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Policies and Practices for the conservation of natural resources during infrastructure development in Nepal

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Abstract

Rapid infrastructure development in Nepal, has created economic opportunities but poses significant challenges for natural resource conservation. This article examines the policies and practices currently in place to protect Nepal's natural resources during infrastructure development, highlighting gaps and opportunities for improvement. It explores the role of Environmental Impact Assessments (EIAs), legal frameworks, and community engagement in minimizing ecological damage from projects such as roads, hydropower, and urban development. Findings reveal that while Nepal has implemented some conservation policies, inconsistencies in enforcement, limited community involvement, and insufficient eco-friendly practices compromise environmental sustainability. The study recommends strengthening policy frameworks, enhancing EIA processes, promoting eco-friendly infrastructure practices, and fostering public-private partnerships to achieve a balanced approach. With effective conservation strategies, Nepal can progress towards a sustainable model of development that safeguards its diverse ecosystems while supporting economic growth.

Keywords: Conservation, hydropower, infrastructure development, natural resources, sustainability

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1. Introduction

Conservation of natural resources during infrastructure development is crucial in Nepal, a country known for its rich biodiversity, fragile ecosystems, and susceptibility to natural disasters like landslides and floods. Nepal is rich in natural resources, including water resources, forest resources, and mineral resources. These resources are important for the country's development as they contribute to agriculture, tourism, energy production, employment generation, foreign currency earnings, and maintaining ecological balance. Natural resources can contribute to economic growth, but their contribution depends on how they are managed (Heinen, J. T.; Mehta, J. N., 2000). Over-reliance on natural resources can lead to economic instability and decline. The role of natural resources in economic growth must be balanced with environmental sustainability. Natural resources provide essential raw materials and other commodities, and are an important source of income and jobs. They also support the provision of ecosystem services necessary to develop human and social capital.

Conservation is the practice of caring for these resources so all living things can benefit from them now and in the future. All the things we need to survive, such as food, water, air, and shelter, come from natural resources. Some of these resources, like small plants, can be replaced quickly after they are used. An abundance of natural resources should accelerate economic development because it increases exports so that more capital goods can be imported to build up the economy, and also because the natural resource rents (returns in excess of those required by an efficient producer) can be used to boost capital investment. Soil and water resources are essential for agricultural activities, a key part of the economy in many developing countries (Guthman, J, 1997). Mineral extraction contributes considerably to the wealth of countries such as Kuwait and Botswana. Renewable energy can play a key role in providing poor people with energy access. Sustainability is the practice of using natural resources responsibly, so they can support both present and future generations. Forests are one natural resource that sustainability groups are focused on conserving. Sustainable utilization of natural resources is the proper management of natural resources for the benefit of the entire human community. The main aim of sustainable development is to provide resources for present generations without compromising the needs of future generations.

One of the strengths of Nepal's approach, in policy and practice, is that it allows for a mix of activities to address both conservation and development without defining outcomes or framing conservation and development as polarized goals. Comparison of four protected areas highlights the need to balance conservation and development in terms of the larger context and opportunities and constraints on people's livelihoods and opportunities (Allendorf, T; Gurung, B, 2016).

Well-designed infrastructure projects can freeze and even reverse degradation of natural habitats and biodiversity loss. Communicating this vision creates a much more receptive environment, where government agencies and the public are aware that infrastructure projects

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can simultaneously provide services and support conservation efforts. While individual population settlements creating their own service network to alleviate immediate needs may have insufficient resources to ensure environmental conservation, a well-designed infrastructure project can control encroachment into natural habitats, improve makeshift engineering solutions, and improve inadequate use and disposal of water resources (Quintero, J. D., 2007).

Thorough Environmental Assessments are the foundation of successful environmental outcomes. Because an EA (Environmental Assessment) is the first line of identification of potential challenges and their magnitude, the thoroughness with which it is carried out will prevent surprises further into the project. Where environmentally sensitive areas are concerned, an EA should explore multiple routings, site locations, and nonstandard engineering techniques (Quintero, J.D., C.E. Menem, E. Sánchez-Triana, 1997). An EA will also identify where the complexity of social and environmental issues should require a supervisory or executive committee to follow and keep track of impacts or programs that fall outside the scope of the direct civil works. Making the EA publicly available also allows stakeholders to voice concerns early on and creates an opportunity for greater participation throughout the project.

