

Sustainable Tourism And Integrated Infrastructure Planning For Ziro Valley, Arunachal Pradesh

A Thesis Project

*submitted in partial fulfilment of the requirements for
the award of the degree of*

Bachelor of Planning

By

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DECLARATION

I **YANGKEYNAM DANGGEN**, Scholar No **2211002116** hereby declare that the thesis titled Sustainable Tourism and Integrated Infrastructure Planning For Ziro Valley, Arunachal Pradesh submitted by me in partial fulfilment for the award of degree of Bachelor of Planning, at Maulana Azad National Institute of Technology, Bhopal, India, is a record of Bonafide work carried out by me. The matter/result embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

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CERTIFICATE

This is to certify that the declaration made by **YANGKEYNAM DANGGEN** is true to the best of my knowledge and that the student has worked under my guidance for one semester in preparing this thesis.

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ABSTRACT

Ziro Valley in Lower Subansiri District of Arunachal Pradesh is a culturally significant and ecologically sensitive valley known for the Apatani community, traditional paddy-cum-fish cultivation, bamboo-pine landscapes, village settlement patterns and emerging tourism activity. The valley represents a living cultural landscape where agriculture, water systems, forests, settlements, festivals, craft traditions and community-based practices are closely connected. In recent years, tourism growth, urban expansion, changing building materials, pressure on water supply, inadequate waste management and road-side congestion have started affecting the environmental quality, heritage character and everyday infrastructure of the valley. Therefore, this thesis examines sustainable tourism and integrated infrastructure planning for Ziro Valley with the aim of developing a planning framework that can support tourism growth without damaging the ecological and cultural foundations of the area.

The study follows a mixed-method approach based on secondary data, literature review, government records, GIS-based mapping, satellite imagery, LULC analysis, household survey, tourist survey, stakeholder discussions and field observations. Settlement patterns, tourist circuits, environmental features and infrastructure conditions were documented and analysed. A Natural Sensitivity Index was prepared to identify ecologically fragile zones, especially around the Kele River system, paddy-fish fields, forests, water bodies and sensitive slopes. Tourist carrying capacity was assessed using the PCC-RCC-ECC method to understand the realistic level of tourism pressure that the valley can manage. Infrastructure gaps related to water supply, waste disposal, sanitation, mobility, drainage, parking, tourist facilities and heritage-sensitive development were also examined.

The findings show that Ziro Valley does not require mass-tourism development, but a controlled and locally rooted tourism model. Tourism can become a source of livelihood for homestay owners, guides, farmers, craft workers and local entrepreneurs only if it is supported by proper infrastructure, visitor management and environmental safeguards. The proposals focus on tourist circuit management, wayfinding, homestay improvement, local guide certification, Talley Valley controlled eco-adventure circuit, paddy-fish agri-tourism trail, local produce stalls, shared processing and packaging facilities, seasonal toilets, waste management, road-edge improvement, drainage, lighting, parking and heritage-sensitive building controls. The thesis concludes that sustainable tourism in Ziro Valley should be planned as a low-impact, community-oriented and infrastructure-supported model that protects the Apatani cultural landscape while improving services for both residents and visitors.

Keywords: Ziro Valley, Apatani Cultural Landscape, sustainable tourism, integrated infrastructure planning, carrying capacity, Natural Sensitivity Index, paddy-fish cultivation, heritage conservation

सारांश

अरुणाचल प्रदेश के लोअर सुबनसिरी जिले में स्थित ज़ीरो घाटी एक सांस्कृतिक रूप से महत्वपूर्ण और पर्यावरणीय रूप से संवेदनशील क्षेत्र है। यह घाटी अपातानी समुदाय, पारंपरिक धान-मछली कृषि प्रणाली, बाँस और पाइन आधारित परिदृश्य, पारंपरिक गाँवों, स्थानीय त्योहारों, हस्तशिल्प और सामुदायिक जीवन पद्धति के लिए जानी जाती है। ज़ीरो घाटी केवल एक पर्यटन स्थल नहीं है, बल्कि एक जीवंत सांस्कृतिक परिदृश्य है, जहाँ कृषि, जल प्रबंधन, वन क्षेत्र, बसावट, आजीविका और सामाजिक-सांस्कृतिक परंपराएँ एक-दूसरे से गहराई से जुड़ी हुई हैं। हाल के वर्षों में पर्यटन गतिविधियों, शहरीकरण, आर.सी.सी. आधारित निर्माण, जल आपूर्ति पर दबाव, ठोस अपशिष्ट प्रबंधन की कमी, सड़क किनारे अव्यवस्था और अवसंरचना अंतरालों के कारण घाटी के पर्यावरण, पारंपरिक बसावट स्वरूप और सांस्कृतिक पहचान पर दबाव बढ़ रहा है। इसी संदर्भ में यह शोध ज़ीरो घाटी के लिए सतत पर्यटन और एकीकृत अवसंरचना नियोजन का अध्ययन करता है।

इस अध्ययन का मुख्य उद्देश्य ऐसा नियोजन ढांचा तैयार करना है जो पर्यटन विकास को बढ़ावा दे, लेकिन घाटी की प्राकृतिक संवेदनशीलता, पारंपरिक कृषि प्रणाली और सांस्कृतिक विरासत को सुरक्षित रखे। शोध में द्वितीयक आँकड़ों, साहित्य समीक्षा, सरकारी अभिलेखों, जी.आई.एस. आधारित मानचित्रण, उपग्रह चित्रों, भूमि उपयोग/भूमि आवरण विश्लेषण, घरेलू सर्वेक्षण, पर्यटक सर्वेक्षण, हितधारक चर्चा और क्षेत्रीय अवलोकन का उपयोग किया गया है। अध्ययन में बसावट पैटर्न, पर्यटन परिपथ, प्राकृतिक विशेषताओं और अवसंरचना स्थितियों का दस्तावेजीकरण किया गया। केले नदी प्रणाली, धान-मछली खेतों, वन क्षेत्रों, जल निकायों और ढाल वाले क्षेत्रों की पर्यावरणीय संवेदनशीलता को समझने के लिए प्राकृतिक संवेदनशीलता सूचकांक तैयार किया गया। पर्यटन दबाव का आकलन करने के लिए PCC-RCC-ECC पद्धति से पर्यटक वहन क्षमता की गणना की गई। इसके साथ ही जल आपूर्ति, स्वच्छता, ठोस अपशिष्ट प्रबंधन, सड़क, जल निकासी, पार्किंग, पर्यटन सुविधाओं और विरासत-संवेदी निर्माण से संबंधित अवसंरचना अंतरालों की पहचान की गई।

अध्ययन के निष्कर्ष बताते हैं कि ज़ीरो घाटी को अनियंत्रित और बड़े पैमाने के पर्यटन विकास की आवश्यकता नहीं है, बल्कि नियंत्रित, स्थानीय समुदाय आधारित और पर्यावरण-संवेदी पर्यटन मॉडल की आवश्यकता है। पर्यटन से होमस्टे संचालकों, स्थानीय गाइडों, किसानों, हस्तशिल्पकारों, महिला समूहों और छोटे उद्यमियों को आजीविका के अवसर मिल सकते हैं, परंतु इसके लिए उचित अवसंरचना, आगंतुक प्रबंधन और पर्यावरणीय सुरक्षा उपाय अनिवार्य हैं। प्रस्तावों में पर्यटन परिपथ और वे-फाइंडिंग प्रणाली, होमस्टे उन्नयन, स्थानीय गाइड प्रमाणन, टैली वैली नियंत्रित ईको-एडवेंचर सर्किट, धान-मछली कृषि पर्यटन पथ, स्थानीय उत्पाद बिक्री केंद्र, साझा प्रसंस्करण और पैकेजिंग सुविधा, मौसमी शौचालय, ठोस अपशिष्ट प्रबंधन, सड़क किनारे सुधार, जल निकासी, प्रकाश व्यवस्था, पार्किंग और विरासत-संवेदी भवन नियंत्रण शामिल हैं। यह शोध निष्कर्ष देता है कि ज़ीरो घाटी में सतत पर्यटन को कम प्रभाव वाले, समुदाय-आधारित और अवसंरचना समर्थित मॉडल के रूप में विकसित किया जाना चाहिए, जिससे अपातानी सांस्कृतिक परिदृश्य की रक्षा हो और स्थानीय निवासियों तथा पर्यटकों दोनों के लिए सुविधाएँ बेहतर हों।

मुख्य शब्द: ज़ीरो घाटी, अपातानी सांस्कृतिक परिदृश्य, सतत पर्यटन, एकीकृत अवसंरचना नियोजन, वहन क्षमता, प्राकृतिक संवेदनशीलता सूचकांक, धान-मछली कृषि, विरासत संरक्षण

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LIST OF ABBREVIATIONS

Table 1: List of Abbreviations Used in the Report

Abbreviation	Full Form
AMSL	Above Mean Sea Level
AP	Arunachal Pradesh
ASHA	Accredited Social Health Activist
BIS	Bureau of Indian Standards
ECC	Effective Carrying Capacity
GIS	Geographic Information System
LULC	Land Use / Land Cover
MANIT	Maulana Azad National Institute of Technology
NH	National Highway
NSI	Natural Sensitivity Index
PCC	Physical Carrying Capacity
PHED	Public Health Engineering Department
PWD	Public Works Department
RWD	Rural Works Department
SHG	Self-Help Group
TCC	Tourist Carrying Capacity
UNESCO	United Nations Educational, Scientific and Cultural Organization
WTP	Water Treatment Plant
ZMF	Ziro Music Festival

CHAPTER 1: INTRODUCTION

1.1 Brief Introduction

Ziro Valley in Lower Subansiri District of Arunachal Pradesh is a high-altitude cultural landscape where settlement form, agriculture, water systems, forests and community institutions have developed together over a long period. The valley is widely associated with the Apatani cultural landscape, which is listed on the UNESCO Tentative List because of its distinctive settlement pattern, wet-rice cultivation and community-managed ecological systems [UNESCO World Heritage Centre, 2014].

The same qualities that make the valley attractive for visitors also make it vulnerable. Tourism is increasing around festivals, music events, landscape viewpoints, homestays, trekking routes and heritage villages, while studies on Ziro show that urbanisation and land-use change are already placing pressure on environmental quality and settlement edges [Mondal and Tripathy, 2023; Gogoi and Gogoi, 2025].

The planning issue is therefore not whether tourism should be promoted, but how tourism should be organised within ecological, cultural and infrastructural limits. Unregulated growth can weaken the Kele River system, paddy-fish fields, forest edges, sacred groves and traditional settlement character; planned tourism, by contrast, can support livelihoods through homestays, interpretation, guided routes and local enterprises [Raha and Tripathy, 2022; Mize et al., 2016].

The study uses an integrated infrastructure planning approach. Settlement pattern, tourist circuits, natural sensitivity, carrying capacity, service gaps, built-form change and institutional capacity are examined together because Ziro's tourism potential is inseparable from its agricultural, ecological and community-managed landscape systems [Tewari et al., 2019; Dollo et al., 2009].

1.2 Need for Study and Justification

The immediate need for this study arises from the mismatch between the pace of tourism growth and the capacity of local infrastructure. Visitor arrivals are concentrated during particular seasons and events, while water supply, waste collection, parking, road edges, toilets, signage and accommodation services remain uneven across the valley [Government of Arunachal Pradesh, 2023].

Ziro's tourism appeal depends on assets that cannot be replaced once damaged. The paddy-fish system is not simply agricultural land; it is also a drainage system, food system, visual landscape and cultural marker, and its vulnerability has been noted in studies of Apatani agro-pisciculture and traditional irrigation [Dollo, 2009; Saikia et al., 2021; Lahkar, 2019].

The study is also justified by the visible transition in built form. Traditional bamboo and pine construction is increasingly being replaced by RCC buildings, flat roofs, commercial signboards and visually incompatible street edges, even though bamboo-pine homegardens and material practices remain important parts of the Apatani resource system [Tangjang and Nair, 2016; Tewari et al., 2019].

Field observations and survey responses indicate that infrastructure issues are not isolated. Waste disposal affects water quality and paddy fields; poor signage increases unmanaged tourist movement; weak road drainage damages pedestrian comfort and village edges; and inadequate toilets or parking reduce both resident comfort and visitor experience [Author, 2024; Mara and Tagiya, 2024].

The thesis contributes at a planning level by combining GIS-based spatial analysis, primary survey evidence, tourist carrying-capacity calculation and literature-based understanding of traditional ecological knowledge. It shifts the discussion from tourism promotion alone to spatially guided, community-sensitive infrastructure management [Barua and Slowik, 2009; Patnaik, 2020].

1.3 Aim and Objectives

The aim of the thesis is to develop an integrated infrastructure and physical planning framework for Ziro Valley, Arunachal Pradesh, that supports sustainable tourism while preserving the natural environment and living cultural heritage of the Apatani community.

The first objective is to document and georeference settlement patterns and tourist circuits across Ziro Valley. The second objective is to develop a Natural Sensitivity Index to analyse ecological pressure on the Kele River, paddy-fish ecosystems and sensitive forest edges. The third objective is to calculate tourist carrying capacity and identify infrastructure service gaps for residents and visitors. The fourth objective is to prepare an integrated infrastructure layout and physical planning framework that balances seismic safety, heritage preservation and local economic benefit.

1.3.1 Planning Questions

The objectives are supported by the following planning questions. First, where is tourism pressure currently concentrated, and which settlements or landscape edges are most exposed to it? Second, which natural and cultural areas require strict control, controlled access or low-intensity intervention? Third, which infrastructure gaps directly reduce visitor experience and resident quality of life? Fourth, what kind of tourism infrastructure is suitable for Ziro Valley without converting it into a mass-tourism destination? Fifth, how can proposals be phased so that low-cost improvements, regulatory actions and larger infrastructure investments support one another?

These questions help keep the research focused. They also prevent the thesis from becoming a general description of Ziro Valley. Every later analysis - LULC, NSI, carrying capacity, service gaps and proposals - is connected back to these questions.

1.4 Scope of Study

The geographical scope covers the main valley system of Ziro, including Hapoli urban core, Old Ziro, Hong, Hija, Hari, Bulla, Diibo and associated tourism and landscape nodes. This focus is consistent with the cultural-landscape reading of Ziro, where settlement clusters, paddy fields, forest edges and water channels function as connected spatial systems [UNESCO World Heritage Centre, 2014; Tewari et al., 2019].

Hapoli is treated as the administrative and service core, while the traditional village clusters are treated as heritage and community landscape zones. This distinction is important because the same development rule cannot be applied uniformly across the whole valley. A road-edge improvement in Hapoli, for example, has different planning logic from a visitor-control measure in Hong or an ecological buffer near paddy-fish fields.

1.4.2 Thematic Scope

The thematic scope includes sustainable tourism, physical infrastructure, land-use change, carrying capacity, ecological sensitivity, community-based tourism, heritage-sensitive built form, waste management, water and sanitation, road-edge improvement, signage and institutional coordination. These themes follow from literature that treats

sustainable tourism as a combined environmental, cultural and service-delivery question [Raha and Tripathy, 2022; Mondal and Tripathy, 2023].

1.4.3 Analytical Scope

The analytical scope is planning-level. The thesis uses spatial mapping, field survey, secondary data, literature review and case-study learning to identify problems and convert them into proposals. The GIS outputs are used for zoning, sensitivity identification and route planning, not for cadastral demarcation. The carrying-capacity calculation gives a provisional planning threshold, not a legally notified limit. Costing is indicative and meant to support phasing rather than replace detailed project reports.

1.4.4 Exclusions

The study does not prepare structural engineering designs, DPR-level drawings, detailed hydrological modelling, statutory Environmental Impact Assessment, household-level land ownership mapping or full economic cost-benefit modelling. It also does not attempt to redesign the entire town. The focus is on tourism-linked infrastructure and physical planning interventions that can protect Ziro's environmental and cultural assets while improving visitor and resident facilities.

1.5 Limitations of the Study

The limitations of the study are important because Ziro Valley is a data-scarce, geographically sensitive and institutionally complex area. The thesis uses the best available combination of official records, field observation, surveys, GIS layers and literature, but the results should be read as a planning framework rather than a final statutory plan.

First, official datasets are not always available at the exact scale of the valley. Many records are available at district, subdivision or circle level, while the thesis requires a valley-level reading. Where direct valley-level data was not available, the study used interpretation, field verification and cross-checking. This is suitable for thesis-level planning, but implementation would require updated departmental data and ground surveys.

Second, the primary survey sample is limited. The household survey covers 43 households and the tourist survey covers 21 visitors. These surveys are useful for understanding direction, patterns and lived issues, but they cannot represent every

household, season, income group or tourist category in statistical terms. The survey is therefore used as validation and planning evidence rather than as a complete census of opinion.

Third, the fieldwork period affects the kind of responses captured. Tourism pressure varies sharply across ordinary days, festival periods, monsoon months and peak travel seasons. A short survey window can identify recurring problems such as waste, water, road condition and visitor facilities, but it cannot capture all seasonal extremes. The tourist carrying-capacity assessment is therefore provisional and should be updated after longer monitoring of visitor numbers, waste generation, water availability and accommodation occupancy.

Fourth, GIS analysis depends on satellite imagery, DEM accuracy, classification choices and the availability of base layers. The Natural Sensitivity Index is robust enough for identifying broad planning zones, but it should not be treated as a substitute for cadastral verification, forest boundary demarcation, detailed slope stability assessment or site-specific environmental clearance. Before any construction or access control is implemented, the relevant department must verify land ownership, permissions and ground conditions.

Fifth, some aspects of traditional ecological knowledge and cultural practice cannot be fully captured through mapping or short interviews. Institutions such as the Bulyang, festivals, sacred spaces and household-level agricultural practices require careful community consultation. The thesis therefore avoids proposing intrusive heritage controls without community involvement. The proposals are framed as design support, co-management and visitor regulation rather than top-down conservation.

Sixth, cost estimates and phasing are indicative. They are prepared to show implementability and relative priority, not to replace detailed engineering estimates. Material rates, transport costs, departmental schedules and tender values in a hill state can vary significantly. Before execution, each proposal would require departmental estimation and local procurement planning.

1.6 Methodology

The study follows a mixed-method planning methodology. It combines spatial analysis, secondary data, primary survey, stakeholder inputs, literature review and case-study

learning, allowing official records, field evidence and published research to support each planning decision [Government of Arunachal Pradesh, 2023; Author, 2024].

Phase	Purpose	Data / Method	Output
Phase I	Study-area delineation and data inventory	Boundary definition, base maps, satellite imagery, district records, literature catalogue, tourism-site list	Study-area base, data inventory and initial problem framing
Phase II	Primary data collection	Household survey, tourist survey, stakeholder discussions, transect observation and site photography	Field validation of infrastructure gaps, tourist experience and local concerns
Phase III	Spatial and GIS analysis	QGIS mapping, LULC interpretation, road and node mapping, hydrology and slope layers	Settlement maps, circuit maps, LULC reading and Natural Sensitivity Index
Phase IV	Literature and case-study synthesis	Reviewed literature on sustainable tourism, Apatani systems, sacred groves, urbanisation, homestays and resilience	Planning principles and proposal logic
Phase V	Carrying capacity and proposal formulation	PCC-RCC-ECC framework, service-gap findings, NSI zones, implementation phasing	Integrated infrastructure proposals with priorities and institutional roles

Table 2: Research Design and Methodological Phases

1.6.1 Objective 1: Documentation and Georeferencing

The first objective required the preparation of a spatial baseline. Base maps were prepared in QGIS using available GIS layers, satellite imagery, Google Earth interpretation, Bhuvan and USGS references, district maps and field verification. Settlement locations, tourist sites, road access, river and stream corridors, paddy-field edges, village clusters and service nodes were identified and organised into a working GIS database.

Georeferencing was important because the thesis proposals are location-sensitive. A generic proposal for signage, toilets or waste bins is weak unless it is linked to specific nodes and movement routes. Therefore, tourist attractions such as Seeh Lake,

Pine Grove, Hong, Diibo, Hari-Bulla, Pamu Yalang and related circuit points were treated as spatial nodes rather than only names in a list. This helped connect the later wayfinding, service-node and no-entry-zone proposals to actual geography.

1.6.2 Objective 2: Natural Sensitivity Index

The Natural Sensitivity Index was prepared to identify areas where tourism infrastructure should be avoided, controlled or allowed with safeguards. The index used the planning logic that ecological sensitivity in Ziro is not limited to forests. Paddy-fish fields, irrigation channels, the Kele River system, steep vegetated edges and sacred grove surroundings also need protection because they support both ecological function and cultural landscape value.

The GIS overlay considered stream proximity, LULC sensitivity and slope as key layers. Stream proximity was used because areas close to the Kele River and tributaries are more vulnerable to pollution, erosion and disturbance. LULC sensitivity was used to distinguish paddy-fish fields, forest areas, built-up zones and transition edges. Slope was used because construction and uncontrolled movement on steeper edges increase erosion and landslide risk. These layers were combined through a weighted overlay to classify areas into sensitivity zones.

The NSI output was not used as a decorative map. It directly informed proposal decisions: high-sensitivity zones were treated as no-construction or guided-access areas; moderate zones were treated as controlled intervention areas; and low-sensitivity service corridors were considered more suitable for basic infrastructure such as signage, toilets, waste points, parking management and road-edge improvements.

1.6.3 Objective 3: Carrying Capacity and Service Gaps

The third objective combined quantitative and qualitative methods. Secondary data from census records, district statistics and tourism records provided the official baseline. Primary surveys and stakeholder discussions then helped identify what the official numbers do not show clearly: irregular water supply, waste-handling gaps, parking pressure, visitor confusion, homestay needs, road-edge problems and resident concerns during peak tourism periods.

Tourist carrying capacity was assessed through the PCC-RCC-ECC sequence. Physical Carrying Capacity estimates the number of visitors that can physically fit in a defined area based on usable area, space standard and rotation factor. Real Carrying Capacity reduces that number by applying correction factors such as ecological sensitivity, seasonal concentration, monsoon or festival pressure and safety concerns. Effective Carrying Capacity further reduces the threshold according to actual management capacity, especially water, waste, toilets, accommodation, staff, signage and enforcement.

This staged approach is useful for Ziro because the physical area alone is misleading. A heritage street or paddy-edge path may appear capable of holding many visitors, but the real limit is lower when resident privacy, waste disposal, water availability, pedestrian safety, seismic evacuation and ecological disturbance are considered. The carrying-capacity result is therefore treated as a management threshold rather than a simple crowd-count calculation.

1.6.4 Objective 4: Proposal Formulation

The fourth objective converted analysis into implementable proposals. Each proposal was tested against four questions: what problem does it solve, where should it be located, why is it suitable for Ziro, and how can it be implemented. This avoided generic recommendations such as 'improve tourism infrastructure' and instead led to proposals such as visitor service nodes, decentralised waste points, road-edge improvements, homestay support, guide certification, agri-tourism trails and heritage-sensitive building controls.

Case studies were used carefully. Dharamshala contributed lessons on seismic safety and vernacular-compatible construction; Khonoma contributed lessons on community-led conservation and tourism management; Shirakawa-go and Gokayama contributed lessons on living-heritage controls, visitor management and heritage-finance mechanisms. These were not copied directly. They were translated into Ziro-specific proposals by checking them against local governance, landscape character, cultural practices and infrastructure gaps.

The proposal stage also considered phasing. Short-term actions were selected where low-cost, high-visibility interventions could create immediate improvement, such as signage, bins, toilets, lighting and route information. Medium-term actions included

road-edge upgrades, waste hubs, heritage-control notification and eco-adventure circuit formalisation. Long-term actions focused on enforcement, carrying-capacity management, institutional strengthening and heritage maintenance funding.

1.7 Chapter Overview

Chapter 1 frames the research problem, aim, objectives, scope, limitations, methodology and primary data. It clarifies why Ziro requires managed tourism infrastructure rather than conventional mass-tourism expansion.

Chapter 2 reviews the literature on sustainable tourism, tribal tourism, traditional ecological knowledge, paddy-fish cultivation, bamboo-pine agroforestry, sacred groves, biodiversity, urbanisation, homestays and visitor behaviour. It identifies the planning ideas that support the later analysis and proposals.

Chapter 3 studies selected case examples to understand how other sensitive landscapes manage seismic risk, community tourism, heritage controls and visitor pressure. Chapter 4 prepares the study-area profile of Ziro Valley through environmental, demographic, economic, infrastructure, socio-cultural, tourism and governance dimensions.

Chapter 5 synthesises the main analysis, including infrastructure gaps, LULC change, NSI, tourist carrying capacity, potentials and challenges. Chapter 6 converts the findings into integrated planning proposals with dimensions, locations, costs, phasing, funding and institutional roles. Chapter 7 concludes the thesis by summarising the planning argument and expected contribution.

1.8 Chapter Summary

This chapter establishes the thesis as an integrated planning study of Ziro Valley. The central argument is that tourism can support local development only when it is managed within ecological, cultural, infrastructural and community thresholds. The valley should not be planned as a generic hill destination; it should be planned as a living cultural landscape where agriculture, settlement, forest, water and tourism are interdependent.

The chapter also clarifies the study's limits. The thesis uses planning-level data, survey evidence and GIS analysis; it does not claim to replace statutory approvals, cadastral surveys or detailed engineering. Its value lies in connecting scattered issues

into a structured framework that can guide future departmental action and community discussion.

CHAPTER 2: LITERATURE REVIEW

2.1 Conceptual Understanding

The literature review provides the conceptual base for the thesis. Ziro Valley cannot be understood through one theme alone. It is simultaneously a tourism destination, a cultural landscape, an agricultural system, a biodiversity setting, a settlement system and an infrastructure service area. Therefore, the review brings together literature on sustainable tourism, tribal tourism, traditional ecological knowledge, paddy-fish cultivation, bamboo-pine agroforestry, sacred groves, urbanisation, homestays, visitor behaviour and resilience.

The review was not conducted as a decorative background chapter. Each source was read for a planning purpose: what does it explain about Ziro, what problem does it reveal, what principle can be used in analysis, and what kind of proposal can be supported by it. This approach helps avoid a common weakness in thesis writing where literature is listed but not used. In this thesis, the literature supports the selection of indicators for the Natural Sensitivity Index, the logic of carrying capacity, the need for visitor regulation, the importance of community institutions and the design direction for heritage-sensitive infrastructure.

Four major concepts structure the review. Sustainable tourism explains the need to balance visitor experience, local livelihood and environmental protection. Traditional ecological knowledge explains why Apatani agricultural, forest and water systems should be treated as planning assets rather than only cultural background. Eco-sensitive planning explains why certain areas require development control, guided access or no-construction buffers. Carrying capacity explains why tourism infrastructure must be planned according to limits rather than unlimited demand.

Concept	Meaning	Use in This Thesis
Sustainable tourism	Tourism that supports livelihood and visitor experience without degrading environmental, cultural or social assets	Used to frame tourism as managed local development rather than mass inflow

Tribal / indigenous tourism	Tourism based on cultural practices, homestays, festivals, food, crafts and community experience	Used to support community-led circuits, interpretation and local guide systems
Traditional ecological knowledge	Long-term community knowledge of land, water, forests, crops, materials and rituals	Used to justify protection of paddy-fish fields, bamboo-pine systems and community governance
Eco-sensitive planning	Spatial planning that identifies fragile zones and controls intensity of use	Used in NSI zoning, no-construction ecological edges and guided-access proposals
Carrying capacity	A threshold approach that links visitation with ecological, social and infrastructure limits	Used in PCC-RCC-ECC calculation and visitor-management recommendations
Vernacular-compatible infrastructure	Modern services designed with local material language, scale and climate suitability	Used in homestay upgrading, facade control, stalls, signage and street-edge improvement

Table 3: Key Concepts Used in the Literature Review

Source: Raha and Tripathy (2022); Dollo et al. (2009); Taka and Tangjang (2015); Tangjang and Nair (2016); Dutta et al. (2017); Das and Anku (2020); Mara and Tagiya (2024); Tewari et al. (2019).

2.2 Sustainable Tourism and Tribal Tourism

Sustainable tourism literature argues that tourism should not be measured only by arrival numbers or income. In sensitive destinations, the quality of local benefit, the condition of the environment, the dignity of community life and the ability of infrastructure to absorb visitors are equally important [Raha and Tripathy, 2022; Mize et al., 2016].

Tribal tourism in Arunachal Pradesh has been discussed as a form of sustainable tourism because it links culture, local livelihood and nature-based experience; for this thesis, the key lesson is that homestays, festivals, indigenous knowledge and local enterprise must be supported without converting living settlements into staged displays [Raha and Tripathy, 2022].

For Ziro Valley, tribal tourism cannot be planned as simple cultural display. The Apatani villages are working settlements, not museum exhibits. Residents use streets, platforms, fields, forests and household spaces for everyday life. Tourists may be interested in these spaces, but access must be guided and respectful. This supports proposals for interpretation boards, local guides, visitor conduct rules, resident-only edges and controlled movement within heritage villages.

The literature also highlights livelihood opportunity. Homestays, local produce stalls, guide services, cultural interpretation, farm-based learning and craft sales can create income for households and youth. But benefits may become uneven if only a few households near prime tourist routes capture most tourism income. Therefore, the thesis links tourism proposals with SHGs, village clusters, guide certification and circuit distribution so that footfall and income are not concentrated at a few points.

2.3 Traditional Resource Management and Paddy-Fish Systems

The Apatani paddy-cum-fish system is central to the literature on Ziro Valley. Dollo et al. (2009) describe the Apatani landscape as an example of traditional natural resource management where agriculture, forestry, water management and community knowledge operate together. The study shows that the valley's productivity is not accidental; it is the result of careful land use, water control, crop diversity and social rules developed over time.

The paddy-cum-fish and bamboo-cum-pine systems show how seasonal practice, fish rearing, millet on bunds, bamboo use and pine management form a linked livelihood system; this supports planning interventions that protect productive landscapes instead of treating them as vacant scenery [Taka and Tangjang, 2015].

Integrated bamboo and pine homegardens connect construction material, household landscape and resource management, showing that bamboo and pine are not only traditional materials but also part of a wider ecological and economic system [Tangjang and Nair, 2016].

The paddy-fish system also shapes tourism planning. Visitors are attracted to the field landscape, but unmanaged walking, littering, photography pressure and informal entry can disturb field operations and resident privacy. Therefore, the literature supports low-intensity agri-tourism through defined trails, viewing decks, guide-led interpretation and no-entry signs rather than open access across fields.

2.4 Biodiversity, Sacred Groves and Eco-Sensitive Areas

The ecological literature shows that Ziro Valley and its surrounding landscapes are biodiversity-rich and culturally protected. Dutta et al. (2017) describe sacred groves, locally known as *ranthii*, as traditional conservation areas associated with Apatani beliefs, rituals and community protection. These groves are important because they

show that conservation in Ziro has not depended only on formal state boundaries. Community norms have historically helped protect vegetation, species and sacred landscapes.

Fish diversity in Swkhe stream, a tributary of the Kele River near Hong village, shows the ecological value of local streams and their connection to paddy fields; this makes water pollution and stream-edge disturbance central planning concerns [Das and Anku, 2020].

Ethnomedicinal plant knowledge in Ziro also points to pressure on wild plant habitats and forest-edge resources, strengthening the case for controlled access and conservation-oriented interpretation [Ayam, 2017].

The biodiversity literature gives direct support to zoning. Talley Valley, sacred groves, forest edges, river corridors, paddy-fish fields and steep slopes require different degrees of restriction. A single tourism infrastructure standard cannot be applied across these areas. High-sensitivity zones need no-construction controls and guided access; moderate zones need low-impact interventions; lower-sensitivity built-up corridors can absorb facilities such as signage, toilets, parking management and waste collection points.

2.5 Urbanisation, Built Form and Infrastructure Pressure

Urbanisation literature is important because Ziro's tourism problem is not only about visitors. It is also about the gradual transformation of the valley's built environment. Mondal and Tripathy (2023) examine the impact of urbanisation on environmental change in Ziro Valley and identify pressures such as built-up expansion, loss of agricultural land, environmental degradation and unplanned construction. Their findings support the thesis argument that infrastructure planning and land-use control must be addressed together.

The shift from bamboo-pine construction to RCC buildings is a practical household response to changing aspirations, durability concerns and modern service needs. However, when this transition occurs without design guidance, it creates visual discontinuity, heavier structures in a seismic region, reduced climate responsiveness and loss of heritage character. The literature therefore does not suggest freezing the valley in the past. Instead, it supports a managed built-form approach: modern

facilities inside, locally compatible exterior form, controlled height, sloping roofs, muted colours and improved construction safety.

Infrastructure pressure appears most clearly in road edges, drainage, water supply, waste disposal and public facilities. Tourism increases these pressures but does not create them from zero. Many services already serve residents under constrained conditions. During peak tourism periods, the same weak systems must support visitors as well. This justifies proposals that benefit both residents and tourists, such as improved drains, lighting, waste points, service nodes and clearer movement routes.

The urbanisation literature also supports the need for spatial differentiation. Hapoli can absorb more service infrastructure because it functions as the administrative and commercial core. Heritage villages require more sensitive treatment. Paddy-field edges and forest interfaces require low-impact controls. This differentiated approach is more suitable than applying uniform urban standards across the valley.

2.6 Homestays, Green Practices and Visitor Behaviour

Homestays are a major interface between tourism and local life in Ziro. Mara and Tagiya (2024) study green practices, green mindfulness and pro-environmental behaviour among tourists staying in homestays in Ziro Valley. Their work is important because it shifts attention from infrastructure supply alone to user behaviour. Even well-designed facilities can fail if visitors do not understand waste rules, water scarcity, local customs or environmental sensitivity.

The concept of green mindfulness suggests that visitors are more likely to behave responsibly when environmental choices are made visible and understandable. For Ziro, this supports practical measures such as QR-linked interpretation boards, waste-segregation instructions, homestay environmental guidelines, visitor conduct signs, water-saving messages and guide-led explanation of paddy-field and sacred-grove sensitivity.

Homestays also raise quality and equity questions. Tourism can improve household income, but uneven standards can affect visitor experience. Some homes may have better toilets, signage, waste practices and booking access than others. A homestay upgradation and certification programme can improve minimum standards without forcing every homestay to become a hotel. The literature therefore supports locally appropriate service improvement rather than commercial standardisation.

Visitor behaviour must also be linked to carrying capacity. If tourists stay longer, use guided circuits and distribute across multiple nodes, pressure on a single heritage village or festival site reduces. If visitors arrive in large numbers without information, toilets, parking or waste systems, the same volume becomes damaging. Literature on green behaviour therefore supports both soft interventions and hard infrastructure.

2.7 Literature Inputs Used for Proposal Development

The reviewed literature directly informs the proposal chapter. Sustainable tribal tourism supports community-led circuits, local guide certification and cultural interpretation. Traditional resource management literature supports paddy-field buffers, agri-tourism trails and bamboo-pine design language. Biodiversity and sacred-grove literature supports no-entry zones, sensitive-area mapping and guided access. Urbanisation literature supports heritage-sensitive building controls, road-edge improvement and development regulation. Homestay and green-behaviour literature supports visitor conduct systems, environmental signage and service standards.

The proposal logic is therefore evidence-based. The thesis does not propose tourism infrastructure simply because tourism is growing. It proposes managed infrastructure because literature and field evidence show that Ziro's assets are sensitive, community-linked and infrastructure-dependent. The final proposals are designed to protect the landscape that produces tourism value.

Literature Source	Main Idea	Application in Thesis
Raha and Tripathy (2022)	Tribal tourism combines culture, livelihood, homestays and nature-based learning	Community-based tourism, local guide interpretation and cultural circuit planning
Dollo et al. (2009)	Apatani land, forest and water management show long-term ecological knowledge	Protection of paddy-fish systems and forest-water linkages
Taka and Tangjang (2015); Tangjang and Nair (2016)	Paddy-fish and bamboo-pine systems are productive and culturally embedded	Agri-tourism trail, bamboo/timber stalls, signage, railings and design vocabulary
Dutta et al. (2017)	Sacred groves function as traditional conservation spaces	No-entry zones, interpretation, community conservation support
Das and Anku (2020); Ayam (2017)	Streams, fish diversity and ethnomedicinal plants show ecological value and vulnerability	Stream buffers, waste control and sensitive-zone mapping

Mondal and Tripathy (2023)	Urbanisation affects environmental quality, agricultural land and settlement form	Built-form controls, road-edge improvement and planning regulation
Mara and Tagiya (2024)	Green practices and green mindfulness influence visitor pro-environmental behaviour	Visitor conduct signs, homestay standards, QR information and waste behaviour
Tewari et al. (2019)	Community, craft and culture operate as resilience systems in Ziro	Community-led governance, craft-linked proposals and heritage-sensitive infrastructure

Table 4: Literature Inputs Used for Proposal Development

Source: Raha and Tripathy (2022); Dollo et al. (2009); Taka and Tangjang (2015); Tangjang and Nair (2016); Dutta et al. (2017); Das and Anku (2020); Ayam (2017); Mondal and Tripathy (2023); Mara and Tagiya (2024); Tewari et al. (2019).

2.8 Literature Gap and Position of the Thesis

The literature on Ziro Valley is rich in ecological, cultural and agricultural description, but it is less integrated at the level of physical planning. Many studies explain why the Apatani system is valuable; fewer studies translate that value into infrastructure standards, visitor-management zones, carrying-capacity thresholds or phased planning proposals. This thesis addresses that gap by converting literature into a spatial and implementable planning framework.

Another gap is the separation between tourism studies and infrastructure studies. Tourism literature often highlights culture, homestays and visitor experience, while infrastructure discussions focus on roads, water, waste and buildings. In Ziro, these cannot be separated. A visitor's experience of a heritage village depends on signage, toilets, drains, waste management, resident privacy and built-form quality. Similarly, ecological protection depends on where visitor facilities are placed and how waste and movement are managed.

