

# **SUSTAINABLE DEVELOPMENT OF GREEN INFRASTRUCTURE IN RURAL RUONGLEVAISUO (TIPAIMUKH), MANIPUR**

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## **ABSTRACT**

Sustainable development of green infrastructure in rural and hilly areas is imperative for balancing ecological health, economic growth, and community well-being. This study investigates the integration of green infrastructure practices tailored to the unique challenges and opportunities presented by hilly rural Tipaimukh Manipur. Green infrastructure, which includes practices such as the creation of green roofs, permeable pavements, bios wales, and the restoration of natural habitats, can effectively manage storm water, reduce erosion, and enhance biodiversity. In hilly areas, these practices must be adapted to the terrain, addressing issues like soil stability, water runoff, and limited flat land.

Key strategies include the use of terraced farming combined with vegetation buffers to prevent soil erosion, the implementation of rainwater harvesting systems to address water scarcity, and the restoration of native vegetation to support local wildlife and enhance ecosystem services. Additionally, community involvement and local knowledge are emphasized as critical components for the sustainable development and maintenance of these systems.

Economic analysis within this study reveals that while initial investments in green infrastructure can be substantial, long-term benefits include reduced costs associated with storm damage, improved agricultural productivity, and enhanced tourism opportunities due to increased natural beauty. Furthermore, the paper discusses policy recommendations to support the adoption of green infrastructure in rural hilly areas, such as financial incentives for farmers, technical assistance programs, and the inclusion of green infrastructure in regional planning processes.

In conclusion, the sustainable development of green infrastructure in hilly rural areas presents a viable path towards ecological resilience and socio-economic development. By leveraging natural processes and engaging local communities, green infrastructure can address environmental challenges while fostering sustainable livelihoods and preserving the natural beauty of Tipaimukh Manipur.

## **INTRODUCTION**

### **About Tipaimukh Manipur**

Tipaimukh is a hill town that borders the state of Mizoram and is located in the Pherzawl district of Manipur. The words "Tipai," which essentially means "Tuivai River," and "Mukh," a native term meaning "the mouth," combine to form the name Tipaimukh. Nonetheless, the location is also referred to by its native term, Ruonglevaisuo. The total geographic area of the sub-division block is 789.48 km<sup>2</sup>, having 55 villages with the total population of 23,995 approx. The majority of the people inhabiting Tipaimukh are the indigenous Hmar people who are spread in large numbers in neighbouring Indian states of Mizoram, Assam, Tripura and Meghalaya. Tipaimukh is currently one of Churachandpur district's most popular natural wonders. The town of Tipaimukh is well known for its untouched surroundings, breathtaking scenery, and pleasant atmosphere, but it's also the site of the unique confluence of the Tuivai and Barak rivers. The lush landscapes serving as the background perfectly capture the breathtaking appearance of this convergence. If you want to get a closer look at the local environment while on vacation, you can opt for a stroll along the riverbank, where the breathtaking scenery will amaze you. In addition to being a well-liked destination for tourists in Churachandpur, the picturesque village of Tipaimukh provides boating offers an additional means of taking in the beauty of the surroundings. Blessed with a stunning variety of flora and animals, hill tract forests encompass 67% of Manipur's land area. A hill range's elevation determines the climate, which spans from tropical to sub- alpine. A variety of rare and endemic plant and animal species can be discovered in the wet woods and pine forests, which are located between 900 and 2700 meters above mean sea level. Orchids, which are highly prized for their stunning and valuable blossoms, exude an air of mystery and

exoticism. Local festivals are an occasional event that highlight the region's rich heritage, attracting interested tourists and gradually enhancing the area's image as a cultural tourism destination. With more people traveling in search of Tipaimukh's unspoiled rivers, forests, and animals, ecotourism has grown in popularity. Farmers cultivate a wide range of fruits, vegetables, and crops. Foods growing nearby include pepper, corn, oranges, pineapples, pumpkins, kawlkai, ginger, turmeric, and bal. additionally, a few significant events are Sizo Festival, Chapchar Kut, Ginger Festival, Unau Suopui Cultural Festival, and Sikpuiroi.