2. Conservation Policy, Rules and Regulations in Nepal

A conservation policy is a policy aimed at conserving or restoring a declining species, a community, an ecosystem or a natural or semi-natural site. Conservation provides the basis for sustainability by ensuring the availability and quality of natural resources and ecosystem services. Sustainability supports conservation by reducing human pressures and impacts on the environment and enhancing human well-being and resilience. The conservation ethic is an ethic of resource use, allocation, exploitation, and protection. Its primary focus is upon maintaining the health of the natural world: its forests, fisheries, habitats, and biological diversity (NPC, 2015). Here are some strategies and considerations for conserving natural resources during infrastructure development in Nepal:

- Environmental Impact Assessment (EIA) is essential before implementation of any major infrastructure project. This assesses potential impacts on the environment and suggests mitigation measures. EIAs will consider biodiversity, water resources, soil erosion, and other ecological factors.
- Green Infrastructure: promotes green infrastructure solutions such as green roofs, permeable pavements, and bio-swales to manage storm water, reduce erosion, and enhance biodiversity. Integration of natural features like wetlands and forests into infrastructure plans where feasible.
- Energy Efficiency: Incorporation of energy-efficient designs into buildings and transportation systems to reduce the demand for resources like wood and fossil fuels. Encourages the use of renewable energy sources like solar and hydroelectric power.

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- Waste Management: Development of effective waste management systems to prevent pollution of rivers and land. Encourages recycling and proper disposal practices on construction sites.
- Community Engagement: Involve local communities in planning and decision-making processes. They often have valuable knowledge about local ecosystems and can suggest sustainable solutions. Raises awareness about the importance of conservation and sustainable development.
- Preservation of Forests and Watersheds: Protect critical habitats and biodiversity-rich areas from development. Implements reforestation and watershed management projects to ensure a sustainable supply of water and prevent erosion.
- Regulations and Enforcement: Strengthen and enforce laws and regulations related to environmental protection and resource management. Holds developers accountable for adhering to these regulations.
- Innovative Technologies: Explore and implement innovative technologies such as GIS (Geographic Information Systems) for better planning and monitoring of projects. Uses drone for surveying and monitoring, reducing the need for extensive ground infrastructure.
- Disaster Risk Reduction: Design infrastructure with disaster resilience in mind, considering the country's vulnerability to earthquakes, landslides, and floods. Uses nature-based solutions like reforestation to reduce landslide risks.
- Investment in Sustainable Transport: Prioritize sustainable transport modes like public transit, cycling lanes, and pedestrian-friendly infrastructure to reduce reliance on fossil fuels.
- Education and Training: Offer training programs for engineers, architects, and construction workers on sustainable practices. Educates the public through campaigns and school programs about the importance of conservation.

By integrating these strategies, Nepal can develop its infrastructure while safeguarding its precious natural resources for future generations (NPC, 2015).

In line with these strategies Government of Nepal (GON) endorsed (i) Constitution, (ii) Plans and Policies, (iii) Acts, (iv) Rules and Regulations, (v) Guidelines and (vi) International Conventions; for the protection of natural resources during the implementation of development projects. The highlights of the documents are presented.

2.1 Constitution of Nepal, 2015

The (Constitution of Nepal, 2015), assures the right to every citizen to live in a clean environment and requires the state to keep the environment clean and to provide priority to the protection of the environment and prevention of further damage to the environment due to

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development activities and to take special measures for protection of wildlife, vegetation and forests.

2.2 Environment Related Acts

2.2.1 Environment Protection Act and Environmental Protection Regulation, 1997

The legal regime on the environment makes every effort to integrate environmental aspects in the Projects and programs. The Environment Protection Act (EPA, 1997) and the Environment Protection Rules (EPR, 1997) amendment 1999, enforced since June 1997, oblige the proponent to get approval of the IEE report of this level of Project before implementation. The environmental laws contain elaborated provisions on the approval process of the IEE report. Sections 3 to 6 of the EPA, 1997 and Rules 3 to 11 of the EPR, 1997 contain such provisions and this IEE report has been prepared following those legal requirements. Rule 12 of the EPR, obliged the proponent to comply with the matters mentioned in the report and other conditions, if any, prescribed by the approving agency or concerned agency.