The thesis also responds to a gap between conservation and household aspiration. A purely conservationist approach may ignore the need for modern housing, toilets, road access, income and comfort. A purely development-oriented approach may damage the valley's cultural and ecological identity. The thesis positions itself between these extremes by proposing vernacular-compatible, service-oriented and community-linked planning interventions.

2.9 Chapter Summary

The literature review shows that sustainable tourism in Ziro must be based on restraint, interpretation, infrastructure support and community participation. The valley's tourism potential is inseparable from the Apatani cultural landscape, paddy-fish agriculture, bamboo-pine resource use, sacred groves, biodiversity, festivals, homestays and settlement character.

The reviewed works support the thesis direction in three ways. First, they establish the value of Ziro's traditional systems. Second, they identify pressures from urbanisation, tourism and behavioural change. Third, they provide planning principles for zoning, carrying capacity, visitor management, homestay improvement and heritage-sensitive infrastructure. The next chapters use this literature base to analyse the study area, identify gaps and formulate integrated proposals.

CHAPTER 3: CASE STUDIES

Sustainable planning for a high-altitude, culturally sensitive landscape like Ziro Valley requires a synthesis of localized wisdom and proven global methodologies. This chapter examines three distinct case studies—ranging from regional Himalayan examples to international UNESCO World Heritage sites—to identify viable strategies for seismic resilience, community-led conservation, and sustainable heritage economics. By analysing the successes, limitations, and planning approaches of these diverse locations, the study extracts actionable lessons that can be adapted to Ziro’s unique socio-ecological and administrative context.

3.1 Dharamshala, Himachal Pradesh

Context and Planning Approach

Dharamshala, also situated in Seismic Zone V, underwent a Comparative Structural Vulnerability Assessment and Seismic Hazard Mapping exercise that compared the dead load and ductility performance of modern RCC construction against traditional timber-framed systems. Planners overlaid construction typologies with seismic hazard maps and found that building with natural hillside contours — avoiding deep excavation — is a primary technique for maintaining topsoil stability on fragile Himalayan slopes. The location and planning-area context of Dharamshala is shown in Fig. 1.

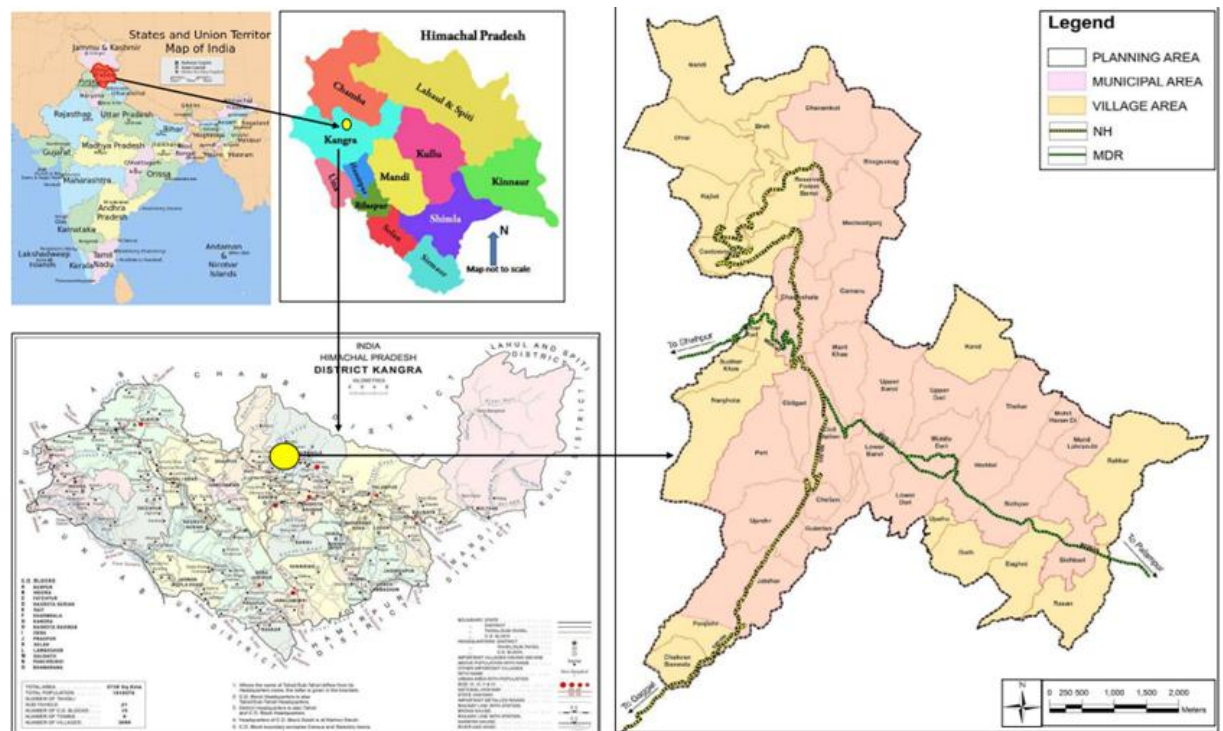


Fig. 1: Location and Planning Area Map of Dharamshala, Himachal Pradesh

Source: District Disaster Management Authority, Kangra; Census of India; Himachal Pradesh GIS/administrative base layers.

Positive Learnings

- **Flexible Skeletal Systems:** Traditional Dhajji-Dewari and Kath-Khuni timber-framed construction sways and absorbs seismic energy during tremors rather than fracturing catastrophically — demonstrating that bamboo and timber are high-performance structural materials for Zone V conditions.
- **Passive Thermal Regulation:** Earth and timber infill maintains interior temperatures 3°C–4°C cooler in summer and warmer in winter than concrete equivalents — providing climate comfort without energy-intensive mechanical systems.
- **Contour-Responsive Construction:** Building in alignment with the natural hillside gradient, without violent slope excavation, preserves fragile topsoil and minimises landslide risk.

Limitations

- Rapid tourism profit incentives often override compliance with heritage construction codes — a "concrete forest" risk replicates itself unless FAR and material enforcement mechanisms are active.
- Traditional material knowledge is being lost rapidly as builders default to concrete as the perceived "modern" choice; active technical dissemination programmes are necessary.

Application to Ziro Valley

A Lightweight Construction Mandate for Heritage Core and Buffer Zones; a Ziro-specific Hillside Construction Guide developed through AP PWD in collaboration with IIT Guwahati; and mandatory Seismic Hazard Map overlay as a condition of all development permits in the valley.

3.2 Khonoma, Nagaland

Context and Planning Approach

Asia's first designated "Green Village," Khonoma (Kohima District, Nagaland) employed a Social-Ecological Inventory integrating indigenous ecological knowledge with Participatory Mapping to identify community water harvesting sites and solar energy zones. Community monitoring replaced top-down government enforcement as the primary conservation mechanism. The location and terrain context of Khonoma village is shown in Fig. 2.

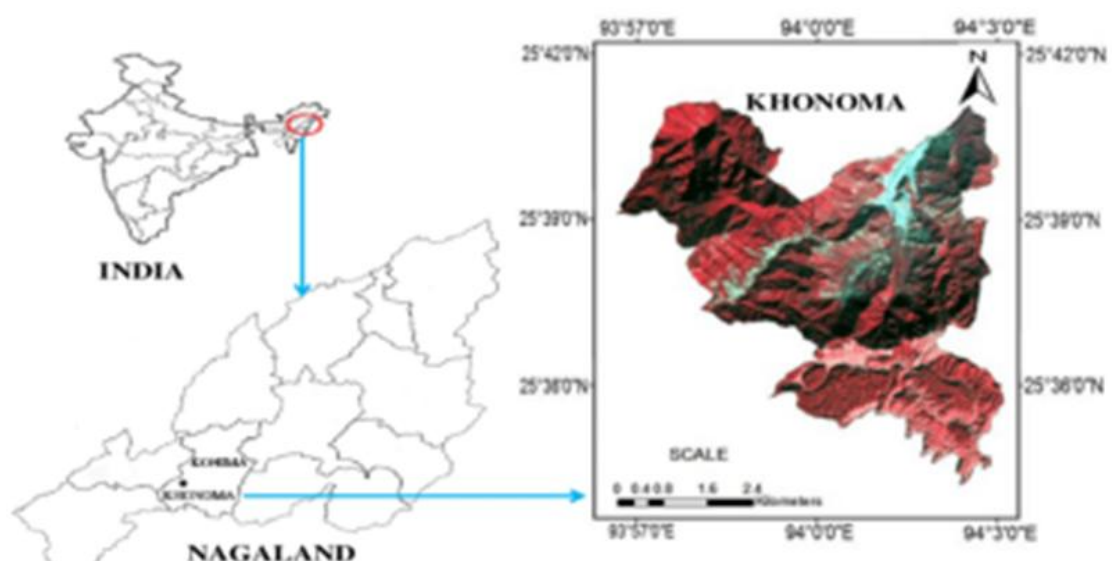


Fig. 2: Location and Terrain Context of Khonoma Village, Nagaland

Source: Khonoma case-study paper; Nagaland state administrative base map; Bhuvan/NRSC DEM and satellite imagery.

Positive Learnings

- **Alnus nepalensis as Natural Engineer:** The alder tree, integrated into field margins, fixes atmospheric nitrogen and stabilises fragile hillside terraces — a chemical-free erosion control model directly transferable to Ziro's agricultural hillside margins.
- **Social Bonds over State Sanctions:** Community pride, peer accountability, and social stigma protect forest resources more effectively than distant government penalties — the Apatani Youth Association has the social capital to serve as Ziro's frontline conservation monitoring body.
- **Decentralised Self-Reliance:** MGNREGA-funded solar lighting and community water harvesting demonstrate that geographically remote communities can modernise utility infrastructure independently of large government projects.

Limitations

- **Tourism economic benefits concentrated among a few homestay-owning households** — an equity gap that risks youth outmigration and community fragmentation if structural redistribution mechanisms are not built in.
- **High levels of community social cohesion are a prerequisite** — external land monetisation pressures can rapidly erode collective conservation commitment.

Application to Ziro Valley

A Decentralised Waste Hub (DWH) network funded through MGNREGA; formal statutory recognition of the Bulyañ as the co-governance body for heritage conservation monitoring; and equitable Heritage Maintenance Fund distribution proportional across all eight settlements, not concentrated in Hapoli.

3.3 Shirakawa-go and Gokayama, Japan

Context and Planning Approach

Shirakawa-go and Gokayama, joint UNESCO World Heritage Sites since 1995, are remote mountain villages in Japan whose traditional gassho-zukuri (steeply pitched thatched-roof) farmhouses are maintained as living residences. Planners employed Core-Buffer Zoning and an Economic Flow Analysis to develop a Circular Heritage Revenue Model in which tourism directly finances the conservation of the heritage it depends upon. The preservation-district structure of Shirakawa-go is shown in Fig. 3, while the settlement landscape character is shown in Fig. 4.

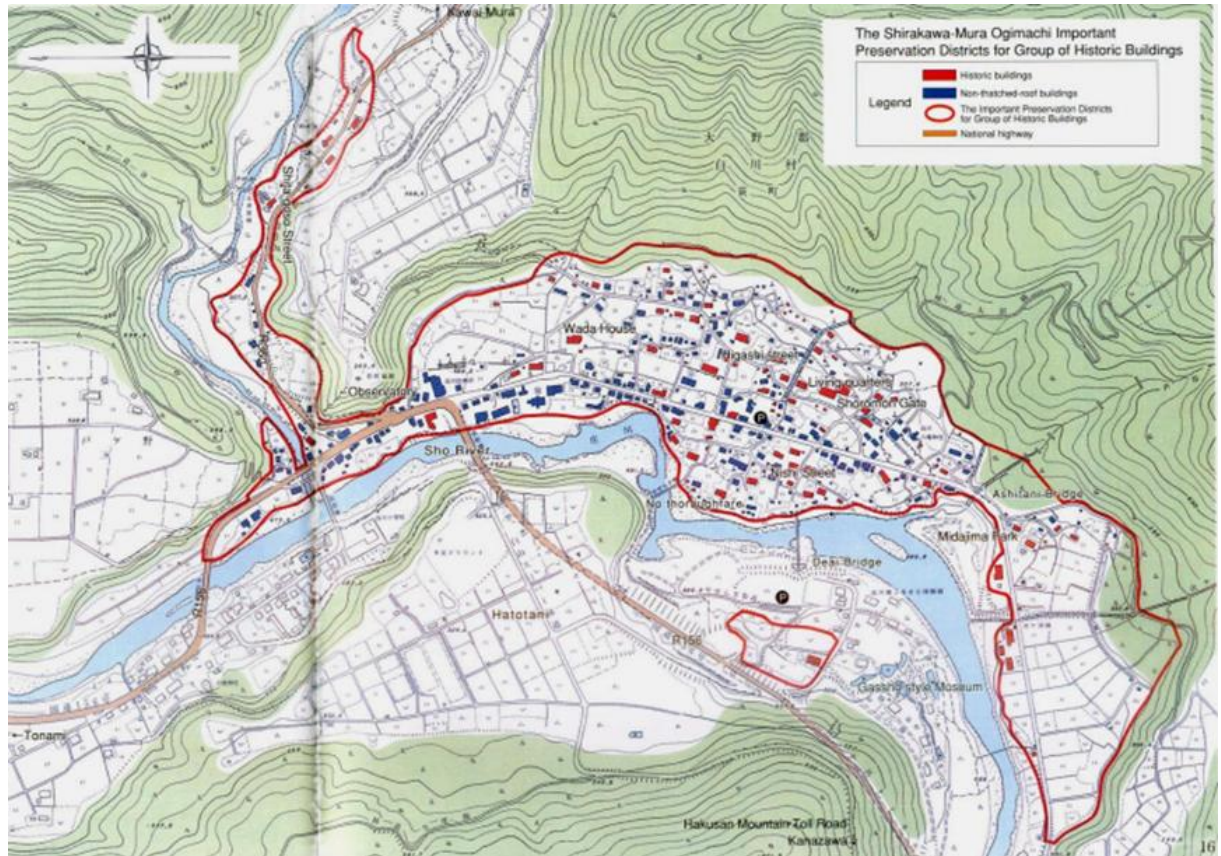


Fig. 3: Preservation District Map of Shirakawa-go and Gokayama, Japan

Source: Shirakawa-go and Gokayama preservation district material; UNESCO World Heritage Centre; Kuroda (2019).



Fig. 4: Traditional Gassho-zukuri Settlement Landscape of Shirakawa-go, Japan

Source: UNESCO World Heritage Centre photographic record for Historic Villages of Shirakawa-go and Gokayama; Kuroda (2019).

Positive Learnings

- **Circular Revenue Model:** Thirty per cent of tourist parking and entry fees are directed to fund ninety per cent of the cost of re-thatching traditional roofs — tourists directly finance the heritage asset that draws them to the destination.
- **Modern Interiors, Ancestral Exteriors:** Strict Core-Buffer zoning controls exterior appearance (roof pitch, facade materials, fenestration proportions) while permitting modern interior upgrades — residents live comfortably without compromising the visual heritage character.
- **Visitor Flow Management:** A bus reservation system prevents seasonal overtourism at the main heritage village — directly applicable to Ziro Music Festival peak visitor management.
- **Converting the "90-Minute Visitor":** Making certified overnight accommodation the central tourism offers transformed short-stay visitors

into revenue-generating guests with genuine cultural engagement, eliminating the "90-minute visitor" economic loss.

Limitations

- "Fishbowl" Stress: Residents report psychological discomfort when private agricultural and domestic life becomes a public spectacle — "Resident-Only" zones must be clearly demarcated, physically signed, and enforced.
- The Circular Revenue Model requires disciplined, transparent administrative mechanisms — governance quality and community trust in the managing body are non-negotiable prerequisites.

Application to Ziro Valley

A Heritage Maintenance Surcharge (10–15 per cent of festival tickets and site entry fees) directed to a Bulyañ-managed Heritage Fund; three-tier Heritage Zoning (HCZ/HBZ/CDZ) with mandatory vernacular exterior standards; and a Digital Visitor Reservation System for peak festival season access management.

CHAPTER 4: STUDY AREA PROFILE

Ziro Valley is a unique cultural landscape in Arunachal Pradesh, shaped over centuries by the Apatani tribe's indigenous land-use practices and gravity-fed irrigation systems. This chapter introduces the valley — its location, its terrain, how to get there, and the historical events that have shaped it into what it is today.

4.1 Location and Regional Setting

Ziro Valley is situated in the **Lower Subansiri District** of Arunachal Pradesh, in the far north-eastern corner of India (see Map 1 below). Geographically, the valley occupies the coordinates 27°30'–27°38' N and 93°45'–93°55' E, at an elevation ranging between 1,500 and 1,800 metres above mean sea level. The valley floor sits at approximately 1,525 metres, surrounded by forested hills rising to 2,900 metres on the northern and eastern margins. What makes this valley unusual is that it is remarkably flat — a rare basin of level ground tucked inside the steep Himalayan foothills. Table 3 below summarises the key geographic facts. The relevant information is summarised in Table 5.

Parameter	Details
Coordinates	27°30'–27°38' N, 93°45'–93°55' E
Elevation	1,500–1,800 m AMSL; valley floor at 1,525 m; hills up to 2,900 m
Total Valley Area	~148 sq. km; cultivable area ~32 sq. km
Settlement Area	~3.86 sq. km
Administrative Unit	Lower Subansiri District (HQ: Ziro / Hapoli)
Seismic Zone	Zone V — Highest seismic hazard category in India

Table 5: Key Geographic and Administrative Indicators

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Lower Subansiri district records.

The related visual is shown in Fig. 5.

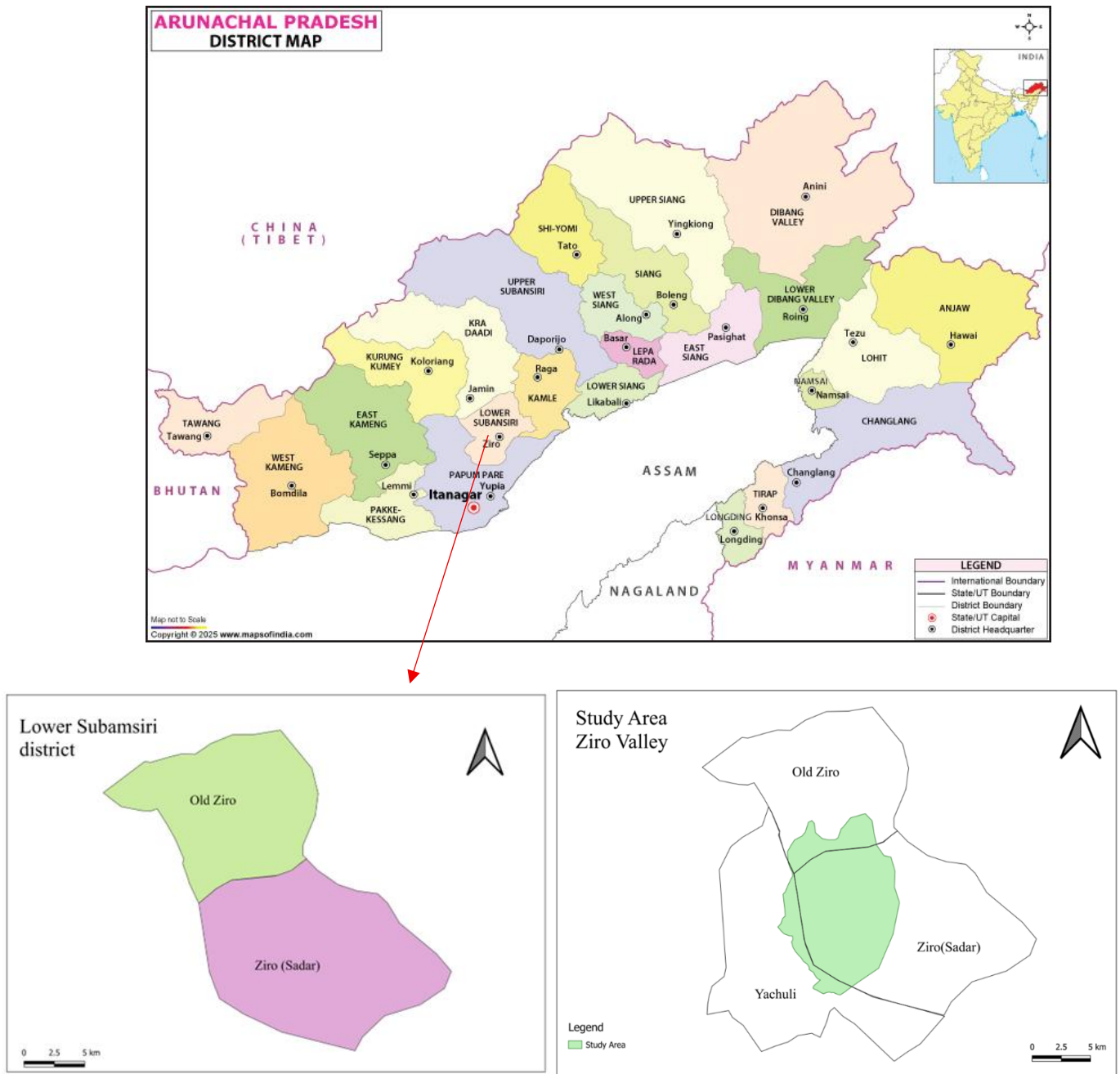


Fig. 5: Location Map of Ziro Valley

Source: Survey of India/Arunachal Pradesh administrative boundaries; Bhuvan/NRSC base layers; USGS satellite imagery; field verification.

4.1.1 Topography and Physiographic Character

Ziro Valley is a flat-bottomed inter-montane valley of alluvial origin, enclosed on all sides by forested ridgelines of the Eastern Himalayan foothills. The valley floor is characterised by an exceptionally level terrain, which the Apatani people have used for millennia through their elaborate paddy-cum-fish cultivation system. The surrounding slopes transition from moderately inclined secondary forests to dense

primary forest at higher elevations, culminating in a series of ridges that form natural watershed boundaries separating Ziro from the Kamla Valley to the west and the Subansiri River basin to the south.

The principal water body traversing the valley is the Kele River — a perennial stream that serves as the primary source of irrigation water for the paddy-fish fields through a network of hand-built bamboo channels. The river is supplemented by numerous seasonal springs originating from the forested slopes, collectively maintaining the high-water table that sustains the agro-ecosystem.

4.1.2 Access and Connectivity

- **Road:** Itanagar → Naharlagun → Yazali → Ziro (National Highway 229; ~115 km; travel time 3.5–4 hours). Sections of this route are vulnerable to landslides during the monsoon season (June–September), periodically cutting off the valley from the broader regional road network.
- **Rail:** The nearest functional railway station is Naharlagun (~96–100 km from Ziro), on the Assam Rail Link. A proposed rail extension to Itanagar and beyond remains under implementation.
- **Air:** Ziro Airport (IATA Code: ZER) is a state-managed airstrip with regional connectivity (Alliance Air services resumed in 2022). Donyi Polo Airport, Hollongi (~133 km), and Lilabari Airport, Assam (~116 km) serve as alternative international access points.

4.2 Historical Context

The Apatani people are among the earliest documented sedentary agriculturalists of Arunachal Pradesh. Archaeological and oral historical evidence suggests that the Apatani settlement of Ziro Valley dates to several centuries before recorded contact, with the community having evolved a sophisticated agro-pastoral civilisation independently of the plains. The relevant information is summarised in Table 6.

Period	Event / Development
Pre-contact era (pre-1944)	Apatani settlements fully functional; paddy-fish cultivation, Sacred Groves (Ranthii), Bulyañ governance system all in practice
1944	First British contact — J.P. Mills visits Ziro Valley
1948	Ziro Valley incorporated into the North East Frontier Agency (NEFA) under the Government of India
1954–1971	NEFA under direct Union Government administration; development of first road access to Ziro

1972	NEFA reorganised as Union Territory of Arunachal Pradesh (UT)
1987 (20 Feb)	Arunachal Pradesh attains full Statehood
2014	Apatani Cultural Landscape nominated to UNESCO World Heritage Tentative List (Ref. 5893)
2012–present	Ziro Music Festival established; grows to national and global prominence
2024 (Feb–Mar)	Keyi Panyor District carved out of southern Lower Subansiri

Table 6: Historical Events

Source: District Statistical Handbook of Lower Subansiri District 2022-23; UNESCO World Heritage Centre (2014); Lower Subansiri district records.

UNESCO Tentative Listing — Scope Clarification: The UNESCO nomination (Reference No. 5893, 2014) covers the **entire Apatani Cultural Landscape of Ziro Valley**. The Outstanding Universal Value is attributed to the collective agro-cultural system — the paddy-cum-fish cultivation, the compact nucleated settlement pattern, and the living traditional governance — as practised across all across Ziro valley. Hong Village is the best-preserved exemplar within this broader living cultural landscape.

4.2.1 Administrative History

Over the decades, the original Subansiri district has been progressively divided into smaller administrative units. Each split happened for practical reasons — the territory was too large, urban growth demanded separate administration, or remote communities needed closer access to government services. Table 5 below explains each bifurcation and the reason behind it. Map 2 shows the current Lower Subansiri district boundary. The relevant information is summarised in Table 7.

Year	Event	Territory Carved Out	Resultant Entity	Reason
1980 (13 May)	Subansiri District bifurcated	Daporijo Sub-Division and upper catchment areas	Upper Subansiri District; Lower Subansiri retains Ziro and remaining sub-divisions	Size. The original district was too huge and rugged to be managed from one office. Moving files and people across the mountains was a nightmare.
1992 (22 Sep)	Lower Subansiri further bifurcated	Papum area sub-divisions	Papumpare District	Urban Growth. Itanagar (the capital) was growing fast. It needed its own administrative setup to handle urban planning and government headquarters.
2001 (16 Apr)	Lower Subansiri bifurcated again	Koloriang Sub-Division and parts of Ziro (Sadar) Sub-Division	Kurung District Kumey	Border Development. These northern areas were extremely remote and lacked basic roads. Creating a new district meant more focused funding for border infrastructure.
2017 (Oct)	Kamle District notified	Raga, Dollung, Kumpurijio circles from Lower	Kamle District — 25th district of Arunachal Pradesh	Distance. People in the Kamle area had to travel too far to reach Ziro or Daporijo. This split brought the

		Subansiri; 3 circles from Upper Subansiri		District Collector's office closer to them.
2024 (Feb–Mar)	Keyi Panyor District notified	195 villages from southern Lower Subansiri (HQ: Yachuli; ~30,000+ population; primarily Nyishi tribe)	Keyi Panyor — 26th district; AP now has 28 districts (Bichom from Kameng Districts notified simultaneously)	Local Demand. This was driven by the Nyishi community's desire for a separate administrative unit to focus on the development of the foothills and Terai regions.

Table 7: Administrative History

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Lower Subansiri district administration records.

The related visual is shown in Fig. 6.

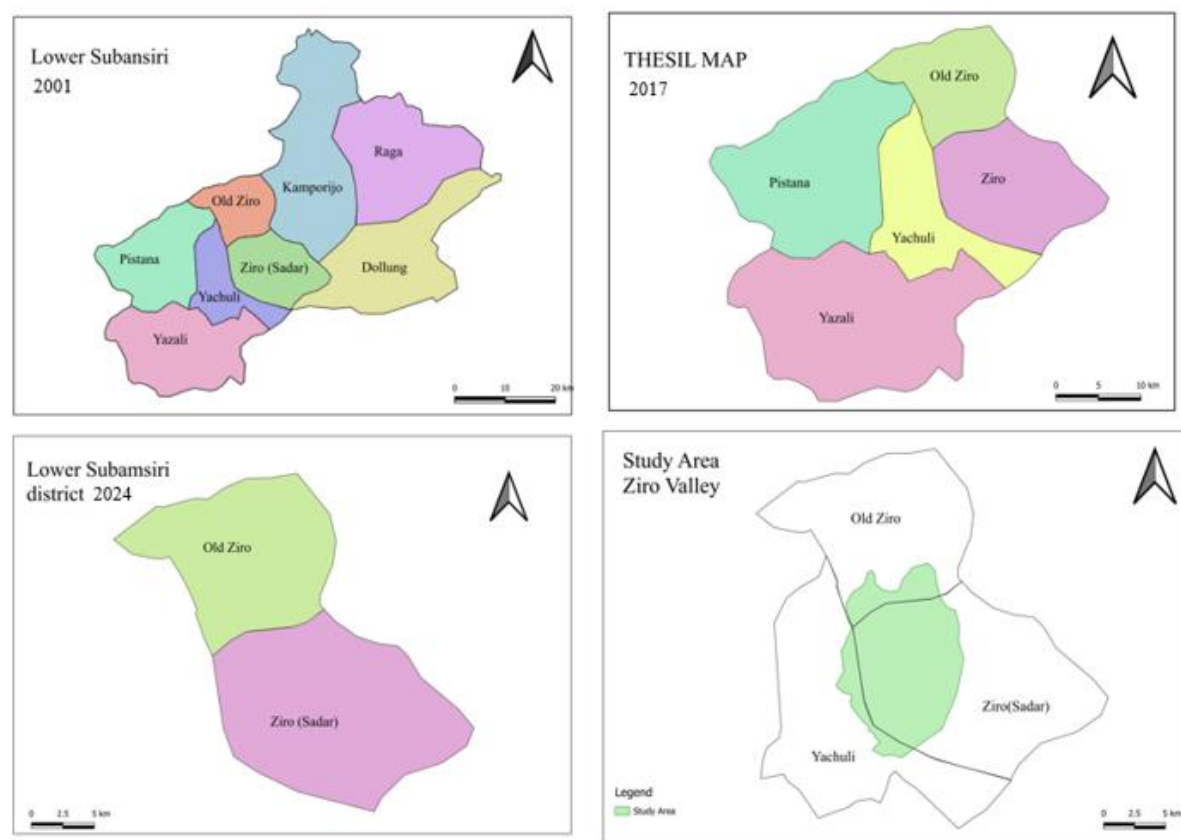


Fig. 6: Administrative Map of Ziro Valley

Source: Survey of India/Arunachal Pradesh administrative boundaries; Lower Subansiri district records; Bhuvan/NRSC base layers.

Net planning implication: Each successive bifurcation has progressively transferred non-Apatani-dominated sub-divisions out of Lower Subansiri. The post-2024 administrative unit is now substantially co-terminus with the Apatani heartland of Ziro Valley — creating an alignment of governance boundary with cultural landscape that offers a unique opportunity for culturally-sensitive, community-integrated planning.

4.3 Settlement Hierarchy and Village Structure

The Apatani people are a very close-knit community, and this is reflected in how they build their houses — extremely close together, almost touching each other. The related visual is shown in Fig. 7.

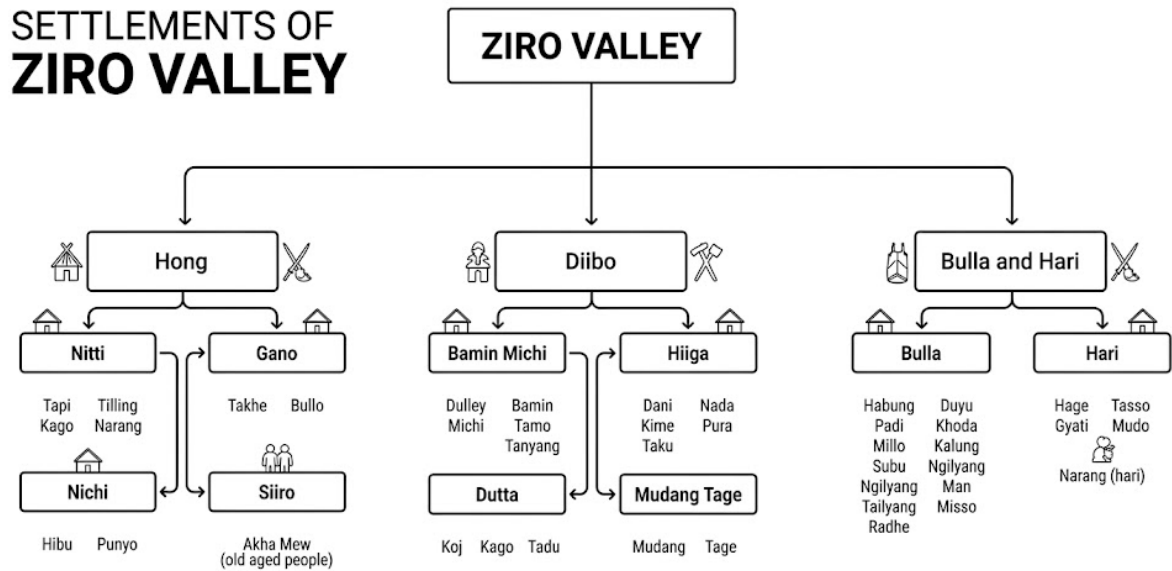


Fig. 7: Settlement Density and Close Housing Pattern in Ziro Valley

Source: Bhuvan/NRSC satellite imagery; Google Earth interpretation; field verification.

The Apatani settlement pattern in Ziro Valley is organised around three principal settlement clusters, distinct from the Hapoli urban core. Within each cluster, individual villages correspond to specific clan lineages — each Apatani surname group occupies its own distinct village, and in most cases the village itself takes its name from the clan surname. While this intra-village subdivision is rooted in social and kinship organisation rather than formal administrative hierarchy, it is in practice also recognised as a functional unit in local governance and community decision-making. The related visual is shown in Fig. 8.

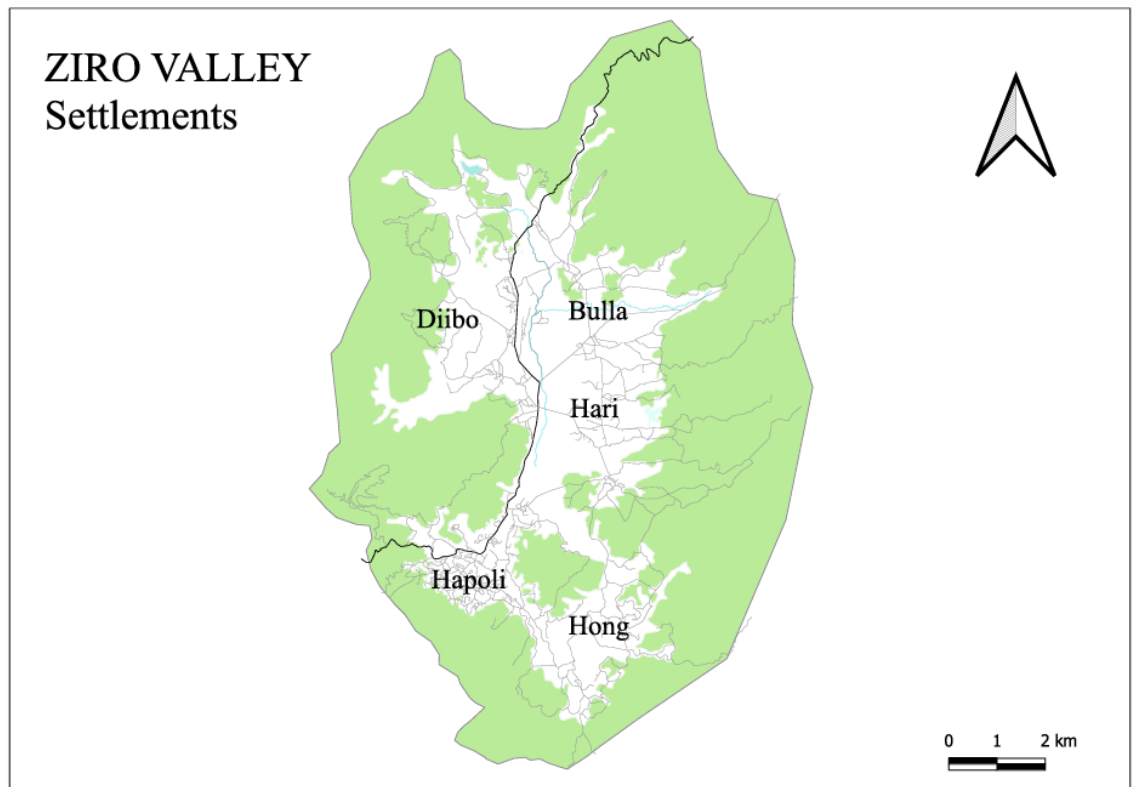


Fig. 8: Settlement Map of Ziro Valley

Source: Survey of India/Arunachal Pradesh administrative boundaries; Bhuvan/NRSC base layers; OpenStreetMap road/settlement data; field verification.

4.4 Past Planning Efforts

Formal planning intervention in Ziro Valley has historically been fragmented and sector-specific, lacking an integrated spatial planning framework. The principal planning-related actions undertaken to date include:

- **Swadesh Darshan Scheme (Ministry of Tourism):** Infrastructure development under this scheme includes the establishment of trekking trails at Talley Valley Wildlife Sanctuary and the installation of wayside amenities at designated tourist nodes. According to the Tourism Department, three projects have been completed under this scheme:
 - **Convention center Ziro (constructed)**
 - **Development of kardo hill**
 - **Craft bazaar with amphi theatre at Siiro**
- **Swachh Bharat Mission:** Sanitation infrastructure, specifically community toilet blocks, has been positioned within select village clusters.

The district currently maintains its status under the national sanitation guidelines established by the mission.

