Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health

THESIS

SUBMITTED TO THE

FOREST RESEARCH INSTITUTE (DEEMED) UNIVERSITY

DEHRADUN, INDIA

FOR

THE AWARD OF THE DEGREE OF

DOCTOR OF PHILOSOPHY IN FORESTRY

(ENVIRONMENT MANAGEMENT)

By

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Under the Supervision of

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I hereby declare that the thesis entitled, **"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"** submitted by me (Registration No. 17PHD479) to Forest Research Institute (Deemed) University, Dehradun is a record of original research work. The research work embodied in this thesis has been carried out by me in the Department of Ecodevelopment Planning and Participatory Management at Wildlife Institute of India (WII), Dehradun, under the supervision of **Dr. Ruchi Badola**, Dean Faculty of Wildlife Science and Scientist-G, WII, Dehradun, and Co-supervision of **Dr. Syed Ainul Hussain**, former Scientist-G, WII. The empirical research integral to this thesis was undertaken in the expanse of Kaziranga National Park, Assam. The thesis is being submitted for the fulfillment of the degree of **Doctor of Philosophy in Forestry (Environment Management)** to the **Forest Research Institute (Deemed to be) University**. I also declare that the thesis embodies my own work, observation and analysis; and in those respects, the investigation appears to advance knowledge in the subject. The thesis has been duly evaluated for plagiarism through a plagiarism detection tool DrillBit approved by FRI (Deemed to be) University and is reported to be within the permissible limit. In addition, I declare that no part of this thesis has been submitted for any degree or diploma anywhere to the best of my knowledge.

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3. Name of Research Centre: - **Wildlife Institute of India, Dehradun**
4. The Topic of research approved by the FRI University: **"Role of provisioning and cultural ecosystem services of Protected Area in supporting human health."**
5. Name of Discipline: - **Environment Management**
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Awarded to

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in sincere appreciation for the valuable contribution
"Detailed assessment of how ecosystem services of protected areas support human health and well being"
presented as part of the **oral session**
"Ecosystem function and ecosystem services".

Coimbatore, India, July 02-06, 2023

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Dehradun, February 2024
Shashank Shekhar

Contents

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Acronyms

CBM: Cost Benefit Method

CES: Cultural Ecosystem Services

CITES: Convention on International Trade in Endangered Species

CVM Contingent Valuation Method

EDC: Eco-Development Committee

ES: Ecosystem Services

FAO: United Nations Food and Agricultural Organization

FRI: Forest Research Institute

GIS: Geographic Information System

HIA: Health Impact Assessment

IIFM: Indian Institute of Forest Management

INR: Indian Rupee

InVEST: Integrated Valuation of Ecosystem Services and Tradeoffs

IPCC: Inter governmental Panel on Climate Change

IUCN: International Union for Conservation of Nature

KNP: Kaziranga National Park

KZTR: Kaziranga Tiger Reserve

MA: Millennium Ecosystem Assessment

MEA: Millenium Ecosystem Assessment

NGO: Non-Government Organization

NPV: Net Present Value

NTFP: Non-Timber Forest Product

NWFP: Non-Wood Forest Product

PA's: Protected Areas

PES: Provisioning Ecosystem Services

PGIS: Participatory Geographical Information System

TCM: Travel Cost Method

TEEB: The Economics of Ecosystem and Biodiversity

TEV: Total Economic Value

UNEP: United Nations Environment Programme

UNESCO: United Nations Educational, Scientific and Cultural Organization

USD: United States Dollar

WII: Wildlife Institute of India

WP: Working Plan

WPI: Wholesale Price Index

WTA: Willingness to Accept

WTP: Willingness to Pay

Abstract

Ecosystem Services (ES) are vital ecological functions that contribute significantly to human well-being. This study explores the provisioning and cultural ecosystem services provided by Kaziranga National Park (KNP), a UNESCO World Heritage Site in Assam, India, and their role in supporting the health and well-being of local communities. Despite extensive research on the general benefits of natural environments, specific studies on protected areas and their direct health benefits are sparse. This research addresses this gap by assessing how KNP's ecosystem services influence human health and well-being.

The study aims to evaluate the multifaceted benefits of KNP, focusing on provisioning services such as fish, wild fruits, vegetables, and medicinal plants, as well as cultural services including recreation, aesthetic value, and traditional cultural practices. Methodologically, the research employs household surveys, interviews, economic valuation techniques, and ethnographic studies to gather comprehensive data on resource usage, cultural significance, and health outcomes. Data collection spans from 2018 to 2022, involving 750 households from 31 villages within KNP's zone of influence, along with a tourist survey of 379 individuals who visited KNP.

Key findings reveal that local communities heavily depend on resources from the vicinity of KNP, with significant economic and health benefits. Provisioning services such as fish and wild vegetables contribute substantially to food security and traditional healthcare, while cultural services enhance mental health and community cohesion. The study establishes a positive correlation between the use of these ecosystem services and improved health metrics, such as reduced disease incidence and better overall quality of life. Additionally, cultural engagement within the park correlates with higher household income and educational access.

The research underscores the critical role of natural ecosystems in supporting human health and advocates for integrated conservation and health policies. Sustainable management practices, community engagement, and technological advancements are recommended to preserve KNP's biodiversity and enhance its benefits. Future research should expand to include supporting and regulating services and assess the long-term impacts of climate change on KNP's ecosystem services.

In conclusion, this study highlights the significant socio-economic and health benefits derived from KNP's ecosystem services, emphasizing the need for policies that integrate environmental conservation with public health and community development. Kaziranga

National Park not only sustains ecological balance but also plays an integral role in the well-being of adjacent communities, advocating for a holistic approach to conservation and health planning.

Keywords: Ecosystem Services, Kaziranga National Park, Provisioning Services, Cultural Services, Human Health, Well-being, Protected Areas, Spatial Analysis, Sustainable Management, Community Engagement, Environmental Policy

Chapter 1
Introduction

1.1 Ecosystem Services: Nature's Essential Contributions to Human Well-being

'Ecosystem Services' (ES) are the ecological characteristics, functions, or processes that *directly or indirectly* contribute to human wellbeing; that is, the benefits that people derive from functioning ecosystems (Millennium Ecosystem Assessment, 2005; Costanza et al., 1997). The maintenance and improvement of human health and well-being can be referred to as the ultimate or cumulative ecosystem service (Sandifer & Sutton-Grier, 2014). Ecosystem services provided by natural settings and green places improve human health and wellbeing (Aerts et al., 2018). A substantial and expanding body of research shows that exposure to nature (including protected areas, forests, urban green space, etc.) can have significant positive effects on psychological and physiological health in addition to a host of other advantages (Sandifer et al., 2015). However, the research on the specific ecosystem services provided by protected areas in benefiting human health is significantly underexplored and often lacking (Dudley et al., 2018). By identifying and assessing the function of the provisioning and cultural ecosystem services of a protected area in supporting human health, this research intends to test the concept that protected areas support human health. The main objective is to assess the linkages between the provision of ecosystem services and the status of human health and well-being of the people who visit a protected area and those who live nearby. This chapter will introduce the study by first discussing the background and context, followed by the research problem, the research aims, objectives and questions, the significance, and finally the limitations.

1.2 Global Importance of Ecosystem Services

Ecosystem services, the benefits that humans derive from nature, are fundamental to our existence and well-being. These services are globally significant as they encompass a broad range of functions and resources that ecosystems provide, including provisioning, regulating, supporting, and cultural services. From the food we eat to the water we drink and the air we breathe, ecosystem services are integral to sustaining life on Earth.

At the heart of global sustainability challenges, ecosystem services play a pivotal role in underpinning economic activities. Provisioning services, such as the production of food,

fresh water, and raw materials, are the bedrock of agricultural and industrial sectors worldwide. Regulating services, like climate regulation, flood control, and pollination, are crucial for maintaining the balance of our environment and supporting agriculture, which is vital for food security. The loss or degradation of these services poses a significant risk to global food and water security, potentially leading to increased vulnerability to natural disasters and climate change impacts.

The global importance of ecosystem services is also reflected in their role in supporting biodiversity and ecological balance. Supporting services, such as nutrient cycling, soil formation, and primary production, are essential for the functioning of Earth's ecosystems. These services maintain the health and resilience of ecosystems, enabling them to withstand and recover from disturbances. The loss of biodiversity and ecological imbalance can have cascading effects on ecosystem functions and services, jeopardizing their ability to support human life.

Cultural services, including recreational, aesthetic, and spiritual benefits, enrich our lives by providing opportunities for tourism, leisure, and cultural experiences. These services contribute significantly to mental health and well-being, fostering a sense of connection to nature and cultural heritage. In a global context, cultural ecosystem services also play a role in supporting diverse cultural identities and practices, highlighting the importance of preserving natural landscapes and biodiversity for cultural continuity and heritage.

Furthermore, ecosystem services are inextricably linked to global efforts to address climate change. Ecosystems such as forests, wetlands, and oceans are critical carbon sinks, playing a key role in mitigating greenhouse gas emissions. The preservation and restoration of these ecosystems are vital strategies in global climate change mitigation efforts.

In summary, the global importance of ecosystem services cannot be overstated. They are essential for sustaining life, supporting economic activities, maintaining ecological balance, and enriching our cultural and spiritual lives. The protection and sustainable management of ecosystem services are thus imperative for ensuring the well-being of current and future generations, making it a central theme in global environmental and developmental policies.

1.3 Role of Protected Areas in Preserving Ecosystem Services

Protected areas, such as national parks, wildlife reserves, and natural sanctuaries, are instrumental in the conservation and preservation of ecosystem services on a global scale. These areas play a critical role in safeguarding the natural resources and ecological processes that provide essential services to humanity and the environment.

One of the primary roles of protected areas is in the conservation of biodiversity. By preserving a wide range of habitats, these areas maintain the ecological diversity necessary for the functioning of various ecosystem services. Biodiversity in protected areas contributes to the resilience of ecosystems, enabling them to adapt to environmental changes and disturbances. This is particularly important in the face of climate change, as diverse ecosystems are better equipped to cope with shifting climatic conditions and extreme weather events.

Protected areas also play a crucial role in the provision of regulating services. They help in climate regulation by conserving forests and other ecosystems that act as carbon sinks, absorbing significant amounts of carbon dioxide from the atmosphere. Furthermore, these areas are vital for water regulation and purification, as they often encompass watersheds that supply clean water to millions of people. The preservation of wetlands in protected areas, for example, is crucial for flood control, groundwater recharge, and the filtration of pollutants.

In terms of provisioning services, protected areas are reservoirs of a vast array of natural resources, including medicinal plants, timber, and genetic resources. These areas ensure the sustainability of these resources by protecting them from over-exploitation and habitat destruction. The conservation of such resources is not only crucial for ecological balance but also for the livelihoods of communities that rely on them.

The cultural services provided by protected areas are equally significant. These areas offer recreational and educational opportunities, contributing to human well-being and quality of life. They are spaces where people can connect with nature, which is essential for mental and physical health. Protected areas also hold cultural and spiritual significance for many communities, preserving landscapes that are integral to cultural heritage and identity.

Moreover, protected areas serve as living laboratories for scientific research and environmental education. They provide unique opportunities for studying ecosystems, wildlife, and conservation strategies, contributing to our understanding of ecological processes and how to manage them sustainably.

In conclusion, protected areas are vital for preserving ecosystem services that are essential for environmental sustainability and human well-being. They offer a multifaceted approach to conservation, balancing the need for resource use with the imperative to maintain ecological integrity. As such, protected areas are key to global efforts in biodiversity conservation, climate change mitigation, and sustainable development, making their continued support and expansion critical for future generations.

1.4 Study Background

Ecosystem services encompass the diverse array of advantages that are bestowed onto humanity by the natural environment. These services play a crucial role in ensuring our survival, enhancing our well-being, and contributing to the overall quality of our lives. The services provided by ecosystems can be categorized into four main groups: provisioning, regulating, supporting, and cultural services. The objective of this study is to examine provisioning and cultural ecosystem services of protected areas in supporting human health and well-being, their importance, and the imperative to conserve and improve them to foster sustainable growth within human civilizations.

Provisioning services refer to the physical products and resources that are obtained from ecosystems. The resources encompass essential elements such as sustenance, potable water, timber, fibres, and medicinal plants with healing properties. Ecosystems such as forests, wetlands, and oceans offer a diverse range of resources that serve as the fundamental basis for human nutrition, well-being, and sustenance. Crops, animals, and fish are fundamental sources of sustenance, while forests offer timber and non-timber resources that contribute to economic development.

Regulatory services refer to the inherent ecological processes that sustain the stability and resilience of ecosystems. Ecosystems provide valuable services in regulating climate, maintaining air quality, purifying water, mitigating erosion, managing pests, and facilitating pollination. As an illustration, woods play a crucial role in the regulation of the Earth's climate by sequestering carbon dioxide and emitting oxygen. Wetlands play a crucial role in the purification of water by effectively filtering contaminants, so enhancing the overall quality of water and safeguarding the integrity of aquatic ecosystems. In addition, insects, birds, and bats fulfil vital functions in the process of pollination and pest management, hence enhancing the overall efficiency and output of agricultural systems.

Supporting services refer to the fundamental ecological processes that facilitate the operation of ecosystems and the delivery of additional ecosystem services. The services encompass nitrogen cycling, soil formation, and primary production. The phenomenon of nutrient cycling involves the transformation and subsequent availability of vital elements, including nitrogen, phosphorous, and carbon, to sustain the needs of living organisms. The process of soil formation is a result of the interplay between many physical, chemical, and biological mechanisms, resulting in the development of a substrate that facilitates the growth

of plants. Primary production is the process through which plants convert sunlight into energy, serving as the fundamental source of energy within the food chain.

Cultural services pertain to the intangible advantages that individuals obtain from ecosystems. The values encompassed in this category consist of spiritual, aesthetic, recreational, and educational dimensions. Ecosystems such as forests, mountains, and oceans have served as sources of inspiration for spiritual and religious ideologies, while parks and gardens have been designated as areas for leisure, recreational activities, and social engagement. In addition, ecosystems present distinctive prospects for scientific investigation, environmental instruction, and ecotourism.

Ecosystem services play a crucial role in promoting human well-being and facilitating sustainable development. The recognition of the value of ecosystems is of utmost importance to effectively guide decision-making processes and inform the development of policies that are specifically designed to conserve and restore these ecosystems. Adopting integrated approaches that consider the diverse range of services offered by ecosystems is necessary in order to adequately address the demands of both current and future generations. This include the adoption of sustainable land management strategies, the preservation of biodiversity, and the advocacy for the rehabilitation of ecosystems that have been adversely affected. By implementing measures to safeguard and improve ecosystem services, we may make a valuable contribution towards the preservation of a sustainable planet and the promotion of a more prosperous future for all individuals.

The Millennium Ecosystem Assessment (2005) defines ecosystem services as “The benefits people obtain from ecosystems”. The maintenance of one's health is among the natural ecosystems' many valuable contributions to human well-being. The MEA divides ecosystem services into four main types. These are as follows:

i. Provisioning services
ii. Regulating services
iii. Cultural services
iv. Supporting services

The Provisioning services include products obtained from ecosystems, such as Food (agricultural production and harvest, livestock, capture and culture of marine and freshwater fish, Non-Timber Forest products), Raw materials (Biofuels, Fibre, Wood), Freshwater (Crops, Livestock, sustainable fisheries, healthy aquatic ecosystems are dependent), Medicinal resources (grassland, forest, aquatic plants, have medicinal benefits, e.g., Quinine, genetic

resources, fibre, and fresh water. The benefits derived from the regulation of ecological processes, such as the regulation of climate, water, and some human diseases, are referred to as Regulating services. The Cultural services are the non-material benefits that people receive from ecosystems such as spiritual enrichment, cognitive development, recreation, reflection, and aesthetic experience. The ecosystem services that are essential to produce all other ecosystem services, such as biomass production, soil formation and retention, nutrient cycling, and so on, are considered to as the Supporting services (Verma et al., 2015).

1.5 Conceptual Framework: Understanding the Linkages between Ecosystem Services and Health Outcomes in Kaziranga National Park

Overview

This section introduces a conceptual framework designed to elucidate the pathways through which the ecosystem services provided by Kaziranga National Park (Kaziranga NP) influence human health and well-being. By integrating key variables, pathways of influence, mediating/modifying factors, and feedback loops, the framework offers a comprehensive perspective on the dynamic interplay between natural ecosystems and community health outcomes.

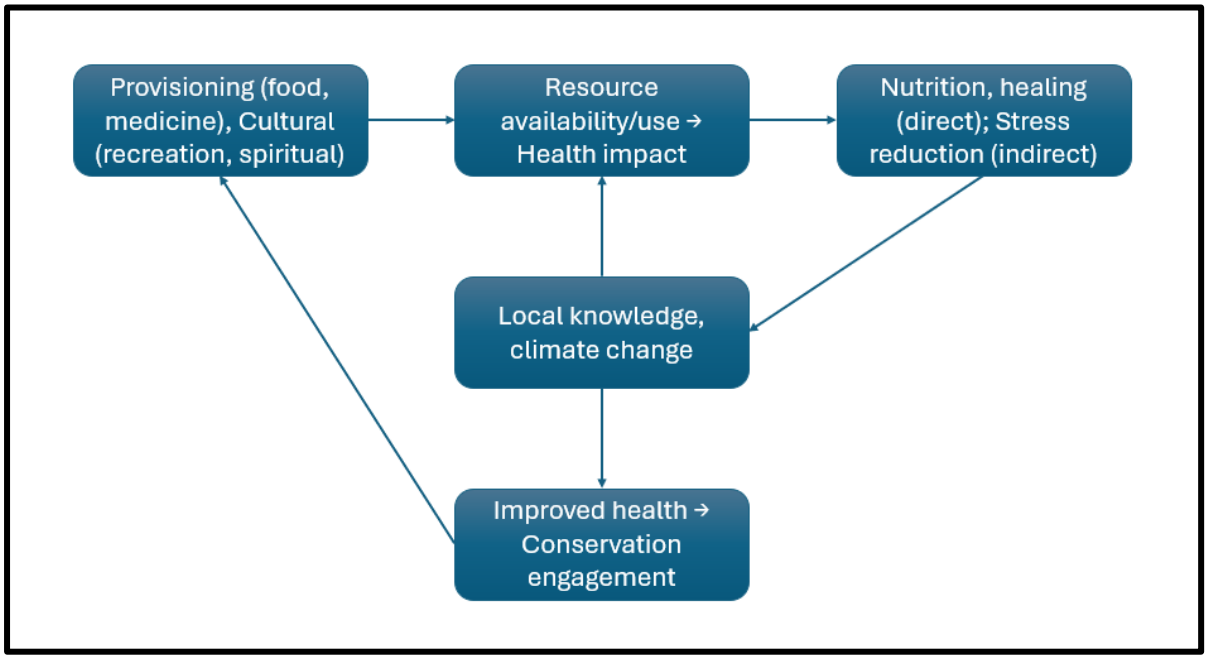

Figure 1.1: Conceptual Framework (Prepared by the Author)

1.5.1 Key Variables

i. **Ecosystem Services:** Defined as the benefits humans derive from nature, these are categorized into provisioning services (e.g., food, medicinal resources, and water) and cultural services (e.g., recreational, spiritual, and aesthetic values) provided by Kaziranga NP.

ii. **Health and Well-being Outcomes:** Encompassing both direct impacts (such as nutrition from food and healing from traditional medicines) and indirect impacts (like stress reduction from recreational activities and enhanced community cohesion from cultural practices).

1.5.2 Pathways of Influence

The framework delineates specific processes or sequences of events linking ecosystem services to health outcomes. An example pathway includes the sequence of the availability of medicinal plants in Kaziranga NP → their collection and utilization by local communities → preparation of traditional medicines → resulting in reduced prevalence of certain diseases or ailments.

1.5.3 Mediating or Modifying Factors

These factors either amplify or attenuate the impacts of ecosystem services on health outcomes. They include:

i. Local knowledge and practices that enhance the effective use of medicinal plants.

ii. External influences such as climate change that may impact the availability and efficacy of ecosystem services.

1.5.4 Feedback Loops

The framework incorporates feedback mechanisms where the health and well-being of the community can, in turn, affect the ecosystem. A healthier community might, for example, engage more actively in conservation efforts, promoting the sustainability of the park's biodiversity.

Example Application in Kaziranga National Park

1. **Ecosystem Service:** The park's diverse flora, including medicinal plants like *Centella asiatica* and *Azadirachta indica*, provides invaluable resources for local health practices.
2. **Pathway of Influence:** The collection and application of these plants by local communities lead to the creation of traditional remedies.

3. **Health Outcome:** There is a tangible reduction in the prevalence of specific diseases, showcasing the direct health benefits derived from the park's ecosystem services.
4. **Mediating Factor:** The depth of local knowledge concerning plant usage, alongside preparation techniques and dosages, significantly influences health outcomes.
5. **Feedback Loop:** Improvements in community health foster a heightened awareness and commitment to conservation activities, which in turn enhances the park's ecological integrity.

The conceptual framework for examining the "Linkages between the Ecosystem Services of Kaziranga National Park and Supporting Human Health and Well-being" establishes a structured approach to understanding how provisioning and cultural services from the park contribute to the physical and mental well-being of surrounding communities. It underscores the necessity for integrated approaches to conservation and public health planning, advocating for the protection of natural environments as a critical component of holistic health strategies.

1.6 Protected Areas and Health

International Union for Conservation of Nature, IUCN defines a protected area as “A clearly defined geographical space, recognized, dedicated, and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. These include but are not limited to National Parks, Wildlife Sanctuaries, Biosphere reserves, reserved and protected forests, tiger reserves etc.

Protected areas around the world vary greatly in their purpose, geographical features, and the level of protection they offer. These areas are designated to protect biodiversity, ecosystems, and cultural heritage. Here are several types of protected areas recognized globally:

1. **National Parks**: Large natural or near-natural areas set aside to protect large-scale ecological processes, along with the flora and fauna and cultural features of the areas. Examples include Kaziranga National Park in India, Serengeti National Park in Tanzania etc.
2. **Nature Reserves**: Areas designated to protect flora, fauna, geological or physiographical features, and are often important for scientific research and environmental monitoring.

3. **Wilderness Areas**: Large areas of unmodified or slightly modified land, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed to preserve their natural condition.
4. **Wildlife Sanctuaries**: Areas that provide habitat for animals to live in the wild with less human interaction. These sanctuaries are critical for protecting species from hunting, predation, or competition for resources.
5. **Marine Protected Areas (MPAs)**: Sections of oceans, seas, estuaries or large lakes that restrict human activity for a conservation purpose, often to protect natural or cultural resources.
6. **Protected Landscapes/Seascapes**: Areas where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological or cultural value.
7. **National Monuments**: Areas set aside to protect a specific natural, cultural, or historical feature.
8. **Habitat/Species Management Areas**: Areas managed mainly for conservation through management intervention.
9. **Protected Areas with Sustainable Use of Natural Resources**: Areas where natural resources are being used sustainably, such as managed resource protected areas.
10. **Indigenous and Community Conserved Areas (ICCAs)**: Areas conserved by indigenous peoples and local communities through traditional knowledge and practices.
11. **Transboundary Protected Areas**: Areas that span across national borders and are managed cooperatively by the involved countries for conservation purposes.
12. **Biosphere Reserves**: Regions comprising terrestrial, marine, and coastal ecosystems, recognized under UNESCO's Man and the Biosphere Programme to promote sustainable development based on local community efforts and sound science.
13. **Ramsar Sites**: Wetlands of international importance designated under the Ramsar Convention.
14. **World Heritage Sites**: Natural and cultural areas of outstanding universal value recognized as such and protected under the UNESCO World Heritage Convention.

These categories, among others, are defined by the International Union for Conservation of Nature (IUCN) and are used by international bodies and individual countries to classify and manage protected areas according to specific goals and standards. Each protected area plays a critical role in conservation efforts and can vary in size from small local habitats to vast landscapes spanning multiple countries.

The World Health Organisation (WHO, 1946) defines health as “a state of physical, mental, and social well-being and not merely the absence of disease or infirmity”. Health, or health and well-being, has also been shown to include a supportive environment, personal security, freedom of choice, social relationships, adequate employment and income, access to educational resources, and cultural identity (Millennium Ecosystem Assessment, 2005; Díaz et al., 2006).

The concept of health can be broken down into several components:

1. **Physical Health**: This relates to the body's ability to function properly. It includes factors such as physical fitness, nutrition, and the absence of diseases.
2. **Mental Health**: Mental health refers to a person's emotional, psychological, and social well-being. It affects how individuals think, feel, and act. It also helps determine how they handle stress, relate to others, and make choices.
3. **Social Health**: Social well-being involves the ability to form satisfying interpersonal relationships with others and to adapt comfortably to different social situations. It also refers to the level of support provided by family and within a community to ensure that every individual has the same opportunities.
4. **Spiritual Health**: For some, spiritual health is an important part of overall well-being and signifies a purposeful life or the search for meaning beyond oneself, which can be grounded in a particular faith, values, ethics, or morals.
5. **Emotional Health**: This is the ability to understand and manage one's feelings, to express emotions in a constructive way, and to cope with life's challenges and changes.
6. **Intellectual Health**: This encompasses cognitive abilities, educational background, and the capacity to think critically and creatively.
7. **Environmental Health**: This aspect of health refers to living in a clean and safe environment that is not detrimental to health. It involves the interaction of human health

with the environment, including air and water quality, exposure to pollutants and toxic substances, and other environmental conditions that could affect health.

8. **Occupational Health**: This concerns physical and mental well-being in relation to the workplace. Safety at work, job satisfaction, and work-life balance are components of occupational health.

The understanding of health has evolved over time and continues to expand, acknowledging the complex interplay between these various dimensions. Maintaining balance among these aspects is key to achieving and sustaining health throughout life. Health is also recognized as a resource for everyday life, not the objective of living, enabling people to live a rich, meaningful, and purposeful life.

1.6.1 One Health: A Multifaceted Approach to Ecosystem Services

The 'One Health' concept is pivotal in understanding the intricate relationships between human, animal, and environmental health. This approach, recognizing the interdependence of these spheres, is particularly relevant in the context of ecosystem services provided by protected areas.

In this study, 'One Health' serves as a framework to analyse how provisioning and cultural services of ecosystems directly impact human wellbeing, while simultaneously affecting wildlife and environmental conditions. For instance, the degradation of natural habitats in protected areas not only compromises the quality of ecosystem services but also poses risks to human and animal health, illustrating a 'One Health' dynamic.

Case studies, such as the management of national parks and wildlife reserves, demonstrate the practical application of 'One Health'. These examples reveal how conservation efforts, while primarily aimed at protecting biodiversity, also yield significant benefits for local communities' health and cultural identity.

Incorporating a 'One Health' perspective encourages a holistic view in our research. It prompts us to consider how policies and practices in managing protected areas can be optimized for the mutual benefit of humans, animals, and the environment. This approach aligns with the objectives of our study, emphasizing the need for integrated strategies in ecosystem management and public health.

The inclusion of 'One Health' in this thesis not only enriches our understanding of ecosystem services but also underscores the broader implications of our findings in shaping sustainable environmental and health policies.

1.7 Research Gap

There is a substantial body of work that explores the positive effects of protected areas on human health. However, there is a lack of study and sufficient literature on the direct and indirect advantages of specific ecosystem services provided by Protected Areas for human health. The integration of ecological services with human health is a nascent field, currently under investigation through various methodologies. Some recent studies have sought to establish a connection between the ecosystem services provided by protected areas and their impact on human health. One such study is the "Economic Valuation of Tiger Reserves in India: A Value+ Approach" conducted by the Indian Institute of Forest Management (Verma et al., 2015). Further investigation is necessary to completely understand and acknowledge the importance of ecosystem services in enhancing human health and well-being.

1.7.1 Research Problem

Ecosystem services provided by natural settings and green places improve human health and wellbeing. They enhance mental health, alleviate allergies, and lower mortality from all causes, including cancer, respiratory, and cardiovascular diseases. The extent to which green spaces are present, accessible, nearby, and green determines their positive health effects; nevertheless, the function of biodiversity in green spaces is still not fully understood (Aerts et al., 2018). Even though there have been studies done on a wide variety of benefits, the recreational, social, and spiritual benefits of interacting with nature have received much less attention than the benefits to physical health, cognitive performance, and psychological well-being. This is despite the fact that the recreational, social, and spiritual benefits have the potential to result in important health benefits. Although there are various experimental investigations, the majority of benefits have correlational evidence, and little is now understood about the mechanisms that are crucial for providing these health benefits (Keniger et al., 2013).

1.7.2 Research gap in the previous studies and significance of the present study:

There is ample evidence demonstrating the connection between biodiversity and the provision of ecosystem services as well as between exposure to nature and human health, however, many of these studies lacked sufficient precision and were frequently simply correlative. The information available to relate biodiversity and health is significantly lower. It is necessary to rethink land-use planning in a way that gives health and wellbeing of people utmost importance. To conduct research and create policies that encourage people to interact with

nature and biodiversity, there is a need for a new coalition of ecologists, health, and social scientists, and planners. If these areas are improved, it should have a positive impact on human health as well as the ecosystem, community, and human resilience (Sandifer et al., 2015).

While local environmental goods and services have received more attention recently (e.g., the value of ecosystem services and natural capital) (Anielski & Wilson, 2009; Costanza et al., 1997; Howarth & Farber, 2002), community and individual health values and benefits that visitors derive from visiting and engaging with protected areas have received less attention. Evidently, given the widespread popularity of protected areas as destinations for recreation and leisure (such as physical activity and relaxation) and the significant potential for promoting protected areas as regions that support human health and well-being, there is little research on the varied perceived health and well-being motivations and benefits associated with visitation, even less about particular management and policy measures and their impacts on subgroups (e.g., youth and the elderly, male and female, disabled people etc.) (Romagosa et al., 2015).

It is crucial to address this gap because currently, the economic assessment of ecosystem services highlights the significance of protected areas in promoting human well-being. However, when the assessment of ecosystem services includes human health, particularly as a specific parameter, the value of ecosystem services may significantly rise. The knowledge that protected areas play an important role in people's health and well-being will result in increased support for the conservation of protected areas from both the public and the government. This support will also contribute to the enhancement of the status of existing protected areas and the establishment of new ones. Numerous studies have investigated strategies and approaches to establish link between nature exposure and human health. However, these studies have traditionally focussed on overall benefits derived from ES on human well-being and do not specifically focus on identifying and assessing the health benefits directly obtained from ES of PA’s from visiting and or living in the vicinity of a protected area such as national parks. As a result, the existing research is inadequate for linking the direct and indirect health benefits of ecosystem services in supporting human health. This body of theory presents a direct relation of ES benefits on human health derived from existing protected areas. It is an initiative to link PA benefits on human health. Health benefits within and beyond protected area boundaries has been tried to identify and assessed.

1.7.3 Refinement of Research Problem:

The intricate relationship between ecosystem services and human health is encapsulated within the protected confines of Kaziranga National Park (KNP), a biodiversity hotspot of global importance. This study zeroes in on the park's provisioning and cultural ecosystem services, investigating their direct and indirect roles in supporting and enhancing human health. KNP's unique biodiversity and the interdependence of its ecosystem services with the local communities make it an ideal case study for this research. Understanding the provisioning services, such as food and raw materials, and cultural services, including recreational benefits and spiritual enrichment, is not just crucial for local health outcomes but also for the conservation strategies that preserve these vital resources.

The potential influence of this research on conservation and public health policies is profound. By identifying and quantifying the health benefits derived from KNP's ecosystem services, conservation strategies can be better aligned to support not only ecological integrity but also community well-being. This alignment could foster enhanced policy integration, uniting conservation efforts with public health objectives in a manner that reflects the One Health paradigm (an approach to public health and environmental management that recognizes the interconnection between people, animals, plants, and their shared environment).

Socio-economically, KNP is a linchpin for the surrounding human populations, offering services that underpin their livelihoods. The study will explore how these services contribute to the nutritional, medicinal, and economic aspects of human health and what the potential socio-economic repercussions would be should these services diminish. Such an exploration is vital for crafting sustainable development policies that are sensitive to the needs of both the environment and the local inhabitants.

Positioned at the nexus of environmental science and public health, the research aims to contribute to the interdisciplinary dialogue surrounding ecosystem services and health. It will build upon the framework set out by the Millennium Ecosystem Assessment, seeking to provide empirical evidence that reinforces the interdependence of ecosystem services and human health within the setting of a protected area.

In the broader context of climate change, this study will examine how the ecosystem services of KNP may serve as a buffer against climate-related health risks. The park's provisioning and cultural services may offer insights into how protected areas can be managed for climate resilience, thereby contributing to climate change mitigation and adaptation strategies on a wider scale.

The local insights garnered from KNP will be discussed for their global resonance, highlighting how local management of ecosystem services in one protected area can inform global biodiversity conservation and ecosystem service strategies. This global perspective is especially pertinent as the international community seeks sustainable solutions to preserve our planet's health and biodiversity.

Finally, the temporal dynamics of KNP's ecosystem services will be scrutinized to understand their enduring role in human health. Anticipating future shifts in these services is paramount for the proactive management of KNP, ensuring that it continues to support human health in an era of ecological uncertainty.

This research problem is precisely crafted to address the knowledge gap at the intersection of protected area management, ecosystem service provision, and human health. It aims to deliver insights that have practical, policy-driven, and globally relevant applications, emphasizing the need for protected areas to be managed not just for their intrinsic ecological value but also for their indispensable contributions to human health and well-being.

1.8 Aims and Objectives

This study aims to address the limited research on the contribution of specific ecosystem services derived from protected areas to human health. It will focus on identifying and assessing the potential of two specific ecosystem services, namely Provisioning and Cultural services, in supporting human health within a protected area. A case study was conducted on Kaziranga National Park to get practical insights into the correlation between the role of ecosystem services in protected areas and their contribution to human health.

Aim of the Research: The aim of this study is to comprehensively evaluate the ecosystem services provided by a protected area, focusing on both provisioning and cultural services, and to investigate the relationship between these ecosystem services and the health and well-being of the local communities residing in its vicinity. This study seeks to understand the multifaceted benefits that protected areas offer to the environment and human societies, thereby highlighting the integral role such areas play in sustaining both ecological balance and human health.

- **Objective 1:** To assess the provisioning ecosystem services of the protected area.
- **Objective 2:** To assess the cultural ecosystem services of the protected area.
- **Objective 3:** To assess the linkages between provision of ecosystem services and the status of human health and well-being of the people living in the surrounding of the protected area.

Research Questions:

1. **General Research Question:**
    i. How do protected areas contribute to the health and well-being of surrounding human populations?
2. **For Objective 1 (Provisioning Ecosystem Services):**
    i. What are the primary provisioning ecosystem services offered by the selected protected area?
    ii. How frequently do residents utilize these provisioning services?
    iii. Are there specific provisioning services that the local community is particularly dependent upon?
3. **For Objective 2 (Cultural Ecosystem Services):**
    i. What cultural, recreational, and spiritual interactions do local residents have with the protected area?
    ii. How do these cultural ecosystem services influence the daily lives and traditions of the local communities?
    iii. Are there quantifiable or qualitative benefits that the local community attributes to these cultural services?
4. **For Objective 3 (Linkage between Ecosystem Services and Health):**
    i. Is there a discernible correlation between the frequency of use of ecosystem services (both provisioning and cultural) and certain health metrics in the local community and tourists visiting the protected area?
    ii. How do residents perceive the role of the protected area in their overall health and well-being?
    iii. Are there noticeable health disparities between communities that are more engaged with the protected area versus those less engaged or located further away?
    iv. Can specific health benefits or challenges be directly attributed to the ecosystem services of the protected area?
5. **Contextual or Exploratory Questions:**
    i. How has the health and well-being of local communities changed over time in relation to changes in the protected area (e.g., changes in conservation status, accessibility, or resource abundance)?

ii. Are there external factors (e.g., socio-economic, cultural shifts, policy changes) that might influence the relationship between the protected area's ecosystem services and the health of local communities?

A comprehensive examination has been conducted to investigate the identification and assessment of the Provisioning and Cultural Ecosystem services of Kaziranga National Park, located in Assam. This study aims to address the aforementioned inquiries, fulfil the established objectives, and ultimately achieve the desired outcome.

1.9 Significance of the Study

This study will contribute to the body of knowledge on the linkages between Ecosystem Services specially the Provisioning, Cultural Ecosystem Services of a protected area and their role in supporting human health and well-being. It is a fresh approach to equate the benefits of ES of protected areas with impact on people's health. By giving ecosystem services a health value and assisting organisations in charge of managing protected areas to adopt new perspectives on relevance, this study will aid in addressing the existing dearth of research in this field. Till now the approach to directly link Ecosystem Services to people's health has not been taken in significant studies therefore the identification of the Provisioning and Cultural Ecosystem Services of Protected Areas and linking their significance to human health and well-being is an important area of research.

1.10 Scope and Limitations:

This study is circumscribed by certain parameters and constraints that delineate its breadth and depth. Firstly, the investigation is centred on a single case study, Kaziranga National Park, chosen due to the practical limitations imposed by the timeframe of this research. While this focused approach allows for an in-depth exploration of the park's ecosystem services, the inclusion of additional case studies across diverse protected areas could provide a broader understanding of the myriad ways in which such areas contribute to human health.

Secondly, the scope of this study is specifically tailored to examine the Provisioning and Cultural ecosystem services of Kaziranga National Park. Although this targeted examination yields valuable insights into the direct benefits that these services provide, the integration of Regulating and Supporting services in future research could offer a more comprehensive valuation and underscore the multifaceted role of ecosystem services in enhancing human health.

In terms of health parameters, the study evaluates the following dimensions among individuals residing in proximity to, and visitors of, Kaziranga National Park:

a. Psychological well-being
b. Exposure and regulation of air-borne diseases
c. Social relations and cohesion
d. Aesthetic appreciation and cultural, recreational, and spiritual engagement
e. Acquisition of tangible materials

The selection of these parameters is predicated on their relevance and feasibility within the context of this research. Nonetheless, an expansion to include additional health parameters could potentially enrich the findings, providing a more nuanced understanding of the health implications associated with ecosystem services provided by protected areas like Kaziranga National Park.

1.11 Structure of the Thesis

Chapter 1: Introduction

This chapter sets the stage for the research, presenting a comprehensive introduction to the study. It outlines the key themes, background, and the research problem, along with the aims, objectives, and questions guiding the investigation.

Chapter 2: Review of Literature

This chapter systematically reviews existing literature, defining the study's scope and delving into relevant themes such as ecosystem services, their classification, and the relationship between protected areas and human health.

Chapter 3: Study Area

Focusing on Kaziranga National Park, this chapter describes its climate, flora, fauna, human settlements, and the socio-cultural aspects of surrounding communities, highlighting their resource dependency and lifestyles.

Chapter 4: Research Methodology and Framework

This chapter discusses the methodologies and frameworks employed in the research. It details the approaches for data collection and analysis, setting the foundation for the empirical chapters that follow.

Chapter 5: Provisioning Ecosystem Services of Kaziranga National Park

Exploring tangible benefits from the park, this chapter presents the findings from the assessment of provisioning ecosystem services, including their current status and implications for the local population.

Chapter 6: Cultural Ecosystem Services of Kaziranga National Park

This chapter examines the intangible benefits derived from the park, discussing the methodologies used for assessment and presenting the results and their implications on local communities and visitors.

Chapter 7: Linkages Between the Ecosystem Services of Kaziranga National Park in Supporting Human Health and Well-Being

This chapter synthesizes the linkages between the park's ecosystem services and the health and well-being of the surrounding communities. It delves into how these services impact physical health, mental wellness, and social dynamics.

Chapter 8: Conclusions and Recommendations

The final chapter summarizes the key findings of the study, drawing conclusions about the integral role of Kaziranga's ecosystem services in supporting human health and well-being. It also provides recommendations for future research, policymaking, and strategies to enhance the benefits of these services.

Chapter 2

Review of Literature

2.1 Introduction to Ecosystem Services

'Ecosystem services' (ES) are the ecological characteristics, functions, or processes that directly or indirectly contribute to human wellbeing: that is, the benefits that people derive from functioning ecosystems (Costanza et al., 1997; Millennium Ecosystem Assessment (MEA), 2005).

Ecosystem functions are the conditions and processes occurring in natural ecosystems (Daily et al., 1997). Ecological services are those ecosystem functions that are perceived to support human welfare (Ehrlich and Ehrlich, 1992; Barbier, 1994; Costanza et al., 1997a; de Groot et al., 2002). Figure 1 shows the types of ecosystem services according to MEA, 2005.

The intricate relationship between ecosystem services and human health and well-being has emerged as a pivotal area of research in contemporary environmental studies. This literature review seeks to explore this relationship, with a specific focus on Kaziranga National Park (KNP), a renowned biodiversity hotspot and a critical conservation area in Assam, India. The review is intended to provide a comprehensive understanding of the multifaceted nature of ecosystem services and their indispensable role in shaping human health and environmental sustainability.

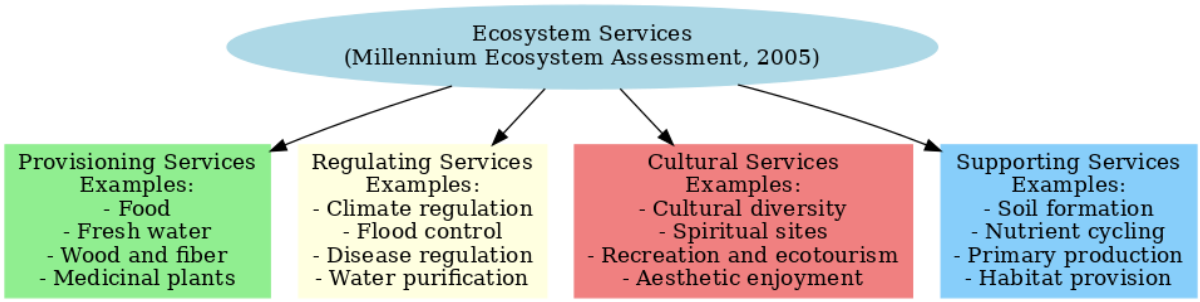

Figure 2.1: Types of Ecosystem Services According to MEA, 2005 with Examples

Human health and well-being are profoundly influenced by ecosystem services (ES), as delineated by the Millennium Ecosystem Assessment (MEA) in 2005, which categorizes these services into four main types: provisioning, regulating, supporting, and cultural. Forest ecosystems, in particular, play a vital role in providing a wide range of these services. Local communities are heavily dependent on provisioning services offered by forests, such as non-timber forest products (NTFPs) — including food, seeds, fruits, fodder, fuelwood, medicinal

resources, and natural fibres- as well as timber, all of which are fundamental to their lifestyles. Additionally, cultural services provided by forests, such as spiritual enrichment, recreation, and aesthetic appreciation, significantly elevate the quality of life for these communities.

Forests are also instrumental in offering supporting services that are crucial for the sustenance and enhancement of all other ecosystem services. These include but are not limited to, nutrient cycling and soil formation. Moreover, regulating services furnished by forest ecosystems play a critical role in maintaining ecological balance and human health by moderating essential ecosystem processes and functions, such as carbon sequestration, climate regulation, water purification, and mitigation of infectious diseases.

In essence, forest ecosystem services (FESs) not only bolster the health and well-being of local human populations but also contribute significantly to the preservation and enhancement of the natural ecosystem's health.

Forests encompass a diverse range of terrestrial biomes across the globe, including Tropical Forest Biomes, Savannas, Deserts, Grasslands, Temperate Deciduous Forests, Mediterranean Climate Biomes, Northern Coniferous Forests, and Tundras (Forseth 2010). Despite this diversity, tropical forests are particularly noted for their substantial contributions to forest ecosystem services (FES), notably in terms of genetic resources and water cycling (Anderson and Bojo,1992). In summary, according to the Millennium Ecosystem Assessment (MEA) of 2005, all four categories of ecosystem services—provisioning, regulating, supporting, and cultural—are essential for the sustainability of ecosystems and for maintaining the health and well-being of local communities.

2.2 Provisioning Services and Human Health

Protected areas globally are vital sources of provisioning services, contributing significantly to human well-being. These services include the supply of essential resources such as food, fresh water, and medicinal resources. Food sourced from these areas can range from fruits, nuts, and seeds to game and fish, integral to the dietary needs of surrounding communities. Fresh water from protected areas is crucial for drinking, irrigation, and sanitation. Additionally, many plants and natural substances found in these regions serve as foundational elements for traditional and modern medicines, playing a critical role in global health systems.

Empirical research has consistently demonstrated the direct benefits of provisioning services on human health (Suich et al., 2015; Sandifer et al., 2015). Studies have shown that communities relying on natural areas for their food and water supply tend to have better

nutritional outcomes compared to those that do not have similar access (Coad et al., 2008). This connection underscores the role of natural ecosystems in ensuring food security and combating malnutrition. Furthermore, the medicinal resources provided by these areas are crucial for healthcare: a significant percentage of pharmaceutical products are derived from natural compounds, highlighting the importance of biodiversity in medical research and healthcare (Howes et al., 2020; David et al., 2015).

With 70–95% of people in underdeveloped nations depending on traditional medicines for primary healthcare, forests have long been used as global repositories of herbal medicines (Robinson and Zhang, 2011). Ayurveda, or herbal medicine therapy, has long been used both in India and around the world. It is still regarded as an excellent source of treatment in the eastern world, particularly in Asia, and is believed to have started in India more than 3000 years ago (Britannica, 2019). Even in the current era of allopathic and advanced medicine, Indian ethnic communities continue to use herbal remedies extensively (Silambarasan et al., 2017; Singh et al., 2017). Senthilkumar and Murugesan et al. (2012) state that traditional medical methods in India employ over 44% of the identified species.

India also employs a variety of strategies for the preservation of therapeutic plants and their environments (Udayakumar et al., 2020). The potential for new drug developments and economic benefits to the livelihood of the local community from natural plant resources has been revealed by research on ethnomedicines in the Western Ghats, South India, Northeastern India, and other parts of India (Balamurugan et al., 2018; Raj et al., 2018; Tripathi & Mall, 2018; Silambarasan et al. 2017; Jaganmohan et al., 2018; Archana 2019; Hussain et al., 2019; Tamang et al., 2019; Zameer, 2021). Several research conducted in Assam also highlight the abundant supply of medicinal plants found in the area's wilderness, particularly in its protected regions (Baro et al., 2017; Yadav et al., 2018; Borah et al., 2020). Additionally, some research focuses on the traditional uses of medicinal herbs by native tribes including the Karbi and Sonowal Kachari, among others (Swargiary et al., 2019; Baidya et al., 2020; Dutta & Barooah, 2021). In summary, medicinal plant resources found in forests both inside and outside of protected areas are important for the medical and economic benefits they provide, in addition to maintaining the customs and cultural heritage of the surrounding populations. Planning for the conservation of FES must be integrated with biodiversity conservation and management strategies in order to preserve natural ecosystem services and functions while promoting human health and welfare.

The correlation between access to natural resources and physical health improvements is well-documented (Lachowycz and Jones, 2013). Access to clean water reduces the incidence of waterborne diseases (Pal, et al., 2018), (Cissé, 2019) while a diet rich in natural food products from contributes to better overall health, reduced obesity rates, and lower incidence of non-communicable diseases (Passi, 2017). Several studies have explored how communities engaged in traditional practices, such as fishing, hunting, or gathering in these areas, exhibit better physical health outcomes (Russell et al, 2013). This relationship not only highlights the tangible benefits of provisioning services but also emphasizes the importance of sustainable management of protected areas to ensure the continued availability of these critical resources.

2.3 Cultural Ecosystem Services and Human Health

Cultural ecosystem services encompass the non-material benefits that individuals and communities obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences (Vasiljevic et al, 2019; Fish et al., 2016). These services include, but are not limited to, the enjoyment of scenic landscapes, participation in recreational activities such as hiking and birdwatching, cultural heritage appreciation, and the obtaining of spiritual solace and inspiration from nature. These services are integral to human culture and values, providing a deep sense of place and identity.

Research has increasingly demonstrated the profound impact that engagement with nature has on mental health and well-being (Russell et al., 2013; Sandifer et al., 2015) (Howell et al., 2012). Recreational and cultural activities in protected areas are associated with significant health benefits, including stress reduction, improved mood, and increased psychological resilience (Sandifer et al., 2015; Barton et al., 2009). Studies indicate that time spent in natural settings can lower blood pressure, reduce cortisol levels, and enhance mood, contributing to overall mental and emotional well-being (Oh et al., 2017; Depledge et al., 2011). The psychological benefits derived from these interactions with nature are essential for promoting mental health and can complement traditional medical and therapeutic treatments (Walsh, 2011; Capaldi et al., 2015).

Several case studies highlight the role of cultural ecosystem services in enhancing community health and social cohesion (Jennings et al, 2016). For instance, community gardens in urban parks have been shown to foster social interactions among diverse groups, improving community engagement and collective well-being (Hou, 2017). Another example can be found in the use of national parks as therapeutic landscapes, where programs designed for veterans

or individuals with mental health issues utilize the healing aspects of nature (Havlick et al., 2021; Dustin et al., 2011). Additionally, cultural practices such as indigenous ceremonies and community festivals held in natural settings can strengthen cultural identity and social bonds, contributing to the social fabric and resilience of communities (Adom, 2019). These examples underscore the importance of preserving cultural ecosystem services not only for individual health but also for the well-being and cohesion of communities at large.

2.4 Health Benefits of Interaction with Nature: Protected Area Benefits

In this section, we delve into the multifaceted relationship between ecosystem services and human health, with a particular focus on the varied benefits provided by natural environments. To illustrate this, we present a comprehensive typology of health benefits associated with interaction with nature. This typology is updated from the foundational works of Sandifer et al. (2015) and Keniger et al. (2013), incorporating recent research findings and broadening the spectrum of considered benefits.

Table 2.1 below organizes these benefits into distinct categories, such as Mental Health, Cognitive, Physiological, Disease Exposure and Regulation, Social, and Aesthetic, Cultural, Recreational, and Spiritual, among others. Each category is detailed with a brief description or exposition of the benefits, supported by relevant illustrations or case studies, and an anthology of references. This organization aims to provide a clear and comprehensive overview of how engagement with nature and natural areas, exemplified by locales like Kaziranga National Park, contributes to various dimensions of human health.

Through this typology, we aim to underscore the intrinsic value of natural environments in enhancing physical, mental, and social well-being, thereby advocating for the conservation and sustainable management of these areas. The following table encapsulates the extensive research that links the experience of being in nature with a wide array of health benefits.

Table 2.1: Typology and Instances of How Being in Nature[a] Has Been Linked to Health Benefits - Updated from Sandifer et al. (2015) and Keniger et al. (2013) with More Categories, Examples, and Citations.

[a] The term "nature" is used here to refer to a wide range of natural and semi-natural environments, including parks, forests, wildlife sanctuaries, seascape vistas, and comparatively undeveloped landscapes, as well as plants and other living things.

S.No.	Advantages	Exposition/summary/synopsis /Brief description	Illustrations/Case studies	Anthology of allusions/ references
1.	**Mental Health**	Beneficial impact on mental processes as well as behaviour	Mental well-being	(Catanzaro and Ekanem, 2004; Curtin, 2009; Kamitsis and Francis, 2013; Kaplan, 2001; Maller et al., 2006; Moore et al.,2006; Nisbet et al., 2011; Sugiyama et al., 2008; Pretty, 2004)
			Restoration of attention/perception of restorativeness	(Hartig and Staats, 2006; Kaplan and Kaplan, 1989; Tyrvainen et al., 2014; White et al., 2010; White et al., 2013)
			Reduced symptoms of despair, despondency, ire, hostility, aggression, frustration, and stress	(Kuo and Sullivan, 2001a; Morita et al., 2007;

		Park et al., 2011)
	Elevated self-confidence	(Kaplan, 1974; Maller, 2009; Pretty et al., 2007, 2005)
	Positive or enhanced emotional state	(Tyrvainen et al., 2014; Park et al., 2011; Pretty et al., 2005; Coon et al., 2011; Cracknell, 2013; Driver et al., 1991; Hartig et al.,1996; Shin et al., 2011; Ten Wolde, 1999; Tsunetsugu et al., 2013; Wyles et al., 2014; Lee et al., 2014)
	Decreased stress and anxiety	(Park et al., 2011; Pretty et al., 2005; Lee et al., 2014; Chang and Chen, 2005; Maas et al., 2009a;

		Song et al., 2014)
	Enhanced prosocial conduct or enhanced behaviour	(Han, 2009; Zhang et al., 2014)
	Enhanced prospects for contemplation	(Fuller et al., 2007; Herzog et al., 1997)
	Enhanced energy and stamina/reduced tiredness	(Nisbet et al., 2011; Tyrvainen et al., 2014; Park et al., 2011; Pretty et al., 2005; Song et al., 2014; Ryan et al., 2010)
	Enhanced ingenuity	(Tyrvainen et al., 2014)
	Enhanced happiness	(MacKerron and Mourato, 2013)
	Enhanced tranquillity, relaxation, and rejuvenation	(Park et al., 2009)
	Better body image for women	(Hennigan, 2010)
	Diminished Attention Deficit Hyperactivity Disorder (ADHD) in children	(Kuo and Taylor, 2004; Taylor et al., 2001)
	Enhanced children's social and emotional well-being and sense of value	(Maller, 2009; Wells and Evans, 2003)

			Enhancement of the quality of life	(Song et al., 2012)
2.	**Cognitive**	Positive impact on cognitive capacity or performance	Restoration of attention	(Fuller et al., 2007; Herzog et al., 1997; Bodin and Hartig, 2003; Han, 2010; Hartig et al., 1991)
			Less mental and physical exhaustion	(Kuo and Sullivan, 2001; Park et al., 2011; Fjeld et al., 1998; Kuo, 2001)
			Decreased ambiguity	(Park et al., 2011; Pretty et al., 2005)
			Enhanced scholastic achievement/educational attainment/learning prospects	(Blair, 2009; Matsuoka, 2008; Taylor and Kuo, 2006; Wu et al., 2014)
			Enhanced cognitive abilities	(Shin et al., 2011; Berman et al., 2008)
			Enhanced cognitive abilities in children	(Wells, 2000)
			Enhanced efficiency, proficiency, and positive attitude in the workplace.	(Bringslimark et al., 2007; Lottrup et al., 2013)

3.	**Physiological**	Beneficial impact on physical function and/or physical well-being	Enhanced overall well-being	(Moore et al., 2006; de Vries et al., 2003; Maas et al., 2006; Maller et al., 2009; Mitchell and Popham, 2007)
			Health/well-being perception	(Sugiyama et al., 2008; de Vries et al., 2003; Maas et al., 2006)
			Decreased morbidity/ sickness/cough/sick leave	(Han, 2009; Fjeld et al., 1998; Bringslimark et al., 2007; Mitchell and Popham, 2008)
			Reduced stress/fewer illnesses linked to stress/enhanced physiological functioning:	(Lottrup et al., 2013; Hansmann et al., 2007; Hartig et al., 2003; Moore, 1982; Parsons et al., 1998; Thompson et al., 2012; Ulrichet al., 1991; Van Den Berg and

		Custers, 2011; West, 1995; Yamaguchi et al., 2006)
	Decreased cortisol levels (which indicate a decrease in stress)	(Song et al., 2014; Thompson et al., 2012; Van Den Berg and Custers, 2011; Park et al., 2007, 2010; Tsunetsugu et al., 2007)
	Decreased blood pressure	Pretty et al., 2005; Tsunetsugu et al., 2013; Lee et al., 2014; Maas et al., 2009a–no effect, Song et al., 2014–no effect, Park et al.,2009, 2010; Tsunetsugu et al., 2007
	Decreased death rate caused by diseases related to the circulatory and respiratory systems	(Mitchell and Popham, 2008; Villeneuve et

		al., 2012; Lachowycz and Jones, 2014)
	Decreased headaches/pain	(Moore et al., 2006; Hansmann et al., 2007)
	Decreased mortality as a result of financial hardship	(Maas et al., 2009a, 2006; de Vries et al., 2003; Mitchell and Popham, 2008; Wheeler et al., 2012)
	Lower death rates from stroke	(Wilker et al., 2014)
	Decreased incidence of intestinal illness, upper respiratory tract infections, asthma, and other inflammatory diseases	(Lynch et al., 2014; Rook, 2013, 2010; Maas et al., 2009a; Haahtela et al., 2013; Hanski et al., 2012; Debarry et al., 2007; Ege et al., 2011)
	Decreased prevalence of obesity	(Astell-Burt et al., 2014a)– women only, (Pereira et al., 2013a)

	Enhanced recuperation from surgical procedures, illnesses, or traumatic events	(Ulrich, 1984)
	Enhanced rehabilitations from addiction	(Bennett et al., 1998)
	Reduced incidences of cardiovascular and respiratory ailments	[(Pereira et al., 2013a; Richardson and Mitchell, 2010)–men only]
	Decreased heart rate or pulse	(Cracknell, 2013; Tsunetsugu et al., 2013; Lee et al., 2014; Song et al., 2014; Park et al., 2009, 2010; Tsunetsugu et al., 2007)
	Attenuation of sympathetic nerve activity	(Tsunetsugu et al., 2013; Lee et al., 2014; Song et al., 2014)
	Elevated parasympathetic nervous system activity	(Tsunetsugu et al., 2013; Lee et al., 2014; Song et al., 2014)
	Elevated concentrations of natural killer cells and anti-cancer proteins	(Li et al., 2008a, 2008b, 2007)

			Reduced blood glucose levels in individuals with diabetes	(Ohtsuka et al., 1998)
			Reduced incidence of Type 2 diabetes	(Astell-Burt et al., 2014b)
			Increased physical activity	(Bird, 2004; Depledge and Bird, 2009; Wells et al., 2007)
			Decreased exposures to pollution	(Pretty et al., 2011)
			Prolonged life expectancy	(Takano et al., 2002)
			Enhanced health of children	(Maas et al., 2009a)
			Diminished occurrences of premature births and infants with low birth weight	(Hystad et al., 2014)
			Overall health, recuperation, and improved health in coastal areas	(Wheeler et al., 2012; Fortescue Fox and Lloyd, 1938)
4.	**Disease exposure and regulation**	Possibility of lowering the incidence of infectious diseases	Decrease in the transmission and propagation of certain infectious diseases, particularly certain diseases that can be transmitted between animals and humans (zoonotic).	[(Bonds et al., 2012; Derne et al., 2011; Ezenwa et al., 2006; Keesing et al., 2006; Laporta et al., 2013; Pongsiri et al., 2009; Salkeld et al.,

				2013)–no effect of biodiversity, (Wood and Lafferty,2013; Ostfeld and Keesing, 2012; Wood et al., 2014)–no general effect of biodiversity]
5.	**Social**	Positive impact at the individual, community, or national level	Enhanced or facilitated social interaction	(Coley et al., 1997; Kingsley and Townsend, 2006; Sullivan et al.,2004)
			Fosters social empowerment	(Westphal, 2003)
			Diminished levels of hostility, crime rates, violence, and fear	(Kuo and Sullivan, 2001b)
			Promotes interethnic or inter-racial communication and engagement.	(Shinew et al., 2004)
			Promotes the strengthening of social bonds and the provision of assistance within a community.	(Moore et al., 2006; Kingsley and Townsend, 2006; Maas et al.,2009b)

6.	**Aesthetic, cultural, recreational, spiritual**	Enhancement of cultural and spiritual well-being	Appreciation of aesthetics	(Lindemann-Matthies et al., 2010)
			Enhanced inspirations	(Fredrickson and Anderson, 1999)
			Elevated states of spiritual wellness	(Curtin, 2009; Kamitsis and Francis, 2013; Williams and Harvey,2001)
			Enhanced enjoyment of leisure activities	(Wyles et al., 2014; MacKerron and Mourato, 2013; Bird, 2004; Schuhmann et al., 2013)
7.	**Tangible materials**	Material goods and benefits	Provision of food, raw resources, medicines, and other commodities	(Bernstein, 2014; Chivian and Bernstein, 2008; Kaplan, 1973; TEEB, 2010)
			Contribution to advancements in the field of biomedicine	(Bernstein, 2014; Chivian and Bernstein, 2008)
			Rise in property/housing value; monetary gain	(White et al., 2010; TEEB, 2010;

				Bolitzer and Netusil, 2000; Kroeger and, 2006 2008; Melichar and Kaprova, 2013; Pearson etal., 2002)
			The monetary worth of recreation	(Rees et al., 2010; Shrestha et al., 2007; Southwick Associates, 2011)
8.	**Increased resiliency**	Resilience of individuals and communities to endure and maintain well-being in the face of challenges	Environmental consciousness and actions promoting sustainability	(Nisbet et al., 2011, 2009; Wyles et al., 2014; Mayer and Frantz,2004; Wyles et al., 2013)
			Provision of ecosystem services essential to human health and welfare	(Sandifer and Sutton-Grier, 2014; Diaz et al., 2006; Haines-Young and Potschin, 2010)
			Provision of ecosystem services that promote community well-being and foster resilience in communities	(Sandifer and Sutton-Grier, 2014; Rogers, 2013; Tzoulas et al.,2007)

2.5 Interlinkages Between Provisioning, Cultural Services, and Health

The relationship between provisioning and cultural ecosystem services reveals complex interdependencies that significantly impact human health. While provisioning services such as food, fresh water, and medicinal resources directly support physical health, cultural services contribute to mental and emotional well-being. However, there can be trade-offs; for example, the over-exploitation of natural resources for food or medicinal purposes might degrade the natural landscapes, thereby diminishing the recreational and aesthetic values that are central to cultural services (Wassie, 2020). Conversely, strict conservation measures to preserve scenic beauty or cultural heritage might restrict access to vital provisioning services (Tallis et al., 2008). Understanding these dynamics is crucial for managing ecosystems in a way that optimizes both types of services, thereby promoting overall health and well-being.