The environmental management plan is the heart of the environmental study report. The proponent is obliged to implement the mitigation measures. The environmental monitoring works should be performed by the concerned agency and auditing by the Ministry of Forests and Environment (MoFE) in accordance with the provisions of the EPR, 1997. Furthermore, the environmental law has made the public consultation a pre-requisite to all the prescribed Projects to provide different stakeholders an opportunity to raise their concerns. Section 18 of the EPA, 1997 empowers the prescribed authority case any person implements a proposal requiring environmental assessment without any approval or carries any act in contrary to the approved proposal. The proponent has duly followed these legal requirements while finalizing this report and will continue to follow them, particularly the implementation of EMP during the Project construction stage and operational phase.

2.2.2 Local Self-Governance Act (LSGA), 1999

The Local Self-Governance Act (LSGA, 1999) empowers the local bodies for the Conservation of soil, forest and other natural resources and implements environmental conservation activities. Sections 28 and 43 of the Act provide the Village Development Committee a legal mandate to formulate and implement programs related to protection of environment and bio-diversity. Similarly, Sections 189 and 201 of the Act provide that the Districts Development Committees are liable to formulate and implement programs related to protection of environment and give adequate priority for protection of environment during formulation and implementation of districts level plan(s). The respective Municipality and DCC (former DDC) can regulate soil and water conservation activities that support to stabilize the slopes and minimize likely adverse impacts on the infrastructure.

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2.2.3 Public Road Act, 1994

The Public Road Act, (PRA, 1994) has been enacted to ensure the construction and operation of the road Projects smoothly. Section 3 of the Act empowers GON to prohibit the construction of permanent structures (buildings) in the prescribed distance from the road, i.e. the Department of Roads (DoR) has the authority over everything within the boundaries of the road. The DoR may acquire temporarily the land and other property adopting compensatory measures during the construction, rehabilitation and maintenance of the public road (Sections 14 and 15). The Act obliges the DoR to plant trees on both sides of the road and handover it to the local bodies (Municipality) for their management (Section 16). The Act also empowers the DoR to operate quarries and borrow pits and other facilities during the road construction (Section 17). In sum, the Act facilitates the construction of this road by even acquiring land and property including for the execution of construction materials and development of other facilities during road construction through compensation as negotiated and as well as to maintain greenery along the roadside.

2.2.4 Land Acquisition Act, 1977

The Land Acquisition Act (LAA, 1977) empowers the Government to acquire land for development purposes, by paying compensation for the landowner. The Land Acquisition Guidelines, 1989 have been issued to facilitate the acquisition process under the Act.

The Act clearly empowers the Government to acquire necessary land and fixed property of any owner for development use and welfare, diplomatic mission, international organizations after issuing public notice and completing required procedures. Under this Act, the Government can also acquire land for public and private corporations, organizations, private firms for public use and welfare. However, the Government will not acquire land for corporations, organizations and private firms for agriculture purpose except for research purpose under this Act. The Government will provide compensation to the concerned person and organization as decided by the Compensation Fixation Committee. The compensation rate to be determined may differ for person whose land was wholly acquired or for those whose land was partially acquired. There are different provisions regarding the compensation rate:

- Compensation rate to landowner whose land has been acquired for government-owned institutions, organizations and local bodies;
- Compensation rate to landowner whose land has been acquired for other institutions and organizations; and
- Compensation rate to land owner whose land exceeds land ceiling according to Land Reform Act, 2021 B. S. acquired for government-owned institutions, organizations and local bodies.

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Land acquisition through negotiation is an important aspect included in Section 27 of this Act which has a provision that the Government can acquire land through direct negotiation with the owner. This will minimize dissatisfaction of landowners regarding compensation and loss. Section 34 of the Act has a provision to return acquired land to the owner if it is not required. Similarly, the Government may also cancel its decision regarding land acquisition.

However, as there is no amendment on this Land Act over the last 35 years, it has many gaps while dealing with problem of involuntary settlement, particularly in the context of international practices and approaches.

2.2.5 Forest Act, 1993 and its Rules 1995

Forest Act (FA, 1993) and the Forest rules (FR, Forest Rules, 1995) is attracted if the road passes through patches of forests and/or privately owned trees. Section 68 of the Forest Act, 1993 empowers GON, in case of no alternatives, to provide parts of any types of forests for the implementation significantly. The competent forestry organization will give consent to fell down trees along the road alignment by enforcing Section 68 of the Act to facilitate road construction. Furthermore, the forestry laws oblige the proponent to conserve the legally protected species (plans and wild animals). If the road pass through the protected areas (National Park, Wildlife Reserve, Conservation Area, Hunting Reserve or strict nature reserve or declared watershed area), the National Parks and Wildlife Conservation Act (NPWCA, 1973) and the Soil and Watershed Conservation Act (SWCA, 1982) and their rules will also be attracted.