- **Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGA):** Works executed under this program consist of village-level water pipeline installations, the construction of community ponds, and routine maintenance of the rural road network.
- **AP Building Bylaws 2019:** This is the gazetted statutory framework governing local development. It specifies a maximum Floor Area Ratio (FAR) of 1.75, alongside defined height restrictions and setback requirements for all new constructions.
- **UNESCO Tentative Listing:** The Apatani Cultural Landscape has been on the UNESCO Tentative List since 2014. Heritage management efforts are currently aligned with the UNESCO "Five Cs" Strategy (Credibility, Conservation, Capacity-building, Communication, and Community).
- **Ziro Airport (IATA: ZER):** The airstrip is currently operational, with regional air services restored in 2022. It serves as the primary point of air connectivity for the Lower Subansiri district.

4.6 Environmental Profile

Ziro Valley is known for its breathtaking landscapes and pleasant climate, which varies distinctly throughout the year. Understanding the valley's climate, terrain, water systems, soil, forests, and natural hazards is essential for planning any development. This chapter covers all of these environmental factors and explains what they mean for infrastructure planning and tourism management. The charts below illustrate the seasonal climate patterns.

4.6.1 Climate and Temperature

Ziro is situated at a significant elevation of approximately **1,568 meters** above sea level. Under the Köppen-Geiger system, the valley is classified as **Cwa (Humid Subtropical, Dry Winter)**.

The thermal profile of the region is characterized by a moderate annual mean temperature of **23.59 C**. Seasonal variations are distinct:

- **Summer/Monsoon Peak:** The warmest period occurs in August, with average highs reaching **31.87 C**.
- **Winter Minimums:** January is the coldest month, with a daily mean of **17.8 C** and average lows dipping to **11.18 C**.
- **Historical Extremes:** The region has recorded absolute maximums of **38 C** and minimums as low as **5 C**, indicating a need for building envelopes that can manage both solar gain and significant heat loss.

Average temperature throughout the year according to the historic data is also shown in the Fig. 9.

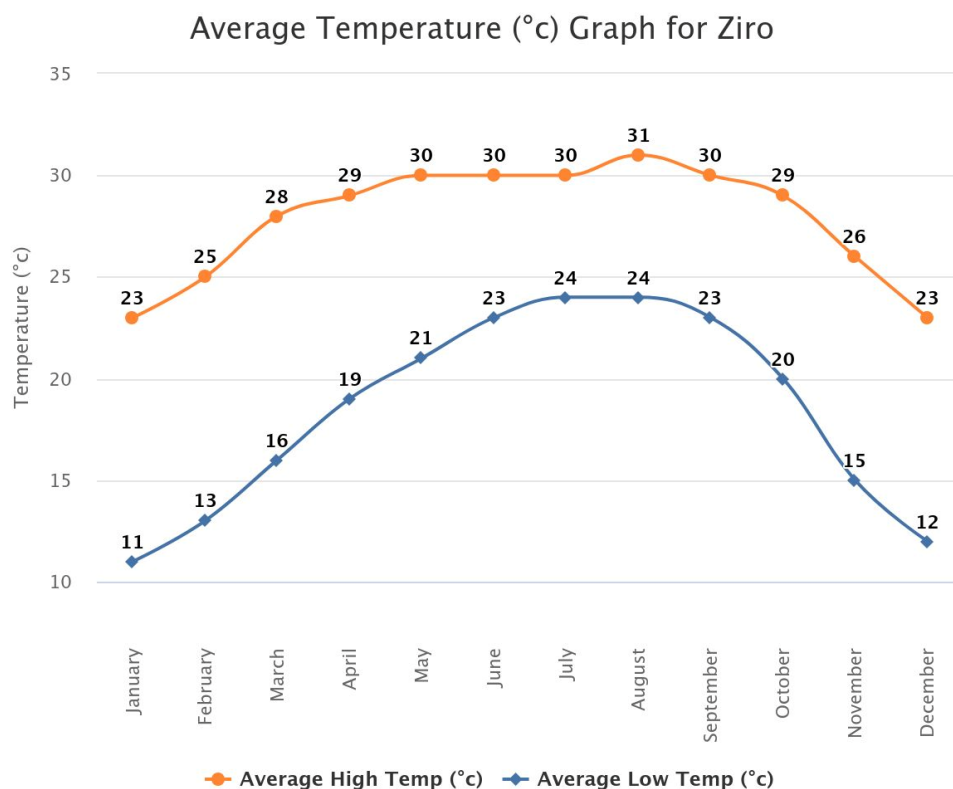


Fig. 9: Average Temperature Trend in Ziro Valley

Source: World Weather Online historical climate data for Ziro.

4.6.2 Rainfall and Precipitation

The valley exhibits a highly seasonal hydrological cycle, heavily influenced by the Indian Monsoon.

- **Rainfall Distribution:** While the data notes a concentrated annual precipitation, the distribution is uneven. The wettest month is **July**, receiving an average of **369.9 mm**, followed by significant rainfall in June and August.
- **Dry Period:** In contrast, the winter months (November to January) are notably dry, with December receiving only **13.11 mm** of rain.
- **Frequency:** Rainfall occurs on approximately **71.64 days** annually, meaning that for roughly **20%** of the year, precipitation is a factor in local drainage and construction scheduling.

Average rainfall in Ziro throughout the year according to historic data are shown in Fig. 10.

Rainfall Averages

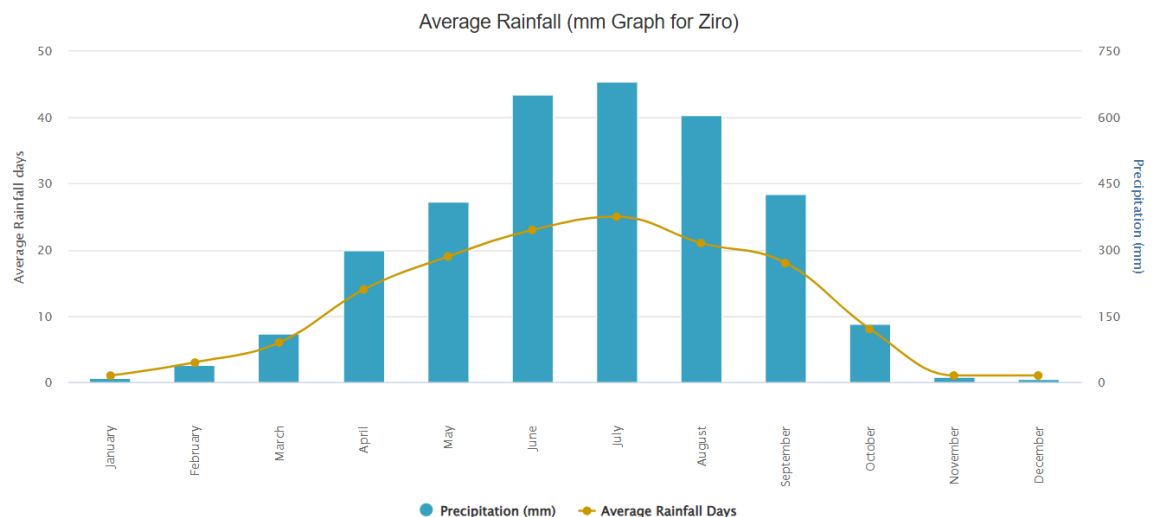


Fig. 10: Average Rainfall Trend in Ziro Valley

Source: World Weather Online historical climate data for Ziro.

4.6.3 Humidity and Atmospheric Conditions

The atmospheric conditions in Ziro reflect its sub-tropical highland location:

- **Relative Humidity:** The average annual humidity is high at **75.1%**. During the peak monsoon months (July–September), this figure rises above **87%**, which is a critical consideration for material durability and natural ventilation in planning traditional or modern structures.

The related visual is shown in Fig. 8.

- **Solar Access:** Despite the rainfall frequency, the valley maintains a high mean of **10.26 monthly sunshine hours**. The maximum solar exposure occurs in June (**11.87 hours**), suggesting significant potential for passive solar heating and decentralised solar energy systems.

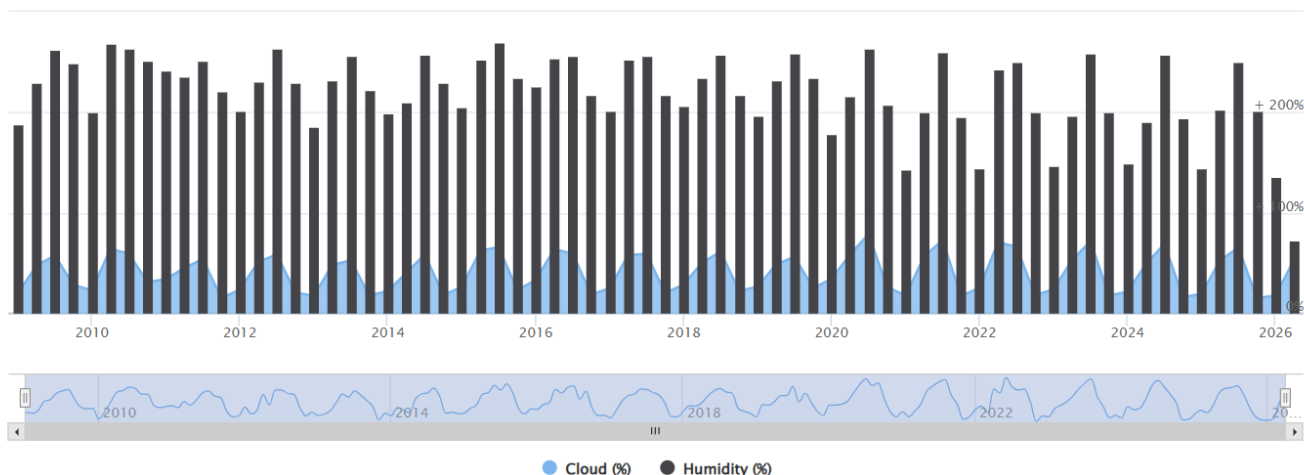


Fig. 11: Annual Cloud Cover and Humidity Averages in Ziro Valley

Source: World Weather Online historical climate data for Ziro.

The gist of climate of Ziro valley is shown in table 8. The relevant information is summarised in Table 8.

Climatic Parameter	Value / Range	Remarks
Mean Annual Temperature	~16°C (range: 5°C in January to 28°C in August)	1°C rise documented 2011–2021 (Gogoi & Gogoi, 2025) — urbanization-induced micro-climate shifts.
Winter Minimum (Dec–Jan)	~5°C	Frost-free valley floor; light snowfall on surrounding hills above 2,500 m
Summer Maximum (Jul–Aug)	~28°C	Peak monsoon coincides with peak agricultural activity
Mean Annual Rainfall	1,700–2,000 mm	Predominantly June–September; orographic precipitation from Eastern Himalayan ridges
Monsoon Season	June – September	High landslide risk on NH-13; road access periodically disrupted
Post-Monsoon (Oct–Nov)	Clear, cool, ideal tourist conditions	Peak tourism season coincides; Music Festival September
Winter (Dec–Feb)	Cool and dry; occasional fog in valley floor	Moderate tourist season
Spring (Mar–May)	Warm transition; rhododendron and orchid blooming	Spring festival season; Myoko celebration

Table 8: Climatic Baseline and Seasonal Activity Profile of Ziro Valley

Source: World Weather Online historical climate data; IMD regional climate normals; District Statistical Handbook of Lower Subansiri District 2022-23.

Climate Change Context: A documented 1°C rise in mean temperature over 2011–2021 (Gogoi & Gogoi, 2025) is attributed to increased built-up area and reduced green cover in the valley. This urban heat island effect poses a direct threat to the agro-climatic conditions that sustain the paddy-cum-fish cultivation system, which depends on precise water temperature and irrigation timing. Any planning intervention must include mandatory green buffer provisions to arrest this trend.

4.6.4 Geography and Terrain

Ziro stands out because it is a rare flat basin tucked inside the steep Himalayan foothills. This natural layout directly determines how life and activity in the valley are organised. By examining the altitude and slope zones, we can understand how the land transitions from the central rice fields up to the high forest ridges.

Physiographic Position: Ziro Valley occupies a geomorphologically distinct inter-montane basin within the Eastern Himalayan foothills, bounded by northeast-trending fault-controlled ridgelines. The valley's characteristic flatness — a product of millennia of alluvial sedimentation by the Kele River and its tributaries — distinguishes it sharply from the rugged terrain of the surrounding district.

Slope Classification: The valley floor (approximately 40 per cent of the study area) records slopes of 0–3 degrees, constituting the primary agricultural and settlement zone. The transitional fringe (approximately 30 per cent) records slopes of 3–15 degrees, where traditional village extensions and forest fringe settlements are located. The hillside zone (approximately 30 per cent) records slopes of 15–35 degrees and above, constituting the forested catchment area that feeds the valley's irrigation system. This is also represented in map using gis using DEM which is taken from USGS as shown in fig 12.

- 5 Valley floor: ~1,525 m AMSL; slope 0–3°; agricultural and settlement use.
- 6 Forest transition zone: 1,525–2,000 m; slope 3–25°; forest fringe settlements and trekking routes.
- 7 Upper catchment ridgelines: 2,000–2,900 m; slope >25°; undisturbed primary forest.
- 8 Highest accessible point: Dolo Mando / Mando Katu (1,864 m); Dusu-Kattu ridge (2,450 m).

The related visual is shown in Fig. 12.

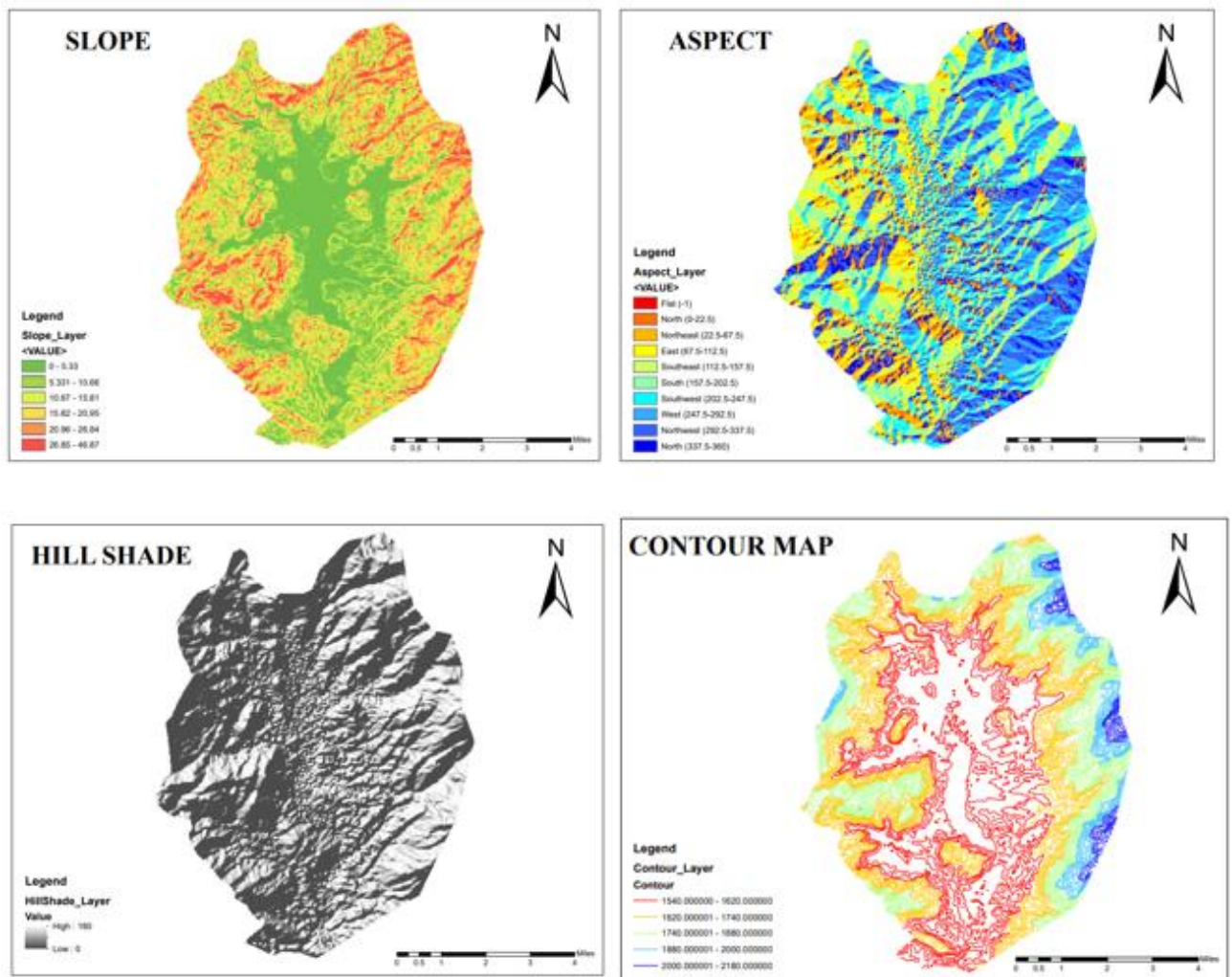


Fig. 12: Slope, Aspect, Hillshade and Contour Map of Ziro Valley

Source: USGS/NASA SRTM DEM; Bhuvan/NRSC base layers; QGIS terrain analysis.

4.6.5 Water Bodies and Hydrology

The hydrological network of Ziro Valley functions as the foundational utility spine for both the natural ecosystem and the human settlements. At the macro scale, the **Kele River** acts as the primary perennial artery, fed by a combination of monsoon precipitation and snowmelt from the surrounding ridges. This river is the basis for the **Bogo**, a sophisticated traditional irrigation system perfected through centuries of community involvement. Unlike a single centralised network, the Bogo system taps water near the forest foothills and channels it through major canals on either side of the valley to ensure every plot of land is well-supplied as shown in Images 2 & 3.

The technical efficiency of the **Bogo** system relies on a tiered use of natural materials and gravity-fed engineering:

- **Conveyance Infrastructure:** Terraces are connected using bamboo pipes (10–15 cm circumference) at higher elevations, while lower elevations utilize larger pine pipes (15–25 cm) made from hollowed trunks.
- **Flow Regulation:** To prevent backflow and maintain precise water levels for the **Aji-ngyii** (rice-fish cultivation), outflow pipes are placed 5 to 8 inches above the surface of lower plots.

The related visual is shown in Fig. 13.

- **Resource Recycling:** The system is designed so that surplus water and organic matter drain back into the main canals, while village wastewater—carrying domestic biodegradable waste—is strategically connected to irrigation channels to act as a natural fertilizer.



Fig. 13: Drainage and Desilting Channels in the Paddy-field Irrigation System

Source: Primary field photograph, Ziro Valley, 2026.

While the Kele River provides the regional framework, the valley's water security is characterized by a highly decentralised network of settlement-specific streams. Each village cluster manages its own distinct hydrological source:

- **Hapoli:** Pange River
- **Hong:** Siikhe Stream
- **Bamin Michi:** Tado Lambia
- **Hari:** Yath Stream
- **Bulla:** Yachi Stream

- **Old Ziro, Mudang Tage, and Dutta: Supyu Stream**

In recent years, this natural network has been supplemented by man-made water bodies designed to stabilize the water table and support low-impact tourism. **Siikhe Lake** (developed between September 2017 and January 2019) and **Seeh Lake** (completed in September 2022) represent modern hydrological interventions that must be integrated into the traditional water-sharing logic. Because the valley's flat topography facilitates the rapid spread of upstream pollutants into these interconnected paddy-fish plots, the entire basin is designated as **NSI Zone 1 (High Sensitivity)**, requiring the strictest levels of infrastructure protection within this spatial framework. The water bodies and the lake is shown in the map 14.

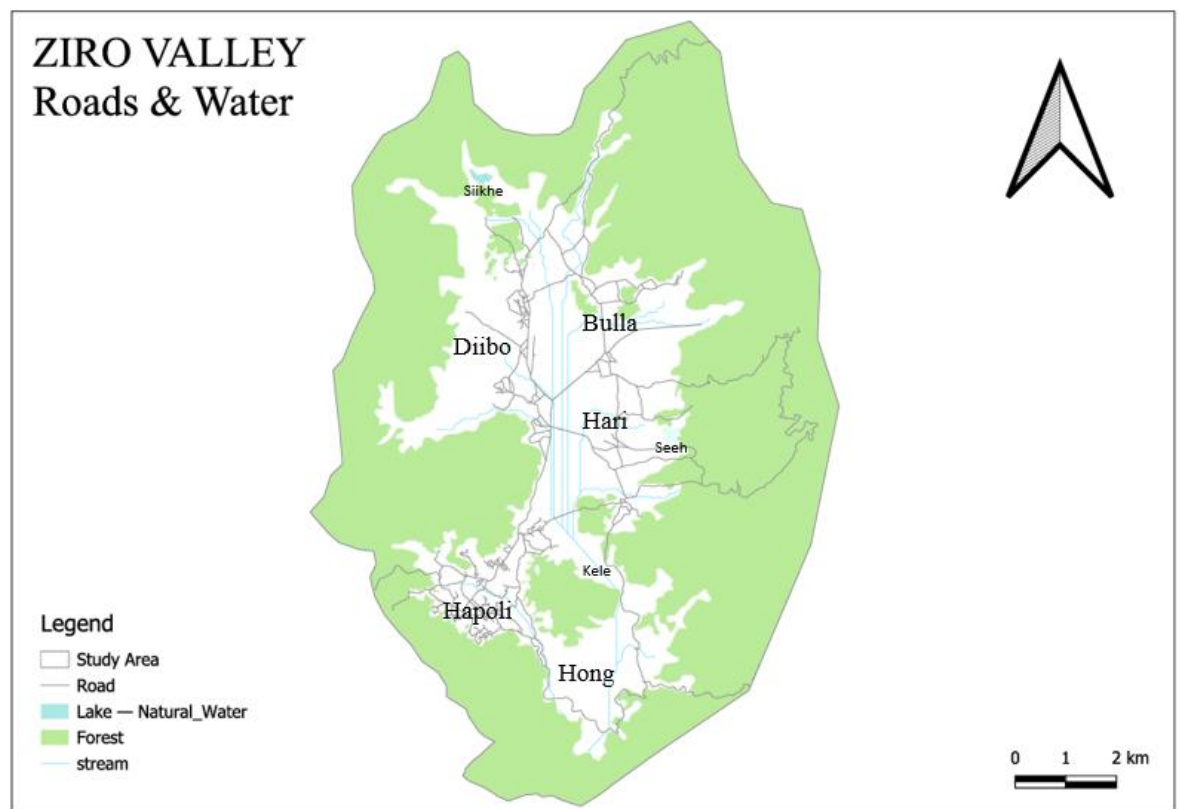


Fig. 14: Water Bodies Map of Ziro Valley

Source: Bhuvan/NRSC hydrology layers; OpenStreetMap waterbody data; USGS satellite imagery; field verification.

4.6.6 Geology and Soil

Ziro Valley lies in the sub-Himalayan fold-thrust belt, composed of Tertiary sedimentary formations (Siwalik Group equivalents) overlain by Quaternary alluvial and colluvial deposits. The valley floor is underlain by poorly consolidated

alluvial sediments — gravels, sands, and silts — deposited by the Kele River and its tributaries over geological time. The surrounding hills expose moderately folded and fractured sandstones, siltstones, and phyllites.

The region falls within **Seismic Zone V** — the highest seismic hazard zone in India, as designated by the Bureau of Indian Standards (IS 1893: 2016). The proximity to the Mishmi Thrust and the Bomdila Fault System places the valley at risk of high-intensity ground shaking. The 1950 Assam earthquake (Richter Scale 8.6) — one of the largest recorded earthquakes in human history — originated in this tectonic domain. This seismic context fundamentally informs the construction typology recommendations in this study. The relevant information is summarised in Table 9.

Soil Type	Location in Valley	Characteristics	Agricultural Significance
Alluvial — Sandy Loam to Clay Loam	Valley floor (paddy-fish fields)	Deep, well-structured; pH 5.5–6.5 (slightly acidic); high organic matter from fish waste; naturally fertile	Ideal for paddy cultivation; sustains paddy-fish system without chemical inputs
Colluvial — Sandy Loam	Valley margins and lower slopes	Transported material from hillside erosion; moderate fertility; occasionally waterlogged	Mixed use; terraced cultivation possible with management
Lateritic — Reddish Loam	Hillside zones above 1,700 m	Leached, iron-rich; low fertility; well-draining; pH 4.5–5.5 (acidic)	Forest soils; not suitable for paddy; supports pine and oak cover
Riparian Alluvium	Kele River banks	Sandy, poorly consolidated; high permeability	Flood-sensitive; no construction zone recommended

Table 9: Soil Profile of Ziro Valley

Source: National Bureau of Soil Survey and Land Use Planning; District Statistical Handbook of Lower Subansiri District 2022-23; field observations.

4.6.7 Forest and Biodiversity

The forests surrounding Ziro Valley belong to the **Eastern Himalayan Subtropical Broadleaf Forest** and **Eastern Himalayan Subalpine Conifer Forest** biomes — both recognised as globally significant biodiversity hotspots under WWF classification. Species composition includes pine (*Pinus roxburghii* and *Pinus kesiya*), oak (*Quercus* spp.), alder (*Alnus nepalensis* — ecologically critical for nitrogen fixation on hillside terraces), rhododendron, and a diverse assemblage of orchids, ferns, and bamboo.

4.6.8 Talley Valley Wildlife Sanctuary

Established in 1995 and spanning 337 sq. km, the **Talley Valley Wildlife Sanctuary** serves as the critical "End-Node" for the valley's sustainable tourism circuit. Historically, the area represents the ancestral home of the Apatani people before their migration to the Ziro Valley floor—a transition driven by the ecological constraints of high-altitude agriculture. The sanctuary's name itself is a tribute to this heritage, derived from "Talley," the local name for the wild onion (*Allium hookeri*). Today, the sanctuary is being positioned as a premier eco-tourism destination designed to increase visitor "stay-duration" and boost the local economy through high-value, low-volume engagement. The related visual is shown in Fig. 15.



Fig. 15: Talley Valley Wildlife Sanctuary Welcome Gate

Source: Primary field photograph, Talley Valley Wildlife Sanctuary entrance, 2026.

The infrastructure strategy for Talley Valley is intentionally "minimalist" to preserve its fragile micro-climate and unique biodiversity, including the **Blyth's Tragopan**, the **Clouded Leopard**, and the critically endangered ***Rhododendron pangenam***. To prevent habitat fragmentation and the risk of "reverse succession," the management framework employs the following integrated infrastructure controls:

- **Non-Motorized Transit Corridor:** A strict "no-car" policy is maintained for the 15 km stretch from Pange to the sanctuary core. This

preserves the 30 km trekking trail (60 km round trip) as a pedestrian-only experience, mitigating the risk of the area transitioning into a "cold desert" environment—a primary concern for local forest officials regarding black-topped road construction.

- **Capacity Management & Entry Protocol:** To ensure a low-impact footprint, infrastructure is designed to support a capped visitor limit (approximately 90 visitors), with entry strictly regulated through a mandatory permission system.
- **Biological Assets as Tourism Anchors:** The "Integrated Infrastructure" includes the development of specialized trails that allow for the controlled observation of rare species, such as the **Kaiser-i-Hind** and **Bhutan Glory** butterflies, and the high-altitude lakes. This approach turns the sanctuary's rare flora—including **Ginseng**, *Paris polyphylla*, and *Illicium griffithii*—into educational and economic assets without the need for high-intensity built structures.

4.6.9 Sacred Ranthii Groves

The sacred groves of the Ziro Valley, locally known as **ranthii**, are relict forest patches protected by the Apatani tribe through traditional, cultural, and religious beliefs. These groves are situated on the periphery of villages and are regarded as the sacred abodes of various spirits and deities. Traditionally, it is believed that the original vegetation in these plots was planted by the ancestors of the village, and out of respect for this ancestral work, the areas are maintained as undisturbed ecosystems.

Traditional Names and Locations

Each clan within the Apatani society typically maintains its own ranthii. According to documented research, the specific names associated with the primary village clusters are shown in table 10. The relevant information is summarised in Table 10.

Sl. No	Name of villages	Name of sacred groves	Latitude(N)	Longitude (E)	Altitude (m asl)	Population(in persons)	No. of sacred groves
1.	Bamin-Michi	Bamin Michi <i>ranthii</i>	27°34'07"-27°34'21"	93°49'33"-93°49'39"	1615	Bamin-157 Michi -188	1
2.	Dutta	Dutta <i>ranthii</i> *	27°34'39"-27°49'40"	93°49'47"-93°49'46"	1548	404	1
3.	Hari	i)Puming pubiang ii)Suthii pach eko iii)Yapun yapyo	27°35'02"-27°35'08" 27°35'48"-27°34'58" 27°35'00"-27°35'52"	93°51'40"-93°51'46" 93°51'02"-93°51'05" 93°51'10"-93°51'13"	1618.50 1623.25 1625.80	Hari –I 436	3
4.	Hong	Saro samii	27°33'12"-27°34'09"	93°50'35"-93°51'34"	1568	Hong I-1019 Hong II-512 Hong III-704	1
5.	Mudang -Tage	Dilang posa	27°34'22"-27°34'28"	93°50'04"-93°50'11"	1564.50	M.T.-I 177 M.T.-II 370	1
6.	Nani-Tajang	Nani-Tajang <i>ranthii</i> *	27°36'02"-27°36'09"	93°50'18"-93°50'20"	1563	Tajang-612	1

Note: Some sacred groves have their traditional name or often called as 'Ranthii' along with the name of the village.

Table 10: Sacred Groves in and Around Ziro

Source: Dutta et al. (2017).

Core Characteristics

- **Biodiversity Value:** These groves function as reservoirs for culturally valued species and represent climax vegetation, often serving as the last refuge for rare flora and fauna in the region.
- **Spiritual Protection:** The groves are governed by strict taboos that historically forbade any interference with the biota; traditionally, even the removal of leaf litter, grazing, or hunting was prohibited.
- **Sacred Species:** While the groves contain diverse vegetation, the **Peach tree (*Prunus persica*)** is a specific sacred species associated with the clan and household dwellings. Its flowering is used as a traditional indicator for the commencement of the Myoko festival.
- **Physical Environment:** The groves are typically located at altitudes ranging from approximately 1,548 meters to 1,625 meters above mean sea level. The soil within these undisturbed areas is generally rich in nutrients and thick with humus.

4.6.10 Flora and Fauna

The valley floor is defined by a meticulously managed vegetative structure. The Apatani farmers maintain **integrated homegardens** combining bamboo (*Phyllostachys bambusoides*) and pine (*Pinus wallichiana*). These plantations are traditionally referred to as **Bidu Bikan** (bamboo groves) and **Sasisapa** (pine trees). This system is so efficient that it allows the valley to export timber while maintaining a high carbon sink.

- **Medicinal Biodiversity:** The Apatani utilize over **158 medicinal plant species** from the valley core. Key species include *Allium hookeri* (used for cough and wounds) and *Acorus calamus* (for skin diseases and bone fractures).
- **Cultural Indicators:** The **Peach tree** (*Prunus persica*) serves as a vital phenological indicator; its blossoming in late February traditionally signals the start of the **Myoko festival**.

The fauna of the inhabited valley floor is centered around the **wet rice-fish cultivation system**.

- **The Rice-Fish Ecosystem:** Common carp (*Cyprinus carpio*) are the primary species introduced into the flooded **Aji** (paddy plots). They thrive on natural algae and pests, contributing to a chemical-free agricultural cycle. High-altitude breeding at the **Tarin Fish Farm** ensures a steady supply of fingerlings for this system.
- **Avian Diversity:** Ziro Valley is a major stopover for migratory birds. Recent sightings include the **Mandarin Duck** and the **White-cheeked Starling**, which are rare in other parts of India. The **Blue Whistling Thrush** and **Striated Laughingthrush** are common endemic residents seen near settlements.
- **Butterfly Highlights:** The region is globally famous for rare butterflies like the **Bhutan Glory** and the **Kaiser-i-Hind**, which are often found in the moist forest patches surrounding the valley.

The relevant information is summarised in Table 11.

Category	Key Species / Types	Status & Significance
Managed Trees	Apatani Bamboo (<i>Phyllostachys bambusoides</i>), Blue Pine (<i>Pinus wallichiana</i>), Alnus nepalensis	Integrated in homestead agroforestry; provides

		construction material and fuel.
Traditional Bamboo	Bidu Bikan (Apatani bamboo groves), <i>Dendrocalamus hamiltonii</i> , <i>Bambusa tulda</i>	Essential for traditional architecture and household items.
Orchids & Flowers	Sanji Apu (<i>Rhododendron arboreum</i>), Pappi Apu (<i>Hedychium ellipticum</i>), <i>Thrixspermum japonicum</i>	High cultural value; Ziro is a major orchid diversity hub with 134+ documented species.
Birds	Blue Whistling Thrush , Mandarin Duck , Mandarin Starling , Himalayan Buzzard	Migratory path highlights; Ziro is a critical wintering site for waterbirds.
Mammals	Assamese Macaque , Jungle Cat , Hoary-bellied Squirrel , Himalayan Porcupine	Primarily smaller mammals and arboreal species adapted to the village-forest edge.
Fish	Common Carp (<i>Cyprinus carpio</i>), Indigenous Cyprinids (<i>Cyprinion semplotum</i> —locally likened to Mahseer)	Core of the Aji-ngyii system; bred at Tarin Fish Farm for distribution to paddy fields.

Table 11: Biological Inventory of Ziro Valley

Source: Dutta et al. (2017); Das and Anku (2020); Ayam (2017); Bamin and Gajurel (2015); Talley Valley Wildlife Sanctuary records.

4.6.11 Disaster

While Ziro is known for its steady landscape and deep traditions, it faces several environmental threats that can disrupt the valley's balance. Recent incidents, like the 2025 landslides and the record-breaking heatwaves of 2024, show that the area is more fragile than it appears. This section details these hazards and the specific risks they pose to the land and the local community.

4.6.12 Seismic Hazard

Ziro Valley falls within Seismic Zone V under BIS IS 1893: 2016 — the highest hazard designation in India. All structures must comply with ductile detailing requirements. Traditional Apatani bamboo-pine construction has demonstrably superior seismic performance to reinforced concrete in high-hazard zones — bamboo and timber flex and absorb energy during ground shaking, while concrete fails brittlely. The progressive shift to RCC construction (25.6% of surveyed households) represents a compounding structural risk, increasing dead load without corresponding ductility.

4.6.13 Landslide Hazard

Landslides are a recurrent and documented hazard in and around Ziro Valley, triggered by intense monsoon precipitation on steep, partially degraded hillside slopes. In May 2025, a landslide struck a farm near the Pine Grove area along the Ziro–Kamle road, killing two labourers from Lakhimpur, Assam. National Highway 13 (connecting Ziro to Kamle and Upper Subansiri districts) was severely disrupted. The Deputy Commissioner of Lower Subansiri conducted field visits to assess damages and direct emergency response (Arunachal Times, June 2025). The NH-229 corridor (Yazali–Ziro section) is similarly landslide-prone during peak monsoon, periodically severing the valley primary road link to the rest of Arunachal Pradesh.

Documented Incident: May 30, 2025 — Landslide near Pine Grove, Ziro. 2 killed; NH-13 badly damaged. DC Lower Subansiri directed highway officials to maintain standby machinery throughout the monsoon season. (Source: Arunachal Times / Arunachal24, June 2025)

4.6.14 Climate Change and Heatwave Risk

In 2024, Ziro experienced one of the worst heatwaves in recent recorded memory — an unusual event for a valley historically known for its temperate climate. The extreme heat in the earlier part of the season, combined with sudden heavy rainfall in October–November 2024, caused significant rice crop damage across the valley. Farmers reported a sharp decline in yield per hectare, and several households reported shifting away from farming due to income instability (Eastmojo / AIPP Fellowship Report, December 2024). Arunachal Pradesh annual mean land surface temperature in 2023 was already 0.93°C above the 1981–2010 long-term average — the third warmest year on record for the state since 1901.

This heatwave context compounds the LULC-linked urban heat island documented by Gogoi & Gogoi (2025), which recorded a 1°C mean temperature rise in Ziro specifically over 2011–2021. The **paddy-cum-fish cultivation system is acutely sensitive to temperature and water availability** — heatwave events threaten crop timing, fish survival in flooded plots, and irrigation water temperature, all of which directly affect the UNESCO-nominated cultural landscape.

Documented Event: 2024 — Ziro heatwave (worst in recent memory) followed by unseasonal October–November rains; rice yield per hectare dropped significantly; farmers reported income instability and crop failure. (Source: Eastmojo, December 2024)

4.6.15 Forest Fire Risk

No major forest fire has been recorded within the Ziro Valley study area during the 2024–25 season. However, the LULC analysis documents a measurable decline in forested hillside cover on the upper slopes surrounding the valley. These upper catchment forests — which directly feed the Kele River irrigation system supporting the paddy-cum-fish fields — face an elevated dry-season fire risk as climate change drives longer and drier inter-monsoon spells. The Ranthii Sacred Groves, located at the forest–settlement interface, are particularly vulnerable. A community-based fire watch network and firebreaks at the forest–settlement boundary are recommended as precautionary measures.

Planning Note: While Ziro Valley has no recorded major forest fire in the study period, the combination of declining green cover (LULC 2025), rising dry-season temperatures (2024 heatwave), and forest proximity to the Kele irrigation corridor makes proactive fire risk management a planning priority.

4.6.16 Flood and Water Scarcity

- **Flood Risk:** The flat valley floor is susceptible to inundation during prolonged monsoon events, particularly near the Kele River and its tributaries. The October–November 2024 unseasonal rains triggered flood-like conditions in low-lying paddy field areas. According to the District Disaster Management Department, flooding also occurs in the Hapoli urban area during the monsoon season due to the lack of a proper drainage system.
- **Water Scarcity (Seasonal):** Increasingly erratic monsoon patterns — intense rainfall followed by prolonged dry spells — directly threaten the water-intensive paddy-fish system. Survey data confirms 41.9% of households experience water scarcity during peak festival season, indicating the system is already stressed under current demand.