### **Understanding Green Infrastructure**

Green infrastructure refers to a network of natural and semi-natural systems that provide ecological, economic, and social benefits through sustainable land management practices. These systems include green roofs, permeable pavements, rain gardens, bio wastes, urban forests, and the restoration of wetlands and other natural habitats. In rural and hilly areas like Tipaimukh, green infrastructure also encompasses terraced agriculture, agroforestry, watershed management, and reforestation efforts. The primary goals are to manage water sustainably, reduce erosion, enhance biodiversity, and improve the quality of life for local communities.

### **Environmental Challenges in Tipaimukh Manipur**

Manipur's topography is characterized by steep hills and valleys, making it prone to soil erosion and landslides, particularly during the monsoon season. Deforestation for timber, fuelwood, and shifting cultivation further exacerbates soil degradation and disrupts water cycles. Additionally, climate change has intensified these problems, leading to unpredictable rainfall patterns, prolonged droughts, and severe flooding. These environmental challenges threaten agricultural productivity, water security, and the overall resilience of rural communities.

### **Green Infrastructure Strategies for Tipaimukh Manipur**

#### **1. Terraced Farming and Agroforestry**

Terraced farming is an age-old practice in hilly regions that involves creating stepped levels on slopes to reduce soil erosion and manage water runoff. In Manipur, promoting terraced farming combined with agroforestry can significantly enhance soil stability and fertility. Agroforestry integrates trees and shrubs into agricultural landscapes, providing multiple benefits such as improved soil health, increased biodiversity, and additional income sources from timber, fruits, and other forest products.

#### **2. Rainwater Harvesting**

Water scarcity is a critical issue in many parts of Manipur, particularly during the dry season. Rainwater harvesting systems can capture and store rainwater for agricultural and domestic use, reducing dependence on unreliable water sources. Implementing community-based rainwater harvesting projects can ensure equitable water distribution and empower local communities to manage their water resources sustainably.

### 3. Restoration of Natural Vegetation

Reforestation and afforestation initiatives are vital for restoring degraded lands and improving ecosystem services. In Manipur, restoring native vegetation can enhance biodiversity, stabilize soils, and regulate water cycles. Community participation is crucial for the success of these projects, as local knowledge and involvement ensure that the chosen species and methods are appropriate for the specific environmental and cultural context.

### 4. Sustainable Watershed Management

Watershed management involves protecting and rehabilitating the land area that drains into a common water body. In hilly regions like Manipur, integrated watershed management practices can mitigate soil erosion, improve water quality, and enhance groundwater recharge. Techniques such as contour bonding, check dams, and vegetative barriers are effective in controlling runoff and sedimentation.

## **Case Studies of Successful Green Infrastructure Projects**

### 1. Terraced Farming

Manipur has successfully implemented terraced farming practices to combat soil erosion and increase agricultural productivity. Local farmers, supported by government and non-governmental organizations, have constructed terraces on steep slopes, planted diverse crops, and integrated agroforestry practices. These efforts have led to improved soil fertility, higher crop yields, and enhanced resilience against extreme weather events.

### 2. Community-Based Rainwater Harvesting in Churachandpur

In Churachandpur, community-based rainwater harvesting projects have transformed water management practices. Villagers have constructed rainwater storage tanks and ponds to capture monsoon rains, ensuring a reliable water supply during the dry season. These initiatives have not only improved water security but also fostered community cooperation and self-reliance.

## **Policy Recommendations**

To promote the sustainable development of green infrastructure in Tipaimukh, Manipur several policy measures are recommended:

1. Financial Incentives and Subsidies

Providing financial incentives and subsidies for green infrastructure projects can encourage farmers and communities to adopt sustainable practices. Grants, low-interest loans, and subsidies for materials and equipment can lower the initial cost barriers and promote widespread adoption.

2. Technical Assistance and Capacity Building

Offering technical assistance and capacity-building programs can equip local communities with the knowledge and skills needed to implement and maintain green infrastructure projects. Training workshops, extension services, and demonstration projects can enhance understanding and ensure long-term success.

3. Integration into Regional Planning

Incorporating green infrastructure into regional and local planning processes is essential for coordinated and sustainable development. Policies should mandate the inclusion of green infrastructure in land-use planning, infrastructure development, and climate adaptation strategies.