2.2.6 Soil and Watershed Conservation Act, 1982

In order to properly manage the watersheds of Nepal, the (SWCA, 1982) was enacted. Section 3 of the Act empowers GoN to declare any area as a protected watershed area. Section 4 of the Act provides that a watershed conservation officer has the authority to implement the following works in protected watershed areas.

Construct and maintain dam, embankment, terrace improvements, diversion channels and retaining walls. Protect vegetation in landslide-prone areas and undertake afforestation programs, and Regulate agricultural practices pertinent to soil and watershed conservation.

Under Section 10 of the Act, power is extended to the Watershed Conservation Officer to grant permission to construct dams, drainage ditches, canals, cut privately owned trees, excavate sand, boulders and soil, discharge solid waste, and establish industry or residential areas within any protected watershed. The Act outlines the essential parameters necessary for proper watershed management (including rivers and lakes). The Act is applicable to protected watersheds.

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2.2.7 Explosive Material Act, 1961

The Explosive Material Act (EMA, 1961) has made a legal provision on how to use explosive material during the construction stage of the Project. The provisions on the category of explosives and the handling procedures and the necessary approvals required are stipulated in the Act. Article 4 of the Act requires license for procurement, storage, use and transportation of explosives, including for any development Projects.

If construction activities require the use of explosive, in accordance with the Explosive Material Act, 1961, prior approval of the Chief District Officer (CDO) is needed to purchase explosives. Article 4 of the Act is relevant.

2.2.8 Motor Vehicle and Transport Management Act, 1993

The (MVTMA, 1993) defines and prescribes necessary standards for vehicles emission and mechanical condition for vehicle registration by the Transport Management Office (TMO) and the TMO can deny a permit based on environmental factor. Standards are set for petrol and diesel engine under the Nepal Vehicle Mass Emission Standard 1999.

2.2.9 Solid Waste Management Act, 2011

The (SWM, 2011) expedient to make the management of the solid waste in a systematic and effective way by reducing at its source, re-use, processing or discharge and for maintaining a clean and healthy environment through the reduction of adverse effects that may be caused to the public health and environment by amending and consolidating the law relating to the management of solid waste like most essential services laws.

2.3 Environment Related Rules

2.3.1 Environmental Protection Rules (EPR), 1997, First amendment 1999

The (EPR, 1997) obliges the proponent to inform the public on the contents of the proposal in order to ensure the participation of stakeholders. EPR contains the elaborative provisions on the process to be followed during the preparation and approval of Projects requiring IEE and EIA including scoping document, terms of reference, information dissemination, public consultation and hearing and environmental monitoring and auditing. Article 12 of the EPR, requires the proponent to comply with the matters mentioned in the report and other conditions, if any, prescribed by the approving agency or concerned agency, while Rule 13 and 14 are related to environmental monitoring and environmental auditing.

2.3.2 Forest Rules, 1995

The Forest Rules (FR, 1995) elaborates legal measures for the conservation of forests and wildlife. Based on forest legislation, thirteen plant species are included in the level protection list. Of them, GoN has banned the felling, transportation and export of Champ (*Michelia champacta*), Khayer (*Acacia catechu*) and Sal (*Shorearobusta*). Rule 65 stipulates that in case the execution of any Project having national priority in any forest

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area causes any loss or harm to any local individual or community, the proponent of the Project itself will bear the amount of compensation to be paid. The Rule also stipulates that the entire expenses for cutting and transporting the forest products in a forest area to be used by the approved Project will be borne by the proponents of the Project.

2.4 Plans and Policies

2.4.1 Forest Policy, 1993

The forest policy (FP, 1993) is attracted when a development project directly or indirectly impacts on the forest resources. The forest policy is directed, inter alia, to contribute food production through effective interaction between forestry and farming system, to protect land against degradation by soil erosion, landslide, and other effects of ecological disturbances, and to conserve ecosystem and genetic resources. However, the forest policy re-emphasizes to avoid forest destruction or tree cutting while constructing infrastructures during implementation of project other than forest sector. The policy has prioritized the protection of Siwalik, the geologically vulnerable area, with a view to ensure watershed conservation, and maintenance of water recharge. The policy also stresses conservation of endangered species. It has reiterated that forest area will not be used for any activities other than prescribed in Operational Forest Management Plan. The forest policy emphasizes the implementation of community and private forestry development programs, national parks and conservation areas management programs, soil and watershed conservation program, management and development of medicinal plants, and conservation of biological diversity.