The relevant information is summarised in Table 12.

Hazard Type	Severity Level	Documented Incidents (Recent)	Key Vulnerable Elements	Recommended Mitigation
Seismic (earthquake)	CRITICAL — Zone V	1950 Assam earthquake (M8.6) epicentre in this tectonic domain; ongoing micro-seismicity	RCC buildings; hillside structures; Kele River embankments	Vernacular construction mandate; seismic hazard map overlay on all permits; retrofitting programme
Landslide	HIGH — hillside zones	May 2025: 2 killed near Pine Grove, Ziro; NH-13 disrupted (DC field visit, June 2025)	NH-13 and NH-229 corridors; hillside settlements; trekking routes	Slope stabilisation; check dams; standby machinery on NH-13 monsoon season
Heatwave / Crop Failure	MODERATE-HIGH — emerging	2024: worst heatwave in recent memory; rice yield decline; farmer income instability	Paddy-fish cultivation; Kele irrigation timing; Ziro Music Festival peak season	Green buffer mandate; urban heat island mitigation; crop insurance integration
Forest Fire	LOW-MODERATE — localised risk	Dry-season risk to upper catchment forests (no major incident recorded in study period)	Upper catchment forests; Kele River source areas; Ranthii Sacred Groves	Community fire watch network; firebreaks at forest-settlement interface; SDRF coordination
Flood (seasonal)	MODERATE	Oct–Nov 2024: unseasonal rains caused flood-like conditions in paddy areas 30 May 2025.: Flood in hapoli, urban area because of no proper drainage system	Valley floor paddy fields; Kele River riparian zone	30 m no-build riparian buffer; drainage improvement; early warning system
Water Scarcity (seasonal)	MODERATE-HIGH	41.9% households report festival-peak scarcity (primary survey 2026)	Paddy-fish irrigation; festival water demand; tourist water needs	Kele River water audit; rainwater harvesting; TCC-based demand management

Table 12: Environmental Hazards and Recent Incidents

Source: District Disaster Management Authority, Lower Subansiri; EastMojo/AIPP Fellowship Report (2024); field observations.

4.7 Demographic Profile of Ziro Valley

The demographic profile of Lower Subansiri District is fundamentally defined by the unique cultural and geographic landscape of the Ziro Valley. Following a significant administrative reorganization on March 1, 2024, the district was

bifurcated to create the new Keyi Panior District, leaving the current Lower Subansiri focused primarily on the Ziro Sadar and Old Ziro circles. This core area serves as the ancestral home of the Apatani Tribe, whose permanent settled lifestyle and high educational standards have produced a demographic structure that differs significantly from the more migratory patterns seen in other parts of the state. By analyzing the current population distribution, social composition, and literacy trends, this section establishes the human baseline required to support a resilient infrastructure and sustainable tourism framework.

4.7.1 Population Dynamics and Distribution

The population of the district is primarily concentrated within the inter-montane Ziro plateau, which is situated at an altitude of approximately 1,564 meters above sea level. As per current records, the district supports a total of **8,109 households** and a **total population of 42,352 individuals**. The settlement pattern remains predominantly rural, though the urban center of Hapoli serves as a critical infrastructure hub for the valley. The relevant information is summarised in Table 13.

Category	Total	Rural	Urban
Number of Households	8,109	5,105	3,004
Total Population	42,352	29,546	12,806
Male Population	21,346	14,963	6,383
Female Population	21,006	14,583	6,423
0–6 Years Age Group	3,825	—	—

Table 13: Population and Household Summary of Ziro Valley

Source: Census of India (2011); District Statistical Handbook of Lower Subansiri District 2022-23; Lower Subansiri district records.

4.7.2 Growth and Age Structure

The district has maintained a steady growth pattern, recording a **decennial growth rate of (+) 15.14%** between 2001 and 2011. The age structure indicates a significant young population, with 3,825 children in the 0–6 age group, including 1,936 boys and 1,889 girls. This younger demographic represents a key consideration for future educational and health infrastructure planning within the valley.

4.7.3 Ethnic and Religious Composition

The social identity of Lower Subansiri is defined by the **Apatani Tribe**, who are the primary inhabitants of the valley core. The Scheduled Tribe population stands at 35,919, accounting for approximately **85.88% of the total district population**. Mirroring many other parts of the state, there is **no recorded Scheduled Caste population** within the district.

Religiously, the community remains closely tied to the indigenous **Danyi-Pwlo faith**, which governs much of the valley's cultural and agricultural calendar. However, there has been a high documented influence of Christianity in the recent past, leading to a multi-religious social fabric.

4.7.4 Demographic Balance and Gender Ratios

The demographic balance of the district is relatively stable, with the urban and rural areas showing distinct differences in gender distribution. The overall sex ratio is a critical indicator of the district's social health and accessibility to services.

4.7.5 Sex Ratio Analysis

The average sex ratio for the district is **984 females per 1,000 males**. When broken down by settlement type, the urban area shows a higher ratio of 1,006 females per 1,000 males, while the rural areas record 974 females per 1,000 males. This urban-leaning gender balance often suggests better access to healthcare and education in the township core.

4.7.6 Vital Statistics and Mortality (2024)

The vital statistics for 2024 reflect a growing population with an effective healthcare baseline. During this period, the district recorded **356 live births** and 4 stillbirths. Mortality records show a total of **109 deaths** during the year. Notably, the reporting year of 2024 saw zero infant deaths, indicating strong maternal and child health performance in the valley core.

4.7.7 Literacy and Education

Education is a high priority in the Ziro Valley, resulting in a **total literacy rate of 81.06%**, which is significantly higher than many other Himalayan districts. The

literate population totals 31,233 individuals. Male literacy is particularly high at 86.12%, while female literacy stands at 75.94%.

4.7.8 Educational Infrastructure

The educational landscape is supported by a mix of government schools and a robust private sector. Private institutions currently serve a larger number of students, particularly at the collegiate level. The relevant information is summarised in Table 14.

Institution Type	Government	Non-Government (Private)
Colleges	0	3
Higher Secondary Schools	2	2
Secondary Schools	6	8
Middle Schools	13	17
Primary/Pre-Primary	5	10
Total Enrolled Students	3,461	6,875

Table 14: Educational Institutions and Student Distribution in Lower Subansiri District

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Department of Education, Government of Arunachal Pradesh.

4.7.9 Economic Profile and Workforce

The economic structure of the valley is transitioning from a traditional agrarian base to a more diversified workforce. The **total working population is 15,755**, representing 37.20% of the population. The workforce is divided between those with stable employment and those in seasonal or temporary roles. The relevant information is summarised in Table 15.

Worker Category	Number of Persons	Percentage of Total Pop
Main Workers	11,599	27.38%
Marginal Workers	4,156	9.81%
Non-Workers	28,597	67.52%

Table 15: Workforce Composition of Lower Subansiri District

Source: Census of India (2011); District Statistical Handbook of Lower Subansiri District 2022-23.

The high percentage of non-workers (67.52%) includes a large student base and dependent age groups, emphasizing the need for infrastructure that supports both the active workforce and the large non-earning population.

4.7.10 Comparative Analysis and Benchmarking

Benchmarking the district against state averages reveals that Lower Subansiri consistently outperforms regional trends in social development.

4.7.11 Regional Indicators

The district's literacy rate of **81.06%** is significantly higher than the Arunachal Pradesh state average of **66.95%**. Furthermore, the sex ratio of **984** is more balanced than the state average of **920** and neighboring tourism hubs like Tawang, which records a ratio of **701**. The relevant information is summarised in Table 16.

Indicator	Lower Subansiri	Arunachal Pradesh	Papum Pare	Tawang
Total Literacy Rate	81.06%	66.95%	87.33%	68.54%
Sex Ratio (F per 1000 M)	984	920	950	701
Population Density	24 per sq. km	17 per sq. km	51 per sq. km	23 per sq. km

Table 16: Benchmarking Ziro against State and Regional Averages

Source: Census of India (2011); District Statistical Handbook of Lower Subansiri District 2022-23; Arunachal Pradesh state statistical records.

4.7.12 Migration Profile

Migration in Ziro Valley is characterized by historical ancestral movements and modern socio-economic shifts driven by urbanization. While direct Census tables for migration are not in the handbook, employment cell registrations serve as a quantitative proxy for socio-economic movement toward the urban core.

The relevant information is summarised in Table 17.

Year	APST Total	Non-APST Total	Grand Total	YoY Growth (%)	Share of APST (%)
2020-21	83	5	88	—	94.3%
2021-22	1,115	712	1,827	+1,976%	61.0%
2022-23	230	311	541	-70.4%	42.5%
2023-24	467	892	1,359	+151.2%	34.3%
2024-25	1,704	0	1,704	+25.4%	100.0%

Table 17: Employment Registration Trends as a Proxy for Economic Migration

Source: District Employment Exchange records; District Statistical Handbook of Lower Subansiri District 2022-23.

4.8 Economic Profile

The economic profile of Lower Subansiri District is currently defined by a steady transition from traditional subsistence farming to a more diversified economy centered on high-value horticulture and tourism. The high-altitude Ziro plateau serves as the primary economic engine, where the Apatani community's unique land-use practices—such as paddy-cum-fish cultivation—are increasingly being integrated into formal commercial networks. Following the administrative bifurcation in March 2024, the district's economic resources have consolidated around the Ziro and Old Ziro circles, which now manage the bulk of the region's hospitality and MSME growth.

4.8.1 Geographic and Administrative Profile

The district's economic landscape is governed through a streamlined administrative structure designed to support its unique high-altitude terrain. The administrative headquarters in Ziro, situated at **1,564 meters**, provides the climatic conditions necessary for temperate agricultural output and seasonal tourism. The relevant information is summarised in Table 18.

Category	Particulars
Administrative Sub-Divisions	Ziro and Old Ziro
Community Development Blocks	Ziro-I and Hong-Hari
Altitude of Economic Core (Ziro HQ)	1,564 meters above sea level
Total Number of Villages	219

Table 18: Administrative and Geographic Baseline of Ziro Valley

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Lower Subansiri district administration records.

4.8.2 Sectoral Analysis

The economy of the Ziro Valley core is characterized by a unique interplay between its traditional agrarian foundations and a rapidly emerging tertiary sector. Economic activities are increasingly shifting from subsistence-based models to commercialized value chains, particularly in high-value horticulture and tourism-linked services. This sectoral analysis evaluates the primary, secondary, and tertiary drivers of the district to understand how the valley leverages its natural capital for economic growth while maintaining its status as a nominated UNESCO World Heritage cultural landscape.

4.8.3 Agriculture and Allied Activities

Agriculture remains the fundamental pillar of the district's economy, specifically through permanent wet-rice cultivation. However, horticulture has emerged as a high-value sector, with Ziro Valley becoming a major hub for temperate fruits. These agricultural products are sold in local markets as shown in Images 5 and 6. The markets offer a diverse range of goods including foraged produce from nearby forests, home-grown vegetables, fruits, and locally sourced meat.



The relevant information is summarised in Table 19.

Produce Category	Key Species/Crop	Latest Annual Production	Yield Rate
Primary Crop	Rice	21,348 MT (2022-23)	3.60 MT per Hect.
Horticulture	Kiwi	2,741 MT (2024-25)	—
Horticulture	Apple	17 MT (2024-25)	—
Fisheries	Inland fish (Common Carp/Indigenous)	780 MT (2024-25)	—

Table 26: Key Agricultural and Allied Production

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Agriculture and allied departments, Government of Arunachal Pradesh.

The related visual is shown in Fig. 16.



Fig. 16: Inside and Outside Image of the Local Market

Source: Primary field photograph, Hapoli/Ziro local market, 2026.

4.8.4 Industry and MSME Sector

The industrial sector is characterized by small-scale units (SSI) and traditional handicrafts that focus on local resources such as bamboo, timber, and handlooms. Formalization of these units has increased through the Udyam registration system. The relevant information is summarised in Table 20.

Metric	Details
Total Registered Units (Udyam)	789 units
Key Processing Units	M/S Ziro Kiwi Wine
Craft Center Out-turn (Ziro)	600,000 Rupees
Primary Industrial Activities	Steel Fabrication, Wood Furniture, Weaving

Table 20: Industrial and MSME Infrastructure (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; District Industries Centre, Lower Subansiri.

The related visual is shown in Fig. 17, showing the winery machine in Naara-Aaba a MSME initiative. It is a processing unit.

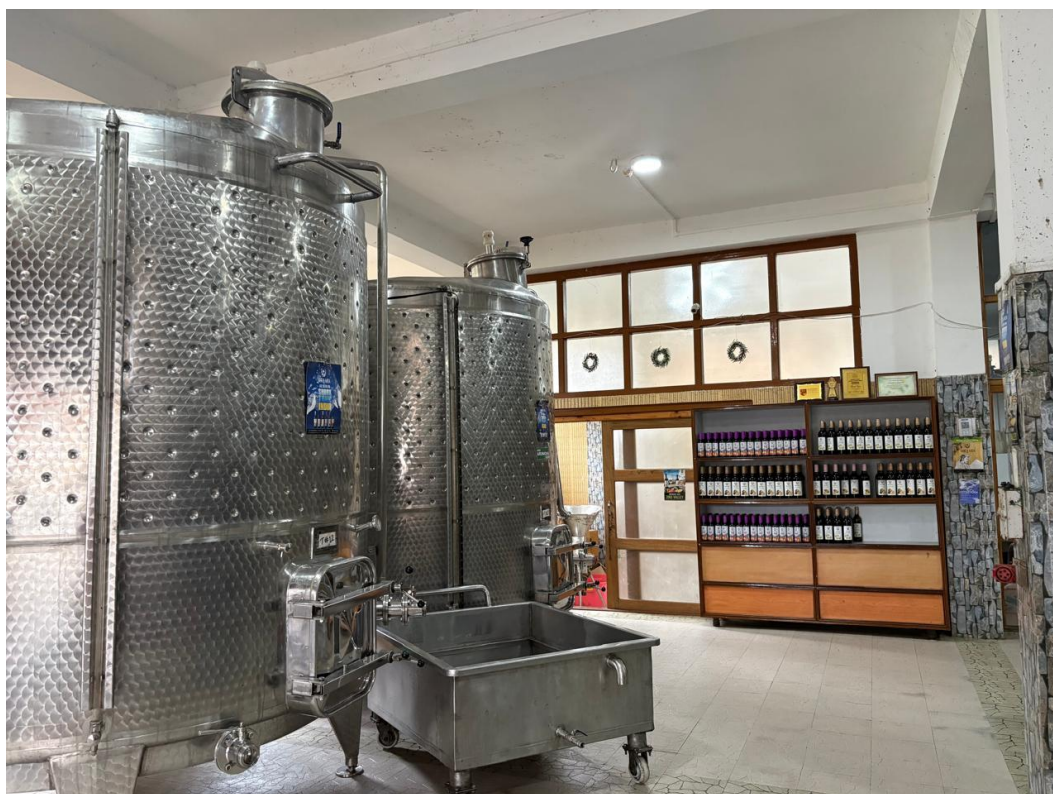


Fig. 17: Fermenting Winery Machine, Naara-Aaba

Source: Primary field photograph, Ziro Kiwi Wine / local processing unit, 2026.

4.8.5 Services and Infrastructure

The service sector is dominated by the tourism industry, which saw a massive expansion in the 2024-25 cycle, necessitating a rapid increase in hospitality infrastructure. The relevant information is summarised in Table 21.

Indicator	Volume/Revenue
Domestic Tourist Footfall	176,172 visitors
Foreign Tourist Footfall	772 visitors
Accommodation Infrastructure	13 Hotels, 5 Resorts, 42 Homestays
Urban Hydropower Revenue	17.13 Lakhs
Water Supply Revenue (Ziro Urban)	40.30 Lakhs

Table 21: Tourism and Utility Indicators (2024-25)

Source: Lower Subansiri District Tourism Office records; District Statistical Handbook of Lower Subansiri District 2022-23; PHED and power department records.

4.8.6 Economic Impact of Tourism

The transition to a tourism-led economy is evidenced by sharp increases in visitor footfall and the simultaneous expansion of the micro-enterprise and utility sectors.

- **Growth in Visitor Revenue:** Domestic tourist arrivals increased significantly from 66,682 in 2022–23 to 176,172 in 2024–25. Foreign tourist arrivals also saw a substantial rise, growing from 264 to 772 during the same reporting period.
- **Expansion of Hospitality Infrastructure:** To accommodate this surge, the district formalised a multi-tier lodging network. As of 2025, there are 13 hotels, 5 resorts, and 42 registered homestays. The homestay model is particularly impactful as it allows rural households to participate directly in the tourism value chain.
- **Formalization of Tourism Enterprises:** The sector has spurred the creation of specialized businesses, such as **M/S Ziro Kiwi Wine** (registered March 2021) and the **Ziro Tourism and Transport Cooperative Society Limited** (registered November 2021), which link local agriculture and logistics to the visitor market.
- **Utility Revenue Generation:** High tourist demand contributes to the district's utility earnings. For example, the Ziro Urban water supply

generated 40.30 lakhs in revenue during 2024–25, a significant portion of which is driven by peak seasonal consumption in the hospitality sector.

The relevant information is summarised in Table 22.

Year	Foreign Tourists	Domestic Tourists	Total Visitors
2020-21	118	5,033	5,151
2021-22	78	861	939
2022-23	264	66,682	66,946
2023-24	476	204,994	205,470
2024-25	772	176,172	176,944

Table 22: Tourism Arrival Trends (2020–2025)

Source: Lower Subansiri District Tourism Office records, 2020-2025.

4.8.7 Labour and Workforce Profile

The district's labor profile shows a significant dependency ratio, with a large segment of the population classified as non-workers, including students and homemakers. The formal workforce is primarily composed of main workers in stable employment. The relevant information is summarised in Table 23.

Worker Category	Number of Persons	Percentage (%)
Main Workers	11,599	27.38%
Marginal Workers	4,156	9.81%
Non-Workers	28,597	67.52%
Total Working Population	15,755	37.20%

Table 23: Workforce Distribution (2011 Census/2025 Update)

Source: Census of India (2011); District Statistical Handbook of Lower Subansiri District 2022-23.

4.8.8 Financial Institutions and Credit Flow

Economic growth is supported by a growing network of commercial and cooperative banks, with the urban center of Hapoli managing the majority of the district's credit flow. The relevant information is summarised in Table 31.

Metric	SBI (Hapoli Branch)	Total District (12 Branches)
Total Deposits	3,319.49 Lakhs	12,199.09 Lakhs
Loans to Priority Sectors	3,020.31 Lakhs	—
Loan Recovery Rate	1,209.64 Lakhs	—

Table 24: Banking and Credit Summary (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; lead bank/district credit records.

4.8.9 Government and Development Programmes

Developmental expenditure is funneled through local area schemes and community blocks to improve rural infrastructure and generate employment.

The relevant information is summarised in Table 25.

Scheme/Program	Funding (Rupees)	Allotted	Impact/Output
MLALAD (Ziro-Hapoli)	30,000,000		34 projects (100% implementation)
District Planning (Untied)	40,900,000		25 schemes (100% implementation)
MGNREGA (Ziro-I Block)	281.02 Lakhs		133,065 mandays generated

Table 25: Development Scheme Funding and Impact (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; district development programme records.

4.9 Infrastructure Profile

The infrastructure of Ziro Valley serves as the critical intersection between its preserved status as a cultural landscape and its rapid evolution into a premier high-altitude tourism destination. Following the administrative reorganization in March 2024, infrastructure planning for the valley is now centered within the Ziro Sadar and Old Ziro circles. This chapter analyses the physical and social systems currently in place, drawing on official records and primary survey data to highlight the capacity and constraints of the valley's utility networks.

4.9.1 Physical Infrastructure

The physical infrastructure of Ziro Valley is undergoing a transition driven by the valley's status as a UNESCO heritage-nominated site and the seasonal pressures of international events like the Ziro Music Festival (ZMF).

4.9.2 Housing

Residential patterns in the valley are shifting from traditional indigenous architecture to modern construction methods. Primary survey data reveals that nearly half of the residences are semi-permanent. The relevant information is summarised in Table 26.

Material Type	Percentage of Households
Semi-Pucca (Timber frame with masonry/concrete)	44.19%
Traditional (Bamboo, Timber, and Thatch)	30.23%
RCC / Concrete Frame	25.58%

Table 26: Building Materials of Primary Residences in Ziro Valley

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 18.



Fig. 18: Traditional Apatani House and Modern RCC Building

Source: Primary field photographs, Ziro Valley, 2026.

4.9.3 Water Resource Management

Water management in Ziro Valley is a decentralised system where every settlement draws from different small streams and rivers across the plateau. The infrastructure is supported by **Water Treatment Plants (WTP)** that stand approximately 17 to 18 feet in height, where water is collected and treated before being distributed to the public. The relevant information is summarised in Table 26.

Settlement Category	Supply Standard (Liters Per Capita - lpc)
Rural Areas	55 lpc
Semi-Urban Areas	70 lpc
Urban Areas (Hapoli/Ziro)	120 lpc

Table 26: Water Supply Standards in Ziro Valley

Source: CPHEEO Manual on Water Supply and Treatment; PHED Arunachal Pradesh norms; field observations.

Every major village and cluster in the valley relies on a specific water source, ensuring a distributed but limited supply across the region. The relevant information is summarised in Table 27.

Settlement / Village	Primary Water Source
Hapoli	Pange River
Hong	Siikhe Stream
Bamin Michi	Tado Lambia
Hari	Yath
Bulla	Yachi
Old Ziro, Mudang Tage, Dutta	Supyu

Table 27: Settlement-wise Water Sources

Source: PHED/local water-supply records; village-level field interviews, 2026.

Festival Impact and Community Response During major events like the **Ziro Music Festival (ZMF)**, the valley faces significant pressure as there is often no formal provision for extra water supply to handle the huge gatherings. Camping sites are frequently identified as "problem water sites." In response, the local community plays a vital role; when shortages occur at festival grounds or campsites, residents bring water in private tanks to assist guests. This community-led initiative not only solves an infrastructure gap but also serves as a micro-economic opportunity for locals to earn extra income.

Expansion of Settlements A notable trend in Ziro Valley is the spontaneous creation of new settlements. This typically begins with a single house built in the outskirts, followed by others joining over time. New settlement clusters tend to emerge approximately every two years, placing continuous new demands on the existing stream-based water distribution network.

4.9.4 Electricity Connection

The valley's power grid is supported by four 33/11 KV sub-stations and a network of distribution transformers. Urban Ziro currently supports 2,195 domestic consumers. However, residents face frequent power outages during the monsoon season because of tangled and exposed wiring. Image 10 below shows a typical congested electricity pole in the valley. The relevant information is summarised in Table 28.

Asset Type	Capacity	Quantity
33/11 KV Sub-stations	5000KVA	4
Distribution Transformers	500KVA to 630KVA	10

Asset Type	Capacity	Quantity
Distribution Transformers	100KVA and below	295
Annual Urban Revenue	Utility Revenue	17.13 Lakhs

Table 28: Ziro Valley Power Infrastructure Assets (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Department of Power, Government of Arunachal Pradesh.

The related visual is shown in Fig. 19.



Fig. 19: Congested Electricity Pole and Overhead Wiring

Source: Primary field photograph, Ziro Valley, 2026.

4.9.5 Solid Waste Management

Waste disposal has been partially formalised as a municipal service under the Swachh Bharat Abhiyan, though residents still use varied traditional methods as shown in Table 28. During surveys, residents reported that the collection service operates only once a week, which is insufficient for the volume of waste generated. Local women volunteer to sweep and clean the main roads, and the Apatani Youth Association (AYA) has taken the initiative to maintain cleanliness in public areas. Despite these community efforts, tourist sites still lack adequate dustbins, and garbage is frequently found thrown near lakes and along roads, creating an unsightly and unhygienic environment. The relevant information is summarised in Table 29.

Disposal Method	Percentage of Households
Municipal Collection	67.44%
Open Burning / Dumping	11.63%

Disposal Method	Percentage of Households
Pit Composting	11.63%
Direct Disposal (River/Field)	6.98%

Table 29: Solid Waste Disposal Methods in Ziro Valley

Source: Primary household survey, Ziro Valley, 2026.



Fig. 20: Community Waste Bin and Littering Condition in Ziro Valley

Source: Primary field photograph, Ziro Valley, 2026.

4.9.6 Information Technology and Communication

Ziro Valley serves as the digital connectivity node for the region. However, the tourist survey indicates that satisfaction with internet services remains low, with only 9.5% of visitors rating local connectivity as “very satisfied.” While the urban area of Hapoli has reasonable network access, other parts of the valley remain poorly connected. Services also become unreliable during the monsoon season when wires get tangled or broken by strong winds.

4.9.7 Transport Network

The road network is managed by the PWD and RWD, maintaining crucial links such as the 7 km route between Ziro and Old Ziro. Private vehicles are the primary mode of travel for over 90% of visitors according to survey data. The related visual is shown in Fig. 21.

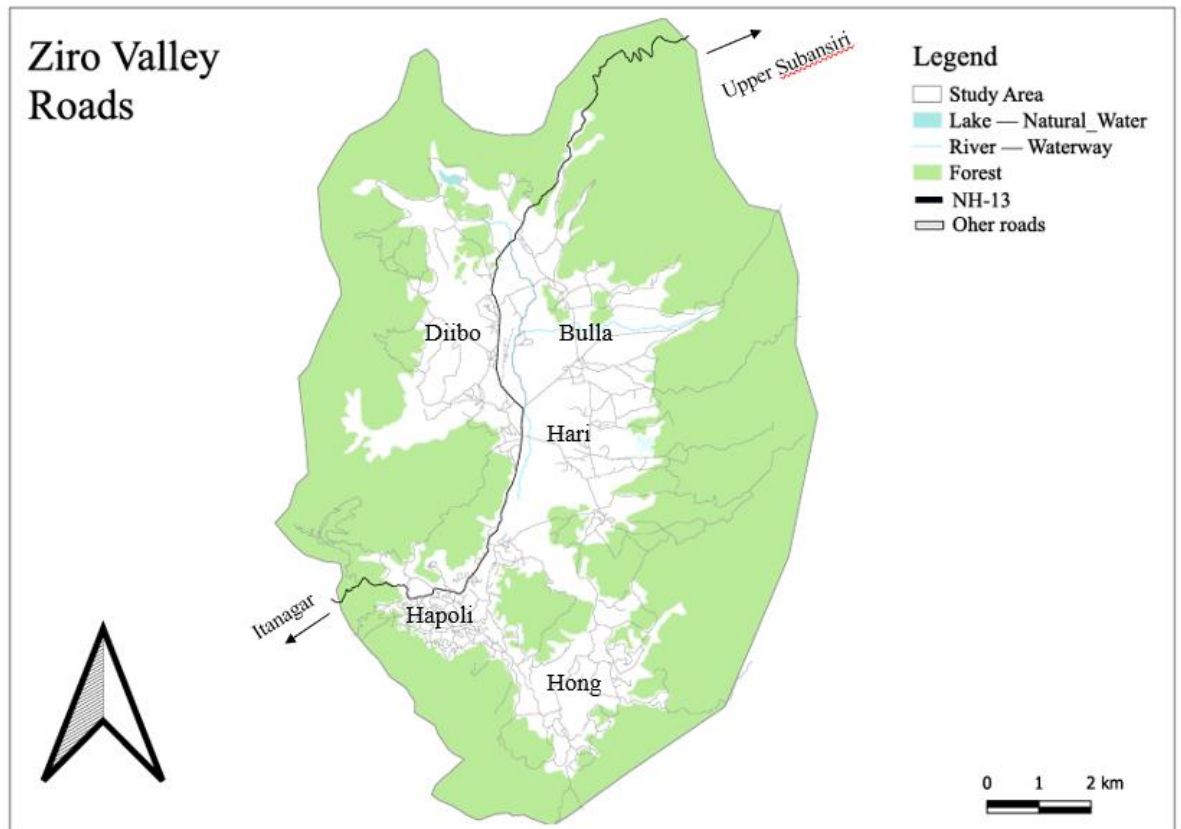


Fig. 21: Road Network Map of Ziro Valley

Source: OpenStreetMap road network; Bhuvan/NRSC base layers; field verification.

Connectivity and mobility are highlighted as primary "negative" observations for the valley's current infrastructure.

- **Network Dead Zones:** Service is inconsistent across different parts of the valley, impacting the usability of digital tourism resources.
- **Transport Constraints:** Public transport (buses, autos, or tuk-tuks) is largely unavailable, making the valley reliant on expensive private rentals. The available public transport are vans and which is considered to be expensive by the locals and tourist too. These drivers formed a union to manage the price and printed the prices so that everyone is informed. Check Annexure D for details.
- **Road Gaps:** Congestion is high in Hapoli due to a lack of parking, forcing cars onto the narrow roads. Additionally, key tourist routes like the one leading to **Seeh Lake** remain unpaved.

- **Vulnerability:** Landslides frequently occur on **NH-13** at Keyi Pyayai (between Potin and Doimukh) and between Ziro and Raga, requiring standby heavy machinery during monsoon seasons.

4.9.8 Tourism Infrastructure and Schemes

Under the **Swadesh Darshan Scheme**, several key infrastructure projects have been completed to boost the valley's capacity:

- **Convention Center:** Constructed in Ziro to host large-scale events.
- **Craft Bazar:** Located at Siiro, including an amphitheater for cultural showcases.
- **Eco-Tourism:** The Forest Department is developing trekking trails toward the **Talley Valley Wildlife Sanctuary** (337 km²) to encourage longer tourist stays and minimize peak-season crowds.

4.9.9 Social Infrastructure

Social infrastructure in Ziro Valley constitutes the institutional framework that supports the community's quality of life, human development, and social well-being. Unlike physical utilities, these facilities—ranging from regional education hubs to specialized healthcare units—provide the essential services required to sustain a resilient and inclusive society. The urban node of Hapoli serves as the primary service center for the entire plateau, offering a unique blend of government-led initiatives and a robust private sector presence that caters to both the local Apatani population and the growing seasonal tourist demographic.

The following sections detail the current status of social services in the valley, including education, healthcare, safety, banking, and community hospitality.

4.9.10 Education

Ziro Valley has established itself as a significant regional educational hub, attracting students from across the state. The educational landscape is defined by a strong partnership between the public sector and a highly active private sector, particularly at the secondary and collegiate levels.

The relevant information is summarised in Table 30.

Level of Institution	Government	Non-Government (Private)	Total
Colleges	0	3	3
Higher Secondary Schools	2	2	4
Secondary Schools	6	8	14
Middle Schools	13	17	30

Table 30: Educational Institutions in Ziro Valley (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Department of Education, Government of Arunachal Pradesh.

The related visual is shown in Fig. 21.

Fig. 21: Donyi-Polo Shrine as Cultural Learning Spaces

Source: Primary field photographs, Ziro Valley, 2026.

4.9.11 Health

Health services in the valley are anchored by the District Hospital at Ziro, which provides specialized care through maternal and T.B. units. The system is designed to provide a safety net for the high-altitude population, though capacity remains a primary planning consideration during peak tourist seasons. There is only one hospital serving the entire valley, which is a significant concern during peak tourist seasons and emergencies. The relevant information is summarised in Table 31.



Facility Type	Census 2011 Status	Current Status (2024-25)	Capacity/Beds (Current)
District Hospital (DH)	1	1	100 Beds
Community Health Centre (CHC)	1	1	12 Beds
Primary Health Centre (PHC)	1	1	—
Sub-Centres (SC)	8	10	—
T.B. Centre	1	1	—

<i>Facility Type</i>	<i>Census 2011 Status</i>	<i>Current Status (2024-25)</i>	<i>Capacity/Beds (Current)</i>
Homeopathic/Ayush	0	1	—

Table 31: Healthcare Facility Classification and Growth (Census 2011 vs. 2025)

Source: Census of India (2011); District Statistical Handbook of Lower Subansiri District 2022-23; district health records.

- The **District Hospital, Ziro** accounts for approximately **89%** of the total authorized bed capacity in the valley core, highlighting the heavy centralization of health services in the urban center.
- Since the 2011 Census, the number of Sub-Centres (Small Centers) has increased to 10, reflecting a planning focus on decentralised health access for the rural Apatani villages.
- The current health framework is supported by **12 medical doctors** and **15 nursing staff** (Staff Nurses and ANMs) within the Ziro Sadar core.
- Health facilities are identified as critical infrastructure in the **Disaster Management** profile, particularly given the valley's vulnerability to fire accidents and seasonal health pressures during huge tourist gatherings.

4.9.12 Safety and Community Governance

Public safety is managed by the Ziro Sadar Police Station, while social order is strongly supported by community networks and the cooperative nature of the local population. Student unions also take on social responsibilities, such as organising cleanliness drives to mitigate the environmental impact of tourism. To address substance abuse concerns, regular awareness campaigns are conducted, including anti-drug events featuring invited speakers and performers. The relevant information is summarised in Table 32.

<i>Designation / Unit</i>	<i>Count</i>
SP (HQ) Ziro	60
Sadar Police Station	36
Traffic Cell	14
Women Police Station	11

Table 32: Police Personnel Strength (Ziro Sadar Core)

Source: District police records; District Statistical Handbook of Lower Subansiri District 2022-23.

4.9.13 Banking and Finance

The financial infrastructure is concentrated in the Hapoli township, acting as the economic engine for the plateau. These institutions facilitate the credit flow necessary for traditional agrarian activities as well as modern tourism enterprises.

The relevant information is summarised in Table 33.

Bank Name	Number of Branches
State Bank of India (SBI)	2
Cooperative Apex Bank	3
Arunachal Rural Bank	2
Total Valley Branches	12

Table 33: Banking Network in Ziro Valley (2024-25)

Source: District Statistical Handbook of Lower Subansiri District 2022-23; lead bank/district credit records.

4.9.14 Community Hospitality and Tourism Facilities

In Ziro, hotels and homestays function as a "Social-Economic Hybrid" infrastructure. While they provide lodging, they are also centers for cultural exchange. The government supports this social development through **Exposure Tours** for homestay and hotel owners to places like Tawang and Mechuka to improve hospitality standards. The relevant information is summarised in Table 34.

Facility Type	Count	Social/Planning Context
Registered Hotels	13	Primarily located in the urban Hapoli area.
Registered Resorts	5	Focused on adventure and leisure tourism.
Homestays	80*	High social impact; allows direct local benefit.
Tourist Guides	9	Mostly part-timers connected to hotels.
Rental Vehicles	Available	Essential for movement given lack of public transport.

Table 34: Hospitality and Community Accommodation Baseline

Source: Lower Subansiri District Tourism Office records; primary homestay inventory, 2026.

Note: Recent primary data indicates a surge to 80 homestays, reflecting rapid community participation compared to earlier records.

4.10 Socio-Cultural Profile

The socio-cultural fabric of the **Ziro Valley** is woven from the centuries-old traditions of the **Apatani** people, a community whose identity is inextricably linked

to the plateau they inhabit. Unlike the nomadic or semi-nomadic tribes typically found in Northeast India, the Apatanis established a remarkably stable, sedentary civilisation defined by a profound synergy between human governance and natural resource management.

This chapter provides a comprehensive profile of the Apatani community—from their sophisticated **Paddy-cum-Fish** agricultural systems to the traditional **Bulyañ** council that continues to guide village life. By analyzing these socio-cultural pillars, we can better understand the "Outstanding Universal Value" that forms the basis of the valley's UNESCO nomination and identify how traditional heritage can be integrated into a resilient, modern planning framework.

4.10.1 The Apatani Tribe

The **Apatani** (self-designation: *Apa Tani*, meaning "people of the plateau") are a scheduled tribe numbering approximately **60,000–80,000** in the broader region, with the Lower Subansiri District Census 2011 recording 83,030 total district population. Unlike most tribal communities of northeast India that practised nomadic or semi-nomadic swidden (slash-and-burn) cultivation, the Apatanis permanently settled Ziro Valley, developing a remarkably sophisticated and stable sedentary civilisation over many centuries.

- 9 Origin: Descendants of Abotani in Tani mythology — the common ancestor of all Tani-speaking peoples of Arunachal Pradesh.
- 10 Language: Apatani — a member of the Tani branch of the Tibeto-Burman language family; unwritten until recently.
- 11 Population: ~60,000–80,000 (Lower Subansiri and adjoining areas).
 - Literacy: High relative to regional averages — consistent emphasis on education within the community.

4.10.2 Traditional Agricultural System

The **paddy-cum-fish cultivation system** is the defining feature of the Apatani cultural landscape and the primary basis for the UNESCO nomination. Rice fingerlings are introduced into flooded paddy plots at the time of transplanting. The

fish consume insects and weeds, their waste fertilises the rice, and the system requires no chemical pesticides or synthetic fertilisers. Each irrigated plot is connected to the next by the Aji bamboo channel network, with water stepping downward through gravity from one plot to the next in a closed-loop system.

This system achieves a **dual yield** — rice and fish — from a single plot, with an overall productivity per unit area that has astonished agronomists since first documentation. The system is the centrepiece of the Outstanding Universal Value (OUV) assessment of the Apatani Cultural Landscape.

The related visual is shown in Fig. 22.



Fig. 22: Traditional Paddy-cum-fish Cultivation

Source: Primary field photograph, Ziro Valley, 2026.

4.10.3 Traditional Governance – the Bulyañ System

Each Apatani village is governed by a **Bulyañ** — a traditional council of elders that functions through **social consensus and community conscience** rather than punitive legal sanctions. The Bulyañ is the primary decision-making body for land use, resource management, conflict resolution, and the enforcement of community norms including the protection of Sacred Groves.

The Bulyañ system has historically been the most effective mechanism for sustainable resource management in the valley — predating and in many ways outperforming modern statutory governance. This study's proposals explicitly recommend the formal recognition and integration of the Bulyañ as a co-governance partner in planning and heritage management, consistent with Free, Prior, and Informed Consent (FPIC) principles.

