrastructure due to increasing climate vulnerabilities. The National Adaptation Plan (NAP) 2021-2050 emphasizes integrating climate considerations into infrastructure projects. This will include:

- Green road construction techniques such as bioengineering and slope stabilization.
- Flood-resistant and earthquake-resilient bridges and buildings.
- Integration of sustainable drainage systems to prevent urban flooding.

b. Expansion of Energy and Energy-Efficient Technologies

Currently, Nepal relies heavily on hydropower, but future energy policies will focus on a diversified renewable energy mix to reduce climate and environmental risks. Key trends include:

- Increased solar and wind energy deployment to complement hydropower.
- Energy-efficient urban planning, including smart grids and low-emission public transport.
- Decentralized renewable energy solutions to enhance rural electrification.

c. Sustainable Urban Planning and Eco-Cities

By 2050, Nepal's urban population is expected to grow significantly, necessitating sustainable city planning. Future cities will feature:

- Eco-friendly buildings with energy-efficient designs and waste recycling systems.
- Smart public transport solutions, including electric buses and metro systems.
- Expansion of green spaces, urban forests, and pollution control measures.

d. Nature-Based Solutions for Infrastructure Development

Nepal is likely to embrace nature-based solutions in infrastructure planning to mitigate climate risks and conserve natural resources. These will include:

- Watershed conservation projects to sustain hydropower and irrigation.
- Wildlife-friendly infrastructure, ensuring ecological corridors and habitat restoration.
- Ecosystem-based disaster risk reduction, such as reforestation to prevent landslides.

e. Strengthening Environmental Governance and Policies

By 2030, Nepal is expected to strengthen environmental policies with stricter regulations with polluters pay and incentives for sustainable infrastructure. Key measures will include:

- Mandatory implementation of Strategic Environmental Assessments (SEA) for all large-scale projects.
- Introduction of carbon pricing (Polluters pay) mechanisms to regulate emissions from infrastructure projects.
- Enhanced public-private partnerships (PPPs) for sustainable infrastructure investments.

f. Key Challenges and Opportunities

Challenges:

- Implementation Gap: Weak enforcement of environmental laws could slow progress.
- Financial Constraints: High initial costs for green infrastructure may hinder adoption.



- Lack of micro (local) climate change scenario. It is important in mountains with rapid elevation and orientation change.
- Lack of understanding the environmental economics, and method to price the environmental damages to the doers.
- Community Engagement: Resistance from local communities if not properly consulted in development projects.

Opportunities:

- International Climate Financing: Access to Green Climate Fund (GCF) and climate adaptation funds.
- Carbon Trading: Bulking the actions, licensed authenticating agencies and mediating agency.
- Technological Innovations: Use of AI, remote sensing, and smart monitoring for environmental conservation.
- Regional Collaboration: Nepal can leverage partnerships with India, China, and international organizations to promote sustainable development.

By 2040-2050, Nepal's infrastructure development is expected to be more sustainable, climate-resilient, and environmentally conscious. The shift from resource-intensive, high-emission projects towards green, energy-efficient, and eco-friendly infrastructure and the way of living will be crucial in balancing economic growth and environmental conservation. However, achieving such future require knowledge of environment (and its economics), good governance, financial investment, and public awareness.

Nepal is actively pursuing sustainable infrastructure development to balance economic growth with environmental conservation. Recent initiatives and policy reforms indicate a commitment to integrating sustainability into infrastructure projects.

g. Policy Reforms and Sustainable Practices

The government has introduced policies to protect natural resources during infrastructure development, optimal use of natural resources. However, challenges in enforcement persist, necessitating strengthened institutions and enhanced accountability (Shrestha D. K., Praveen B. M., 2024).

h. Green, Resilient, and Inclusive Development (GRID) Approach

Nepal is shifting towards a Green, Resilient, and Inclusive Development (GRID) path to address complex challenges such as environmental and ecological degradation and climate change impacts. This approach emphasizes infrastructure that supports economic development while ensuring environmental sustainability (GRID, 2021).

i. International Collaborations and Investments

Collaborations with international organizations, such as the World Bank, have led to significant investments aimed at improving infrastructure resilience and sustainability. For instance, a \$128 million project was launched to enhance the connectivity, efficiency, resilience, and safety of Nepal's provincial and local road network (GON-WB, 2024).



j. Challenges and Considerations

Despite these positive developments, challenges remain. The approval of large-scale hydropower projects within protected areas has raised concerns about potential conservation setbacks (Joshi A. R., 2024).