2.4.2 Land Acquisition, Resettlement and Rehabilitation Policy, 2015

The Policy (LARRP, 2015) contributes to overall development of the nation and its citizens by creating conducive environment for implementation of infrastructure development projects. The Policy supports timely execution (Completion) of development project, minimizing adverse impacts on economic, social and cultural aspects of affected families/people and the project area.

The Policy aims to improve social and economic status of project affects families by providing fair and adequate compensation, appropriate resettlement and rehabilitation assistance/allowances while acquiring land for infrastructure development projects and projects of public interests.

The Policy's objectives are:

- To avoid displacement wherever possible and if not, explore alternative to minimize adverse impacts as far as possible.
- To provide adequate compensation, rehabilitation assistance, and opportunities of social and economic benefit to the affected person, family, and the community

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- To create conducive environment for timely completion of project by making land acquisition, valuation, compensation, resettlement, and rehabilitation process simple, easy, transparent and fair.

2.5 Review of Environment Related Guidelines

2.5.1 National EIA Guidelines, 1993

The (EIA Guidelines, 1993) guideline states clear directions about the process of conducting EIA. This guideline makes EIA in Nepal legally mandatory and contains process for ensuring public involvement during the preparation of EIA report. It calls for information regarding identification of physical, biological, socio-economic and cultural impacts. Impacts ranking method also suggested in this guideline. It stresses the inclusion of mitigation measures to avoid, minimize and mitigate adverse impacts and maximize beneficial impacts resulting from the development Project and monitoring & environmental auditing in the EIA report. Its revision in 1997 calls for the ensuring local people's participation , collection of relevant information, identifying major issues of public concerns, evaluate them and establishing priorities for EIA study.

2.5.2 Environmental Management Guidelines, GESU / DoR, July, 1997

The (EMG, 1997) Guideline, prepared by the Geo-Environment & Social Unit (GESU) of DoR, stipulates the integration of environmental mitigation measures in surveying, design, tender document preparation, contract document preparation, construction, maintenance, rehabilitation and operation of road Projects. The guideline results from a program undertaken jointly by GoN and the World Bank under the Road Maintenance and Rehabilitation Project (RMDP). The Guideline has been formally approved by Minister level decision in 1997.

The Guideline is the part of operational practices for all road maintenance, rehabilitation and construction activities under DoR schemes. The environmental mitigation measures are broken down into twelve categories including (i) Quarries; (ii) Borrow Pits; (iii) Spoil and Construction Waste Disposal; (iv) Work Camp Location and Operation; (v) Labor Camp Location and Operation; (vi) Earthwork/Slope Stabilization; (vii) Use of Bitumen; (viii) Stockpiling of Materials; (ix) Explosive, Combustible and Toxic Materials Management; (x) Setting Up and Operation of Stone Crushing Plants; (xi) Water Management; (xii) Air & Noise Pollution.

The Guideline suggests methods for determining how and when the public should be included in the environmental analysis. Apart from providing a comprehensive list for mitigation measures to be incorporated into DoR Projects, it describes the procedures for public participation, and other socio-economic safeguard considerations. It gives advice on assessing socio-economic impacts and strategies for reducing or avoiding potential adverse impacts, and for maximizing the positive ones for the benefit of local residents. The Socio-

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economic impacts include important issues of land acquisition and compensation and other economic impacts related with markets for agriculture production, agriculture inputs, nutrition, extraction of natural resources beyond replenishment, migration and influx of migrants, land speculation, illegal logging and mining, carrying goods by porters etc. It also includes the handling of impacts on cultural heritage.

2.5.3 Environmental and Social Management Framework, DOR, 2007

This Environmental and Social Management Framework report (ESMF, 2007) intends to provide technical and managerial inputs and guidance into the design of the strategic roads (both designated for rehabilitation and, to lesser extent, to new construction), through identification of key environmental and social issues related to the foreseen Projects, mitigate potential impacts and concerns and, devise opportunities to enhance the benefits. The framework integrates in a step-wise approach the most important environmental and social considerations into all stages of Project preparation, implementation, monitoring and operation and is applicable to all future Projects.

The ESMF is applicable to all proposed subproject activities and through all stages of the subproject cycle, i.e. from pre-planning, planning and design, implementation to post-implementation. The design flow of ESMF activities will be coordinated and integrated into the Project cycle.