4.10.4 Festivals and Cultural Calendar

The rhythmic life of **Ziro Valley** is dictated by its cultural calendar, where ancient agricultural rites and contemporary celebrations coexist in a unique seasonal cycle. These festivals serve as the socio-economic heartbeat of the valley, acting as primary drivers for community bonding, heritage preservation, and tourism. From the reconciliation rituals of the spring to the globally recognized eco-music festival in the autumn, each event defines the valley's cultural identity and creates distinct peaks in visitor arrivals. The relevant information is summarised in Table 35.

Festival	Season	Character	Tourism Potential
Myoko	March–April	Spring community bonding festival; inter-village social reconciliation; traditional food and music	High — spring visitation opportunity; low-season tourism anchor
Dree	First week of July	Agricultural festival; prayer for good harvest and freedom from epidemic; community food sharing	Moderate — monsoon season limits access; authentic cultural experience
Murung	Autumn	Traditional harvest celebration; community gathering	Moderate
Ziro Music Festival	September (annual)	Contemporary eco-music festival; 11th edition September 26–29, 2024; national and international artists	Very High — primary tourist driver; 2,04,994 arrivals in 2023 season

Table 35: Seasonal Calendar of Major Festivals and Tourism Impact in Ziro Valley

Source: District tourism calendar; field interviews; Raha and Tripathy (2022); UNESCO World Heritage Centre (2014).

4.10.5 Heritage Assets and Material Culture

12 **Lapang**: Traditional community gathering hall constructed in bamboo and pine. Each traditional village maintains at least one Lapang, which serves as the venue for Bulyañ deliberations, community festivals, and social functions.

The related visual is shown in Fig. 23.



Fig. 23: Takhe Lapang and Nago Near It, Takhe, Ziro Valley

Source: Primary field photograph, Ziro Valley, 2026.

13 Nago: A sacred ceremonial bamboo structure with a central supporting pillar, present in each Apatani village. The Nago is central to Myoko festival rites — the pillar holds ritual offerings and the priest performs prayers at the structure while men of the clan perform ceremonial dances around it. It is a socio-religious landmark, not a storage structure.

14 Traditional Housing Typology: Bamboo wattle-and-daub walls; pine timber structural frame; woven bamboo flooring on raised platform; thatched or tin-sheet roof. Rapidly being replaced by RCC construction (25.6% of surveyed households are now full RCC).

The related visual is shown in Fig. 24.



Fig. 24: Traditional Apatani House

Source: Primary field photograph, Ziro Valley, 2026.

15 Cane and Bamboo Crafts: Weaving of baskets, mats, and traditional dress accessories — both a living craft tradition and a potential homestay programme component.

The related visual is shown in Fig. 25.



Fig. 25: Bamboo Crafted Bridge

Source: Primary field photograph, Ziro Valley, 2026.

The related visual is shown in Fig. 26.

16 Facial Tattoo and Nose Plug (Arin): Traditional Apatani female adornment practice — cylindrical nose plugs and facial tattoo patterns. Discontinued from approximately the 1970s; visible on elderly women; significant cultural documentation interest.



Fig. 26: Traditional Apatani Facial Tattoo (Tiipe) Practice

Source: Primary field photograph, Ziro Valley, 2026.

The related visual is shown in Fig. 25.

17 Herbal Black Salt (Khar): A traditional mineral salt extracted and processed from local plant ash — a culturally significant food ingredient and potential artisanal product for heritage tourism.



Fig. 27: Herbal Black Salt, Gonde Unio Plant and Wooden Storage Box

Source: Panda et al. (2016).

4.11 Tourism Profile and Tourist Sites

The tourism landscape of **Ziro Valley** is defined by a unique paradox: it is at once a fragile "living cultural landscape" nominated for UNESCO World Heritage status and a rapidly emerging global hotspot for contemporary eco-tourism. This chapter explores the multi-dimensional nature of the valley's appeal, ranging from its ancient Apatani heritage and sophisticated agricultural systems to its status as a premier destination for adventure seekers and music enthusiasts.

By analyzing recent statistical trends and documenting the diverse array of natural, cultural, and religious assets, this section establishes the baseline required to address the central problem of this study—balancing a dramatic surge in visitor arrivals with the ecological and social carrying capacity of the plateau.

4.11.1 Tourism Growth

Tourist arrivals data from the primary data collected for this thesis (tourist population.xlsx) for Ziro Valley / Lower Subansiri District, sourced directly from the district tourism department records, reveals a dramatic trajectory that defines the central problem of this study. The relevant information is summarised in Table 36.

Year	Domestic Tourists	International Tourists	Total Arrivals	Key Event / Trend
2019	24,196	709	24,905	Pre-COVID baseline; festival-driven growth
2020	601	0	601	COVID-19 lockdown — near-complete tourism suspension
2021	5,033	118	5,151	Partial recovery; inter-state travel restrictions
2022	2,583	156	2,739	Below pre-COVID levels; cautious recovery
2023	2,04,994	476	2,05,470	7,832% surge in domestic arrivals; Music Festival at full scale
2024	1,76,172	772	1,76,944	Sustained at ~1.76 lakh; 11th Ziro Music Festival (Sep 26–29)
2025	1,12,788	504	1,13,292	Partial year data; ongoing high volume

Table 36: Comparative Annual Tourist Arrivals and Growth Trends in Ziro Valley (2019–2025)

Source: Lower Subansiri District Tourism Office records, 2019-2025.

The related visual is shown in Fig. 26.

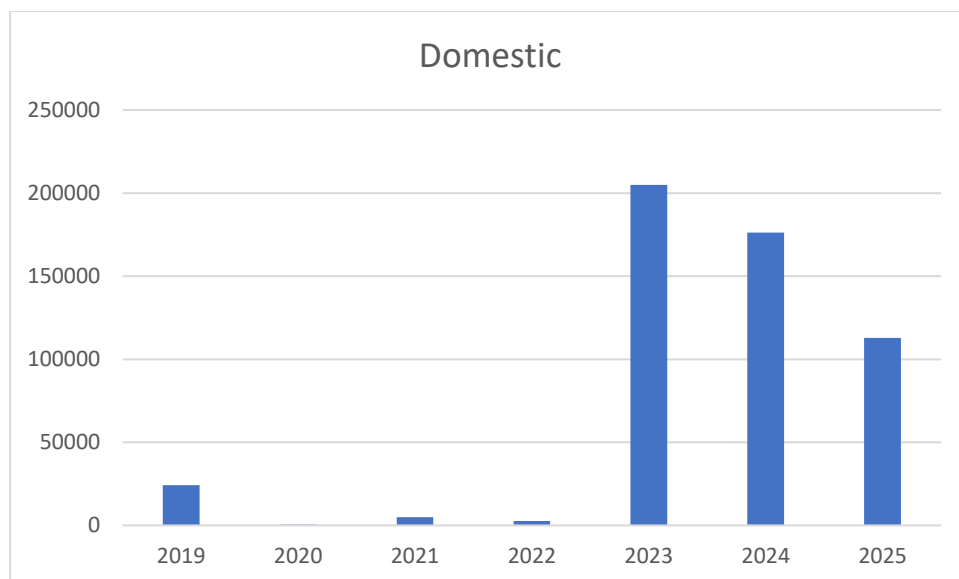


Fig. 28: Year Wise Domestic Tourist Population

Source: Lower Subansiri District Tourism Office records, 2019-2025.

The related visual is shown in Fig. 27.

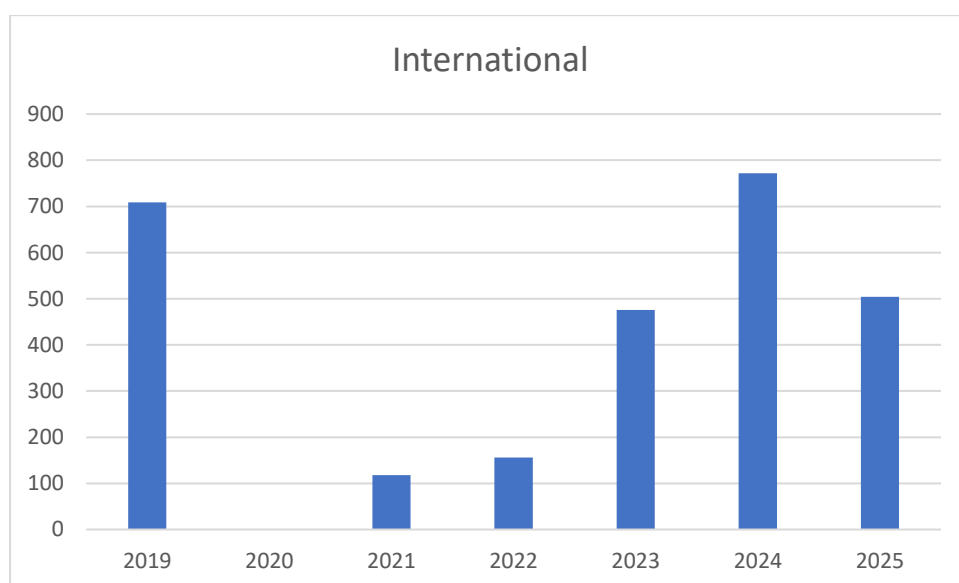


Fig. 29: Year Wise International Tourist Population

Source: Lower Subansiri District Tourism Office records, 2019-2025.

The 2023 domestic arrival figure of 2,04,994 is equivalent to approximately 561 visitors per day averaged across the year. During the Music Festival fortnight (late September), this daily equivalent would be several thousand — far exceeding the Provisional TCC of 300–500 visitors/day for heritage core zones established in Chapter 11.

4.11.2 Natural Attractions

The natural attractions of **Ziro Valley** are not merely scenic backdrops but are active components of the Apatani cultural landscape, often holding sacred or functional significance. While these sites possess high tourism value for activities such as trekking, birdwatching, and paragliding, field observations reveal a consistent lack of basic visitor infrastructure and site management frameworks. The following table catalogs these key natural assets alongside the critical infrastructure and service gaps identified during primary research. The relevant information is summarised in Table 37.

Site	Description and Location	Tourism Value	Current Gaps
Pamu Yalang (Hawk Stone)	Sacred rock at Dolo Mando hill (1,828 m); panoramic viewpoint of the entire valley; hilltop meadow; adjacent Mando Katu (1,864 m) suitable for paragliding; connected by Sibe–Pamu Yalang heritage trek (7 km).	High — panoramic views, trekking, paragliding potential	No interpretation boards; no toilet; poor access road; no waste bins
Seeh Lake	High-altitude lake in forested setting; birdwatching; tranquil natural landscape.	Moderate — natural serenity; low visitor load	Undeveloped; no facilities or signage
Pine Grove	Planted pine forest near Hapoli; leisure walks, photography, picnics.	Moderate	Littering; unmanaged visitor flow; no waste infrastructure
Bamboo Corridors	Traditional bamboo groves lining inter-village pathways; iconic Apatani landscape feature.	High — visual heritage character	Encroachment by concrete construction; bamboo thinning
Kele River Banks	Scenic river corridor; supports paddy-fish irrigation; angling potential.	Moderate	Waste dumping; erosion from informal foot trails; no access management

Table 37: Profile of Key Natural Attractions and Operational Gaps in Ziro Valley

Source: Lower Subansiri District Tourism Office records; field survey; UNESCO World Heritage Centre (2014).

4.11.3 Cultural and Heritage Sites

The cultural identity of Ziro Valley is physically manifested through its unique "living heritage" sites, which represent the sedentary civilisation of the Apatani people. These assets comprise both the "active" working landscapes of the paddy-fish fields and the distinct architectural typologies that facilitate the community's social and spiritual governance. Central to the valley's UNESCO **Outstanding Universal Value (OUV)**, these sites are not merely historical relics but remain integral to the daily socio-cultural rhythm of the eight traditional settlements. The relevant information is summarised in Table 38.

Site	Description	Heritage Significance
Hong Village	Best-preserved Apatani settlement; bamboo-pine houses, Lapang halls, Nago granaries; endpoint of Talley Valley Trek (4 days, 32 km).	Critical — UNESCO OUV core exemplar; primary heritage tourism destination
Old Ziro	Traditional settlement ~6 km from Hapoli; authentic Apatani street-level urban fabric intact.	High — buffer zone heritage character
Paddy-Fish Fields (all villages)	Active working cultural landscape across all eight settlements; the foundation of the UNESCO nomination.	Critical — UNESCO OUV basis; entire valley scope
Lapang (Community Halls)	Traditional ceremonial and social gathering structures in each village.	Medium-High — intangible social heritage
Nago (Sacred Ceremonial Structure)	Bamboo structure with central ritual pillar; central to Myoko festival rites performed by Apatani clans.	High — spiritual and ceremonial heritage; misidentified as granary in popular sources
Ranthii (Sacred Groves)	Biodiversity-rich groves maintained through Donyi-Polo religious observance.	High — ecological and spiritual heritage

Table 38: Inventory and Heritage Significance of Cultural Assets in Ziro Valley

Source: UNESCO World Heritage Centre (2014); field survey; Bamin and Gajurel (2015); Hilaly (2018).

4.11.4 Religious Sites

Beyond its indigenous Apatani cultural assets, Ziro Valley encompasses significant religious landmarks that have become major drivers for domestic pilgrimage tourism. These sites, often located within ecologically sensitive forest zones, highlight a unique intersection where natural formations are integrated into the valley's spiritual landscape. The following profile details the primary religious site

that contributes to the valley's growing national profile as a destination for both devotees and nature enthusiasts. The relevant information is summarised in Table 39.

Site	Description	Significance
Siddheshwarnath Temple / Shivalinga — Kardo Forest	Located in Kardo Forest near Hapoli at ~1,780 m elevation. Houses what is described as the world's largest natural Shiva Linga — 25 feet tall, 22 feet in circumference. Discovered on 14 July 2004 (Shravan month). Stone engravings of Parvati and Kartikeya (right), Ganesha (left with leftward trunk), Nandi and Ganga at base. No built temple structure — the linga sits in natural forest with a havan kund, well, and bells.	Listed on Lower Subansiri District Government official website; growing regional and national pilgrimage significance; significant draw for religious tourists and nature enthusiasts

Table 39: Profile and Significance of Religious Sites in Ziro Valley

Source: District tourism records; field survey; UNESCO World Heritage Centre (2014).

4.11.5 Eco-tourism and Adventure Sites

Ziro Valley's appeal extends beyond its sedentary cultural core into the surrounding temperate forests and high-altitude wilderness. This diverse range of eco-tourism and adventure assets provides a critical buffer for the valley, offering opportunities for biodiversity conservation, active recreation, and contemporary cultural expression. From the dense, species-rich canopy of the **Talley Valley Wildlife Sanctuary** to the globally recognized **Ziro Music Festival**, these sites define the valley's reputation as a premier destination for sustainable and experiential tourism. The relevant information is summarised in Table 40.

Site / Route	Description	Activity Details
Talley Valley Wildlife Sanctuary (~337 sq. km)	Eastern Himalayan biodiversity; conifers, indigenous bamboo, grasslands, Tragopan pheasant, rare butterflies; snow-clad mountain backdrop.	Talley Valley Trek: 4 days, 32 km; Manipolyang → Taria tabe khoke pass → Pange River → Talle Valley → Labya penggo pass (2,725 m) → Hong Village.
Sibe to Pamu Yalang Trek	Heritage route once used for forest resource collection; soft trek through forest and hillside.	7 km; 4–5 hours; Sibe village → Tado Lambia lake → Dip Putu hill → aged sacred pine (Dip Piisa) → Hija village.
Hakhe-Tari Trek	Soft trek; waterfall on Pange River; orchids, butterflies, migratory birds (September peak).	3–4 hours; suitable for all ages; rafting potential on Pange River.

Site / Route	Description	Activity Details
Dusu-Kattu Trek	Moderate; highest valley viewpoint at 2,450 m; dense forest and spring blossoms.	9.4 km; 10–11 hours; starts from Hari village.
Tarin Fish Farm / Integrated Aqua Park	Government fish hatchery and aquarium; educational; family-friendly.	Self-guided; year-round.
Ziro Music Festival Site	Open-air eco-festival; annual September (since 2012; 11th edition 2024); national and international artists.	4-day event; peak season; primary tourist attraction.
Ziro Butterfly Park	Butterfly conservation and observation; near Hapoli.	Year-round; growing interpretation potential.
Heritage Park and Botanical Garden	Resort, café, museum, park, gaming zone — multi-function leisure complex.	Year-round; moderate footfall.
Tale Camp	~30 km from Ziro; wilderness camping; Talley Valley trek approach.	Camping base; low footfall.

Table 40: Profile of Eco-tourism and Adventure Sites in Ziro Valley

Source: District tourism records; Talley Valley Wildlife Sanctuary records; field survey.

4.12 Governance Profile

Governance in **Ziro Valley** is characterized by a unique "Co-Governance" model, where the formal administrative machinery of the state operates alongside deeply rooted traditional institutions. This dual system ensures that while modern regulations—including urban planning and building bylaws—are implemented, the community's cultural integrity and ancestral land rights are respected through traditional village councils.

4.12.1 Administration

The administrative framework is designed to manage the transition of Ziro Valley from a rural plateau to a significant urban and tourism node. Governance is centralised in Hapoli (Ziro Sadar), which serves as the district headquarters.

4.12.2 Administrative Structure

The administration follows a standard bureaucratic hierarchy, ensuring that state policies are implemented from the district level down to individual village clusters. The relevant information is summarised in Table 41.

Level	Unit	Head of Office
District	Lower Subansiri	Deputy Commissioner (DC)
Sub-Division	Ziro	ADC / EAC
Circle	Ziro Sadar / Old Ziro	Circle Officer (CO)
C.D. Block	Ziro-I / Hong-Hari	Block Development Officer (BDO)

Table 41: Administrative Hierarchy of Ziro Valley

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Lower Subansiri district administration records.

4.12.3 Key Departments

Several specialized departments manage the valley's growth. While the **Town Planning Department** oversees the implementation of the *Arunachal Pradesh Building Bye-laws 2019*, other departments play equally critical roles in governance.

The following table categorizes the primary departments operating within the valley core (Ziro Sadar and Old Ziro) based on their functional roles. The relevant information is summarised in Table 42.

Category	Department Name	Primary Functional Area in Ziro
Executive	District Administration (DC Office)	General administration, revenue, land records, and inter-departmental coordination.
	ICDS (Integrated Child Development Services)	Management of the 104 Anganwadi centers and maternal/child nutrition.
Engineering	PWD (Public Works Department)	Maintenance of major district roads and government buildings.
	PHED (Public Health Engineering)	Management of the stream-based water supply and Water Treatment Plants .
	RWD (Rural Works Department)	Construction and maintenance of rural village connectivity roads.
	Power / Electrical Department	Management of the 33/11 KV sub-stations and distribution transformers.
	WRD (Water Resources Department)	Management of irrigation channels and flood control measures.
Natural Resources	Forest Department	Protection of Talley Valley Wildlife Sanctuary and management of Sacred Groves.
	Agriculture Department	Support for traditional Paddy-cum-Fish cultivation systems.
	Horticulture Department	Development of the Kiwi and Apple sectors and temperate fruit nurseries.

Category	Department Name	Primary Functional Area in Ziro
	Fisheries Department	Support for inland fish production in village ponds and paddy fields.
Social Services	Department of Education	Oversight of both government and private elementary and secondary schools.
	Health & Family Welfare	Management of the District Hospital, Ziro , and rural sub-centres.
	Disaster Management (DMMO)	Handling emergency responses for floods, landslides on NH-13 , and fire accidents.
Economic	Department of Tourism	Regulation of homestays, tour guides, and Swadesh Darshan projects.
	Department of Industries	Support for MSMEs, handicrafts, and Udyam-registered units.
	Economics & Statistics	Data collection for the District Statistical Handbook and census updates.
Safety	Police Department (SP Office)	Maintenance of law and order, traffic management, and women's safety.

Table 42: Departmental Framework and Responsibilities

Source: Government of Arunachal Pradesh departmental records; District Statistical Handbook of Lower Subansiri District 2022-23.

4.12.4 Local Self-governance

Ziro Valley utilizes a hybrid model of local governance that balances modern democracy with indigenous tradition.

- **Panchayati Raj Institutions (PRI):** Statutory local governance follows the *Arunachal Pradesh Panchayati Raj Act*, managing rural development schemes and local funding.
- **The Bulyañ System:** This is the traditional council of elders. Each village has its own Bulyañ that functions through social consensus rather than punitive legal sanctions. They are the primary decision-makers for land use, resource management (such as the Aji bamboo channels), and conflict resolution.
- **Village Hierarchy:** Settlements are traditionally organized by surnames, where people of the same surname live in specific sub-villages (e.g., the Niiti cluster in Hong or the Bamin-Michi cluster in Diibo).

4.12.5 Law and Order Administration

The safety of residents and the high volume of seasonal tourists is managed by the District Police. The **Ziro Sadar Police Station** acts as the primary hub, supported by specialized units for traffic and women's safety. The relevant information is summarised in Table 43.

Unit	Total Personnel
SP (HQ) Ziro	60
Sadar Police Station	36
Traffic Cell	14
Women Police Station	11

Table 43: Police Personnel and Infrastructure (Ziro Core)

Source: District police records; District Statistical Handbook of Lower Subansiri District 2022-23.

4.12.6 Judiciary

The judicial framework in the valley is dual-track:

1. **Formal Judiciary:** Matters of criminal law and significant civil disputes are handled by the District & Sessions Court.
2. **Customary Law:** Under the *Arunachal Pradesh Amending Act*, traditional village authorities—specifically **Gaon Buras** and the **Bulyañ**—resolve local civil and land disputes according to Apatani customary laws.

4.12.7 Schemes and Programmes

Governance is often delivered through targeted development programmes that emphasize the valley's "Cultural Landscape". The relevant information is summarised in Table 44.

Framework	Key Provisions	Relevance to Ziro
UNESCO "Five Cs" Strategy (Credibility, Conservation, Capacity-building, Communication, Communities)	Global standard for World Heritage site management; community integration requirement	Directly applicable to Tentative Listing management and nomination advancement
AP Tourism Policy	State-level mandate for responsible, community-integrated tourism development	Lacks a site-specific Ziro Valley implementation plan

Framework	Key Provisions	Relevance to Ziro
AP Building Bylaws 2019	FAR maximum 1.75; height regulations; setback norms	Legally operative but poorly enforced in heritage cores
National Building Code 2016 (IS 1893)	Seismic Zone V construction standards; ductile detailing requirements	Adaptation to traditional bamboo-pine systems is the critical planning gap
Swadesh Darshan Scheme	Tourism infrastructure funding: trekking trails, wayside amenities, eco-circuits	Partially implemented in Ziro; not integrated with community utility grid
Swachh Bharat / MGNREGA	Village sanitation, solid waste, community assets, rural livelihoods	Implemented in silos; coordination failure identified
Biological Diversity Act, 2002	Protection of biodiversity heritage sites; community biodiversity registers	Relevant to formal recognition of Ranthii Sacred Groves

Table 44: Schemes and Programmes

Source: District Statistical Handbook of Lower Subansiri District 2022-23; Government of Arunachal Pradesh scheme records.

CHAPTER 5: ANALYSIS, FINDINGS, POTENTIAL AND CHALLENGES

This chapter synthesizes the core analytical outputs of the study, moving from observed spatial changes to the development of specific planning metrics. By establishing a data-driven baseline through Land Use Land Cover (LULC) analysis, the Natural Sensitivity Index (NSI), and Carrying Capacity calculations, we can identify the critical thresholds for sustainable development in Ziro Valley.

5.1 Findings

The analytical findings of this study establish a quantitative link between Ziro Valley's rapid physical expansion and the declining health of its core agro-ecological assets.

5.2 Infrastructure Service Gap

The baseline assessment of Ziro Valley reveals significant friction between the existing utility framework and the escalating demands of both the permanent resident population and seasonal visitors. Through a synthesis of household surveys, tourist questionnaires, and on-ground field observations, specific deficits have been identified across critical infrastructure sectors. These gaps not only impact the quality of life for the Apatani community but also act as the primary binding constraints on the valley's Effective Carrying Capacity (ECC). The relevant information is summarised in Table 45.

Sector	Gap Identified	Evidence Source
Water Supply	Demand exceeds supply during peak festival season; 41.9% of households report scarcity with no tourist load	Household survey; PHED stakeholder interview
Solid Waste Management	32.6% informal disposal; zero tourist waste infrastructure at any village node	Household survey; field observation
Public Sanitation	Complete absence of public toilet facilities at all seven major tourist nodes	Field survey; tourist survey (57% inadequate)
Mobility and Transport	No inter-village public transport; single road causing congestion; no pedestrian or cycling infrastructure	Tourist survey (71.4% congestion); field observation
Internet and Power	Internet satisfaction 3.10/5 — lowest rated; power outages during festivals	Tourist survey; household interviews

Sector	Gap Identified	Evidence Source
Heritage Conservation	No conservation fund; no material standards enforcement; no interpretation infrastructure at any site	Field observation; government scheme review

Table 45: Sector-wise Infrastructure Deficits and Service Delivery Gaps in Ziro Valley

Source: Primary household survey; tourist survey; field observations; PHED, PWD/RWD and district department records.

5.3 LULC Change (2011-2025)

Analysis of Landsat 8 satellite imagery reveals that Ziro Valley is undergoing an irreversible transition from an organic cultural landscape to a densifying urban node.

- **Urban Proliferation:** A **56.3% decadal growth rate** in built-up area was recorded between 2011 and 2021, primarily characterized by the substitution of vernacular bamboo-pine structures with reinforced concrete (RCC).
- **Thermal Trajectory:** This densification has induced an **Urban Heat Island** effect, with a documented **1°C mean temperature rise** over the last decade. This shift threatens the precise water-temperature requirements of the paddy-cum-fish system.
- **Agro-Cultural Contraction:** The primary paddy-fish fields—the core of the UNESCO nomination—are actively receding at the urban fringes of Hapoli and along the NH-13 road corridor.
- **Forest Interface Erosion:** Declining green cover at the settlement margins indicates that the **Ranthii Sacred Groves** are increasingly under pressure from spontaneous housing extensions.

The relevant information is summarised in Table 46.

Land Use Category	Observed Trend 2011–2025	Planning Implication
Agricultural — Paddy-fish fields	Declining at urban margins and road corridors	Direct threat to UNESCO OUV — paddy-fish fields are the core cultural landscape element and must be protected from encroachment

Land Use Category	Observed Trend 2011–2025	Planning Implication
Built-up Area	Expanding — 56.30% decadal growth (1991–2011); concrete replacing bamboo-pine	Heritage zoning with FAR enforcement required before further irreversible loss
Forest and Green Cover	Declining at urban-forest interface; Ranthii Sacred Groves under pressure	Biodiversity loss and heat island effect; formal planning protection required
Barren / Degraded Land	Increasing at construction sites and disturbed slopes	Earthwork regulation; mandatory revegetation conditions on permits
Water Bodies — Kele River basin	Under stress from sediment runoff and riparian encroachment	30-metre no-build riparian buffer essential; water quality audit required

Table 46: Land Use Land Cover (LULC) Change Analysis (2011-2025)

Source: USGS Landsat imagery (2011 and 2025); Bhuvan/NRSC base layers; QGIS LULC classification.

The related visual is shown in Fig. 30.

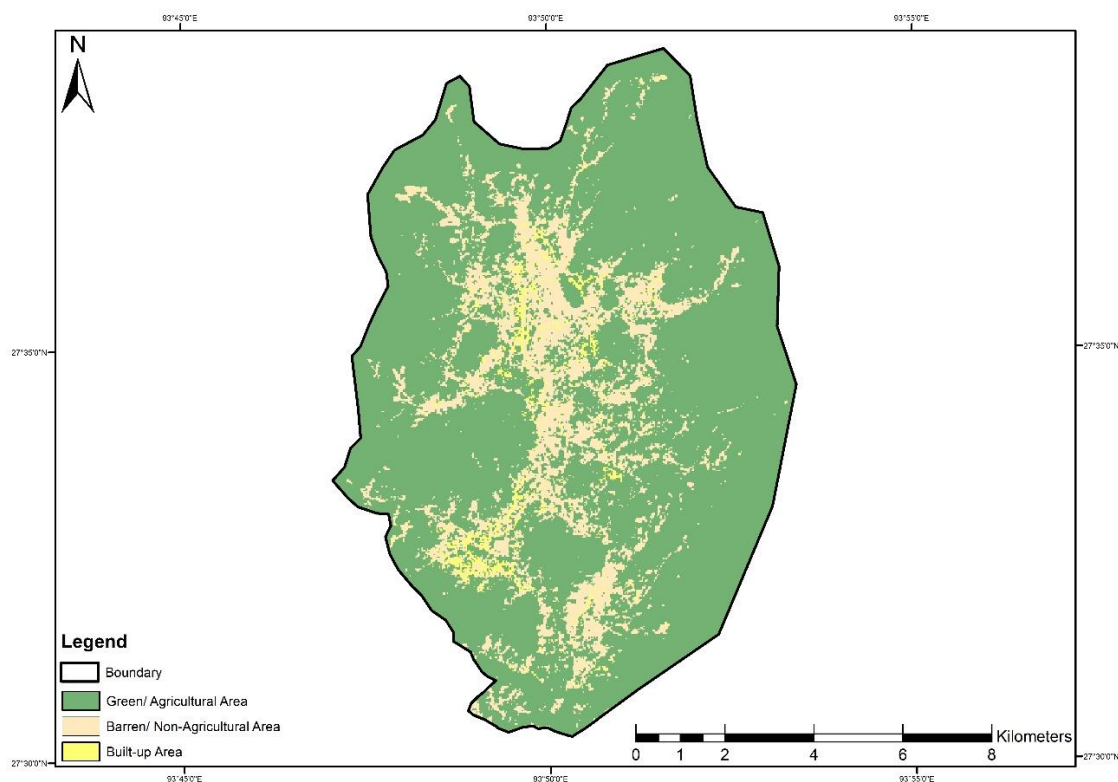
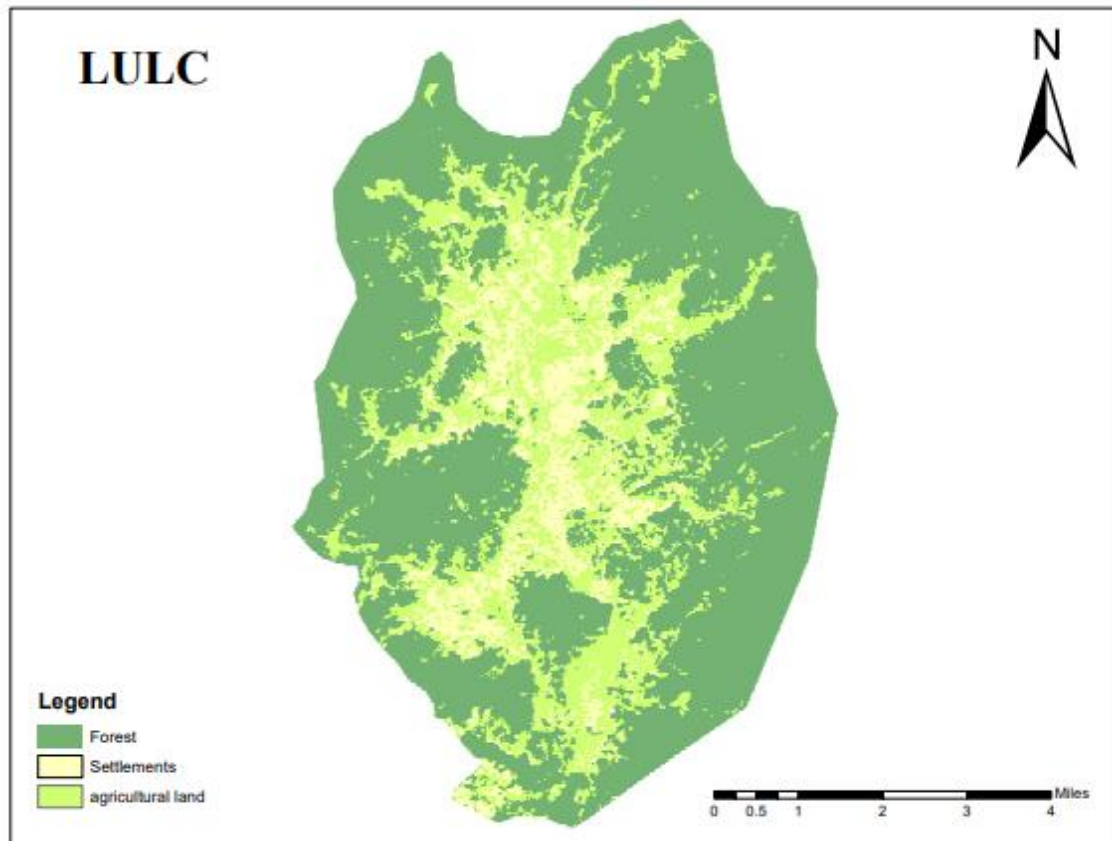


Fig. 30: LULC 2011 & LULC 2025

Source: USGS Landsat imagery (2011 and 2025); Bhuvan/NRSC base layers; QGIS LULC classification.



5.4 Natural Sensitivity Index (NSI)

The spatial sensitivity of Ziro is driven by several interconnected physical and social problems identified during the research:

- **Hydrological Interconnectivity:** The valley's exceptionally flat terrain ensures that any pollutants or solid waste discarded in "Very High" (red) zones flow instantly through the entire gravity-fed Aji bamboo network, contaminating downstream paddy-fish plots.
- **Seismic Dead-Load Risk:** As a Seismic Zone V region, the "High" and "Very High" zones sit on poorly consolidated alluvial soils. The shift of 25.6% of households to heavy concrete frames creates a brittle failure risk that traditional bamboo-pine frames (which sway during tremors) avoid.
- **Irrigation Sedimentation:** Construction runoff in riparian zones chokes the 10–15 cm bamboo irrigation pipes. The NSI Orange and Red zones identify where earthwork must be strictly regulated to prevent the collapse of the Aji-nyyii ecosystem.

- **Spring-Level Stress:** Despite being a high-rainfall area, 41.9% of households report water scarcity. This confirms the valley's natural springs are operating at peak capacity and cannot support high-intensity infrastructure in orange or red zones.
- **Spontaneous Settlement Proliferation:** New settlements emerging every two years erode the natural buffers between forests and village cores. The NSI Moderate (Tan) zone identifies the "last line of defence" to prevent further loss of the cultural landscape.

The NSI was developed as a spatial decision-support tool to classify the valley floor and surrounding slopes based on their inherent ecological vulnerability.

Methodology and Scoring Logic: The index was constructed using a Multi-Criteria GIS Spatial Overlay in QGIS. Each of the following five parameters was assigned a weighted value to generate a composite sensitivity score ranging from 0.0 to 10.0:

- **Slope Gradients:** Higher scores assigned to slopes above 20° to identify landslide risk.
- **Proximity to Kele River:** Buffers were established to protect the primary hydrological spine.
- **Forest Density:** Evaluation of primary forest versus degraded secondary growth.
- **LULC Classification:** Ranking land types from highly sensitive (paddy-fish) to low sensitivity (Hapoli urban core).
- **Proximity to Paddy-Fish Fields:** Protection zones established for the irrigation network.

Based on the composite scoring and visual output of the NSI map, the valley is divided into five specific planning zones:

The relevant information is summarised in Table 47.

NSI Category	Map Color	Score Range	Key Features	Planning & Development Mandate
Very High	Red	8.5–10.0	Kele River core,	Strict Preservation:

NSI Category	Map Color	Score Range	Key Features	Planning & Development Mandate
			primary paddy-fish plots, and Sacred Groves .	Zero new built-up area; guided scientific access only.
High	Orange	7.0–8.4	Stream buffers and traditional settlement cores of Hong, Hari, and Bulla.	Heritage Conservation: Mandatory G+1 height limit ; vernacular construction only.
Moderate	Tan	4.0–6.9	Forest-settlement interface; secondary agricultural margins.	Controlled Growth: Controlled non-motorized trails; certified homestay expansion only.
Low	Green	2.0–3.9	Semi-urban fringes and established road corridors.	Sustainable Development: Standard master plan enforcement with mandatory green buffers.
Very Low	Pale Green	< 2.0	Hapoli urban core and established institutional zones.	Urban Densification: Standard AP Building Bye-laws (FAR 1.75) applied with drainage standards.

Table 47: Refined Five-tier Natural Sensitivity Index (NSI) Classification and Land Use Mandates

Source: USGS Landsat imagery; SRTM DEM; Bhuvan/NRSC hydrology layers; Dutta et al. (2017); Das and Anku (2020); field verification.

The related visual is shown in Fig. 30.