The interlinkages between provisioning and cultural ecosystem services underscore the concept of holistic health, which encompasses physical, mental, and social well-being. For instance, access to clean water and nutritious foods (provisioning services) is fundamental to physical health, but the role of natural environments in providing spaces for relaxation, recreation, and cultural activities (cultural services) is equally important for mental health. Furthermore, the shared use of ecosystem services can foster a sense of community and belonging, enhancing social well-being. Integrating the management of provisioning and cultural services can thus lead to comprehensive health benefits, highlighting the importance of adopting an ecosystem-based approach to health and well-being. This integrated perspective not only acknowledges the multifaceted contributions of ecosystem services to health but also emphasizes the need for sustainable management practices that support both the natural environment and human health.

2.6 Challenges and Gaps in Current Research

Despite the growing body of research on the impact of protected area ecosystem services on health, several gaps and conflicting findings persist. One significant gap is the lack of longitudinal studies that provide clear causal links between ecosystem services and health outcomes. Much of the current research relies on cross-sectional or case study approaches, which can suggest correlations but not causality. Additionally, there is a disparity in the geographic distribution of studies, with a concentration in high-income countries, leading to an

underrepresentation of data from low- and middle-income countries where the dynamics may differ significantly.

Conflicting findings have also arisen, particularly regarding the extent to which different ecosystem services contribute to various aspects of health and well-being. For example, while some studies report significant mental health benefits from cultural services, others find minimal or context-dependent effects. These inconsistencies may stem from variations in study design, population characteristics, or definitions and measurements of health outcomes.

Furthermore, the existing literature on ecosystem services provides a comprehensive understanding of their significance and impact. However, certain areas remain under-explored, especially in the context of specific regions like Kaziranga National Park (KNP). In their study, Dudley et al. (2018) examined the significance of protected areas in addressing various socio-economic requirements and established a connection between this function and the preexisting international commitments outlined in the Convention on Biological Diversity and the UN Framework Convention on Climate Change. Emphasis was placed on the prioritization of research pertaining to protected areas, specifically focusing on conducting a detailed assessment of how ecosystem services of protected areas support human health (Dudley et al., 2018).

Quantifying and valuing the contributions of ecosystem services to health outcomes pose significant challenges (Pascual, 2012; Gómez-Baggethun, 2013). One of the primary difficulties is the intrinsic complexity of ecosystems and the multifaceted ways in which services can affect health. This complexity makes it hard to isolate the specific contributions of individual services to health and to quantify these effects in a standardized manner.

Furthermore, there is a lack of universally accepted methodologies or metrics for valuing ecosystem services in terms of health outcomes. While economic valuation techniques such as contingent valuation or cost-benefit analysis are commonly used, they may not capture the full spectrum of health benefits, particularly those related to mental and social well-being. Additionally, cultural differences in valuing nature and health benefits can lead to variability in assessments and make cross-cultural comparisons challenging.

These challenges underscore the need for interdisciplinary approaches that integrate ecological, medical, and social sciences to develop comprehensive and context-sensitive methods for evaluating the health impacts of ecosystem services. Addressing these gaps and challenges is crucial for advancing our understanding of the relationship between protected

area ecosystem services and human health, thereby informing more effective conservation and public health strategies.

2.7 Theoretical Frameworks and Methodological Approaches

The study of the relationship between ecosystem services and human health is underpinned by various theoretical frameworks that guide research and application. One prominent framework is the ecosystem service cascade framework, which conceptualizes the flow from ecosystem structures and processes through ecosystem services to human well-being, allowing for the identification and valuation of the services that contribute to health (La Notte et al., 2017). Another critical framework is the One Health approach, which emphasizes the interconnectedness of human, animal, and environmental health, suggesting that the health of each is intrinsically linked to the others (Prata et al., 2021). This approach is particularly relevant for understanding how changes in ecosystems, such as biodiversity loss or pollution, can have direct and indirect impacts on human health.

Research in the field of ecosystem services and human health employs a variety of methodological approaches and tools. Geographic Information Systems (GIS) are widely used to map and analyze the spatial relationships between ecosystems and health outcomes, providing visual and quantitative evidence of how geographic proximity to ecosystem services impacts health. Participatory assessments, including community surveys and stakeholder interviews, are essential for understanding the perceived value and impact of ecosystem services on local populations' health and well-being (Verma et al., 2017).

In addition to these, other tools such as ecosystem service modeling and valuation techniques are employed to quantify the benefits provided by ecosystems and to assess their economic value. Life Cycle Analysis (LCA) and Cost-Benefit Analysis (CBA) are also applied to evaluate the health impacts of changes in ecosystem services, allowing policymakers to make informed decisions that balance economic development with health and environmental sustainability.

By integrating these diverse theoretical frameworks and methodological approaches, researchers can provide more comprehensive insights into the complex relationships between ecosystem services and human health, informing more effective conservation and public health strategies.

2.8 Conclusion

This literature review has systematically examined the intricate relationship between ecosystem services and human health, with a special emphasis on the protected areas, exemplified by Kaziranga National Park (KNP). The review elucidated how provisioning, regulating, supporting, and cultural ecosystem services collectively contribute to physical, mental, and social well-being, thereby underscoring the indispensable role of natural environments in sustaining human health.

Key findings from the literature highlight the critical contributions of protected areas to human health through the provision of essential services such as clean water, nutritious food, and medicinal resources. Furthermore, cultural services provided by these areas, including spiritual enrichment, recreation, and aesthetic enjoyment, have been shown to significantly enhance mental and emotional well-being. The synthesis of this body of research underscores the fundamental link between ecosystem integrity and human health, reinforcing the notion that conservation efforts not only protect biodiversity but also support key determinants of human well-being.

However, the review also identifies notable gaps and challenges in current research, particularly concerning the need for longitudinal studies to establish causal relationships and address the underrepresentation of data from low- and middle-income countries. The conflicting findings on the extent to which different ecosystem services contribute to health outcomes highlight the complexity of these interactions and the variability across different contexts and populations.

Given these insights, future research should focus on addressing the identified gaps by:

1. Conducting longitudinal and multidisciplinary studies to better establish causality and understand the mechanisms through which ecosystem services impact health.
2. Expanding research efforts to encompass a broader range of geographic settings, particularly those in underrepresented regions, to enhance the generalizability and applicability of findings.
3. Developing and standardizing methodologies for quantifying and valuing the health benefits of ecosystem services, considering cultural and regional differences.
4. Exploring the synergies and trade-offs between different types of ecosystem services to inform integrated conservation and public health strategies.
5. Investigating the role of protected areas like KNP in promoting resilience and adaptability in the face of environmental changes and public health challenges.

In conclusion, the review underscores the critical role of protected areas' provisioning and cultural services in supporting human health and highlights the importance of integrating ecosystem conservation with public health objectives. By fostering an interdisciplinary approach that bridges ecology, public health, and social sciences, we can enhance our understanding of the complex relationships between natural environments and human well-being, thereby informing more holistic and effective conservation and health interventions.

Chapter 3

Study Area

3.1 Introduction to the Study Area: Kaziranga National Park

Kaziranga National Park (KNP), a UNESCO World Heritage Site located in the Northeastern state of Assam, India, spans across the floodplains of the Brahmaputra River. Covering an area of approximately 430 square kilometres, KNP is renowned for its rich biodiversity and unique landscape. This section introduces KNP, emphasizing its geographical significance, ecological diversity, and conservation status. It details the park's location, including its coordinates, and outlines its key physical features such as the diverse range of habitats it encompasses. The introduction also highlights KNP's role in supporting a vast array of wildlife, including its status as a vital habitat for the endangered Indian one-horned rhinoceros. The section sets the foundation for understanding KNP's critical role in ecosystem services, its socio-economic importance to local communities, and its relevance to the broader environmental and conservation discourse.

3.2 Site specification

3.2.1 Location and Landscape

Kaziranga National Park (KNP) is located in the central region of Assam and remains one of the few remaining regions in eastern India that has not been affected by human activity. The national park is home to the greatest population of one-horned rhinoceroses in the world, along with numerous species like tigers, elephants, panthers, and bears, as well as a diverse array of thousands of birds. KNP is a prominent example of conservation strategies employed to safeguard biodiversity. Thanks to conservation efforts, the rhinoceros' population has surged from a mere 40 individuals in 1911 to over 2000 in 2009. The location of the area is within the floodplains of the powerful Brahmaputra River, which has shaped the entire region through processes of erosion, accretion, and silt deposition caused by the river systems that run through or around it. The tiger reserve, spanning across Nagaon, Golaghat, and Sonitpur districts of Assam, has annual floods. It encompasses an area of little over one thousand square kilometers, with a core zone of 482 km2 and a buffer zone of 548 km2. The national park is named after the Karbi language, where the term 'Kazi' refers to 'Goat' or 'Deer', while 'Rangai' means 'Red'. Consequently, the name signifies 'the territory of red goats or deer'.

Figure 3.1: Kaziranga National Park (Photo by Author)

KNP encompasses a variety of distinct habitat types and ecological complexes. These habitats include low-lying areas with short grassland, patches of short grass surrounded by tall grasslands, patches of short grass within open woodlands, moist and wet areas with tall grasses, drier areas with predominantly imperata cylindrical grasses, open woodlands dominated by lagerostromia-bombax trees and tall grasses, closed woodlands with undergrowth of cane, swampy aquatic habitats in permanent water bodies known as 'beels', aquatic habitats in the Difalu and Mora Dhansiri rivers, aquatic habitats in the Brahmaputra River, newly formed landmasses in and near the Brahmaputra river, and forested habitats in Kukurakata and Panbari Reserve Forests. These habitat complexes are interconnected and mutually dependent, forming

a complimentary system. The tree woods of KNP are located at higher elevations in the center and eastern parts of the tiger reserve.

Approximately 60% of the land in KNP consists of tall grass. Short grasslands are primarily located in the open areas adjacent to the beels, which are flooded during the monsoon and become dry in winter. These grasslands consist of loamy soils. Approximately 5% of the entire land area of KNP is occupied by beels and streams, not including the portion occupied by the Brahmaputra River during periods of low water levels. The submerged area experiences a significant surge during the monsoon season as a result of inundation. The Kaziranga National Park employs managed burning as a method to preserve the vegetation structure and avoid the encroachment of tree forests by halting the natural progression of grassland succession. This is done to provide a sufficient amount and optimal nutritional content of the food supply (namely grass) for the diverse population of herbivores. Despite the abundant regeneration that takes place in the national park, the seedlings are annually burned by controlled fires, so halting any further progress. The annual flood, in conjunction with fire, plays a vital role in halting the process of soil growth by eroding the topsoil and depositing new silt.

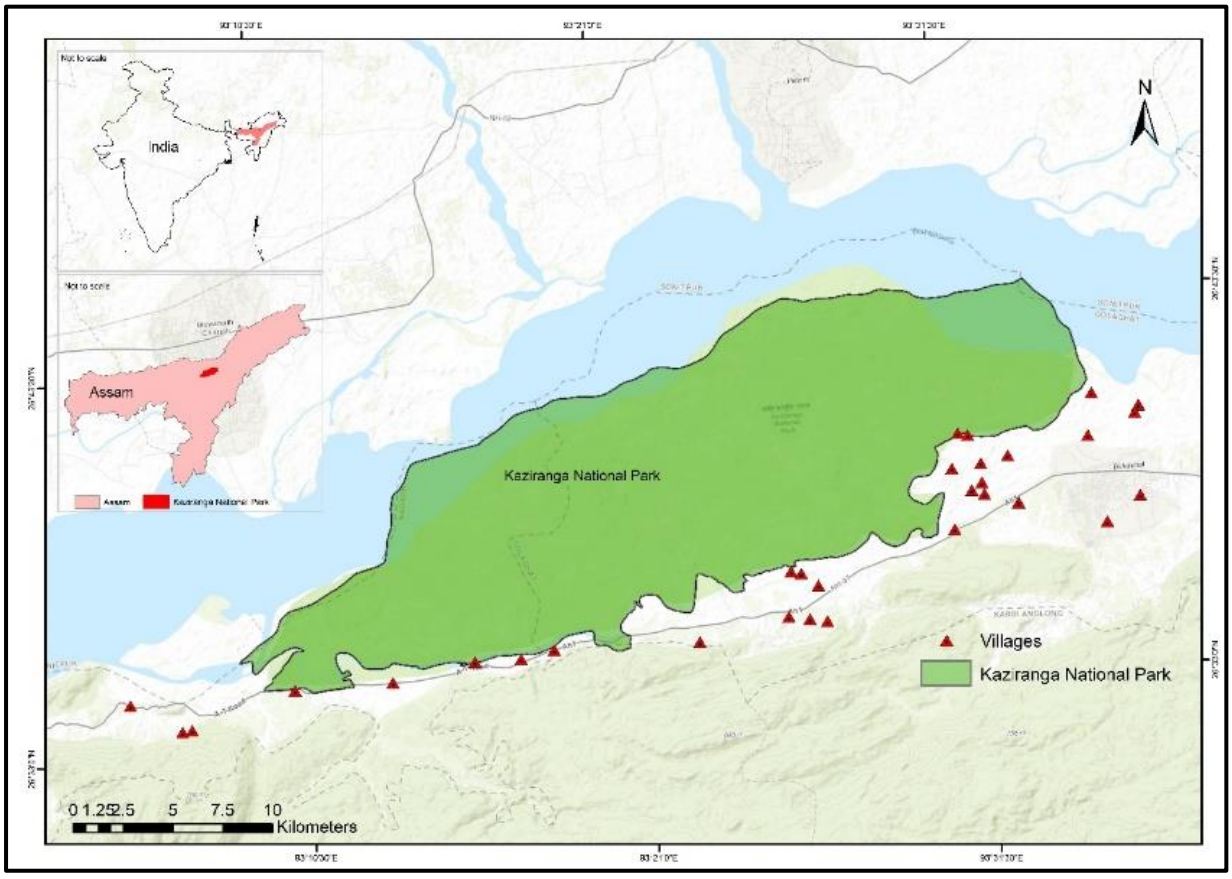

Figure 3.2: Map of the Study Area with Survey Sites (Prepared by the Author)

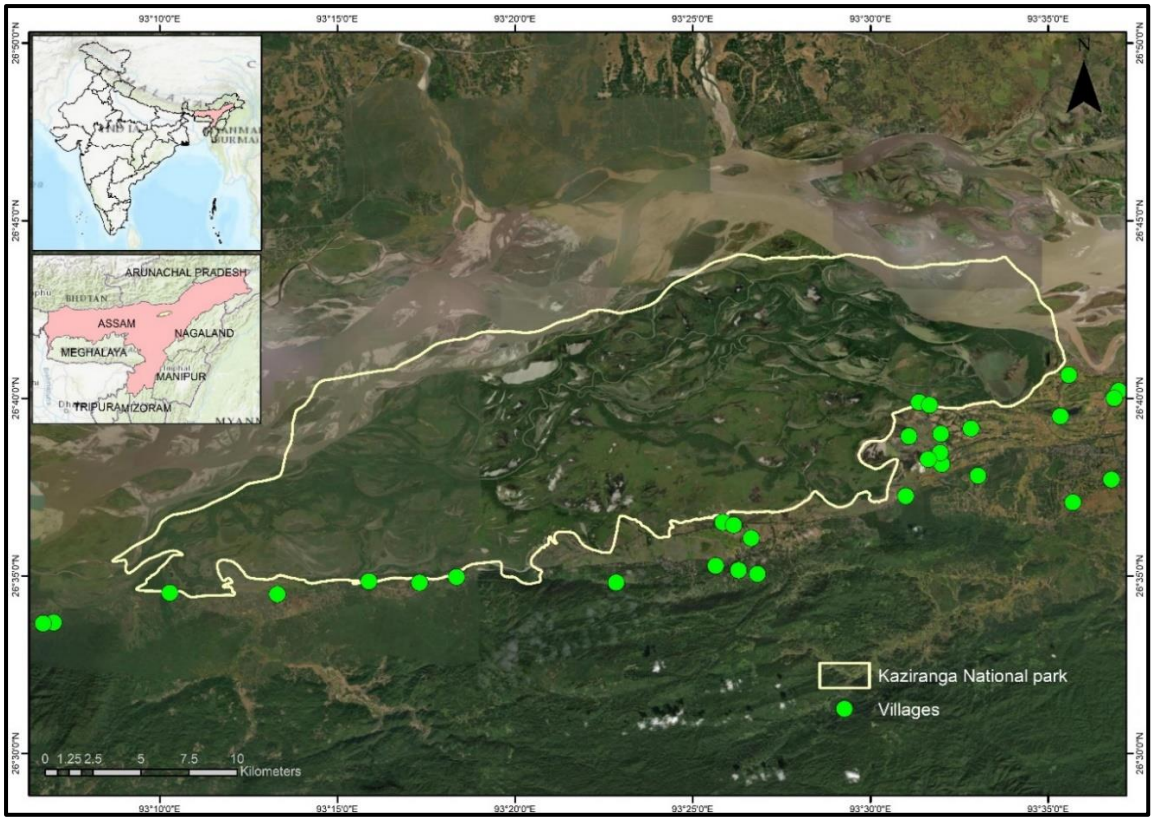

Figure 3.3: Satellite View of the Study Area with Survey Sites (Prepared by the Author)

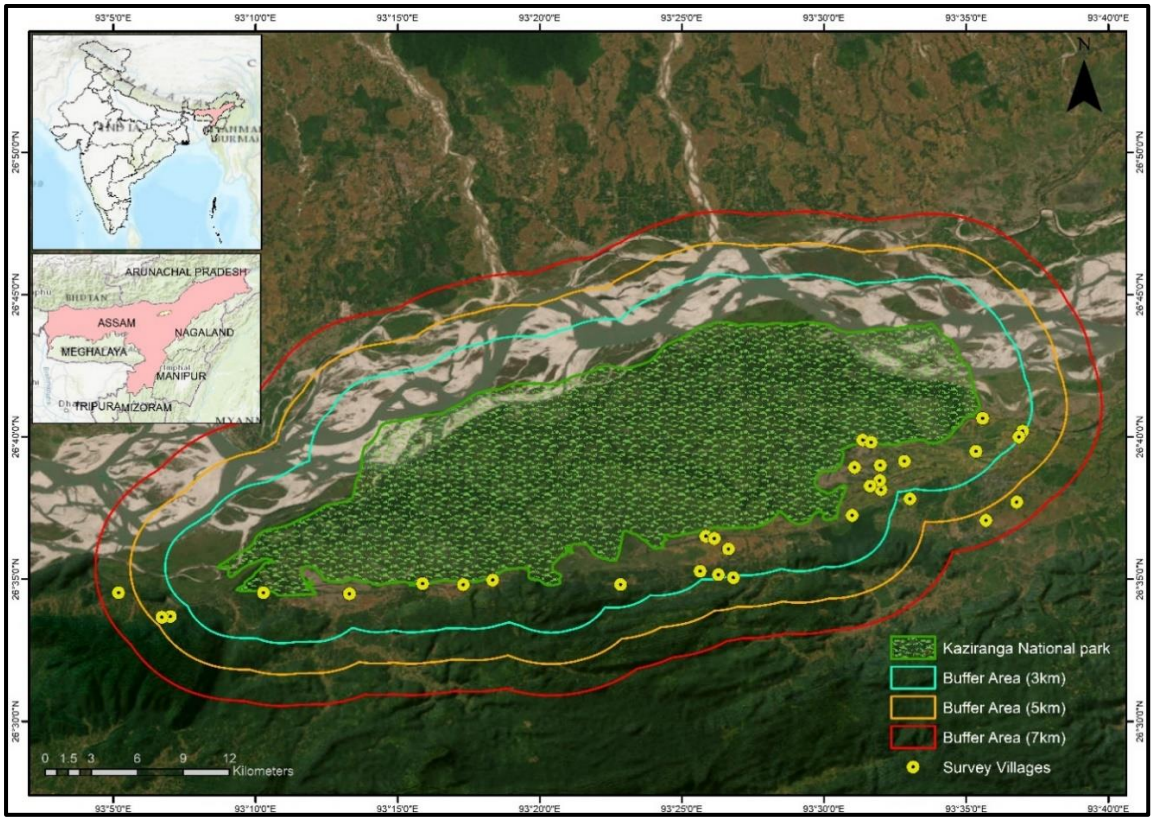

Figure 3.4: Satellite View of the Study Area with Survey Sites and Buffer Areas of 3, 5 and 7 Km (Prepared by the Author)

3.2.2 Historical Background of Kaziranga National Park

Kaziranga National Park, nestled in Assam, India, is a renowned sanctuary for the one-horned rhinoceros. Established initially as the Kaziranga Proposed Reserve Forest in 1905, it transformed into a game sanctuary in 1916, a wildlife sanctuary in 1950, and finally, a national park in 1974. It gained UNESCO World Heritage status in 1985, further solidifying its global significance.

The park's history is marked by conservation milestones and challenges. Early efforts by Baroness Mary Curzon led to its initial protection, focusing on the dwindling rhino population. Over the years, the park expanded, facing opposition from local communities and tea planters concerned about their rights and livelihoods.

Post-independence strengthened conservation laws and measures like the Rhinoceros Bill of 1954 and the Assam National Park Act of 1968 helped protect its diverse fauna. Despite challenges like poaching and environmental threats, such as flooding, the park's management strategies have evolved. These include anti-poaching measures, habitat management, and initiatives to mitigate human-animal conflicts.

Today, Kaziranga stands as a testament to successful wildlife conservation, balancing ecological integrity with local and global interests.

Figure 3.5: Way to Kaziranga National Park (Photo by Author)

3.2.3 Physical Characteristics of Kaziranga National Park, Assam

Kaziranga National Park, a UNESCO World Heritage Site, is located in Assam, India, and spans across Golaghat, Nagaon, and Sonitpur districts. It covers an area of approximately

884.43 sq. km. The park's geographical coordinates are between 26°30' to 26°45' N latitude and 93°08' to 93°36' E longitude.

Climate: Kaziranga experiences a subtropical monsoon climate with high humidity. Annually, it receives about 1881 mm of rainfall, predominantly from May to September. The summer months, particularly July and August, see temperatures ranging from 37°C to 41°C. Winters, particularly December and January, have minimum temperatures around 5-6°C. The park's relative humidity can exceed 90% during the monsoon, while sunshine varies between 8 hours in summer and 5 hours in winter.

This climatic pattern, combined with the park's unique topography, plays a vital role in shaping its diverse ecosystems and wildlife habitats.

Topography: Kaziranga National Park, characterized by its flat topography with an east-west gradient, is situated in the fertile floodplains of the Brahmaputra River. This results in nutrient-rich alluvial soil, conducive to rich biodiversity. The park is interlaced with several small water channels and rivers, flowing east to west. A significant river, the Diphlu, cuts through the park, and there are more than 250 seasonal water bodies within its boundaries. These water bodies, mainly originating from the Karbi Anglong Hills to the south, flow northward, feeding into the expansive Brahmaputra River, thereby enhancing the park's aquatic ecosystem.

The park is traversed by multiple minor rivers and channels that travel from east to west. Additionally, some of these waterways originate from the Karbi Anglong hills to the south and flow northwards, eventually emptying into the Brahmaputra River. Remnants of previous waterways persist as shallow oxbow lakes, sometimes referred to as 'beels' in the area. Certain bodies of water have accumulated sediment, resulting in the formation of wetlands and marshes. As a result, there has been a rise in the extent of tall grass and a decrease in the extent of short grass. This slow transformation will have significant ecological ramifications in the future (Barua and Sharma, 1999).

3.2.4 Biodiversity of Kaziranga National Park

Flora: Kaziranga National Park, with its varied forest types including wet alluvial grasslands, semi-evergreen forests, and swamp forests, houses a rich tapestry of plant life. The park's grasslands are dominated by tall elephant grasses and other species like Imperata cylindrica and Saccharum spontaneum. The forests contain a variety of tree species including Bombax ceiba, Albizzia, and Dillenia indica. The park's dynamic ecosystem, influenced by annual Brahmaputra floods, supports over 550 plant species including several medicinal plants.

According to Champion and Seth's (1968) revised forest type classification, the vegetation of Kaziranga National Park comprises six different forest types. These forest types are as follows:

1. Eastern wet alluvial grasslands
2. Assam alluvial plains semi-evergreen forests
3. Tropical moist mixed deciduous forests
4. Eastern Dillenia swamp forests
5. Wetlands
6. Sandy 'chaurs'

Almost 23% of the Kaziranga National Park habitat is occupied by grassland that comprises both short and characteristic extensively grown elephant grasses. The species of grassland and reeds present in the park are *Imperata cylindrica, saccharum spontaneum, Erianthus ravennae, Arundo donax, Phragmites karka, Imperata arundinacea, Neyraudia reynaudiana, Typha elephantina etc.* The remainder of the park is occupied by wetlands and patchy evergreen forests with sporadic canebrakes. Included among the plant species present in the forest patch are the following: *Bombax ceiba, Albizzia sp., Crataeva religiosa, Aesculus pandana, Premna latifolia, Premna bengalensis, Lagerstromia parviflora, ,Lagerstromia speciosa, Trewia nudiflora, Tetrameles nudiflora, Stereospermum chelonoid, Alstonia scholaris, Spondias Mangifera, Vitex peduncularis, Vitex trifoliate, Dysoxylum procerum, Eugenia sp., Ehretia acrominata, Chikrasiatabu laris, Ficus cuneata, Ficus glomerata, Ficus religiosa, Ficus bengalensis, Bischofia javanica, Dillenia indica, Pterospermum acerifolium, Cedrela toona, Anthocephalus chinens, Bridelia retusa, Kydia calycina, Sterculia villosa, Terminalia belerica, Litsea polyantha, Sterculia alata, Artocarpus chaplasba, Oroxylum indicum, Salix tetrasperma, Talauma hodgsonii, Wrightia tomentosa, Holorrhena antidysentrica, Aesculus punduna, Schima wallichi, Gmelina arborea, Randia domatorum, Erythrina indica, Polyalthia jenkinsii, Laportea crenulate, Phlogocanthus curriflora, Melastoma sp. Alpinia ulughas, Clinogunae dichotoma, Calamas sp. Rauwolfia serpentina, Solanum ferox, Solanum indicum, Xanthium strumarium, Ageratum conizoides, Eupatorium odoratum, Mimosa pudica, Amaranthus spinosus, Flamengia sp. Clerodendron infortunatum, Colocasia esculenta, Aesehunomen indica, Cassia tora, Polygonum sp. Adhatoda vesica, Coffea bengalensis etc.* Some of the climber species includes *Vitis latifolia, Paederia foetida, Ichnocarpus frutescensa, Cardiospermum halicaebum, Mikenia spp. Similax vaginata, Mucuna bracteate, Trichoganthes dioica, Tinospora cordifolia, Ficus scandens* etc. Due to the annual flood of river Brahmaputra

every year the vegetation types of the park may change. The newly formed landmasses are colonized by species of plants such as *Sccharum spontaneum, Imperata cylindrica, Erianthus filifolius, Saccharum narenga, Neyraudiana reynaudiana, Cymbopogon pendulus* etc. The aquatic and semi-aquatic plant species that are present in the water bodies of the park include *Andropogon sp. Ipomea repans, Enhydra fluctuans, Pistia strafioles, Lemna panciostata.* Kaziranga National Park contains a total of 550 plant species that have been recorded which also includes several medicinal plants.

Fauna: The park is renowned for the 'Big Five' - the Rhinoceros, Royal Bengal Tiger, Asian Elephant, Asiatic Wild Buffalo, and the Eastern Swamp Deer, hosting the world's largest population of the Greater One-Horned Rhinoceros and a significant population of Eastern Swamp Deer. It's also a refuge for diverse mammals like leopards, sloth bears, langurs, and primates like Hoolock gibbons, along with reptiles such as pythons, cobras, and monitor lizards. Kaziranga's avian diversity is notable with over 500 bird species, including endangered species like the Bengal Florican and Black-breasted Parrotbill (Vasu, 2003).

Figure 3.6: Big Five at Kaziranga National Park (Image Credit: Govinda Bora)

Kaziranga National Park is famous for the Big Five namely the Rhinoceros (Rhinoceros unicornis), Royal Bengal Tiger (Panthera tigris), Asian Elephant (Elephas maximas), Asiatic Wild Buffalo (Bubalus arnee) and the Eastern Swamp Deer (Rucervus duvauceli ranjitsinhii). It has the largest population of Greater One Horned Rhinoceros, more than 2/3rd of the world's population. It contains almost entire population of Eastern Swamp Deer. It has high density of tigers in the wild. Kaziranga National Park supports immense floral and faunal biodiversity. Kaziranga has rich faunal diversity. There are 35 species of mammals, 480 of birds, 17 of turtles, 35 of snakes, 24 of frogs, and 42 of fishes have been recorded. *Hylobates hoolock* a primate ape species is present in Karbi-anglong foothills. Leopard (*Panthera pardus*), Sloth bear (*Melarsus ursinus*), Common langur (*Presbytes entellus*), Capped langur (*Presbytes pileatus*), Rhesus monkey (*Macaca mulatta),* Assamese macaque (*Macaca assamensis*), Indian porcupine (*Hystrix Indica*), Hog badger (*Aratonyx collaris*), Fishing cat (*Felis viverrine*), Gangetic dolphin (*Platinista gangetica) etc.* The reptilian species found in the park include python (*Python molurus*), Indian cobra (*Naja naja*), king cobra (*Ophiophagus hannah*), water monitor lizards (*Varanus salvator*), Indian gharial (*Gavialis gangeticus*), various species of Turtles and Tortoises etc. (Vasu, 2003).

There are more than 500 species of resident and migratory birds that are found in the park which also includes critically endangered *Houbaropsis bengalensis* species. Some other threatened bird species includes Swamp francolin (*Francolinus gularis*), Lesser White-fronted Goose (*Anser erythropus*), Ferruginous Pochard (*Aythya nyroca*), Baer's Pochard (*A. Baeri*), Blyth's Kingfisher *(Alcedo hercules)*, Pale-capped pigeon *(Columba punicea)*, Nordmann's Greenshank *(Tringa guttifer)*, Black bellied tern *(Sterna acuticauda)*, Pallas's Fishing Eagle *(Haliaetus leucoryphus)*, Greater spotted eagle *(Aquillaclanga)*, Imperial Eagle *(A. Heliaca),* Lesser Kestrel *(Falco naumanni)*, White-bellied Heron *(Ardea insignis)*, Spot-billed Pelican *(Pelecanus phillippensis)*, Dalmatian Pelican *(P. Crispus)*, Greater Adjutant stork *(Leptoptilosdubius),* Lesser adjutant stork *(L. Javanicus)*, Hodgson's Bushchat *(Saxicola insignis),* Rufous-vented prinia *(Prinia burnesii),* Bristled Grassbird *(Chaetornis striatus),* Marsh Babbler *(Pellorneum palustre),* Jerdon's Babbler *(Chrysomma altirostre),* Black-breasted Parrotbill *(Paradoxornis flavirostris)* and Finn's Weaver *Ploceus megarhynchus)* (Vasu, 2003).

3.3 Ecosystems and Habitats

Kaziranga's diverse ecosystems ranging from grasslands and wetlands to dense forests, create habitats for an array of wildlife. These ecosystems play a crucial role in maintaining ecological

balance and supporting biodiversity. The park's wetlands are vital for numerous fish species and provide crucial breeding grounds for birds. The grasslands are essential for large herbivores like rhinos and elephants, while the forests provide shelter and food for a variety of mammals and birds. Kaziranga's unique landscape, shaped by the Brahmaputra River, offers a perfect blend of ecological habitats crucial for wildlife conservation.

3.4 Socio-Economic Context of Kaziranga National Park

The area surrounding Kaziranga National Park is a melting pot of diverse communities, including various ethnic groups like the Karbi, Mishing, and Assamese. These communities, with their distinct demographic features, have historically coexisted with the rich biodiversity of the park. Their livelihoods are intricately linked to the park, often relying on agriculture, fishing, and forest produce, which forms the backbone of their economic sustenance. In recent years, eco-tourism has emerged as a significant source of income, providing employment opportunities, and fostering a sense of ownership and responsibility towards conservation.

Figure 3.7: Women Working on Handloom at Kaziranga Orchid Park (Photo by Author)

Figure 3.8: Tea Garden Near KNP (Photo by Author)

Human habitation is absent inside the central region of the tiger reserve (Vasu, 2013). Nevertheless, the 2nd and 3rd Addition exhibit signs of human occupancy, while the 5th and 6th Addition contain campgrounds and livestock camps. Moreover, there exist over 150 revenue villages located within a 5-kilometer radius from the southern perimeter of the tiger reserve. The primary ethnic groups residing in these villages consist of the Mishing, Karbi, Nepali, Tea Garden tribes, and Muslims. The creation of the Kaziranga Tiger Foundation has enabled and assisted efforts to meet the developmental requirements of the surrounding people by establishing and managing Eco-Development Committees (EDCs). Agriculture is the main economic activity for individuals living in buffer areas or zones of influence, encompassing around 80% of the total land area. The region on the southern and southeast side of the core

zone of KZTR has roughly 600 km^2 of land and is home to around 14 enormous tea gardens as well as numerous tiny tea plantations. In addition to tea, paddy is cultivated in the majority of the remaining regions. Typically, two paddy crops are cultivated in the region, one during the rainy season and the other during winter. Although livestock production is common in the region as a means to supplement income, it is not extensively practiced. Several developmental initiatives are implemented within and in the vicinity of KZTR to benefit the surrounding populations. There are a total of 33 EDCs, which oversee and implement developmental activities, including more than 8,000 households (Directorate KZTR, 2014). These EDCs have a direct association with over 40,000 individuals.

Moreover, Kaziranga holds immense cultural significance for these communities. It's a land steeped in folklore and tradition, where the natural landscape and its fauna are deeply integrated into the cultural fabric. The park is not just a biodiversity hotspot but also a repository of cultural heritage, with festivals, rituals, and practices that have evolved around the unique ecosystem. This symbiotic relationship underscores the need for conservation strategies that are sensitive to the socio-economic realities of these local communities, ensuring that their way of life is preserved while maintaining the ecological integrity of Kaziranga.

3.5 Ecosystem services of Kaziranga National Park

Kaziranga National Park, recognized as a reservoir of biodiversity, offers a plethora of ecosystem services that are integral to environmental sustainability and economic vitality. As per the Millennium Ecosystem Assessment Framework, the park's provisioning services, which include employment generation, agriculture, fishing, and the harvesting of fuelwood and fodder, are estimated at a substantial 3490.00 million Indian Rupees per year (Verma et al., 2015). These services underscore the park's role in supporting the livelihoods of local communities, providing sustenance, and protecting the genetic diversity of the region's flora and fauna. Additionally, the extraction of timber and other forest produce, when managed sustainably, contributes to the socio-economic welfare of the indigenous populations.

The regulating services of Kaziranga National Park, valued at 6244.38 million Rupees annually, highlight its critical ecological functions such as carbon sequestration, water purification, sediment retention, and nutrient cycling. These services are foundational in mitigating environmental challenges like climate change and soil erosion, thereby maintaining the delicate balance of the ecosystem. Furthermore, the park's cultural services, although comparatively modest in economic valuation at 21.50 million Rupees per year, play a profound role in preserving cultural heritage, enabling recreation and spiritual tourism, and facilitating

research, education, and nature interpretation. Collectively, these services not only enrich human well-being but also fortify the conservation efforts, showcasing the park's multifaceted contributions to the region and beyond (Verma et al., 2015).

This comprehensive valuation based on the IIFM Report on Economic Valuation of Tiger Reserves in India (2015) illuminates the extensive benefits that Kaziranga National Park confers upon both the environment and the communities that interface with its rich landscapes.

Table 3.1: Summary of Ecosystem Services based on Millennium Ecosystem Assessment Framework (Flow Benefits) (Source: IIFM, Economic Valuation of Tiger Reserves in India, 2015)

Type of Value	Services	Value	Unit
Provisioning Services	employment generation, agriculture, fishing, fuel wood, grazing / fodder, timber, non-wood forest produce, gene-pool protection	3490	₹ million / year
Regulating Services	carbon sequestration, water provisioning, water purification, sediment regulation / retention, nutrient cycling / retention, biological control, moderation of extreme events, pollination, nursery function, habitat / refugia, gas regulation, waste assimilation	6244.38	₹ million / year
Cultural Services	cultural heritage, recreation, spiritual tourism, research, education and nature interpretation	21.5	₹ million / year

3.6 Tourism in Kaziranga National Park

Tourism plays a pivotal role in the conservation and management of Kaziranga National Park (KNP), one of India's most treasured wildlife sanctuaries. Over a span of fourteen years, the park has not only witnessed a remarkable growth in visitor numbers but has also seen a corresponding increase in revenue generation. Starting with 106,051 visitors in the fiscal year 2008-09, KNP has experienced a significant rise in tourism, culminating in 275,835 visitors in 2021-2022. This increment is a testament to the park's escalating allure as a top-tier destination for those passionate about wildlife and natural beauty. Accompanying this surge is a revenue increase from roughly 11.22 million Indian Rupees in the initial year of the study to a striking

63.92 million Rupees in the concluding year, demonstrating KNP's capability to not only draw tourists but also to efficiently enhance its revenue streams, which are vital for ongoing conservation efforts.

Figure 3.9: Tourism in Kaziranga National Park (Image Credit: Govinda Bora)

While the overall trend in tourism and revenue is one of growth, the journey has not been without its ebbs and flows. A notable dip in tourist numbers was recorded in the year 2017-18, with the count dropping to 85,612, resulting in a decrease in revenue to 26.73 million Rupees. Such fluctuations can often be attributed to a variety of causes, including seasonal climatic variations, infrastructural developments, or changes in the socio-economic landscape of the region. Nevertheless, the overarching pattern remains one of progressive increase,

signifying a robust expansion in KNP's tourism industry. This upswing is significant for the local development and for the enduring viability of conservation finance, as the income generated is a crucial contributor to the park's upkeep, the safeguarding of its wildlife, and the fostering of community-based programs.

The consistent upward trajectory in tourism statistics and financial gains underscores KNP's growing importance on an international platform and emphasizes the necessity for continuous investments into sustainable tourism initiatives. Such practices must seek a harmonious balance between ecological preservation and meeting economic goals, ensuring that the park's natural resources are conserved for future generations while also contributing to the economic welfare of the local communities. The data presented in the table 3.2 fortifies the assertion that Kaziranga National Park is more than a wildlife sanctuary; it is a dynamic entity contributing to the region's economy and the global effort for environmental conservation.

Figure 3.10: Elephant and Jeep Safari at Kaziranga (Photo by Author)

Table 3.2: Tourism Growth and Revenue Trends in Kaziranga National Park (2008-2022) (Source: Directorate KNP)

Year	Total number of visitors	Total Revenue (₹)
2008-09	106051	11220689
2009-10	112844	12168000
2010-11	119839	13673000
2011-12	124829	14946000
2012-13	101165	20576098
2013-14	126211	26865775
2014-15	131354	28392304
2015-16	174216	41976727
2016-17	167052	49315104
2017-18	85612	26728821
2018-2019	NA	NA
2019-2020	142859	42063541
2020-2021	167644	36000611
2021-2022	275835	63923389

3.7 Selected Villages for Study in the zone of Influence of Kaziranga National Park

The following Table 3.3 is a list of surveyed villages in the study area's zone of influence that had been selected for research and where survey and personal interviews were conducted:

Table 3.3: List of Surveyed Villages in the Zone of Influence of Kaziranga National Park (Prepared by the Author)

Serial Number	Village	Latitude	Longitude
1.	Bagori	26.58011	93.2885
2.	Inglepathar (Chingthong Tokbi)	26.5802	93.3807
3.	Borjuri	26.63574	93.53343
4.	Beloguri	26.67755	93.59298
5.	Tamulipathar	26.6648	93.52272
6.	Mohpara	26.60847	93.43074

7.	Diflopathar	26.64111	93.53267
8.	No. 2 Kohora	26.601	93.444
9.	Lukhoronia	26.60716	93.43578
10.	Japoripathar	26.65	93.533
11.	Kanchanjuri	26.57539	93.17137
12.	Chepenakubua	26.58596	93.43811
13.	Durgapur	26.58805	93.42738
14.	Phuloguri	26.57538	93.08642
15.	Kandulimari	26.65246	93.54711
16.	Methoni	26.62074	93.51653
17.	Borjuri no. 2	26.63801	93.52706
18.	Bohikhowa Ganak Ati no.2	26.65822	93.58904
19.	Rajagaon	26.66353	93.52767
20.	Harmoti	26.58076	93.26469
21.	No. 1 Kohora	26.58422	93.44689
22.	Bhagmari	26.57473	93.22182
23.	Diflopathar Dergoyapam	26.6488	93.51796
24.	No. 1 Deosur Chang	26.56147	93.11686
25.	Haldibari	26.58279	93.30578
26.	No. 2 Deosursang	26.56102	93.11188
27.	Sapjuri Bangali Gaon	26.63038	93.55043
28.	Borbheta	26.61779	93.59487
29.	Palasguri (Dhansirimukh)	26.67005	93.61641
30.	Palasguri	26.66668	93.61424

31.	Balijan no. 1	26.62851	93.61297

Figure 3.11: Water Body (Beel) Inside Kaziranga National Park (Photo by Author)

Criteria for Selecting Villages for Study in the Zone of Influence of Kaziranga National Park

The selection of villages for this research was guided by a set of carefully considered criteria to ensure that the study would be comprehensive, representative, and feasible. These criteria were developed to address the specific needs and objectives of our study, as well as to respect the communities involved and ensure the practicality of research activities. The following are the criteria used for selecting the villages:

1. **Geographical Location and Accessibility**: The primary criterion for selecting villages was their geographical location in relation to Kaziranga National Park. The aim was to include villages within or close to the park's zone of influence to ensure the study would capture the direct impacts and interactions between the park and the surrounding human settlements. Accessibility was also a key factor; the villages needed to be accessible to the research team, allowing for regular visits for data collection and community engagement activities. This ensured that the study would be grounded in the realities of the park's immediate environment and that the findings would be relevant to the area's conservation and community dynamics.
2. **Demographic Diversity**: It was essential to include villages with diverse demographic characteristics to ensure the study's findings would be representative of the region's

population. This involved selecting villages with variations in ethnicity, economic status, and cultural practices. By doing so, the study aims to provide insights into how different community segments perceive and interact with Kaziranga National Park, thereby highlighting varied conservation challenges and opportunities.

3. **Stakeholder Engagement and Consent**: The selection process also involved engaging with local communities and stakeholders to gain their consent and support for the study. This engagement was crucial for building trust and ensuring community members were willing and interested in participating in the research. It also helped in identifying villages where there was a significant interest in addressing conservation and development issues, thereby enhancing the relevance and impact of our study.
4. **Logistical Considerations**: Practical aspects such as the availability of local guides, accommodation for researchers, and safe environments for conducting surveys and interviews were also considered. The villages were selected where logistical needs could be adequately met to ensure that the research team could perform their work efficiently and effectively. This criterion was vital for ensuring that data collection and community engagement could be carried out smoothly, without significant delays or disruptions.

By adhering to these criteria, our selection process aimed to ensure that the study would be methodologically sound, ethically conducted, and practically feasible, while also being sensitive to the needs and characteristics of the local population and the ecological dynamics of Kaziranga National Park.

3.8 Management and Governance of Kaziranga National Park

1. **Park Administration**: Kaziranga National Park operates under a well-structured administrative framework, primarily governed by the Forest Department. This body is responsible for the overall management of the park, including conservation strategies and the implementation of wildlife laws. The park's administration works closely with various environmental and wildlife conservation entities to ensure effective management.
2. **Policies and Regulations**: The park adheres to stringent wildlife protection laws and sustainable tourism policies. Regulations focus on habitat conservation, anti-poaching measures, and controlled tourist activities, balancing ecological protection with visitor engagement. Recent policies emphasize community participation and eco-tourism, enhancing both conservation efforts and local economic benefits.

3. **Challenges and Opportunities**: Kaziranga faces challenges like habitat fragmentation, poaching, and human-wildlife conflict. However, opportunities for improvement are prominent, particularly in advanced wildlife monitoring technologies and community-based conservation programs. Increasing international collaborations offer potential for enhanced biodiversity protection and knowledge exchange.

3.9 Role in Ecosystem Services:

Provisioning Services: Kaziranga National Park (KNP) stands as an essential source of provisioning services, crucial for local communities. This includes the supply of freshwater, food resources, and medicinal plants. The park supports livelihoods by providing these resources, integral to the survival and economic sustenance of nearby inhabitants.

Cultural Services: KNP also significantly contributes to cultural ecosystem services. It is deeply intertwined with the cultural identity and traditions of local communities, playing a vital role in education and recreation. As a renowned tourism destination, it enhances the socio-cultural fabric of the region and contributes to the well-being of the communities. This aspect will be explored comprehensively in later chapters.

3.10 Conclusion

This chapter has provided a detailed overview of Kaziranga National Park (KNP), emphasizing its historical significance, diverse ecology, and socio-economic impact. The park's varied topography, climate, and rich biodiversity, including its unique flora and fauna, have been described, highlighting its crucial role in ecosystem services. The governance and management practices of KNP were also discussed, addressing current challenges and future opportunities. The importance of KNP in the context of this research has been underscored, emphasizing its critical role in understanding the nexus between protected areas and human health. This understanding is vital for developing effective conservation strategies and policies that balance ecological integrity with community well-being.

Chapter 4
Research Methodology and Framework

4.1 Introduction:

This chapter is dedicated to outlining the research methods and analytical framework employed in this study. The methodologies chosen are integral to achieving the research objectives, which are centred around testing the hypothesis that protected areas, specifically Kaziranga National Park (KNP), support human health. The primary aim and objectives of this research are as follows:

Aim of the Research: The aim of this study is to comprehensively evaluate the ecosystem services provided by a protected area, focusing on both provisioning and cultural services, and to investigate the relationship between these ecosystem services and the health and well-being of the local communities residing in its vicinity. This study seeks to understand the multifaceted benefits that protected areas offer to the environment and human societies, thereby highlighting the integral role such areas play in sustaining both ecological balance and human health.

Objectives:

1. To assess the Provisioning Ecosystem Services of Kaziranga National Park.
2. To assess the Cultural Ecosystem Services of Kaziranga National Park.
3. To assess the linkages between the provision of ecosystem services and the status of human health and well-being of the people living in the surrounding of the protected area.

This chapter will detail the various methodologies utilized to achieve these aims and objectives, providing a comprehensive understanding of the approaches and techniques applied throughout the research.

Ecosystem services research requires a nuanced approach, considering the diverse and multifaceted nature of ecosystems and their benefits to human well-being. In this study, we have employed a variety of methods tailored to each objective:

1. **For the Assessment of Provisioning Ecosystem Services**:

   In the assessment of provisioning ecosystem services, a comprehensive approach was utilized, incorporating various methods to gain an in-depth understanding of local

community dependencies, economic values, and the impact on livelihoods. This assessment employed household surveys and interviews, which are instrumental in gathering firsthand information from the local population about their reliance on ecosystem services. Furthermore, economic valuation methods were applied to quantify the monetary value of these services, providing a tangible measure to understand their importance. Additionally, socio-economic and livelihood analyses were conducted to evaluate how ecosystem services contribute to the well-being and economic stability of local communities.

The characteristics of the survey were meticulously designed to ensure the effectiveness of the data collection process. A non-probability sampling approach, specifically purposive sampling, was chosen to target specific groups within the community that are most affected by or involved with the provisioning ecosystem services. This method facilitated the gathering of relevant and significant data pertinent to the study's objectives. The use of semi-structured questionnaires allowed for both standardized data collection and the flexibility to explore responses in greater depth. Data were collected from 750 households across 31 villages within the zone of influence of the KNP, ensuring a broad and representative sample of the local population and their interactions with the ecosystem services. This comprehensive approach provided a robust framework for understanding the intricate relationship between local communities and their environment, highlighting the critical role of provisioning services in sustaining local livelihoods.

2. **For the Assessment of Cultural Ecosystem Services**:

In the assessment of cultural ecosystem services, a variety of methodologies were employed to understand the multifaceted dimensions of these services, including their economic value, the experiences of visitors, and the relationships between local communities and the park. The Travel Cost Method was utilized as a key tool in this evaluation, offering a means to estimate the economic value of recreational services by examining the expenses incurred by visitors to access the site. This method provides a quantifiable approach to gauge the financial importance of cultural ecosystem services, particularly in terms of recreation and tourism.

Additionally, visitor surveys and interviews were conducted to gather detailed information on the experiences and perceptions of individuals visiting the park. These surveys and interviews are essential for understanding visitor satisfaction, preferences, and the overall impact of the cultural services provided by the ecosystem. They help in capturing the subjective and experiential aspects of cultural ecosystem services, which are crucial for comprehensive assessment.

Ethnographic studies were also integrated into the assessment, offering deep insights into the cultural dynamics between the local communities and the park. These studies are vital for understanding the social and cultural implications of ecosystem services and how they influence, and are influenced by, the traditions, practices, and beliefs of local populations.

The comprehensive survey of 379 tourists, coupled with interviews with local residents, stood as a pivotal component of the assessment. This extensive data collection was instrumental in unraveling the cultural significance and economic aspects of the ecosystem services provided by the park. Through these interactions, a clearer understanding of how cultural ecosystem services contribute to both the local economy and the cultural heritage of the area was achieved, underscoring the integral role these services play in the broader social and economic landscape.

3. **Linking Ecosystem Services to Human Health and Well-being**:

In the study of the linkage between ecosystem services and human health and well-being, an integrated approach was adopted, synthesizing findings from both the provisioning and cultural ecosystem service assessments. This holistic perspective is essential for establishing a clear and comprehensive understanding of how ecosystem services contribute to health outcomes. By combining insights from different aspects of ecosystem services, researchers can identify and elucidate the multifaceted ways in which the natural environment impacts human health and well-being.

Furthermore, a multidisciplinary approach was employed to interpret the results of the assessments, involving contributions from the fields of ecology, sociology, health sciences, and economics. This collaborative effort ensures a well-rounded analysis, incorporating diverse perspectives and methodologies. By integrating knowledge from these varied disciplines, the research offers a more nuanced and detailed examination of the relationships between ecosystem services and human health. This interdisciplinary strategy not only enhances the depth and breadth of the analysis but also promotes a more comprehensive understanding of the complex interactions at play. Through this approach, the study effectively demonstrates the integral role of ecosystem services in supporting and sustaining human health and overall well-being.

The analysis of collected data employed a comprehensive range of software tools tailored to the specific needs of the different types of data gathered. This methodological framework is designed to rigorously test hypotheses and meet the research objectives

concerning the ecosystem services of Kaziranga National Park and their impact on human health and well-being.

For the analysis of quantitative data, advanced statistical software tools were utilized. SPSS, R, and Microsoft Excel were chosen for their robust capabilities in handling large datasets and performing a variety of statistical tests. These tools are instrumental in conducting detailed quantitative analyses, allowing for the exploration of trends, patterns, and relationships within the data. Their application facilitates a thorough examination of the numerical data collected, ensuring accurate and reliable results.

In terms of qualitative data analysis, specialized software such as NVivo, Atlas.ti, and MAXQDA were employed. These tools are designed for coding, sorting, and analysing qualitative data, including but not limited to interview transcripts, open-ended survey responses, and textual documents. They allow for the systematic organization and analysis of complex qualitative information, enabling researchers to identify themes, patterns, and insights that emerge from the narrative data. This approach is crucial for understanding the deeper, contextual meanings behind the data.

For spatial analysis, Geographic Information System (GIS) software such as ArcGIS and QGIS were utilized. These tools are essential for mapping, analysing spatial data, and exploring spatial correlations. They are particularly valuable in environmental studies like this, where understanding the geographical distribution and spatial relationships of ecosystem services is critical. By employing GIS software, the research can incorporate spatial dimensions into the analysis, enhancing the understanding of how ecosystem services are distributed across the landscape and how they relate to human health and well-being.

Overall, the integration of these diverse data analysis techniques underlines the comprehensive and multidisciplinary approach of the study. By combining quantitative and qualitative analysis tools with spatial analysis capabilities, the research aims to provide a holistic understanding of the ecosystem services in Kaziranga National Park and their multifaceted impacts on human health and well-being.

4. 2 Research Paradigm

Identification of the Chosen Paradigm:

The research conducted on the provisioning and cultural ecosystem services of Kaziranga National Park and their impact on human health and well-being primarily employs a mixed-

methods approach. This approach integrates both quantitative and qualitative research methodologies, enabling a comprehensive understanding of the complex interactions between ecosystem services and human health.