Balancing infrastructure development with environmental conservation continues to be a critical issue. Nepal's future in infrastructure development is geared towards sustainability, with a focus on conserving natural resources. Ongoing policy reforms, international collaborations, and a commitment to the GRID approach are pivotal in shaping a sustainable infrastructure landscape.

5. Actions for the Better Future

For a better future in conserving natural resources and ecological services in infrastructure development and climate action, a combination of lessons from the past, analysis of the present and strategic actions for the future is necessary. Here's a structured approach:

a. Lessons from the Past

- **Traditional Sustainable Practices:** Indigenous methods like bioengineering, stone masonry, and water harvesting ensured environmental balance.
- **Resource Degradation:** Past infrastructure projects led to deforestation, soil erosion, and loss of biodiversity due to unsustainable practices.
- **Policy Gaps:** Weak enforcement of environmental regulations resulted in over-extraction of resources and ecosystem damage.

b. Present Scenario and Challenges

- **Infrastructure Expansion vs. Environmental Sustainability:** Rapid development has increased deforestation, waste generation, and greenhouse gas emissions.
- **Climate Change and Infrastructure Resilience:** Rising temperatures, extreme weather, and glacier retreat threaten rural and urban infrastructure.
- **Technology and Innovation:** Green materials, renewable energy, and smart infrastructure are gaining traction but require broader adoption.
- **Community Engagement:** Limited participation of local communities often leads to poorly implemented conservation measures (UNDP, 2019).

c. Actions for a Sustainable Future

- **Strengthening Policies and Governance:** Enforce Environmental Impact Assessments (EIA) with strict monitoring and accountability mechanisms (UNEP, 2021).
- **Promote Public-Private Partnerships (PPP) for green and climate-resilient infrastructure:** Implement Nature-Based Solutions (NBS) in policies to integrate ecological protection with development (IPCC, 2022).
- **Establish eco-sensitive zones with controlled infrastructure development to preserve biodiversity.**
- **Circular Economy in Construction:** Promote reuse of materials and minimize construction waste.

d. Climate Resilient Infrastructure Development



- Disaster Risk Reduction (DRR) Integration: Incorporate flood-resistant designs, earthquake-resilient structures, and slope stabilization techniques (UNDRR, 2020).
 - Early Warning Systems: Deploy climate-smart planning tools and monitoring systems for disaster preparedness. Develop and adopt the early warning systems.
 - Nature-Based Solutions: Use afforestation, wetlands restoration, and river embankments for natural disaster mitigation.
- e. Renewable Energy for Infrastructure Sustainability**
- Decentralized Renewable Energy: Expand off-grid solar and micro-hydro systems in rural areas (IRENA, 2022).
 - Green Transport Systems: Develop electric public transport, bicycle-friendly roads, and energy-efficient highways.
 - Energy-Efficient Buildings: Enforce green building codes and use solar-passive designs (IEA, 2021).
- f. Community Empowerment and Capacity Building**
- Training and Capacity Development: Equip local communities with knowledge, skills in eco-friendly construction and sustainable resource management (UNDP, 2019).
 - Women and Youth Engagement: Encourage participation in climate-smart infrastructure projects.
 - Eco-Tourism and Sustainable Livelihoods: Develop tourism infrastructure that conserves nature while providing economic benefits (WRI, 2021).

g. The Way Forward: Integrating Nature Conservation with Development

Achieving a sustainable future requires a balanced approach, where infrastructure development supports both economic growth and environmental conservation. By integrating nature-based solutions, policy reforms, resilient design, renewable energy, and community-driven approaches, we can create infrastructure that not only meets present needs but also ensures a sustainable and climate-resilient future.

6. Conclusions

The balance between infrastructure development and natural resource conservation is critical in ensuring a sustainable and climate-resilient future. By analyzing past practices, the present scenario, and future projections, it is evident that a multi-faceted approach is necessary to mitigate environmental degradation while enabling economic progress.

Key Takeaways:

- Lessons from the Past: Traditional infrastructure methods emphasized sustainability but were often replaced by unsustainable modern techniques.
- Poor environmental policies and unregulated resource extraction have contributed to deforestation, biodiversity loss, and soil erosion.

Current Scenario and Challenges:

- Rapid urbanization and infrastructure expansion continue to put pressure on forests, water sources, and land resources.



- Climate change is increasing vulnerabilities in infrastructure, making resilient-building essential.
- While green technologies exist, their adoption remains slow due to policy gaps, financial constraints, and limited awareness.