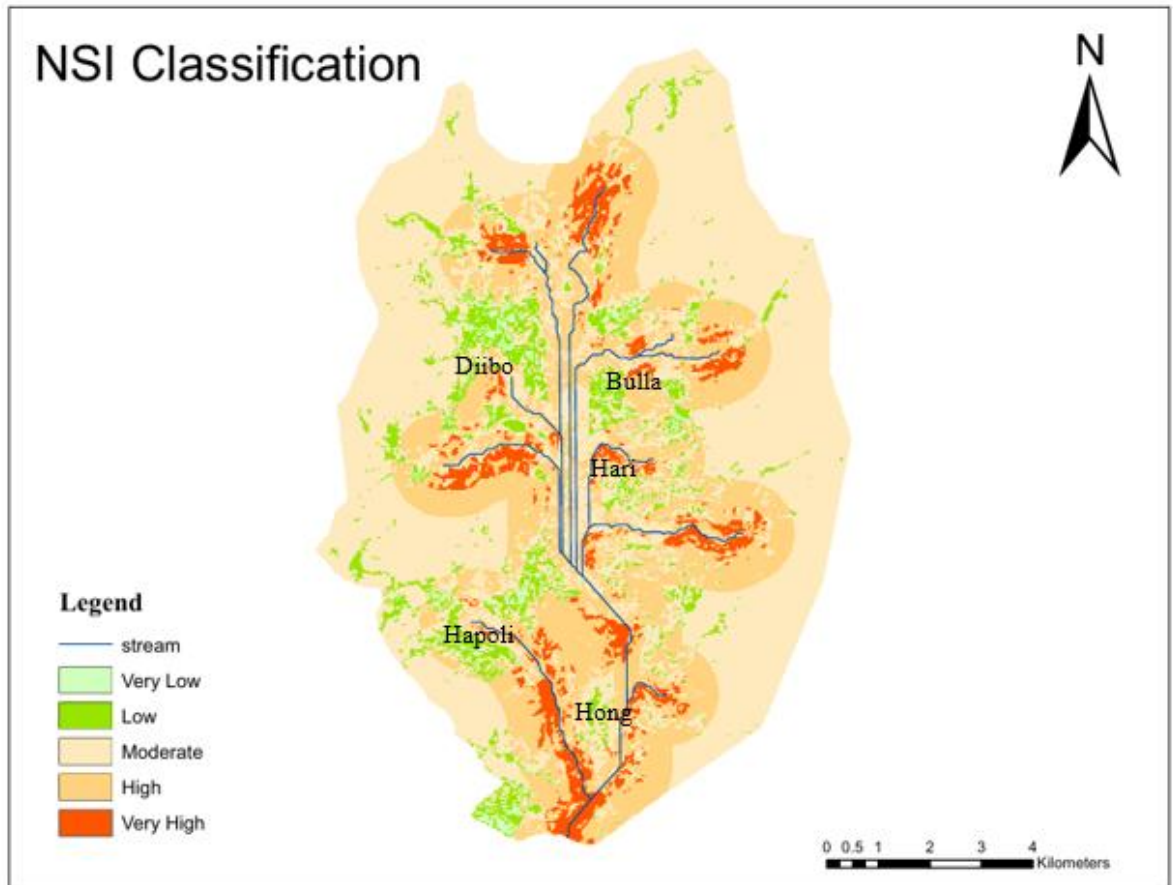


Fig. 30: NSI Classification Overlay Map

Source: USGS Landsat imagery; SRTM DEM; Bhuvan/NRSC hydrology layers; QGIS NSI overlay analysis.

5.5 Tourist Carrying Capacity

Tourist Carrying Capacity (TCC) determines the maximum number of visitors a destination can accommodate without causing unacceptable environmental, social, or infrastructural damage. Given the 7,832 per cent surge in domestic arrivals in 2023, the establishment of a provisional TCC is the most urgent planning imperative for Ziro Valley.

5.6 Types of Carrying Capacity

The calculation of **Tourist Carrying Capacity (TCC)** is a fundamental requirement for the sustainable management of Ziro Valley, particularly following the unprecedented **7,832% surge** in domestic arrivals recorded in 2023. This framework provides a data-driven method to determine the maximum number of

visitors the valley can accommodate without causing irreversible damage to the Apatani cultural landscape or the collapse of local utility networks.

The following table establishes the multi-stage methodology used to derive a realistic regulatory threshold for the valley's sensitive heritage zones. The relevant information is summarised in Table 48.

Type	Definition	Binding Variable in Ziro
Physical Carrying Capacity (PCC)	Maximum number of visitors a site can physically contain based on available space and space standard per visitor	Space in heritage village cores and designated tourist sites
Real Carrying Capacity (RCC)	PCC adjusted downward for ecological sensitivity, seasonal hazard, and safety constraints through correction factors	NSI Zone 1 sensitivity; monsoon season; peak demand concentration
Effective/Permissible Carrying Capacity (ECC)	RCC further reduced by actual management capacity — water supply, waste infrastructure, staffing, interpretation	Water supply and waste management are the binding constraints under current conditions

Table 48: Multi-stage Tourist Carrying Capacity Framework and Site-specific Constraints for Ziro Valley

Source: UNWTO carrying-capacity framework; Lower Subansiri tourism records; primary survey; NSI analysis.

5.7 Physical Carrying Capacity (PCC)

The **Physical Carrying Capacity (PCC)** represents the first stage of the carrying capacity assessment, establishing the absolute spatial threshold of Ziro Valley's primary tourist zones. By calculating the theoretical maximum number of visitors each site can physically accommodate based on its square footage and a defined "comfort standard" per person, we establish the upper limit before ecological and infrastructure constraints are applied.

The calculation utilizes the standard planning formula:

Formula: $PCC = (\text{Area Available for Tourism} \times \text{Rotation Factor}) / \text{Space Standard per Visitor}$

Where the **Space Standard** is adjusted based on the site's sensitivity—for example, more space is allotted per visitor in the fragile paddy-fish ecosystems (15 sq. m) compared to established viewpoints like Pamu Yalang (4 sq. m).

The relevant information is summarised in Table 49.

Village / Tourist Zone	Tourism Area (sq. m)	Space Standard (sq. m/visitor)	Rotations/Day	PCC (visitors/day)
Hong Village Heritage Core	~18,000	10 (heritage sensitivity applied)	2 (AM and PM slots)	3,600
Old Ziro (Ziro Putu) Core	~12,000	10	2	2,400
Paddy-Fish Field Viewing Paths	~5,000 (designated paths only)	15 (fragile living ecosystem)	1 (guided access only)	333
Pamu Yalang Viewpoint	~800	4	3	600
Siddheshwarnath Temple, Kardo	~2,000	5	2	800
TOTAL VALLEY PCC	—	—	—	~7,733

Table 49: Calculated Physical Carrying Capacity (PCC) by Tourist Zone

Source: UNWTO carrying-capacity framework; GIS-measured tourist-zone areas; Lower Subansiri tourism records.

5.8 Real Carrying Capacity (RCC) with Correction Factors

The **Real Carrying Capacity (RCC)** represents the second tier of the assessment, moving beyond theoretical spatial availability to incorporate the specific environmental and safety constraints of Ziro Valley. While the Physical Carrying Capacity (PCC) establishes a maximum spatial limit, it does not account for the fragile state of the **Apatani agro-ecosystem** or the extreme seasonal variability of the Himalayan climate.

To derive a realistic threshold, the PCC is adjusted downward using three specific **Correction Factors (Cf)**. These factors ensure that the resulting visitor limit protects high-sensitivity ecological zones, accounts for the massive surges during festival periods, and maintains safety standards during the heavy monsoon season.

The RCC is calculated by applying a chain of reduction factors to the theoretical spatial maximum:

$$\text{Formula: } \text{RCC} = \text{PCC} \times (1 - \text{Cf1}) \times (1 - \text{Cf2}) \times (1 - \text{Cf3})$$

18 Cf1 — Ecological Sensitivity: Paddy-fish zones and Kele River riparian areas score in the highest NSI bracket. Cf1 = 0.30 (30% reduction).

19 Cf2 — Seasonal Concentration: The September–October festival period concentrates over 40% of annual visitors into two months, meaning non-peak infrastructure must be sized for peak demand. Cf2 = 0.20 (20% reduction).

20 Cf3 — Monsoon and Precipitation Safety: Monsoon conditions (June–September) create hazardous trail surfaces; applied as an annual average safety adjustment. Cf3 = 0.10 (10% reduction).

Calculation Results

Applying these constraints to the total valley PCC:

$$\text{RCC} = 7,733 \times (1 - 0.30) \times (1 - 0.20) \times (1 - 0.10)$$

$$\text{RCC} = 7,733 \times 0.70 \times 0.80 \times 0.90$$

$$\text{RCC} \approx 3,902 \text{ visitors/day (Recommended spatial upper limit)}$$

5.9 Effective Carrying Capacity (ECC)

The **Effective Carrying Capacity (ECC)** serves as the ultimate "reality check" for Ziro Valley's tourism development. While spatial calculations suggest the valley can physically accommodate thousands of visitors, the ECC filters those numbers through the actual operational capabilities of local utilities. In Ziro, the capacity to host is currently dictated by the two most critical bottlenecks identified during fieldwork: **water supply reliability** and the total absence of **formal solid waste infrastructure**.

Water-Based ECC

Water supply under normal conditions shows a modest surplus under the AP Building Bylaws 2019 norm (100 lpcd). However, household survey data (41.9% of households experiencing festival-period water scarcity) and PHED stakeholder interviews confirm that supply reliability is inconsistent — the surplus is not dependably available year-round. The relevant information is summarised in Table 50.

Parameter	Value / Basis	Source
Estimated daily water supply (non-festival period)	~1,500,000 litres/day	PHED Ziro (stakeholder estimate — to be verified by independent audit)

Parameter	Value / Basis	Source
Daily water requirement per resident (AP Building Bylaws 2019 norm)	100 lpcd (litres per capita per day)	Arunachal Pradesh Building Bye-Laws 2019 — hill town standard
Estimated permanent resident population	~15,000 persons (Hapoli + surrounding villages)	Census 2011 base + estimated decadal growth
Water required for residents (daily)	$15,000 \times 100 \text{ lpcd} = 15,00,000$ litres/day	Calculated from AP Building Bylaws 2019 norm
Water surplus available for tourist use	~5,00,000 litres/day (estimated)	Derived — supply exceeds resident demand; water not the binding constraint
Daily tourist water requirement (short-stay norm)	45 lpcd (short-stay visitor norm)	UNWTO tourism planning standard

Table 50: Parameters and Findings for Water-based Effective Carrying Capacity (ECC) Calculation

Source: PHED water-supply norms and records; primary household survey; Lower Subansiri tourism records.

KEY FINDING: Under the AP Building Bylaws 2019 norm (100 lpcd), estimated daily supply of ~15 lakh litres marginally meets resident demand with a nominal surplus of ~5 lakh litres/day. However, festival-period scarcity reported by 41.9% of surveyed households confirms that supply reliability is the real constraint — not headline capacity. Waste disposal infrastructure (near-zero formal capacity) remains the binding ECC constraint.

Solid waste management is the most severe inhibitor of growth in the valley. With formal processing capacity currently at **near-zero**, every additional visitor contributes to the 18.6% of households currently forced into informal and ecologically harmful disposal methods, such as **open burning** or **dumping into the Kele River**.

- **Generation Rate:** Estimated at **0.5 kg/tourist/day**.
- **Binding Constraint:** The lack of tourist-specific waste infrastructure at any node means the current formal ECC is effectively zero.
- **Planning Prerequisite:** The establishment of the **Seven Decentralised Waste Hubs** (Proposal 3) is a mandatory condition for increasing the valley's carrying capacity.

Accommodation-Based ECC

Tourist carrying capacity in Ziro differs from a purely spatial calculation because the valley also has a limited lodging base. The official tourism records list accommodation

establishments and homestays, but the bed-level field inventory gives the more useful operational check for overnight tourism. The scanned hotel inventory records 26 accommodation establishments with an estimated usable bed stock of approximately 517 beds. Applying a conservative planning occupancy of 75 per cent and an average length of stay of two nights gives an accommodation-based ECC of about 194 overnight tourist arrivals per day. This does not replace the ecological or infrastructure-based TCC; it acts as a practical ceiling on overnight conversion during festival periods.

Formula: Accommodation ECC = (Bed stock × planning occupancy) ÷ average length of stay = (517 × 0.75) ÷ 2 ≈ 194 overnight tourist arrivals/day.

The relevant information is summarised in Table 51.

Parameter	Value Used	Planning Interpretation
Field accommodation inventory	26 accommodation establishments	Used for bed-level operating capacity check
Estimated usable bed stock	Approx. 517 beds	Derived from hotel/resort room and dormitory inventory
Planning occupancy factor	75%	Avoids assuming 100% operational occupancy
Average length of stay	2 nights	Festival and nature-tourism planning assumption
Accommodation-based ECC	Approx. 194 overnight tourist arrivals/day	Limits overnight visitor conversion unless registered homestay capacity is expanded and verified

Table 51: Accommodation-based Effective Carrying Capacity Check

Source: Lower Subansiri District Tourism Office accommodation inventory; primary homestay inventory, 2026.

5.10 Summary: Provisional Tourist Carrying Capacity

The following summary reconciles theoretical spatial limits with the current infrastructure deficit to establish a scientifically grounded **Regulatory TCC** for Ziro Valley.

The relevant information is summarised in Table 52.

Constraint Type	Calculated Value	Binding Constraint?
Physical Carrying Capacity (PCC)	~7,733 visitors/day	No — theoretical spatial maximum only
Real Carrying Capacity (RCC)	~3,902 visitors/day	Recommended spatial upper limit for long-term planning
Water-Based ECC (current infrastructure)	< 500 visitors/day (estimated)	YES — most binding current constraint

Waste-Based ECC (current infrastructure)	Near-zero formal capacity	YES — binding until DWH network is operational
Actual 2023 annual daily equivalent	~561 visitors/day (2,04,994 ÷ 365)	Already at or above the water-based ECC limit
Provisional Regulatory TCC (current state)	300–500 visitors/day for heritage core zones	Recommended for gazettelement; subject to infrastructure upgrade review
Accommodation-Based ECC (hotel-bed check)	Approx. 194 overnight tourist arrivals/day at 75% occupancy and 2-night average stay	YES — limits overnight conversion during festivals

Table 52: Summary Matrix of Calculated Carrying Capacities and Identified Binding Constraints

Source: UNWTO carrying-capacity framework; PHED records; tourism-office records; primary survey.

5.11 Agriculture

Agriculture in Ziro is not merely an economic sector but the foundational utility of the Apatani civilisation. The valley's rare flat terrain within the steep Himalayan foothills has allowed for a sophisticated agro-ecological system that has remained productive for centuries without chemical inputs.

5.12 Potentials

- **Irreplaceable Heritage Asset:** The permanent **paddy-cum-fish** cultivation system is the globally unique foundation for the UNESCO nomination.
- **Organic Circularity:** The system is naturally chemical-free, utilising fish waste as fertilizer and gravity-fed **Aji** channels for precise nutrient recycling.
- **High-Value Horticulture Node:** Ziro is a regional leader in temperate fruits, with an annual out-turn of **2,741 MT of Kiwi** and **17 MT of Apple** (2024–25 records).
- **Pedological Advantage:** Deep, well-structured alluvial soils (pH 5.5–6.5) with high organic matter offer a naturally high yield rate for rice at **3.60 MT per hectare**.

5.13 Challenges

- **Climate Instability:** A documented **1°C temperature rise** (2011–2021) and the **2024 heatwave** have already led to significant crop failure and income instability.
- **Hydrological Stress:** Erratic monsoon patterns directly threaten the water-intensive rice-fish system; **41.9% of households** report water scarcity during critical growth periods.
- **Arable Land Loss:** Spatial LULC trends confirm that agricultural land is receding as **RCC built-up area** expands at urban margins and road corridors.

5.14 Industry

The industrial profile of Ziro is currently transitioning from traditional subsistence crafts to a formalised MSME network. This shift is anchored in the valley's rich biological resources, allowing for localized value addition in sectors like fruit processing and sustainable aquaculture.

5.15 Potentials

- **Emerging MSME Sector:** The valley currently hosts **789 registered Udyam units**, with specialized processing facilities like **M/S Ziro Kiwi Wine**.
- **Aquaculture Hub:** The **Tarin Fish Farm** acts as a central hatchery, ensuring the steady supply of fingerlings required for the Aji-nyyii system.
- **Intangible Craft Economy:** A strong living tradition of cane, bamboo, and handloom weaving offers potential for an artisanal value chain linked to **heritage homestays**.

5.16 Challenges

- **Spatial Imbalance:** Industrial growth is heavily centralised in the Hapoli urban core, leaving rural village clusters with limited formal employment opportunities.
- **Skill Erosion:** As builders default to concrete, the master craftsmanship required for traditional **bamboo-pine architecture** is rapidly being lost.
- **Transport Vulnerability:** Periodic landslides on **NH-13** during the monsoon isolate the valley, disrupting the supply chain for industrial materials and exports.

5.17 Tourism

Tourism in Ziro represents a unique intersection between a "living cultural landscape" and a globally recognized hotspot for contemporary eco-tourism. While it serves as a powerful economic engine, its rapid growth presents a paradox between high visitor footfall and the ecological carrying capacity of the plateau.

5.18 Potentials

- **Exponential Inflow:** Domestic visitor arrivals surged from 2,583 (2022) to **2,04,994 (2023)**, highlighting the global strength of the Ziro brand.
- **Multi-Dimensional Appeal:** Ziro offers a unique mix of **Cultural Heritage** (Hong Village), **Adventure** (Talley Valley), and **Religious Tourism** (Siddheshwarnath Shivalinga).
- **Revenue Legitimacy:** **85.7% of surveyed tourists** expressed a willingness to pay a "Heritage Maintenance Surcharge," providing a path for self-funded conservation.

5.19 Challenges

- **The 90-Minute Visitor:** 19% of tourists arrive as day-trippers who consume infrastructure without generating overnight revenue, creating a "footfall without finance" crisis.
- **Experience Degradation:** **76.2% of tourists** felt that the proliferation of concrete buildings negatively impacted the cultural landscape.
- **Management Gaps:** An absence of public toilets at major nodes and **71.4% street congestion** reported by visitors threaten Ziro's long-term reputation.

5.20 Physical Infrastructure

Physical infrastructure in the valley functions as the utility spine that connects sedentary village life with modern service delivery. The challenge lies in expanding these networks to meet seasonal spikes without disrupting the traditional gravity-fed systems that have historically sustained the valley.

5.21 Potentials

- **Decentralised Water Governance:** Every settlement manages distinct hydrological sources (e.g., Siikhe, Supyu streams), allowing for **resilient, village-level utility grids**.
- **Renewable Access:** High solar exposure (max **11.87 hours** in June) suggests the potential for off-grid solar energy systems for rural villages and campsites.

5.22 Challenges

- **Drainage and Flooding:** The lack of a formal drainage master plan resulted in the **May 2025 urban floods** in Hapoli.
- **Unregulated Expansion:** New housing clusters emerge every two years without a formal master plan, placing unsustainable pressure on the stream-based water network.
- **Power Reliability:** Frequent outages occur during the monsoon season due to entangled wiring and the lack of underground cabling in sensitive areas.
- **Healthcare facilities, particularly hospital bed capacity and specialist services, remain below adequate standards for the resident population and seasonal tourist influx.**

5.23 Social Infrastructure

Social infrastructure in Ziro constitutes the institutional framework—including regional educational hubs and specialized healthcare—that supports the community's high standards of human development. Ensuring equitable access to these services is critical as the valley's demographic profile continues to modernize.

5.24 Potentials

- **High Human Capital:** A literacy rate of **81.06%** (significantly higher than the state average of 66.95%) provides a capable workforce for heritage management.
- **Regional Educational Node:** With **3 colleges** and **30 middle schools**, Ziro serves as a critical academic hub for central Arunachal Pradesh.

5.25 Challenges

- **Health Centralization:** 89% of hospital beds are concentrated in Hapoli, leaving the outer village settlements underserved for emergency care.
- **Disaster Vulnerability:** The compact, nucleated settlement pattern—where houses are built exceptionally close—creates a high risk of catastrophic fire spread.

5.26 Service Centres

Governance and service delivery in Ziro rely on a unique "Co-Governance" model where formal administrative units operate alongside indigenous councils. This dual system offers a powerful opportunity for culturally sensitive planning, provided that statutory policies and traditional norms can be effectively integrated.

5.27 Potentials

- **Administrative Alignment:** The 2024 bifurcation created a **Lower Subansiri administration** that is substantially co-terminus with the Apatani heartland.
- **Indigenous Co-Governance:** The **Bulyañ** (traditional council) remains an active and respected body for local land-use and resource management.

5.28 Challenges

- **The Silo Effect:** Developmental schemes (Swachh Bharat, MGNREGA, Swadesh Darshan) are often implemented independently without spatial coordination.
- **Byelaw Enforcement:** While statutory height and FAR limits exist (AP Building Bylaws 2019), they remain largely unenforced in the heritage village cores.

5.29 Conclusion

Ziro Valley's primary potential lies in its **living cultural heritage**, but this asset is currently being eroded by unplanned urban growth and infrastructure deficits.

Transitioning from "silo-based" administration to **integrated spatial planning** is essential to ensure Ziro's long-term resilience

CHAPTER 6: PROPOSALS

The proposals for Ziro Valley have been prepared as direct planning responses to the findings of the earlier chapters. The aim is not to add isolated tourist facilities, but to convert the analysis into implementable interventions that address specific problems and use identified potentials. The previous chapters established that Ziro Valley is facing increasing tourism pressure, weak visitor management, inadequate tourist infrastructure, ecological sensitivity around the Kele River and paddy-fish fields, pressure on heritage village cores, and uneven conversion of tourism into local income.

The proposal strategy follows the principle of “protect the sensitive landscape, develop only the service edge, and guide the visitor.” This means that high-sensitivity areas such as the Kele River, paddy-fish fields, forest edges and sacred groves are not treated as construction sites. Instead, infrastructure is proposed at road-accessible service edges such as Hapoli, Hong entry, Hari-Bulla entry, Seeh Lake, Pine Grove, Kardo and Talley/Pange entry. Visitor movement is controlled through planned circuits, guide systems, signs, interpretation panels, service nodes and permit-based access.

Section 4.4 showed that previous planning efforts in Ziro Valley have been fragmented and sector-specific. Tourism development, sanitation, road works, building regulation, heritage recognition and village-level works exist separately, but not as one integrated spatial planning framework. This chapter addresses that weakness by linking tourism management, infrastructure provision, heritage protection, livelihood generation and environmental control into one coordinated proposal package.

6.1 Sector-wise Proposal Arrangement

The proposals are arranged under four main sectors: Tourism, Agri, Industry and Infrastructure. This arrangement is used only to make the chapter easier to understand and defend. The content of the proposals remains integrated, because many interventions overlap across sectors. For example, the agri-tourism trail is placed under Agri because it protects the paddy-fish landscape, but it also supports tourism. Similarly, visitor service nodes are placed under Infrastructure because they provide toilets, water, waste and rest facilities, but they also improve tourist experience.

The Tourism sector addresses visitor movement, interpretation, circuits, homestays, guides and eco-adventure. The Agri sector focuses on the paddy-fish landscape and farmer-led tourism. The industry sector focuses on local produce, SHG income, craft,

packaging and market linkage. The infrastructure sector includes visitor service nodes, water, waste, access, drainage and heritage-sensitive built-form control.

6.2 Tourism Proposals

The tourism proposals respond to the tourism arrival trends, tourist-site inventory, carrying-capacity analysis and visitor-experience gaps identified earlier in the report. Table 44 should be interpreted by separating the COVID-disruption years from the normal tourism trend. The 2020–2022 period was affected by travel restrictions and therefore should not be used as a normal comparison period. For planning purposes, 2019 is treated as the pre-COVID baseline, while 2023 and 2024 are treated as the post-COVID tourism-pressure years. This comparison shows that Ziro’s tourism demand has not merely recovered after COVID, but has expanded far beyond the pre-COVID level, creating higher pressure on visitor movement, accommodation, water supply, waste management, roads and heritage village cores. Tables 45, 46 and 48 identified Ziro’s natural, cultural and eco-tourism assets. However, the analysis also showed that these assets are not organised into a managed visitor system. Therefore, the tourism proposals focus on structuring movement, improving interpretation, regulating adventure tourism, and strengthening community-based stay and guide systems.

6.2.1 Proposal 1: Tourist Circuit and Wayfinding System

This proposal comes directly from the tourism analysis in Chapter 4 and Table 44, which shows that Ziro has moved into a high-tourism phase. Tourist arrivals increased from 24,905 in 2019 to 2,05,470 in 2023, with 2024 also remaining high. This means that Ziro can no longer depend on informal tourist movement.

The proposal also uses the tourist-site inventory from Tables 45, 46 and 48. Table 45 identifies natural attractions such as Seeh Lake, Pine Grove, Kele River and Tarin Fish Farm. Table 46 identifies cultural assets such as Hong village, Nago/Lapang structures, traditional houses and Donyi-Polo cultural sites. Table 48 identifies eco-tourism and adventure potential around Talley Valley, Pamu Yalang/Dolo Mando and trekking routes. The issue is not that Ziro lacks tourist places. The issue is that these places are not organised into a planned visitor system.

At present, tourists move through Ziro based on informal advice, local drivers, social media or individual knowledge. This creates uneven tourist distribution, overcrowding

at known sites, unmanaged entry into village interiors and weak understanding of sensitive landscapes. Carrying-capacity control also becomes difficult because routes and entry points are not clearly defined.

This proposal uses Ziro's existing cultural, natural and adventure tourism potential. It connects already-existing sites instead of creating artificial attractions. This helps increase tourist stay duration and spreads tourism benefits across more settlements.

Planning Response

Three tourist circuits are proposed. The **Cultural Heritage Circuit** will connect Hapoli, Hong village, Nago/Lapang structures, paddy-fish field viewing edges, Donyi-Polo cultural sites and Hari-Bulla. The **Nature and Landscape Circuit** will connect Hapoli, Kele River edge, Tarin Fish Farm, Pine Grove, Seeh Lake and Kardo/Siddheshwarnath. The **Eco-Adventure Circuit** will connect Hapoli, Seeh Lake, Pamu Yalang/Dolo Mando and Talley/Pange entry. The related visual is shown in Fig.

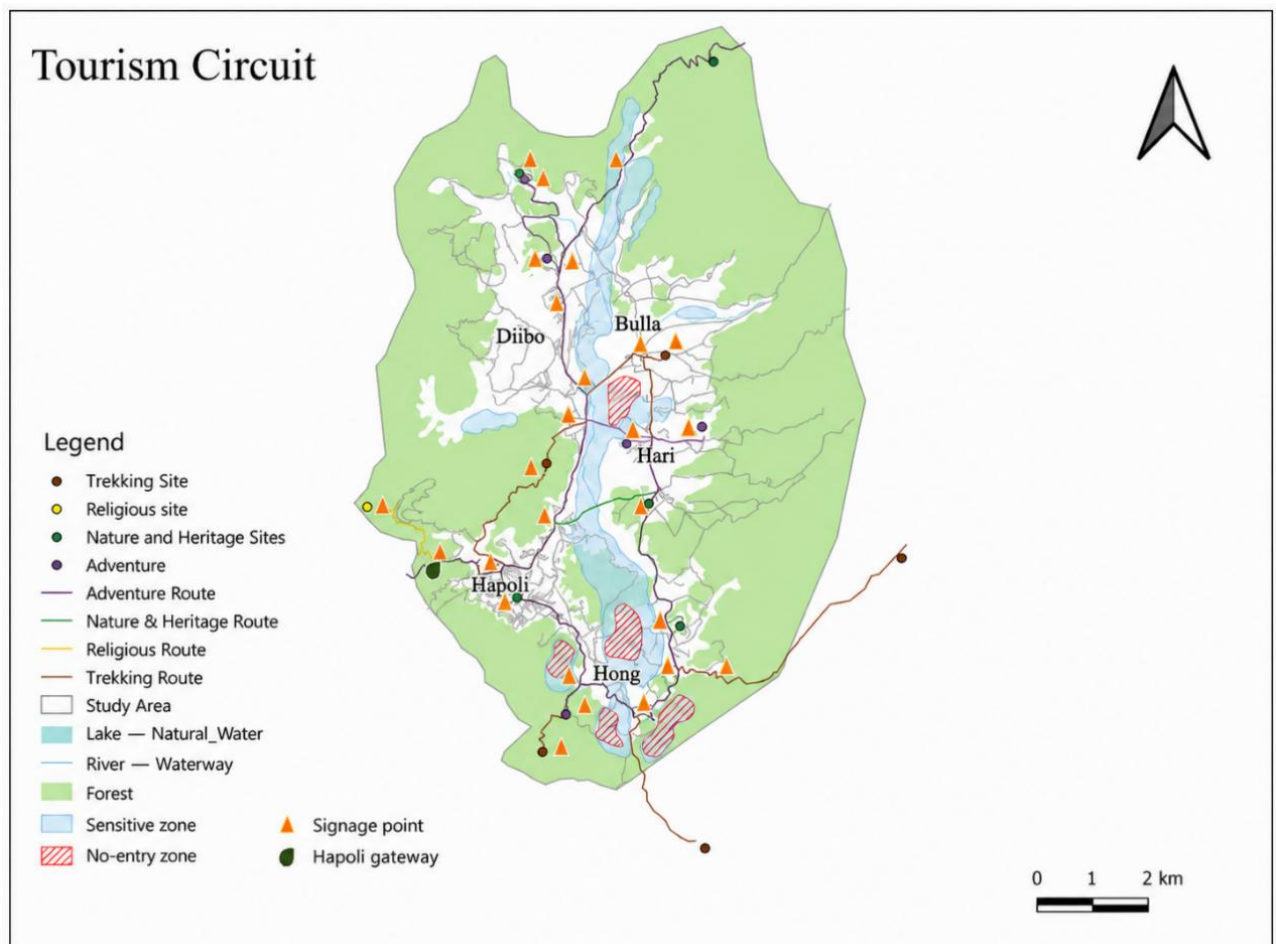
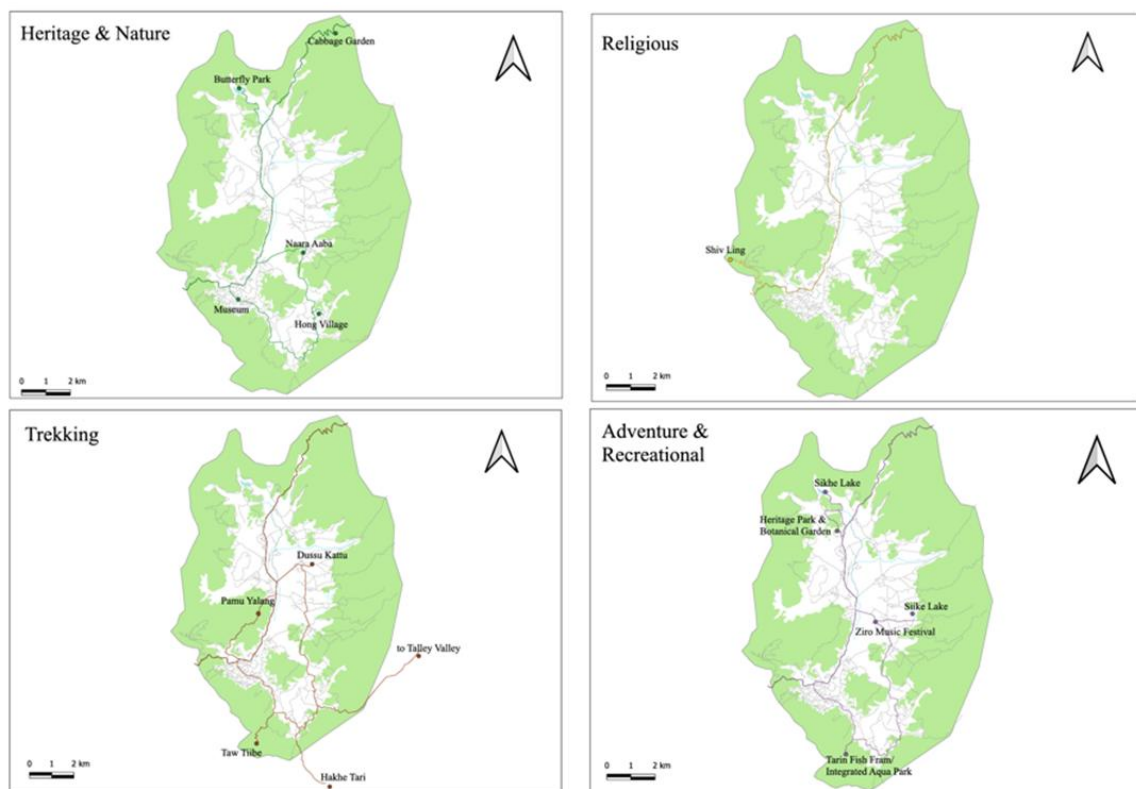


Fig. 31: Tourist Circuit and Wayfinding Proposal Map



Source: OpenStreetMap road data; Bhuvan/NRSC base layers; Lower Subansiri tourism-site inventory; field verification.

A typical wayfinding signage module is proposed for gateway and village-level signboards. It should use a bamboo/timber post, bilingual text, QR code, map panel, direction arrows and visitor conduct rules.

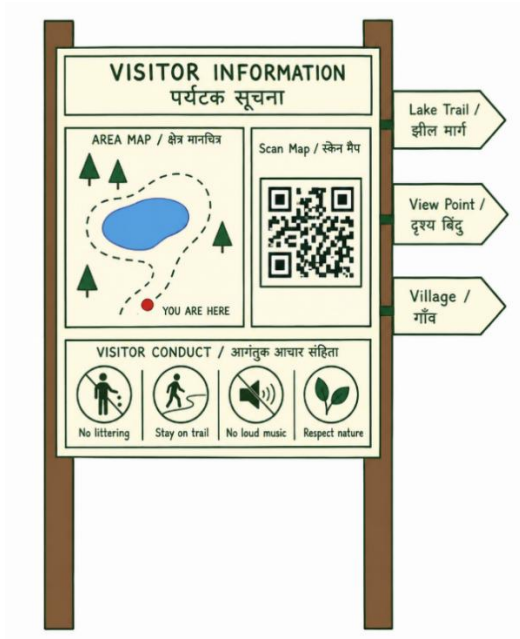


Fig 32: An Example of Typical Wayfinding Signage

The relevant information is summarised in Table 53.

Component	Quantity	Dimension Specification	Purpose
Main valley gateway board	1	3.0 m × 2.0 m	Introduces Ziro circuits at arrival point
Secondary orientation boards	7	1.8 m × 1.2 m	Placed at Hapoli, Hong, Hari-Bulla, Seeh Lake, Pine Grove, Kardo and Talley/Pange
Direction signs	30	0.90 m × 0.30 m	Guides tourists at junctions
You-are-here markers	20	0.60 m × 0.45 m	Helps self-navigation at nodes
Interpretation panels	12	1.20 m × 0.90 m	Explains culture, ecology and visitor rules
QR-based digital map	1 package	Digital map, rules, emergency contacts	Supports visitor information and future monitoring

Table 53: Components of Tourist Circuit and Wayfinding System

Source: Tourism proposal based on Lower Subansiri tourism-site inventory, field observations and CPWD/Arunachal Pradesh schedule-rate assumptions.

The relevant information is summarised in Table 54.

Item	Quantity	Assumed Rate	Unit	Amount
Main gateway board	1	₹4,00,000		₹4,00,000
Secondary orientation boards	7	₹1,50,000		₹10,50,000
Direction signs	30	₹25,000		₹7,50,000
You-are-here markers	20	₹15,000		₹3,00,000
Interpretation panels	12	₹45,000		₹5,40,000
QR/digital map and content	1 package	₹4,00,000		₹4,00,000
Installation, local transport and contingency	Lump sum	—		₹5,00,000
Total				₹39,40,000

Rounded planning estimate: **₹40 lakh**

Table 54: Cost Estimate for Tourist Circuit and Wayfinding System

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; field observations; tourism-site inventory.

6.2.2 Proposal 2: Homestay Upgradation and Local Guide Certification

This proposal is linked to the accommodation baseline, tourist survey, cultural asset mapping and carrying-capacity analysis. The carrying-capacity study showed that Ziro's effective tourism capacity is not limited only by physical space, but also by accommodation, water, waste and heritage sensitivity. Therefore, increasing tourist numbers without improving local stay capacity and interpretation will create pressure.

The proposal also responds to the cultural tourism potential identified in Table 46. Ziro's heritage value cannot be experienced properly without local interpretation. Guides are needed to explain Apatani settlement structure, paddy-fish cultivation, festivals, traditional institutions, village etiquette and sensitive areas.

The problem is that tourism experience in Ziro depends heavily on local knowledge, but guide systems and homestay standards are not sufficiently structured. Tourists may enter heritage areas without understanding rules, photograph people or private spaces inappropriately, or miss the deeper meaning of the cultural landscape. Accommodation quality also affects tourist satisfaction and carrying capacity.

This proposal uses community-based tourism potential. Homestays allow local households to earn directly from tourism without large hotel construction. Certified guides create local employment while also controlling tourist behaviour.

Selected homestays in Hapoli, Hong, Hari-Bulla and Diibo should be upgraded with basic guest-room standards, clean toilets, water storage, signboards, first-aid kits and cultural rule sheets. A minimum guest-room size of 3.0 m × 3.5 m is proposed.

Local guides should be certified for cultural circuits, agri-tourism trails and eco-adventure routes. Training should include Apatani heritage interpretation, environmental conduct, emergency response, tourist handling and route management. The relevant information is summarised in Table 55.

Component	Quantity / Standard	Purpose
Homestay upgrade support	30 units	Improves local stay quality
Minimum guest room	3.0 m × 3.5 m	Ensures basic comfort
Toilet and water support	Per selected unit	Improves hygiene and tourist satisfaction
Homestay signboard	30 units	Identifies certified homestays
First-aid kit	30 units	Improves safety
Cultural rule sheet	30 units	Communicates village etiquette
Guide training	50 guides	Supports visitor control and interpretation
Guide certification	ID card, uniform, rule book	Creates accountable guide system

Table 55: Homestay and Guide Certification Components

Source: Ministry of Tourism homestay and guide-skill guidance; field observations; primary survey.

The relevant information is summarised in Table 56.