2.5.4 Environmental Management Guidelines for Roads and Bridges, GESU/DoR, 1999

The (EMG, 1999) ensures that environmental considerations are integrated into the Project survey and design, tender document, contract document, and Project supervision and monitoring. The guideline is intended to minimize environmental impacts resulting from road and bridge construction, operation, maintenance and rehabilitation. The guideline intents to improve road performance and reliability, increase benefits to local residents and maximize cost effectiveness.

2.5.5 Manual for Environmental and Social Aspects of Integrated Road Development, MoPIT/ DoR, 2003

This Manual (DoR, 2003) is designed to help integrate social and environmental considerations, including public involvement strategies, with technical road construction practices. It suggests stepwise process of addressing Environmental and Social issues alongside the technical, financial and others. The Manual is a suggestive, and not exhaustive, and advise and recommends various environmental and social approaches, actions and strategies to assist developers in following mandatory requirements of the law and improving public involvement. The Manual is based on the experiences of Nepal, as well as incorporates the national and international ‘best practices’. It suggests process of environmental and social assessment process, roles and responsibilities of stakeholders at

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various stages of the Project, advice on impact mitigation action plans, and process for involving the public.

2.5.6 EIA Guidelines for the Forestry Sector, 1995

EIA Guidelines for the Forestry Sector (NPC and IUCN, 1995) has given focus to make proposals which have forest components socio-culturally acceptable, economically feasible and environmentally sustainable, thereby to conserve genetic resources and biodiversity, and minimize environmental damage in forest areas and facilitate in identification of positive and adverse impacts of proposal implementation.

2.5.7 Forest Produce Collection and Sales Distribution Guidelines, 2058 (2001)

The guideline's (MoFE, 2001) clauses 3 to 10 have specified various procedure and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume etc. and government offices and officials responsible for the approval, delineation and evaluation. These provisions have a direct relevance to the development of the Project and need compliance to these provisions.

3. Infrastructure Development and conservation of natural resources in Nepal

The conservation of natural habitats can help ensure the long-term resilience of ecological systems and their main properties. Among them, biodiversity—the diversity of plant and animal life or ecosystems has made the Earth a uniquely habitable place for humans. Healthy ecosystems carry out a diverse array of processes that provide humanity with both goods, such as food, construction materials, medicinal plants, and tourism/ recreation opportunities, and services, such as hydrological cycle maintenance, climate regulation, soil generation and maintenance, nutrient storage and cycling, and cleansing of air and water (Quintero, 2007). Mainstreaming conservation into infrastructure projects requires an appreciation for the extent of services they can provide to the environment and local communities. Although infrastructure projects comprise a trade-off between service benefits and environmental costs, the final balance need not be one of environmental losses. On the contrary, infrastructure projects can be vehicles for improving institutional and legal frameworks for natural resource conservation, identifying new high-priority habitats, improving and expanding protected areas, securing state-of-the-art advice for specific conservation issues, and even leveraging important funds for conserving otherwise unprotected habitats. The high visibility and political significance of typical large infrastructure projects can act as a catalyst for advancing conservation actions that might not otherwise be a country priority.

In Nepal, infrastructure development and natural resource conservation are tightly linked, given the country's varied geography, ecological sensitivity, and economic aspirations (T. D. Allendorf and B. Gurung, 2016). Here's an overview of key aspects, challenges, and strategies regarding these two priorities in Nepal:

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3.1 Infrastructure Development:

Transportation: Nepal's rugged terrain has made road development challenging but essential. The government has prioritized building highways, rural roads, and alternative modes like railways. Projects such as the Postal Highway and the East-West Highway aim to enhance connectivity across the country, while local governments are also focusing on rural road networks to improve access to remote areas.

Hydropower and Energy: Nepal's rivers have significant potential for hydropower, and energy development is a priority to meet both domestic demand and export capacity, especially to India. With projects like the Upper Tamakoshi Hydropower Plant, Nepal is working towards energy independence and reducing power cuts. However, balancing hydropower development with ecological conservation, especially in biodiversity-rich areas, remains a challenge.

Urban Development: Kathmandu, Pokhara, and other urban areas have seen a rise in urbanization, with new projects like smart cities and housing developments. However, these cities face issues with congestion, pollution, and waste management. Planned development and sustainable urban planning are essential to ensure these cities remain livable.

Tourism Infrastructure: As a major economic sector, tourism relies on good infrastructure. The development of trekking routes, airports and cultural heritage sites are aimed at improving tourist accessibility and experiences. However, these developments must also consider the preservation of cultural and natural resources.