Actions for a Sustainable Future:

- **Policy Reforms:** Strengthen environmental laws, enforce sustainable land-use planning, and integrate climate adaptation measures.
- **Sustainable Design:** Promote nature-based solutions, green materials, and circular economy principles in construction.
- **Climate Resilience:** Incorporate disaster risk reduction (DRR) strategies in infrastructure projects.
- **Renewable Energy Integration:** Shift towards energy-efficient buildings, green transportation, and off-grid solar/hydro solutions.
- **Community Engagement and Capacity Building:** Strengthen local participation, empower marginalized groups, and build skilled labor in eco-friendly infrastructure.

The Way Forward:

The future of sustainable infrastructure lies in a holistic, integrated, and climate-smart approach that prioritizes environmental conservation while meeting development goals. By combining science, innovation, traditional knowledge, and inclusive governance, infrastructure development can serve as a catalyst for sustainable progress rather than a threat to natural resources. Urgent, collaborative, and well-planned actions today will determine the environmental and economic security of future generations.

7. Recommendations

To ensure sustainable infrastructure development while conserving natural resources and addressing climate change, the following recommendations should be implemented at policy, planning, implementation, and community levels.

a. Strengthening Policies and Governance

- **Integrate Conservation into Development Policies:** Enforce strict Environmental Impact Assessments (EIA) and Strategic Environmental Assessments (SEA) for all infrastructure projects.
- **Adopt Nature-Based Solutions (NBS):** Implement policies that promote green infrastructure, ecosystem restoration, and sustainable land use planning.
- **Enforce Climate-Resilient Regulations:** Establish building codes that mandate the use of climate-smart designs, renewable energy, and resource-efficient materials.
- **Encourage Public-Private Partnerships (PPP):** Engage private sector investments in eco-friendly infrastructure and climate adaptation projects.
- **Improve Cross-Sector Coordination:** Strengthen collaboration between government agencies, researchers, NGOs, and private developers to integrate conservation efforts.

b. Sustainable Infrastructure Planning and Design



- Promote Green Building Practices: Encourage low-carbon materials, energy-efficient designs, and passive cooling techniques.
 - Develop Climate-Resilient Infrastructure: Integrate flood-proof, earthquake-resistant, and eco-friendly road and housing designs.
 - Minimize Land Degradation: Adopt bioengineering, afforestation, and soil conservation in infrastructure projects to reduce erosion and biodiversity loss.
 - Implement Circular Economy in Construction: Promote recycling and reusing materials, reducing construction waste and minimizing resource extraction.
 - Enhance Water Conservation Strategies: Utilize rainwater harvesting, wastewater recycling, and watershed management in infrastructure projects.
- c. Investing in Renewable Energy and Low-Carbon Technologies**
- Increase the Use of Renewable Energy: Integrate solar, wind, and micro-hydro power in infrastructure to reduce carbon emissions.
 - Promote Sustainable Transport Systems: Develop electric public transport, cycling infrastructure, and pedestrian-friendly urban planning.
 - Encourage Energy-Efficient Infrastructure: Use smart grids, energy-efficient lighting, and advanced insulation materials.
- d. Community Engagement and Capacity Building**
- Empower Local Communities in Conservation Efforts: Provide training on sustainable construction techniques and involve them in decision-making processes.
 - Promote Indigenous and Traditional Knowledge: Encourage the use of local, time-tested construction techniques that align with ecological conservation.
 - Enhance Public Awareness Campaigns: Educate stakeholders about the importance and possible methods of sustainable infrastructure and climate resilience.
 - Support Eco-Tourism and Sustainable Livelihoods: Develop nature-friendly infrastructure that promotes conservation while benefiting local economies.
- e. Research, Innovation, and Future Forecasting**
- Invest in Green Technologies: Promote biodegradable construction materials, AI-driven sustainability tools, and carbon capture methods.
 - Use Climate Data for Future-Planning: Implement GIS mapping, remote sensing, and AI-based climate modeling for risk-sensitive infrastructure planning.
 - Encourage Multi-Stakeholder Collaboration: Strengthen partnerships between academia, private sectors, and government agencies to drive research-based conservation strategies.
 - Develop Financial Incentives for Sustainable Practices: Calculate the cost/benefits and then provide tax benefits, subsidies, and grants to encourage the adoption of green infrastructure solutions.

The conservation of natural resources in infrastructure development and climate action requires a holistic and multi-sectoral approach. By integrating sustainable policies, innovative design, renewable energy solutions, community participation, and data-driven planning, infrastructure



can be developed in a way that supports both economic growth and environmental protection. Implementing these recommendations will ensure long-term resilience, resource efficiency, and climate adaptation for future generations.

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