Item	Quantity	Assumed Unit Rate	Amount
Homestay basic upgrade support	30 units	₹1,50,000	₹45,00,000

Item	Quantity	Assumed Unit Rate	Amount
Homestay signage and rule boards	30 units	₹10,000	₹3,00,000
First-aid and emergency kits	30 units	₹5,000	₹1,50,000
Guide training and certification	50 guides	₹14,000	₹7,00,000
Booking/listing support	1 package	₹4,00,000	₹4,00,000
Contingency	Lump sum	—	₹5,00,000
Total			₹65,50,000

Rounded planning estimate: **₹65–70 lakh**

Table 56: Cost Estimate for Homestay and Guide Support

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; field observations; primary survey.

6.2.3 Proposal 3: Talley Valley Controlled Eco-adventure and Eco-sport Circuit

This proposal is based on the eco-tourism and adventure-site inventory in Table 48, the NSI analysis in Table 55 and the carrying-capacity findings in Table 60. Talley Valley, Pamu Yalang/Dolo Mando, Seeh Lake and nearby trail landscapes have strong adventure-tourism potential, but they are ecologically sensitive.

The carrying-capacity analysis showed that tourism must be controlled through infrastructure, guides, permits, water, waste and accommodation systems. Therefore, Talley Valley should not be developed as a mass-tourism destination. It should be planned as a low-volume, high-value and guide-led adventure circuit. Along with trekking and controlled camping, the proposal also includes eco-sport tourism activities such as cyclothon and green marathon / trail run, but only as regulated seasonal events.

The problem is that adventure tourism can damage sensitive landscapes if it remains unregulated. Random trekking, informal camping, lack of toilets, poor route marking, open waste disposal and weak emergency support can harm forest areas and create tourist safety risks. Similarly, large cycling or running events can also create waste, crowding, traffic conflict and ecological disturbance if they are not controlled through route planning and event management.

The proposal uses Ziro's forest, viewpoint, lake and trekking landscape to increase tourist stay duration. It can attract trekkers, birdwatchers, students, researchers, nature tourists, cyclists, marathon runners and eco-tourism groups while creating income for guides, homestays, drivers, food providers, cycle-rental operators, local youth volunteers and emergency-support teams.

The circuit will begin at Hapoli as the booking and orientation point. Seeh Lake will function as the adventure base node. Pamu Yalang/Dolo Mando will function as a short

viewpoint route. Pange/Talley entry will function as the permit gate and guide-check point. The Talley route will operate only through registered guides, group-size limits, route signs, rest shelters, dry toilets, controlled campsites and carry-in carry-out waste rules.

The Ziro Eco-Cyclothon will use existing motorable and semi-motorable routes between Hapoli, Seeh Lake and the Pange/Talley approach area. No new road cutting will be proposed for this activity. The cyclothon will be conducted only during suitable weather months and will require registration, route marshals, helmet checks, hydration points, first-aid points and post-event waste collection.

The Ziro Green Marathon / Trail Run will use existing road edges, village-edge stretches and approved nature-trail sections around Hapoli, Seeh Lake and Pamu Yalang/Dolo Mando. The marathon will avoid highly sensitive forest interiors and no-go ecological areas. Participant numbers will be capped according to carrying capacity, and the route will include medical stations, drinking-water refill points, directional markers and emergency exit points. Both the cyclothon and marathon pathway is shown in fig: 33.

Therefore, the Talley Valley Eco-Adventure and Eco-Sport Circuit will include four linked activity types: guided trekking, birdwatching and nature interpretation, controlled camping, and seasonal eco-sport events such as cyclothon and green marathon. These activities will increase tourist stay duration while keeping the main principle unchanged: low-volume, guided, regulated and environmentally accountable tourism

The Talley Valley eco-adventure and eco-sport circuit should be mapped at implementation stage using Forest Department boundary data, NSI zones and field-verified trailheads.

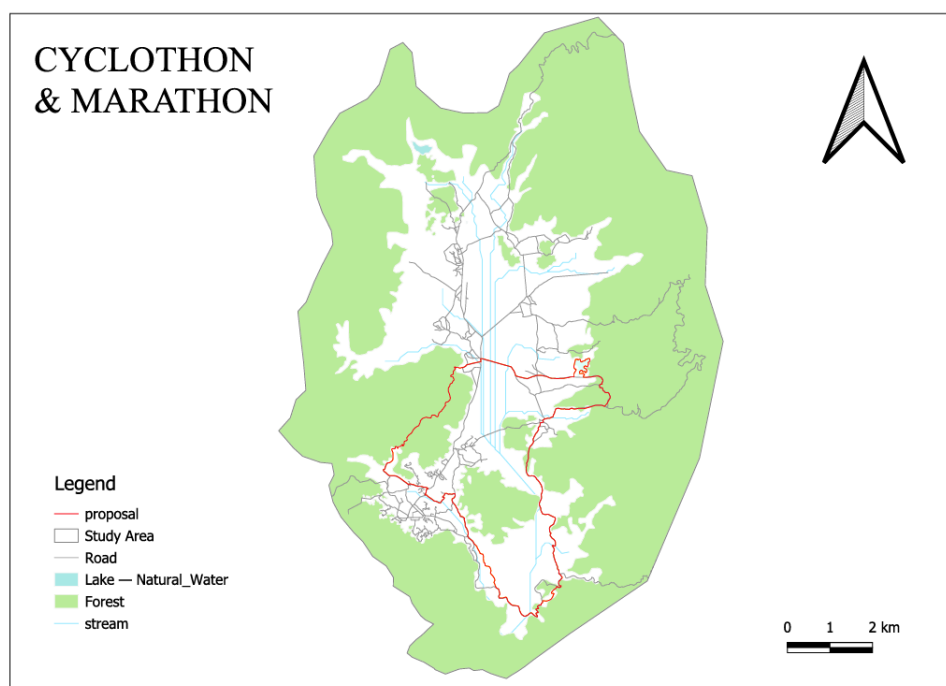


Fig. 33: Proposed Cyclothon and Marathon Pathway, Ziro Valley

The relevant information is summarised in Table 57.

Item	Quantity	Assumed Rate	Unit	Amount
Trailhead kiosks	2	₹5,00,000		₹10,00,000
Route signs and safety markers	30	₹20,000		₹6,00,000
Rest shelters	4	₹4,00,000		₹16,00,000
Controlled campsites	2	₹15,00,000		₹30,00,000
Dry toilets and waste-back system	2	₹6,00,000		₹12,00,000
Guide safety/rescue equipment	5 sets	₹1,00,000		₹5,00,000
Digital permit system	1	₹4,00,000		₹4,00,000
Cyclothon route markers and safety equipment	1 event set	₹3,00,000		₹3,00,000
Marathon/trail-run route markers	1 event set	₹2,50,000		₹2,50,000
Temporary medical, hydration and marshal points	6 points	₹75,000		₹4,50,000
Event waste-back and clean-up system	2 events/year	₹1,00,000		₹2,00,000
Contingency	Lump sum	—		₹10,00,000
Total				₹1,05,00,000
Item	Quantity	Assumed Rate	Unit	Amount
Trailhead kiosks	2	₹5,00,000		₹10,00,000
Route signs and safety markers	30	₹20,000		₹6,00,000
Rest shelters	4	₹4,00,000		₹16,00,000
Controlled campsites	2	₹15,00,000		₹30,00,000
Dry toilets and waste-back system	2	₹6,00,000		₹12,00,000
Guide safety/rescue equipment	5 sets	₹1,00,000		₹5,00,000
Digital permit system	1	₹4,00,000		₹4,00,000
Contingency	Lump sum	—		₹9,00,000

Item	Quantity	Assumed Rate	Unit	Amount
Total				₹92,00,000

Rounded planning estimate: ₹1.00–1.10 crore

Table 57: Cost Estimate for Talley Valley Eco-adventure and Eco-sport Circuit

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; Talley Valley site observations; district tourism records.

6.3 Agricultural Proposals

The agricultural proposals are based on the paddy-fish landscape analysis, NSI classification and the cultural value of Apatani agriculture. The earlier chapters established that the paddy-fish cultivation system is one of Ziro's strongest identities. However, it is also a working agricultural landscape and cannot be treated as an unrestricted tourist area. Therefore, the agricultural proposals focus on protecting agricultural land while creating controlled farmer-led tourism and income.

6.3.1 Proposal 1: Paddy-fish Agri-tourism Learning Trail

This proposal is directly linked to the NSI analysis in Table 55 and the cultural landscape discussion of the paddy-fish system. The analysis showed that the paddy-fish fields and the Kele River-linked irrigation system are highly sensitive. At the same time, they are among the strongest tourism assets of Ziro Valley.

The proposal also responds to the carrying-capacity analysis in Table 60, which shows that heritage and ecological sensitivity reduce the effective tourism capacity of the valley. Therefore, tourists should not be allowed to move freely through the fields. Their movement must be guided and edge-based.

The problem is that tourists want to experience the paddy-fish landscape, but uncontrolled walking can damage bunds, irrigation channels, crops and fish-culture areas. If tourism is not controlled, the same landscape that attracts visitors may be harmed by them.

The proposal uses the paddy-fish system as a learning and livelihood asset. Tourists can understand rice-fish cultivation, bamboo irrigation channels, water management and agricultural practices through guided interpretation.

Two pilot agri-tourism trail loops are proposed. The first will be along the Hong paddy-field edge because Hong is the strongest heritage tourism node. The second will be

along the Hari-Bulla/Diibo agricultural edge so that tourism benefits are distributed beyond Hong. Tourists will move only along existing field-edge paths or road-accessible edges with certified local guides. Entry into active paddy fields will not be allowed unless specifically permitted by farmers.

Bathroom in ziro festival ground.

The agri-tourism trail and paddy-fish landscape protection map should identify trail edges, viewing decks, no-entry paddy buffers, farmer-SHG sales points and service-node linkages shown in fig. 34.

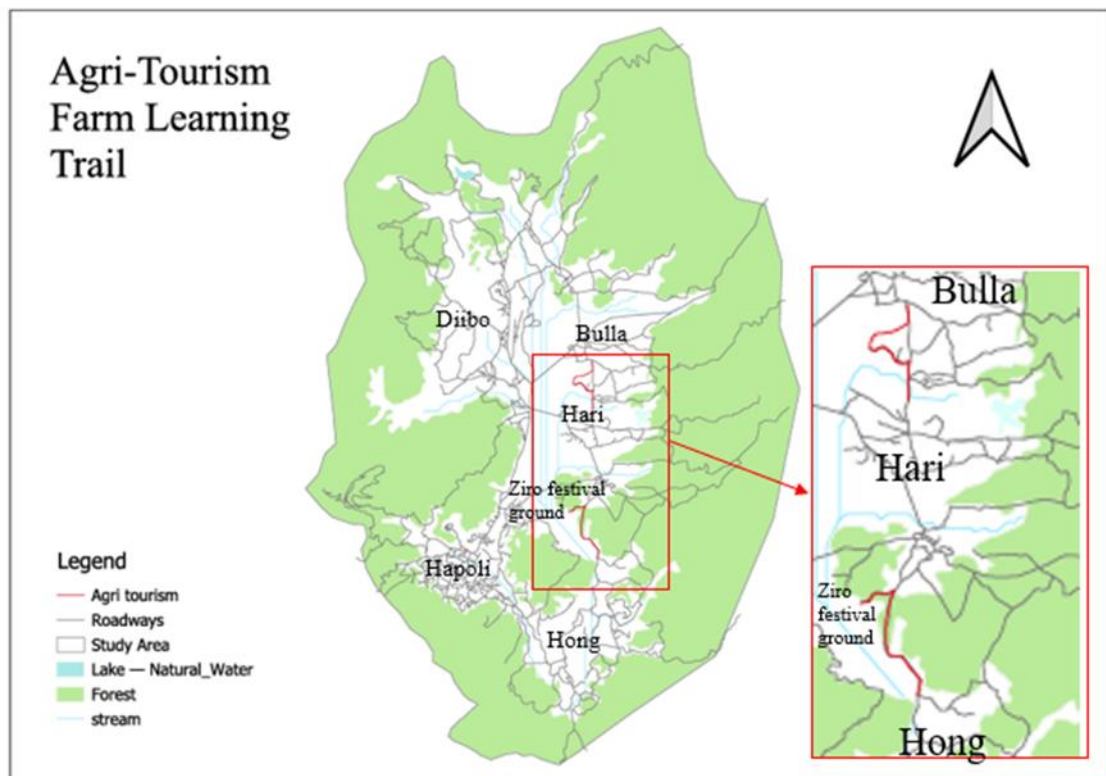


Fig. 34: The Agri-Tourism Trail, Ziro Valley

The typical agri-tourism trail edge should include a 1.2-1.5 m walking trail, 0.9 m bamboo railing, 3 m × 3 m viewing deck, no-entry signage and waste-bin point shown in fig. 35.

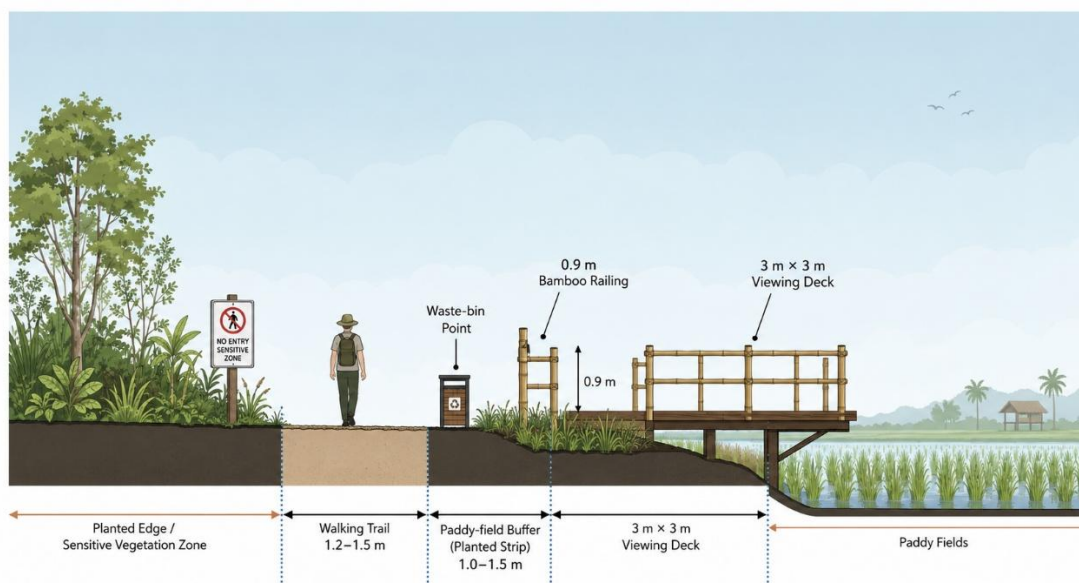


Fig. 35: Paddy-Field Edge Walking Trail and Viewing Deck Layout, Ziro Valley

The relevant information is summarised in Table 58.

Component	Quantity / Size	Assumed Cost	Purpose
Trail preparation and bamboo edging	3 km, 1.2–1.5 m width	₹18,00,000	Controls visitor movement and protects fields
Viewing decks	4 decks, 3 m × 3 m each	₹6,00,000	Allows photography and interpretation without field entry
Rest benches and waste-bin points	20 sets	₹4,00,000	Provides comfort and waste control
Interpretation panels	8 panels, 1.2 m × 0.9 m each	₹2,80,000	Explains paddy-fish system and visitor rules
Guide training and trail launch	1 package	₹3,00,000	Builds local guide capacity
Contingency	Lump sum	₹4,00,000	Covers transport and site variation
Total estimated cost		₹37,80,000	
Rounded estimate		₹38–40 lakh	

Table 58: Agri-tourism Trail Components and Cost

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; agri-tourism trail field observations; primary survey.

Revenue Logic

If the trail operates for 150 days in a year with 40 visitors per day, the annual visitor count will be approximately 6,000. At a trail fee of ₹150 per visitor, annual gross revenue will be ₹9,00,000. This can be distributed as 40% to farmer groups, 30% to guide groups, 20% to trail maintenance and 10% to village council administration.

This ensures that the farmers maintaining the landscape also benefit from tourism.

6.4 Industry Proposals

The industry proposals are based on the economic profile, local production systems, SHG potential, tourism spending and the need to convert tourist arrivals into local income. The earlier analysis showed that Ziro has agricultural produce, bamboo/cane craft, textiles, fermented products, traditional food items and herbal products, but these are not fully organised into a tourist-facing local economy. Therefore, the industry proposals focus on local produce, processing, packaging, sales and enterprise development.

6.4.1 Proposal 1: Local Produce Stalls and Farmer-SHG Sales Points

This proposal is linked to the economic profile and the tourism-livelihood gap identified in the report. Tourism arrivals are increasing, but local farmers, women's groups and small producers do not automatically receive direct income from visitors. Local products exist, but they need organised sale points at tourist nodes.

The problem is weak linkage between tourism spending and local income. Visitors may spend on transport and hotels, but farmers, SHGs and artisans may not benefit unless sale points are created.

The proposal uses local products such as kiwi, rice-based products, bamboo/cane craft, textiles, fermented food products, herbal products and traditional snacks. These products can become part of the tourism economy if presented properly.

Local produce stalls are proposed at Hong, Hari-Bulla, Seeh Lake and Hapoli service nodes. Each stall should be **3 m × 3 m** with a counter, display shelf, lockable storage, waste bin and solar lighting. The stalls should be allotted to SHGs, farmer groups, artisans and local entrepreneurs.

The local produce stall module should be a 3 m × 3 m bamboo/timber unit with counter, display shelves, storage, signage, packaging table and waste bin.

The relevant information is summarised in Table 59.

Component	Quantity / Size	Purpose
Local produce stalls	12 stalls, 3 m × 3 m each	Direct tourist-facing sale space
Display shelves	In each stall	Better product presentation
Lockable storage	In each stall	Safe storage for sellers
Solar light	1 per stall	Evening usability

Component	Quantity / Size	Purpose
Waste bin	1 per stall	Clean operation
Standard signage	1 per stall	Product identity and pricing

Table 59: Local Produce Stall Components

Source: Primary survey; local market field observations; District Industries Centre records.

6.4.2 Proposal 2: Shared Processing and Packaging Facility

This proposal supports the economic and local produce potential identified in the report. The analysis showed that Ziro has local products, but product value remains limited if they are sold without cleaning, grading, packaging, labelling and branding. Therefore, processing and packaging support is required.

The problem is that local producers may not be able to sell at better prices if products are presented informally. Without shared infrastructure, each producer has to manage packaging individually, which reduces quality and consistency.

This proposal uses the potential of SHGs, farmer groups, craft workers and local food producers. It helps turn raw or informal products into visitor-ready products.

A shared processing and packaging room is proposed at Hapoli or another accessible service-edge location. The facility should include an **8 m × 6 m processing room**, **4 m × 3 m dry storage room**, washing counter, drying rack, weighing station, packaging table and display shelves.

The shared processing and packaging room layout should provide separate zones for washing, drying, sorting, sealing, storage, display and waste handling.

The relevant information is summarised in Table 60.

Item	Quantity	Assumed Rate	Unit	Amount
Local produce stalls	12	₹1,50,000		₹18,00,000
Shared processing room	1	₹22,00,000		₹22,00,000
Storage and display equipment	1 package	₹5,00,000		₹5,00,000
Weighing, sealing and packaging equipment	1 package	₹4,00,000		₹4,00,000
Branding, signage and labels	1 package	₹3,00,000		₹3,00,000
SHG training and business support	1 package	₹4,00,000		₹4,00,000
Contingency	Lump sum	—		₹5,00,000
Total				₹61,00,000

Rounded planning estimate: **₹60–65 lakh**

Table 60: Cost Estimate for Industry Proposals

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; District Industries Centre records; field observations.

6.5 Infrastructure Proposals

The infrastructure proposals respond to the infrastructure gap analysis, NSI findings, Section 4.4 on fragmented planning, and the carrying-capacity analysis. They include visitor service nodes, water and waste systems, access improvement, drainage, pedestrian edges and heritage-sensitive built-form control. These are grouped under Infrastructure because they are physical and regulatory systems required to support tourism, agri-tourism and industry.

6.5.2 Proposal 1: Seasonal Water, Toilet and Waste Management for Tourist Nodes

This proposal is based on the carrying-capacity analysis and household survey findings. The earlier analysis showed that water and waste are among the binding constraints on Ziro's effective tourism capacity. Household survey findings also showed that some residents already face unreliable water supply in normal periods and higher water stress during festival periods. Waste disposal is also a concern, with informal disposal, open burning and river/paddy-field disposal documented in the analysis.

However, detailed PHED pipeline alignment, source capacity, reservoir location and pressure-zone data are not available at thesis level. Therefore, this proposal does **not** attempt to redesign or map the existing water-supply network. That would be an engineering-level exercise and should be done during DPR preparation by PHED.

The actual problem is seasonal pressure on tourist nodes, not the entire valley water system. During peak tourism and festival periods, visitor demand adds pressure on drinking water, toilets and waste handling. If this is not managed, the service burden falls on residents, informal vendors, homestays and natural areas.

This proposal uses the planned visitor service nodes as controlled management points. Instead of solving water and waste randomly across the whole valley, the proposal concentrates basic seasonal support at tourist pressure locations. This makes the intervention easier to manage, cheaper to implement and more defensible.

The proposal introduces seasonal water, toilet and waste management at tourist service nodes. During normal periods, each node will have basic drinking-water and sanitation support according to its size. During peak tourist and festival periods, additional

temporary support will be provided through portable tanks, tanker-based backup where required, temporary toilet units at high-pressure sites and increased waste collection frequency.

The proposal should be written clearly as a **management system**, not a full water-infrastructure system.

The relevant information is summarised in Table 61.

Node Type	Normal Requirement	Peak-Season Requirement	Additional
Small node	1 drinking-water point, twin bins, basic toilet-water storage	Portable water tank if required, extra bins, increased cleaning	
Medium node	Drinking-water point, toilet block, 1,000–2,000 L storage, 6 m × 4 m waste room	Temporary tank/tanker support, temporary toilet unit if visitor load rises	
Large node	Multiple drinking-water points, larger toilet block, storage tank, 8 m × 5 m waste room	Tanker backup, daily waste lifting, additional temporary bins and cleaners	
Festival/event site	Temporary drinking-water stations and mobile toilets	Pre-event PHED coordination, tanker plan, daily cleaning, post-event waste clearance	

Table 61: Seasonal Water, Toilet and Waste Management Standards

Source: PHED water-supply norms; Swachh Bharat Mission guidance; field observations.

The relevant information is summarised in Table 62.

Item	Quantity	Assumed Rate	Unit	Amount
Portable/temporary water tanks	7 nodes	₹1,00,000		₹7,00,000
Drinking-water refill points	7 nodes	₹75,000		₹5,25,000
Temporary toilet units for peak season	4 priority nodes	₹2,50,000		₹10,00,000
Additional waste bins and signage	7 nodes	₹75,000		₹5,25,000
Cleaning tools and storage support	7 nodes	₹50,000		₹3,50,000
Peak-season tanker/PHED coordination provision	Lump sum	—		₹5,00,000
Contingency	Lump sum	—		₹4,00,000
Total				₹40,00,000

Rounded planning estimate: **₹40 lakh**

Table 62: Cost Estimate for Seasonal Water, Toilet and Waste Management

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; PHED and Swachh Bharat Mission guidance.

This cost is more realistic than proposing a full water-supply redesign. It addresses the actual planning issue: tourist-season service stress. Temporary storage, refill points, additional toilets, extra bins and cleaning support are cheaper, easier to implement, and

can be scaled depending on the visitor load. The final source of water, tanker route and storage size should be confirmed by PHED at DPR stage.

6.5.3 Proposal 2: Priority Road Edge, Drainage, Lighting and Parking Improvement

This proposal is based on the road, drainage and field-observation findings from the infrastructure analysis. Earlier documentation identified weak road-edge conditions, lack of surface drains, inadequate lighting and parking congestion at tourist nodes. The mid-report also recorded specific infrastructure deficiencies such as the unpaved road to Seeh Lake, near-total absence of surface drains and street lighting in rural village areas, and parking congestion caused by vehicles accumulating on the road at tourist nodes.

This proposal is also linked to the tourism-circuit proposal. Tourist circuits cannot work only through signs. They need safe approach roads, drainage, lighting, pedestrian edges and controlled stopping/parking points.

The problem is weak last-mile access and poor road-edge management. Tourists and residents use the same narrow routes, but these routes are not always supported with drains, lighting, pedestrian edges or parking spaces. During monsoon conditions, poor drainage can damage road edges and reduce access to tourist nodes. During tourist periods, on-road parking can create congestion and reduce safety.

This proposal uses the existing road network rather than proposing new road alignments. That makes it more realistic. The aim is not to widen all roads or redesign the entire transport system. The aim is to improve only the priority tourist-linked stretches where access, safety and visitor movement are most important.

Priority improvements are proposed at Hapoli market approach, Hapoli-Hong route, Hong field-edge trail, Seeh Lake approach, Pine Grove approach and Talley/Pange entry. The works should include road-edge repair, covered drains, pedestrian edges where space allows, solar lighting, directional signage and small drop-off/parking bays.

The priority road-edge improvement map should be prepared for Hapoli market, Hong approach, Seeh Lake approach and other service-node stretches using road width, parking and drainage observations.

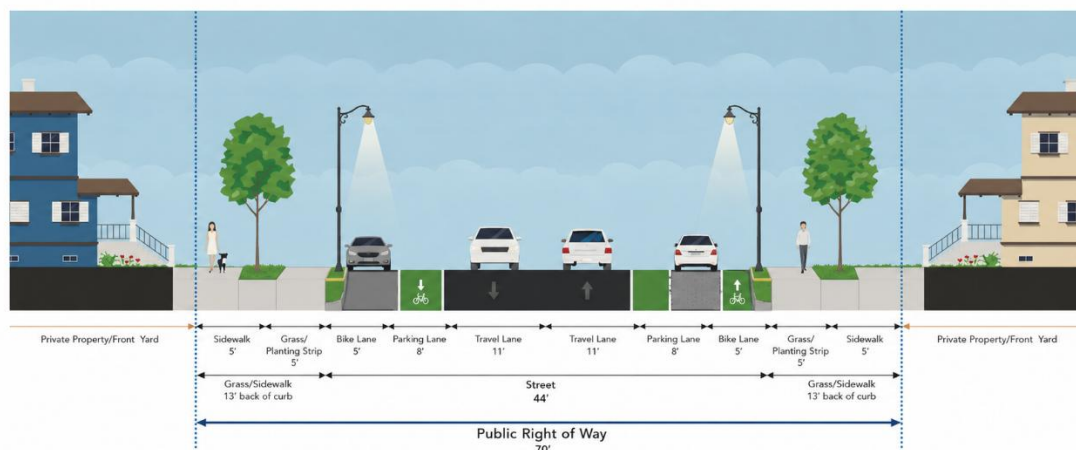


Fig. 36: Proposed Public Right-of-Way Street Section with Drainage, Lighting and Parking

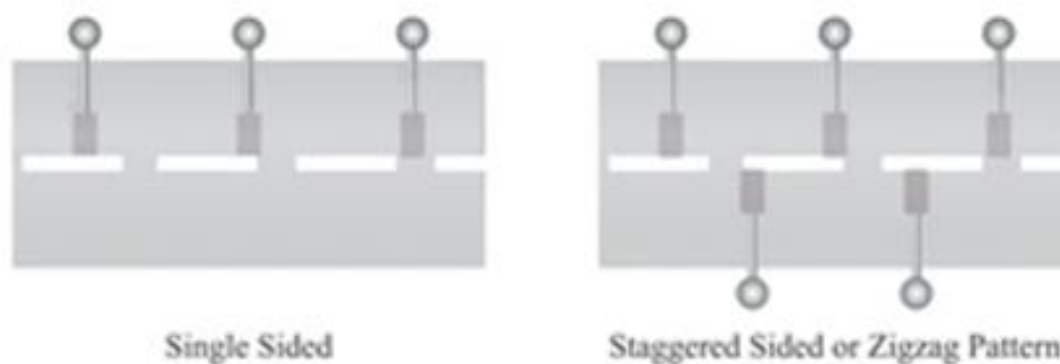


Fig. 37: Pedestrian Lighting Arrangement Patterns for NH 13 and Other roads

The relevant information is summarised in Table 63.

Corridor / Location	Proposed Improvement	Reason
Hapoli market approach	Drainage, pedestrian edge, signage, parking management	Main arrival and service area
Hapoli-Hong route	Road-edge repair, signs, lighting	Cultural tourism access
Hong field-edge trail	Pedestrian edge and visitor control	Paddy-fish landscape protection
Seeh Lake approach	Road-edge improvement, drainage, lighting	Nature tourism pressure
Pine Grove approach	Drainage, stopping point, waste point	Picnic/leisure pressure
Talley/Pange entry	Signage, access support, drop-off point	Eco-adventure gateway

Table 63: Priority Infrastructure Corridors

Source: PWD/RWD road observations; field survey; OpenStreetMap road network; tourism-site inventory.

The relevant information is summarised in Table 64.

Item	Quantity	Assumed Rate	Unit	Amount
Road-edge repair / surface improvement	3 km	₹25,00,000/km		₹75,00,000
Covered drains at priority edges	2 km	₹18,00,000/km		₹36,00,000
Pedestrian edge marking / paving	2 km	₹12,00,000/km		₹24,00,000
Solar streetlights	60	₹35,000		₹21,00,000
Small drop-off / parking bays	5	₹3,00,000		₹15,00,000
Safety and direction signage	30	₹20,000		₹6,00,000
Contingency	Lump sum	—		₹15,00,000
Total				₹1,92,00,000

Rounded planning estimate: **₹1.90–2.00 crore**

Table 64: Cost Estimate for Priority Road Edge, Drainage, Lighting and Parking Improvement

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; PWD/RWD field observations.

This proposal is expensive, so it must be clearly presented as a **priority-corridor intervention**, not full road redevelopment. The cost is justified because the proposal supports both residents and tourists. Drainage reduces monsoon-related road damage, lighting improves safety, pedestrian edges improve walking conditions, and parking/drop-off bays reduce congestion at tourist points.

This component should preferably be funded through PWD, Rural Development, PMGSY, AMRUT-type urban funds or district infrastructure convergence, rather than being treated as tourism-only expenditure.

6.5.4 Proposal 3: Heritage-sensitive Building Control and Design Support

This proposal is based on the built-form analysis, building-material findings, heritage inventory and Section 4.4 on weak planning enforcement. The report identifies that traditional bamboo-pine houses are increasingly being replaced by RCC construction. The thesis findings also link built-form change with heritage loss, seismic risk and degradation of the cultural landscape experience. The issue is serious because Ziro's tourism value depends heavily on the visual and cultural character of its village cores.

This proposal also responds to the fact that AP Building Bye-Laws exist, but heritage-sensitive implementation remains weak in village cores. Therefore, the solution should not be only general building regulation. It should be a localised heritage-sensitive built-form control system.

The problem is that unregulated RCC construction, inconsistent building height, blank façades and visually incompatible materials can damage the character of heritage villages and paddy-field-facing edges. If this continues, the cultural landscape that attracts tourists will gradually lose its identity.

A second problem is that residents may not follow heritage-sensitive design if it is presented only as restriction. They need technical help, examples, craftsmen support and incentives.

This proposal uses traditional Apatani architecture, bamboo-pine construction, local craftsmanship and village settlement character as planning assets. Instead of treating traditional construction as backward, the proposal treats it as a cultural, visual and seismic-sensitive resource.

Three built-form control zones are proposed.

The Heritage Core Zone includes traditional village cores of Hong, Hari, Hija and Bulla. In this zone, new construction should be limited to G+1 or a maximum of 7.5 m height. Sloping roofs, muted colours and bamboo/timber façade treatment should be encouraged.

The Heritage Buffer Zone covers approximately 200 m around paddy-field-facing settlement edges. In this zone, G+2 or maximum 10.5 m may be allowed, but blank RCC walls, reflective glass and visually harsh façades should be avoided.

The Urban Transition Zone includes Hapoli and market areas. Here, regular development may continue, but signage, frontage, parking, drainage and façade treatment should be controlled.

A Heritage Design Support Cell is proposed at Hapoli or the District Tourism/Planning office. The cell will prepare design guidelines, maintain a craftsmen register, provide façade advice, support homestay improvement and help residents understand acceptable construction in heritage-sensitive zones.

The heritage core, buffer and building-control zone map should show heritage village cores, 200 m buffer, paddy-field viewsheds, Hapoli transition zone, no-construction ecological edges and facade-improvement stretches.

The before-after heritage street-edge illustration should compare existing RCC-dominated village edges with a vernacular-compatible edge using sloping roofs, bamboo screens, muted colours, controlled signage and a drainage edge.

The relevant information is summarised in Table 65.

Zone	Location	Control
Heritage Core Zone	Hong, Hari, Hija, Bulla village cores	G+1 / max 7.5 m, sloping roof, bamboo/timber façade, muted colours
Heritage Buffer Zone	200 m paddy-field-facing settlement edge	G+2 / max 10.5 m, no blank RCC wall, no reflective glass
Urban Transition Zone	Hapoli and market areas	Signage, frontage, parking and drainage control
Ecological No-Construction Edge	Kele River, high NSI areas, sacred groves	No permanent tourist building

Table 65: Built-form Control by Zone

Source: Arunachal Pradesh Building Bye-Laws 2019; UNESCO World Heritage Centre (2014); BIS IS 1893:2016; field observations.

The relevant information is summarised in Table 66.

Item	Quantity	Assumed Unit Rate	Amount
Building typology survey	5 villages	₹1,00,000	₹5,00,000
Heritage design guideline booklet	1	₹3,00,000	₹3,00,000
Heritage Design Support Cell setup	1	₹15,00,000	₹15,00,000
Craftsmen training	50 persons	₹8,000	₹4,00,000
Village awareness meetings	10	₹25,000	₹2,50,000
Pilot façade improvement support	10 houses	₹1,00,000	₹10,00,000
Contingency	Lump sum	—	₹4,00,000
Total			₹43,50,000

Rounded planning estimate: **₹40–45 lakh**

Table 66: Cost Estimate for Heritage-sensitive Building Control and Design Support

Source: CPWD/Arunachal Pradesh schedule-rate assumptions; Arunachal Pradesh Building Bye-Laws 2019; field observations.

The cost is justified because this proposal is not only a regulation. It includes the support system required to make regulation acceptable and practical. The design cell, guideline booklet, craftsmen training and façade pilots help residents adopt heritage-sensitive changes without feeling that planning rules are only restrictions. This also protects tourism value because the visual character of the village edge is part of Ziro's attraction.

6.6 Consolidated Infrastructure Cost

The relevant information is summarised in Table 67.

Infrastructure Proposal	Estimated Cost	Main Problem Solved
1: Seasonal Water, Toilet and Waste Management	₹40 lakh	Peak-season water, toilet and waste pressure without claiming full PHED redesign
2: Priority Road Edge, Drainage, Lighting and Parking Improvement	₹1.90–2.00 crore	Weak last-mile access, drainage, lighting and parking at tourist-linked stretches
3: Heritage-Sensitive Building Control and Design Support	₹40–45 lakh	RCC pressure, heritage character loss and weak built-form enforcement
Total Infrastructure Estimate	₹5.90–6.05 crore approx.	Physical and regulatory support for tourism, agri and industry proposals

Table 67: Consolidated Infrastructure Proposal Cost

Source: Proposal cost tables 62, 64, and 66

This infrastructure package is more defensible than the earlier version because it does not overclaim. It avoids unsupported water-network mapping, limits road work to priority stretches, places service nodes only at tourist pressure points, and treats heritage building control as a planning-support system rather than cosmetic beautification.

6.7 Phasing and Implementation

In the first 0–6 months, the priority should be low-cost and high-impact tourism management actions: wayfinding, temporary signage, guide registration, temporary bins, temporary toilets during peak periods and finalisation of service-node sites.

From 6–18 months, the Hapoli, Hong and Seeh Lake visitor nodes should be developed first because they combine high tourist pressure with strategic location. The Hong agri-tourism trail pilot, local produce stalls, first batch of homestay upgrades and guide training should also begin in this phase.

From 18–36 months, the remaining service nodes at Hari-Bulla, Pine Grove, Kardo and Talley/Pange should be completed. The shared processing room, Heritage Design Support Cell, façade-improvement pilots and Talley eco-adventure infrastructure should also be implemented.

After 36 months, the focus should shift to regulation and monitoring. This includes carrying-capacity enforcement, service-node maintenance, permit systems, heritage façade monitoring, annual tourist-arrival review and updating of digital visitor information.

6.8 Funding and Institutional Arrangement

The Tourism Department and Swadesh Darshan-type schemes can support tourist circuits, wayfinding, interpretation, homestay support, guide training and Talley eco-adventure facilities. PHED and Jal Jeevan Mission can support water supply at service nodes. Swachh Bharat Mission can support toilets and waste infrastructure. PWD, Rural Development and PMGSY can support road-edge, drainage and access improvements. MGNREGA can support agri-trail edge works, bamboo railings and minor community assets. NRLM, MSME and District Industries Centre can support local produce stalls, SHG training, branding and packaging infrastructure. Forest Department should be involved in Talley Valley regulation because of ecological sensitivity.

Operation and maintenance should be community-linked. Village youth groups can maintain signs. Node committees can manage toilets and waste rooms through small user fees. Farmer-guide groups can maintain the agri-tourism trail through trail-fee revenue. SHGs can operate local produce stalls. Forest and tourism departments can manage Talley permits with registered guides. Bulyañ councils should be involved in heritage-zone decisions and village-level consent.

6.9 Conclusion

The proposal chapter is arranged under Tourism, Agri, Industry and Infrastructure so that the interventions are easier to understand and defend. The Tourism proposals respond to visitor growth, unmanaged movement, accommodation gaps and eco-adventure potential. The Agri proposal protects the paddy-fish landscape while creating farmer-led tourism income. The Industry proposals convert local produce and craft into tourist-facing enterprise. The Infrastructure proposals provide the physical and regulatory support needed for all sectors, including service nodes, water, waste, road edges, drainage and heritage building control.