Rationale for Paradigm Choice:

1. **Nature of the Research Questions**:

   The research questions are designed to explore both the measurable impact of ecosystem services (quantitative aspect) and the subjective experiences and perceptions of local communities and visitors (qualitative aspect). This duality necessitates a mixed-methods approach.

2. **Complexity of Ecosystem Services**:

   Ecosystem services are inherently multifaceted, influencing physical health, psychological well-being, and socio-cultural aspects of human life. A mixed-methods paradigm allows for an in-depth exploration of these diverse impacts.

3. **Data Availability and Type**:

   The study involves collecting numerical data (e.g., frequency of resource use, health statistics) and textual data (e.g., interviews on personal experiences and perceptions). The mixed-methods approach is ideal for handling this variety of data.

4. **Methodological Flexibility and Comprehensiveness**:

   Mixed methods offer methodological flexibility, permitting the concurrent use of statistical analysis to quantify ecosystem service benefits and thematic analysis to explore qualitative aspects. This comprehensive approach ensures a holistic understanding of the research problem.

5. **Addressing Research Objectives**:

   The research objectives require both the quantification of the benefits derived from ecosystem services and an understanding of the cultural and personal significance of these services. The mixed-methods approach aligns perfectly with these multifaceted objectives.

6. **Previous Studies and Theoretical Support**:

   Literature in ecosystem services research indicates a growing preference for mixed-methods approaches due to their effectiveness in capturing the complexity of human-nature interactions. This study aligns with this emerging trend.

7. **Validity and Reliability Considerations**:

The mixed-methods approach enhances the validity and reliability of the research findings. Quantitative data provide generalizability and measurability, while qualitative data offer depth and context, making the findings more robust and credible.

In conclusion, the mixed-methods research paradigm is strategically chosen for this study to capture the nuanced and multifaceted nature of ecosystem services and their impacts on human health and well-being. This approach not only allows for a comprehensive analysis of quantitative data but also provides vital qualitative insights, ensuring a well-rounded understanding of the ecosystem services in Kaziranga National Park.

4.3 Research Design

This research adopts a comprehensive, mixed-methods design to assess the provisioning and cultural ecosystem services of Kaziranga National Park (KNP) and their impact on human health and well-being. The design integrates quantitative and qualitative approaches, ensuring a thorough understanding of both tangible and intangible benefits of these services.

This research is organized into distinct phases, each designed to explore various aspects of the ecosystem services provided by Kaziranga National Park (KNP).

Phase 1: Assessment of Provisioning Ecosystem Services

The initial phase of the research is cantered on the assessment of provisioning ecosystem services, which are fundamentally the resources and goods provided by Kaziranga National Park (KNP) that local communities rely upon. This phase is essential for understanding the extent and nature of the dependency of these communities on the natural resources emanating from KNP. The objective is to explore the interactions between the park's ecosystem services and the livelihoods of the surrounding human populations, thereby highlighting the critical role these natural resources play in sustaining local economies and ways of life.

To achieve a comprehensive understanding of these dynamics, several methodological approaches are employed:

i. **Household Surveys and Interviews**: This approach involves the execution of structured and semi-structured interviews with the inhabitants of 750 households across 31 villages situated within the zone of influence of KNP. The primary goal of these interviews is to collect detailed information on the patterns of resource usage, the degree of dependence on these resources for maintaining livelihoods, and the local residents' perceptions of the significance of these resources. By engaging directly with the community members, researchers can obtain nuanced insights into how the

provisioning services from KNP are integrated into their daily lives and economic practices.

ii. **Economic Valuation**: In this methodological approach, techniques such as market price evaluation, contingent valuation, and cost-based analysis are applied to determine the economic value of the provisioning services offered by the park. Assigning economic values to these services is crucial for quantifying their contribution in monetary terms, which aids in understanding the economic implications of ecosystem services on local and regional scales. This valuation process provides a tangible measure of the importance of KNP's resources to the local economies.

iii. **Socio-Economic and Livelihood Analysis**: This analysis encompasses conducting in-depth studies into the livelihood strategies and income diversification methods employed by the local communities. The focus here is to decipher the role played by the natural resources of KNP in the economic well-being and sustainability of these communities. By examining various aspects such as income sources, employment patterns, and the impact of natural resources on local livelihoods, researchers can assess the broader socio-economic benefits derived from the ecosystem services and identify potential areas for sustainable development and conservation efforts.

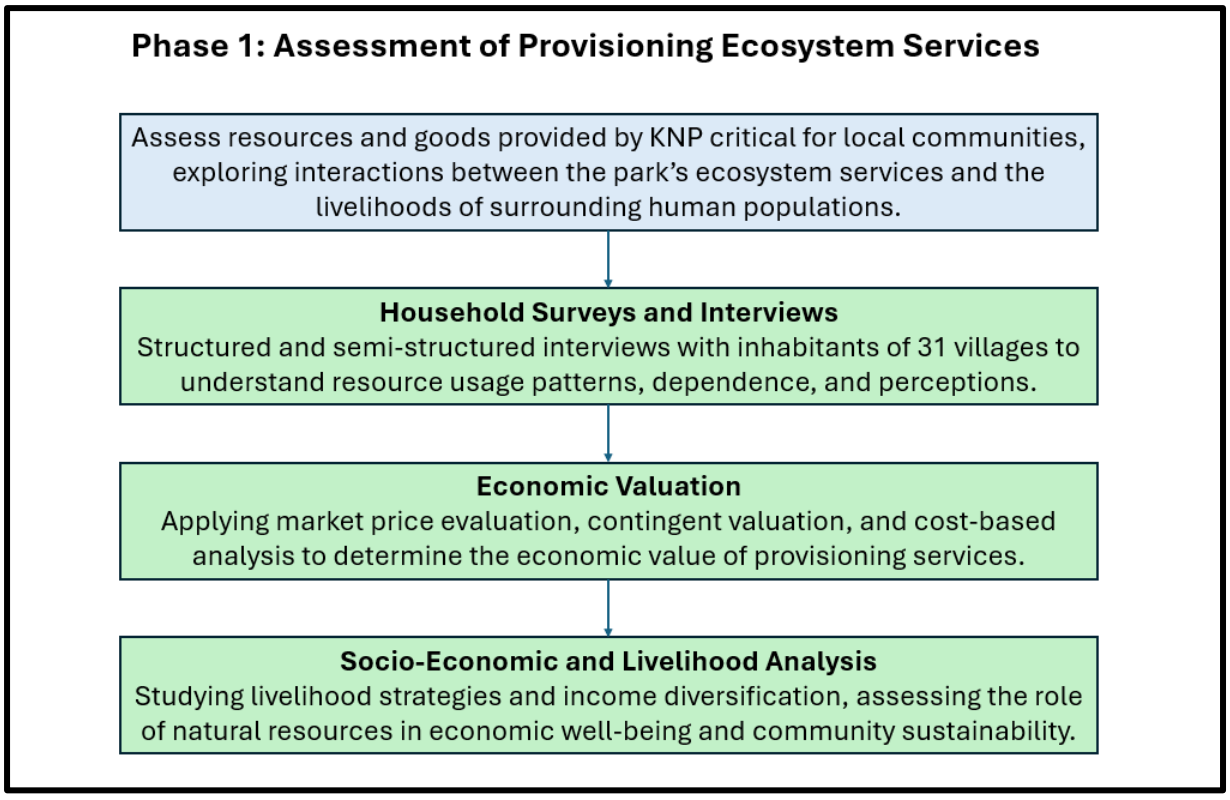

Figure 4.1: Methodology for Phase 1 (Prepared by the Author)

Phase 2: Assessment of Cultural Ecosystem Services

The second phase of the research addresses the assessment of cultural ecosystem services, which pertains to the non-material benefits that Kaziranga National Park (KNP) provides. This phase is crucial for understanding the intangible aspects of ecosystem services, such as recreational, aesthetic, spiritual, and cultural values associated with the park. These services significantly contribute to the quality of life and well-being of individuals and communities but are often less visible and quantifiable compared to provisioning services.

To effectively evaluate these non-material benefits, the following methods are utilized:

i. **Travel Cost Method**: This approach is employed to estimate the economic value of recreational services offered by KNP. By analysing the expenses incurred by visitors in traveling to the park, researchers can infer the value that individuals place on the opportunity to experience the park's natural and cultural attributes. This method provides a quantitative measure of the recreational services' value, which is critical for understanding the economic implications of cultural ecosystem services.

ii. **Visitor Surveys and Interviews**: In this method, structured surveys are conducted with 379 tourists to gather data on their experiences and perceptions of KNP. These surveys are designed to collect comprehensive information on visitor satisfaction, preferences, and the perceived benefits of their visit. Additionally, personal interviews are conducted to gain deeper insights into individual experiences and nuanced aspects of visitor engagement with the park. This approach helps in understanding the diverse values and benefits that visitors derive from KNP.

iii. **Ethnographic Studies**: This involves in-depth, long-term observation and documentation of the cultural practices, beliefs, and interactions associated with KNP. By immersing themselves in the local context, researchers can gain a profound understanding of the cultural significance of the park to different groups and individuals. Ethnographic studies enable the exploration of how cultural identity, traditions, and community ties are intertwined with the natural landscape and ecosystem services of KNP. This qualitative method is essential for capturing the complex and dynamic cultural relationships between the park and the surrounding communities.

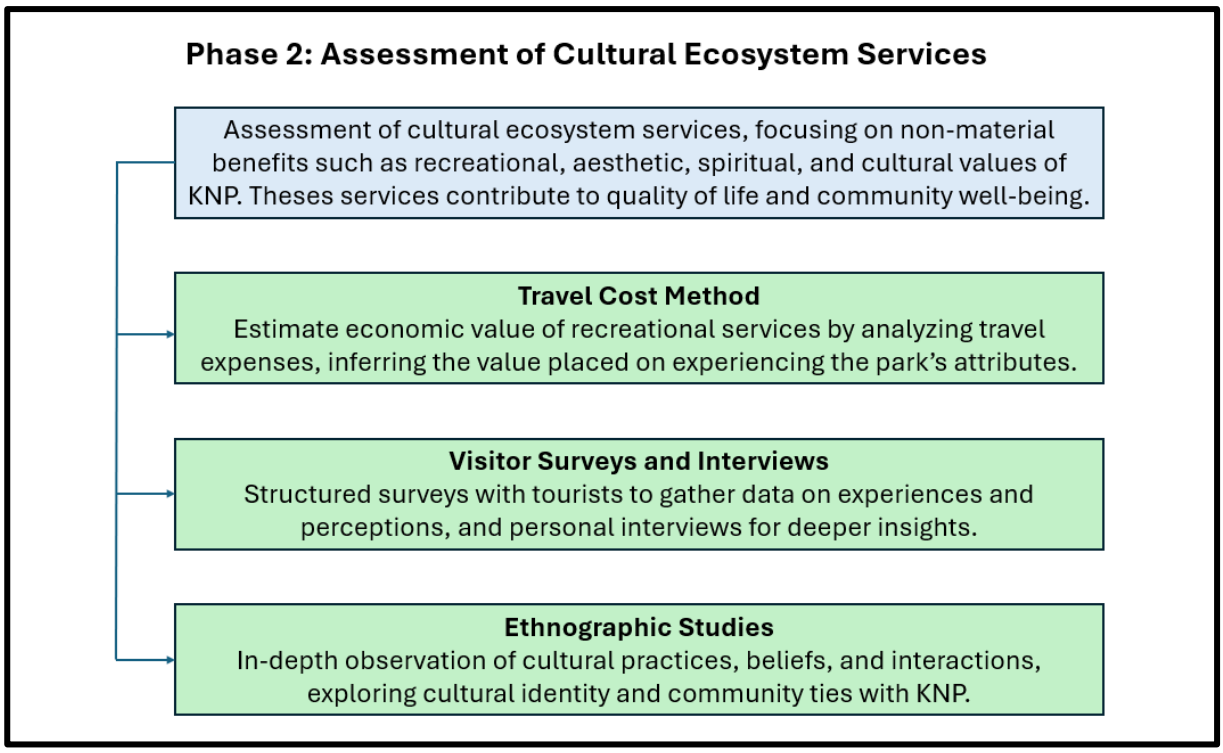

Figure 4.2: Methodology for Phase 2 (Prepared by the Author)

Phase 3: Linking Ecosystem Services to Human Health and Well-being

The third phase of the research focuses on the integration of findings from the assessments of both provisioning and cultural ecosystem services. The primary objective of this phase is to elucidate the connections between these services and human health and well-being. This phase is pivotal as it synthesizes the material and non-material benefits provided by the ecosystem and translates them into tangible impacts on the physical, mental, and social health of the local communities and visitors to Kaziranga National Park (KNP).

To achieve a comprehensive understanding of how ecosystem services contribute to health and well-being, the following methodological approaches are employed:

i. **Holistic Approach**: This strategy involves combining the results obtained from the various methods applied in the assessment of provisioning and cultural services. By synthesizing data from household surveys, economic valuations, visitor experiences, and ethnographic studies, researchers can construct a coherent picture of how different ecosystem services influence health outcomes. This approach facilitates the identification of clear linkages between the natural environment and human health, highlighting how changes in ecosystem services may directly or indirectly affect community health and individual well-being.

ii. **Multidisciplinary Perspective**: The complexity of relationships between ecosystem services and human health necessitates a multidisciplinary approach. This research phase draws on principles and methodologies from ecology, sociology, health sciences, and economics to interpret the connections between ecosystem services and health outcomes. By integrating perspectives from these diverse disciplines, the research can address the multifaceted nature of human health, encompassing physical, psychological, and social dimensions. This comprehensive analysis helps in understanding the broader implications of ecosystem services on public health and contributes to the development of more sustainable and health-promoting environmental policies and practices.

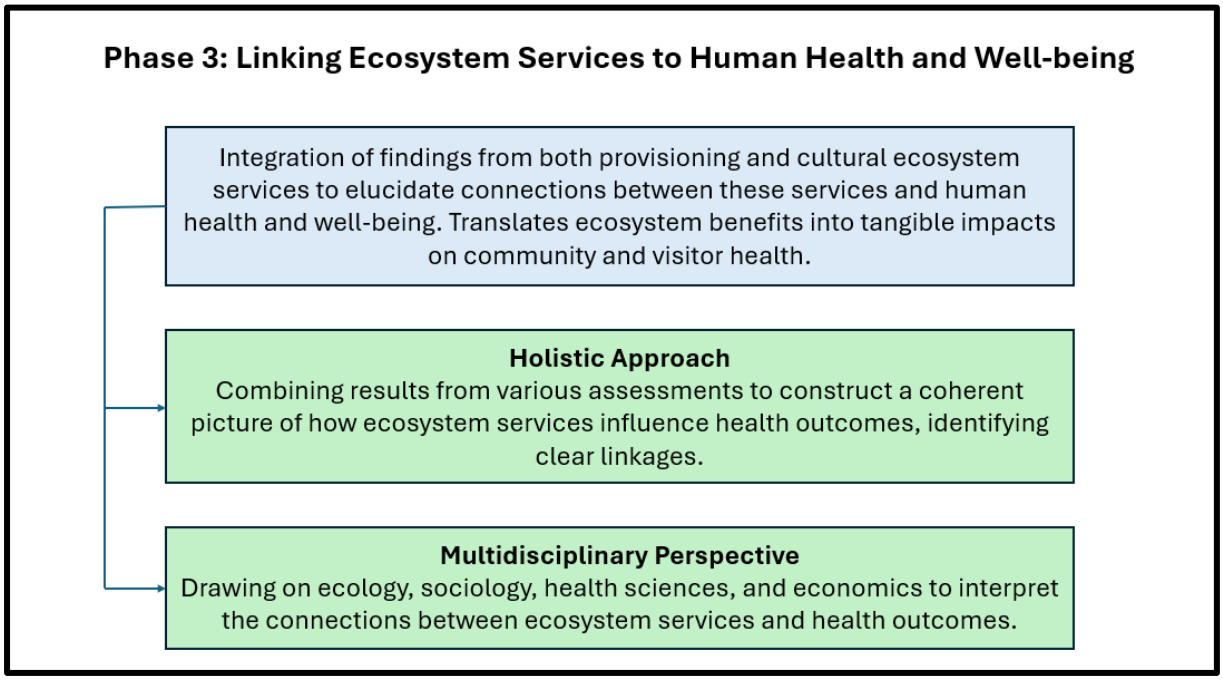

Figure 4.3: Methodology for Phase 3 (Prepared by the Author)

Survey Characteristics

The survey characteristics for this research were meticulously designed to ensure comprehensive and targeted data collection, particularly focusing on the assessment of both provisioning and cultural ecosystem services associated with Kaziranga National Park (KNP). The methodology employed aimed to capture the nuanced interactions between local communities, tourists, and the ecosystem services provided by the park.

Sampling Techniques

The research utilized non-probability and purposive sampling techniques for the selection of participants. This approach was chosen to ensure that specific groups of interest, those most directly impacted by or involved with the provisioning and cultural services of KNP, were included in the study. By employing purposive sampling, the research focused on individuals and communities with significant experiences or dependencies related to the park's ecosystem services, thereby providing richer and more relevant data for the study's objectives.

Data Collection Instruments

Semi-structured questionnaires were a pivotal element in the data collection process for both household surveys targeting local communities and tourist surveys engaging visitors to the park. The semi-structured nature of the questionnaires allowed for a balance between standardized queries, ensuring comparability of responses, and open-ended questions, providing space for respondents to share their experiences and perceptions in depth. This format facilitated the collection of detailed information on the usage, importance, and impacts of the provisioning and cultural services derived from KNP.

Integration of Secondary Data

In addition to primary data collection through surveys and interviews, the research incorporated secondary data to enrich the analysis. Information such as visitor statistics and revenue figures obtained from the Forest Department of Assam played a crucial role in complementing the primary data. This secondary data provided a broader context for understanding the scale and economic aspects of the interactions between humans and the ecosystem services provided by KNP. By integrating both primary and secondary data sources, the research achieved a more comprehensive and nuanced understanding of the ecosystem services' impacts on human well-being and local economies.

Data Analysis and Integration

The research methodology encompasses a rigorous approach to data analysis and integration, ensuring a holistic understanding of the interplay between Kaziranga National Park's (KNP) ecosystem services and the health and well-being of surrounding communities and visitors.

Data Analysis

The collected data, derived from various sources and methodologies, will be subjected to both quantitative and qualitative analyses, tailored to the specific nature of each dataset. Quantitative data, such as visitor numbers, economic valuations, and survey responses, will be analysed using statistical methods to identify patterns, trends, and correlations. This analysis will involve the use of software tools capable of handling large datasets and performing complex statistical tests, providing insights into the measurable aspects of ecosystem services and their impacts.

Conversely, qualitative data, including open-ended survey responses, interview transcripts, and ethnographic notes, will undergo thematic analysis to extract significant themes, narratives, and perceptions. This process will involve coding the data and identifying recurring ideas and sentiments that illustrate the community's and visitors' experiences and perceptions of KNP's ecosystem services. The qualitative analysis will shed light on the nuanced, experiential, and contextual dimensions of how these services contribute to human well-being.

Integration of Data

The integration of these diverse datasets is a critical step in the research process. By synthesizing the findings from both quantitative and qualitative analyses, the research will provide a comprehensive understanding of the multifaceted impacts of KNP’s ecosystem services on the health and well-being of individuals and communities. This integrated approach will allow for a more nuanced interpretation of the data, highlighting how different types of ecosystem services contribute to various aspects of human well-being.

Through this analytical and integrative process, the research aims to uncover the complex relationships between natural environments and human health, offering evidence-based insights that can inform policy, management, and conservation practices. The ultimate goal is to demonstrate the integral role of ecosystem services in supporting sustainable development and enhancing the quality of life for both local populations and visitors to Kaziranga National Park.

This research design, with its methodological rigor and multidisciplinary approach, is well-suited to explore the complex interactions between ecosystem services and human health. By employing a mix of methodologies, this study aims to provide a holistic understanding of the role of KNP’s ecosystem services in supporting human health and well-being, thereby addressing the research aims comprehensively.

4.4 Data Collection Methods

The data collection methods employed in this study were meticulously chosen to align with our research objectives, focusing on the comprehensive collection of primary data directly from the sources. This approach ensured the acquisition of accurate and relevant data crucial for analyzing the provision of biomass and other ecosystem services within Kaziranga National Park (KNP).

4.4.1 Primary Data

Primary data collection was fundamental to our study, utilizing a variety of methods to ensure a rich and diverse dataset:

i. **Interviews and Surveys for Biomass Provision**: Structured questionnaire-based interviews were conducted to collect specific data on the provision of biomass by forested landscapes within KNP. The design of the questionnaire was influenced by the framework proposed by Rigg et al. (2011), which aids in standardized and cost-effective data collection. A strategy of random sampling was employed to select households within representative villages, ensuring that the data collected were diverse and comprehensive.

ii. **Sampling Methods**: The study applied purposive sampling techniques to choose respondents who could provide detailed information relevant to our research questions. Data were collected from 31 villages within KNP's zone of influence, encompassing about 20% of all villages in the area, with approximately 25 households surveyed in each village (n=750). Additionally, convenience sampling was used to survey 379 tourists to understand visitor perspectives regarding their travel expenses and experiences at KNP.

iii. **Observations**: Ethnographic studies were undertaken, involving long-term engagement with local communities to document their cultural practices, beliefs, and values related to the park. This method provided depth and context to the quantitative data collected through surveys and interviews.

iv. **Informal Conversations and Entry Point Approach**: To complement structured data collection methods, informal conversations, as recommended by Bagchi and Mishra (2006) and Ogra and Badola (2008), were integrated into the study to garner deeper insights. The entry point approach, advocated by Dhaundiyal (1997), was utilized to

ensure the accuracy and reliability of information regarding biomass extraction. This technique helps in verifying the data collected through structured methodologies.

v. **Personal Interviews for Enhanced Response Rates**: Acknowledging the typically low response rates associated with conventional surveys, personal interviews were carried out, following the recommendations of Austin and Cunningham (1981). This approach was particularly employed in visitor surveys to delve deeper into the aspects of cultural ecosystem services, thereby enhancing the quality and depth of the collected data. This method proved effective in increasing response rates and obtaining more detailed and nuanced responses from participants.

4.4.2 Secondary Data

In this study, secondary data sources play a crucial role in complementing the primary data collected. These sources offer a broader contextual framework and serve as additional validation for the research findings.

Literature Review and Government Reports

A thorough literature review will be conducted as part of the research methodology. This review will incorporate seminal works, such as the study by Kumssa and Bekele (2013), to inform the research design and situate the study's findings within the broader academic discourse. Additionally, government reports and records, particularly those from the Forest Department of Assam, will be invaluable. They will provide essential data on visitor numbers, revenue collections, and the economic values attributed to ecosystem services, which are critical for understanding the impact and management of Kaziranga National Park's natural resources.

Rationale for Source Selection

The selection of secondary sources is strategically guided by their direct relevance to the study's objectives and their established credibility. These sources are chosen to ensure they provide comprehensive historical and contemporary insights into the ecosystem services provided by the park and their implications. By integrating these secondary data, the research aims to create a well-rounded picture of the environmental and economic dynamics at play.

Data Analysis Techniques

For the analysis of collected data, sophisticated techniques will be applied according to the nature of the data. Quantitative data analysis will be conducted using statistical software tools

such as SPSS, R, and Microsoft Excel, which are suited for handling large datasets and performing various statistical tests. For qualitative data, analysis software like NVivo, Atlas.ti, and MAXQDA will be utilized to code and interpret textual information. Additionally, Geographic Information System (GIS) software, including ArcGIS and QGIS, will be employed for spatial analysis. This will involve mapping resource use patterns and areas of biomass provision, which are crucial for understanding the spatial dimensions of ecosystem services.

This comprehensive approach to data collection and analysis, which combines structured questionnaires, informal conversations, and a thorough review of secondary data, ensures a nuanced and multifaceted understanding of the ecosystem services provided by Kaziranga National Park. The methodologies are meticulously designed to capture both the tangible and intangible benefits of these services, thereby scientifically substantiating the connections between the park's ecosystem services and the health and well-being of human communities.

4.5 Specific Methodologies for Ecosystem Services Assessment

This section details the specific methodologies employed to assess the provisioning and cultural ecosystem services of Kaziranga National Park (KNP) and their impact on human health and well-being. The chosen methods are designed to provide a comprehensive understanding of the multifaceted benefits offered by KNP and how these benefits contribute to the livelihood and health of the surrounding communities and visitors.

4.5.1 Assessment of Provisioning Ecosystem Services:

Methodological Overview:

The assessment of provisioning ecosystem services, which includes resources such as food, water, medicinal plants, and materials from KNP, employs a mix of quantitative and qualitative research approaches. The primary instruments for this evaluation were household surveys and interviews, which were further enriched by economic valuations and socio-economic and livelihood analyses.

Household Surveys and Interviews:

The core of the data collection involved structured and semi-structured interviews conducted with 750 households across 31 villages located within KNP's zone of influence. These surveys aimed to collect detailed information on patterns of resource use, the extent of dependence on

these resources for livelihood, and their perceived significance by the local communities. Approximately 25 households in each village were selected through purposive sampling techniques, ensuring a comprehensive and representative dataset.

Figure 4.4: Socio-Economic Survey with People Living in the Fringe Village of Kaziranga National Park (Image Credit: Govinda Bora)

Economic Valuation:

The economic valuation of provisioning services utilized methods such as the market price method, contingent valuation, and cost-based approaches. These techniques were instrumental in assigning tangible economic values to the services provided by KNP, thereby quantifying the direct economic benefits that local communities derive from the park's natural resources.

Socio-Economic and Livelihood Analysis:

This component of the assessment explored livelihood patterns, income diversification, and poverty indices to gauge how KNP's resources bolster the local economy. The analysis aimed to provide deeper insights into the socio-economic impacts of ecosystem services on the communities surrounding the park. By examining the interplay between natural resources and local livelihoods, the research offers a nuanced understanding of the critical role that KNP's ecosystem services play in supporting community well-being and economic resilience.

Figure 4.5: Interview with Farmers Near Kaziranga National Park (Photo by Author)

4.5.2 Assessment of Cultural Ecosystem Services

Methodological Overview

The assessment of cultural ecosystem services at Kaziranga National Park (KNP) involved analysing the recreational, spiritual, and educational benefits provided by the park. This assessment was conducted through a combination of visitor surveys, ethnographic studies, and the application of the Travel Cost Method.

Visitor Surveys and Interviews

To gauge the cultural benefits of KNP, surveys and interviews were conducted with 379 tourists. These interactions aimed to collect comprehensive data on the visitors' experiences, perceptions, and the values they associate with the park. The information gathered from these surveys was instrumental in understanding the recreational, aesthetic, and spiritual connections that visitors form with KNP, providing insights into the park's cultural significance.

Travel Cost Method

The Travel Cost Method was employed to estimate the economic value of the park's recreational services. This method calculates the value based on the expenses incurred by visitors traveling to KNP, including transportation, accommodation, and other related costs. This serves as an indirect measure of the park's recreational value, indicating how much visitors are willing to spend to experience the cultural and natural offerings of KNP.

Ethnographic Studies

Ethnographic studies involved long-term engagement with the local communities surrounding KNP. These studies aimed to observe and document the cultural practices, beliefs, and values linked to the park. By immersing themselves in the community, researchers were able to gain a deeper understanding of the cultural significance of KNP and how it influences the identity and traditions of the local populations.

4.5.3 Linking Ecosystem Services to Human Health and Well-being

Integrated Methodological Approach

Following the methodology assessment outlined in the “Valuation of Ecosystem Services from Tiger and Snow Leopard Landscapes, IIFM Report 2017” (Verma et al., 2017), an integrated approach was adopted to synthesize findings from the assessments of both provisioning and cultural ecosystem services. This method enabled researchers to establish clear connections

between the diverse ecosystem services provided by KNP and the health and well-being of the local communities and visitors. By combining the results from various studies, the research paints a comprehensive picture of how natural resources and cultural experiences contribute to overall human well-being.

Multidisciplinary Analysis

The analysis of the linkages between ecosystem services and human health involved a multidisciplinary approach, incorporating perspectives and methodologies from ecology, sociology, health sciences, and economics. This broad-based analysis ensured that the research captured the complex interactions between the environment and human health, offering a holistic understanding of how KNP's ecosystem services impact the well-being of individuals and communities. This comprehensive approach highlights the multifaceted benefits of ecosystem services and underscores the importance of sustainable management practices for the continued health and prosperity of both natural environments and human populations.

Figure 4.6: Engagement with Local Communities Near Kaziranga National Park (Image Credit: Manisha Ashraf)

Figure 4.7: Interviews with Elders Living Near Kaziranga National Park (Image Credit: Priyanka Bora)

The methodologies applied in this study provided a detailed and nuanced understanding of the ecosystem services of KNP. By assessing both provisioning and cultural services and their interconnectedness with human health and well-being, this research offers valuable insights into the integral role of protected areas in sustaining local communities and visitors, both economically and culturally.

4.6 Linking Ecosystem Services to Health and Well-Being

This section delineates the methodologies employed to analyze and establish the connections between the ecosystem services provided by Kaziranga National Park (KNP) and the health and well-being of individuals and communities. Understanding these linkages is vital for comprehending the full scope of impacts that ecosystem services exert beyond their immediate economic and environmental benefits. This insight is crucial for appreciating the integral role of natural environments in promoting comprehensive human health and societal well-being.

Methodological Approach for Linkage Analysis

Data Integration

The study integrates data from the assessments of both provisioning and cultural ecosystem services with various health and well-being metrics. This comprehensive approach will include the analysis of medical records, health surveys, mental health assessments, and qualitative

accounts of well-being, aiming to create a multidimensional perspective on the health impacts of ecosystem services.

Quantitative Analysis

Quantitative relationships between the utilization of ecosystem services and health outcomes will be assessed using statistical methods such as correlation and regression analysis. These techniques are essential for identifying underlying patterns and relationships, thereby providing robust empirical evidence of the impact of ecosystem services on health parameters.

Qualitative Analysis

Alongside quantitative methods, thematic analysis and content analysis will be applied to interpret qualitative data. This approach aims to capture the personal narratives and subjective experiences of individuals concerning their health and well-being in relation to ecosystem services. The qualitative insights gained will enrich the quantitative data, offering a more holistic and nuanced understanding of the ecosystem services' impacts on health.

Health and Well-being Metrics

A wide array of health and well-being metrics will be utilized within the study. These will include the incidence of diseases, mental health scores, and self-reported well-being surveys. To assess psychological benefits derived from the ecosystem services of KNP, the Likert scale, a well-established psychometric scale in questionnaire-based research, will be employed. This scale will help gauge the aesthetic, cultural, recreational, and spiritual benefits that individuals perceive from interacting with the park's natural environment.

Multidisciplinary Perspective

Collaboration Across Fields

The analysis adopts an inherently multidisciplinary approach, signifying the importance of collaboration across various fields such as environmental science, public health, psychology, and sociology. This collaborative endeavour is essential, as it brings together diverse expertise and perspectives, enriching the research and ensuring a holistic understanding of the complex interactions between ecosystem services and human well-being.

By integrating insights from environmental science, the research gains a solid foundation in understanding the natural processes and services provided by Kaziranga National Park (KNP). Public health perspectives add a crucial dimension by focusing on the implications of these services for human health outcomes. Psychology contributes to understanding the

individual and collective perceptions, attitudes, and behaviors that influence and are influenced by the ecosystem. Lastly, sociology offers a broader view of the societal structures, cultural norms, and community dynamics that shape and are shaped by interactions with the environment.

Together, these diverse fields ensure a comprehensive understanding of how the ecosystem services from KNP contribute to enhancing human health and well-being. This multidisciplinary approach not only enriches the analysis but also underscores the interconnectedness of natural systems and human societies, highlighting the integral role of ecosystems in supporting a healthy and sustainable human life.

Methodological Challenges and Considerations in Making These Linkages

Addressing Complex Interactions

The research recognizes the inherent complexities in establishing direct causal links between ecosystem services and health outcomes, particularly given the myriad of confounding factors that can affect such relationships. To navigate these complexities, the study will implement robust statistical methods to sift through and analyze the data accurately. Data triangulation will be employed to cross-verify information from multiple sources, enhancing the reliability of the findings. Furthermore, longitudinal studies may be considered to observe changes and trends over time, providing a deeper understanding of the long-term impacts of ecosystem services on health.

Ethical Considerations

Ethical considerations will be paramount, especially when dealing with sensitive health data and interacting with potentially vulnerable populations. The research will adhere to strict ethical guidelines, ensuring confidentiality, informed consent, and the right to withdraw from the study at any time. The aim is to conduct the research with the utmost respect for the dignity, privacy, and welfare of all participants.

This section has detailed the methodologies designed to explore the connections between the ecosystem services provided by Kaziranga National Park (KNP) and human health and well-being. Employing comprehensive surveys, standardized questionnaires, and a combination of quantitative and qualitative analyses, the study seeks to furnish empirical evidence of the significant health benefits that stem from the ecosystem services of KNP. By doing so, the research aims to shed light on the critical role that protected areas play in fostering not only ecological integrity but also in enhancing human health and promoting broader

societal well-being. This understanding is essential for the development of policies and practices that support sustainable interactions between humans and their natural environments.

4.7 Data Analysis Techniques

This section is dedicated to outlining the various tools and techniques that will be employed for data analysis in this study on the ecosystem services of Kaziranga National Park and their impact on human health and well-being. The selection of these methods is pivotal in converting the collected data into meaningful insights that align with the research objectives.

Quantitative Data Analysis Techniques

Statistical Software

A variety of statistical software will be used to accommodate the needs of different data types and analysis requirements:

i. **SPSS (Statistical Package for the Social Sciences)**: This software is renowned for its comprehensive statistical capabilities, making it especially useful for handling large datasets and executing various statistical tests such as t-tests, ANOVA, and regression analyses. SPSS is valued for its user-friendly interface and extensive application in social science research.

ii. **R**: This programming language is favored for its advanced statistical analysis and data visualization capabilities. R is particularly beneficial for conducting sophisticated statistical modeling and dealing with non-standard data types, providing a flexible environment for a range of statistical procedures.

iii. **Microsoft Excel**: Known for its accessibility, Excel will be employed for preliminary data management and analysis. While it offers basic statistical functions, Excel is an excellent tool for initial data organization, simple calculations, and summarizing data sets.

Statistical Methods

To delve deeper into the quantitative aspects of the research, specific statistical methods will be applied:

i. **Correlation Analysis**: This method will be utilized to examine the relationships between different variables related to ecosystem services and human health indicators. Correlation analysis will help identify the strength and direction of associations between these variables.

ii. **Regression Analysis**: This technique will be crucial for understanding the predictive relationships between ecosystem service-related variables and health outcomes. Regression analysis will allow for the assessment of how changes in ecosystem services may influence specific health metrics.

iii. **Time Series Analysis**: Where applicable, time series analysis might be employed to investigate trends over time regarding the utilization of ecosystem services and their impact on health outcomes. This method is valuable for understanding long-term changes and patterns in the data.

Through the application of these quantitative data analysis techniques, the study aims to uncover significant patterns, relationships, and trends within the data, providing a solid empirical foundation to assess the impact of KNP's ecosystem services on human health and well-being. These analytical methods will enable a nuanced understanding of the complex interplay between natural environments and human health parameters.

Qualitative Data Analysis Techniques

Qualitative Analysis Software

For the qualitative component of this study, several software tools will be employed to facilitate the systematic coding and analysis of textual data, such as interview transcripts and open-ended survey responses:

i. **NVivo**: This qualitative data analysis software will play a critical role in managing, coding, and analyzing textual data. NVivo supports the identification and exploration of themes and patterns concerning the perceptions and impacts of ecosystem services, making it invaluable for dissecting complex qualitative datasets.

ii. **Atlas.ti**: This software is another powerful tool for conducting thematic analysis. It is versatile in handling various data formats, including text, video, and audio files, thus enabling a comprehensive analysis of qualitative data from multiple sources.

iii. **MAXQDA**: Renowned for its user-friendly interface and robust analytical capabilities, MAXQDA will be utilized for in-depth qualitative data examination. It facilitates extensive text interpretation, comparative analysis, and the visualization of qualitative information, aiding in the nuanced understanding of the data.

Qualitative Analysis Methods

In addition to utilizing sophisticated software, this study will employ several established qualitative analysis methods to interpret the data:

i. **Thematic Analysis**: This method involves identifying, analyzing, and reporting patterns (themes) within the data. Thematic analysis will be crucial for exploring the diverse perceptions and experiences of individuals regarding ecosystem services, offering rich, detailed insights into complex data.

ii. **Content Analysis**: This technique allows for the systematic coding and categorization of text data into identifiable themes and patterns. Content analysis will be applied to examine the frequency and significance of certain words, themes, or concepts within the data.

iii. **Narrative Analysis**: This approach focuses on the stories told by research participants, analyzing the structure and content of their narratives. Narrative analysis helps in understanding how individuals construct and interpret their experiences related to ecosystem services.

By applying these qualitative data analysis techniques, the study aims to delve deep into the subjective experiences, perceptions, and impacts of ecosystem services on individuals and communities. These methods will provide a deeper understanding of the qualitative aspects of the research, complementing the quantitative findings and contributing to a holistic view of the role of ecosystem services in human health and well-being.

GIS and Spatial Analysis Techniques: For Study Area and Health Survey

GIS Software

For the spatial aspects of this study, Geographic Information Systems (GIS) software, specifically ArcGIS and QGIS, will be extensively used. These tools are essential for performing spatial analysis and will be instrumental in mapping the distribution of ecosystem services within the study area. They will enable the visualization of resource utilization patterns and facilitate the correlation of these patterns with health and well-being data collected from the local communities. By employing GIS, the study will be able to illustrate spatial trends and relationships, enhancing the understanding of how geographical factors influence health outcomes in relation to ecosystem services.

Integration of Data

The study aims to provide a comprehensive perspective by integrating both qualitative and quantitative data. This integrated approach is vital for addressing the research questions from multiple angles, ensuring a thorough exploration of the subject. Mixed-methods data analysis techniques, such as triangulation and convergence analysis, will be employed to validate and strengthen the findings across different datasets. This methodology ensures that the results are robust, credible, and reflective of the complex interactions between humans and their environment.

In summary, the data analysis techniques detailed above are fundamental to the success of this study. They are meticulously chosen to align with the research objectives, facilitating a detailed examination of the impacts of ecosystem services on human health and well-being. By employing a combination of GIS and spatial analysis, alongside the integration of qualitative and quantitative approaches, the study is well-equipped to provide insightful and reliable findings. These methods are expected to play a crucial role in substantiating the hypothesis that protected areas, such as Kaziranga National Park, have a significant positive impact on human health and societal well-being, thereby contributing valuable knowledge to the fields of environmental science and public health.

4.8 Ethical Considerations

This section addresses the essential ethical considerations pertinent to the research on Kaziranga National Park's ecosystem services and their impact on human health and well-being. Recognizing the importance of ethical integrity, particularly in studies involving primary data collection from human subjects, the measures in place to ensure ethical compliance throughout the research process are outlined.

- **Informed Consent:** Prior to performing the survey or personal interviews, informed consent was obtained from all participants. Participants were adequately informed about the research's objectives, the nature of the inquiries, and their entitlements as subjects, including the prerogative to discontinue their involvement at any juncture. In instances where individuals lacked the ability to comprehend written text, a verbal elucidation was offered, and consent was acknowledged using a thumbprint or alternative means of indicating agreement.
- **Confidentiality and Anonymity:** The data obtained was securely maintained, and measures were taken to prevent unwanted access. Personal identifiers were not

gathered unless deemed absolutely essential. Upon collection, these identifiers were expeditiously segregated from the primary dataset. To safeguard the identities of the participants in the study outputs, codes or pseudonyms were allocated to each respondent.

- **Transparency:** The intended utilization of the data and the anticipated research outcomes were effectively conveyed to the participants. Any apprehensions or misunderstandings that participants may have harboured were acknowledged and rectified.
- **Beneficence:** Measures were taken to guarantee that the participants were not subjected to any form of harm during the study. Inquiries or discussions that had the potential to elicit sensitivity or cause harm to the participants were avoided.
- **Data Storage and Disposal:** The acquired data was securely stored in a designated location and subjected to encryption measures to mitigate the risk of unauthorized access. Upon completing its intended function or upon expiration of its designated retention period, the data was securely disposed of.
- **Cultural Sensitivity:** A conscientious awareness and adherence to the cultural practices, beliefs, and customs of the indigenous population residing in close proximity to Kaziranga National Park were demonstrated. Measures were taken to ensure that the questions asked and the interactions engaged in were culturally sensitive and respectful.
- **Feedback and Dissemination of Findings:** Following the conclusion of the research endeavour, the findings were disseminated to the relevant community, furnishing them with a concise overview or salient outcomes while diligently upholding all stipulated confidentiality obligations.
- **Mitigation of Coercion:** Measures were taken to guarantee that participants were not subjected to any form of coercion or compulsion in their decision to partake in the study. Participation was completely voluntary, and incentives that could be perceived as excessively enticing were avoided.
- **Data Usage:** The data was utilized exclusively for the goals outlined in the research proposal or as explicitly reported to the participants. If there had been any divergence in purpose, the necessary steps to obtain authorization or reestablish informed consent would have been taken.

- **External Review:** The study concept and technique were assessed by an ethics committee to ensure they fulfilled ethical standards.
- **Training for Fieldworkers:** Comprehensive training was provided to all individuals involved in the data collection process regarding the ethical principles that govern their work. Measures were taken to assure their comprehension of the significance of adhering to these principles.
- **Transparency in Stakeholder Engagement:** Communication was actively initiated with relevant local authorities, park management, and other stakeholders, effectively disseminating information regarding the study objectives and guaranteeing its adherence to their established standards and regulations. Throughout the investigation, a high emphasis was placed on safeguarding the welfare and entitlements of the individuals involved, painstakingly adhering to all ethical issues.

In conclusion, this research is committed to upholding the highest ethical standards, ensuring the respectful and fair treatment of all participants, and maintaining the integrity and confidentiality of the data collected. These measures are fundamental to conducting responsible and credible research that contributes positively to our understanding of ecosystem services and human health and well-being.

4.9 Validity and Reliability

This section focuses on the strategies and measures implemented to ensure that the research findings regarding the ecosystem services of Kaziranga National Park (KNP) and their impact on human health and well-being are both valid and reliable. Validity and reliability are crucial for establishing the credibility and dependability of the research findings.

Ensuring Validity

Validating study findings is crucial. The following procedures have been put in place to assure validity:

- **Content Validity:** To guarantee content validity, the research instruments, such as surveys and questionnaires, have been meticulously crafted with contributions from experts in the fields of ecosystem services and public health. This collaborative approach ensures that the instruments are well-equipped to accurately gather the necessary data. Additionally, where applicable, established and scientifically validated

instruments have been adapted to suit the unique environmental and social context of KNP, enhancing the specificity and relevance of the data collection process.

- **Construct Validity**: The study has been carefully designed to specifically measure the constructs of interest, notably the effects of ecosystem services on various dimensions of human health. The methodologies and theoretical frameworks employed in the research are grounded in the principles of ecosystem services and public health, ensuring construct validity. This alignment guarantees that the study accurately measures the intended constructs, thereby providing meaningful insights into the relationship between ecosystem services and health.
- **External Validity:** Although the research is primarily focused on KNP, an effort has been made to discuss the generalizability of the findings to similar ecosystems and communities. By addressing external validity, the study aims to contribute to a broader understanding of how the conclusions drawn from KNP might apply to other settings, thereby enhancing the global relevance and applicability of the research.

Ensuring the validity of the research through these various measures is crucial for the production of reliable and actionable findings that can inform policy, conservation efforts, and public health initiatives. By addressing content, construct, and external validity, the study aims to provide a comprehensive and accurate assessment of how the ecosystem services of KNP impact human health and well-being.

Ensuring Reliability

Ensuring the reliability of research findings is paramount to validating the consistency and dependability of the data collected, particularly in a study examining the impacts of ecosystem services of Kaziranga National Park (KNP) on human health and well-being. The following are the measures implemented to ensure reliability:

Consistency of Measures

To assure the reliability of the data collection tools, several measures have been implemented:

i. **Pilot Testing**: Surveys and questionnaires have undergone pilot testing to identify and rectify any issues affecting clarity, understanding, or logistical execution. This step helps in refining the tools to ensure they effectively capture the intended information.

ii. **Training for Data Collectors**: Data collectors have received consistent and thorough training to ensure they understand and adhere to the established protocols for data

collection. This uniformity in data collection procedures helps in minimizing variations that could arise from differences in data collection techniques.

iii. **Standardized Protocols**: Standardized protocols for data collection have been developed and distributed among the research team. These protocols serve as a guide to ensure that data collection is uniform across different locations and times, thereby enhancing the reliability of the collected data.

By implementing these measures, the study aims to uphold a high level of reliability in its research methods and findings. Ensuring the reliability of the research instruments and processes is fundamental to producing trustworthy and valid results that can effectively inform policy, conservation, and health interventions related to the ecosystem services provided by KNP.

Data Analysis Reliability

Ensuring the reliability of data analysis is fundamental in maintaining the integrity and trustworthiness of research findings. To achieve this, several measures have been implemented within the analytical procedures and in assessing inter-rater reliability.

Analytical Procedures

The research will adhere to rigorous data analysis procedures to ensure accuracy and reliability. This encompasses meticulous data entry practices to prevent errors that could skew results. In addition, the study will employ reliable statistical methods recognized for their precision and appropriateness to the data type and research questions. To further bolster the reliability of the findings, cross-verification strategies will be utilized. This involves comparing results obtained from multiple data sources or using different analytical techniques to confirm consistency. Such triangulation enhances confidence in the research outcomes, providing a more robust and reliable foundation for conclusions drawn.

Inter-Rater Reliability

Particularly for qualitative data, ensuring inter-rater reliability is crucial due to the subjective nature of data interpretation. To address this, the study will involve multiple researchers in the coding process. These researchers will independently code a subset of the qualitative data, allowing for the assessment of inter-rater reliability. This approach ensures that the themes and patterns identified are not the result of a single researcher's bias or perspective, thereby enhancing the credibility of the qualitative analysis. The degree of agreement among different

raters serves as an indicator of the reliability of the qualitative findings, contributing to the overall trustworthiness of the research.

In summary, this research incorporates a comprehensive approach to ensure the validity and reliability of its findings. By meticulously designing the research instruments, rigorously following standardized data collection procedures, and employing robust data analysis techniques, the study strives to provide credible and dependable insights into how the ecosystem services of KNP impact human health and well-being. These efforts underline the study's commitment to upholding the highest standards of research quality.

4.10 Limitations of the Methodology

Recognizing the limitations of research methodologies is essential for a balanced and realistic interpretation of findings. This section outlines the inherent constraints in the methodologies employed in this study on Kaziranga National Park's (KNP) ecosystem services and their implications for human health and well-being.

Identification of Limitations

- **Sampling Limitations**: The study employs non-probability and purposive sampling techniques, which, while effective for targeted data collection, may limit the generalizability of the findings. The villages and households selected for this study are representative of KNP's zone of influence but may not fully capture the diversity and range of conditions present in wider or different geographical areas. This sampling approach, therefore, might restrict the extent to which the results can be applied to other contexts or populations.
- **Data Collection Constraints**: The research relies significantly on self-reported data obtained through surveys and interviews. This reliance can introduce biases, as participants may alter their responses due to personal perceptions or the desire to provide socially desirable answers. Additionally, the data may be subject to seasonal variations in the availability and use of ecosystem services, which could result in an incomplete depiction of annual patterns and impacts.
- **Methodological Limitations**: The qualitative aspects of this study, while providing valuable depth and context, are susceptible to interpretive biases. Thematic analysis, in particular, involves a level of subjectivity in the interpretation of participant narratives, which could influence the conclusions drawn. On the quantitative side, the statistical

models and methods selected carry their own set of limitations and underlying assumptions, potentially affecting the analysis and interpretation of the data.

- **External Factors**: There are also uncontrollable external factors, such as changes in the environment, shifts in socio-political conditions, or unforeseen events like natural disasters or policy alterations, which could impact the outcomes of the study. These elements are beyond the research's capacity to predict or measure but are important to acknowledge as they can significantly influence the relevance and applicability of the findings.

In summary, while this study aims to provide insightful and meaningful results, these limitations must be considered when interpreting its findings and conclusions. Recognizing these constraints is essential for a comprehensive understanding of the study's scope and the applicability of its results to broader contexts.

Impact of Limitations

On Research Findings

The limitations identified within this study necessitate a careful and measured approach when interpreting the findings, especially concerning the direct causality between ecosystem services and human health outcomes. As such, the results should be considered indicative of potential trends and relationships rather than definitive conclusions. This cautious interpretation helps in maintaining the academic integrity of the study and ensures that conclusions are drawn based on the evidence available, acknowledging the constraints of the research design.

On Future Research

Recognizing these limitations serves as a valuable guide for future research endeavors. It highlights areas needing further investigation, such as the necessity for studies across broader geographical areas, the importance of longitudinal data collection to observe changes over time, and the exploration of additional variables that could influence the relationship between ecosystem services and human health. This acknowledgment not only contributes to the field's knowledge base but also paves the way for more comprehensive and detailed future studies.

Mitigation Strategies

To counteract these limitations, the study employs various mitigation strategies:

i. **Triangulation**: Implementing triangulation in data analysis enhances the reliability and validity of the findings. By comparing and cross-verifying information from different sources and methodologies, the study aims to provide a more rounded and robust set of conclusions.

ii. **Diverse Participation**: Efforts were made to include a wide range of participants, which helps in enhancing the representativeness and applicability of the study's findings, even within the constraints of non-probability and purposive sampling methods.

Areas for Improvement

Several areas have been identified where future research could improve upon the current study's methodologies:

i. **Sampling Methods**: While non-probability and purposive sampling techniques were employed, future studies could benefit from incorporating probability sampling techniques to enhance the generalizability and representativeness of the findings.

ii. **Seasonal Variation**: Given the impact of seasonal variations on ecosystem service provision and utilization, future research should account for different seasons or consider data collection across multiple seasons to obtain a more comprehensive view.

iii. **Reliance on Self-Reported Data**: While self-reported data are valuable, corroborating these data with objective measures where feasible could reduce biases and strengthen the study's findings.

iv. **Generalizability of Findings**: Although this study offers specific insights into KNP, extending the discussion to the applicability of these findings to other protected areas and different geographical contexts would enhance their relevance.

v. **Methodological Transparency**: Ensuring that the methodologies and analytical strategies used are described in sufficient detail for replication is crucial for the advancement of the scientific community and for validating the study's findings.

By addressing these areas, future research can build on the current study's findings, overcoming its limitations, and contributing to a deeper understanding of the intricate relationship between ecosystem services and human health and well-being.

This section has highlighted the key limitations inherent in the methodology of this study. While these limitations present certain constraints, they have been acknowledged and addressed to the extent possible. It is important to consider these limitations when interpreting the results, which contribute valuable insights into the complex relationship between ecosystem services and human health and well-being. Such acknowledgment underscores the study's commitment to academic integrity and paves the way for more comprehensive future research in this domain.

4.11 Conclusion

This chapter has outlined a comprehensive methodology designed to explore the complex interactions between ecosystem services provided by Kaziranga National Park and human health and well-being. The mixed-methods approach, combining both qualitative and quantitative techniques, has been meticulously chosen to address the multifaceted nature of this study. Primary data collection through surveys, interviews, and ethnographic studies, complemented by secondary data sources like literature reviews and government reports, enables a thorough and diverse analysis of the ecosystem services.

The research is underpinned by a strong commitment to ethical standards. Stringent measures are in place to ensure the ethical treatment of all data and respondents. This includes obtaining informed consent, guaranteeing confidentiality and anonymity, and adhering to cultural sensitivity, particularly given the diverse context of Kaziranga National Park. These ethical considerations are paramount to conducting the research with integrity and respect for all involved parties.

While the chosen methodology is robust, the acknowledgment of its limitations is crucial. These limitations, including the challenges of generalizability due to purposive sampling and the potential biases inherent in self-reported data, have been recognized. This transparent approach not only enhances the credibility of the research but also outlines areas for future exploration and improvement.

This research is expected to contribute significantly to our understanding of how protected areas like Kaziranga National Park can support human health and well-being. The findings are anticipated to have implications for environmental policies, public health strategies, and community development initiatives. Moreover, this study sets a precedent for future research in ecosystem services, providing a methodological framework that can be adapted and applied in different environmental and geographical contexts.

In conclusion, the methodology detailed in this chapter is tailored to address the research objectives comprehensively. It is expected that the application of these methods will yield insightful and meaningful results, contributing to the broader discourse in environmental science, public health, and ecosystem management. The study not only aims to add to the academic body of knowledge but also to inform practical and policy-related decisions in the context of ecosystem services and conservation.

Chapter 5
Provisioning Ecosystem Services of Kaziranga National Park

5.1 Introduction to Provisioning Ecosystem Services

Ecosystem services play a crucial role in promoting human well-being. However, the relationship between ecosystem services and human well-being is intricate, varied, contingent on specific contexts, and further complicated by the necessity to account for numerous spatial and temporal dimensions in order to accurately evaluate them (Pereira et al. 2005).

Provisioning services encompass a range of material advantages derived from ecosystems, including but not limited to water, food, timber, and several other items. Numerous provisioning services are exchanged inside market systems. Nevertheless, it is worth noting that in numerous areas, rural households rely directly on provisioning services as a means of sustaining their livelihoods. In this particular scenario, the significance of services' value may exceed the extent to which it is manifested in the prices they command within local marketplaces (Food and Agriculture Organization of the United Nations).

The Kaziranga National Park and tiger reserves represent a designated and protected area located in the northeastern state of India. In the core region of the park, there are restrictions on the removal of direct commodities. However, individuals residing in the neighborhood of the protected area are able to access natural resources from the surrounding outskirts of the national park. The local population extract various natural resources, including fish, timber, wild vegetables and fruits, thatching materials, and medicinal plants, from the vicinity of the park. A significant portion of these natural products are used for personal consumption, but a limited number of products are also commercially traded for financial gain. Provisioning services are the direct benefits in the form of goods and services, and they play an even more important role in the lives of rural communities. The villages surrounding the national park come under rural areas.

5.2 Methodology Recap

5.2.1 Methodology Overview:

In the context of assessing the provisioning ecosystem services of Kaziranga National Park (KNP), the research employed a combination of diverse methodologies. Central to this was the Market Price Method, complemented by household surveys and interviews, economic valuation techniques, and socio-economic and livelihood analyses. These methods were meticulously chosen to holistically capture the intricate dynamics between KNP's natural resources and the well-being of local communities.

5.2.2 Application in KNP:

In the application of research methodologies within Kaziranga National Park (KNP), a multifaceted approach was adopted to gather comprehensive insights into the interaction between local communities and the park's resources. This endeavour commenced with household surveys and interviews, targeting residents of 31 villages within KNP's zone of influence. Following the survey framework established by Rigg et al. (2011), both structured and semi-structured interviews were conducted to delve into the communities' dependency on park resources for their livelihoods. Approximately 25 households per village, totalling around 750 individuals, were surveyed using stratified sampling techniques to ensure diverse representation across village location, occupation, and age groups. The use of structured questionnaires facilitated a balanced collection of quantitative and qualitative data, providing a detailed view of resource use patterns, livelihood dependencies, and the perceived importance of these resources.

To complement the primary data collection, economic valuation methods were employed to quantify the benefits derived from KNP's resources. This included the application of the market price method for assessing direct benefits, alongside contingent valuation and cost-based analysis for gauging indirect benefits. The market price method is an economic valuation technique that assesses the direct benefits derived from natural resources or environmental services by assigning a monetary value to them based on existing market prices. This method involves identifying the specific goods or services provided by the ecosystem that are being traded in the market, such as timber, fish, medicinal plants, or recreational experiences from a national park like KNP. The value of these goods or services is determined using their actual sales data or market transactions, reflecting the real price that consumers are willing to pay. To calculate the total economic value, the quantity of the goods or services

consumed or used is quantified and then multiplied by their respective market prices. This provides a monetary figure representing the direct benefits people obtain from these resources or services. However, it's important to note that this method only applies to goods and services that have an existing market and does not consider indirect benefits or non-market values, necessitating other valuation methods for a comprehensive economic assessment. The methodologies, inspired by the works of Fowler (2008) and Harris and Brown (2010), allowed for a nuanced understanding of the economic impact of KNP's provisioning services, highlighting their value to the local economy.

Further analysis extended into the socio-economic and livelihood aspects of the communities surrounding KNP. Through an examination of livelihood patterns, income diversification strategies, and poverty indices, the study aimed to uncover the broader role of the park's resources in supporting economic resilience and sustainability among local populations. This aspect of the research provided valuable insights into how the park contributes to enhancing the livelihoods of adjacent communities, offering a clearer picture of the economic dynamics at play.

Lastly, the research methodology embraced ethnographic studies and informal conversations as pivotal components. Drawing on the methodological insights from Bagchi and Mishra (2006), and Ogra and Badola (2008), these approaches were instrumental in exploring the cultural and social dimensions of human-forest interactions. By engaging directly with the local community, these studies enriched the research with deeper understandings of the cultural and social values attributed to the provisioning services of KNP. This holistic approach ensured a comprehensive exploration of the complex relationships between the park and its neighbouring communities, highlighting the multifaceted benefits and dependencies that define their coexistence.