4. Community Participation and Empowerment

Engaging local communities in the planning, implementation, and management of green infrastructure projects is crucial for their success. Participatory approaches that respect local knowledge and prioritize community needs can foster ownership and long-term commitment.

### **Detailed Implementation Strategies**

To effectively implement green infrastructure in Tipaimukh Manipur, detailed strategies tailored to the region's unique conditions are necessary. These strategies should consider the socio-economic context, cultural practices, and specific environmental challenges of Manipur.

1. Adaptive Terraced Farming Techniques

Adaptive terraced farming techniques should be promoted to suit the varied topography and climatic conditions of Tipaimukh Manipur. Techniques such as contour plowing, stone bunding, and the use of organic mulches can further reduce soil erosion and enhance water retention. Additionally, incorporating traditional knowledge and practices, such as the "Jhum" cultivation system, can provide insights into sustainable land management tailored to local conditions.

2. Advanced Rainwater Harvesting Systems

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Implementing advanced rainwater harvesting systems, such as rooftop harvesting and micro-catchment systems, can increase water availability for households and agriculture. These systems can be designed to capture and store large volumes of water, with filtration and purification mechanisms to ensure water quality. Training local communities on the construction, maintenance, and management of these systems is essential for their sustainability.

### 3. Ecological Restoration and Biodiversity Conservation

Ecological restoration efforts should focus on reestablishing native plant species and creating habitat corridors to support wildlife. Involving local communities in seed collection, nursery management, and tree planting can enhance the success of reforestation projects. Biodiversity conservation programs should also address the protection of endangered species and the restoration of critical habitats.

### 4. Integrated Watershed Management Plans

Developing integrated watershed management plans involves a holistic approach to managing land, water, and vegetation within a watershed. These plans should incorporate scientific assessments, community input, and multi-stakeholder collaboration. Key components include mapping erosion-prone areas, designing erosion control structures, and implementing soil and water conservation practices.

## Monitoring and Evaluation

Monitoring and evaluation (M&E) frameworks are crucial for assessing the effectiveness of green infrastructure projects. These frameworks should include baseline data collection, regular monitoring of environmental and socio-economic indicators, and participatory evaluation processes. Community members can be trained as citizen scientists to collect data and monitor project outcomes, fostering local ownership and accountability.

## Challenges and Solutions

Implementing green infrastructure in rural hilly areas like Tipaimukh Manipur faces several challenges, including financial constraints, lack of technical expertise, and resistance to change. Addressing these challenges requires innovative solutions:

### 1. Mobilizing Financial Resources

The required finance for green infrastructure projects can be obtained by pooling financial resources through international grants, community savings plans, and public-private partnerships. Small-scale farmers and community organizations can also be helped by the establishment of revolving funds and microcredit facilities. Small-scale farmers and community organizations can also be helped by the establishment of revolving funds and microcredit facilities.

## 2. Building Technical Capacity

Building technical capacity through collaboration with academic institutions, research organizations, and extension services can enhance local knowledge and skills. Training programs, workshops, and exchange visits can facilitate the transfer of best practices and innovative technologies.

## 3. Fostering Community Engagement

Fostering community engagement involves creating platforms for dialogue, participation, and decision-making. Community-based organizations, cooperatives, and local governance structures can play a vital role in mobilizing community support and ensuring that projects align with local needs and priorities.

## **CONCLUSION**

In Manipur's rural hilly areas of Tipaimukh, the sustainable development of green infrastructure offers a workable solution to the region's environmental problems while improving the resilience and standard of living for local residents. Sustainable results require encouraging local involvement and incorporating green infrastructure into regional planning. Successful case studies in terraced farming and community-based rainwater harvesting demonstrate the potential benefits of these approaches. However, achieving widespread adoption requires supportive policies, financial incentives, technical assistance, and robust community participation. Tipaimukh can serve as a model for other rural hilly regions facing comparable issues by way of creative solutions and capacity building that enable them to overcome financial, technical, and social hurdles. Tipaimukh's tourist history is still in its early stages, but for those who visit and responsibly utilize its tourism potential, the region's pristine attractiveness, rich cultural tapestry, and natural wonders promise a bright future.

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