This arrangement keeps the same proposal content but makes the chapter more logical. It shows that the proposals are not superficial recommendations. Each one is linked to an earlier analysis, solves a specific problem, uses an identified potential and explains its cost through dimensions, quantities and planning assumptions.

CHAPTER 7: CONCLUSION

The thesis establishes that Ziro Valley cannot be planned only as a scenic tourist destination. Its tourism value comes from a living cultural landscape in which the Apatani settlement system, paddy-fish cultivation, bamboo-pine resource use, sacred groves, festivals, homestays and forested edge conditions operate together.

The analysis shows that the main planning constraint is not the lack of tourist attractions. Ziro already has strong natural, cultural, religious and adventure-tourism assets. The real constraints are visitor management, waste handling, water reliability, road-edge congestion, absence of public transport, weak wayfinding, changing built form and ecological sensitivity around the Kele River, paddy fields and forest edges.

The proposals respond through small, phased and locally adaptable interventions: wayfinding, visitor service nodes, sanitation and waste systems, homestay support, guide certification, agri-tourism trails, local produce stalls, shared processing facilities, road-edge improvements and heritage-sensitive building controls.

The study concludes that Ziro Valley requires an integrated planning framework backed by community institutions, district departments and tourism-sector coordination. With careful implementation, tourism can strengthen Apatani heritage, improve basic services and protect sensitive landscapes.

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ANNEXURES

Annexure A: Household Survey Questionnaire

The following questionnaire items were used for the household survey. Individual responses are anonymised and only aggregated results are reported in the thesis.

1. Timestamp
2. Village Name:
3. Source of Household (family) Income:
4. Building Material of Primary Residence:
5. Do you accommodate tourists in your residence?
6. If you host guests, are the tourists mostly from:
7. Domestic Water Supply Availability:
8. Water Scarcity During Peak Festivals (e.g., Ziro Music Festival):
9. Solid Waste Disposal Method:
10. How is your day-to-day life affected by the influx of tourists?

Annexure B: Tourist Survey Questionnaire

The following questionnaire items were used for the tourist survey. Individual responses are anonymised and only aggregated results are reported in the thesis.

1. Timestamp
2. Which traveler category do you belong to?
3. What is the primary purpose of your visit to the valley?
4. What is the total duration of your stay in Ziro Valley?
5. What type of transportation did you use during your visit?
6. What type of accommodation did you use during your stay?
7. In your opinion, are there sufficient public toilets and dustbins at major tourist sites?
8. Did you find the traditional village streets too narrow for your movement?
9. Does the rise of modern concrete buildings negatively affect your experience of the Cultural Landscape?

10. Would you be willing to pay a small "Environmental/Heritage Fee" if 90% of the funds were used for the welfare of the villages and culture?
11. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Power:]
12. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Water:]
13. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Internet:]
14. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Roads:]
15. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Waste management:]
16. On a scale of 1 to 5 (1=Dissatisfied, 5=Very Satisfied), how satisfied are you with the following utility services? [Stay:]

[Annexure C: Graphical Summary of Survey Responses](#)

The charts below summarise the primary data collected from household and tourist respondents. These graphs support Chapter 4 and Chapter 5.

The related visual is shown in Fig. 38.

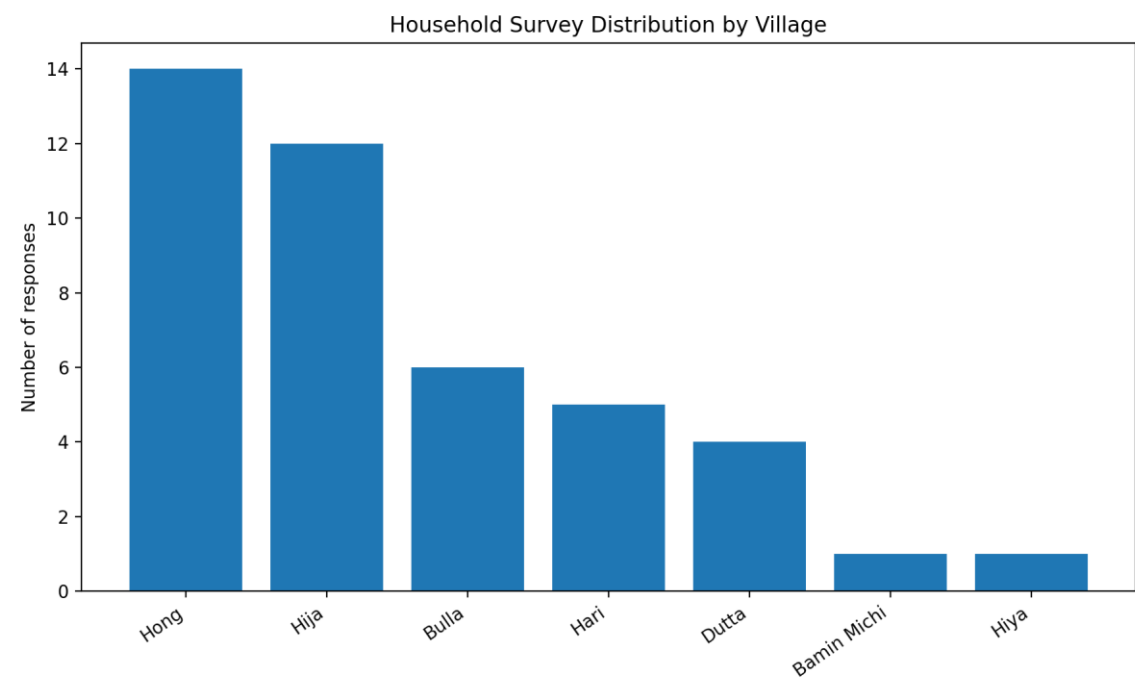


Fig. 38: Household Survey Distribution by Village

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 39.

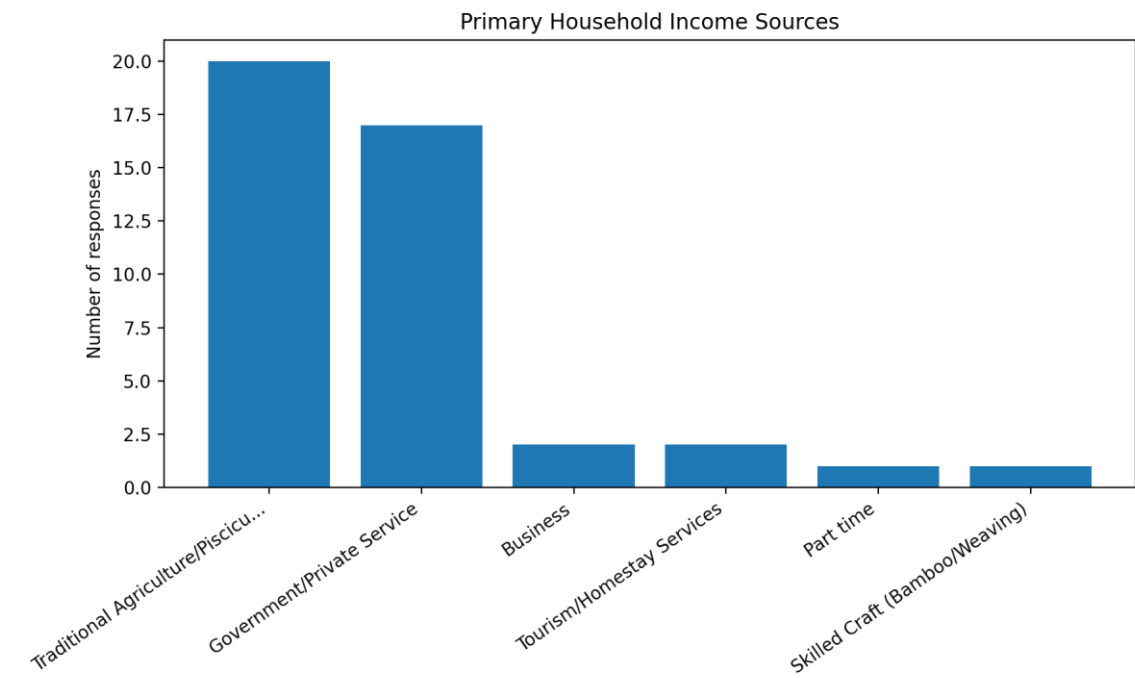


Fig. 39: Primary Household Income Sources

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 40.

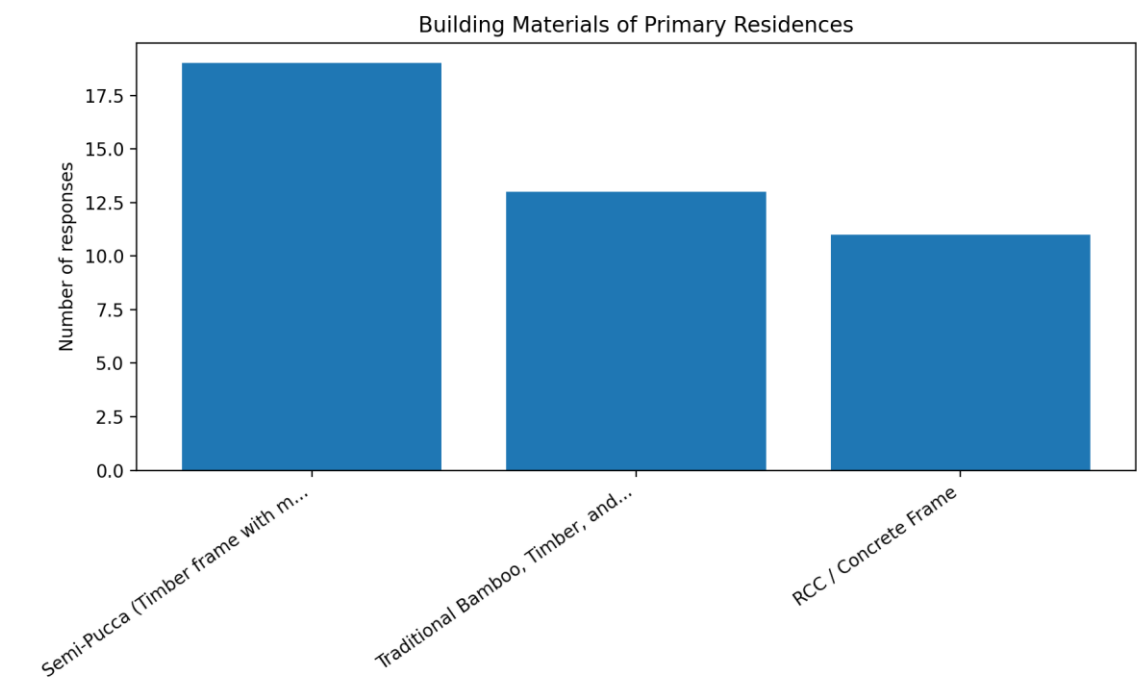


Fig. 40: Building Materials of Primary Residences

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 41.

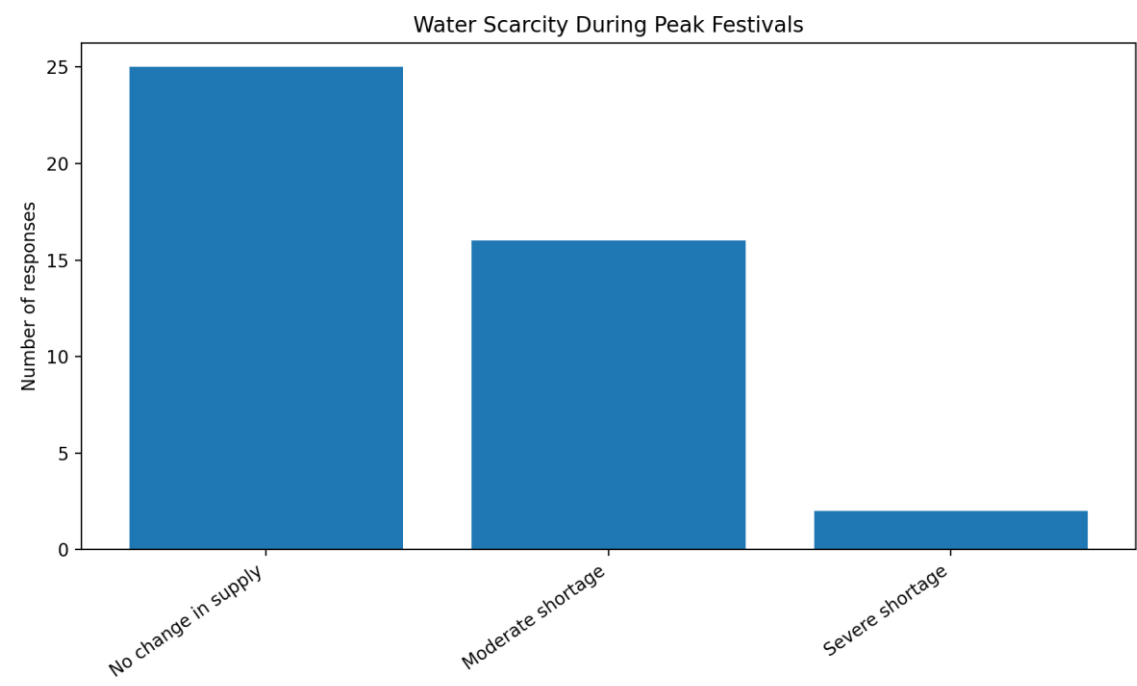


Fig. 41: Water Scarcity during Peak Festivals

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 42.

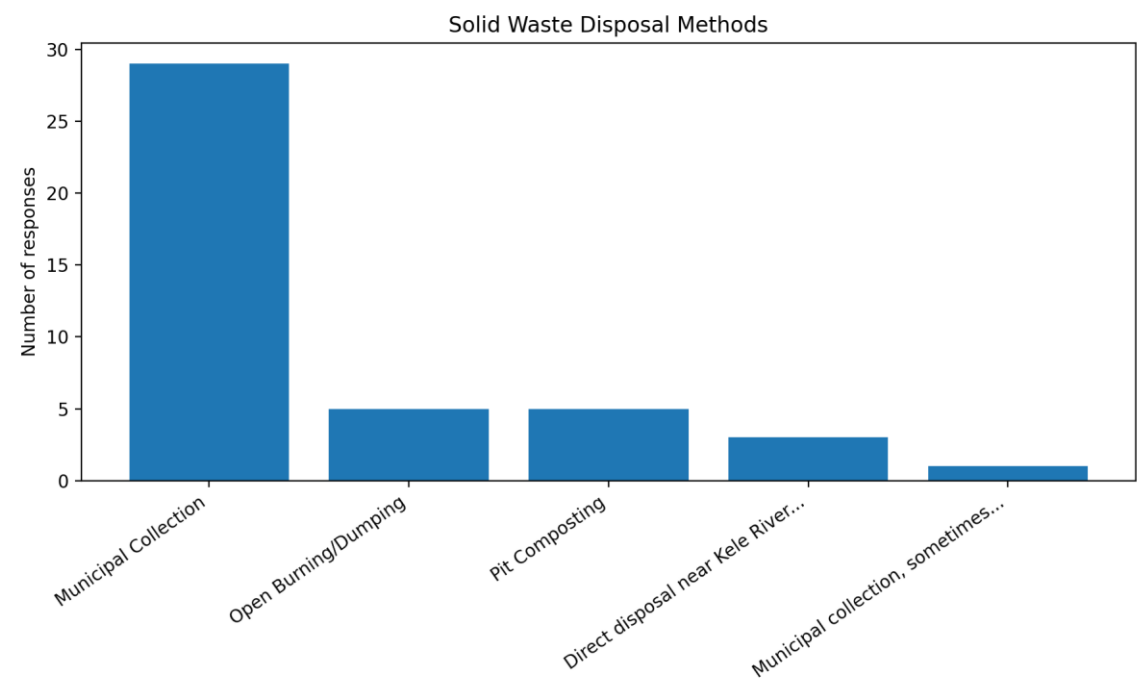


Fig. 42: Solid Waste Disposal Methods

Source: Primary household survey, Ziro Valley, 2026.

The related visual is shown in Fig. 43.

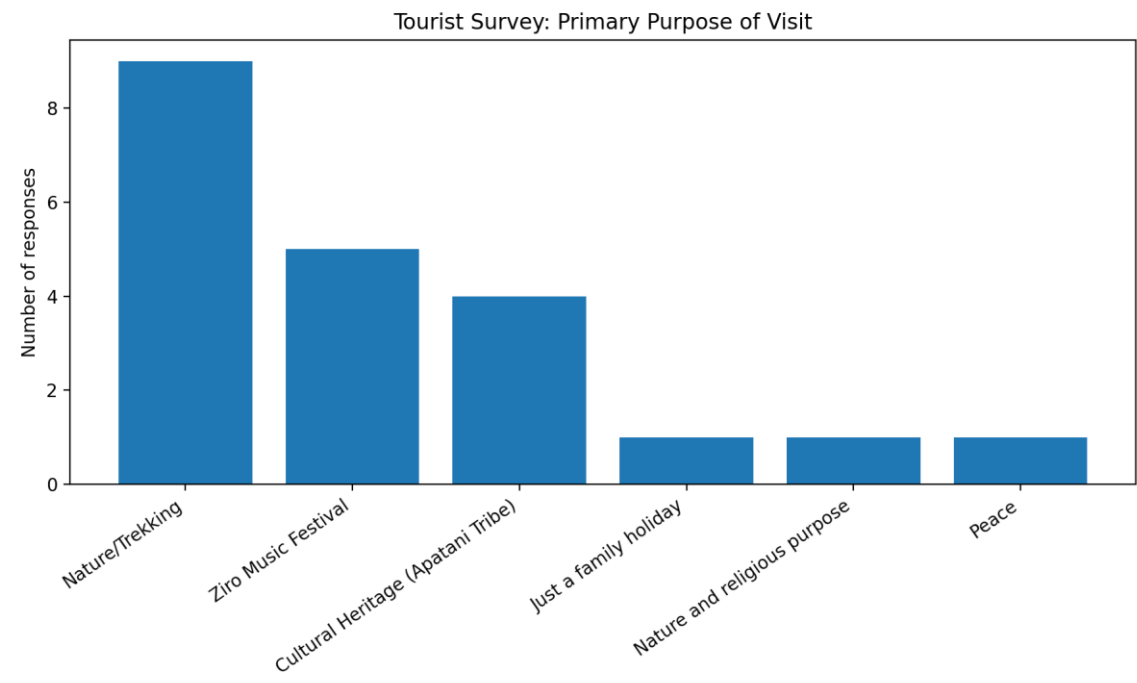


Fig. 44: Tourist Survey: Primary Purpose of Visit

Source: Primary tourist survey, Ziro Valley, 2026.

The related visual is shown in Fig. 45.

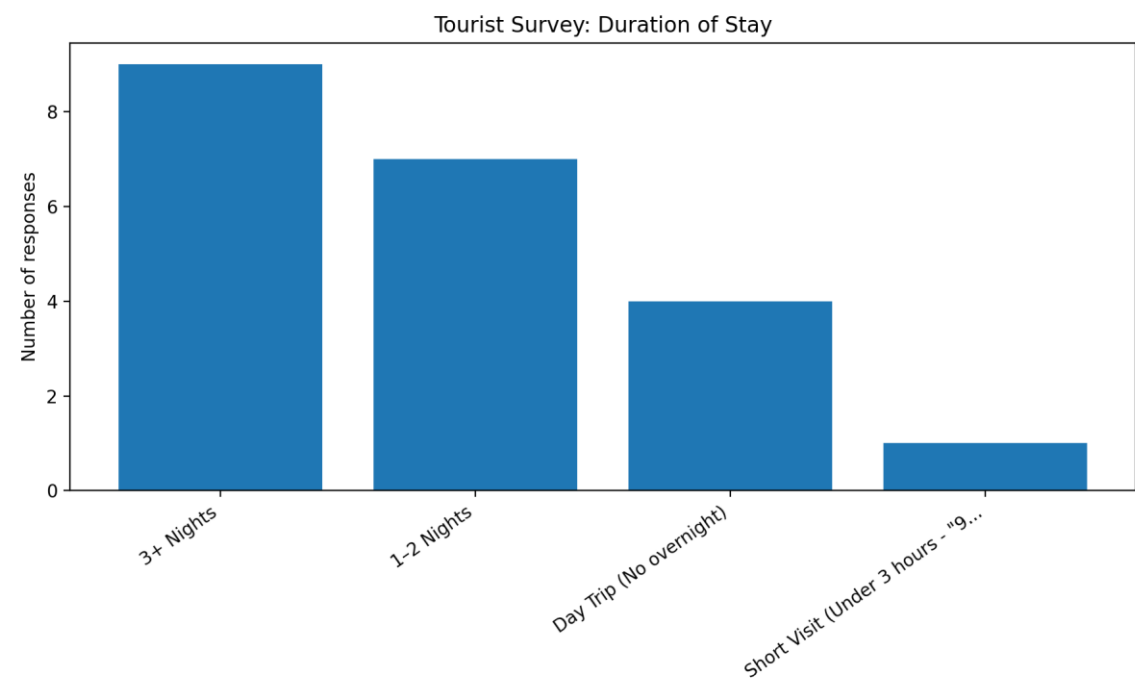


Fig. 45: Tourist Survey: Duration of Stay

Source: Primary tourist survey, Ziro Valley, 2026.

The related visual is shown in Fig. 46.

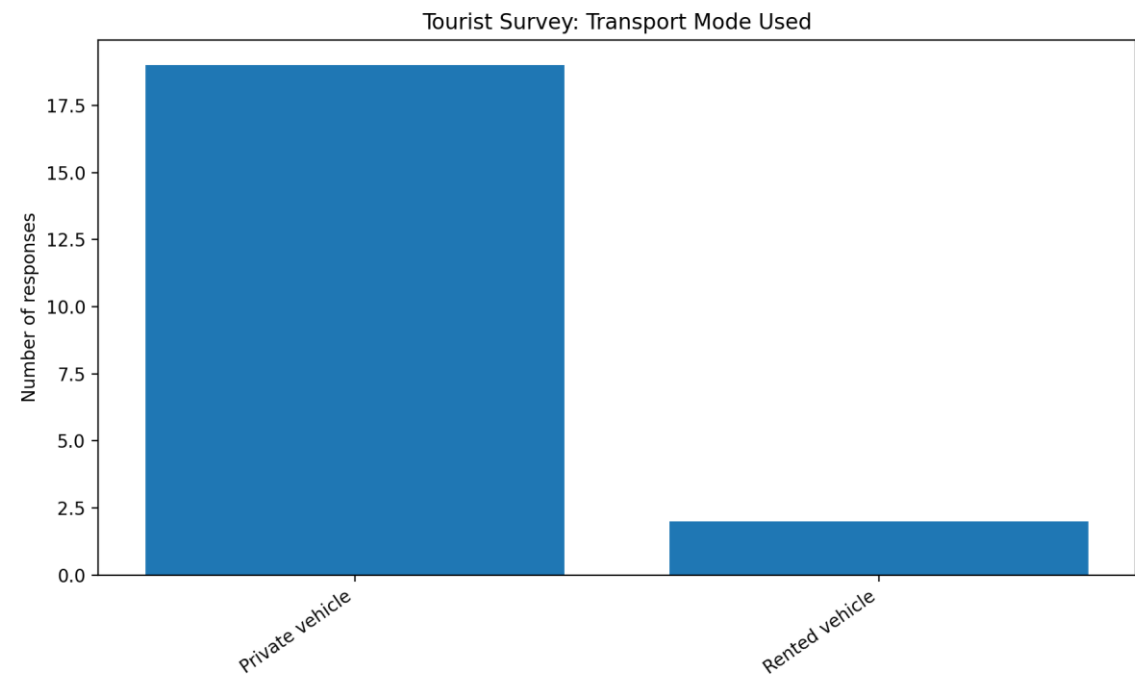


Fig. 46: Tourist Survey: Transport Mode Used

Source: Primary tourist survey, Ziro Valley, 2026.

The related visual is shown in Fig. 47.

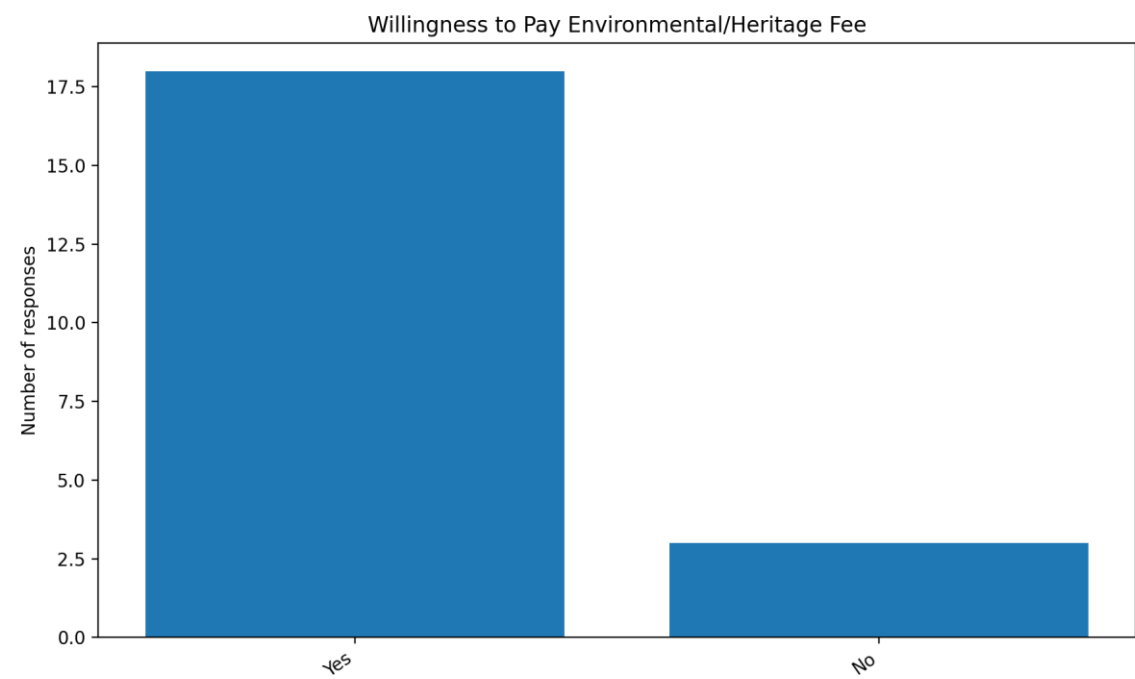


Fig. 47: Willingness to Pay Environmental/Heritage Fee

Source: Primary tourist survey, Ziro Valley, 2026.

The related visual is shown in Fig. 48.

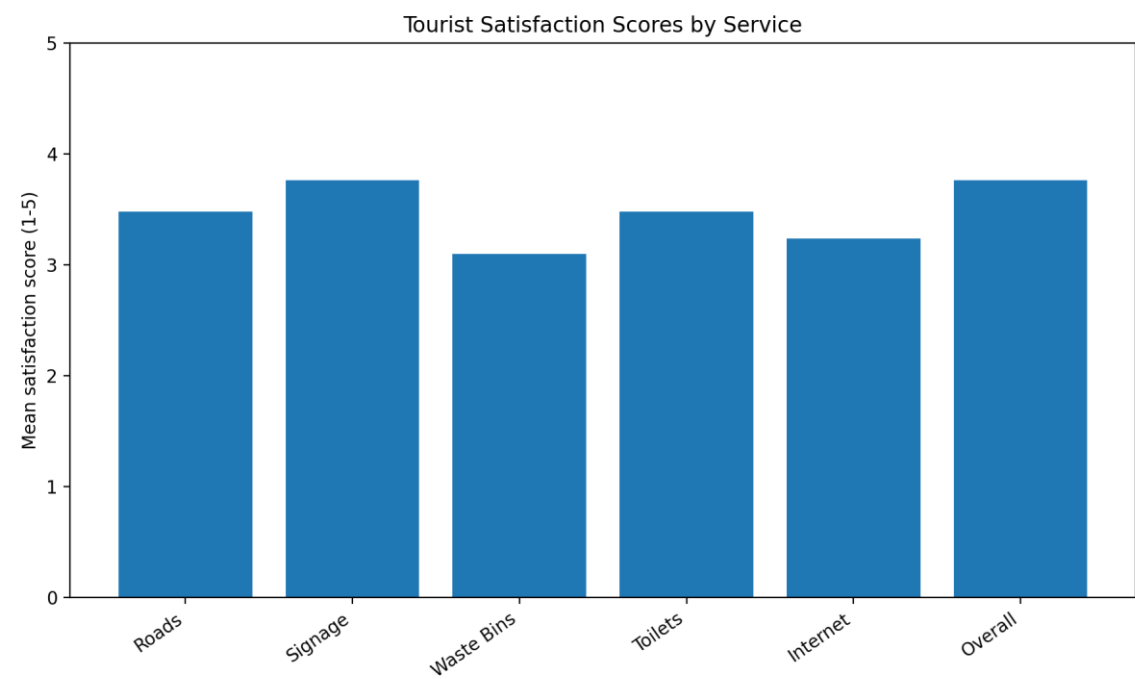


Fig. 48: Tourist Satisfaction Scores by Service

Source: Primary tourist survey, Ziro Valley, 2026.

The relevant information is summarised in Table 67.

Survey Instrument	Valid Responses	Coverage	Use in Report
Household survey	43	Households across Ziro settlements	Field-based household service and tourism-impact assessment.
Tourist survey	21	Visitors at tourist sites and entry/market areas	Visitor profile, movement, satisfaction and fee willingness.

Table 67: Primary Survey Response Summary

Source: Primary household survey and tourist survey, Ziro Valley, 2026.

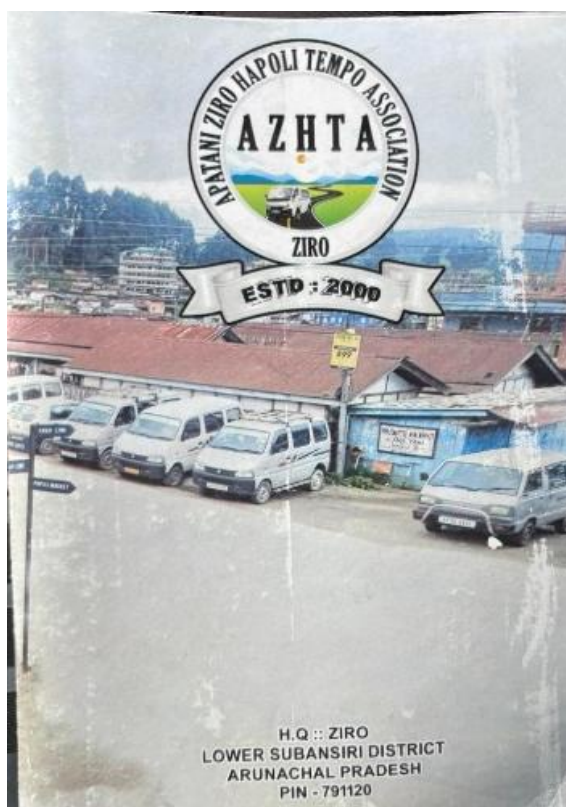
Annexure D: Transport Price Point Figure

The transport price-point figure was shifted to the annexure because it is supporting field evidence rather than a main analytical map or chart.

- Transport Constraints: Public transport (buses, autos, or tuk-tuks) is largely unavailable, making the valley reliant on expensive private vehicle rentals. The only available public transport consists of vans, which are considered expensive by both locals and tourists. The drivers have formed a union to standardise pricing and have printed price lists at key locations so that passengers are informed of rates in advance (see Annexure D).

- The shown in

related visual is Fig. 41.)



-----Apatani Ziro-Hapoli Tempo Association-----

FIXATION OF FARES ARE AS FOLLOWS: (PER TRIP)

DESTINATION	FARE RATE
1. Hapoli to Ziro	(General) - Rs. 40/- per head
2. Hapoli to Ziro	(Reserve) - Rs. 300/-
3. Within Hapoli Market	(Reserve) - Rs. 200/-
4. Hapoli to Medical line	(Reserve) - Rs. 200/-
5. Hapoli to Gas Gowdown	(Reserve) - Rs. 200/-
6. Hapoli to Siibey	(Reserve) - Rs. 200/-
7. Hapoli to Hilltop	(Reserve) - Rs. 250/-
8. Hapoli to Pare Ami	(Reserve) - Rs. 250/-
9. Hapoli to SSB gate	(Reserve) - Rs. 250/-
10. Hapoli to Duku	(Reserve) - Rs. 300/-
11. Hapoli to Gano	(Reserve) - Rs. 250/-
12. Hapoli to Siibey church	(Reserve) - Rs. 250/-
13. Hapoli to Bamin Michi	(Reserve) - Rs. 300/-
14. Hapoli to Mudang Tage	(Reserve) - Rs. 300/-
15. Hapoli to Dutta	(Reserve) - Rs. 300/-
16. Hapoli to Hong	(Reserve) - Rs. 300/-
17. Hapoli to Birrii	(Reserve) - Rs. 400/-
18. Hapoli to Taring	(Reserve) - Rs. 300/-
19. Hapoli to Hija	(Reserve) - Rs. 350/-
20. Hapoli to VKV Dobi	(Reserve) - Rs. 300/-
21. Hapoli to Hari	(Reserve) - Rs. 300/-
22. Hapoli to Miiring	(Reserve) - Rs. 350/-
23. Hapoli to Hanoko	(Reserve) - Rs. 400/-
24. Hapoli to Nago putu	(Reserve) - Rs. 400/-
25. Hapoli to Keelya	(Reserve) - Rs. 400/-
26. Hapoli to Syi Lake	(Reserve) - Rs. 350/-
27. Hapoli to Khanglaya (Hija)	(Reserve)

28. Hapoli to B.D.O office	(Reserve)	- Rs. 350/-
29. Hapoli to Joram top	(Reserve)	- Rs. 400/-
30. Hapoli to Bulla	(Reserve)	- Rs. 400/-
31. Hapoli to Shiviling	(Reserve)	- Rs. 400/-
32. Hapoli to Siiro Bridge	(Reserve)	- Rs. 400/-
33. Hapoli to Lempia	(Reserve)	- Rs. 400/-
34. Hapoli to Kasa Park	(Reserve)	- Rs. 400/-
35. Hapoli to Syi Popi	(Reserve)	- Rs. 600/-
36. Hapoli to Subu lapang (Hija)	(Reserve)	- Rs. 600/-
37. Hapoli to Siya Piro (Hari)	(Reserve)	- Rs. 600/-
38. Hapoli to Pine Grove	(Reserve)	- Rs. 600/-
39. Hapoli to Mani-Polyang	(Reserve)	- Rs. 600/-
40. Hapoli to ST. Claret College	(Reserve)	- Rs. 600/-
41. Hapoli to Poo- Joram	(Reserve)	- Rs. 700/-
42. Hapoli to Dilo-Polyang	(Reserve)	- Rs. 600/-
43. Hapoli to Suphyu	(Reserve)	- Rs. 600/-
44. Hapoli to Siikhe Lake	(Reserve)	- Rs. 600/-
45. Hapoli to Khogyo (Hong)	(Reserve)	- Rs. 500/-
46. Hapoli to Joram Baptist Church	(Reserve)	- Rs. 800/-
47. Hapoli to 73km	(Reserve)	- Rs. 1200/-
48. Hapoli to 13km	(Reserve)	- Rs. 1200/-
49. Hapoli to Jara	(Reserve)	- Rs. 1500/-
50. Hapoli to 16/Tachor Putu	(Reserve)	- Rs. 1800/-
51. Hapoli to Tallo	(Reserve)	- Rs. 2000/-
52. Hapoli to Yachuli	(Reserve)	- Rs. 2000/-
53. Hapoli to 20km	(Reserve)	- Rs. 2000/-
54. Hapoli to Yachuli College	(Reserve)	- Rs. 2100/-
55. Hapoli to Tago Hydel (	(Reserve)	- Rs. 2500/-
56. Hapoli to 23/25km	(Reserve)	- Rs. 2200/-
57. Hapoli to Yarlo	(Reserve)	- Rs. 2500/-

Apatani Ziro Hapoli Tempo Association			
1.	Ziro to Miiring	(Reserve)	- Rs. 600/-
2.	Ziro to Mani-Polyang	(Reserve)	- Rs. 700/-
3.	Ziro to Shivering	(Reserve)	- Rs. 700/-
4.	Ziro to Siro Bridge	(Reserve)	- Rs. 700/-
5.	Ziro to 13km	(Reserve)	- Rs. 1200/-
6.	Ziro to 16km	(Reserve)	- Rs. 1500/-
7.	Ziro to 20km	(Reserve)	- Rs. 1700/-
8.	Ziro to Water Treatment Plant	(Reserve)	- Rs. 500/-
9.	Ziro to Hakhe Tari	(Reserve)	- Rs. 1000/-
10.	Ziro to Tadarko (Linya)	(Reserve)	- Rs. 1500/-
11.	Ziro to Pamu Yalang	(Reserve)	- Rs. 500/-

Note:-

- Waiting charge shall be Rs. 200/- only per hour.
- One day (Reserve) shall be Rs. 3,000/- only (within Ziro)
- If any driver who violates the rate fixed by the association shall be imposed Rs. 2,000/- as fine.
- Above mentioned reserved fare rate is only meant for AZHTA
- Reserve charge of any goods carrier shall be extra charge @ 100/- (Rupees One Hundred) Only.
- A, B, C, so on indicate for member who have more than 1 (One) vehicle

Fig. 49: Transport Price Points for Tourist Destinations in Ziro Valley

Source: Primary field photograph of local transport fare chart, Ziro Valley, 2026.