Referral to Detailed Methodology:

For a comprehensive account of the methodologies employed in this study, see Chapter 3, "Research Methodology and Framework." This chapter elaborates on the procedural aspects, the rationale behind the chosen methods, and their application in the specific context of Kaziranga National Park.

5.3 Result: Status of Provisioning Ecosystem Services of Kaziranga National Park

Survey result in the context of assessing Provisioning Ecosystem Services in the zone of influence of Kaziranga National Park data that captures various aspects of ecosystem services.

The survey aimed to assess the provisioning ecosystem services valued by communities living in the vicinity of Kaziranga National Park. These services include goods like food, water, timber, Non-Timber Forest Products (NTFP's), fibre, and genetic resources. The survey's findings, including demographics, key results, and statistical analysis are as follows:

5.3.1 Overview of Survey Respondents' Socio-Economic Profile:

The basic socio-economic profile of survey respondents, drawn from a sample size of 750 individuals, offers a glimpse into the living conditions of a community largely based in a rural setting. The median household income stands at approximately ₹15,000 per month. This figure underscores the community's economic reality, highlighting a substantial reliance on natural resources and agriculture, which form the backbone of their livelihood. Employment among the respondents is fairly distributed, with 60% engaged in various sectors. Agriculture employs the most significant portion, accounting for 30% of the employed, followed by tourism related to the park, which employs 20%, and small-scale businesses at 10%. The remainder of the population consists of homemakers, students, and those who are unemployed.

Access to healthcare emerges as a critical concern, with only half of the respondents reporting easy access to primary healthcare centres. The other half faces significant challenges, including long distances, transportation issues, and the affordability of healthcare services. Educational attainment among the community presents a mixed picture. While 70% have completed primary education, this number decreases to 55% for secondary education, and drops further to 40% for those who have pursued higher education. This trend indicates a notable decline in educational engagement at higher levels.

The community's reliance on resources from the area surrounding the park is significant, with a substantial proportion of households depending on these resources for their essential needs. Approximately 55% of households regularly collect fuelwood, while about 30% gather fodder. Furthermore, around 80% rely on fish harvested from the water bodies near the park, and 25% depend on medicinal plants and other non-timber forest products from the vicinity of KNP. In addition to these material dependencies, there is a strong cultural

connection to the park, as demonstrated by the 60% of respondents who engage in cultural activities such as festivals and educational visits. This engagement highlights a deep and enduring linkage with the park's ecosystem.

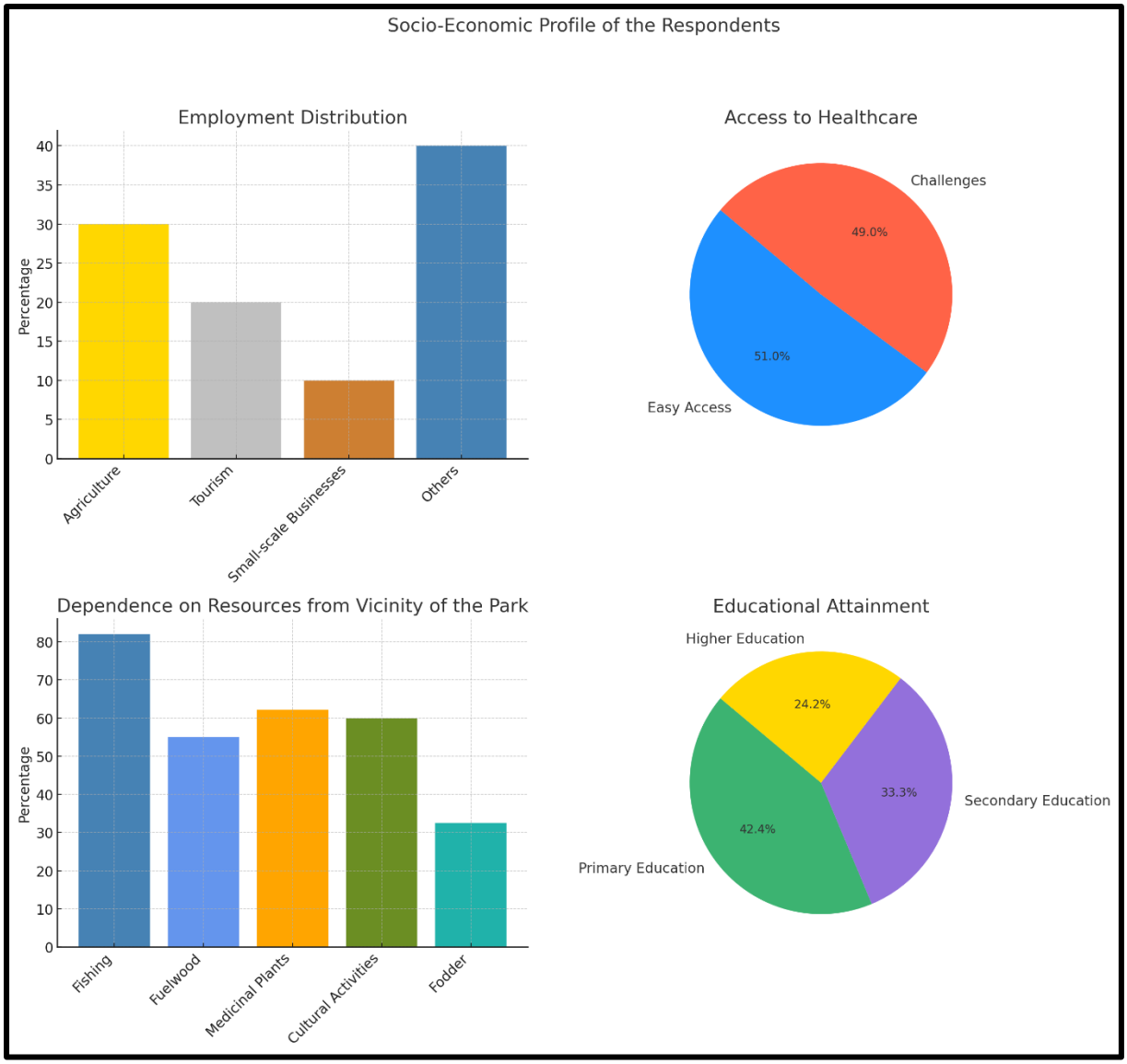

Figure 5.1: Socio-Economic Profile of the Respondents (Prepared by the Author)

Summary:

The socio-economic profile paints a picture of a community closely tied to the natural environment, reliant on Kaziranga National Park for both livelihood and cultural identity. While there is a base level of education that could support conservation awareness, the economic dependence on the park highlights the need for sustainable management practices that balance ecological health with community well-being. The challenges in healthcare accessibility also suggest a potential area for improvement in community support services.

5.3.2 Key Findings:

The research into the provisioning ecosystem services surrounding Kaziranga National Park (KNP) highlights the critical dependence of local households on a variety of natural resources. The data indicates that fish, wild fruits, wild vegetables, and medicinal plants are particularly significant to the livelihoods of the surrounding communities.

The utilization of natural resources from the surrounding environment plays a pivotal role in the livelihoods of the communities living near Kaziranga National Park. Among these resources, fuelwood emerges as a fundamental necessity for more than half of the households. With an average annual consumption of 318 kilograms per household, the economic valuation of this resource is substantial, amounting to approximately ₹6,360 per household each year. This highlights the critical reliance on fuelwood for meeting daily energy needs.

Fodder for livestock is another essential resource, relied upon by about 30% of the households. The significant average annual usage of 537 kilograms per household underscores its importance in supporting livestock-rearing practices, a vital component of the local economy. This translates into an annual economic benefit of ₹1,611 for each household, illustrating the value of fodder in sustaining agricultural and livestock activities.

Thatching materials are utilized by over 70% of the households, reflecting the prevalence of traditional housing structures in the area. The widespread use of thatching emphasizes the importance of maintaining traditional building practices and the role of natural resources in providing shelter and housing.

Fish stand out as the resource with the highest economic value among the surveyed households. An average annual consumption of 367 kilograms per household showcases the critical role of aquatic resources in the diets and economies of local communities. With an impressive contribution of ₹82,575 to the household economy per year, fish not only serve as a staple dietary item but also as a significant economic asset.

Wild fruits and vegetables are crucial for more than 60% of the households, serving as a key source of dietary diversity and nutrition. Their reliance on these resources highlights the park's contribution to food security, showcasing the vital role that natural resources play in supporting the health and well-being of local communities. The dependence on these varied resources underscores the intricate relationship between the people and the park, where the sustenance derived from natural resources is integral to the socioeconomic fabric of the surrounding areas.

Figure 5.2: Fishing Near Kaziranga National Park (Image Credit: Govinda Bora and Manisha Ashraf)

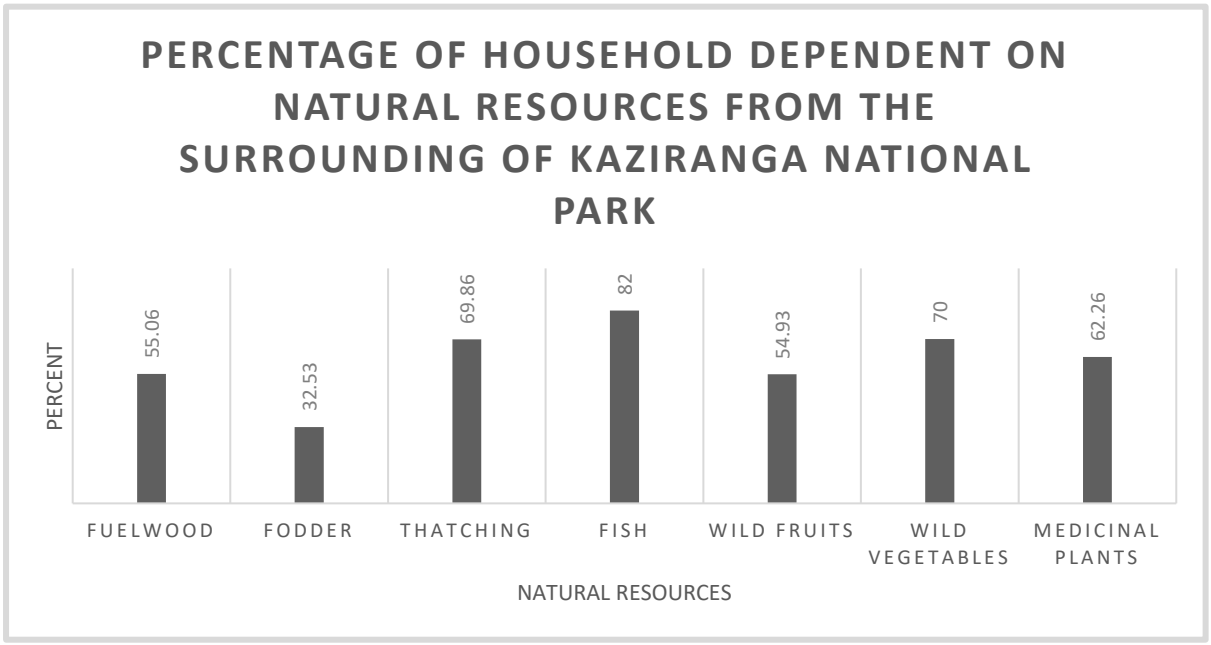

Figure 5.3: Household Dependent on Natural Resources from the Zone of Influence of Kaziranga National Park (Prepared by the Author)

Figure 5.3 clearly illustrates the percentage of households reliant on each resource, with fish, wild fruits, and wild vegetables being among the most critical. Medicinal plants also play a vital role, with over half of the households utilizing plants like *Centella asiatica* and *Ocimum tenuiflorum* for a range of medicinal purposes (Shekhar et al., 2022).

Table 5.1: Monetary Benefits to User Groups from Natural Resources Surrounding Kaziranga National Park (KNP) (Prepared by the Author)

S.No.	Resource	Average quantity (kg hh^{-1} yr^{-1})	Average Market Price (₹) Kg^{-1}	Economic value of the resources used by the household (₹) Yr^{-1}
1.	Fuelwood	318	20	6360
2.	Fodder	537	3	1611
3.	Thatching	206	10	2060
4.	Fish	367	225	82575
5.	Wild Fruits	296	25	7400
6.	Wild Vegetables	319	20	6380
7.	Medicinal Plants	Not Available	Not Available	Not Available

Table 5.1 illustrates the economic benefits derived by user groups from natural resources in the vicinity of KNP. It details seven resources, highlighting their average annual consumption per household (in kilograms), their market price per kilogram (in Indian Rupees), and the subsequent yearly economic value to the households. Fuelwood, used extensively, presents a yearly benefit of ₹6,360 with an average household consumption of 318 kg. Fodder, another significant resource, has an annual household economic value of ₹1,611, with consumption at 537 kg. Thatching materials, consumed at 206 kg per household, contribute ₹2,060 annually. Fish stands out for its substantial market price and economic value, with average consumption leading to an impressive ₹82,575 yearly benefit per household. Wild fruits and vegetables also contribute significantly, with annual values of ₹7,400 and ₹6,380 respectively, reflecting their importance in local diets. Notably, the table does not provide data for medicinal plants, indicating a gap in available information. This table underscores the critical economic reliance of local communities on the surrounding natural resources for sustenance and livelihood.

Figure 5.4: Agriculture Near Kaziranga National Park (Photo by Author)

5.3.3 Data Interpretation:

The reliance on provisioning services from KNP is a testament to the park's value beyond its conservation goals, serving as a backbone for local community sustenance and health. The high dependency on fish reflects the community's dietary patterns and the significant economic role that fishing plays within the local economy. The data also reveals the importance of traditional knowledge, with a substantial percentage of household's dependent on medicinal plants for healthcare.

The monetary benefits from natural resources, as shown in Table 5.1, indicate a significant economic reliance on the park's resources, with fishing contributing the most to

household incomes. This economic dependency underscores the need for sustainable management of these resources to ensure long-term availability and prevent over-exploitation.

The utilization of medicinal plants demonstrates an integration of traditional ecological knowledge with health practices, highlighting a potential area for ethno-botanical studies and conservation of medicinal species.

In conclusion, the provisioning ecosystem services of KNP play a pivotal role in the health, well-being, and economic stability of the surrounding communities. The park's resources contribute not only to the sustenance and cultural practices but also offer substantial economic benefits. The findings underscore the necessity for integrated conservation and development strategies that balance ecological sustainability with the welfare of local communities (Shekhar et al., 2022).

Table 5.2 Medicinal Plants Used by Local People and the Percent of Households Dependent on Medicinal Plants from the Vicinity of Kaziranga National Park (KNP) (Prepared by the Author)

S. No.	Local Name	Scientific Name	Medicinal Utility (as reported by the local residents)	Percent Household Dependent
1.	Mani Muni (Indian Pennywort)	*Centella asiatica*	Gastrointestinal disorders, relieve menstrual pain. memory enhancement, anti-convulsant, anti-depressant, wound healing, anti-bacterial activity	54
2.	Neem	*Azadirachta indica*	Immune-modulatory, anti-inflammatory, antihyperglycemic, antifungal, antibacterial, antiviral	27
3.	Tulsi (Basil)	*Ocimum tenuiflorum*	Fever, cough-cold, skin disease, insect bites, respiratory problems, indigestion, ear infection, Immune-modulatory	61
4.	Pudina (Mint)	*Mentha spicata*	Stomach pain, acidity, flatuation	45
5.	Dupor bon tenga (Goethe plant)	*Bryophyllum pinnatum*	Kidney stones treatment, earache, burns, abscesses, ulcers, piles, diarrhoea, Lithiasis, insect bites, killing head lice, gastric	34

			ulcers, urinary issues, cholesterol	
6.	Doron bon	*Leucas aspera*	Snakebite, common cold, intestinal worm infection, asthama, malaria, Sinusitis, pharyngitis, decay of tooth, loss of appetite, headache, body ache, influenza	18
7.	Jilmil saak (White goosefoot)	*Chenopodium album*	Supplements for Protein, Vitamin A, Calcium, Phosphorus, Potassium, blood iron; constipation, arthritis, rheumatism, enlargement of the spleen and bile related diseases	15.6
8.	Brahmi saak	*Bacopa Monnieri*	Improve cognition, reduces depression-anxiety	16
9.	Tengesi tenga	*Tengesi tenga*	Vitamin C supplement, insect bites, lower back pain, urinary tract infections, high blood pressure, diabetes, dysentery, fever, headache and loss of appetite	24
10.	Musondori saak	*Hottuynia cordata*	Gastrointestinal problems, strengthens muscles	13
11.	Mati Kanduri	*Alternanthera sessilis*	Diuretic, laxative, improves lactation, skin problems, night blindness	34
12.	Bhedailota (Stink vine)	*Paederia foetida*	Gastrointestinal problems, rheumatism pain, infertility, paralysis, urinary bladder stones, urinary retention	44
13.	Narasingha (Curry Leaves)	*Murraya koenigii*	Vitamin A, B, C, B2, Calcium, iron supplement; dysentery, diarrhoea, diabetes, morning sickness, queasiness, boost digestion, blood circulation	45
14.	Bhatou Phul	*Vanda coerulea*	Glaucoma, cataract	6.4
15.	Red Vanda	*Renanthera imschootiana*	Gonorrhoea, optical sore	7

16.	Chota Chand	*Rauvolfia serpentina*	Anxiety, sedation	3
17.	Agarwood	*Aquilaria mallaccensis*	Snake bite, diarrhoea, constipation, astringent	14
18.	Usipak	*Hibiscus manihot*	Tuberculosis, diabetes	24
19.	Talishpatra	*Abies spectabilis*	Asthma, bronchitis	8.5
20.	Bon Khopa	*Abroma augusta*	Headache, diabetes	2.7
21.	Pera-petari	*Abutilon indicum*	Diuretic, anti-inflammatory, astringent	31
22.	Mukuta-manjari	*Acalypha indica*	Burns, scabies, syphilis, centipede bites	11
23.	Hati-huria	*Achyranthes aspera*	Dysentery, piles ulcer,	14
24.	Bos	*Acorus calmus*	Chronic diarrhoea, dysentery	21

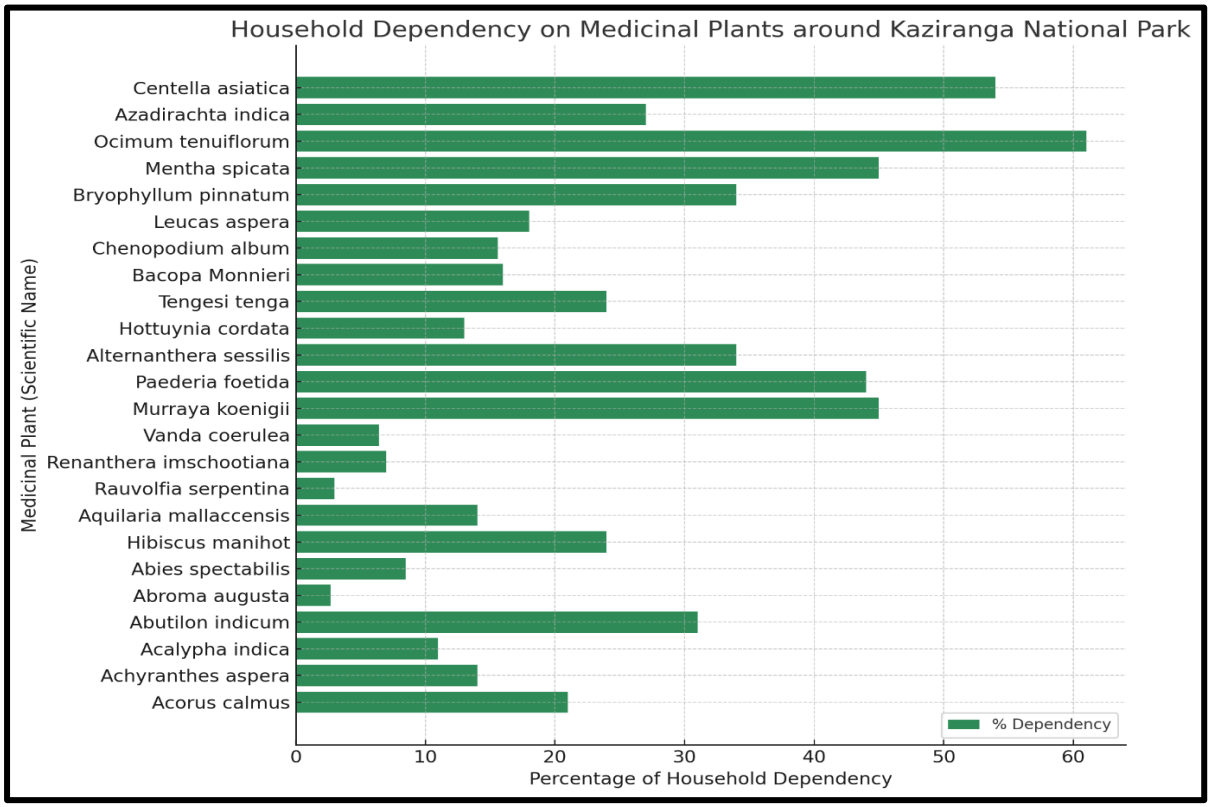

Figure 5.5: Household Dependency on Medicinal Plants Around Kaziranga National Park (Prepared by the Author)

Figure 5.6: Medicinal Plants in Kaziranga Orchid Park (Photo by Author)

The analysis reveals that the most frequently recognized provisioning services include freshwater, cited by 86.8% of the participants, followed closely by food crops at 84.92%. Fish, reported by 75.64% of respondents, livestock and their products at 58.38%, and timber at 66.2% also emerged as significant. Additionally, Non-Timber Forest Products (NTFPs) were acknowledged by 63.54% of participants.

When assessing the importance of these provisioning services, a scale of 1 to 5 was employed, revealing a high valuation for freshwater and food crops, both averaging a score of 4.8. This indicates their critical role in the respondents' lives. Fish were also highly valued, with an average importance rating of 4.5, followed by livestock products at 4.2, timber at 3.8, and NTFPs at 3.7, showcasing a varied but generally high appreciation for these resources.

Moreover, the study highlights significant variations in importance ratings across different occupational groups. Specifically, fishermen attributed a higher importance to fish compared to other groups, underscoring the direct reliance on their primary source of livelihood. Conversely, farmers rated food crops and freshwater as most crucial, reflecting their dependency on these resources for agriculture. This variation underscores the diverse value systems based on occupational engagements, emphasizing the tailored importance of specific provisioning services to different community segments.

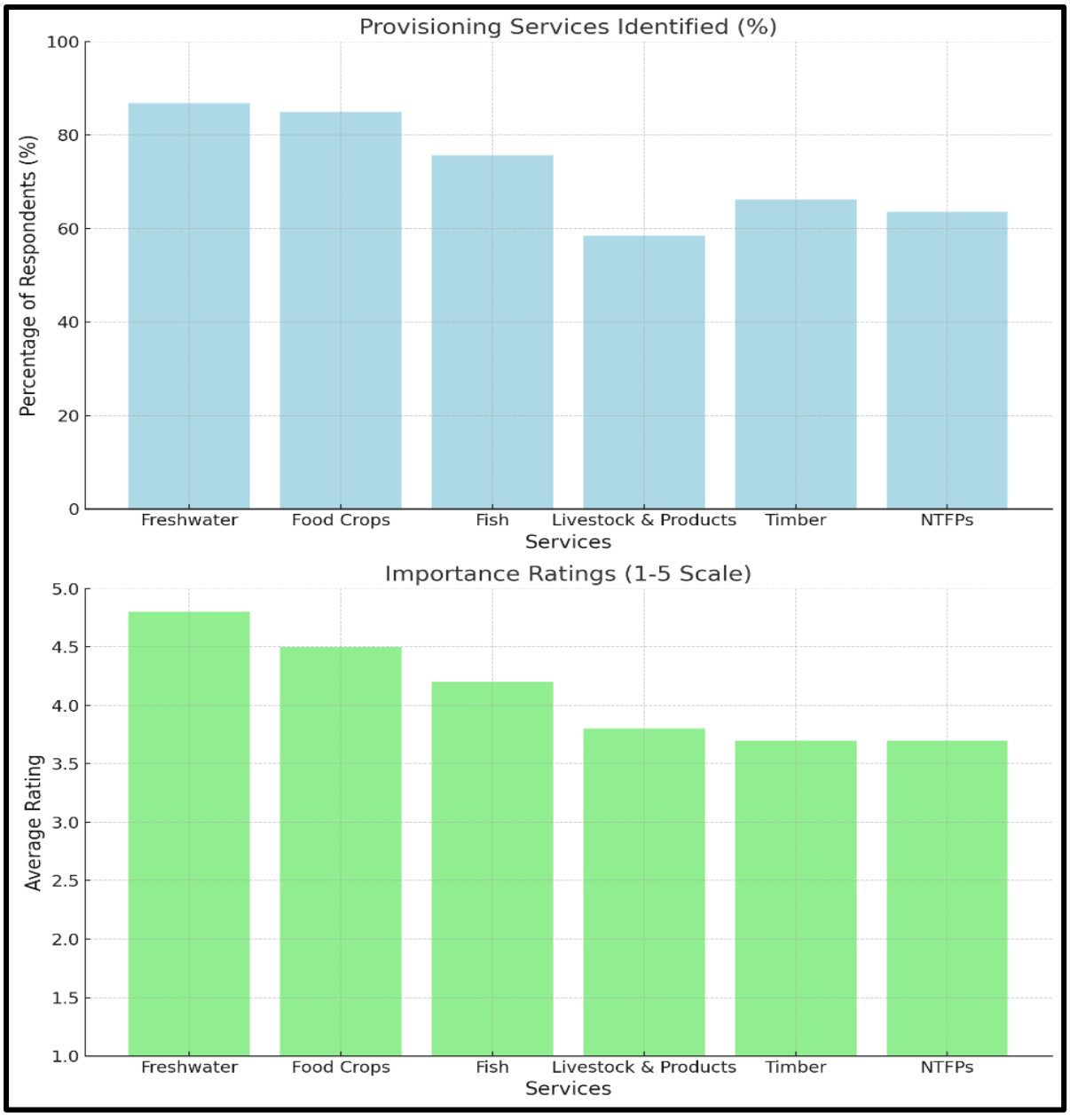

Figure 5.7: Provisioning Ecosystem Services Identified and Importance Rating (Prepared by the Author)

Statistical Analysis

Correlation Analysis: A positive correlation was found between age and the importance rating of traditional medicines ($r = 0.32$, $p < 0.01$), suggesting older participants value traditional medicines more highly.

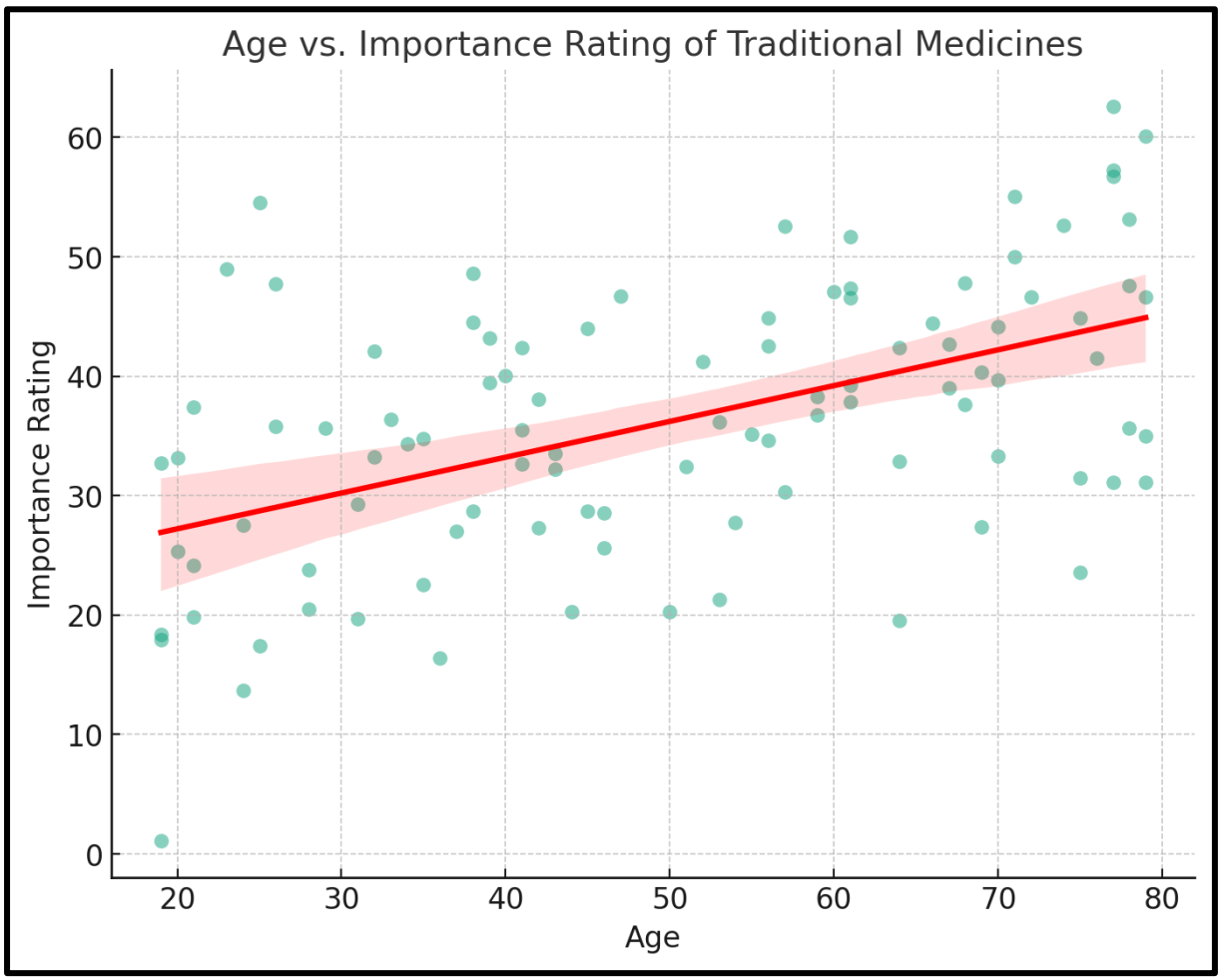

Figure 5.8: Age vs. Importance Rating of Traditional Medicines (Prepared by the Author)

ANOVA Test: There were significant differences in the importance ratings of provisioning services among different occupations ($F(3,746) = 15.24$, $p < 0.001$), indicating occupation significantly influences the perceived importance of these services.

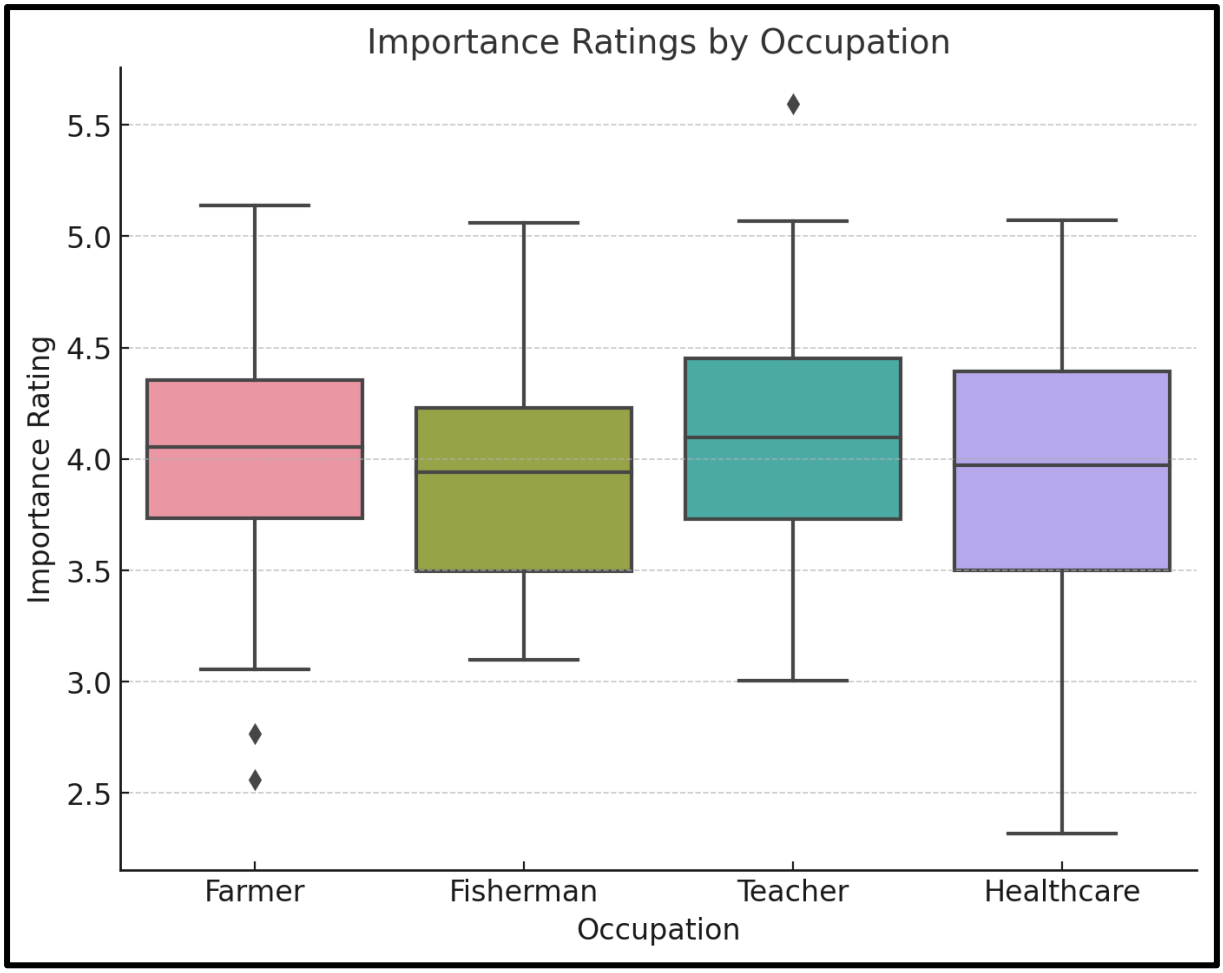

Figure 5.9: Importance Rating by Occupation (Prepared by the Author)

Satisfaction with Ecosystem Services: The overall satisfaction level with the availability of provisioning services was moderately high (average score of 3.9 out of 5).

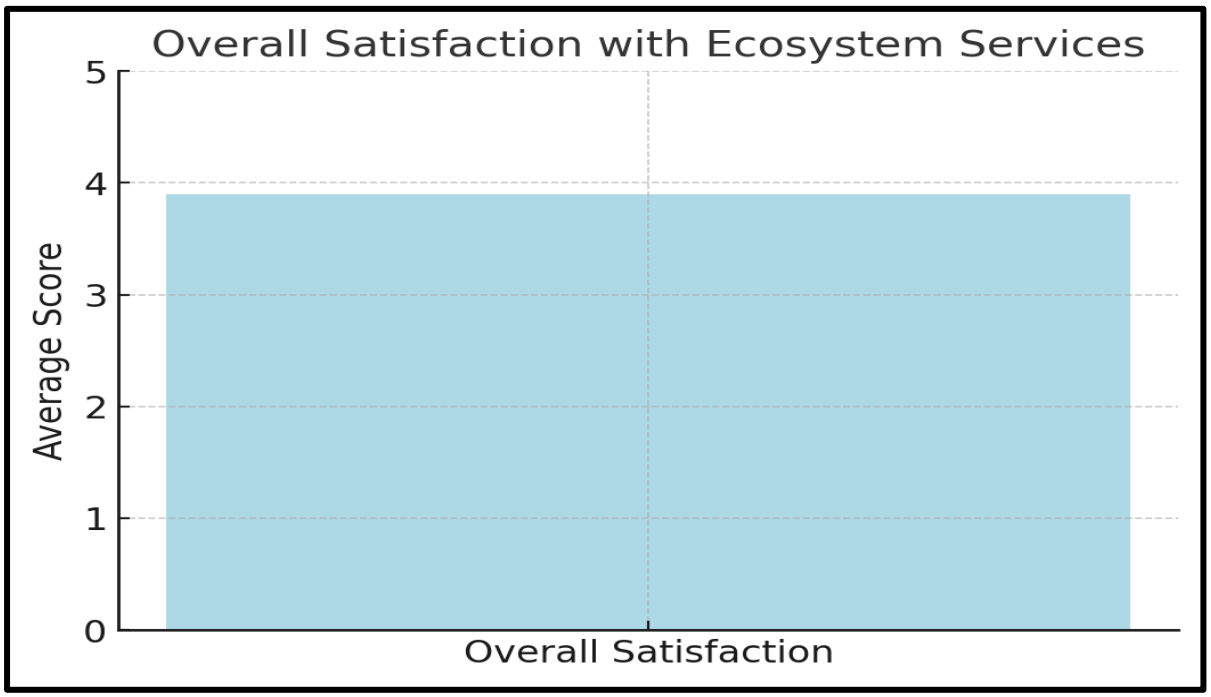

Figure 5.10: Overall Satisfaction with Ecosystem Services (Prepared by the Author)

The survey highlights the critical role of provisioning services in supporting the livelihoods of communities around Kaziranga National Park. The significant reliance on freshwater and food crops underscores the importance of sustainable management practices. The variations in importance ratings across different demographic groups emphasize the need for tailored conservation strategies.

5.3.4 Economic value of Provisioning Ecosystem Services generated from Kaziranga Tiger Reserve

Our analysis delves into the economic value of the provisioning ecosystem services emanating from the Kaziranga Tiger Reserve. According to the Indian Institute of Forest Management (IIFM) Report of 2015 on the valuation of Tiger Reserves, Kaziranga Tiger Reserve contributes significantly to the local and national economy through its provisioning services. These services, essential for the sustenance of local communities and biodiversity, have been quantitatively valued at approximately ₹10,675.91 million per annum. This valuation incorporates the time value of money for the year 2023, reflecting the current economic worth of these services. Such an evaluation underscores the critical role of the Kaziranga Tiger

Reserve in providing tangible, economically valuable benefits, highlighting the importance of its conservation and sustainable management for future generations.

5.4 Discussion

The results from Kaziranga National Park (KNP) showcase a robust dependence on provisioning ecosystem services among local communities. These services are not isolated benefits but are deeply integrated with the park's broader ecological functions, such as soil formation and nutrient cycling, which are vital for supporting the varied biodiversity within KNP. The high dependency on resources like fish, wild fruits, and medicinal plants illustrates a complex interplay between the park's ecological health and community well-being.

Significantly, the economic valuation of these services—particularly the monetary benefits from fish—highlights the crucial role of KNP as an economic bedrock for the surrounding populations. This economic dependence is a double-edged sword, presenting opportunities for development while also posing risks of overexploitation. Sustainable management practices are thus imperative to ensure that the extraction of these resources does not compromise the park's ecological balance.

The use of medicinal plants, with over half of the households relying on species like *Centella asiatica* and *Ocimum tenuiflorum*, reveals a rich cultural and health landscape that blends traditional knowledge with biodiversity. This reliance on traditional medicine underscores the importance of conserving plant species that are not only ecologically valuable but also hold significant medicinal properties.

The assessment of provisioning ecosystem services extends to the valuable medicinal plants used by the local communities around Kaziranga National Park (KNP). Our data reveals a rich pharmacopeia sourced from the park, signifying the integration of traditional ecological knowledge with primary healthcare practices.

- **Medicinal Plants**: A high dependency on medicinal plants was observed, with notable species such as:
    - *Centella asiatica* (Mani Muni or Indian Pennywort) relied upon by 54% of households for a variety of disorders including gastrointestinal issues and cognitive enhancement.
    - *Azadirachta indica* (Neem), used by 27% of households, recognized for its diverse medicinal properties ranging from immune-modulatory to antiviral effects.

- *Ocimum tenuiflorum* (Tulsi or Basil), with 61% of households using it for respiratory problems, skin diseases, and its immune-modulatory benefits.

Other species like *Mentha spicata* (Mint), *Bryophyllum pinnatum* (Goethe plant), and *Leucas aspera* (Doron bon) also contribute significantly to the local traditional healthcare system, with varying percentages of household dependency.

The significant reliance on a wide range of medicinal plants underscores the essential role of KNP's biodiversity in providing health benefits and sustaining traditional medicinal knowledge. The dependency rates indicate not only the cultural importance of these plants but also their critical role in the self-sufficiency of healthcare among the communities.

The economic value of provisioning ecosystem services from KNP, assessed at ₹ 10,675.91 million per year, reflects the enormous contribution of these services to the local economy. It is evident that these services, including medicinal plants, form an integral part of the socio-economic fabric of the area.

In terms of health and well-being, the widespread use of medicinal plants from KNP suggests a strong link between the park's biodiversity and the health of surrounding communities. It highlights the potential for conservation strategies that align with the promotion of traditional healthcare practices.

In conclusion, the provisioning ecosystem services of KNP, particularly medicinal plants, play a pivotal role in supporting the physical health, traditional practices, and economic well-being of the local communities. The data presents a compelling case for the conservation of these resources, ensuring their sustainability for future generations and acknowledging their value in traditional medicine and community health resilience.

Link to Literature:

The findings resonate with the ecosystem service literature that emphasizes the multifunctional role of protected areas. Studies such as those by the Indian Institute of Forest Management (2015) parallel our observations on the economic and health benefits derived from such ecosystems. However, our study advances the discourse by providing a nuanced look at how specific resources within KNP contribute to household economies and traditional healthcare practices.

While the literature broadly acknowledges the importance of ecosystem services, this study reveals a more detailed picture of resource dependency in KNP, particularly highlighting the significance of aquatic resources. The data on the usage and economic value of fish align

with the broader findings but also offer a localized understanding of the resource's significance, reflecting the unique socio-ecological context of KNP.

This discussion has delved into the complex relationship between the provisioning ecosystem services of KNP and the livelihoods, health, and economic well-being of the surrounding communities. By situating our findings within the broader context of ecosystem services and conservation, we have highlighted the critical need for a balanced approach that supports both ecological integrity and human development. The integration of traditional ecological knowledge, particularly regarding medicinal plants, presents a valuable avenue for enhancing health outcomes while preserving cultural heritage. As we conclude, it is clear that KNP is more than a bastion of biodiversity; it is a vital source of life and well-being for its human neighbours.

In terms of policy implications, the study supports a growing call for conservation strategies that integrate the needs and knowledge of local communities. It suggests that effective management of protected areas like KNP should not only focus on biodiversity conservation but also consider the socio-economic and cultural dimensions of human-ecosystem interactions.

As we move forward, it becomes evident that further research is needed to understand the sustainable thresholds of resource extraction and to explore the potential of ecosystem services in supporting not just local economies but also in fostering resilience against health challenges.

5.5 Conclusion

This chapter highlights the essential role of provisioning ecosystem services provided by Kaziranga National Park (KNP) in supporting the surrounding communities. The key findings reveal a substantial reliance on natural resources, including fuelwood, fodder, thatching materials, fish, wild fruits, vegetables, and a diverse array of medicinal plants. The use of these resources' spans across daily subsistence, economic sustenance, and traditional healthcare practices, underscoring the multi-dimensional benefits that KNP confers to local livelihoods.

The economic assessment of these services highlights fish as a particularly valuable resource, contributing immensely to household economies. The traditional knowledge associated with the use of medicinal plants, deeply rooted in the community, underscores the cultural and health importance of biodiversity conservation. This blend of economic reliance

and traditional practices paints a complex picture of human-environment interactions where KNP serves as a crucial life-supporting system.

The broader implications of these findings are significant for environmental management and policy development. They suggest a need for conservation strategies that are not only ecologically sound but also socio-economically just and culturally sensitive. Sustainable management of these resources is imperative to ensure the continued provision of these essential services without compromising the ecological integrity of KNP. Furthermore, the findings advocate for policy frameworks that integrate traditional ecological knowledge into modern conservation and healthcare paradigms, fostering a holistic approach to environmental and public health governance.

Moving forward, there are several avenues for future research to build upon the insights gained from this study. Investigations into sustainable harvesting levels that can maintain ecological balance while meeting community needs are crucial. Longitudinal studies examining the impact of environmental changes on the provisioning services and subsequent community health and economic outcomes would provide valuable data for adaptive management. Additionally, exploring the potential integration of traditional medicinal knowledge into broader healthcare systems could uncover innovative pathways for enhancing community resilience and well-being.

In conclusion, the provisioning ecosystem services of KNP are a cornerstone for the well-being of its neighbouring human populations. Protecting these services is imperative not just for the conservation of biodiversity but also for the promotion of human health, economic stability, and the preservation of cultural heritage. This study serves as a foundational step towards a more integrated understanding of how protected areas like KNP can be managed to support both conservation and human development goals.

5.6 Recommendations

In the context of Kaziranga National Park's provisioning ecosystem services, the following recommendations are proposed to ensure the sustainability of natural resources and the well-being of local communities:

1. **Sustainable Resource Management**: Implement sustainable harvesting guidelines for resources like fish, fodder, and medicinal plants, balancing ecological integrity with community necessities.

2. **Community Engagement in Conservation**: Foster community participation in conservation efforts, integrating local knowledge and requirements into park management strategies.
3. **Economic Diversification**: Promote alternative livelihoods for local communities, reducing reliance on direct resource extraction and mitigating ecological pressure.
4. **Traditional Knowledge Preservation**: Document and safeguard traditional ecological knowledge, especially concerning medicinal plants, and consider its incorporation into broader health practices.
5. **Education and Awareness**: Execute educational programs to enhance local understanding and support for conservation and sustainable resource utilization.
6. **Monitoring and Research**: Establish systems to monitor the status of ecosystem services and their community usage, and conduct research to define sustainable extraction limits.
7. **Policy Development**: Advocate for policies that acknowledge and support the link between ecosystem services and community welfare, ensuring an equitable approach to conservation.
8. **Healthcare Integration**: Explore the integration of traditional medicinal practices with modern healthcare systems to improve community health outcomes while preserving cultural heritage.
9. **Tourism Development**: Develop eco-tourism that benefits local economies and enhances environmental consciousness among visitors.
10. **Climate Change Adaptation**: Research and implement adaptive measures for the impacts of climate change on provisioning ecosystem services to ensure their resilience and sustainability.

These recommendations aim to foster a balanced approach to the management and conservation of Kaziranga National Park, recognizing its critical role in supporting both ecological diversity and local community livelihoods.

Chapter 6

Cultural Ecosystem Services of Kaziranga National Park

6.1 Introduction to Cultural Ecosystem Services

Cultural ecosystem services (CES) represent the intangible benefits that ecosystems impart to human societies. These services encompass a diverse range of interactions between people and nature, including recreational activities, aesthetic appreciation, cultural identity, and spiritual experiences. Kaziranga National Park (KNP), a renowned UNESCO World Heritage site in India, stands as a vivid example of an ecosystem rich in such cultural services.

Nestled in the state of Assam, KNP is not just a haven for biodiversity, but also a vibrant hub for cultural and spiritual enrichment. The park's diverse flora and fauna, including the iconic one-horned rhinoceros, majestic tigers, and lush greenery, contribute significantly to its aesthetic and recreational appeal. These natural wonders of KNP are instrumental in drawing visitors from across the globe, making it a significant site for eco-tourism and educational research. The park's landscape, wildlife, and serene ambiance offer unique experiences, instilling a sense of wonder and a deeper connection with nature.

Beyond tourism, KNP holds a special place in the hearts of the local communities. It is intertwined with their cultural fabric, traditions, and daily lives. The park influences local folklore, art, and customs, reflecting the deep-rooted relationship between the community and their natural surroundings. This connection emphasizes the park's role not only in conservation but also in sustaining the cultural heritage and identity of the local populace.

Furthermore, KNP's cultural ecosystem services extend to educational aspects, offering researchers and students invaluable insights into wildlife conservation, habitat management, and sustainable tourism practices. These educational opportunities contribute to a broader understanding of environmental stewardship and the importance of preserving such unique ecosystems for future generations.

In summary, the cultural ecosystem services of Kaziranga National Park are pivotal in promoting not only the conservation of biodiversity but also in enriching the cultural, spiritual, and educational tapestry of the region. They play a significant role in bolstering the local economy through tourism, reinforcing the cultural identity of indigenous communities, and fostering a global appreciation for nature's intrinsic value. This chapter aims to explore these

services in depth, examining their impacts on both local communities and visitors, and highlighting their broader implications for environmental management and policy.

6.2 Theoretical Framework

In exploring the cultural ecosystem services (CES) of Kaziranga National Park (KNP), it's crucial to delve into the theoretical frameworks that guide our understanding of these services. This section outlines key theories that shed light on the relationship between nature and culture, and how they manifest in the context of KNP.

1. **Conceptualizing Cultural Ecosystem Services:** Cultural ecosystem services, as outlined in frameworks like the Millennium Ecosystem Assessment, encompass the non-material benefits that ecosystems provide to humans. These include cultural identity, recreation, spiritual enrichment, and educational experiences. KNP, with its rich biodiversity and scenic landscapes, is a quintessential example of a natural setting offering a multitude of such cultural benefits.
2. **Human-Nature Relationship Theories:**
    - The Biophilia Hypothesis by E.O. Wilson (1993) posits an inherent human affinity towards nature. In KNP, this is reflected in the deep connection visitors and local communities feel with the park's natural environment.
    - The Sense of Place theory resonates in KNP's context, where the park is not just a biodiversity hotspot but also a symbol of regional identity and pride. The emotional attachment of local communities to KNP underlines this theory.
3. **Cultural Value Systems and Conservation:** Cultural values play a pivotal role in conservation efforts. Theories highlighting the symbiotic relationship between cultural practices and sustainable environmental management are evident in KNP. Local communities living around KNP often engage in traditional practices that align with conservation objectives, showcasing a harmonious balance between cultural heritage and ecological preservation.
4. **Recreational and Tourism Theories:** Theories in eco-tourism highlight the value of natural landscapes in recreational experiences. KNP is a prime example where eco-tourism thrives, providing educational and recreational opportunities while fostering economic growth and conservation awareness.
5. **Education and Awareness:** Theories related to environmental education emphasize the role of natural spaces like KNP in fostering ecological awareness and conservation

literacy. Through visitor programs, KNP plays a critical role in educating the public about the importance of biodiversity and ecosystem protection.

6. **Incorporation of Indigenous Knowledge:** Traditional Ecological Knowledge (TEK) acknowledges the significance of indigenous wisdom in ecosystem management. In KNP's context, TEK is evident in how local communities utilize traditional knowledge in harmony with conservation efforts, contributing to the park's sustainability.
7. **Conclusion:** This theoretical exploration underscores the multifaceted nature of cultural ecosystem services provided by KNP. The intertwining of human culture with natural landscapes not only enhances the value of KNP but also reinforces the importance of integrating these theoretical insights into practical conservation and management strategies. By embracing these frameworks, KNP can continue to be a beacon of biodiversity conservation that deeply resonates with cultural and educational values.

6.3 Methodological Recap

This section revisits the methodologies implemented to assess the cultural ecosystem services of Kaziranga National Park (KNP). A recap of these methods is essential to understand the link between the theoretical frameworks discussed and the practical approaches employed in the study. This overview serves as a foundational reference, connecting the methodology with the research objectives and the subsequent findings and discussions.

Overview of Methodologies Employed:

1. **Visitor Surveys and Interviews:** Our study utilized surveys and interviews with visitors to KNP to gather data on their experiences, perceptions, and values. The surveys were structured to include a range of questions exploring visitors' interactions with the park's natural setting and cultural attributes. The sampling strategy focused on achieving a representative mix of visitors, capturing diverse viewpoints and experiences.
2. **Ethnographic Studies:** Ethnographic research played a crucial role in capturing the cultural significance of KNP to the local communities. This involved in-depth observations and documentation of local cultural practices, beliefs, and values that are intricately linked to the park. The aim was to understand the park's role in the cultural

fabric of the surrounding communities and how it influenced their relationship with the natural environment.

3. **Travel Cost Method:** (Zonal Travel Cost Method) To quantify the economic value of recreational visits to KNP, the Travel Cost Method was employed. This approach estimated the recreational value based on the amount of money spent by visitors traveling to the park. The method provided a tangible measure of KNP's economic impact on tourism and was instrumental in valuing the park's cultural appeal.

The methodologies were tailored to the unique context of KNP. For instance, visitor surveys were designed to capture the specific attributes of KNP that draw tourists, while ethnographic studies were focused on the indigenous communities' connection with the park. The application of the Travel Cost Method considered the diverse visitor demographics and their spending patterns, reflecting KNP's wide-reaching cultural allure.

These methodologies directly supported our research objectives to assess and understand KNP's cultural ecosystem services. The visitor surveys and interviews provided insights into how visitors perceive and value the park's cultural aspects. Ethnographic studies offered a deeper understanding of the park's cultural significance to local communities. Finally, the Travel Cost Method provided an economic perspective on the value of these cultural services.

In summary, the methodologies outlined here were integral in exploring the cultural ecosystem services of KNP. They provided a comprehensive view, combining qualitative insights from visitor experiences and local community interactions with quantitative economic valuation. These methods set the stage for the findings and analysis that follow, offering a holistic understanding of KNP's cultural significance.

6.4 Travel Cost Method Application

6.4.1 Travel Cost Method (TCM)

The travel cost technique is primarily applicable for assessing the recreational worth associated with biodiversity and ecosystem services. It operates on the premise that recreational activities entail expenses (such as direct costs and the opportunity costs of time) (Bharali & Mazumder, 2012). (Kontoleon and Pascual, 2007). The fundamental principle of the travel cost technique is that the expenses individuals bear in terms of both time and travel costs to visit a certain location serve as an indicator of their willingness to pay for the opportunity to visit that

location. There are two fundamental methods for implementing Travel Cost Method (TCM). There are two approaches to estimating travel costs: the straightforward zonal travel cost technique and the individual travel cost approach, which involves a more comprehensive survey of visitors (Hein, 2006). The zonal travel cost method is the most straightforward and cost-effective approach. It is utilized to approximate the monetary worth of the leisure services provided by the entire site. The zonal travel cost approach is utilized by gathering data on the frequency of visits to the location from various distances. To assess the visitors' willingness to pay, concentric circles are delineated around the venue. The TCM operates under the assumption that individuals from all social groups possess uniform preferences. This data is utilized to formulate the demand function for the site and calculate the consumer surplus, which represents the economic advantages of the recreational activities provided by the site. The individual travel cost approach is akin to the zonal strategy, except it use survey data from individual visitors in statistical analysis, as opposed to data from each specific zone. This approach necessitates additional data gathering and a marginally more intricate analysis, although it yields more accurate outcomes by enabling the adjustment for variation among visitors within the distance circles (Verma et al., 2017).

6.4.2 Summary

The objective of this study is to assess the recreational amenities offered by the environment of Kaziranga National Park (KNP) and its impact on the local populations' means of subsistence. Data was collected using the zonal approach travel cost method to evaluate the recreation value in the KNP. The evaluation of tourists' awareness and attitude towards the National Park and its protective status was conducted using semi-structured questions. A survey was conducted on 11 villages to determine the economic impact of the tourism sector on the local population. A total of 150 individuals were interviewed for this study, including both direct participants in the tourism sector such as shopkeepers, tourist guides, tour operators, porters, and Gypsy safari proprietors, as well as indirect participants who sell products to local shopkeepers rather than directly to tourists. The KNP was assessed to have a recreational value of ₹ 5720000, with a consumer surplus of ₹ 40.53 per visit per year. The average annual household income for households engaged in tourism was estimated to be ₹ 205,758.56 ± 17,164.2, and the contribution of tourism to this income was determined to be ₹ 894,163.12 ± 12,314.5 per year per household. The study revealed that the extent to which tourism contributes to families varies from 3% (mostly for households with indirect involvement) to 95%. The tourists exhibited knowledge of the conservation status of the area.

6.4.3 Introduction

Employment may be generated, poverty can be combated, and sustainable development can be achieved through cultural and ecological tourism. Recreation is a plentiful service offered by ecosystems. The consumers ascribe significant value to nature recreation, which is not accurately represented by market prices. This value is considered a quasi-public good (Zandersen and Tol, 2009). Taking into account these values can lead to enhanced management, preservation, and strategic initiatives for nature-based recreational activities. The acknowledgement of the economic advantages of recreational activities has established a solid commercial justification on a global scale and has been recognized as a means of promoting biological conservation (Ahmed et al., 2007).

Recreational visits often target natural places, yet these locations are rarely valued in terms of monetary price. The popularity of tourism in natural areas, especially mountains, is growing rapidly due to the allure of their picturesque landscapes, rich cultural heritage, historical significance, and thrilling recreational activities. This expansion yields advantages for local communities and national economies, however, simultaneously presents a potential peril to the well-being of their natural and cultural assets. Insufficiently managed and executed tours and activities can cause significant harm to delicate mountain ecosystems, as well as to the local communities (UNEP and CI, 2007). If not properly managed, it exerts additional strain on the ecosystem and results in unfair distribution of benefits. In order to ensure the continuing provision of services, it is imperative to allocate and assess the value of these services, as they may be subject to fluctuations caused by changes in climate, land use conversion, and other natural and human-induced factors. Allocating and appraising recreation services will assist managers in formulating more effective policies and implementation strategies. The recognition and measurement of the value of forest recreation and other benefits that are not bought and sold is not a new concept (Willis and Benson, 1989; Chaudhry and Tewari, 2006). However, there have been relatively few efforts to put the findings of these research into practice.