3.2 Conservation of Natural Resources:

Forestry and Biodiversity: With over 40% of Nepal's land covered by forests, conserving these areas is crucial. Community forestry initiatives have empowered local communities to manage and benefit from forest resources, leading to successful reforestation and wildlife conservation. National parks and conservation areas, like Chitwan and Sagarmatha, are also crucial for protecting biodiversity.

Water Resources: Nepal is home to thousands of rivers, streams, and glaciers, which are critical for drinking water, agriculture, and hydropower. Climate change, however, poses a risk to these water resources, particularly with the melting of Himalayan glaciers. Integrated water resource management practices are needed to protect these resources for future generations.

Soil and Land Management: Soil erosion, landslides, and land degradation are significant challenges, especially in hilly and mountainous areas. Sustainable agricultural practices, terracing, and afforestation efforts help combat these issues. Projects focusing on land management in rural areas aim to reduce soil degradation and increase productivity.

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Air Quality and Climate Change: Air pollution in cities like Kathmandu has become a serious health concern. Emissions from vehicles, brick kilns, and dust contribute to poor air quality. Renewable energy solutions, emission controls, and public transportation improvements are needed to mitigate this issue.

3.3 Challenges and Strategies:

Balancing Development with Conservation: The push for infrastructure often conflicts with conservation. For instance, hydropower development must avoid adverse impacts on river ecosystems and downstream communities. Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA) help balance these needs but must be enforced more rigorously.

Community Involvement: Nepal has a strong tradition of community-based natural resource management, especially in forestry. Engaging communities in development and conservation initiatives is crucial for long-term success, as they can provide local insights and ensure that projects align with environmental needs.

Policy and Regulation: Nepal has policies for both infrastructure development and environmental conservation, but enforcement is often weak due to limited resources and political challenges. Strengthening institutions, enhancing accountability, and mobilizing local governments can improve implementation.

3.4 Opportunities for Sustainable Development:

Eco-Tourism: By promoting eco-tourism, Nepal can benefit economically while conserving natural and cultural resources. Projects like the Annapurna Conservation Area are models for how tourism revenue can support conservation and community development.

Renewable Energy: Apart from hydropower, Nepal has potential in solar and wind energy, which are being explored to provide cleaner alternatives and mitigate dependency on a single source.

International Collaboration: Nepal can benefit from international funding, technical assistance, and knowledge-sharing initiatives, especially concerning climate resilience and sustainable infrastructure.

In summary, Nepal faces the dual challenge of fostering development while preserving its rich natural resources. Integrated, community-oriented, and sustainable approaches will be essential to balancing these priorities in the future.

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4. Findings

Here are some key findings that could be derived from this article on "Policies and Practices for the Conservation of Natural Resources during Infrastructure Development in Nepal".

a) **Lack of Comprehensive Policies**: Nepal has made progress in creating environmental regulations, but policies specific to infrastructure development often lack clarity and enforcement. This gap makes it challenging to systematically implement conservation measures in projects like roads, dams, and urban development.

b) **Limited Environmental Impact Assessments (EIAs)**: While EIAs are legally required for major infrastructure projects, many developments proceed with inadequate assessments or weak follow-up on mitigation plans. This results in unchecked environmental damage, including deforestation, soil erosion, and loss of biodiversity.

c) **Encroachment on Protected Areas**: Infrastructure projects, particularly in rural and mountainous areas, often encroach on protected lands, which are vital for biodiversity and ecosystems. This leads to habitat loss and fragmentation, impacting wildlife corridors and increasing the risk of species endangerment.

d) **Insufficient Community Involvement**: Local communities, who often have valuable knowledge of natural resources and local ecosystems, are typically underrepresented in conservation-related decision-making. This limits the effectiveness and sustainability of conservation practices in development projects.

e) **Opportunities in Eco-Friendly Practices**: Some successful examples exist of using sustainable methods, such as reforestation, erosion control techniques, and green infrastructure, which minimize the ecological impact of development. Expanding such practices could help balance infrastructure needs with environmental sustainability.

f) **Weak Implementation of Existing Laws**: Nepal has a legal framework for environmental conservation, but inconsistent enforcement and corruption hinder its effectiveness. Strengthening governance and transparency could enhance the application of conservation practices.

g) **Potential for Integrated Planning**: There is an opportunity to integrate conservation planning into the initial stages of infrastructure development. This would allow for better site selection, reduce environmental impacts, and make use of natural resource conservation as a cornerstone of sustainable development in Nepal.

h) **Climate Resilience and Natural Resource Management**: Nepal's geography makes it highly vulnerable to climate-related disasters, which are exacerbated by unsustainable development. Adopting nature-based solutions and climate-adaptive planning could help mitigate these risks and support resource conservation.