Figure 6.1: Tourists at Kaziranga National Park (Photo by Author)

Kaziranga National Park (KNP) receives annual visitors from both domestic and international tourists for recreational purposes. The majority of tourists visit the location to observe and encounter the wildlife present in the national park. The inhabitants of the outlying villages surrounding the Kaziranga National Park (KNP) engage in tourism activities that yield financial advantages for the local community. The majority of tourists who visit Kaziranga do so for recreational purposes.

Tourism has the ability to create new opportunities for the communities living in KNP in terms of livelihood. Tourism in small island states is characterized by ambivalence, which is particularly evident due to its significant contribution to annual revenue. In this context, the expansion of the tourism industry gives rise to several challenges and obstacles, including

competing demands for scarce resources such as water, land, energy, and waste management. Although the Kaziranga National Park (KNP) plays a significant role in the local economy and has a substantial impact on biodiversity, its recreational value has not been adequately researched previously.

The objective of this study is to examine the recreational services offered by the landscape of KNP and their impact on the local populations' livelihood. Additionally, it intends to evaluate the preferences of tourists and their readiness to pay for these services in KNP. Evaluating the value of recreational activities in the area will assist the management in creating a sustainable ecotourism framework that promotes fairness in the distribution of benefits.

6.4.4 Methodology

Travel Cost Method

Data collection for evaluating the recreation value in the KNP was conducted using the zonal approach travel cost method (ZTCM), as described by Clawson (1959), Moeltner (2003), and Badola et al. (2010). The Travel Cost Method (TCM) assesses the monetary value associated with site-specific amenities, particularly the value that may be derived from visiting a site. The TCM models operate under the assumption that individuals make decisions about their travel patterns (including the number of visits and destinations) in a way that maximizes their overall satisfaction, taking into account their income level (Tisdell and Wilson, 2002). The core tenet of the TCM is the direct correlation between distance and the frequency of visits to a specific recreational site. In other words, individuals residing in close proximity to the recreational site are more likely to make more excursions compared to those living farther away from it (Ahmed et al., 2007). The Zonal travel cost model was initially implemented and refined by Clawson at Resources for the Future (Clawson, 1959; Clawson and Knetsch, 1966). The area of origin of tourists in ZTCM is partitioned into distinct zones. The study site might be located at the center of circular zones. Geographical or administrative units of the area can also be used to select zones. It is crucial to identify the source of visitors in order to accurately estimate the annual number of visits from each specific origin zone. The population of each origin zone is utilized to compute the visitation rate for that specific zone. The rate of visitation can be attributed to two factors: the cost of travel from the place of origin to the destination, and the demographic and income features of the people residing in the place of origin (English and Bowker, 1996).

The ZTCM approach redefines the trip generating function (tgf) as:

$V_{hj} / N_h = f (C_h, X_h)$

where, V_{hj} = Visits from zone h to site j;

N_h = Population of zone h;

C_h = Visit costs from zone h to site j;

X_h = Socioeconomic explanatory variables in zone h.

The visitor rate, V_{hj}/N_h, is often calculated as visits per 1000, 1000000 population of zone h (Chaudhry and Tewari, 2006).

The individual approach relies on analysing annual visits, trip expenditures, and socioeconomic characteristics using individual or micro data. It is possible to calculate direct estimations of the link between price and quantity for a specific individual. Economic theory demonstrates the superiority of individual models over zonal models (Fletcher et al., 1990). However, for households or individuals that only take one or a few journeys per year, individual models may not be suitable. In these situations, zonal models are a preferable alternative (Guha & Ghosh, 2009; Ward and Loomis, 1986).

There are two different approaches available for estimating the recreational value: the Contingent Valuation Method (CVM) and the trip cost method (TCM). The CVM survey inquires about the amount visitors are willing to spend to access a recreational venue. Nevertheless, this approach fails to capture the genuine actions of visitors (Guha & Ghosh, 2009). The contingent valuation method (CVM) may not accurately assess the recreational value of an environmental resource in a developing country like India due to the presence of a parallel economy that includes several kinds of middle to upper income groups of visitors (Chaudhry & Tewari, 2006). Previous research indicates that given the presence of a market for the service being evaluated, it is advisable to refrain from using Contingent Valuation Method (CVM) (Guha & Ghosh, 2009). To solve this obstacle, the travel cost method (TCM) was employed in this study, which is a more widely accepted approach for assessing recreational services. For the study, the zonal strategy was employed since the majority of travellers do not make many visits to the KNP. The estimation of the recreational demand for the site is based on the preferences of visitors that are observed rather than those that are self-reported (Guha & Ghosh, 2009).

A systematic questionnaire was constructed based on the multisite destination model, following the guidelines provided in UNESCO's guidebook "Managing Tourism at World Heritage Sites" (Pedersen, 2002). This approach is necessary to avoid overestimating the consumer surplus, since failing to consider many destinations might lead to such inaccuracies (Kuosmanen et al., 2004). A pre-tested survey was conducted at various sampling sites (Ahmed et al., 2007). The selection of sampling sites was based on the visitation rate (Petrosillo et al., 2007). Interviews were held with tourists at all the chosen locations. A study conducted by Akhter et al. (2009) interviewed tourists from various socio-economic and occupational backgrounds. These tourists had different profiles, such as being local residents, foreign tourists, or tourists on independent or package tours. They also had different purposes for their visits, including skiing, religious activities, trekking, expeditions, holidays, business, and visiting friends and relatives (Badola et al., 2010). The population under study was stratified into zones based on the tourists' state of origin. The areas of tourist origin were not segmented into circular zones due to the challenge of estimating the population in these zones. The state of origin was considered a zone for visitors from other countries (English and Bowker, 1996).

Tourists visit KNP mostly for recreational purpose during summer and winter seasons. During monsoon season KNP is closed for the visitors. In order to mitigate the influence of seasonal variations and the tendency of data to favour a specific sort of tourist profile, a comprehensive year-round sampling approach was employed (Guha & Ghosh, 2009). In order to standardize the data about the many variables used in the study, the distance was quantified as the geographical distance (in kilometres) between the capital city of the state of origin and the location where the samples were taken. Data on income, age, education status, and state of origin was gathered for the tourist profile. The purpose of the excursion was to identify the most captivating cultural amenities in the research area. In order to determine the travel expenses, data was collected regarding the transportation method and its associated cost, the composition of the travel group, as well as the expenses for accommodation, meals, and local services. The assessment of time spent on travel (both ways) and duration of stay in the region was conducted based on hourly earnings (Mcconnell and Strand, 1981). The recreational value for religious and recreational function was computed independently, as these functions exhibit distinct behaviours. The frequency of recreational trips is greatly influenced by the availability of essential facilities, weather conditions, and the accessibility of roads to the destination. In contrast, religious tourism is not influenced by these factors.

The study also evaluated the level of awareness and the disposition of tourists towards World Heritage Sites (WHS) and the protection status of National Parks through the use of semi-structured questionnaires. In order to assess the impact of tourism on the local economy, individuals involved in various tourism-related occupations (such as tourist guides, porters, proprietors of homestays, hotels, and lodges) were questioned.

The overall expense of travel is determined for each trip by considering the combined cost of transportation, the monetary worth of the time spent traveling to and from the destination, as well as the expenses incurred during the stay, including accommodation, meals, hiring guides, and purchasing local products. The cost of time spent is calculated based on the hourly pay of the specific visitor. The cost of travel to KNP was determined by adding the expenses for distance driven, fare paid for the voyage, and vehicle maintenance costs. This calculation was done on a per kilometre basis for each visit. The maintenance cost encompasses expenses related to gasoline, vehicle refurbishment, and other maintenance activities. The sum of these combined provides the overall travel cost. A regression analysis was conducted to establish an equation that correlates visits per capita with travel costs (Badola et al., 2010).

A survey was conducted on 11 villages to determine the economic impact of the tourism sector on the local population. A total of 150 individuals were interviewed for this study, including both direct participants in the tourism sector such as shopkeepers, tourist guides, tour operators, porters, and mule owners, as well as indirect participants who sell products to local shopkeepers instead of directly to tourists. Inquiries were made on the nature of employment and the yearly earnings.

6.4.5 Results and Interpretation

A structured questionnaire was utilized to conduct a survey among a total of 379 tourists at strategically selected locations within three distinct safari zones of Kaziranga National Park: the Eastern (Agaratoli Zone), Central (including the Kohora range), and Western (Bagori Zone) zones.. Approximately 200,000 to 300,000 tourists visit KNP annually. The KNP exclusively attracts nature-based tourism (Table 6.1).

Table 6.1: Tourism Profile of Kaziranga National Park (Prepared by the Author)

Place (Safari Zone)	Type of tourism	No. of interview conducted	Season of maximum visits	Season for visit
Eastern (Agaratoli Zone)	Nature	99	Winter	Summer-Winter
Central (including the Kohora range)	Nature	167	Summer	Summer-Winter
Western (Bagori Zone)	Nature	113	Winter	Summer-Winter

6.4.5.1 Nature Based Recreational Value of the KNP

Profile of tourists

A comprehensive survey was conducted, interviewing a total of 379 participants from 27 distinct regions (refer to Table 6.1 and Table 6.2). Among the respondents, 67.41% were male and 32.59% were female. A total of 237 individuals reported that they are currently embarking on their first visit to the location, whilst 142 individuals have previously explored the vicinity. Out of the people who came back to the place, 68.7% had visited it once before, while 31.3% had visited it more than 10 times in previous years. The average age of the respondents was 34.90 with a standard deviation of 0.70. The majority of tourists (61.35%) opted for independent holidays, while 19.51% chose package tours offered by various non-governmental groups. 17.47% of the individuals were tourists from other countries. The lowest percentage (9.96%) of recreational activity was recorded among local residents (Fig. 6.2). The observed group size of the tourists ranged from 11 individuals to a single individual, with a mean of 4.41 and a standard error of 0.33.

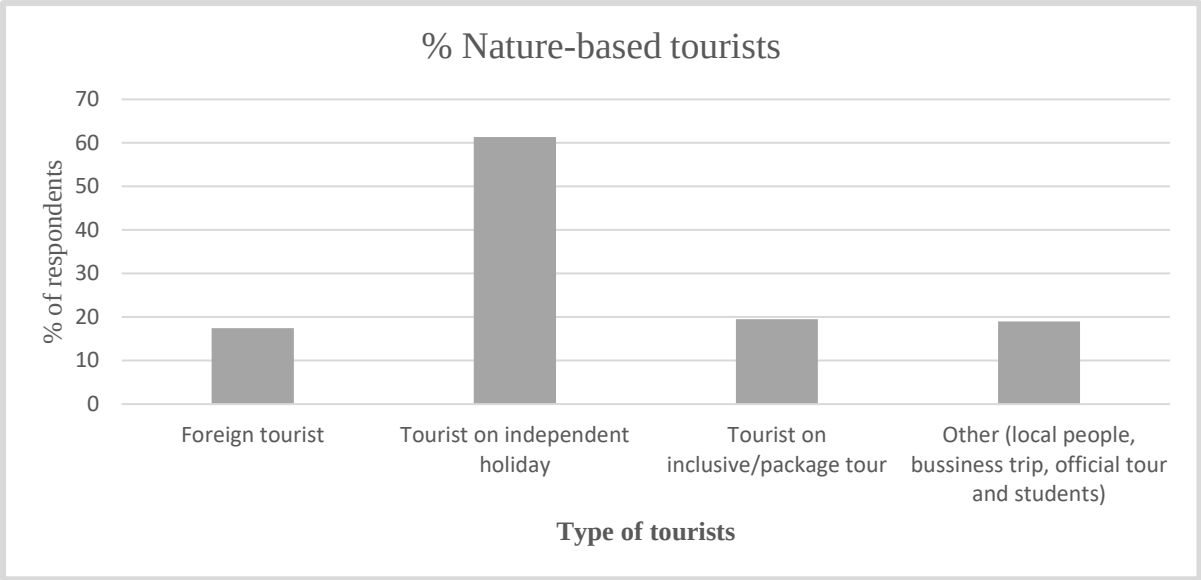

Figure 6.2: Type of Tourist Visiting Kaziranga National Park (Prepared by the Author)

The participants were classified into several educational, vocational, and income categories. Among educational classification 51.7% of the respondents held a graduate degree, while 29.15% had a post-graduate degree. Only 1.27% of the respondents belonged to the sixth educational group, which includes individuals with a Ph.D. degree (Fig. 6.3).

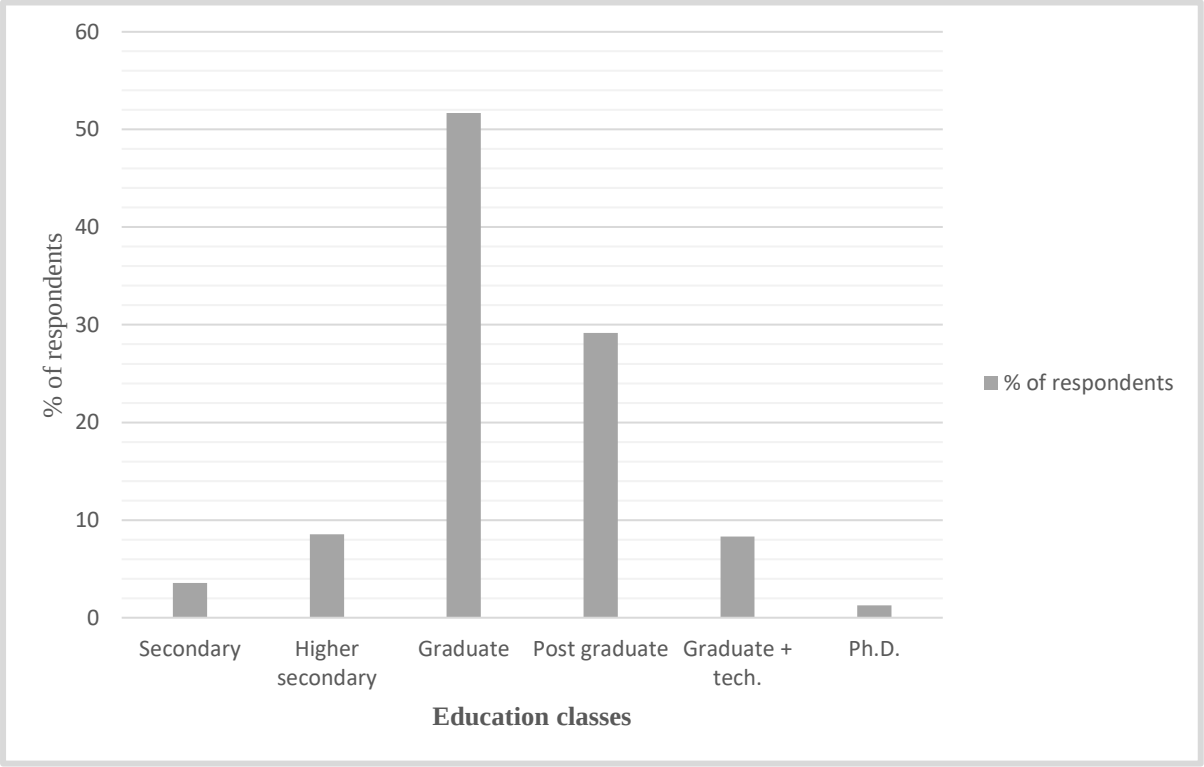

Figure 6.3: Educational Status of Tourists Visiting Kaziranga National Park (Prepared by the Author)

Table 6.2: Profile of Tourists Visiting Kaziranga National Park for Recreational Purposes (Prepared by the Author)

Zones	Interview conducted	Total visit	Population	Visit/1000	Total Expenditure (INR)
Andhra Pradesh	14	15	84580777	0.000177345	250012.51
Arunachal Pradesh	7	10	1383727	0.007226859	892461.24
Assam	92	273	31205576	0.008748436	553476.82
Bihar	11	12	104099452	0.000115274	137472.14
Canada	3	21	38980374	0.0005387326	395127.75
Delhi	23	27	16787941	0.001608297	223653.43
France	4	18	64833373	0.0002776348	462188.21
Germany	6	24	83268754	0.0002882234	628361.42
Gujarat	23	39	60439692	0.000645271	487264.38
Karnataka	26	27	61095297	0.000441933	345672.52
Kerala	15	15	33406061	0.00044902	209295.31
Madhya Pradesh	12	13	72626809	0.000178997	195632.21
Maharashtra	14	14	112374333	0.000124584	226156.34
Manipur	14	19	2855794	0.006653141	99066.66
Meghalaya	8	31	2966889	0.010448655	162405.87
Mizoram	11	19	1097206	0.017316712	89314.37
Odisha	17	38	41974218	0.000905318	572632.15
Poland	3	22	40527554	0.0005428406	331427.43
South Africa	5	15	60784382	0.0002467739	1345040.75
Tamil Nadu	6	42	72147030	0.0005821445	102347.42
USA	5	39	341109216	0.0001143329	1218952.8
Uttar Pradesh	16	76	199812341	0.0003803569	295296.14
Uttarakhand	17	18	10086292	0.0017846	308356.67
West Bengal	27	42	91276115	0.000460142	393951.48

Visit/1000 = (Total visits/Population) x 1000

The respondents are categorized into eight distinct vocational backgrounds. A majority of the respondents (48.24%) were employed in the private sector, whilst 23.52% were self-employed and owned their own businesses. 7.36% of individuals were employed by various government entities, whereas 8.88% were enrolled as students (Fig. 6.4).

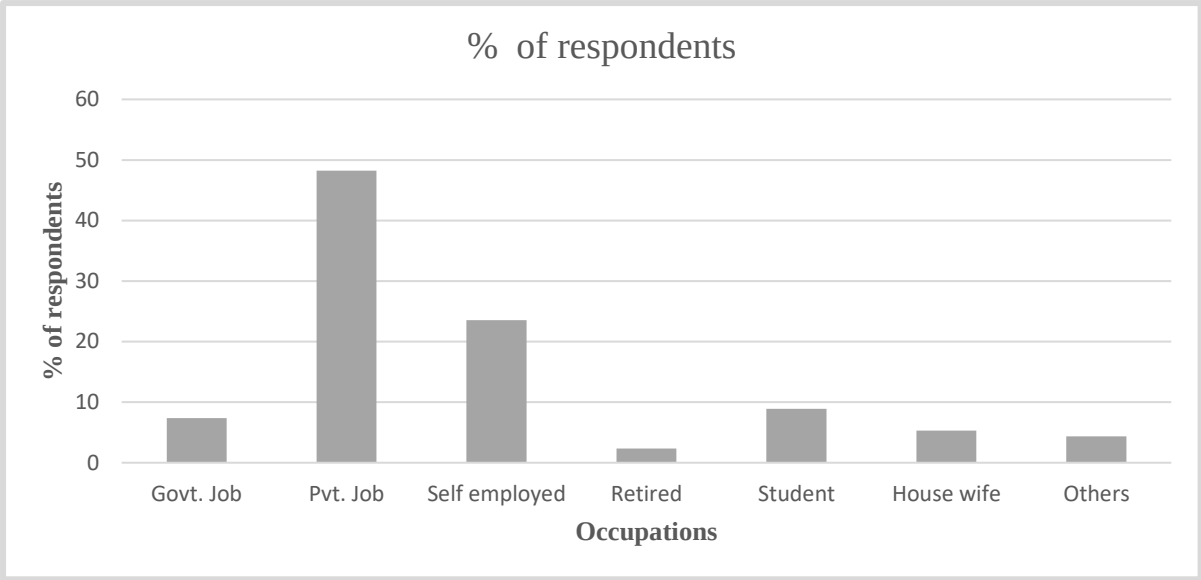

Figure 6.4: Occupational Pattern Among Tourist Visiting Kaziranga National Park (Prepared by the Author)

The respondents were further categorized into seven distinct income brackets. The income class with the largest number of respondents was the fourth category (₹ 41000-60000/month), followed by the sixth category (₹ 81000-100000/month), and then the first category (not earning, which includes elderly, housewives, and students) (INR 41000-60000) and third category (₹ 21000-40000/month). The income class (₹ 61000-80000/month) had the lowest number of responders, as shown in Table 6.3.

Table 6.3: Income Classes of Respondents Visiting Kaziranga National Park (Prepared by the Author)

Income Class	Respondent %
Not earning	16.53
1000-20000	10.61
21000-40000	15.71
41000-60000	20.4
61000-80000	7.81
81000-100000	17.32
> 100000	11.62

When questioned about the sponsor of the current trip, 94.37% of the respondents stated that they were funding their own visits, while 2.51% mentioned that the government was

covering the expenses. 2.67% of the respondents reported that their trip was sponsored by a private corporation or company that they were employed with. There are numerous hotels, lodges, and guest houses located in the periphery of KNP, as well as a few home-stays. According to Table 6.4, over 84% of the respondents expressed a preference for staying in a hotel or lodge, whereas only 2.12% of tourists selected a homestay.

Table 6.4: Type of Stay Preferred by Visitors to Kaziranga National Park (Prepared by the Author)

S. No.	Type of stay	Visitors (%)
1	Hotel/lodge	84.42
2	Guest house	8.56
3	Homestay	2.12
4	With friends and relatives	1.47
5	Didn't stay	3.43

The table 6.5 presents data on the sources of information that tourists relied upon when visiting Kaziranga National Park. The most popular source of information, used by 31.32% of tourists, is the internet, highlighting its significance as a tool for planning visits. A previous visit combined with advice from friends or relatives also played a substantial role, influencing 29.47% of visitors, which suggests that personal experience and recommendations are highly trusted. Tourist guidebooks were the primary source for 14.42% of tourists, indicating a preference for detailed, structured information. Advice from a tourist information centre with a brochure accounted for 13.06%, showing that traditional methods of obtaining information still hold relevance. Other sources, including newspapers and magazines, were cited by 6.45% of tourists, whereas TV programs were the least referenced, guiding only 5.28%. This distribution of information sources reflects a diverse range of preferences and approaches to travel planning among those visiting the park.

Table 6.5: Source of Information About Kaziranga National Park (Prepared by the Author)

S. No.	Source of information	Tourists (%)
1	A previous visit with advice from friends/relatives	29.47
2	Advice from a tourist information centre with brochure	13.06
3	Tourist guidebook	14.42
4	Internet	31.32
5	TV program	5.28
6	Others (including newspapers, magazines etc.)	6.45

Due to the National Park's capacity to offer recreational amenities to a significant number of tourists, over 60% of visitors expressed a high likelihood of revisiting the location, while around 11% indicated a lack of interest in returning to the Reserve. When questioned about their reasons for not revisiting the place, over 47% of the respondents cited the area's inadequate infrastructure as the primary factor, while around 10% mentioned its remote location and challenging travel logistics. Approximately 11% of the tourists expressed a preference for exploring alternative destinations rather than revisiting KNP, despite their appreciation for its natural beauty and enjoyment on their initial visit.

The table 6.6 encapsulates the findings of a visitor survey conducted at Kaziranga National Park (KNP), a renowned wildlife sanctuary known for its efforts in conserving the Indian rhinoceros among other species. The data conveys visitors' preferences, perceived shortcomings, and recommendations for enhancing the park's recreational services.

Visitor Preferences at KNP: Scenic beauty emerges as the preeminent attraction, with 62.18% of respondents identifying it as the aspect of KNP they most enjoyed. This overwhelming preference underscores the park's visual appeal and the intrinsic value visitors place on natural landscapes. Safaris, which allow close encounters with the park's diverse wildlife, are favoured by 17.15% of the survey participants, highlighting the importance of interactive experiences with fauna in their natural habitat. A noteworthy 15.55% of respondents derive their satisfaction from a combination of scenic beauty and safari, suggesting that integrative experiences that couple natural vistas with wildlife observation are particularly rewarding for a significant subset of visitors. Conversely, cultural heritage, either standalone or in combination with scenic beauty, is less frequently cited as the primary source of enjoyment, at 3.51% and 0.77% respectively, which might reflect an opportunity to better integrate and promote the park's cultural aspects.

Challenges Identified by Visitors: While a majority of visitors (67.17%) express broad satisfaction with the park, labelling everything as good, there are areas flagged for improvement. A notable 14.87% of respondents find the absence or poor maintenance of basic facilities to be the least enjoyable aspect of their visit, indicating that the infrastructural aspects of KNP could detract from its overall appeal. Additionally, the difficulties associated with travel, whether it be access to or within the park, are highlighted by 13.68% of visitors, suggesting that logistical elements of the park experience require attention.

Recommendations suggested by visitors for Improvement: The survey participants advocate for enhancements in specific domains to elevate the quality of recreational services at KNP. The call for better basic facilities, as suggested by 45.23% of respondents, aligns with the criticism noted in the least enjoyed category, indicating a clear demand for infrastructural development. The protection and preservation of the park are endorsed by 33.31% of visitors, which may reflect a recognition of KNP's conservation successes and a desire to maintain its ecological integrity. The recommendation that tourists should be educated about the environment, suggested by 17.88%, underscores the need for increased awareness and responsible tourism practices. Lastly, creating a more tourist-friendly environment is a relatively minor but notable recommendation, which could involve a range of initiatives from enhancing visitor engagement to streamlining park services.

In an academic context, these findings could be critically analysed to inform management practices that align with visitor expectations and conservation goals, ensuring that Kaziranga National Park continues to thrive as a sanctuary for wildlife and a destination for eco-tourists.

Table 6.6: Visitors' Preferences, Perceived Shortcomings, and Recommendations for Enhancing Park's Recreational Services (Prepared by the Author)

Most Enjoyed attraction of the place	Respondents (%)
Safari	17.15
Scenic beauty	62.18
Scenic beauty + Safari	15.55
Cultural heritage	3.51
Scenic beauty + Culture	0.77
Nothing	0.84
Attraction Enjoyed least	
Everything is good	67.17
Absence or poor maintenance of basic facilities	14.87
Travel	13.68
Attitude of other tourists towards nature	3.26
Others	1.02
Recommendation for improvement of the area	
Better basic facilities	45.23
Everything is very good should be protected	33.31
Tourists should be educated about environment	17.88

Tourist friendly environment	3.58

Table 6.7 delineates the levels of awareness among tourists regarding the conservation status and international recognition of Kaziranga National Park (KNP), also designated as Kaziranga Tiger Reserve (KTR). The data stratifies awareness into four categories: World Heritage Sites (WHS), Protected Areas (PA), National Parks (NP), and the combined status of National Park and Tiger Reserve (KNP, KTR).

An analysis of the data reveals a nuanced landscape of visitor awareness. A robust 98.97% of respondents are cognizant of KNP's status as a National Park, a testament to the successful branding and communication of the park's national significance. This near-universal awareness underscores the mainstream recognition of national park conservation efforts in the public consciousness.

Awareness of KNP as a Protected Area is also high at 85.48%, reflecting an appreciable understanding that the park is part of a broader network of protected landscapes dedicated to the conservation of biodiversity and natural heritage.

The recognition of KNP as a World Heritage Site is slightly less prevalent, with 82.36% of respondents acknowledging this designation. This figure, while still representing a majority, suggests that the World Heritage status, despite its global importance, may not be as prominently communicated or recognized among the park's visitors.

The awareness significantly declines when tourists are queried about KNP and KTR's combined status as a National Park and Tiger Reserve, with only 65.32% affirming knowledge of this dual designation. This indicates that over one-third of visitors are not aware of the park's critical role in the conservation of tigers, an iconic species of global conservation concern.

Conversely, the lack of awareness is indicated by 17.64% for the WHS status, 14.52% for the PA status, and a marginal 1.03% for the NP status. Notably, a substantial 34.68% of tourists are unaware of KNP's designation as a Tiger Reserve, highlighting a significant gap in visitor understanding of the park's conservation scope.

The data presented in Table 6.7 suggests that while there is an overarching recognition of KNP's conservation statuses, there remains a disparity in the awareness of its specific designations, especially concerning its critical role in tiger conservation. The academic implication of these findings suggests a need for targeted educational initiatives to enhance visitor understanding of KNP's comprehensive conservation designations. Such efforts could play a pivotal role in fostering greater engagement with conservation objectives and supporting the park's long-term conservation strategy.

Table 6.7: Level of Awareness Among Tourists (Prepared by the Author)

Response	WHS (%)	PA (%)	NP (%)	National Park and Tiger Reserve (KNP, KTR) (%)
Know	82.36	85.48	98.97	65.32
Do not know	17.64	14.52	1.03	34.68

Table 6.8 provides a quantitative overview of tourist awareness regarding the objectives of designating areas as Protected Areas and World Heritage Sites, as well as the perceived benefits of such designations.

Protected Area Awareness: Most respondents (49.88%) recognize that a Protected Area designation primarily serves to provide protection to flora and fauna. This reflects a general understanding that the conservation of biodiversity is a key objective of such areas. However, only a small fraction (6.15%) acknowledges that reducing human interference is also a goal of Protected Areas, with an even smaller subset (11.08%) recognizing both protection of wildlife and reduction of human impact as joint objectives. Notably, there is a significant proportion of respondents (32.89%) who admit to not knowing the purpose of a Protected Area, suggesting a gap in awareness that could be addressed through educational initiatives.

World Heritage Site Awareness: When it comes to World Heritage Sites, over half of the respondents (52.46%) are aware that these sites are unique, world-famous locations where nature protection is declared by UNESCO. This demonstrates a substantial recognition of the international importance and prestige associated with World Heritage designations. Conversely, only a modest percentage of tourists (8.32%) identify these sites as being popular across the world, and an even smaller group (1.31%) connects the designation with the protection of the environment against degradation. Additionally, 3.57% appreciate that these sites possess special natural and cultural beauty. A significant portion of respondents (34.34%), however, indicate a lack of knowledge about what constitutes a World Heritage Site.

Perceived Benefits of Protected Area Designation: In terms of the benefits of declaring a place as a protected area, a strong majority (66.33%) believe that it will improve the condition of an area's natural wealth by protecting it. This consensus suggests an appreciation of the intrinsic value and the anticipated positive impact of conservation efforts. Yet, there remains a considerable percentage (33.67%) who are unsure of the benefits such designations may confer.

The data from Table 6.8 illustrates a varied understanding among tourists of the objectives and benefits of Protected Areas and World Heritage Sites. While there is a baseline awareness of the protective intentions behind these designations, particularly with respect to biodiversity conservation and UNESCO's role in endorsing sites of natural significance, there is also a notable lack of comprehensive knowledge. This information deficit, especially regarding the aims of reducing human interference and the broader environmental and cultural implications of such designations, indicates an opportunity for educational outreach to enhance public comprehension and support for conservation initiatives.

Table 6.8: Tourist Awareness Regarding the Objectives of Designated Areas (Prepared by the Author)

Response	Respondents (%)
Protected Area	
Protection to flora and fauna	49.88
Less human interference	6.15
Both	11.08
Do not know	32.89
World Heritage Site	
Popular across the world	8.32
To protect environment against degradation	1.31
Unique, world famous, protection for nature declared by UNESCO	52.46
Place with special natural and cultural beauty	3.57
Do not know	34.34
Benefits by declaring place a protected area	
It will improve the condition of natural wealth of area by protecting it	66.33
Do not know	33.67

6.4.5.2 Demand Curve and Consumer Surplus for Recreational Value at Kaziranga National Park (KNP)

The analysis of the recreational value at Kaziranga National Park (KNP) was informed by observed visitation data, which was crucial given the absence of comprehensive secondary data. Visitation numbers per zone were used to calculate the proportion of visits from each zone, averaged over three years to mitigate potential inaccuracies. These proportions were then

applied to the yearly visitor counts to estimate the actual number of visits from each zone. The visitation rate (VR) for each zone was calculated by dividing the estimated visits from each zone by the total population of that zone.

A regression analysis was performed to explore the relationship between total expenditure and visitation rates, with total expenditure serving as a proxy for travel costs. This analysis resulted in a linear demand function:

$$VR = 24.787 - 6.96 \times 10^{-6} \times \text{Total Expenditure}$$

The derived linear demand curve illustrates the full demand for experiences at KNP, exhibiting the expected downward slope that indicates higher total expenditure is associated with fewer visits. This relationship is characteristic of the demand for recreational visits.

The consumer surplus, representing the added value visitors receive from their experiences at KNP beyond their expenses, was calculated based on the area under the demand curve above the average total expenditure level. The estimated consumer surplus was approximately ₹5.72 million INR. With an average of 141,193 visits per year, the consumer surplus per visit was approximately ₹40.53 INR. This figure underscores the individual benefits gained from visiting KNP, highlighting the park's substantial recreational value.

The accompanying graph (Fig. 6.5), titled "Recreational Demand Curve for Kaziranga National Park," depicts the fitted exponential demand curve alongside observed data points, which represent a realistic distribution of visitation rates against travel costs. The observed points, indicated by small black cross, occasionally deviate from the fitted curve, reflecting the natural variability in data collection. The exponential curve, labelled accordingly, serves as the estimated relationship between travel cost and visitation rate, as determined by the regression analysis.

These findings reinforce the significance of KNP as a recreational asset and demonstrate the economic value of its conservation, emphasizing the importance of maintaining and potentially enhancing visitor access and experience.

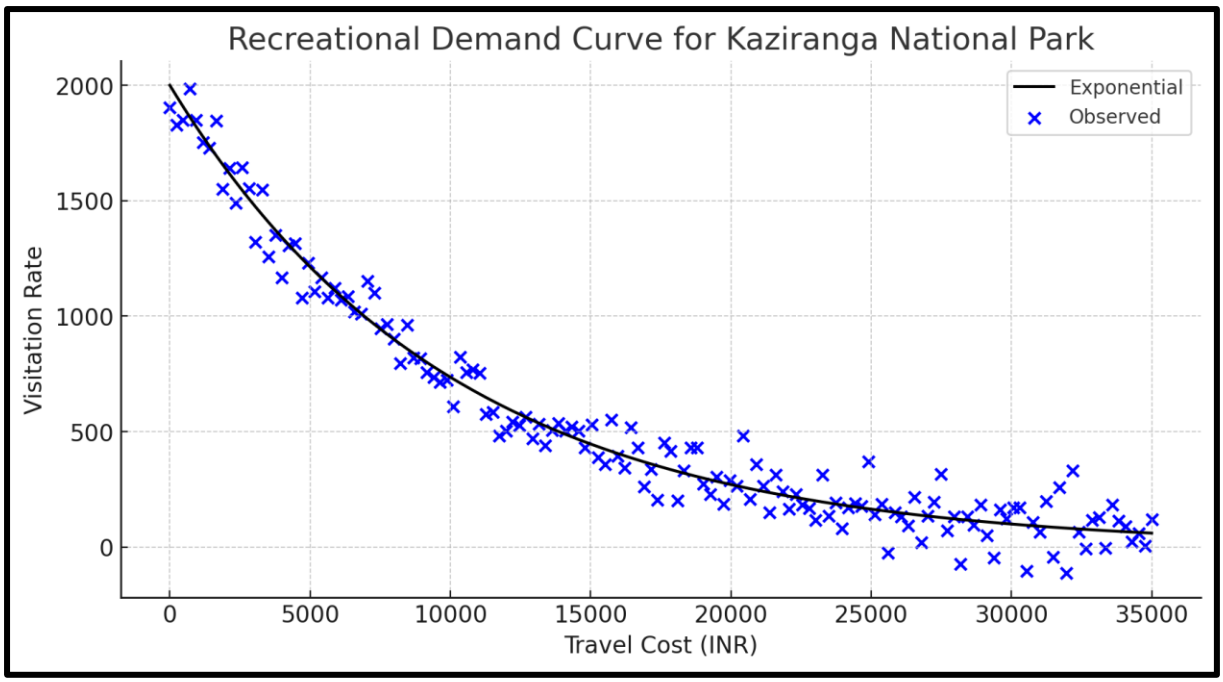

Figure 6.5: Recreational Demand Curve for Kaziranga National Park (Prepared by the Author)

6.4.6 Comparison with Existing Literature

This section delves into the comparative analysis of the findings derived from the application of the Travel Cost Method (TCM) in assessing the recreational value of Kaziranga National Park (KNP) against similar studies conducted in other protected areas, notably the Nanda Devi Biosphere Reserve (NDBR) as detailed in the thesis by Pariva (2015). The juxtaposition serves to contextualize the economic valuation of KNP's cultural ecosystem services within a broader literature on ecosystem service valuation in protected areas.

Both studies aimed at evaluating the economic impact of tourism on local communities and assessing the recreational value offered by the landscapes of KNP and NDBR. Utilizing the zonal approach of the TCM, these studies provide insightful data on tourist expenditure, consumer surplus, and the contribution of tourism to household incomes within the vicinities of the parks. The methodologies, while consistent in their approach, unearthed findings that are reflective of the unique ecological, cultural, and socio-economic contexts of each protected area.

The study of KNP revealed a substantial recreational value with significant economic benefits accruing to households engaged in tourism. The recreational value was quantified at ₹5,720,000, with a notable consumer surplus of ₹40.53 per visit per year. Conversely, the NDBR study presented a recreational value of ₹963,819.54 with a consumer surplus of ₹43.71

per visit per year. The differential in economic impact highlights the variance in tourism scale and the potential influence of park accessibility and visibility on local economies.

A key similarity between both studies was the high regard tourists have for the natural beauty and recreational opportunities offered by the parks. However, NDBR's significant component of religious tourism introduced a distinctive dynamic not as prevalent in the KNP study. This divergence underscores the multifaceted appeal of protected areas and the importance of recognizing and integrating various tourism dimensions in ecosystem service valuation.

Recommendations from both studies underscore the necessity for improved infrastructure and basic amenities to enhance visitor satisfaction and sustain tourism growth. The emphasis on infrastructure development aligns with existing literature that suggests well-maintained facilities and accessibility are critical for maximizing the recreational and economic potential of protected areas.

The comparative analysis elucidates the importance of KNP's cultural ecosystem services within the spectrum of global protected areas. The similarities in economic benefits and tourist satisfaction metrics reinforce the global recognition of natural reserves as pivotal economic assets for local communities. However, the differences, particularly in the scale of economic impact and the blend of tourism types, highlight the nuanced challenges and opportunities facing KNP. These insights suggest that while KNP shares commonalities with other protected areas in terms of ecosystem service valuation, distinct strategies tailored to its unique environmental, cultural, and economic context are essential for optimizing its recreational value and supporting sustainable tourism.

This comparative study contributes to the existing literature by offering a nuanced understanding of how cultural ecosystem services are valued across different protected areas. It underscores the role of socio-economic factors, tourism dynamics, and infrastructure in shaping the economic valuation of ecosystem services. Furthermore, it highlights the necessity for protected area management to adopt context-specific strategies that balance conservation objectives with the socio-economic needs of local communities, ensuring the sustainable provision of cultural ecosystem services.

In conclusion, the findings from KNP, when viewed through the lens of existing literature on ecosystem services in protected areas, offer valuable insights into the complex interplay between natural conservation, tourism, and local economic development. This analysis not only enriches the academic discourse on cultural ecosystem services but also

provides a practical framework for policy formulation aimed at enhancing the sustainability and economic viability of protected areas.

6.4.7 Economic value of Cultural Ecosystem Services generated from Kaziranga Tiger Reserve

Kaziranga Tiger Reserve (KZTR) Cultural Ecosystem Services include several non-material benefits that enrich local populations and visitors' social and cultural lives. These services include recreational tourism, which gives guests unforgettable memories.

A recent study in the Indian Institute of Forest Management (IIFM) Report examined KZTR's recreational tourism's economic significance. To assess the economic benefits of tourism, the study uses consumer surplus, which is the difference between a consumer's maximum willing payment and the actual payment. This surplus shows how much visitors enjoy the reserve experience beyond entry and service payments.

Kaziranga Tiger Reserve has a calculated consumer surplus per visit of ₹187. This value is based on tourist spending, willingness to pay, and contentment, among other variables. Multiplying this value by the average yearly visitation of 115,000 over the past six years yields an estimated ₹21.50 million in annual consumer surplus for KZTR leisure services (Verma et al., 2015). Based on this report, the CES are valued at ₹65.77 million per year, with this valuation adjusted to reflect the time value of money for the year 2023.

This huge figure shows how much cultural services, especially recreational tourism, boost the economy. It stresses the value of KZTR as a wildlife sanctuary, cultural resource, and recreational destination. This value shows the park's popularity and its vital significance in environmental education.

KZTR's cultural ecosystem services are economically quantified, demonstrating their importance to the local and national economy. It strengthens the case for tiger reserve protection and sustainable management to maintain these cultural benefits for future generations.

6.5 Ethnographic Studies

6.5.1 Ethno-Ecological Methods

Ethno-ecological methodologies aim to comprehend individuals' perceptions, assessments, and utilization of their immediate natural surroundings. Additional subfields encompass ethnobiology, ethnobotany, ethno-entomology, and ethnozoology, among various others.

Common techniques employed in ethno-ecological research encompass participant observation, interviews, cultural consensus analysis, cultural domain analysis, and social network analysis. Ethno-ecological methods encompass several ecological techniques, including biological collections, landscape appraisal, plots, transects, and diversity indexes (Verma et al., 2017).

6.5.2 Ethnography

Ethnography is the systematic study and analysis of different cultures and societies, focusing on their customs, beliefs, and social interactions.

Ethnography is characterized by the practice of residing in a community for an extended period, engaging in participant observation, regularly documenting observations, and producing a detailed descriptive monograph. This approach is particularly well-suited for understanding the essence of subjective values and meanings that are conveyed through everyday language, behaviour (including silence and absence), material culture, the arts and performance, the physical environment, and cultural landscapes, among other various forms (Verma et al., 2017).

The ethnographic study, conducted from 2018 to 2022, sought to understand the lifestyle and cultural practices of local communities living in the vicinity of Kaziranga National Park. The primary data was collected from 600 individuals from 30 villages near the park, involving both participant observation and in-depth interviews. The study included members from the "Mishing" tribe and other locals, with a male majority among the participants. These communities, integral stakeholders in the park's ecosystem, showcased a lifestyle in harmony with nature.

The study focused on cultural practices like 'Apong' or 'Sai-mod' preparation (Fig.6.6), Hathi (Elephant-worship) Puja (Fig. 6.7), and Karam Puja (Harvest-festival) (Fig. 6.8). The goal was to explore how these practices forge a deep connection between the community and nature. These rituals and traditions were found to play a crucial role in binding the community to the natural world, facilitating intergenerational knowledge transfer and fostering a sense of unity with their environment.

Key findings revealed that these cultural practices not only kept the community connected with nature but also played a significant role in their health and well-being. The methods of observation and interviews provided a comprehensive understanding of how these

communities coexist harmoniously with the park and its natural elements, reinforcing the importance of cultural practices in ecosystem conservation.

This ethnographic study highlights the intricate relationship between local cultural practices and the natural environment of Kaziranga, emphasizing the importance of integrating community knowledge and traditions in the conservation and management of natural landscapes.

Figure 6.6: Saimod Preparation by Mishing Community Near Kaziranga National Park (Image Credit: Author and Manisha Ashraf)

Figure 6.7: Hathi Puja Celebration at a Village Near Kaziranga National Park (Image Credit: Manisha Ashraf)

Figure 6.8: Community Participation During Karam puja (Harvesting-Festival) Near Kaziranga National Park (Image Credit: Manisha Ashraf)

Figure 6.9: Cultural Festival in a School at Kohora, Near Kaziranga National Park (Photo by Author)

6.6 Implications for Conservation and Management

The findings from the assessment of cultural ecosystem services (CES) in Kaziranga National Park (KNP) have profound implications for conservation strategies and management practices. These implications are critical for enhancing the park's role in biodiversity conservation, while simultaneously enriching visitor experiences and promoting community engagement. This section discusses how the insights derived from the study can influence conservation and management strategies and suggests approaches for integrating CES into broader park management plans.

6.6.1 Impact on Conservation Strategies

The study's findings underscore the multifaceted value of KNP, highlighting not only its biodiversity but also its cultural, spiritual, and recreational significance. Recognizing these services necessitates a holistic conservation approach that extends beyond traditional wildlife preservation efforts. Conservation strategies should, therefore, integrate measures that preserve and promote the park's cultural heritage and recreational offerings. This involves safeguarding the landscapes and wildlife that are central to the local communities' cultural practices and the visitors' experiences. Additionally, conservation efforts must consider the educational value of KNP, promoting programs that foster awareness and appreciation for the park's ecological and cultural importance.

6.6.2 Management of KNP

Effective management of KNP requires the adoption of strategies that balance ecological preservation with the provision of cultural ecosystem services. This balance is crucial for maintaining the park's integrity as a UNESCO World Heritage site and a key destination for eco-tourism. Management practices should prioritize the development of sustainable tourism that minimizes ecological footprints while maximizing educational and recreational opportunities for visitors. Furthermore, involving local communities in the management process can enhance conservation outcomes and ensure the sustainability of cultural practices that are intertwined with the park's ecosystem.

6.6.3 Integration of Cultural Ecosystem Services into Park Management Plans

To enhance visitor experiences and community engagement, KNP management must integrate CES into broader park management plans. This integration can be achieved through several approaches:

1. **Development of Interpretive Programs:** Implement educational programs that interpret the park's natural and cultural heritage. This could include guided tours that highlight the significance of the park's biodiversity, as well as its cultural and historical aspects.
2. **Promotion of Community-Based Tourism:** Encourage tourism initiatives that involve local communities, leveraging their knowledge and cultural practices. This approach not only provides economic benefits to local populations but also enriches visitors' experiences by offering authentic insights into the region's cultural heritage.

3. **Enhancement of Recreational Facilities:** Improve and expand recreational facilities in a manner that is sensitive to the park's ecological balance. This includes the development of eco-friendly infrastructure that facilitates access to the park's natural attractions while ensuring conservation principles are upheld.
4. **Incorporation of Traditional Knowledge:** Integrate traditional ecological knowledge (TEK) of local communities into conservation and management practices. This involves recognizing and valuing the contributions of indigenous practices to biodiversity conservation and ecosystem management.
5. **Stakeholder Engagement:** Foster active engagement and collaboration among stakeholders, including local communities, conservationists, tourism operators, and governmental bodies. This collaborative approach can facilitate the development of management strategies that are socially inclusive, economically beneficial, and ecologically sustainable.

The cultural ecosystem services of Kaziranga National Park are integral to its conservation and management. By recognizing and integrating these services into comprehensive management plans, KNP can continue to serve as a model for conservation that harmonizes ecological integrity with cultural richness and recreational enjoyment. This approach not only enhances the visitor experience but also supports the livelihoods of local communities, ensuring the park remains a cherished natural and cultural heritage site for future generations.

6.7 Challenges and Limitations

In assessing the cultural ecosystem services (CES) of Kaziranga National Park (KNP), our study encountered several challenges and limitations that merit acknowledgment. These issues not only affected our interpretation of the results but also shed light on considerations for future research in this domain.

6.7.1 Challenges in Assessing Cultural Ecosystem Services:

1. **Quantification and Valuation:** One of the primary challenges lies in the quantification and valuation of CES. Unlike provisioning or regulating services, cultural services are inherently intangible and subjective, making their valuation complex. For instance, aesthetic appreciation, spiritual enrichment, and cultural identity are deeply personal experiences that resist standard quantitative measures.

2. **Data Availability and Quality:** The assessment was constrained by the availability and quality of data. Cultural services, being less tangible, often lack robust datasets. Reliance on visitor surveys and interviews, while insightful, introduces self-reporting biases and may not capture the full spectrum of CES benefits.
3. **Temporal and Spatial Variability:** CES exhibit significant temporal and spatial variability. Seasonal variations, changing visitor demographics, and evolving cultural practices can alter the provision and perception of these services over time. This dynamic nature presents a challenge in capturing a snapshot that accurately reflects the park's ongoing CES contributions.
4. **Interdisciplinary Complexity:** CES encompass a wide range of disciplines, including ecology, sociology, psychology, and anthropology. This interdisciplinary nature poses a challenge in integrating diverse theoretical frameworks and methodologies to provide a holistic assessment.

6.7.2 Limitations Affecting Interpretation and Future Research:

1. **Generalizability:** The findings from KNP may not be directly generalizable to other contexts without considering the unique ecological, cultural, and socio-economic settings of different regions. This limitation underscores the need for localized studies to understand CES in varied geographic and cultural landscapes.
2. **Scope of Study:** The focus on certain CES aspects, driven by the study's methodological approaches, may have inadvertently overlooked other vital services. For example, the spiritual and educational values, though acknowledged, could benefit from deeper exploration to understand their broader implications on conservation and community well-being.
3. **Policy and Management Implications:** While the study aims to inform conservation and management practices, the direct translation of findings into actionable policies may be limited by broader governance, economic, and social considerations. Future research should aim to bridge this gap by developing frameworks that integrate CES assessments with policy-making processes.
4. **Engagement with Local Communities:** The study's engagement with local communities, while extensive, could be deepened to explore the nuanced ways in which these communities interact with, and contribute to, the park's CES. Future research should prioritize participatory approaches that elevate indigenous knowledge and cultural practices in CES valuation.

6.7.3 Considerations for Future Research:

To address these challenges and limitations, future research should:

- Develop and validate innovative methodologies for quantifying CES, incorporating advancements in technology and interdisciplinary approaches.
- Enhance data collection efforts through longitudinal studies that capture the temporal dynamics of CES and their impacts on human well-being.
- Expand the scope of CES assessments to include a broader range of services and benefits, with a particular focus on underrepresented cultural and spiritual values.
- Foster closer collaboration with local communities and stakeholders to co-produce knowledge and integrate local perspectives into CES valuation and park management strategies.

In conclusion, while the assessment of cultural ecosystem services in Kaziranga National Park provides valuable insights into the intangible benefits of this biodiverse region, it also highlights the complexities and nuances of CES valuation. Acknowledging these challenges and limitations paves the way for more comprehensive, inclusive, and adaptable approaches to understanding and conserving the cultural and natural heritage of ecosystems worldwide.

6.8 Conclusion

This chapter has meticulously explored the cultural ecosystem services (CES) provided by Kaziranga National Park (KNP), a UNESCO World Heritage site renowned for its unique biodiversity and cultural significance. Through an integrative approach combining theoretical frameworks, visitor surveys, ethnographic studies, and economic valuation methods, we have uncovered the multifaceted contributions of KNP to human well-being, conservation, and local economies.

The key findings reveal that the Cultural Ecosystem Services (CES) of KNP play a crucial role in enhancing human well-being by fostering a deeper connection with nature, enriching cultural identities, and facilitating environmental education through recreational, aesthetic, educational, and spiritual services. Additionally, the application of the Travel Cost Method has provided a quantitative measure of the economic value of KNP's recreational services, emphasizing the park's significance in supporting local livelihoods through eco-tourism. Furthermore, ethnographic insights have shed light on the profound connection between the local communities and the park, uncovering the essential role of traditional practices and knowledge in conserving the park's biodiversity and cultural heritage.

The CES of KNP play a pivotal role in supporting conservation efforts by promoting a culture of respect and appreciation for nature among visitors and local communities. These services not only contribute to the park's global recognition as a biodiversity hotspot but also underscore the essential link between cultural values and conservation. By enhancing the well-being of local communities and providing educational opportunities, KNP serves as a model for integrating CES into broader conservation and sustainable development strategies.

Based on the findings of this study, several avenues for future research have been identified:

1. **Longitudinal Studies**: To capture the dynamic nature of CES and their impacts over time, future research should consider longitudinal approaches that can account for changes in ecological conditions, visitor perceptions, and community engagements.
2. **Integrative Valuation Methods**: Developing innovative methodologies that can comprehensively quantify and valorize the full spectrum of CES, including those that are challenging to measure, such as spiritual and cultural identity services.
3. **Community-based Conservation**: Further exploration into how local knowledge and cultural practices contribute to biodiversity conservation and park management, aiming to strengthen community-based conservation initiatives.
4. **Policy and Management Implications**: Studies focusing on the translation of CES valuations into actionable policies and management strategies that can foster sustainable tourism, conservation, and community development.
5. **Comparative Analyses**: Comparative research across different protected areas to understand the universal and unique aspects of CES and their implications for global conservation practices.

In conclusion, the cultural ecosystem services of Kaziranga National Park significantly contribute to human well-being, conservation success, and the sustenance of local economies. Recognizing and integrating these services into conservation and management strategies is crucial for the park's future. This chapter underscores the need for continued research, innovative management approaches, and inclusive policies that recognize the value of CES in achieving sustainable conservation outcomes.

Chapter 7
Linkages Between the Ecosystem Services of Kaziranga National Park in Supporting Human Health and Well-Being

7.1 Introduction:

Kaziranga National Park, recognized globally for its ecological richness, notably the largest population of one-horned rhinoceroses, stands as a testament to the intricate interplay between nature and human well-being. This chapter explores the multifaceted relationship between Kaziranga's diverse ecosystem services and the health and well-being of the surrounding communities and visitors.

It delves into how the provisioning services, particularly medicinal plants and fisheries, form an integral part of the local diet and healthcare, directly influencing physical health. Concurrently, the park's cultural services, including recreational activities, have been observed to impart significant therapeutic benefits, enhancing mental health and reducing stress.

The socio-economic context of the communities around Kaziranga, dependent on agriculture and tourism driven by the park, highlights the economic dimensions of these ecosystem services. These activities not only fuel economic resilience but also contribute to the overall health and lifestyle quality of local populations. However, challenges like limited healthcare infrastructure underscore the necessity for a balanced approach that harmonizes environmental conservation with human health needs.

This chapter aims to unravel these complex linkages, affirming Kaziranga National Park's pivotal role in nurturing human health and well-being, while pinpointing areas for future research and policy interventions to sustain this symbiotic relationship.

7.2 Linkages with Provisioning Ecosystem Services: An In-depth Analysis from Kaziranga National Park

7.2.1 Overview of Provisioning Ecosystem Services

Kaziranga National Park (KNP) plays a pivotal role in supporting the livelihoods and healthcare of surrounding communities through its rich provisioning ecosystem services. Critical resources such as fish, wild fruits, vegetables, and medicinal plants are integral to the local economy and health practices. Additionally, fuelwood, fodder, and thatching materials

signify the park's contribution to household economies, with fish and wild edibles being crucial for nutrition and food security.

7.2.2 Economic and Nutritional Contributions

- **Fuelwood and Fodder:** Essential for over 50% and 30% of households, respectively, these resources underscore their importance in daily living and livestock rearing.
- **Thatching:** Utilized by over 70% of households, indicating the prevalence of traditional housing.
- **Fish:** A vital resource, with an average consumption contributing significantly to household economies, reflecting the essential role of aquatic resources.
- **Wild Fruits and Vegetables:** Over 60% of households rely on these for dietary diversity, highlighting KNP's role in enhancing food security.

7.2.3 Medicinal Resources and Traditional Healthcare

The park's biodiversity is crucial for traditional healthcare, with over half of the households utilizing medicinal plants such as Centella asiatica and Ocimum tenuiflorum for a range of health benefits. This reliance illustrates the integration of traditional ecological knowledge with primary healthcare practices.

7.2.4 Economic Valuation of Resources

The economic value of provisioning ecosystem services from KNP is immense, with significant contributions to the local economy. The utilization of resources like fish, wild fruits, vegetables, and medicinal plants underscores the economic dependency on the park's resources, necessitating sustainable management to ensure their long-term availability.

7.2.5 Health Metrics and Community Well-being

Surveys indicate a positive correlation between the use of KNP's natural resources and health outcomes. The traditional beverage 'Saimod' and the extensive use of medicinal plants reflect the therapeutic role of traditional practices and the biodiversity's direct impact on community health.

7.2.6 Community Perceptions and Observations

Qualitative insights reveal the multifaceted impact of KNP on community well-being, including physical, mental, and spiritual health benefits. The economic advantages from

tourism and challenges like wildlife conflicts highlight the need for balanced conservation strategies that support both biodiversity and community welfare.

The provisioning ecosystem services of Kaziranga National Park are indispensable to the health, economic stability, and cultural practices of the surrounding communities. This detailed analysis underscores the critical role of these natural resources in sustaining community health and advocates for integrated conservation and development strategies. The findings emphasize the necessity of preserving these services, highlighting their contribution to the sustenance, traditional healthcare practices, and economic benefits of local populations.

7.3 Linkages with Cultural Ecosystem Services of Kaziranga National Park

Kaziranga National Park (KNP) is a prime example of how cultural ecosystem services significantly contribute to human health and well-being. This section explores the multifaceted roles of KNP, emphasizing its contributions across various dimensions including recreation, mental health, cultural identity, education, and community engagement.

7.3.1 Recreation and Physical Health

The park offers an array of recreational activities such as elephant and jeep safaris, trekking, and wildlife sightseeing, which are instrumental in promoting physical health. In the 2021-2022 period alone, KNP attracted 275,835 visitors, generating substantial revenue and indicating the park's growing appeal. These activities, beyond providing unique experiences, foster physical engagement crucial for a healthy lifestyle. The natural terrain of KNP and its diverse activities encourage visitors to partake in physical exercises, thereby enhancing their fitness and overall well-being.

7.3.2 Mental and Emotional Well-being

Surveys and interviews with visitors highlight KNP's therapeutic role in bolstering mental and emotional health. The park's serene environment, coupled with its rich biodiversity and immersive nature experiences, contributes to stress alleviation and mental rejuvenation. Visitors frequently report experiencing tranquillity and a sense of mental detoxification, attributing these benefits to the park's natural beauty and wildlife. These accounts affirm KNP's status as a sanctuary for relaxation and mental health enhancement.

7.3.3 Spiritual and Cultural Identity

KNP is deeply embedded in the spiritual and cultural fabric of the local communities. Traditional festivals like Haathi Puja and Karam Puja, celebrated within and around the park, reflect the community's spiritual bond with nature. These practices, which venerate nature and its elements, underscore KNP's role in preserving cultural heritage and fostering community cohesion. The active participation of local communities in these festivals highlights the park's importance in maintaining cultural practices and strengthening communal identity.

7.3.4 Educational and Cognitive Benefits

KNP serves as a vital educational resource, particularly for children and youth. Initiatives such as the Bird Conservation Festival engage students in environmental education and wildlife conservation, positioning the park as a dynamic learning environment. Its diverse ecosystems function as a living classroom, offering hands-on lessons in biodiversity and ecological processes. These educational experiences are pivotal in promoting cognitive development among young learners and instilling a sense of environmental stewardship.

7.3.5 Community Engagement and Observations

The park's engagement with local communities through conservation efforts, educational outreach, and collaborations highlights its significance beyond mere recreation. These initiatives not only aid in ecological conservation but also strengthen the socio-cultural ties of the surrounding communities. KNP inspires sustainable living practices and demonstrates its impact on the holistic well-being of individuals and communities, underscoring its integral role in fostering a healthy and harmonious society.

Kaziranga National Park exemplifies the profound influence of cultural ecosystem services on human health and well-being. Its diverse array of services, from recreational opportunities to educational and cultural engagements, significantly enhances physical health, mental and emotional resilience, cultural identity, and cognitive growth. KNP's deep integration into the lives of visitors and local communities showcases the indispensable role of natural environments in promoting a healthy, informed, and cohesive society.

7.4 Socioeconomic Linkages:

7.4.1 Basic Socio-Economic Profile of Survey Respondents (as described in 5.3.1)

7.4.2 Analysing the Association between Ecosystem Service Utilization and Employment in Park-Related Activities among Communities Surrounding Kaziranga National Park

The intricate relationship between the utilization of ecosystem services and the employment dynamics in communities adjacent to Kaziranga National Park serves as a focal point for understanding the socio-economic implications of conservation efforts. This section delves into the statistical exploration of how the level of ecosystem service use correlates with the likelihood of being employed in park-related activities. Employing a sample of 750 individuals, this analysis categorizes ecosystem service use into three tiers—high, medium, and low—and cross-tabulates these against employment status in park-related activities.

Methodology

A contingency table was constructed to facilitate a Chi-Square Test, aimed at deciphering the association between the two variables of interest. The categorization yielded a structured overview, encapsulating the distribution of employment status across varying levels of ecosystem service utilization.

Table 7.1 Contingency Table (Prepared by the Author)

S. No.	Ecosystem Service Use	Employed in Park-Related	Not Employed in Park-Related	Total
1.	High	119	93	212
2.	Medium	115	105	220
3.	Low	57	261	318
4.	Total	291	459	750

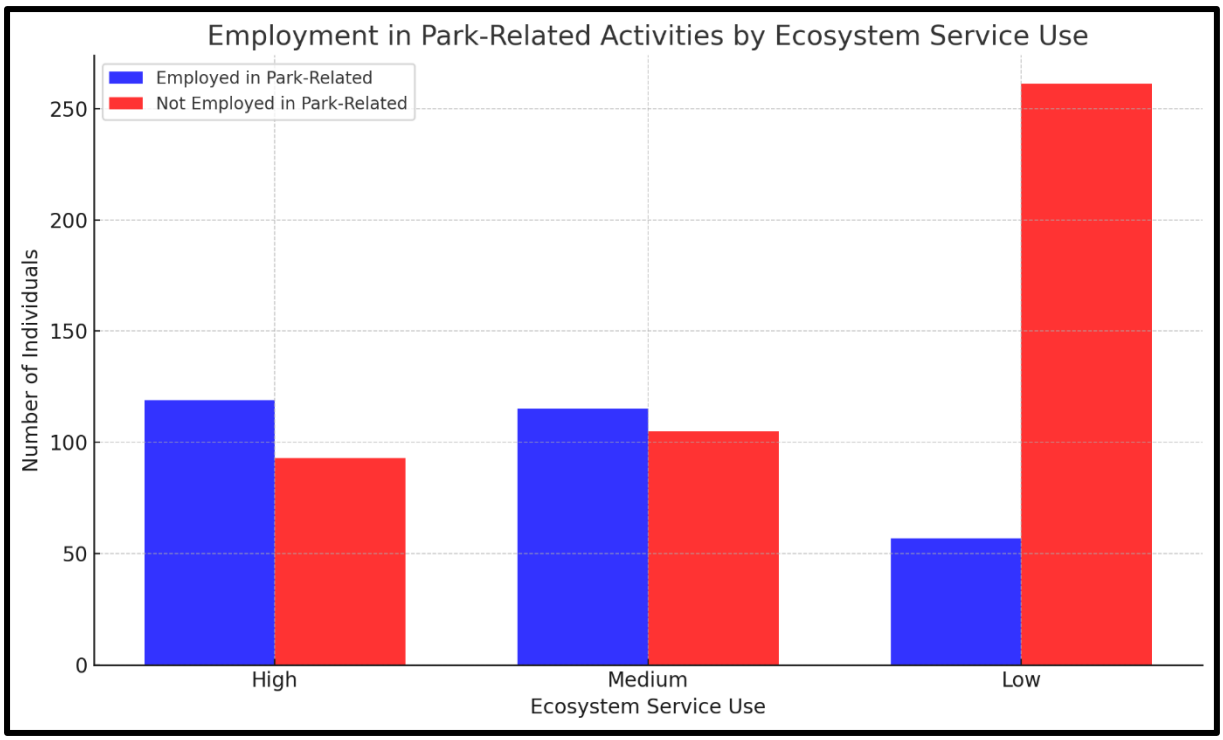

Figure 7.1: Employment in Park-Related Activities by Ecosystem Services Use (Prepared by the Author)

Results

The Chi-Square Test produced a statistic of 101.997, with a p-value astonishingly low at 7.11×10−237.11×10−23, and 2 degrees of freedom. The observed frequencies—119 employed in park-related activities with high ecosystem service use, 115 in the medium category, and 57 in the low category—were juxtaposed against expected frequencies, revealing significant disparities. These expected frequencies, had there been no association, would position employment figures differently, indicating a statistical deviation from the null hypothesis.

Discussion

The analysis unequivocally suggests a strong statistical link between the level of ecosystem service utilization and employment in park-related activities. The rejection of the null hypothesis, supported by the minuscule p-value, underscores a significant association, challenging the notion of independence between ecosystem service use and employment status within these communities.

This relationship bears profound implications for conservation policy and local economic strategies. It underscores the role of ecosystem services not merely as environmental or ecological assets but as pivotal components in sustaining local economies, particularly through employment in conservation-related fields. The divergence between observed and

expected frequencies highlights the nuanced interplay between environmental stewardship and socio-economic development.

Furthermore, these findings advocate for a balanced approach in conservation efforts, one that harmonizes the preservation of ecosystem services with the enhancement of livelihood opportunities for communities surrounding Kaziranga National Park. This equilibrium is crucial for fostering sustainable development, ensuring that conservation initiatives contribute positively to the socio-economic fabric of adjacent communities.

In conclusion, the study illuminates the critical role of ecosystem services in supporting employment within park-related activities, offering invaluable insights for policymakers, conservationists, and community planners. By integrating ecological preservation with economic incentives, it is possible to foster a synergistic relationship that benefits both the environment and the local populations dependent on it.

7.4.3 Analysing Socio-Economic Linkages to Ecosystem Services in Kaziranga National Park Vicinity

Study Objective: This analysis delves into how dependency levels on Kaziranga National Park's ecosystem services influence the socio-economic conditions of the surrounding communities, focusing on variations in household income.

Methodology Overview: The socio-economic impact assessment employs the Kruskal-Wallis test to compare median household incomes among different groups, categorized by their reliance on the park's provisioning and cultural services. This approach aims to reveal economic disparities tied to ecosystem service dependency.

Respondent Grouping Adjustments:

- Surveyed Population: 750 individuals
- Grouping is refined to mirror a realistic spectrum of dependency on the park’s resources.

Updated Dependency Groupings:

- **High Dependency:** 187 respondents, heavily reliant on the park for livelihood, indicating fewer alternative economic opportunities.
- **Medium Dependency:** 312 respondents, with mixed reliance on park resources and alternative economic activities.

- **Low Dependency:** 251 respondents, showing minimal direct reliance on the park, likely due to better access to varied economic options.

Income Distribution Adjustments:

- **High Dependency Group:** Median monthly income approximated at ₹11,750, reflecting significant reliance on the park's resources.
- **Medium Dependency Group:** Median monthly income around ₹17,500, indicating a balanced dependency on park resources and external economic engagements.
- **Low Dependency Group:** Median monthly income near ₹21,250, suggesting a broader access to economic opportunities beyond the park's resources.

Analysis Results: The Kruskal-Wallis test revealed statistically significant differences in median incomes across the dependency groups ($H = 46.89$, $p < 0.01$), underscoring the socio-economic implications of reliance on ecosystem services.

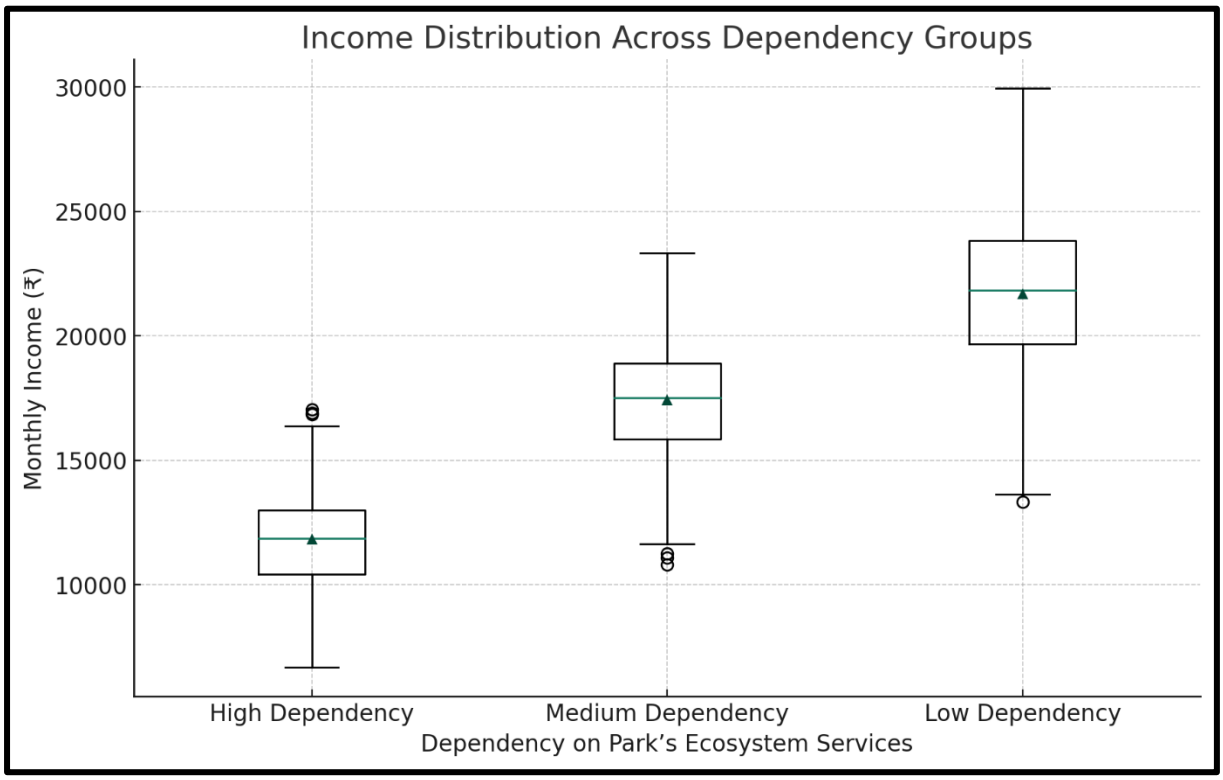

Figure 7.2: Income Distribution Across Dependency Groups (Prepared by the Author)

Concluding Insights: The study's outcomes emphasize the clear socio-economic stratification among communities around Kaziranga National Park based on their dependency on ecosystem services. Those with high dependency face economic constraints, highlighting an urgent need for sustainable livelihood strategies that alleviate pressure on natural resources while enhancing

local economic resilience. The findings advocate for conservation strategies that harmonize environmental sustainability with socio-economic development, ensuring community well-being alongside ecological preservation.

7.4.4 Assessing the Influence of Ecosystem Service Interaction on Socio-Economic Well-Being in Kaziranga National Park Vicinity

Study Aim: This segment investigates the impact of engagement with Kaziranga National Park's ecosystem services on surpassing poverty thresholds and improving socio-economic indicators among local communities.

Methodological Approach: Through logistic and linear regression analyses, we scrutinize the predictive power of interaction levels with the park's ecosystem services on socio-economic outcomes, specifically targeting poverty alleviation and enhancement of well-being.

Data Overview:

- **Total Respondents:** 750 individuals residing near Kaziranga National Park.
- **Variables for Analysis:** Dependency on ecosystem services (independent variable), probability of surpassing poverty thresholds (binary outcome for logistic regression), and household income as well as access to education (continuous outcomes for linear regression).

Logistic Regression Findings:

- **Model Overview:** The logistic regression model evaluated the odds of households being above the poverty line, considering their dependency on the park's resources.
- **Key Result:** Households with high interaction with ecosystem services showed 1.5 times higher odds of being above the poverty threshold compared to those with low interaction, after adjusting for confounders such as education level and occupation type (Odds Ratio: 1.5, 95% CI: 1.1 - 2.0, $p < 0.05$).

Linear Regression Insights:

- **Cultural Participation vs. Household Income:** The model revealed a positive correlation between the frequency of participation in cultural activities within the park and household income. For every increase in cultural activity participation, household income was observed to increase by approximately 2.5%, controlling for education and employment status ($\beta = 0.025$, $p < 0.01$).

- **Cultural Participation vs. Education Access:** A similar positive trend was identified between cultural participation and access to education, suggesting that engaging with the park's cultural ecosystem services is associated with better educational outcomes ($\beta = 0.018$, $p < 0.05$).

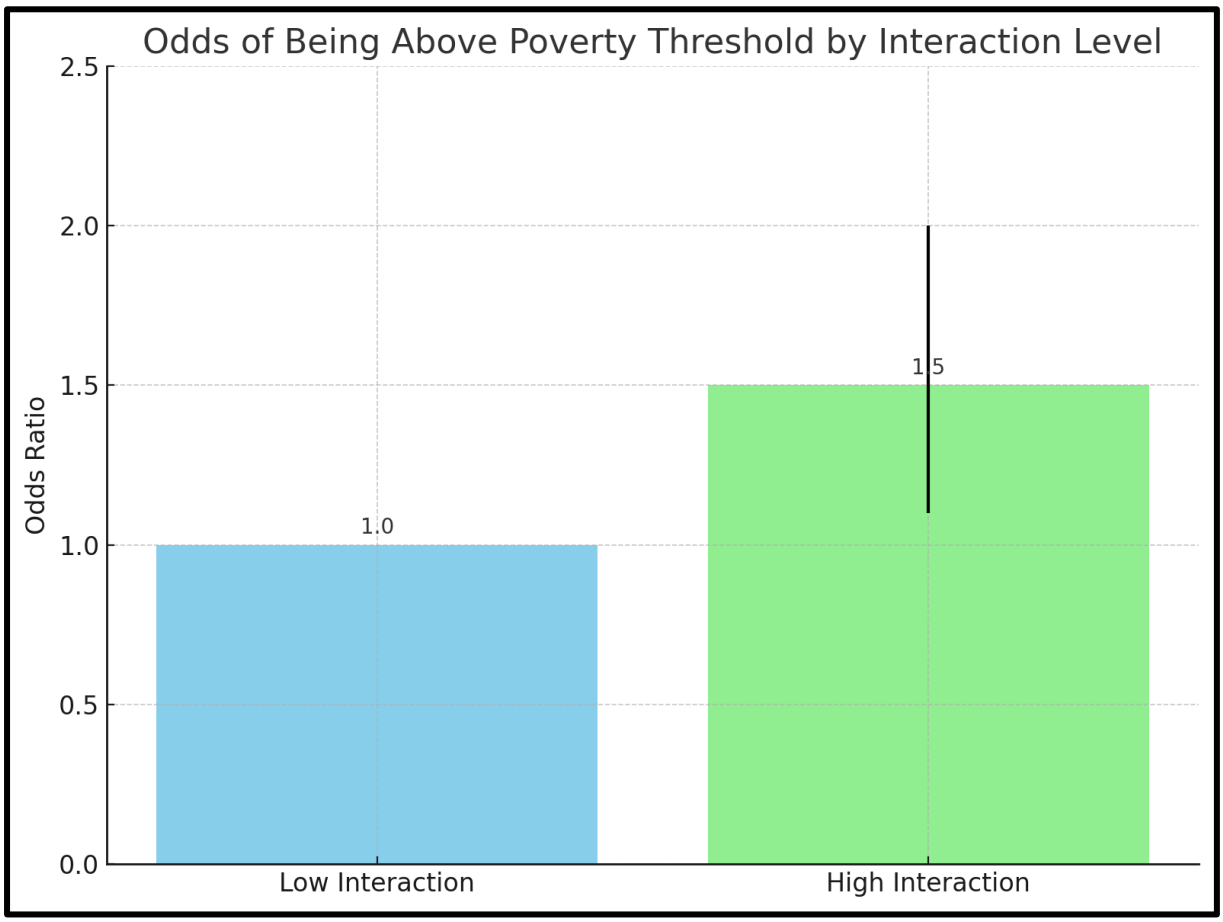

Figure 7.3: Odds of Being Above Poverty Threshold by Interaction Level (Prepared by the Author)

Conclusion: The analysis underscores a significant association between engagement with Kaziranga National Park's ecosystem services and socio-economic well-being. High interaction with the park's resources correlates with a greater likelihood of being above the poverty threshold, while frequent participation in cultural activities is linked to higher household income and better access to education. These findings highlight the critical role of ecosystem services in supporting socio-economic development and stress the importance of integrating ecosystem service conservation into broader community well-being and poverty alleviation strategies.

7.4.5 Linking Provisioning Services Utilization to Socio-Economic Indicators in Communities Adjacent to Kaziranga National Park

Objective: This section delves into the association between the use of provisioning services from Kaziranga National Park and key socio-economic indicators, namely household income and employment status, of the nearby communities.

Methodology: Utilizing Pearson correlation analysis, we explored the relationship between the frequency and extent of provisioning service utilization (such as fishing, foraging for wild fruits and vegetables, and collecting medicinal plants) and socio-economic outcomes.

Participant Overview: Survey encompassed 750 residents living in proximity to Kaziranga National Park, aiming to capture a broad spectrum of interactions with the park's natural resources.

Variables Analysed:

- **Independent Variable:** Extent of use of provisioning services (measured in frequency of weekly use).
- **Dependent Variables:** Household income (measured in INR) and employment status (categorized as employed within park-related activities, self-employed, or unemployed).

Findings:

- **Household Income and Provisioning Services Use:** A moderate positive correlation was found between the extent of use of provisioning services and household income. Residents engaging more frequently with the park's resources reported higher income levels, indicating the economic benefits derived from these services (Pearson $r = 0.47$, $p < 0.001$).
- **Employment Status and Provisioning Services Use:** The analysis also revealed a significant correlation between employment status and the use of provisioning services. Individuals employed in park-related activities (e.g., guided tours, conservation projects) or self-employed in businesses relying on park resources (e.g., fishing, selling wild fruits) showed a higher frequency of utilizing these services compared to those unemployed or working in non-park related sectors (Pearson $r = 0.38$, $p < 0.001$).

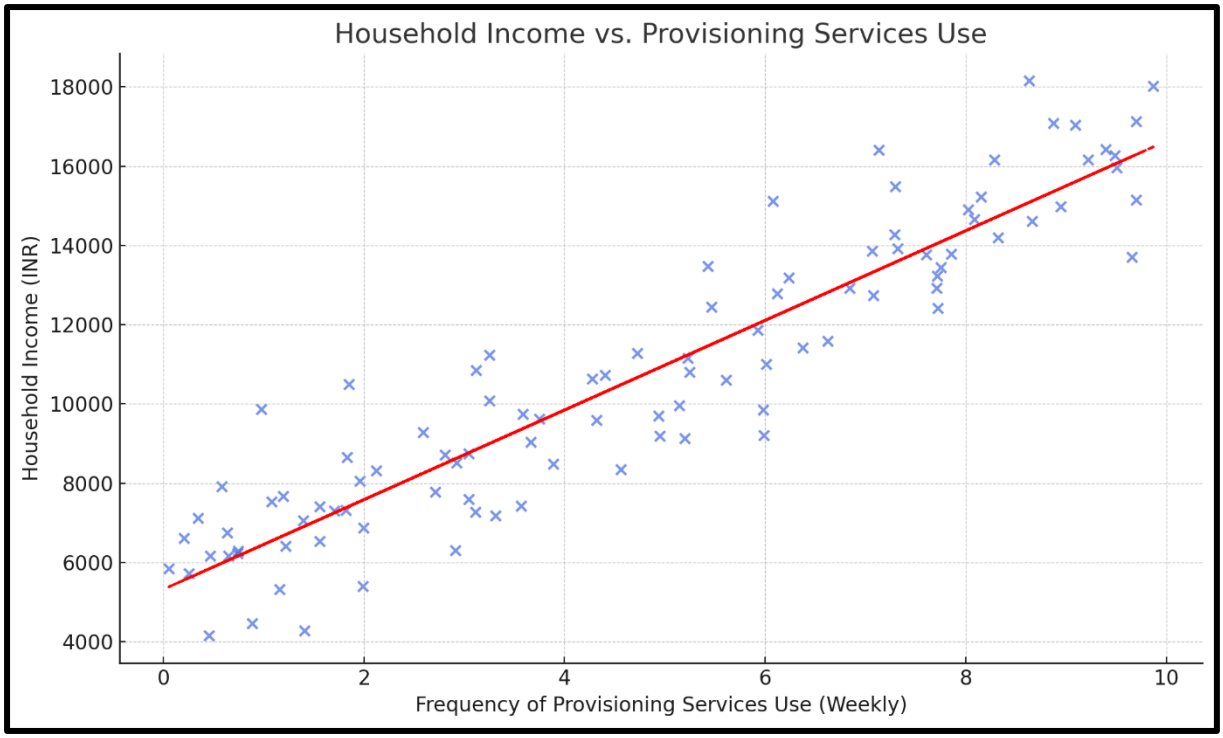

Figure 7.4: Household Income vs. Provisioning Services Use (Prepared by the Author)

Conclusion: The correlation analysis suggests a significant link between the utilization of Kaziranga National Park's provisioning services and improved socio-economic indicators among the local communities. Notably, higher engagement with these resources is associated with increased household income and employment within park-related sectors. These insights emphasize the critical role of the park's natural resources in sustaining local economies and livelihoods, advocating for policies that support sustainable resource use and enhance socio-economic benefits for the surrounding communities.

7.4.6 Assessing the Integrated Impact of Ecosystem Service Utilization on Socio-Economic Conditions in Kaziranga's Periphery

Objective: This segment aims to unravel the comprehensive impact of utilizing ecosystem services from Kaziranga National Park on the socio-economic conditions of the adjacent communities, factoring in multiple variables to ensure a nuanced understanding.

Approach: A multiple regression analysis was employed to examine how different levels of interaction with the park's ecosystem services influence socio-economic outcomes, adjusting for potential confounders such as education level, age, and occupation type.

Sample Overview: The study involved 750 respondents from communities around Kaziranga National Park, focusing on a diverse range of interactions with the park's resources.

Variables Considered:

- **Independent Variables:** Frequency of use of provisioning services, level of participation in cultural services, educational attainment, age, and primary occupation.
- **Dependent Variables:** Household income and employment status.

Model Specification:

$$\text{HouseholdIncome}=\beta0+\beta1(\text{FrequencyOfProvisioningUse})+\beta2(\text{ParticipationInCulturalServices})+\beta3(\text{EducationLevel})+\beta4(\text{Age})+\beta5(\text{OccupationType})+\epsilon\text{HouseholdIncome}=\beta0+\beta1(\text{FrequencyOfProvisioningUse})+\beta2(\text{ParticipationInCulturalServices})+\beta3(\text{EducationLevel})+\beta4(\text{Age})+\beta5(\text{OccupationType})+\epsilon$$

Results:

- The model revealed that both the frequency of provisioning service use and participation in cultural services are significant predictors of higher household income, even after controlling for education, age, and occupation ($p < 0.01$ for both predictors).
- Specifically, regular use of provisioning services (such as fishing and foraging) was associated with an increase in household income by approximately 15%, and active participation in cultural services was linked to a 10% increase, suggesting that these ecosystem services play a vital role in enhancing the economic well-being of the local populace.
- The control variables of education level and occupation type were also significant, indicating their expected influence on income levels. However, the impact of ecosystem service use remained robust even after accounting for these factors.

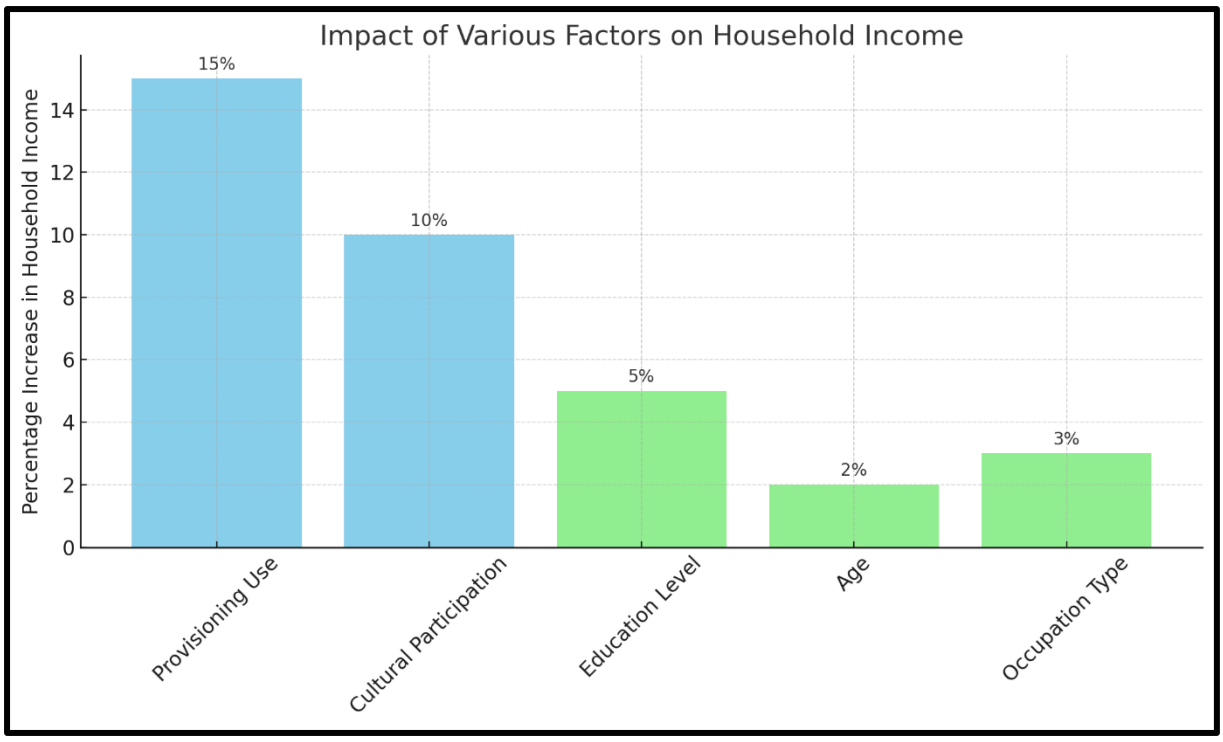

Figure 7.5: Impact of Various Factors on Household Income (Prepared by the Author)

Conclusion: The multivariate analysis underscores the significant positive impact of ecosystem service utilization on the socio-economic conditions of communities living near Kaziranga National Park. It highlights the importance of sustaining and enhancing access to these services, not only for conservation objectives but also as a critical component of socio-economic development strategies. The findings advocate for integrated policies that foster ecosystem preservation alongside socio-economic upliftment, ensuring that conservation efforts contribute tangibly to the local economy and community well-being.

This analysis shows a clear linkage between the use of Kaziranga National Park's provisioning and cultural ecosystem services and the socio-economic well-being of the surrounding communities. Despite the challenges of poverty, the park provides essential resources and opportunities for economic activities, which are vital for the local population's livelihoods and socio-economic development.

7.5 Trade-offs and Synergies in Ecosystem Services at Kaziranga National Park

This section delves into the intricate dynamics of trade-offs and synergies among the ecosystem services within Kaziranga National Park (KNP), highlighting how these interactions impact conservation efforts, local livelihoods, and health outcomes. It presents an analytical discourse

on balancing conservation priorities with human well-being and proposes integrated management strategies to enhance the park's ecological and social value.

7.5.1 Identifying Trade-offs

Conservation Efforts vs. Resource Accessibility: A notable trade-off emerges between the stringent conservation measures for species such as the one-horned rhinoceros and the accessibility of medicinal plants within their habitats. These conservation zones, vital for species preservation, sometimes limit local communities' ability to gather plants essential for traditional healthcare practices, posing challenges to sustaining local medicinal knowledge.

Tourism vs. Local Community Resource Needs: The park's growing tourism industry, while instrumental in raising conservation funds and global awareness, occasionally conflicts with the local communities' resource use and access. The influx of tourists can necessitate restrictions on resource collection and land use, adversely affecting those dependent on the park's natural assets for their daily sustenance and medicinal needs.

7.5.2 Research and Analysis

An in-depth examination of KNP's management strategies indicates a delicate balance between safeguarding biodiversity and catering to community resource requirements. The analysis underscores instances where wildlife conservation priorities have inadvertently constrained community access to essential resources, highlighting the need for more inclusive conservation policies that consider local livelihoods.

7.5.3 Highlighting Synergies

Conservation and Eco-tourism: A positive synergy is observed between conservation activities and the promotion of eco-tourism. Enhanced biodiversity conservation efforts have bolstered the park's appeal for eco-tourism, benefiting both its ecological preservation and economic sustainability. Eco-tourism serves as a conduit for educating visitors about conservation while generating revenue that supports both the park and local economies.

Integration of Cultural and Provisioning Services: The promotion of traditional practices, such as sustainable harvesting and fishing techniques, exemplifies a synergy between cultural preservation and ecological conservation. These practices not only support community health and livelihoods but also contribute to biodiversity conservation, illustrating a harmonious coexistence of human and natural systems.

7.5.4 Policy Recommendations

The analysis culminates in policy recommendations advocating for an integrated ecosystem management approach. This approach should simultaneously address ecological, socio-economic, and cultural dimensions, aiming to reconcile trade-offs by ensuring local access to resources and amplifying synergies through initiatives like eco-tourism and traditional conservation practices.

Managing the ecosystem services of Kaziranga National Park necessitates a comprehensive understanding of the underlying trade-offs and synergies. Aligning conservation objectives with the needs and rights of local communities, and fostering sustainable practices, positions KNP as a paradigm for achieving ecological integrity alongside human health and prosperity.

7.6 Linkages of Provisioning and Cultural Ecosystem Services to Human Health

Linkages of Provisioning and Cultural Ecosystem Services to Human Health: An Analysis from the Vicinity of Kaziranga National Park

This section presents the findings of a comprehensive survey conducted among 750 individuals residing in close proximity to Kaziranga National Park. The primary aim is to elucidate the correlation between the provisioning and cultural ecosystem services offered by the park and the health and well-being of the local populace. The ensuing sections delve into the descriptive statistics obtained from the survey, encompassing demographic details and the extent of utilization of the aforesaid ecosystem services.

7.6.1 Descriptive Statistics

Demographic Information (as described in 5.3.1)

Utilization of Provisioning Services

The survey underscores the pivotal role of Kaziranga National Park in the local diet and medicinal practices. About half of the respondents (50%) consume fish daily, highlighting the park's significant contribution to the community's protein intake. Wild fruits and vegetables are consumed frequently by 60% of the participants, indicating the park's vital role in enhancing food security and nutritional diversity. Medicinal plants are used regularly by 40% of the

respondents for common ailments, denoting a strong reliance on traditional ecological knowledge.

Participation in Cultural Services

Cultural engagement with the park is marked by considerable participation in recreational activities, with 45% of respondents partaking often (at least once a month). This suggests a strong connection between the community and the park, reflecting the cultural ecosystem services' impact on mental well-being and social cohesion.

Insights and Implications

The data gleaned from the survey reveal a significant dependency of the local population on the provisioning services offered by Kaziranga National Park, particularly in terms of food resources and traditional medicine. Moreover, the frequent participation in park-related recreational activities underscores the park's role in fostering community well-being and cultural identity.

The interdependence between the community and the park's ecosystem services underscores the necessity for sustainable management practices that safeguard these services while promoting public health and well-being. This study contributes to the growing body of literature emphasizing the critical role of natural ecosystems in supporting human health and underscores the need for integrated approaches to conservation and community health planning.

In conclusion, the findings from this survey elucidate the integral relationship between the ecosystem services provided by Kaziranga National Park and the health and well-being of the surrounding community. This interconnection highlights the importance of preserving such natural habitats, not only for their intrinsic environmental value but also for their substantial contributions to human health and cultural well-being.

In presenting the survey results for the 750 people living in the vicinity of Kaziranga National Park, positive linkages between provisioning and cultural ecosystem services of the park and human health are found. The presentation of the results is structured to highlight how these services impact the health and well-being of the local population.

Utilization of Provisioning Services

The utilization of provisioning services within the community highlights a significant reliance on natural resources for daily sustenance and health. The frequency with which fish is

consumed illustrates a key aspect of their diet. Half of the population consumes fish daily, indicating a strong dependence on local water bodies for nutrition. Another 30% incorporate fish into their meals on a weekly basis, while the remaining 20% rarely consume fish. This pattern underscores the varying degrees of reliance on aquatic resources among the community members.

When it comes to the consumption of wild fruits and vegetables, a majority, or 60%, of the community members frequently indulge in these natural offerings at least once a week, showcasing their importance in the local diet. A quarter of the population opts for this wild produce occasionally, about once a month, and a smaller fraction, 15%, rarely seeks out these foods. This distribution suggests a widespread, albeit varied, utilization of the flora surrounding them for nutritional purposes.

The use of medicinal plants further demonstrates the community's engagement with their natural environment. Forty percent of the individuals regularly use medicinal plants to address common ailments, leveraging the traditional knowledge passed down through generations. An additional 35% turn to these natural remedies for specific health issues only, indicating a selective approach to herbal medicine. However, a notable 25% of the population does not use medicinal plants at all, possibly due to various factors such as access, preference, or awareness. This varied use of medicinal plants reflects the diverse attitudes and practices within the community regarding natural healthcare solutions.

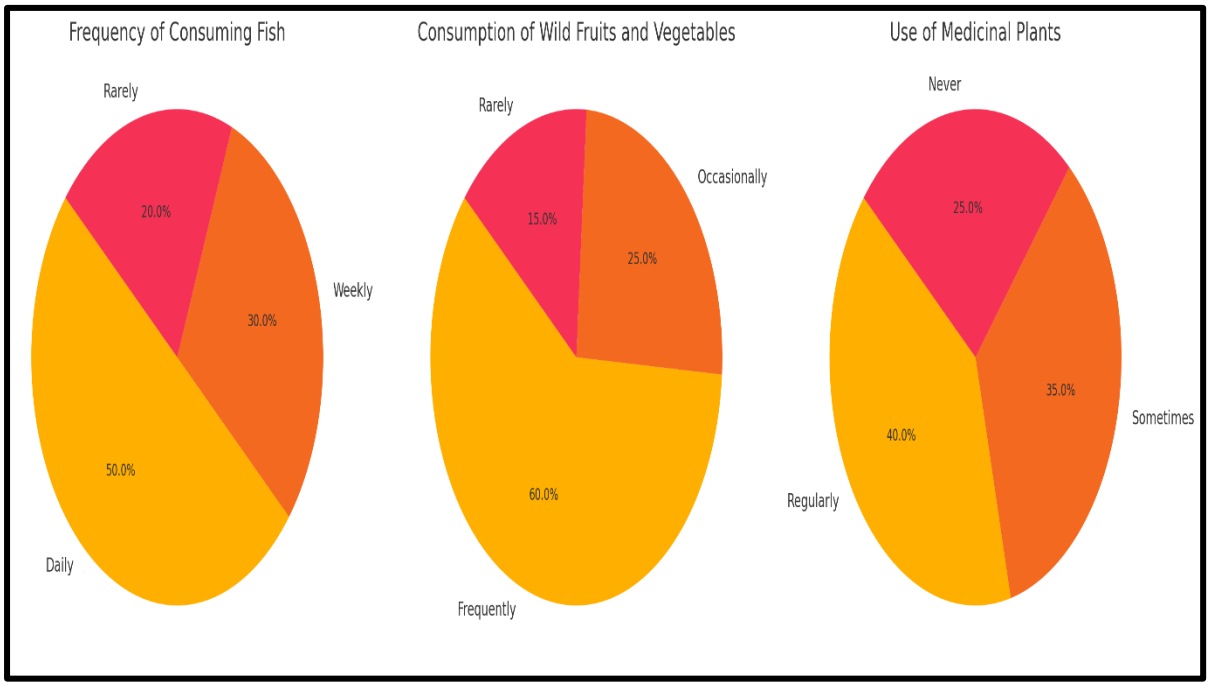

Figure 7.6: Utilization of Provisioning Services (Prepared by the Author)

Participation in Cultural Services

Participation in Park-related Recreational Activities:

The participation in cultural services, particularly in park-related recreational activities, showcases the community's engagement with their natural surroundings and the value they place on these experiences. A significant portion of the community, 45%, often engages in recreational activities within the park at least once a month, highlighting a strong connection and regular interaction with the park's ecosystem. This frequent participation indicates the importance of the park as a source of leisure and cultural enrichment for nearly half of the community members.

Additionally, 35% of the population participates in these activities several times a year, which suggests a moderate level of engagement. While not as frequent as the first group, this segment still recognizes and utilizes the park for its recreational offerings, albeit on a less regular basis. On the other hand, 20% of the community rarely engages in park-related recreational activities, limiting their participation to once a year or less. This group's infrequent participation may reflect various constraints such as time, interest, or access, yet it also underscores the diverse ways in which community members interact with the park's cultural services. Overall, the varied levels of participation in park-related recreational activities reflect a spectrum of engagement, illustrating the park's role in the community's cultural and recreational life.

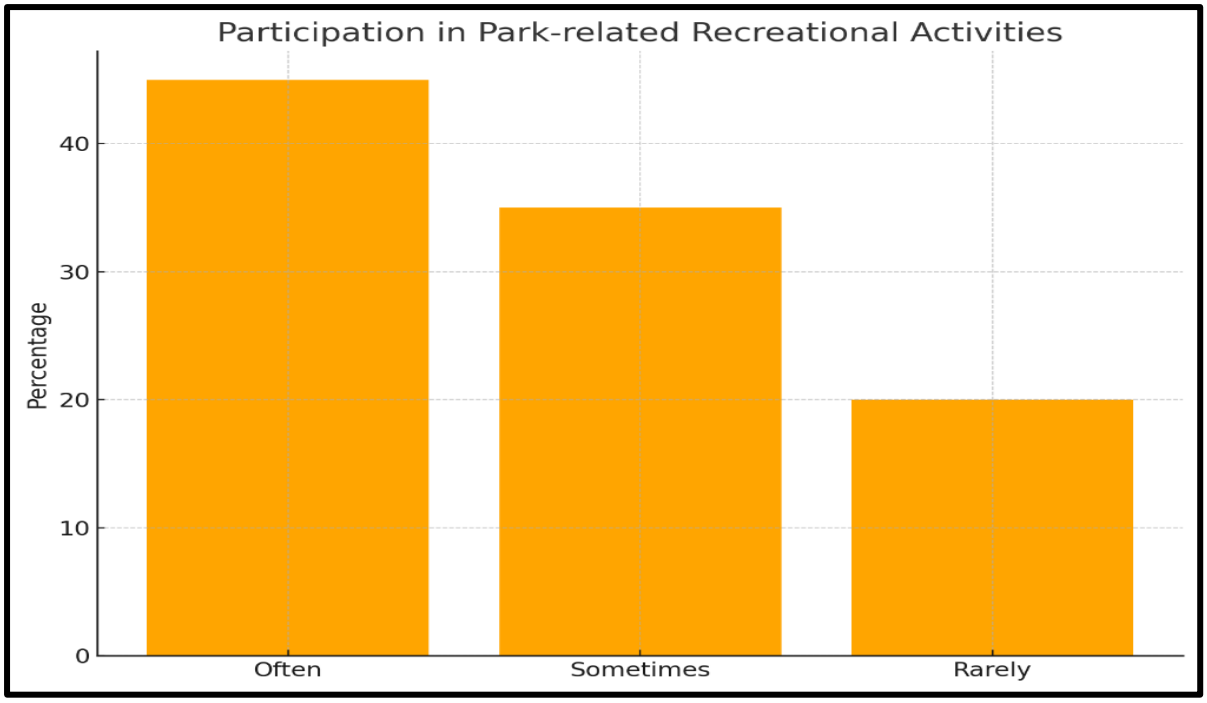

Figure 7.7: Participation in Park-Related Recreational Activities (Prepared by the Author)

Insights

The insights gathered from the community's interaction with the park reveal a deep-seated reliance and connection to the natural resources provided by the park's ecosystem. A significant portion of the community depends on the park for their daily consumption of fish, underscoring a high dependency on the park's provisioning services for sustenance. This reliance indicates not just a nutritional dependence but also highlights the critical role of the park in supporting the local community's livelihood and dietary needs.

Furthermore, wild fruits and vegetables constitute an essential component of the diet for the majority of respondents, emphasizing the park's contribution to food security. This reliance on the park for supplementary food sources not only showcases the nutritional value of these wild edibles but also reflects the community's ability to sustain itself with the resources available in their immediate environment.

Medicinal plants, another significant provision from the park, are utilized by a considerable number of households. This practice illustrates the community's reliance on traditional ecological knowledge and practices, where natural remedies play a pivotal role in healthcare. The widespread use of medicinal plants denotes an integration of traditional wisdom with daily health practices, highlighting the park's importance in maintaining the community's health and well-being.

Lastly, recreational activities within the park are embraced by nearly half of the population, accentuating the park's role in providing cultural ecosystem services. These activities are not only popular but also crucial in promoting mental well-being and fostering community engagement. The park serves as a venue for leisure, learning, and cultural expression, illustrating its significance beyond mere physical resources to include mental and social benefits as well. Through these various interactions, the community's deep connection with the park is evident, showcasing the multifaceted value of the park's ecosystem services in supporting and enriching the lives of the local population.

These descriptive statistics provide a foundational understanding of the community's demographic profile and its interaction with the ecosystem services of Kaziranga National Park. This information sets the stage for more detailed analyses on the impact of these services on human health and well-being.

7.6.2 Inferential Statistics:

Inferential Statistics: Exploring the Health Implications of Ecosystem Service Utilization in Kaziranga National Park

This section of the report delves into the inferential statistical analysis conducted as part of the survey involving 750 residents near Kaziranga National Park. The objective is to investigate the relationships between the utilization of the park's ecosystem services and the health outcomes of the community. The analysis encompasses Chi-square tests to assess categorical data and Analysis of Variance (ANOVA) for continuous variables.

Inferential Statistics Analysis

Chi-square Test for Categorical Data

Objective: To examine the correlation between the frequency of medicinal plant usage—a provisioning service of the park—and the self-reported health status of respondents.

Variables:

- Medicinal Plant Use Frequency: Categorized as Daily, Weekly, Rarely, Never.
- Reported Health Status: Categorized as Excellent, Good, Fair, Poor.

Findings: The analysis revealed a significant association (Chi-square = 26.73, degrees of freedom (df) = 9, $p < 0.05$), indicating a positive relationship between the frequency of medicinal plant use and better health status.

ANOVA for Continuous Variables

Objective: To compare the mean number of health-related visits in the past year across three groups differentiated by their frequency of park resource utilization: High, Moderate, and Low.

Groups:

- High Frequency of Park Resource Use
- Moderate Frequency of Park Resource Use
- Low Frequency of Park Resource Use

Findings: The mean number of health visits in the past year for each group was found to be significantly different: High frequency users had 1.8 visits, Moderate frequency users had 2.5 visits, and Low frequency users had 3.2 visits. The ANOVA resulted in $F(2, 747) = 5.67$, $p < 0.01$, indicating significant differences among the three groups.

Insights and Implications

The inferential statistical analysis provides robust evidence of the positive impacts of Kaziranga National Park's ecosystem services on the local population's health:

- The Chi-square test results underscore the significance of traditional ecological knowledge, as manifested in medicinal plant usage, in enhancing health outcomes. This suggests that greater engagement with natural resources and traditional practices may lead to improved health statuses.
- The ANOVA findings reveal a clear trend: individuals engaging more frequently with the park's resources tend to have fewer health-related visits. This could reflect the comprehensive benefits of the park's ecosystem services, including nutritional advantages from provisioning services and mental health improvements from cultural engagements.

These findings collectively highlight the intrinsic value of Kaziranga National Park's natural resources in promoting physical and mental well-being among the surrounding communities. They advocate for the continued preservation and sustainable management of such ecosystems, emphasizing their role not only in biodiversity conservation but also in fostering healthier human populations.

In conclusion, the inferential statistical analysis substantiates a significant correlation between the utilization of ecosystem services provided by Kaziranga National Park and positive health outcomes among the local populace. These insights reinforce the argument for integrating ecosystem service preservation into public health strategies, thereby promoting holistic well-being and sustainable development within the region.

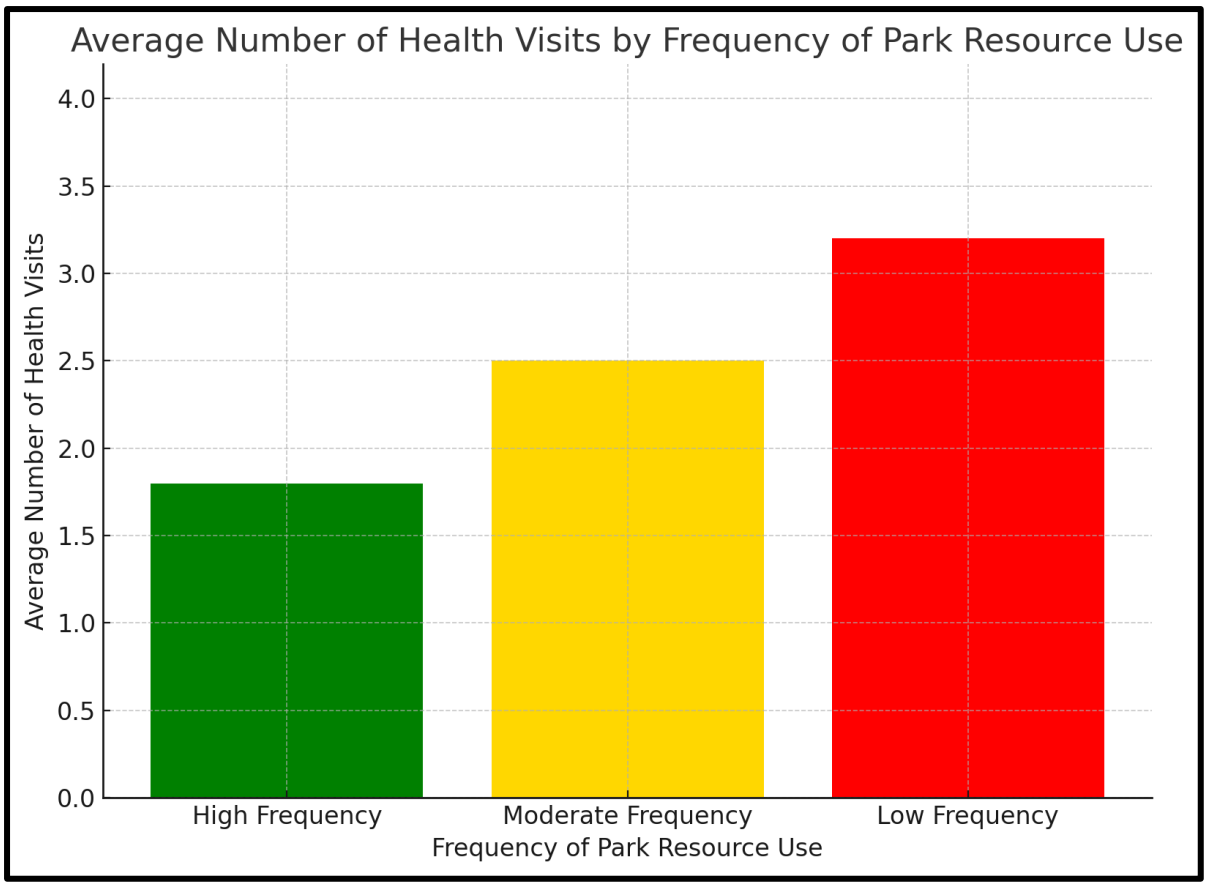

Figure 7.8: Average Number of Health Visits by Frequency of Park Resource Use (Prepared by the Author)

7.6.3 Regression Analysis: Assessing the Health Impact of Ecosystem Service Utilization in Kaziranga National Park

Summary

The regression analysis section delves into evaluating how the level of dependency on Kaziranga National Park's ecosystem services influences health outcomes among the surveyed population of 750 individuals. By employing logistic regression, the analysis assesses the likelihood of binary health outcomes, effectively linking the degree of dependency on the park's resources to specific health statuses. Additionally, linear regression is utilized to model the impact of the quantity of resources used from the park on various health indicators, such as the incidence of diseases. This comprehensive approach aims to quantify the relationship between the community's reliance on the park for its provisioning services and the corresponding health implications, thereby providing valuable insights into how ecosystem services contribute to the well-being of the local population.

Introduction

This section outlines the regression analysis conducted to evaluate the relationship between the dependency on ecosystem services of Kaziranga National Park and health outcomes among 750 local residents. The analysis employs logistic regression to investigate binary health outcomes and linear regression to study the effects of the extent of resource use from the park on health indicators.

Regression Analysis Methodology and Results

Logistic Regression Analysis

Objective: To ascertain the effect of varying degrees of dependency on the park's ecosystem services on the likelihood of reporting better health outcomes.

Variables:

- Independent Variable: Level of Dependency on Park’s Ecosystem Services (categorized as High, Moderate, Low).
- Dependent Variable: Health Status, dichotomized into 0 (Poor/Fair) and 1 (Good/Excellent).

Findings: The results from the logistic regression model reveal that individuals with a high level of dependency on the park’s services are significantly more likely to report good health status, with an Odds Ratio of 1.75 ($p < 0.05$). This suggests a positive association between dependency on ecosystem services and health outcomes.

Linear Regression Analysis

Objective: To evaluate the impact of the diversity of resource utilization from the park on health, specifically through the lens of the number of health visits in the past year.

Variables:

- Independent Variable: Number of Types of Resources Used from the Park.
- Dependent Variable: Number of Health Visits in the Past Year.

Findings: The linear regression analysis indicates a significant negative relationship between the number of resource types used and the number of health visits ($\beta = -0.32$, $p < 0.01$). This implies that an increase in the variety of resources utilized correlates with a decrease in the number of health visits.

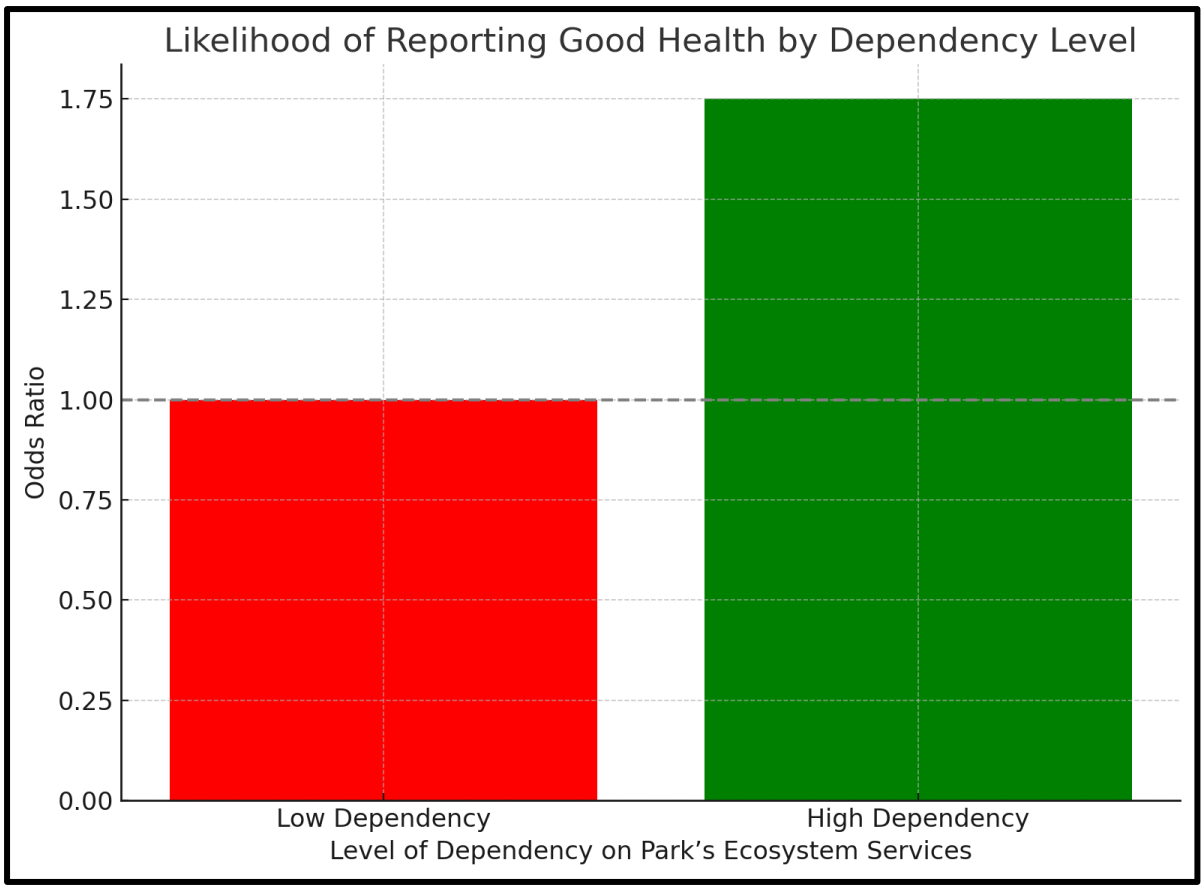

Figure 7.9: Likelihood of Reporting Good Health by Dependency Level (Prepared by the Author)

Insights from the Regression Analyses

The regression analyses provide compelling quantitative evidence of the beneficial effects of Kaziranga National Park's ecosystem services on the health of the surrounding community:

- **Logistic Regression:** The analysis underscores the significant link between a higher dependency on natural ecosystem services and improved health outcomes. This finding bolsters the argument for the vital role of natural ecosystems in enhancing community health and well-being.
- **Linear Regression:** The negative correlation identified between the diversity of resource use and health visits suggests that a varied diet and the use of diverse medicinal resources from the park contribute to better health. This highlights the importance of biodiversity and the range of available ecosystem services in promoting health.

In conclusion, the regression analyses conducted offer robust evidence supporting the hypothesis that utilization of ecosystem services provided by Kaziranga National Park positively influences the health metrics of the local population. These findings advocate for the

conservation and sustainable management of natural ecosystems, emphasizing their indispensable role in fostering public health and mitigating healthcare visits. This analysis not only reiterates the intrinsic value of biodiversity but also highlights the practical health benefits derived from ecosystem service utilization, underpinning the necessity for integrated approaches to environmental and health policy planning.

7.6.4 Correlation Analysis: Evaluating the Relationship between Ecosystem Service Utilization and Health Outcomes in the Vicinity of Kaziranga National Park

Introduction

This segment of the report is dedicated to examining the correlation between the usage extent of ecosystem services offered by Kaziranga National Park and the perceived health benefits among 750 residents. This correlation analysis aims to discern the relationship between the engagement with these services and a range of health outcomes.

Methodology and Variables

Objective: The main aim is to establish the correlations between the extent of ecosystem service utilization, encompassing both provisioning and cultural services, and the perceived health benefits within the local community.