In summary, Nepal has to develop clearer, enforceable policies and practices that integrate environmental conservation into all stages of infrastructure development. By embracing a collaborative approach, leveraging sustainable practices, and strengthening existing frameworks, Nepal can achieve a model of development that respects and preserves its natural resources.

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5. Conclusion

In Nepal, the conservation of natural resources amidst infrastructure development remains both a challenge and an opportunity. While infrastructure growth is essential for economic progress, it often comes at a significant environmental cost. To mitigate these impacts, Nepal must adopt policies that balance development with conservation. By implementing sustainable practices, such as environmental impact assessments, habitat restoration, and strict regulations on resource extraction, the country can protect its diverse ecosystems while fostering growth. Additionally, promoting community involvement, enhancing enforcement mechanisms, and prioritizing eco-friendly technologies will be crucial to achieving long-term conservation goals.

Moving forward, a collaborative approach—engaging government bodies, NGOs, local communities, and private stakeholders—will be essential. This integrated effort can foster a sustainable model of development, where infrastructure projects not only respect but also enhance Nepal's rich natural heritage. If these policies and practices are consistently applied, Nepal can set an example for sustainable development, showing how infrastructure growth and environmental conservation can coexist.

6. Recommendations

Here are some recommendations on "Policies and Practices for the Conservation of Natural Resources during Infrastructure Development in Nepal":

a) **Strengthen Policy and Regulatory Frameworks**: Update and clarify policies related to infrastructure development with specific guidelines for natural resource conservation. Establish stricter regulations for Environmental Impact Assessments (EIAs) and enforce their implementation across all projects, regardless of scale, to ensure consistent environmental protection.
b) **Enhance EIA Effectiveness and Monitoring**: Make EIAs more robust by including regular monitoring and reporting requirements for the entire project lifecycle. Establish independent audit bodies to oversee these assessments and enforce penalties for non-compliance, ensuring developers are held accountable for environmental standards.
c) **Promote Community Participation and Ownership**: Involve local communities in decision-making processes, especially those directly impacted by development projects. Train and employ local communities in conservation practices, so they benefit from and are invested in preserving natural resources during and after project completion.
d) **Adopt and Scale Up Eco-Friendly Infrastructure Practices**: Encourage the use of sustainable materials, green technologies, and methods such as wildlife-friendly infrastructure, erosion control, and reforestation to minimize ecological damage. Incentivize developers to adopt green practices through tax breaks, subsidies, or recognition programs.
e) **Implement Habitat and Biodiversity Offsetting**: Where projects inevitably impact ecosystems, establish a system for biodiversity offsetting, requiring developers to

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restore or conserve equivalent habitats elsewhere. This approach could balance the ecological costs of development with conservation gains in other areas.

f) **Strengthen Law Enforcement and Governance**: Improve the capacity and resources of environmental agencies to monitor and enforce conservation regulations. Combat corruption and ensure transparency in decision-making to reinforce public trust and regulatory effectiveness in infrastructure projects.

g) **Integrate Conservation in Early Planning Stages**: Embed conservation goals into the initial stages of infrastructure planning. Early integration allows for better site selection, which minimizes impacts on sensitive ecosystems and enables more effective mitigation measures.

h) **Promote Climate-Resilient Infrastructure Development**: Given Nepal's vulnerability to climate change, prioritize nature-based solutions and climate-adaptive designs in all infrastructure projects. These approaches can reduce the risk of disasters like landslides and floods while supporting biodiversity conservation.

i) **Encourage Public-Private Partnerships for Conservation**: Establish partnerships between government, private developers, NGOs, and research institutions to co-create and implement conservation strategies. Shared expertise and resources can enhance conservation outcomes and promote innovation in sustainable development.

j) **Educate and Raise Awareness on Sustainable Development**: Conduct awareness campaigns and provide education on sustainable development practices for stakeholders, from policymakers to local communities. Building a strong conservation ethic can encourage sustainable practices and support public accountability.

These recommendations aim to create a balanced approach where infrastructure development in Nepal does not come at the cost of natural resources. By prioritizing sustainability in both policy and practice, Nepal can safeguard its rich biodiversity and landscapes for future generations while achieving its development goals.

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