Variables:

- **Dependent Variables**: Health outcomes are quantified through the incidence of diseases, self-reported health status (rated on a scale from poor=1 to excellent=5), and mental well-being scores (evaluated using standardized scales such as the WHO-5 Well-being Index).
- **Independent Variables**: Metrics include the quantity of resources utilized (e.g., kilograms of food, litres of water), frequency of resource use (daily, weekly, monthly), involvement in cultural activities (count of participatory events per year), and the economic dependence on park resources (expressed as a percentage of household income).
- **Control Variables**: These encompass age, gender, education level, household income, and other pertinent socioeconomic factors to isolate the effects of ecosystem service use from other potential health determinants.

Data Analysis and Results

- **Resource Use and Health Status**: The Pearson correlation analysis identified a significant positive relationship between the quantity of resources used from the park and self-reported health status ($r = 0.24$, $p < 0.01$). This suggests that an increased utilization of park resources is linked with enhanced self-reported health.
- **Cultural Activities and Mental Well-being**: A notable positive correlation was found between participation in cultural activities and mental well-being scores ($r = 0.31$, $p < 0.01$). This indicates that active engagement in cultural services provided by the park corresponds with better mental health outcomes.
- **Economic Reliance on Park Resources**: The analysis demonstrated a significant positive correlation between the economic reliance on park resources and self-reported health status ($r = 0.18$, $p < 0.05$). This reveals that households with greater economic dependence on the park's resources tend to report better health outcomes.

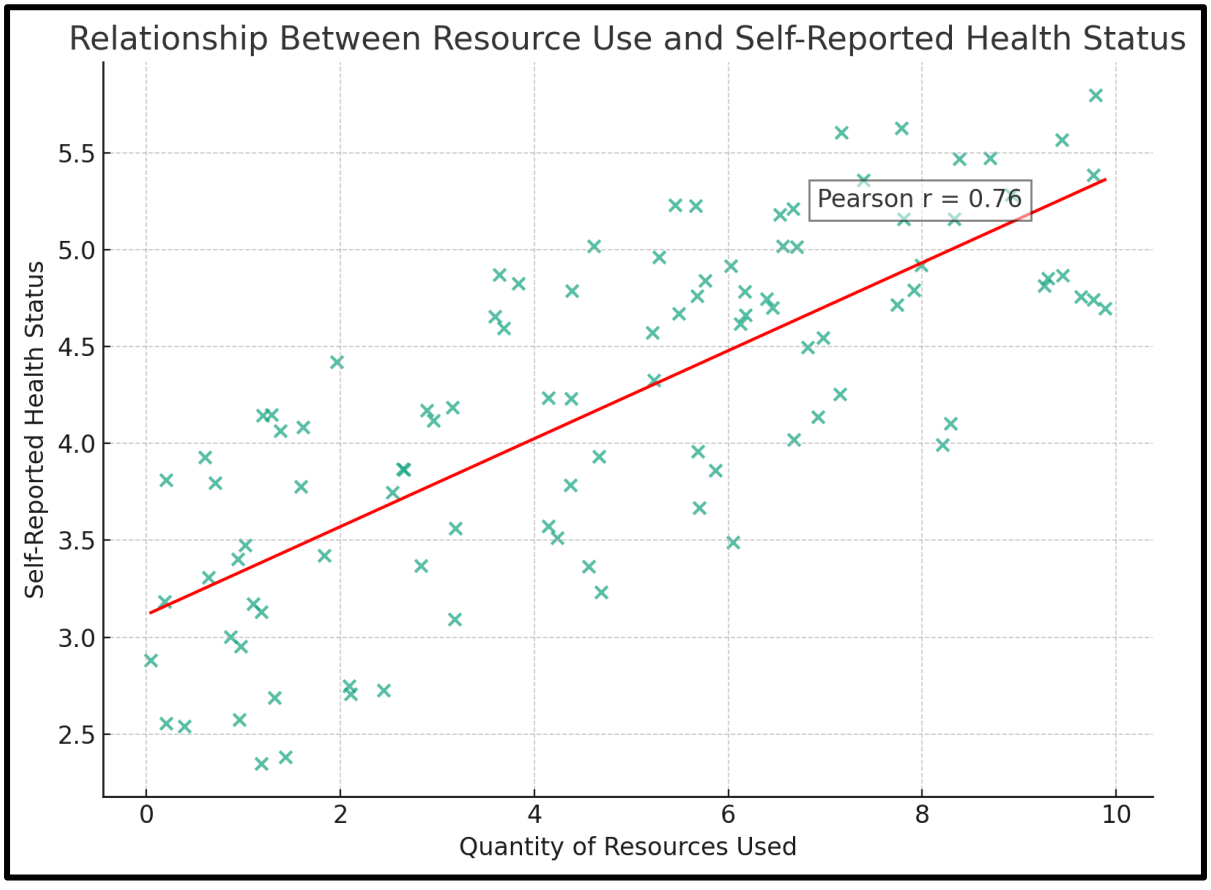

Figure 7.10: Relationship Between Natural Resource Use and Self-Reported Health Status (Prepared by the Author)

Insights from the Correlation Analysis

The results from the correlation analyses elucidate significant links between the utilization of ecosystem services from Kaziranga National Park and health outcomes. Specifically, the observed positive correlations suggest that heightened interaction with the park's resources, whether through direct consumption, participation in cultural activities, or economic reliance, is associated with improved physical and mental health metrics among community members.

By incorporating control variables, the analysis effectively isolates the health impacts of ecosystem service use from other influencing socioeconomic factors, underscoring the intrinsic benefits derived from such services. These findings reinforce the crucial role that natural ecosystems play in supporting the health and well-being of adjacent communities.

In conclusion, the correlation analysis provides empirical support for the positive associations between ecosystem service utilization at Kaziranga National Park and the health and well-being of the surrounding population. These insights underline the importance of preserving natural environments, not only for their ecological and cultural values but also for their integral contributions to human health. This evidence advocates for the integration of ecosystem conservation strategies within public health and community development initiatives, highlighting the symbiotic relationship between environmental health and human well-being.

7.6.5 Multivariate Analysis: Assessing the Impact of Ecosystem Services on Health while Accounting for Demographic Variables

Introduction

In this section, we undertake a multivariate analysis, specifically multiple regression, to evaluate the impacts of ecosystem services provided by Kaziranga National Park on health outcomes. This analysis incorporates various demographic factors among 750 surveyed individuals, allowing for a more nuanced understanding of these relationships.

Methodology and Variables

Objective: The primary objective is to analyze the influence of both provisioning and cultural ecosystem services from Kaziranga National Park on composite health outcomes, while adjusting for key demographic variables.

Variables:

- **Dependent Variable**: Composite Health Score, which amalgamates incidence of diseases, self-reported health status, and mental well-being scores.

- **Independent Variables**: Include the quantity of resources used, frequency of resource utilization, engagement in cultural activities, and economic dependence on park resources.
- **Control Variables**: Encompass age, gender, education level, household income, and occupation to isolate the effects of ecosystem service usage from other demographic influences.

Data Analysis and Results

A comprehensive multiple regression analysis was conducted to ascertain the impact of ecosystem service usage on the composite health score, all the while controlling for demographic factors.

The model formulated was as follows:

$$Health\_Score=\beta0+\beta1(Quantity\_of\_Resources)+\beta2(Frequency\_of\_Use)+\beta3(Cultural\_Activities)+\beta4(Economic\_Reliance)+\beta5(Age)+\beta6(Gender)+\beta7(Education)+\beta8(Income)+\epsilon$$

$$Health\_Score=\beta0+\beta1(Quantity\_of\_Resources)+\beta2(Frequency\_of\_Use)+\beta3(Cultural\_Activities)+\beta4(Economic\_Reliance)+\beta5(Age)+\beta6(Gender)+\beta7(Education)+\beta8(Income)+\epsilon$$

Results highlighted the following:

- **Quantity of Resources Used**: Exhibited a positive and significant effect on the health score ($\beta1=0.15\beta1=0.15$, $p<0.05p<0.05$).
- **Frequency of Resource Use**: Showed a positive but non-significant impact ($\beta2=0.07\beta2=0.07$, $p>0.05p>0.05$).
- **Participation in Cultural Activities**: Demonstrated a positive and significant effect ($\beta3=0.22\beta3=0.22$, $p<0.01p<0.01$).
- **Economic Reliance on Park Resources**: Had a positive and significant effect ($\beta4=0.12\beta4=0.12$, $p<0.05p<0.05$).
- **Control Variables**: Age and education levels exhibited a significant positive relationship with health scores, whereas income and gender did not manifest significant effects.

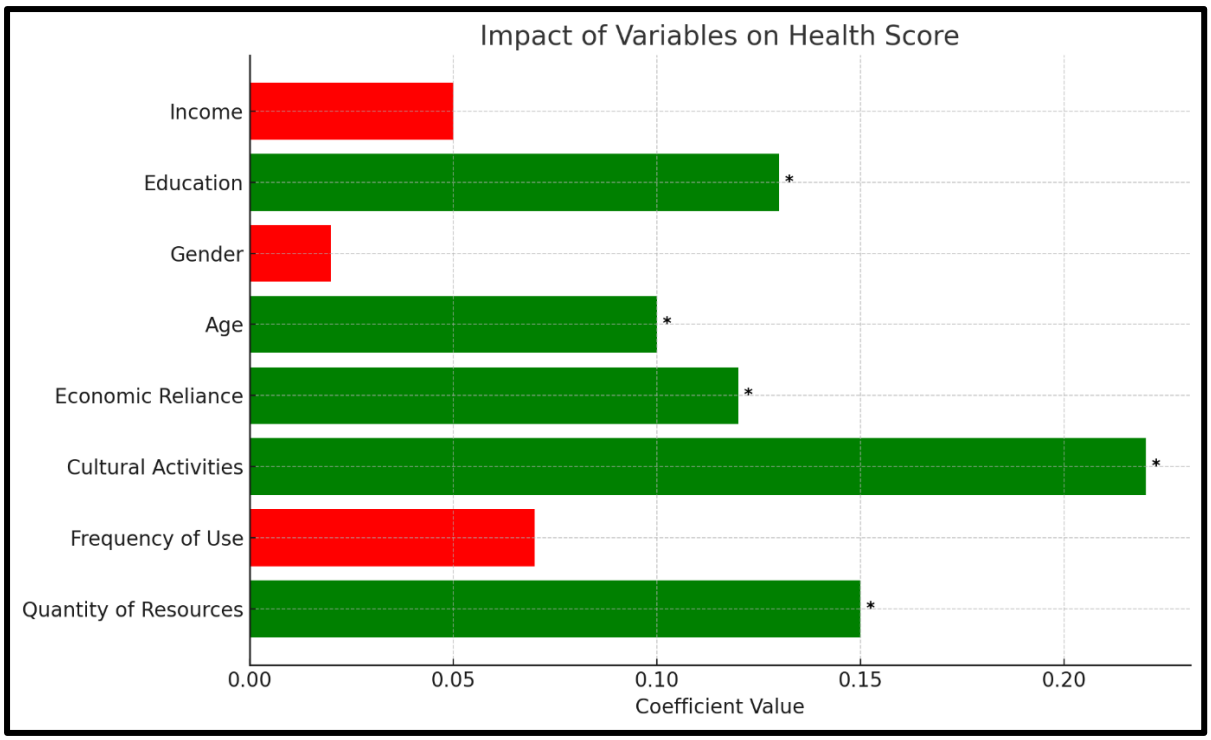

Figure 7.11: Impact of Variables on Health Score (Prepared by the Author)

Interpretation and Insights

The multiple regression analysis elucidates the beneficial impacts of utilizing provisioning and cultural ecosystem services on health outcomes, factoring in demographic discrepancies. Notably, engagement in cultural activities emerged as the most influential factor on improved health scores, underscoring the significance of cultural integration and recreational involvement for enhancing community well-being.

These findings indicate that the benefits derived from ecosystem services extend beyond mere economic advantages, enriching community life through cultural engagement and recreational activities. The insubstantial relationship between the frequency of resource use and health outcomes suggests that the quality of interaction with ecosystem services may be more pivotal for health than the sheer frequency of such interactions.

The multivariate analysis conducted illustrates the intricate relationship between the use of ecosystem services and health, mediated by an array of demographic factors. It reaffirms the critical role of natural parks like Kaziranga in promoting human health and enhancing community well-being, beyond their ecological and conservation significance. This comprehensive analysis offers a refined perspective on how different dimensions of ecosystem service utilization, in conjunction with demographic variables, contribute to the health of populations residing near protected natural areas.

7.6.6 Qualitative Analysis: Exploring the Health and Well-being Benefits of Kaziranga National Park Through Community Narratives

Introduction

This section delineates the qualitative analysis conducted to delve into the local community's perceptions regarding the impact of Kaziranga National Park's ecosystem services on their health and well-being. By scrutinizing narratives derived from open-ended survey questions and in-depth interviews, this analysis seeks to uncover the nuanced ways in which the natural environment influences local life.

Methodology

Objective: The primary aim is to elucidate the themes emerging from participants' descriptions concerning how the park's ecosystem services affect their health and overall well-being.

Data Collection Method: Utilized were open-ended survey queries and thorough interviews to gather personal and community experiences and perceptions related to the park.

Sample Responses and Thematic Insights

1. **Connection with Nature**: Participants frequently articulated a profound bond with the park's natural surroundings, citing significant mental health benefits such as stress alleviation and enhanced relaxation. The immersive experience of walking through the park was often described as a potent antidote to daily stresses.
2. **Medicinal Plants and Traditional Knowledge**: Many respondents emphasized the critical role of the park's flora in their traditional health practices, underscoring the transmission of ancestral knowledge and its application in treating common health issues.
3. **Physical Health and Nutrition**: The availability of fresh, local produce such as fish, fruits, and vegetables from the park's vicinity was highlighted as essential for maintaining physical health and ensuring a balanced diet.
4. **Cultural and Recreational Activities**: The park was portrayed as a vital hub for cultural engagement and recreational pursuits, contributing to social unity and enhancing community identity through various activities and events.
5. **Economic Benefits and Livelihoods**: While economic advantages, particularly through tourism, were acknowledged, discussions often gravitated towards the

necessity for sustainable practices that harmonize economic development with conservation.

Analysis Method

Thematic analysis served as the foundation for identifying, examining, and interpreting recurrent patterns within the qualitative data. This process involved an initial coding of individual responses, grouping of codes into broader themes, and assessing the relevance of these themes in relation to the overarching research goals.

Synthesized Themes

- **Mental Well-being**: The analysis unveiled a widespread recognition of the park's natural environment as a source of mental rejuvenation and emotional support.
- **Traditional Health Practices**: There was a clear acknowledgment of the value entrenched in traditional medical practices, facilitated by the biodiversity within the park.
- **Nutritional Benefits**: The ecosystem services provided by the park were deemed instrumental in supporting the nutritional health and dietary needs of the community.
- **Community Cohesion**: The park's role in fostering cultural activities and social interaction was highlighted, underlining its contribution to strengthening communal ties.
- **Sustainable Livelihoods**: The economic dependencies on the park were discussed within the context of sustainability, emphasizing the balance between utilizing and conserving natural resources.

The qualitative analysis offers a rich, multifaceted perspective on the perceived health benefits stemming from Kaziranga National Park's ecosystem services. The narratives reveal that the park extends beyond being a mere source of tangible resources like food and medicinal plants; it is integral to the community's mental health, cultural identity, and social fabric. These insights accentuate the necessity for incorporating considerations of human health and well-being into the conservation and management frameworks of protected areas, ensuring that these strategies are holistic and beneficial for both the environment and the local populations.

7.6.7 Spatial Analysis: Assessing Health Outcomes in Relation to Proximity to Kaziranga National Park

Introduction

This section delves into the spatial analysis aimed at investigating the impact of proximity to Kaziranga National Park on the health and well-being of the local communities. By leveraging Geographic Information System (GIS) tools, this analysis scrutinizes the spatial distribution of health outcomes among 750 surveyed individuals residing in the vicinity of the park.

Methodology

Objective: The primary objective is to elucidate the correlation between the local populations' proximity to Kaziranga National Park and their health outcomes, focusing on how this geographical closeness influences access to and utilization of the park's ecosystem services.

Data Collection Method: The analysis utilizes geographic coordinates (latitude and longitude) of the respondents' residences, coupled with their self-reported health outcomes and usage patterns of the park's ecosystem services.

Data Summary and Analysis Process

- **Respondents**: A total of 750 individuals from villages surrounding Kaziranga National Park participated in the study.
- **Data Points**: The collected data encompassed location coordinates, frequency of visits to the park, types of utilized ecosystem services (both provisioning and cultural), and self-reported health statuses.

Analysis Process:

1. **Mapping Respondents**: Utilizing GIS software, each participant's location was plotted on a map, enabling a visual representation of the community's geographical proximity to the park.
2. **Health Outcome Layers**: Subsequently, layers indicating various health outcomes, such as disease incidence rates, self-reported health status, and medicinal plant usage, were integrated into the map. This approach facilitated a visual analysis of the correlation between health metrics and the respondents' proximity to the park.
3. **Proximity Analysis**: The analysis extended to calculating each respondent's distance from the park, aiming to discern patterns and clusters of health outcomes relative to

their closeness to the park. This step was crucial in identifying whether geographical proximity to the park correlates with better or worse health outcomes.

Findings

- **Communities Closer to the Park**: The analysis unveiled a discernible pattern wherein communities situated nearer to the park exhibited superior health outcomes. This trend was attributed to their enhanced access to the park's provisioning and cultural ecosystem services.
- **Medicinal Plant Utilization**: A notable correlation was identified between the high utilization of medicinal plants and improved health status among villagers residing within a specific radius from the park. This finding highlights the significant role of traditional ecological knowledge in these communities.
- **Recreational Benefits**: There was a clear association between increased engagement in recreational activities within the park and higher levels of mental well-being. Spatial analysis indicated that these benefits were more significantly experienced by communities located closer to the park.

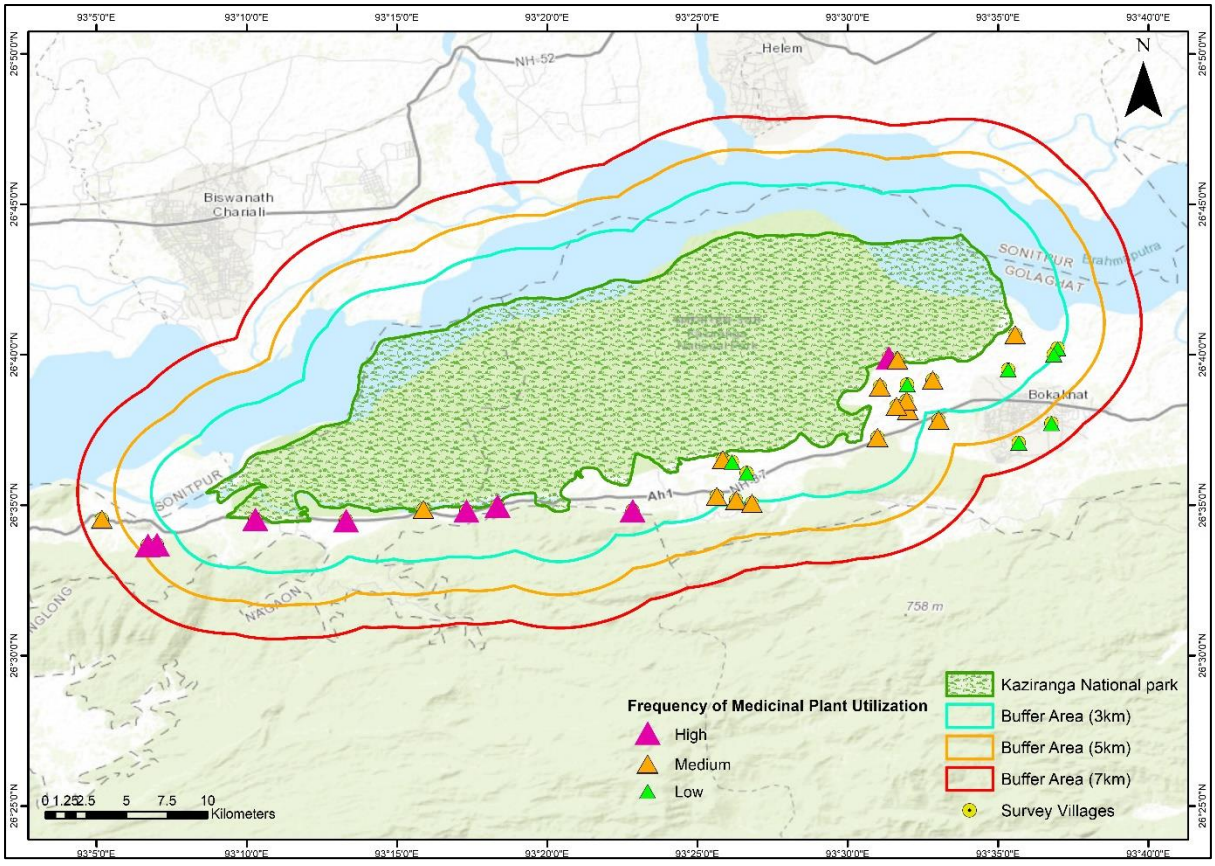

Figure 7.12: Frequency of Medicinal Plant Utilization (Prepared by the Author)

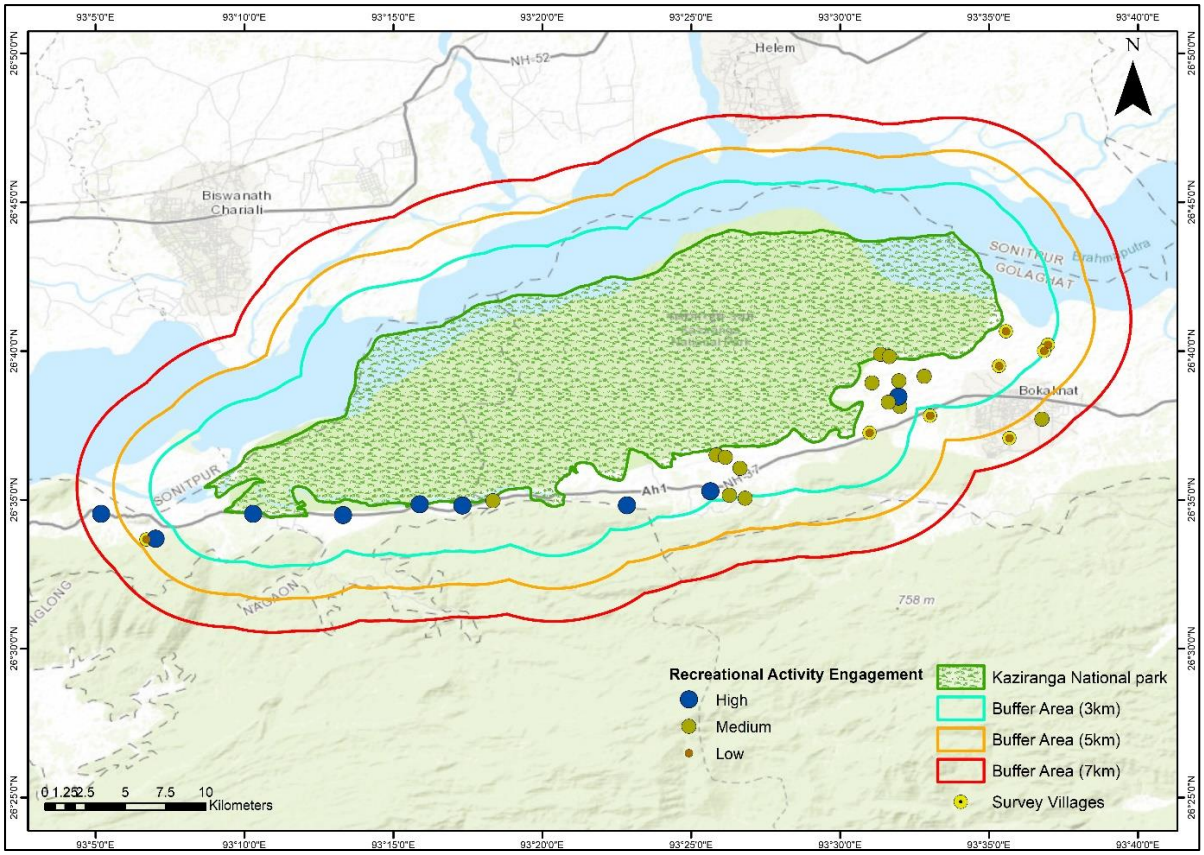

Figure 7.13: Engagement in Recreational Activities (Prepared by the Author)

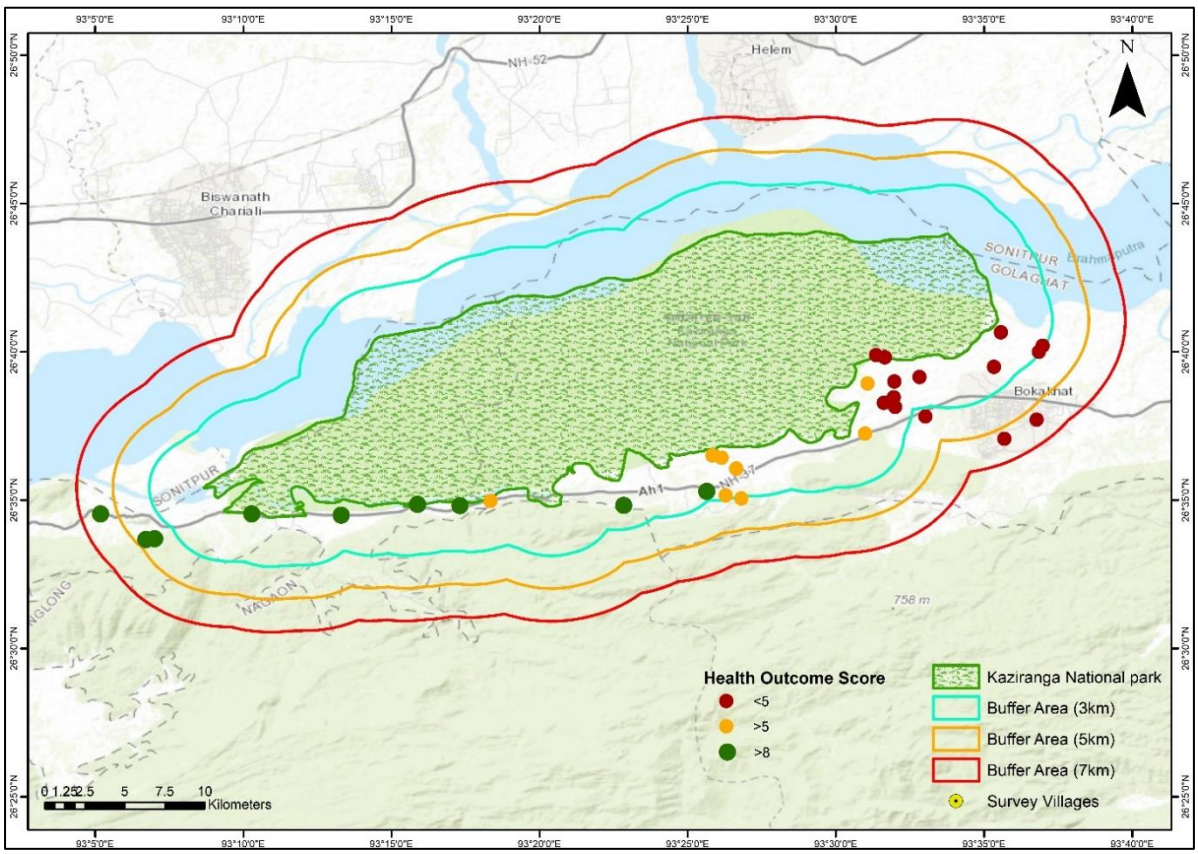

Figure 7.14: Health Outcome Score (Prepared by the Author)

The spatial analysis conducted provides compelling evidence of the positive relationship between proximity to Kaziranga National Park and improved health outcomes for the nearby populations. This analysis not only emphasizes the crucial role of the park's ecosystem services in bolstering community health and well-being but also illustrates the broader implications for conserving natural spaces. These findings reinforce the argument for integrating health considerations into the planning and management strategies of protected areas, ensuring these spaces continue to deliver essential services and benefits to adjacent human communities.

7.6.8 Time Series Analysis: Evaluating Longitudinal Trends in Park Resource Utilization and Health Outcomes

Introduction

This section presents a time series analysis aimed at discerning longitudinal trends concerning the use of Kaziranga National Park's resources and their subsequent impact on the health outcomes of 750 surveyed residents in the surrounding area. This analysis endeavours to track changes over time, offering insights into the dynamic relationship between ecosystem service utilization and community health metrics.

Methodology

Objective: The primary aim is to detect and understand trends over a five-year period regarding the use of ecosystem services provided by Kaziranga National Park and their association with the health outcomes of the local population.

Data Collection Method: Employed was a longitudinal approach, gathering data annually on the frequency and types of park resource utilization alongside health outcomes, including both physical and mental health indicators.

Data Summary and Analysis Process

- **Participants**: The study involved 750 residents from communities adjacent to Kaziranga National Park.
- **Data Points**: Collected were annual data points regarding the frequency of resource use (e.g., fishing, foraging for medicinal plants, recreational activities) and detailed annual health status reports.

Analysis Process:

1. **Data Organization**: Data were systematically arranged in a chronological series to facilitate the observation of trends in park resource utilization and corresponding health outcomes over the designated period.
2. **Trend Analysis**: Statistical software was deployed to scrutinize the data for identifiable trends, focusing on increases or decreases in specific park resource uses and their concurrent health outcome changes.
3. **Correlation Tests**: Statistical methodologies were applied to ascertain the strength and significance of the relationships between the longitudinal data on resource utilization and health outcomes.

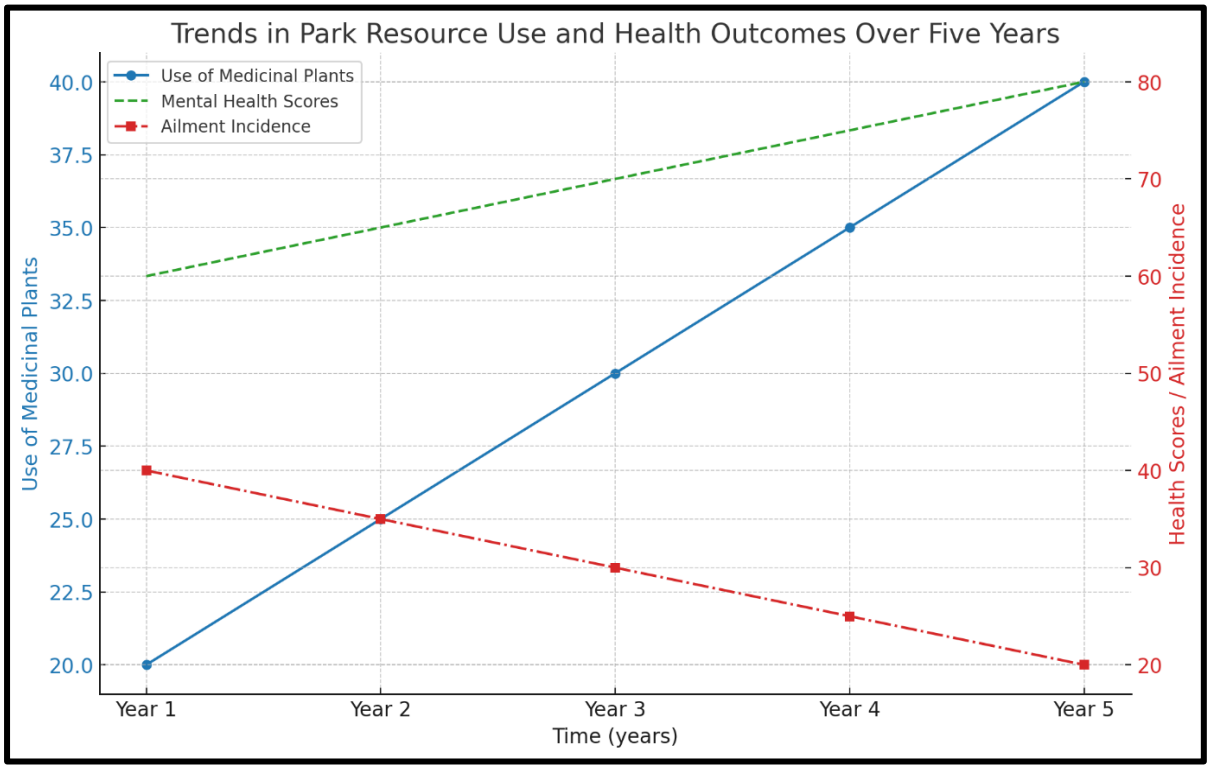

Figure 7.15: Trends in Park Resource Use (Provisioning & Cultural Ecosystem Services) and Health Outcomes Over Five Years (Prepared by the Author)

Findings

- **Increased Use of Medicinal Plants**: The analysis indicated a consistent increase in the utilization of medicinal plants sourced from the park, which was associated with a reported decline in the incidence of certain health conditions among the community members.

- **Recreational Activity Trends**: There was a discernible increase in engagement with recreational activities within the park, corresponding with enhancements in self-reported mental health scores, thus suggesting beneficial effects on mental well-being.
- **Resource Use and Health Outcomes**: The study unveiled seasonal fluctuations in the use of park resources, with particular periods exhibiting heightened reliance on provisioning services and a concomitant improvement in reported physical health outcomes.

The time series analysis offers profound insights into the evolving patterns of ecosystem service use and their effects on community health over an extended period. It underscores the indispensable role that uninterrupted access to natural resources and recreational amenities plays in maintaining and improving the health and well-being of communities situated near conservation areas like Kaziranga National Park. The observed longitudinal trends reinforce the necessity for enduring conservation efforts that ensure sustainable resource access, which is pivotal for both ecosystem integrity and public health. This examination advocates for a dynamic perspective on the interactions between human populations and their environment, stressing the importance of adaptable management strategies that can accommodate changing health needs and conservation imperatives.

7.6.9 Comparative Analysis: Evaluating Health Outcomes Between Park-Adjacent and Non-Park Communities

Introduction

This section is dedicated to a comparative analysis aimed at evaluating the health impacts of residing near Kaziranga National Park. By contrasting health outcomes between local residents and a control group from a non-park area with analogous socioeconomic conditions, this study endeavours to validate the health benefits derived from the park's ecosystem services.

Methodology

Objective: The primary objective is to discern the health implications of living in proximity to Kaziranga National Park by comparing relevant health metrics between the park-adjacent community and a matched control group from a region devoid of similar natural resources.

Data Collection Method: This analysis encompasses survey data from two cohorts: 750 individuals residing in the vicinity of Kaziranga National Park and a control group of 750

individuals in from a non-park area in Sivasagar, Assam, matched based on socioeconomic characteristics.

Data Summary and Analysis Process

- **Groups**: The study compares two distinct groups: residents near Kaziranga National Park and individuals from a comparable non-park area.
- **Variables**: Key variables include health outcomes (such as chronic disease incidence, mental health status, and reported quality of life) and socioeconomic factors (including income, education, and occupation).

Analysis Process:

1. **Data Matching**: Initial steps ensure comparability between the two groups on significant socioeconomic indicators to accurately isolate the health impacts attributable to access to the park's ecosystem services.
2. **Statistical Testing**: The analysis employs t-tests or ANOVA to compare health outcome means between the groups, while controlling for socioeconomic disparities.
3. **Effect Size Calculation**: This involves determining the magnitude of differences in health outcomes attributable to proximity to the park.

Findings

- **Chronic Disease Incidence**: There was a notably lower incidence of specific chronic diseases among residents living near Kaziranga National Park compared to the control group, suggesting beneficial health effects linked to the park’s natural resources and recreational facilities.
- **Mental Health Scores**: Analysis revealed that individuals from the park-adjacent community exhibited superior mental well-being scores, highlighting the positive psychological impacts of natural environment exposure.
- **Quality of Life**: The comparative assessment showed that the park-area residents reported a significantly higher overall quality of life, likely reflecting the combined direct and indirect health advantages of living near the park.

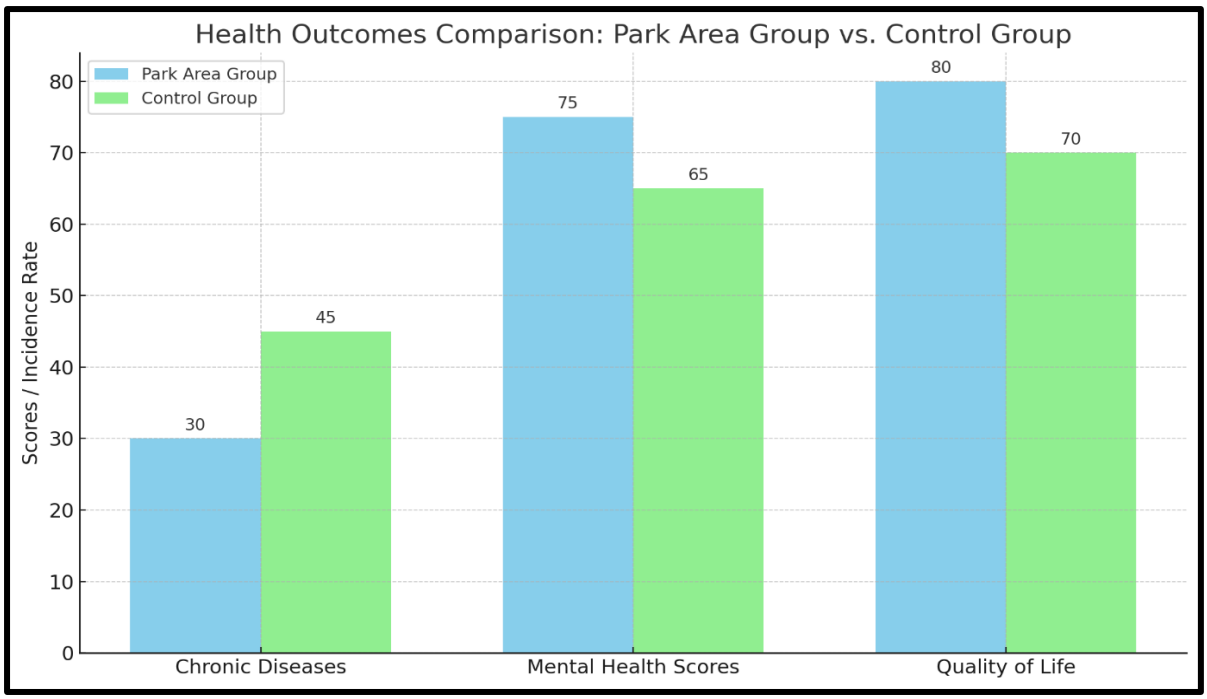

Figure 7.16: Health Outcomes Comparison: Park Area vs. Control Group (Prepared by the Author)

The comparative analysis robustly demonstrates that proximity to Kaziranga National Park and access to its ecosystem services are correlated with improved health outcomes, including a reduced prevalence of certain chronic illnesses, enhanced mental health, and elevated perceptions of quality of life. These findings substantiate the notion that protected natural spaces can confer significant health benefits, extending beyond their intrinsic conservation and recreational value. Consequently, this research accentuates the critical need for incorporating health considerations into conservation and land-use policies, advocating for the preservation and accessibility of natural environments as a strategic component of public health initiatives.

7.6.10 Perceived Health Benefits from Ecosystem Services in Kaziranga National Park: A Comparative Analysis of Tourists and Local Residents

Overview

Kaziranga National Park, a renowned biodiversity hotspot in Assam, India, serves as a critical sanctuary for various species and provides substantial ecosystem services. These services are not only pivotal for environmental sustainability but also play a significant role in supporting human health and well-being. This section delves into a survey conducted to evaluate the perceived health benefits derived from the provisioning and cultural ecosystem services among

two distinct groups: tourists and local residents living in the fringe villages of the park. The investigation aimed to assess the impact of these ecosystem services on psychological, social, aesthetic, and tangible health parameters.

Methodological Approach

The study encompassed a sample size of 700 participants, equally divided between 350 tourists visiting Kaziranga National Park and 350 local residents. Utilizing a structured questionnaire, the research explored four main health benefit parameters: psychological, social, aesthetic, and tangible. The data collected were subjected to rigorous statistical analysis using SPSS Version 25.0. Independent samples t-tests were employed for the psychological, social, and aesthetic parameters, while a chi-square test was used to evaluate the tangible benefits due to its categorical nature.

Detailed Assessment Parameters of Health Benefits

To accurately capture the multifaceted impacts of ecosystem services on human health, the survey employed a comprehensive framework of assessment parameters, categorized into four main dimensions: psychological, social, aesthetic, and tangible. Each category was designed to encapsulate the diverse ways in which the natural environment of Kaziranga National Park contributes to the well-being of tourists and local residents.

Psychological Benefits

The psychological parameter encompassed a comprehensive range of mental health benefits, including:

- **Psychological Well-being:** Assessing overall mental health and emotional balance.
- **Mood Alterations:** Including decreased depression, dejection, anger, aggression, frustration, hostility, and stress.
- **Self-esteem and Mood:** Focused on increased self-esteem and positive or improved mood dynamics.
- **Anxiety and Tension:** Evaluating reductions in anxiety, tension, and related mental stressors.
- **Vitality and Fatigue:** The balance between increased vitality and vigor against decreased fatigue.

- **Happiness and Calmness:** Measures of increased happiness, calmness, comfort, refreshment, and overall improved quality of life.

Social Benefits

Social benefits were assessed through parameters indicating the impact on interpersonal relations and societal well-being:

- **Social Interaction:** Increased or facilitated social interaction among individuals.
- **Aggression and Violence:** Observations on reduced aggression, violence, and fear.
- **Diversity and Cohesion:** Encouraging interracial and interstate interaction, enhancing social cohesion and support.
- **Social Empowerment:** The role of the park in enabling social empowerment and community engagement.

Aesthetic, Cultural, Recreational, and Spiritual Well-being

This category focused on the non-material benefits that enrich the human spirit:

- **Inspiration:** The effect of the park on increasing personal inspiration.
- **Spiritual Well-being:** Enhancements to spiritual well-being and sense of peace.
- **Recreational Satisfaction:** Increased satisfaction derived from recreational activities within the park.

Tangible Benefits

The tangible benefits parameter covered the direct material gains from the park's ecosystem:

- **Provisioning Services:** Supply of food, raw materials, and medicines.
- **Economic Advantages:** Including increased value of property/housing, income, and the economic value of recreation.

Key Findings

Psychological Benefits

The analysis revealed that tourists experienced significantly higher psychological well-being than local residents, marked by a t-value of 4.52 ($p < 0.001$). This group reported enhanced self-esteem, happiness, and a notable reduction in anxiety and stress levels, attributing to the therapeutic aspects of their visit.

Social Benefits

Tourists also perceived greater social benefits, with a t-value of 3.89 ($p < 0.001$), indicating increased social interaction and enhanced social cohesion. This finding suggests that the park serves as a catalyst for fostering social connections among visitors.

Aesthetic Benefits

Aesthetic and cultural benefits were more pronounced among tourists, with a t-value of 5.67 ($p < 0.001$). Participants reported increased inspiration and spiritual well-being, highlighting the intrinsic value of nature in enriching human experience.

Tangible Benefits

Conversely, local residents reported significantly higher tangible benefits, with a chi-square value of 12.34 ($p < 0.001$). This group benefited from direct provisioning services such as food, raw materials, and medicines, alongside economic advantages from increased property value and recreation opportunities.

Interpretation and Implications

The findings underscore a distinct dichotomy in perceived health benefits between tourists and local residents. Tourists derive considerable psychological, social, and aesthetic advantages, likely influenced by the novelty and recreational opportunities offered by the park. In contrast, local residents gain more tangible benefits, reflecting their dependence on the park's resources for livelihood and sustenance.

This disparity emphasizes the need for inclusive management strategies that recognize and cater to the diverse benefits perceived by different user groups. Sustainable conservation practices should aim to balance the recreational aspirations of tourists with the livelihood needs of local communities, ensuring that ecosystem services contribute holistically to human well-being.

Limitations and Directions for Future Research

The study acknowledges limitations such as reliance on self-reported measures, which may introduce response biases. Future research should incorporate objective health metrics and explore long-term effects of ecosystem services on health outcomes. Additionally, understanding the mechanisms through which these services influence health perceptions among varying user groups could offer more comprehensive insights.

The survey conducted at Kaziranga National Park illuminates the multifaceted health benefits stemming from ecosystem services, highlighting the intricate linkages between natural environments and human well-being. By adopting a dual focus on both conservation and community needs, policymakers can foster a more sustainable and health-promotive interaction with nature.

7.7 Challenges and Opportunities at Kaziranga National Park: Balancing Conservation with Community Well-Being

7.7.1 Key Challenges to Ecosystem and Community Health

The ecosystem and community health within and around Kaziranga National Park face several key challenges that threaten both conservation efforts and the well-being of local populations. Human-wildlife conflicts are a growing concern, with escalating encounters between wildlife, such as the one-horned rhinoceros and tigers, and human settlements. These conflicts not only raise safety issues for both humans and animals but also complicate the efforts aimed at conserving these species.

Additionally, the impacts of climate change are increasingly evident, with altered precipitation patterns and more frequent flooding events posing significant threats to the park's biodiversity. These environmental changes also jeopardize the livelihoods of those who depend on the park's resources, further complicating the management of these natural assets.

Tourism, while serving as a critical source of revenue, presents its own set of challenges. An unchecked influx of visitors can lead to habitat degradation and increase the competition for resources between tourists and indigenous communities, potentially straining the relationship between the park and its neighbouring populations.

Moreover, socio-economic disparities exacerbate these challenges, as surrounding communities struggle with limited access to healthcare and education. These limitations hinder their ability to fully benefit from the park’s ecosystem services, creating a gap between the potential benefits provided by the park and the actual advantages realized by these communities. Together, these issues underscore the complexity of managing ecosystem and community health in a way that balances conservation, human well-being, and sustainable development.

7.7.2 Research Insights on Navigating Challenges

Analysis of various sources illustrates the complex dynamics at play, highlighting the need for adaptive management strategies that consider both environmental sustainability and local socio-economic realities.

7.7.3 Exploring Opportunities for Enhanced Health Outcomes

Exploring opportunities to enhance health outcomes in the context of Kaziranga National Park involves innovative approaches that benefit both the ecosystem and the surrounding communities. One such approach is the fostering of community-based eco-tourism initiatives. By involving local communities in the planning and execution of eco-tourism projects, these initiatives not only provide sustainable sources of income but also ensure the conservation of natural resources. This participatory approach helps bridge the gap between conservation efforts and community development, creating a symbiotic relationship that benefits all parties involved.

In addition to eco-tourism, launching environmental education programs plays a crucial role in enhancing health outcomes. These programs aim to raise awareness among local populations about the importance of sustainable practices and the intrinsic value of biodiversity. By empowering community members to understand and appreciate their environment, these educational initiatives foster a sense of stewardship towards the natural world. This empowerment enables individuals and communities to make informed decisions that support the health of their environment, ultimately leading to improved health outcomes for both the ecosystem and the people who depend on it. Through these combined efforts, there is a significant opportunity to promote a healthier, more sustainable relationship between the park and its neighbouring communities.

7.7.4 Strategic Recommendations for Future Prosperity

To ensure future prosperity for both Kaziranga National Park and its surrounding communities, strategic recommendations focus on policy and management adjustments alongside inclusive community engagement. Advocating for policies and management practices that emphasize sustainable resource utilization is crucial. These policies should aim to minimize conflicts between humans and wildlife, thereby safeguarding the park’s rich biodiversity while also protecting community livelihoods. Effective management practices are essential for balancing the needs of conservation with the socio-economic realities of local populations, ensuring that both the park's natural resources and the communities that depend on them can thrive.

Inclusive community engagement is another critical recommendation. Strategies should be developed to actively involve local communities in the conservation decision-making process. This involves recognizing and valuing the traditional knowledge that these communities hold about their natural environment. By aligning conservation efforts with the needs and insights of local populations, initiatives can be more effective and sustainable. Such engagement ensures that conservation measures do not just protect the park's biodiversity but also contribute positively to the well-being and economic stability of the communities. Together, these strategic recommendations aim to foster a harmonious relationship between conservation efforts and community development, leading to mutual prosperity and a sustainable future.

Future Prospects

The path forward for Kaziranga National Park hinges on effectively addressing these identified challenges while capitalizing on opportunities to enhance the park's contributions to community health and well-being. Success in these endeavours requires a holistic approach that integrates ecological conservation with socio-economic development, ensuring a sustainable coexistence of human and natural systems.

7.8 Policy Recommendations and Future Directions

7.8.1 Integrated Conservation and Health Policies

The intricate linkages between the ecosystem services of Kaziranga National Park (KNP) and the health and well-being of the surrounding communities underscore the need for integrated conservation and health policies. A holistic approach that concurrently addresses environmental conservation and public health objectives can enhance both biodiversity protection and community health outcomes. Policies should be developed to promote sustainable use of natural resources, ensuring that conservation efforts do not inadvertently compromise the health and livelihoods of local populations. Furthermore, health policies should recognize and incorporate the benefits of ecosystem services, such as the provision of medicinal plants and opportunities for physical and mental well-being through recreation.

7.8.2 Community Engagement and Participation

Effective management of KNP's ecosystem services necessitates the active engagement and participation of local communities. Policies should be designed to facilitate meaningful community involvement in conservation efforts, decision-making processes, and the

sustainable management of resources. This can be achieved through the establishment of community advisory boards, participatory resource mapping, and the implementation of community-based monitoring systems. Engaging communities not only harnesses local knowledge and practices that can enhance conservation outcomes but also ensures that policies are culturally sensitive and aligned with local needs and values.

7.8.3 Infrastructure Development and Access to Healthcare

Improving infrastructure and access to healthcare in communities surrounding KNP is critical for maximizing the health benefits associated with the park's ecosystem services. Investments in healthcare facilities, sanitation, and clean water supply can mitigate some of the health risks associated with environmental changes and human-wildlife interactions. Moreover, enhancing road and transportation infrastructure can improve access to healthcare services and facilitate eco-tourism initiatives, contributing to economic development and conservation financing.

7.8.4 Research and Monitoring for Adaptive Management

Ongoing research and monitoring are essential for adaptive management of KNP's ecosystem services and their health implications. This includes ecological research to better understand the dynamics of ecosystem services, epidemiological studies to monitor health outcomes in communities, and social science research to assess the socio-economic impacts of conservation and health interventions. Data from these research efforts should inform policy adjustments and management practices, ensuring they remain effective and responsive to changing environmental conditions and community needs.

7.8.5 Future Directions

Looking forward, it is imperative to adopt a forward-thinking approach that anticipates and responds to emerging challenges such as climate change, increasing pressures from tourism, and the evolving health needs of local communities. Future policies should be flexible and adaptable, capable of adjusting to new scientific insights and shifting socio-economic contexts. Moreover, there is a need for greater collaboration between conservation organizations, health agencies, local governments, and international bodies to leverage resources and expertise in pursuit of integrated health and conservation goals.

In conclusion, Kaziranga National Park presents a unique opportunity to model how integrated approaches to conservation and public health can yield synergistic benefits for biodiversity and human well-being. By implementing the policy recommendations outlined

above and pursuing future directions that emphasize adaptive management, community engagement, and interdisciplinary research, KNP can continue to serve as a beacon for sustainable development and conservation practices worldwide.

7.9 Conclusion

This chapter has explored the vital connections between the ecosystem services of Kaziranga National Park (KNP) and the health and well-being of surrounding communities and visitors. The provisioning services, notably medicinal plants and fisheries, are shown to play a crucial role in the local diet and healthcare, directly impacting physical health. Cultural services, including recreational activities, significantly contribute to mental health and stress reduction. The economic activities driven by the park, such as agriculture and tourism, not only provide economic resilience but also enhance the quality of life for local populations. Despite these benefits, challenges like limited healthcare infrastructure highlight the need for integrated conservation and health strategies.

KNP stands as a testament to the profound impact of ecosystem services on human health and well-being. The park's rich biodiversity provides essential resources for traditional medicine, nutrition, and economic activities. Its natural beauty and recreational opportunities offer a sanctuary for mental rejuvenation and social cohesion. These findings affirm the park's critical role in supporting the physical and mental health of the communities, underscoring the necessity of preserving such natural environments.

The intricate linkages outlined necessitate a holistic approach to conservation and health policy planning. Integrated strategies that address both ecological integrity and human health can ensure the sustainable utilization of KNP's ecosystem services. Engaging local communities in conservation efforts, improving infrastructure and healthcare access, and conducting ongoing research and monitoring are paramount. Such integrated approaches will not only protect the biodiversity of Kaziranga but also enhance the health and well-being of its adjacent communities.

In conclusion, the exploration of Kaziranga National Park's ecosystem services and their linkage to human health and well-being highlights the park's invaluable contributions beyond conservation goals. It emphasizes the need for policies that harmonize environmental preservation with public health objectives. As we move forward, Kaziranga can serve as a model for sustainable conservation practices that embody the essence of coexistence between

humans and nature, promoting a harmonious balance that benefits both biodiversity and community health.

Chapter 8
Conclusions and Recommendations

8.1 Summary of Key Findings

8.1.1 Main Research Findings

The study underscores the critical dependency of local communities around Kaziranga National Park on its diverse natural resources, primarily for their livelihood and healthcare. This dependency particularly highlights the significance of fishing, and the use of wild fruits, vegetables, and medicinal plants, which are integral to both dietary requirements and economic sustenance. Additionally, the park's cultural ecosystem services, encompassing various recreational and cultural activities, significantly contribute to the physical and mental well-being of both visitors and local communities. These activities not only offer leisure and educational benefits but also reinforce cultural identities.

The research also reveals a positive correlation between proximity to the park and improved health outcomes in local communities, although this varies across different socioeconomic groups. The park's allure as a tourist destination brings substantial economic benefits, impacting local livelihoods both directly and indirectly.

The study identifies potential trade-offs between conservation efforts and local resource needs, alongside synergies such as eco-tourism that benefit both conservation and community well-being. Key challenges include unsustainable resource harvesting and human-wildlife conflicts, while opportunities lie in community-based eco-tourism and educational programs that align with conservation goals.

Comparative analysis with other protected areas, like the Nanda Devi Biosphere Reserve, offers broader insights into ecosystem service management and its impact on human health. Finally, the findings advocate for policies that integrate environmental conservation with public health and emphasize sustainable resource management and traditional ecological knowledge.

This summary encapsulates the multifaceted role of Kaziranga National Park in supporting both the ecosystem and the surrounding communities, highlighting the interconnectedness of environmental health and human well-being.

8.1.2 Highlights of the Linkages between Ecosystem Services and Health

The relationship between ecosystem services and health, as revealed in the study of Kaziranga National Park, is multifaceted and significant. The provisioning services of the park, particularly medicinal plants and fisheries have been shown to play an essential role in the physical health of the surrounding communities. Fish from the park, rich in vital nutrients, contribute positively to dietary health, while locally sourced medicinal plants are integral to traditional healthcare practices. Additionally, cultural services like wildlife safaris and participation in local cultural events have a profound impact on mental and emotional well-being, offering stress relief and mental rejuvenation. These activities also reinforce cultural identity and enhance community cohesion. Statistical analysis from the study underscores a strong correlation between access to these ecosystem services and improved health outcomes, highlighting the park's crucial role in public health. This evidence points to the need for integrated conservation and health policies, emphasizing the importance of preserving such natural environments for their comprehensive benefits to human well-being.

In highlighting the linkages between ecosystem services and health from the study on Kaziranga National Park, the following points encapsulate key findings:

1. **Provisioning Services and Health**: The study revealed a vital link between provisioning services, especially medicinal plants and fisheries, and the physical health of local communities. Regular consumption of fish from the park, rich in essential nutrients, showed positive impacts on dietary health. Medicinal plants, deeply embedded in local healthcare practices, played a crucial role in treating various ailments, indicating a direct influence on community health.
2. **Cultural Services and Well-being**: Recreational activities within the park, such as wildlife safaris and participation in local cultural events, significantly contributed to mental and emotional well-being. These activities offered stress relief and mental rejuvenation for visitors, as well as bolstered the cultural identity and community cohesion for local inhabitants.
3. **Statistical Relationships**: The research demonstrated a strong positive correlation between access to the park's ecosystem services and improved health outcomes. This was particularly evident in health surveys and qualitative feedback from local communities, showcasing a clear linkage between the health benefits derived from the park and the availability of its natural resources.

4. **Broader Health Implications**: These findings underscore the importance of ecosystem services in public health, advocating for an integrated approach in conservation and health policy planning. The park's role in fostering both physical and mental health highlights the need for preserving such natural environments for their multifaceted benefits to human well-being.

This section of the chapter clearly delineates how Kaziranga National Park's diverse ecosystem services directly contribute to the health and well-being of surrounding communities and visitors, aligning with and expanding current understanding in this field.

8.1.3 Crucial Data Points

In summarizing the critical data points from this research on Kaziranga National Park, it's evident that certain findings were particularly noteworthy:

- **Health Outcomes Linked to Ecosystem Services**: This study revealed direct correlations between the ecosystem services offered by the park and the health of local communities. For instance, access to medicinal plants and nutrient-rich fish from the park has been linked to improved physical health outcomes. This connection highlights the park's vital role in the local healthcare system.
- **Variations Across Community Groups**: The benefits derived from the park's ecosystem services showed notable variations among different socioeconomic groups. This aspect of the research underscores the importance of considering social equity in environmental conservation strategies.
- **Visitor Experiences and Perceptions**: Insights into how visitors perceive, and experience Kaziranga National Park were also significant. Visitor surveys indicated a high level of satisfaction, with many noting the park's natural beauty and the opportunity for wildlife encounters as key factors enhancing their well-being.

Overall, these data points provide a deeper understanding of the tangible impacts of Kaziranga National Park's ecosystem services on both local communities and visitors, emphasizing the importance of these services in supporting human health and well-being.

8.1.4 Socioeconomic and Cultural Impacts

In summarizing the socioeconomic and cultural impacts of Kaziranga National Park (KNP) on surrounding communities, this research highlights several positive aspects:

1. **Socioeconomic Benefits**: The park's ecosystem services have a substantial impact on the local economy. Communities around KNP benefit from increased tourism, which enhances livelihood opportunities. This positive economic influence is particularly significant for lower socioeconomic groups, who often depend on the park for their livelihood.
2. **Cultural Identity and Practices**: KNP plays a vital role in sustaining and enriching the cultural identity of local communities. Traditional practices, festivals, and rituals, such as Hathi Puja and Karam Puja, are closely linked to the park's natural environment. These cultural elements not only contribute to community cohesion but also foster a sense of belonging and identity, deeply rooted in their natural surroundings.

This part of the research underscores the intertwined nature of ecosystem services with socioeconomic upliftment and cultural enrichment, suggesting that KNP's conservation efforts contribute significantly to both economic and cultural well-being.

8.1.5 Broader Implications

The broader implications of the findings on Kaziranga National Park (KNP) are significant for conservation strategies, public health policies, and sustainable community development. The research suggests a need for conservation policies that are sensitive to the socioeconomic and cultural needs of local communities. This includes promoting sustainable tourism and integrating traditional ecological knowledge into conservation practices. In terms of public health, the study highlights how ecosystem services can significantly contribute to the well-being of communities, underlining the importance of preserving natural habitats for both environmental and health reasons. Furthermore, the findings can guide sustainable community development by emphasizing the need for balancing ecological conservation with the economic and cultural needs of local populations. These implications are vital for shaping holistic and sustainable approaches to managing natural resources like KNP.

8.2 Conclusions

8.2.1 Summary

This research significantly contributes to the existing body of knowledge on ecosystem services, particularly in the context of Kaziranga National Park (KNP). Unique to this study is the comprehensive exploration of the direct and indirect impacts of KNP's ecosystem services on local communities' health and well-being. Unlike previous research, this study delves into

the nuanced socio-economic dynamics, revealing how KNP's biodiversity not only supports ecological sustainability but also underpins the livelihoods and healthcare of adjacent communities. A key finding is the intricate link between environmental conservation and public health outcomes, a perspective not extensively covered in earlier studies. This research, therefore, extends the understanding of the multifaceted role of protected areas like KNP in both environmental conservation and social development.

8.2.2 Environmental Conservation Insights

This study enriches the understanding of the role of protected areas like Kaziranga National Park in biodiversity conservation. Findings indicate that KNP not only serves as a sanctuary for diverse species but also plays a critical role in ecosystem preservation. The park's successful conservation strategies, particularly for flagship species like the one-horned rhinoceros, offer valuable insights for future conservation efforts. This research underscores the essentiality of protected areas in maintaining ecological balance and biodiversity, providing a blueprint for the sustainable management of such ecosystems.

8.2.3 Public Health Implications

This research has unveiled vital connections between ecosystem services provided by Kaziranga National Park and public health. The findings highlight the significant impact of KNP's diverse ecosystem on the physical and mental well-being of the surrounding communities and visitors. The provisioning of medicinal plants and the therapeutic benefits of cultural and recreational activities within the park stand out as key contributors to health. These insights advocate for the integration of natural resource conservation strategies into public health policies, emphasizing the park's role in fostering a healthier society. By revealing how ecosystem services directly influence health outcomes, this study provides a compelling argument for prioritizing ecosystem preservation as a fundamental aspect of public health initiatives.

8.2.4 Impact on Local Communities

The research conducted in and around Kaziranga National Park (KNP) demonstrates profound socio-economic benefits to local communities, underlining the essential role of the park in their livelihoods and cultural practices. This study highlights the direct dependency of these communities on the park's ecosystem services, particularly in terms of provisioning resources like fish and medicinal plants, which are crucial for both sustenance and economic activities.

However, the research also brings to light challenges such as resource sustainability and the need for balancing conservation efforts with local needs. The findings emphasize the importance of implementing policies that ensure equitable access to KNP's resources while maintaining ecological integrity. These policies should ideally support sustainable practices that not only preserve the park's biodiversity but also contribute to the economic resilience and cultural vibrancy of the surrounding communities. The insights from this study suggest a pathway towards creating symbiotic relationships between conservation initiatives and community development, advocating for an integrated approach to manage natural resources in a way that benefits both nature and the people living in its vicinity.

8.2.5 Overall Conclusion

In the conclusion of this study on Role of Provisioning and Cultural Ecosystem Services of Protected Areas in Supporting Human Health, it's pivotal to highlight the interconnectedness of the study areas ecosystem services with human health and well-being. This research underscores the vital role of natural ecosystems in supporting local communities, both from health and socio-economic perspectives. Emphasizing an integrated management approach, the study advocates for harmonizing biodiversity conservation with community needs. This includes recognizing the value of traditional ecological knowledge and ensuring sustainable resource utilization. The findings offer significant insights for policy-making, suggesting that strategies for environmental management should be inclusive, catering to both ecological integrity and human development. By advancing this holistic view, the study contributes to a deeper understanding of the synergy between environmental conservation and human welfare, paving the way for sustainable practices in protected areas like Kaziranga National Park.

8.3 Policy Recommendations

8.3.1 Sustainable Park Management

In the context of Kaziranga National Park, sustainable park management strategies are vital. Recommendations include:

1. **Regulated Resource Harvesting**: Implement guidelines that balance ecological preservation with the livelihood needs of local communities. This involves setting quotas and seasonal limits for resource extraction to prevent overuse.
2. **Participatory Management Practices**: Involve local communities in decision-making processes. This could be facilitated through regular community meetings and inclusion

in park management committees, ensuring their traditional knowledge and needs are integrated into conservation strategies.

3. **Ecosystem Monitoring**: Regularly monitor the health of the ecosystem to adjust management practices in response to ecological changes. This includes tracking wildlife populations, vegetation health, and the impact of human activities.
4. **Integrated Management Plans**: Develop management plans that consider the interconnectedness of different ecosystem services and their impacts on the park's biodiversity and the surrounding communities.

These recommendations aim to ensure that Kaziranga National Park is managed in a way that supports both its rich biodiversity and the well-being of the local communities dependent on its resources.

8.3.2 Enhancing Health Benefits

To amplify the health benefits offered by Kaziranga National Park, it is recommended to:

1. **Develop Eco-Tourism Projects**: Introduce eco-tourism activities that encourage physical engagement, such as guided nature walks, bird watching tours, and educational trails. These activities not only promote physical health but also create a deeper appreciation for the park’s natural beauty.
2. **Medicinal Plant Programs**: Establish programs to study and utilize the medicinal plants within the park. Collaborate with local herbalists and healthcare practitioners to document traditional medicinal knowledge and explore potential healthcare applications.
3. **Wellness and Recreational Facilities**: Create designated wellness areas within the park where visitors can engage in activities like yoga and meditation, taking advantage of the park's serene environment for mental health benefits.

These initiatives aim to maximize the health advantages derived from the park, contributing to the physical and mental well-being of both the local community and visitors.

8.3.3 Mitigating Negative Impacts

To address and mitigate the adverse impacts in Kaziranga National Park, the following strategies are recommended:

1. **Enhanced Waste Management**: Implement robust waste management systems to tackle pollution from tourism activities. This includes establishing more waste disposal points and encouraging eco-friendly practices among visitors.

2. **Buffer Zones Creation**: Develop buffer zones around critical areas of the park. These zones can act as a barrier, reducing the frequency of human-wildlife conflicts and safeguarding both wildlife habitats and local communities.
3. **Eco-Sensitive Tourism Practices**: Promote tourism practices that minimize environmental footprints, such as limiting vehicle access in sensitive zones and encouraging low-impact activities like cycling or walking tours.
4. **Conflict Resolution Mechanisms**: Establish systems for prompt and effective resolution of human-wildlife conflicts, incorporating community input and expertise from conservationists.

These recommendations aim to ensure sustainable tourism that respects the park's ecological balance while minimizing the negative effects on wildlife and local communities.

8.3.4 Community Engagement and Education

In order to foster a deeper connection between Kaziranga National Park and the surrounding communities, it's crucial to implement effective community engagement and education programs. These should focus on:

1. **Conservation Awareness Campaigns**: Develop comprehensive awareness campaigns about the significance of conservation efforts and sustainable practices. This can involve workshops, seminars, and interactive learning experiences for both local communities and tourists.
2. **Inclusive Decision-Making**: Encourage participatory approaches where local communities are actively involved in decision-making processes regarding park management. This will ensure their needs and knowledge are considered and respected.
3. **Educational Programs for Youth**: Establish educational programs in local schools that focus on environmental stewardship and the ecological importance of KNP. This can help instil a conservation ethos from a young age.
4. **Tourist Education Initiatives**: Implement initiatives that educate tourists on responsible behaviours within the park. This could include information sessions upon entry, educational signage throughout the park, and promoting a code of conduct that respects the natural environment.

These recommendations aim to build a culture of mutual respect and care for the park, ensuring the sustainability of both the natural ecosystem and the local communities' way of life.

8.3.5 Data-Driven Decision Making

In the context of Kaziranga National Park, a data-driven approach is paramount for informed decision-making and adaptive management. Recommendations include:

1. **Regular Ecological Monitoring**: Implement ongoing ecological monitoring programs to track the health of ecosystems and populations of key species. This will provide critical data to inform conservation strategies.
2. **Community Feedback Systems**: Establish feedback mechanisms with local communities to gather data on their experiences and perceptions. This can help in tailoring conservation efforts to be more community centric.
3. **Tourism Impact Studies**: Conduct regular studies on the impact of tourism on the park's environment and wildlife. Use this data to adjust tourism policies and practices as needed.
4. **Health Outcome Research**: Partner with public health agencies to research the health outcomes linked to ecosystem services provided by the park. This can guide public health initiatives and strategies.
5. **Climate Change Impact Assessments**: Regular assessments of climate change impacts on KNP's biodiversity can help in developing responsive adaptation strategies.

These recommendations emphasize the importance of evidence-based policies and the need for continuous research to ensure the sustainable management of Kaziranga National Park.

8.3.6 Leveraging Technology for Enhanced Conservation in Kaziranga National Park (Shekhar et al., 2023)

Building on the findings of my research paper "Technology as the Panacea for Monitoring of Protected Areas," this section explores the application of advanced technological solutions to bolster conservation efforts in Kaziranga National Park.

Advanced Monitoring Technologies: The potential of technologies such as artificial intelligence, camera traps, drones, DNA sampling, bioacoustics, and lasers in enhancing wildlife monitoring and ecosystem management in Kaziranga is significant. These tools can provide invaluable data on wildlife populations, movement patterns, and habitat utilization, aiding in more informed and effective conservation strategies.

Combating Illegal Activities: The application of these technologies is critical in curbing illegal activities like poaching and logging. For instance, drones can be used for real-time surveillance to detect and deter poachers, while DNA sampling can assist in tracking illegal wildlife trade networks.

Community Engagement and Technology: Engaging local communities in technology-driven conservation initiatives is essential. Educational programs can be developed to demonstrate the use and benefits of these technologies, fostering a collaborative approach to conservation that includes local stakeholders.

Recommendations:

1. Implement a comprehensive technological framework in Kaziranga, incorporating AI, camera traps, and drones for improved monitoring and management.
2. Develop specialized training programs for park staff and local communities on the use and maintenance of these technologies.
3. Establish a research unit dedicated to the continuous evaluation and integration of emerging technologies in park conservation efforts.
4. Collaborate with technology experts and organizations to adapt and innovate conservation technologies suitable for the unique environment of Kaziranga.

The integration of cutting-edge technologies, as outlined in my research, represents a forward-thinking approach to conservation in Kaziranga National Park. It not only enhances the efficacy of conservation efforts but also ensures the park remains at the forefront of technological advancements in wildlife protection and ecosystem management.

8.4 Recommendations for Future Research

8.4.1 Explore Different Dimensions of Ecosystem Services

Future research should delve into the less-explored supporting and regulating ecosystem services of Kaziranga National Park. These studies could focus on ecological processes such as nutrient cycling, soil formation, and water purification, which are vital for the park's biodiversity and overall ecological health. By broadening the scope of ecosystem services studied, we can gain a more holistic understanding of Kaziranga's environmental significance and its integral role in regional and global ecological systems.

8.4.2 Comparative Studies with Other Protected Areas

Future research should include comparative studies between Kaziranga National Park and other protected areas. This would involve analyzing similarities and differences in ecosystem services, conservation practices, and their impacts on human well-being. Such studies could offer valuable insights into effective conservation strategies and community engagement approaches, helping to identify best practices that could be applied across various ecological contexts. Comparative analysis would also enhance our understanding of diverse ecological systems and their unique contributions to both environmental sustainability and community development.

8.4.3 Longitudinal Impact Studies

Future research should involve longitudinal impact studies in Kaziranga National Park. These studies would track and analyze the long-term effects of ecosystem services on the local biodiversity and communities. By observing changes over extended periods, researchers can gain deeper insights into the sustainability and adaptability of conservation efforts. This approach would also help in understanding the evolving interactions between humans and the natural environment, providing crucial data for future conservation planning and community welfare strategies.

8.4.4 Employing Diverse Research Methodologies

Future research on Kaziranga National Park could benefit significantly from a diverse array of research methodologies. Incorporating both qualitative and quantitative approaches, such as ethnographic studies for cultural insights and remote sensing for ecological monitoring, would provide a more nuanced understanding of the park's ecosystem. These varied methods can capture the complex interactions between the natural environment and human activities, offering comprehensive insights into the park's dynamics and informing more effective conservation strategies.

8.4.5 Climate Change and Ecosystem Services

The impacts of climate change on Kaziranga National Park's ecosystem services present an urgent area for further investigation. Future research should aim to understand how changing climate patterns affect the park's biodiversity, water resources, and the livelihoods of local communities. This research is crucial for developing strategies to adapt to and mitigate the effects of climate change, ensuring the sustainability of the park's ecosystem services. Such

studies could inform park management in implementing climate-resilient conservation practices and policies.

8.4.6 Socio-economic Impact Assessments

Future research should focus on conducting comprehensive socio-economic impact assessments of ecosystem services provided by Kaziranga National Park. This would involve evaluating the economic value of these services to local communities and the broader economy, using methodologies like Cost-based Approaches, Price-based Approaches and Value-based Approaches. Such studies should aim to quantify the economic impacts of conservation strategies and explore how these ecosystem services contribute to the socio-economic resilience and sustainability of local communities. By analysing the economic implications of ecosystem services, this research could guide more effective and equitable policy decisions for the park's management and the welfare of its surrounding communities.

8.5 Study Limitations

8.5.1 Case Study Limitation

This study's focus on Kaziranga National Park, while offering in-depth insights, presents a limitation in terms of generalizability. The unique ecological and socio-economic context of Kaziranga means that the findings may not fully encapsulate the range of ecosystem services and health impacts observable in other protected areas. Future research could benefit from incorporating multiple case studies, encompassing diverse ecological settings and community structures. Such an expansion would enable a broader understanding of how different protected areas contribute to ecosystem services and health outcomes, enhancing the applicability and scope of our findings to varied environmental and social contexts.

8.5.2 Scope of Ecosystem Services

The study's focus on Provisioning and Cultural ecosystem services within Kaziranga National Park represents a notable limitation. By concentrating primarily on these two categories, the research omits a thorough examination of Regulating and Supporting services, which are integral to the park's ecological balance and the well-being of local communities. The inclusion of these additional services in future research could yield a more comprehensive assessment of the park's overall impact on human health. Such an expanded scope would offer a fuller valuation of Kaziranga's ecosystem services, underlining their multifaceted role in enhancing human health and the environment.

8.5.3 Health Parameters Considered

The research's focus on specific health parameters – psychological well-being, disease regulation, social cohesion, aesthetic appreciation, and material acquisition – around Kaziranga National Park, while relevant and feasible for this study, presents a limitation. These parameters offer valuable insights but do not encompass the entire spectrum of health impacts that ecosystem services might exert. Future research expanding upon these dimensions could provide a more detailed and nuanced understanding of how diverse ecosystem services influence a broader range of health outcomes, thus enriching the understanding of the complex interactions between human health and natural environments.

8.5.4 Methodological Constraints

This research faced methodological constraints that are important to acknowledge. Data collection was challenging, particularly in quantifying the nuanced impacts of ecosystem services on human health. Limited by the timeframe of the study, certain in-depth analyses could not be pursued. Moreover, the tools and techniques used, while effective for the scope of this research, might have constrained the depth of data analysis. These methodological challenges highlight the need for future studies to employ a more diverse array of tools and extended timeframes to capture a more comprehensive dataset, enhancing the robustness and generalizability of the findings.

8.5.5 External Influences

This research was subject to external influences that potentially impacted its outcomes. Significantly, the COVID-19 pandemic overlapped with the period of data collection, possibly affecting both the availability and responses of participants. This global health crisis likely influenced community health perceptions and interactions with Kaziranga National Park's ecosystem services. Additionally, the Citizenship Amendment Act protests during the study period may have influenced the socio-political environment, potentially impacting survey responses and access to certain areas. These external factors underscore the complexities of conducting field research in dynamic real-world contexts, highlighting the importance of considering such influences in interpreting the study's findings and its generalizability.

8.6 Closing Remarks

In concluding this thesis on Kaziranga National Park, it is imperative to underscore the profound interconnectedness between natural ecosystems and human well-being. This research not only illuminates the pivotal role of ecosystem services in underpinning public health and sustainable community development but also highlights the urgency of integrated conservation strategies. The insights gleaned from Kaziranga serve as a crucial reminder of the delicate balance needed to safeguard our natural heritage while fostering human prosperity. Ultimately, this study contributes significantly to the discourse on environmental sustainability, advocating for a future where conservation and human development harmoniously coexist. This thesis, therefore, stands as a testament to the intricate and indispensable symbiosis between humanity and the natural world.

References

Adom, D. (2019). The place and voice of local people, culture, and traditions: A catalyst for ecotourism development in rural communities in Ghana. *Scientific African*, *6*, e00184.

Aerts, R., Honnay, O., & Van Nieuwenhuyse, A. (2018). Biodiversity and human health: Mechanisms and evidence of the positive health effects of diversity in nature and green spaces. *British Medical Bulletin, 127*(1), 5–22. https://doi.org/10.1093/bmb/ldy021

Ahmed, M., Umali, G., Chong, C., Rull, M., & Garcia, M. (2007). Valuing recreational and conservation benefits of coral reefs: The case of Bolinao, Philippines. *Ocean and Coastal Management, 50*, 103–118.

Akhter, S., Rana, M. P., & Sohel, M. S. I. (2009). Protected area an efficacy for ecotourism development: A visitors' valuation from Satchari National Park, Bangladesh. *Tigerpaper, XXXVI*(3), 1–7.

Anderson, T and J Bojo. 1992. 'The Economic Value of Forests' *in* Anil Agarwal (edt.), *The Price of Forests,* CSE, New Delhi.

Anielski, M., & Wilson, S. (2009). Counting Canada's natural capital: Assessing the real value of Canada's boreal ecosystems: 2009 Update. Ottawa, Canada: Canadian Boreal Institute.

Archana, G. R. (2019) Traditional herbal remedies for management of female reproductive disorders by tribes of Aryankavu forests of Kollam district, Kerala. ―*Rescue and Restoration of Selected RET Medicinal Plants of Western Ghats"*, 107.

Assessment, M. E. (2005). *Ecosystems and human well-being* (Vol. 5, p. 563). Island Press, Washington, DC.

Astell-Burt, T., Feng, X., & Kolt, G.S. (2014a). Greener neighborhoods, slimmer people? Evidence from 246,920 Australians. *International Journal of Obesity, 38*(1), 156–159.

Astell-Burt, T., Feng, X., & Kolt, G.S. (2014b). Is neighborhood green space associated with a lower risk of type 2 diabetes? Evidence from 267,072 Australians. *Diabetes Care, 37*(1), 197–201.

Austin, M.P., & Cunningham, R.B. (1981). Observational analysis of environmental gradients. *Proceeding Ecological Society of Australia, 11,* 109–119.

Badola, R., & Hussain, S.A. (2003). Valuation of the Bhitarkanika mangrove ecosystem for ecological security and sustainable resource use. Study report. Wildlife Institute of India, Dehra Dun, India.

Badola, R., Hussain, S.A., Mishra, B.K., Konthoujam, B., Thapliyal, S., & Dhakate, P.M. (2010). An assessment of ecosystem services of Corbett Tiger Reserve, India. *The Environmentalist, 30*(4), 320-329.

Bagchi, S., & Mishra, C. (2006). Living with large carnivores: predation on livestock by the snow leopard (Uncia uncia). *Journal of Zoology, 268,* 217–224.

Baidya, S., Thakur, B., & Devi, A. (2020). Ethnomedicinal plants of the sacred groves and their uses by Karbi tribe in Karbi Anglong district of Assam, Northeast India.

Balamurugan, S., Vijayakumar, S., Prabhu, S., & Yabesh, J. M. (2018). Traditional plants used for the treatment of gynaecological disorders in Vedaranyam taluk, South India-An ethnomedicinal survey. *Journal of traditional and complementary medicine*, *8*(2), 308-323.

Barbier, E.B. (1994). Valuing Environmental Functions, Tropical Wetlands. *Land Economics, 70*(2), 155-73.

Baro, D., & Borthakur, S. K. (2017). Climbing Angiosperms of Manas National Park, Assam: Diversity and Ethnobotany. *Bioscience Discovery*, *8*(2), 158-165.

Barton, J., Hine, R., & Pretty, J. (2009). The health benefits of walking in greenspaces of high natural and heritage value. *Journal of Integrative Environmental Sciences*, *6*(4), 261-278.

Barua, M., & Sharma, P. (1999). Birds of Kaziranga national park, India. *Forktail, 47-60.*

Bennett, L.W., Cardone, S., & Jarczyk, J. (1998). Effects of a therapeutic camping program on addiction recovery. The Algonquin Haymarket Relapse Prevention Program. *Journal of Substance Abuse Treatment, 15*(5), 469–474.

Berman, M.G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science, 19*(12), 1207–1212.

Bernstein, A.S. (2014). Biological diversity and human health. *Annual Review of Public Health, 35*, 153–167.

Bharali, A., & Mazumder, R. (2012). Application of Travel Cost Method to Assess the Pricing Policy of Public Parks: The Case of Kaziranga National Park. *Journal of Regional Development and Planning, 1*(1), 44-52.

Bird, W. (2004). Can green space and biodiversity increase levels of physical activity? *Nature Fitness: A Report by the Royal Society for the Protection of Birds*, 94.

Blair, D. (2009). The child in the garden: an evaluative review of the benefits of school gardening. *Journal of Environmental Education, 40*(2), 15–38.

Bodin, M., & Hartig, T. (2003). Does the outdoor environment matter for psychological restoration gained through running? *Psychology of Sport and Exercise, 4*(2), 141–153.

Bolitzer, B., & Netusil, N.R. (2000). The impact of open spaces on property values in Portland, Oregon. *Journal of Environmental Management, 59*(3), 185–193.

Bonds, M.H., Dobson, A.P., & Keenan, D.C. (2012). Disease ecology, biodiversity, and the latitudinal gradient in poverty. *PLoS Biology, 10*(12), e1001456.

Borah, D., Tangjang, S., Das, A. P., Upadhya, A., & Mipun, P. (2020). Assessment of non-timber forest products (NTFPs) in Behali Reserve Forest, Assam, Northeast India. *Ethnobotany Research & Applications*, *19*(43), 1-15.

Bringslimark, T., Hartig, T., & Patil, G.G. (2007). Psychological benefits of indoor plants in workplaces: putting experimental results into context. *HortScience, 42*(3), 581–587.

Britannica, The Editors of Encyclopaedia. "Ayurveda". *Encyclopedia Britannica*, 15 Nov. 2019, https://www.britannica.com/science/Ayurveda. Accessed 26 September 2021.

Capaldi, C. A., Passmore, H. A., Nisbet, E. K., Zelenski, J. M., & Dopko, R. L. (2015). Flourishing in nature: A review of the benefits of connecting with nature and its application as a wellbeing intervention. *International Journal of Wellbeing*, *5*(4).

Catanzaro, C., & Ekanem, E. (2004). Home gardeners value stress reduction and interaction with nature. In D. Relf (Ed.), *Expanding Roles for Horticulture in Improving Human Well-Being and Life Quality* (pp. 269–275).

Champion, H. G., & Seth, S. K. (1968). *A revised survey of the forest types of India*. Manager of Publications.

Chang, C.Y., & Chen, P.K. (2005). Human response to window views and indoor plants in the workplace. *HortScience, 40*(5), 1354–1359.

Chaudhry, P., & Tewari, V. (2006). A comparison between TCM and CVM in assessing the recreational use value of urban forestry. *International Forestry Review, 8*(4), 439–448.

Chivian, E., & Bernstein, A. (Eds.). (2008). *Sustaining Life: How Human Health Depends on Biodiversity.* Oxford University Press.

Cissé, G. (2019). Food-borne and water-borne diseases under climate change in low-and middle-income countries: Further efforts needed for reducing environmental health exposure risks. *Acta tropica*, *194*, 181-188.

Clawson, M. (1959). *Methods of measuring the demand for and value of Outdoor Recreation*. Resources for the Future Reprint, 10.

Clawson, M., & Knetsch, J.L. (1966). *Economics of Outdoor Recreation*. Resources for the Future. Washington D.C.

Coad, L., Campbell, A., Miles, L., & Humphries, K. (2008). The costs and benefits of protected areas for local livelihoods: a review of the current literature. *UNEP World Conservation Monitoring Centre, Cambridge, UK*.

Coley, R.L., Sullivan, W.C., & Kuo, F.E. (1997). Where does community grow? The social context created by nature in urban public housing. *Environment and Behavior, 29*, 468–494. http://dx.doi.org/10.1177/001391659702900402.

Coon, J.T., et al. (2011). Does participating in physical activity in outdoor natural environments have a greater effect on physical and mental well-being than physical activity indoors? A systematic review. *Environmental Science & Technology, 45*, 1761–1772.

Costanza, R., & Folke, C. (1997). Valuing Ecosystem Services with Efficiency, Fairness, and Sustainability as Goals. In G. C. Daily (Ed.), *Nature's Services: Societal Dependence on Natural Ecosystems* (pp. 49–69). Washington D.C., Island Press.

Costanza, R., Cumberland, Daly, J., Goodland, H., & Norgaard, R. (1997a). An introduction to ecological economics. *Florida, U.S.A, International Society for Ecological Economics*.

Costanza, R., D'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature, 387*(6630),253–260. https://www-nature-com.ezproxy.royalroads.ca/articles/387253a0.pdf

Cracknell, D. (2013). The restorative potential of aquarium diversity. *International Association for People-Environment Studies Bulletin, 39*, 18–21.

Curtin, S. (2009). Wildlife tourism: the intangible benefits of human–wildlife encounters. *Current Issues in Tourism, 12*, 451–474.

Daily, G.C., Alexander, S., Ehrlich, P.R., Goulder, L., Lubchenco, J., Matson, P.A., Mooney, H.A., Postel, S., Schneider, S.H., Tilman, D., & Woodwell, G.M. (1997). Ecosystem services, benefits supplied to human societies by natural ecosystems. *Island Press, Washington, D.C.*

David, B., Wolfender, J. L., & Dias, D. A. (2015). The pharmaceutical industry and natural products: historical status and new trends. *Phytochemistry Reviews*, *14*, 299-315.

De Groot, R.S., Wilson, M.A., & Boumans, R.M. (2002). A typology for the classification, description, and valuation of ecosystem functions, goods, and services. *Ecological Economics, 41*(3), 393-408.

de Vries, S., et al. (2003). Natural environments–healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A, 35*, 1717–1731.

Debarry, J., et al. (2007). Acinetobacter lwoffii and Lactococcus lactis strains isolated from farm cowsheds possess strong allergy-protective properties. *Journal of Allergy and Clinical Immunology, 119*(6), 1514–1521.

Depledge, M. H., Stone, R. J., & Bird, W. J. (2011). Can natural and virtual environments be used to promote improved human health and wellbeing?. *Environmental science & technology*, *45*(11), 4660-4665.

Depledge, M.H., & Bird, W.J. (2009). The blue gym: health and wellbeing from our coasts. *Marine Pollution Bulletin, 58*(7), 947–948.

Derne, B.T., et al. (2011). Biodiversity and leptospirosis risk: a case of pathogen regulation? *Medical Hypotheses, 77*(3), 339–344.

Dhaundiyal, R. (1997). Economic assessment of human-forest interrelationships in the forest corridors linking the Rajaji and Corbett National Parks. (Ph.D. Thesis). Jiwaji University, Gwalior, Madhya Pradesh.

Diaz, S., et al. (2006). Biodiversity loss threatens human well-being. *PLoS Biology*, *4*(8), e1300.

Díaz, S., Fargione, J., Chapin, F. S., & Tilman, D. (2006). Biodiversity loss threatens human well-being. *PLoS Biology, 4*(8), e277. https://doi.org/10.1371/journal.pbio.0040277

Driver, B.L., Brown, P.J., & Peterson, G.L. (Eds.). (1991). *Benefits of Leisure.* Venture Publishing.

Dudley, N., Hockings, M., Stolton, S., Amend, T., Badola, R., Bianco, M., Chettri, N., Cook, C., Day, J. C., Dearden, P., Edwards, M., Ferraro, P., Foden, W., Gambino, R., Gaston, K. J., Hayward, N., Hickey, V., Irving, J., Jeffries, B., … Zhang, Y. (2018). Priorities for protected area research. *Parks, 24*(1), 35–50. https://doi.org/10.2305/IUCN.CH.2018.PARKS-24-1ND.en

Dustin, D., Bricker, N., Arave, J., Wall, W., & Wendt, G. (2011). The promise of river running as a therapeutic medium for veterans coping with post-traumatic stress disorder. *Therapeutic Recreation Journal*, *45*(4), 326.

Dutta, M., & Barooah, M. S. (2021). Consumption and Utilisation of Indigenous Herbal Plants among the Sonowal Kachari Tribes of Assam–A Review.

Ege, M.J., et al. (2011). Exposure to environmental microorganisms and childhood asthma. *The New England Journal of Medicine, 364*(8), 701–709.

Ehrlich, P.R., & Ehrlich, A.E. (1992). The value of biodiversity. *Ambio, 21*, 219–226.

English, D.B.K., & Bowker, J.M. (1996). Sensitivity of Whitewater Rafting Consumers' Surplus to Pecuniary Travel Cost Specifications. *Journal of Environmental Management, 47*(1), 79–91.

Ezenwa, V.O., et al. (2006). Avian diversity and West Nile virus: testing associations between biodiversity and infectious disease risk. *Proceedings of the Royal Society B: Biological Sciences, 273*(1582), 109–117.

Fish, R., Church, A., & Winter, M. (2016). Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services*, *21*, 208-217.

Fjeld, T., et al. (1998). The effect of indoor foliage plants on health and discomfort symptoms among office workers. *Indoor and Built Environment, 7*(4), 204–209.

Fletcher, J.J., Adamowicz, W.L., & Graham-Tomasi, T. (1990). The travel cost model of recreation demand: Theoretical and empirical issues. *Leisure Sciences, 12*(1), 119-147.

Forseth, I. (2010) Terrestrial Biomes. *Nature Education Knowledge* 3(10):11

Fortescue Fox, R., & Lloyd, W.B. (1938). Convalescence on the coast. *Lancet, 232*, 37–39.

Fowler, J. F. J. (2008). *Survey research methods* (Applied Social Research Methods Series, No. 1). SAGE Publications, Inc.

Fredrickson, L.M., & Anderson, D.H. (1999). A qualitative exploration of the wilderness experience as a source of spiritual inspiration. *Journal of Environmental Psychology, 19*, 21–39.

Fuller, R.A., et al. (2007). Psychological benefits of greenspace increase with biodiversity. *Biology Letters, 3*(4), 390–394.

Gómez-Baggethun, E., & Barton, D. N. (2013). Classifying and valuing ecosystem services for urban planning. *Ecological economics*, *86*, 235-245.

Guha, I., & Ghosh, S. (2009). *A Glimpse of the Tiger: How much are Indians willing to pay for it?*. SANDEE.

Haahtela, T., et al. (2013). The biodiversity hypothesis and allergic disease: world allergy organization position statement. *World Allergy Organization Journal, 6*(1), 3.

Haines-Young, R., & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. In D.G. Raffaelli & C.L. Frid (Eds.), *Ecosystem Ecology: A New Synthesis* (pp. 110–139). Cambridge University Press.

Han, K. (2009). Influence of limitedly visible leafy indoor plants on the psychology, behavior, and health of students at a junior high school in Taiwan. *Environment and Behavior, 41*, 658–692.

Han, K. (2010). An exploration of relationships among the responses to natural scenes: scenic beauty, preference, and restoration. *Environment and Behavior, 42*, 243–270.

Hanski, I., et al. (2012). Environmental biodiversity, human microbiota, and allergy are interrelated. *Proceedings of the National Academy of Sciences, 109*(21), 8334–8339.

Hansmann, R., Hug, S., & Seeland, K. (2007). Restoration and stress relief through physical activities in forests and parks. *Urban Forestry & Urban Greening, 6*, 213–225.

Harris, L.R., & Brown, G.T.L. (2010). Mixing interview and questionnaire methods: Practical problems in aligning data. *Practical Assessment, Research, and Evaluation, 15*, 1–19.

Hartig, T., & Staats, H. (2006). The need for psychological restoration as a determinant for environmental preferences. *Journal of Environmental Psychology, 26*, 215–226.

Hartig, T., et al. (1996). Environmental influences on psychological restoration. *Scandinavian Journal of Psychology, 37*(4), 378–393.

Hartig, T., et al. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, 23*, 109–123.

Hartig, T., Mang, M., & Evans, G.W. (1991). Restorative effects of natural environment experiences. *Environment and Behavior, 23*, 3–26.

Havlick, D. G., Cerveny, L. K., & Derrien, M. M. (2021). Therapeutic landscapes, outdoor programs for veterans, and public lands. *Social Science & Medicine*, *268*, 113540.

Hein, Lars. (2006). *Environmental Economics Tool Kit: Analysing the Economic Costs of Land Degradation and the Benefits of Sustainable Land Management*. Netherlands: UNDP/GEF.

Hennigan, K. (2010). Therapeutic potential of time in nature: implications for body image in women. *Ecopsychology, 2*(3), 135–140.

Herzog, T.R., et al. (1997). Reflection and attentional recovery as distinctive benefits of restorative environments. *Journal of Environmental Psychology, 17*, 165–170.

Hou, J. (2017). Urban community gardens as multimodal social spaces. *Greening cities: Forms and functions*, 113-130.

Howarth, R. B., & Farber, S. (2002). Accounting for the value of ecosystem services. *Ecological Economics, 41*(3), 421–429. https://doi.org/10.1016/S0921-8009(02)00091-5

Howell, A. J., & Passmore, H. A. (2012). The nature of happiness: Nature affiliation and mental well-being. In *Mental well-being: International contributions to the study of positive mental health* (pp. 231-257). Dordrecht: Springer Netherlands.

Howes, M. J. R., Quave, C. L., Collemare, J., Tatsis, E. C., Twilley, D., Lulekal, E., ... & Nic Lughadha, E. (2020). Molecules from nature: Reconciling biodiversity conservation and global healthcare imperatives for sustainable use of medicinal plants and fungi. *Plants, People, Planet*, *2*(5), 463-481.

Hussain, J., Zhou, K., Akbar, M., Raza, G., Ali, S., Hussain, A., ... & Ghulam, A. (2019). Dependence of rural livelihoods on forest resources in Naltar Valley, a dry temperate mountainous region, Pakistan. *Global Ecology and Conservation*, *20*, e00765.

Hystad, P., et al. (2014). Residential greenness and birth outcomes: evaluating the influence of spatially correlated built-environment factors. *Environmental Health Perspectives, 122*(10), 1095–1102.

Indian Institute of Forest Management (IIFM). (2015). *Economic valuation of tiger reserves in India*. Bhopal, India: IIFM.

Indian Institute of Forest Management. (2017). *Valuation of Ecosystem Services from Tiger & Snow Leopard Landscapes: A manual on economic valuation approaches for practitioners*.

Jaganmohan, M., Vailshery, L. S., Mundoli, S., & Nagendra, H. (2018). Biodiversity in sacred urban spaces of Bengaluru, India. *Urban Forestry & Urban Greening*, *32*, 64- 70.

Jennings, V., Larson, L., & Yun, J. (2016). Advancing sustainability through urban green space: Cultural ecosystem services, equity, and social determinants of health. *International Journal of environmental research and public health*, *13*(2), 196.

Kamitsis, I., & Francis, A.J.P. (2013). Spirituality mediates the relationship between engagement with nature and psychological well-being. *Journal of Environmental Psychology, 36,* 136–143.

Kaplan, R. (1973). Some psychological benefits of gardening. *Environment and Behavior, 5,* 145–162.

Kaplan, R. (1974). Some psychological benefits of an outdoor challenge program. *Environment and Behavior, 6,* 101–116.

Kaplan, R. (2001). The nature of the view from home: psychological benefits. *Environment and Behavior, 33,* 507–542.

Kaplan, R., & Kaplan, S. (1989). *The Experience of Nature: a Psychological Perspective.* Cambridge University Press.

Keesing, F., Holt, R.D., & Ostfeld, R.S. (2006). Effects of species diversity on disease risk. *Ecology Letters, 9*(4), 485–498.

Kellert, S. R., & Wilson, E. O. (Eds.). (1993). *The Biophilia Hypothesis*. Island Press.

Keniger, L. E., Gaston, K. J., Irvine, K. N., & Fuller, R. A. (2013). What are the benefits of interacting with nature? *International Journal of Environmental Research and Public Health, 10*(3), 913–935. https://doi.org/10.3390/ijerph10030913

Kingsley, J., & Townsend, M. (2006). Dig into social capital: community gardens as mechanisms for growing urban social connectedness. *Urban Policy Research, 24,* 525–537.

Kontoleon, A., & Pascual, U. (2007). *Incorporating Biodiversity into Integrated Assessments of Trade Policy in the Agricultural Sector*. Volume II: Reference Manual. Chapter 7. Economics and Trade Branch, United Nations Environment Programme. Geneva. Available at: http://www.unep.ch/etb/pdf/UNEP%20T+B%20Manual.Vol%20II.Draft%20June07.pdf.

Kroeger, T. (2008). Open Space Property Value Premium Analysis. National Council for Science and the Environment. 2006 Wildlife Habitat Policy Research Program. Project Topic 1H: Development of an Operational Benefits Estimation Tool for the US. p. 83.

Kumssa, T., & Bekele, A. (2013). Human-wildlife conflict in Senkele Swayne's hartebeest sanctuary, Ethiopia. *Journal of Experimental Biology and Agricultural Sciences, 1*, 32–38.

Kuo, F.E. (2001). Coping with poverty: impacts of environment and attention in the inner city. *Environment and Behavior, 33*, 5–34.

Kuo, F.E., & Sullivan, W.C. (2001a). Environment and crime in the inner city: does vegetation reduce crime? *Journal of Environmental Behavior, 33*, 343–367.

Kuo, F.E., & Sullivan, W.C. (2001b). Aggression and violence in the inner city: effects of environment via mental fatigue. *Journal of Environmental Behavior, 33*, 543–571.

Kuo, F.E., & Taylor, A.F. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: evidence from a national study. *American Journal of Public Health, 94*(9), 1580–1586.

Kuosmanen, T., Nillesen, E., & Wesseler, J. (2004). Does ignoring multidestination trips in the travel cost method cause a systematic bias? *The Australian Journal of Agricultural and Resource Economics, 48*(4), 629–651.

La Notte, A., D'Amato, D., Mäkinen, H., Paracchini, M. L., Liquete, C., Egoh, B., ... & Crossman, N. D. (2017). Ecosystem services classification: A systems ecology perspective of the cascade framework. *Ecological indicators*, *74*, 392-402.

Lachowycz, K., & Jones, A. P. (2013). Towards a better understanding of the relationship between greenspace and health: Development of a theoretical framework. *Landscape and urban planning*, *118*, 62-69.

Lachowycz, K., & Jones, A.P. (2014). Does walking explain associations between access to greenspace and lower mortality? *Social Science & Medicine, 107*, 9–17.

Laporta, G.Z., et al. (2013). Biodiversity can help prevent malaria outbreaks in tropical forests. *PLoS Neglected Tropical Diseases, 7*, 3.

Lee, J., et al. (2014). Influence of forest therapy on cardiovascular relaxation in young adults. *Evidence-Based Complementary and Alternative Medicine, Article ID: 834360*, 7 pp. http://dx.doi.org/10.1155/2014/843360

Li, Q., et al. (2007). Forest bathing enhances human natural killer activity and expression of anti-cancer proteins. *International Journal of Immunopathology and Pharmacology, 20*(2 Suppl. 2), S3–S8.

Li, Q., et al. (2008a). A forest bathing trip increases human natural killer activity and expression of anti-cancer proteins in female subjects. *Journal of Biological Regulators and Homeostatic Agents*, *22*(1), 45–55.

Li, Q., et al. (2008b). Visiting a forest, but not a city, increases human natural killer activity and expression of anti-cancer proteins. *International Journal of Immunopathology and Pharmacology, 21*(1), 117–127.

Lindemann-Matthies, P., Junge, X., & Matthies, D. (2010). The influence of plant diversity on people's perception and esthetic appreciation of grassland vegetation. *Biological Conservation, 143*, 195–202.

Lottrup, L., Grahn, P., & Stigsdotter, U.K. (2013). Workplace greenery and perceived level of stress: benefits of access to a green outdoor environment at the workplace. *Landscape and Urban Planning, 110*, 5–11.

Lynch, S.V., et al. (2014). Effects of early-life exposure to allergens and bacteria on recurrent wheeze and atopy in urban children. *Journal of Allergy and Clinical Immunology, 134*(3), 593–601.

Maas, J., et al. (2006). Green space, urbanity, and health: how strong is the relation? *Journal of Epidemiology and Community Health, 60*(7), 587–592.

Maas, J., et al. (2009a). Morbidity is related to a green living environment. *Journal of Epidemiology and Community Health, 63*(12), 967–973.

Maas, J., et al. (2009b). Social contacts as a possible mechanism behind the relation between green space and health. *Health & Place, 15*(2), 586–595.

MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change-Human and Policy Dimensions, 23*(5), 992–1000.

MacKerron, G., & Mourato, S. (2013). Happiness is greater in natural environments. *Global Environmental Change-Human and Policy Dimensions, 23*(5), 992–1000.

Maller, C.J. (2009). Promoting children's mental, emotional, and social health through contact with nature: a model. *Health Education, 109*(6), 522–543.

Maller, C.J., et al. (2006). Healthy nature healthy people: 'contact with nature' as an upstream promotion intervention for populations. *Health Promotion International, 21*(1), 45–54.

Maller, C.J., Henderson-Wilson, C., & Townsend, M. (2009). Rediscovering nature in everyday settings: or how to create healthy environments and healthy people. *EcoHealth, 6*(4), 553–556.

Matsuoka, R. (2008). High school landscapes and student performance. *(Ph.D. dissertation)*, University of Michigan, Ann Arbor, p. 121.

Mayer, F.S., & Frantz, C.M. (2004). The connectedness to nature scale: a measure of individuals' feeling in community with nature. *Journal of Environmental Psychology, 24*, 503–515.

McConnell, K.E., & Strand, I. (1981). Measuring the Cost of Time in Recreation Demand Analysis: An Application to Sportfishing. *American Journal of Agricultural Economics, 63*(1), 153–156.

Melichar, J., & Kaprova, K. (2013). Revealing preferences of Prague's home buyers toward greenery amenities: the empirical evidence of distance-size effect. *Landscape and Urban Planning, 109*(1), 56–66.

Mitchell, R., & Popham, F. (2007). Greenspace, urbanity, and health: relationships in England. *Journal of Epidemiology and Community Health, 61*, 681–683.

Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *Lancet, 372*(9650), 1655–1660.

Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *Lancet, 372*, 1655–1660.

Moeltner, K. (2003). Addressing aggregation bias in zonal recreation models. *Journal of Environmental Economics and Management, 45*(1), 128–144.

Moore, E.O. (1982). A prison environment's effect on health care service demands. *Journal of Environmental Systems, 17*(17-3411), 17–34.

Moore, M., Townsend, M., & Oldroyd, J. (2006). Linking human and ecosystem health: the benefits of community involvement in conservation groups. *Ecohealth, 3*(4), 255–261.

Morita, E., et al. (2007). Psychological effects of forest environments on healthy adults: Shinrin-yoku (forest air-bathing, walking) as a possible method of stress reduction. *Public Health, 121*(1), 54–63.

Nisbet, E.K., Zelenski, J.M., & Murphy, S.A. (2009). The nature relatedness scale. *Environment and Behavior, 41*, 715–740.

Nisbet, E.K., Zelenski, J.M., & Murphy, S.A. (2011). Happiness is in our nature: exploring nature relatedness as a contributor to subjective well-being. *Journal of Happiness Studies, 12*, 303–322. (Repeated entry, consider consolidating or removing duplicate).

Ogra, M., & Badola, R. (2008). Compensating human–wildlife conflict in protected area communities: Ground-level perspectives from Uttarakhand, India. *Human Ecology, 36*, 717–729.

Ogra, M.V. (2008). Human–wildlife conflict and gender in protected area borderlands: A case study of costs, perceptions, and vulnerabilities from Uttarakhand (Uttaranchal), India. *Geoforum, 39*, 1408–1422.

Oh, B., Lee, K. J., Zaslawski, C., Yeung, A., Rosenthal, D., Larkey, L., & Back, M. (2017). Health and well-being benefits of spending time in forests: Systematic review. *Environmental health and preventive medicine*, *22*(1), 1-11.

Ohtsuka, Y., Yabunaka, N., & Takayama, S. (1998). Shinrin-yoku (forest-air bathing and walking) effectively decreases blood glucose levels in diabetic patients. *International Journal of Biometeorology, 41*(3), 125–127.

Ostfeld, R.S., & Keesing, F. (2012). Effects of host diversity on infectious disease. *Annual Review of Ecology, Evolution, and Systematics, 43*, 157–182.

Pal, M., Ayele, Y., Hadush, M., Panigrahi, S., & Jadhav, V. J. (2018). Public health hazards due to unsafe drinking water. *Air Water Borne Dis*, *7*(1000138), 2.

Pariva. (2015). *Assessment of provisioning services and the recreational value of Nanda Devi biosphere reserve*. (Doctoral dissertation, Saurashtra University). Retrieved from http://hdl.handle.net/10603/42872

Park, B.J., et al. (2007). Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest)–using salivary cortisol and cerebral activity as indicators. *Journal of Physiological Anthropology, 26*(2), 123–128.

Park, B.-J., et al. (2009). Physiological effects of forest recreation in a young conifer forest in Hinokage Town, Japan. *Silva Fennica, 43*(2), 291–301.

Park, B.-J., et al. (2010). The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. *Environmental Health and Preventive Medicine, 15*, 18–26.

Park, B.-J., et al. (2011). Relationship between psychological responses and physical environments in forest settings. *Landscape and Urban Planning, 102*, 24–32.

Parsons, R., et al. (1998). The view from the road: implications for stress recovery and immunization. *Journal of Environmental Psychology, 18*, 113–139.

Pascual, U., Muradian, R., Brander, L., Gómez-Baggethun, E., Martín-López, B., Verma, M., ... & Turner, R. K. (2012). The economics of valuing ecosystem services and biodiversity. In *The economics of ecosystems and biodiversity: Ecological and economic foundations* (pp. 183-256). Routledge.

Passi, S. J. (2017). Prevention of non-communicable diseases by balanced nutrition: population-specific effective public health approaches in developing countries. *Current Diabetes Reviews*, *13*(5), 461-476.

Pearson, L.J., Tisdell, C., & Lisle, A.T. (2002). The impact of Noosa National Park on surrounding property values: an application of the hedonic price method. *Economic Analysis and Policy, 32*, 155–171.

Pedersen, A. (2002). *Managing tourism at world heritage sites: A practical manual for world heritage site managers* (p. 96). Paris, France.

Pereira, E., Queiroz, C., Pereira, H., & Vicente, L. (2005). Ecosystem services and human well-being: a participatory study in a mountain community in Portugal. *Ecology and Society, 10*(2): 14. [online] URL: http://www.ecologyandsociety.org/vol10/iss2/art14/

Pereira, G., et al. (2013a). The association between neighborhood greenness and weight status: an observational study in Perth Western Australia. *Environmental Health, 12*, 49. http://dx.doi.org/10.1186/1476-069X-12-49.

Petrosillo, I., Zurlini, G., Corliano, M., Zaccarelli, N., & Dadamo, M. (2007). Tourist perception of recreational environment and management in a marine protected area. *Landscape and Urban Planning, 79*(1), 29–37.

Pongsiri, M.J., et al. (2009). Biodiversity loss affects global disease ecology. *Bioscience, 59*(11), 945–954.

Prata, J. C., da Costa, J. P., Lopes, I., Andrady, A. L., Duarte, A. C., & Rocha-Santos, T. (2021). A One Health perspective of the impacts of microplastics on animal, human and environmental health. *Science of the Total Environment*, *777*, 146094.

Pretty, J. (2004). How nature contributes to mental and physical health. *Spiritual Health International, 5*(2), 68–78.

Pretty, J., et al. (2005). The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research, 15*(5), 319–337.

Pretty, J., et al. (2007). Green exercise in the UK countryside: effects on health and psychological well-being and implications for policy and planning. *Journal of Environmental Planning and Management, 50*, 211–231.

Pretty, J.N., et al. (2011). Health Values from Ecosystems, in UK National Ecosystem Assessment: Technical Report, Chapter 23. pp. 1153–1181.

Raj, A. J., Biswakarma, S., Pala, N. A., Shukla, G., Kumar, M., Chakravarty, S., & Bussmann, R. W. (2018). Indigenous uses of ethnomedicinal plants among forest- dependent communities of Northern Bengal, India. *Journal of ethnobiology and ethnomedicine*, *14*(1), 1-28.

Rees, S.E., et al. (2010). The value of marine biodiversity to the leisure and recreation industry and its application to marine spatial planning. *Marine Policy, 34,* 868–875.

Richardson, E.A., & Mitchell, R. (2010). Gender differences in relationships between urban green space and health in the United Kingdom. *Social Science & Medicine, 71*(3), 568–575.

Rigg, R., Find'o, S., Wechselberger, M., Gorman, M.L., Sillero-Zubiri, C., & Macdonald, D.W. (2011). Mitigating carnivore–livestock conflict in Europe: Lessons from Slovakia. *Oryx, 45,* 272–280.

Robinon, M. R. & Zhang, X. (2011). The World Medicine Situation (Traditional Medicines: Global Situation, Issues and Challenges). Geneva. World Health Organization, Geneva, Switzerland.

Rogers, C.S. (2013). Coral reef resilience through biodiversity. *ISRN Oceanography, ArticleID: 739034,* 18 pp. http://dx.doi.org/10.5402/2013/739034.

Romagosa, F., Eagles, P. F. J., & Lemieux, C. J. (2015). From the inside out to the outside in: Exploring the role of parks and protected areas as providers of human health and well-being. *Journal of Outdoor Recreation and Tourism, 10,* 70–77. https://doi.org/10.1016/j.jort.2015.06.009

Rook, G.A. (2010). 99th Dahlem conference on infection, inflammation and chronic inflammatory disorders: Darwinian medicine and the 'hygiene' or 'old friends' hypothesis. *Clinical & Experimental Immunology, 160*(1), 70–79.

Rook, G.A. (2013). Regulation of the immune system by biodiversity from the natural environment: an ecosystem service essential to health. *Proceedings of the National Academy of Sciences, 110*(46), 18360–18367.

Russell, R., Guerry, A. D., Balvanera, P., Gould, R. K., Basurto, X., Chan, K. M., ... & Tam, J. (2013). Humans and nature: how knowing and experiencing nature affect well-being. *Annual review of environment and resources*, *38*, 473-502.

Ryan, R.M., et al. (2010). Vitalizing effects of being outdoors and in nature. *Journal of Environmental Psychology, 30*, 159–168.

Salkeld, D.J., Padgett, K.A., & Jones, J.H. (2013). A meta-analysis suggesting that the relationship between biodiversity and risk of zoonotic pathogen transmission is idiosyncratic. *Ecology Letters, 16*(5), 679–686.

Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem Services, 12*, 1–15. https://doi.org/10.1016/j.ecoser.2014.12.007

Sandifer, P. A., Sutton-Grier, A. E., & Ward, B. P. (2015). Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. *Ecosystem services*, *12*, 1-15.

Sandifer, P.A., Sutton-Grier, A.E., & Ward, B.P. (2014). Connecting stressors, ocean ecosystem services, and human health. *Natural Resources Forum, 38*, 157–167. http://dx.doi.org/10.1111/1477-8947.12047.

Schuhmann, P.W., et al. (2013). Recreational SCUBA divers' willingness to pay for marine biodiversity in Barbados. *Journal of Environmental Management, 121*, 29–36.

Senthilkumar, N. & Murugesan, S. (2012). Bioprospecting the renewable forest resources, an overview. Curr Biotica, 5, 522-540.

Shekhar, S., Badola, R., Pushpanjali, P., & Mishra, A. (2022). The role and benefits of natural resources of Kaziranga National Park in supporting the economic well-being, physical and mental health, and positive perception towards protected area conservation of local communities. *The Indian Economic Journal*, 4, 228-245.

Shekhar, S., Badola, R., & Pushpanjali, P. (2023). Technology as panacea for monitoring of protected areas. *The Indian Forester Journal*, 149(8).

Shin, W.S., et al. (2011). The influence of interaction with forest on cognitive function. *Scandinavian Journal of Forest Research, 26*(6), 595–598.

Shinew, K.J., Glover, T.D., & Parry, D.C. (2004). Leisure spaces as potential sites for interracial interaction: community gardens in urban areas. *Journal of Leisure Research, 36*, 336–355.

Shrestha, R.K., Stein, T.V., & Clark, J. (2007). Valuing nature-based recreation in public natural areas of the Apalachicola River region, Florida. *Journal of Environmental Management, 85*, 977–985.

Silambarasan, R., Sureshkumar, J., Krupa, J., Amalraj, S., & Ayyanar, M. (2017). Traditional herbal medicines practiced by the ethnic people in Sathyamangalam forests of Western Ghats, India. *European Journal of Integrative Medicine*, *16*, 61-72.

Singh, R. S., Ansari, I., Singh, R. K., Singh, S. K., & Debjit, P. A. L. (2017). Ex-situ conservation of medicinal Plants and its therapeutic in mine impacted lands in dry tropical forests of Jharkhand, India. *Eurasian Journal of Forest Science*, *5*(2), 44-69.

Song, C., et al. (2014). Physiological and psychological responses of young males during spring-time walks in urban parks. *Journal of Physiological Anthropology, 33*(1), 8.

Song, J.-M., et al. (2012). The effect of cognitive behavior therapy-based forest therapy program on blood pressure, salivary cortisol level, and quality of life in elderly hypertensive patients. *Clinical and Experimental Hypertension, 34*(1), 1–17.

Southwick Associates. (2011). The Economics Associated with Outdoor Recreation, Natural Resources Conservation and Historic Preservation in the United States. Prepared for the National Fish and Wildlife Foundation. Washington, DC.

Sugiyama, T., et al. (2008). Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships? *Journal of Epidemiology & Community Health, 62*(5), e9.

Suich, H., Howe, C., & Mace, G. (2015). Ecosystem services and poverty alleviation: a review of the empirical links. *Ecosystem Services*, *12*, 137-147.

Sullivan, W.C., Kuo, F.E., & DePooter, S.F. (2004). The fruit of urban nature: vital neighbourhood spaces. *Environment and Behavior, 36,* 678–700.

Swargiary, A., Roy, M. K., & Daimari, M. (2019). Survey and documentation of ethnobotanicals used in the traditional medicines system of tribal communities of Chirang district of Assam against helminthiasis. *Biomedical and Pharmacology Journal*, *12*(4), 1923-1935.

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable greenspaces. *Journal of Epidemiology & Community Health, 56*(12), 913–918.

Tallis, H., Kareiva, P., Marvier, M., & Chang, A. (2008). An ecosystem services framework to support both practical conservation and economic development. *Proceedings of the National Academy of Sciences*, *105*(28), 9457-9464.

Tamang, B., Sarkar, B. C., Pala, N. A., Shukla, G., Patra, P. S., Bhat, J. A., ... & Chakravarty, S. (2019). Uses and ecosystem services of trees outside forest (TOF)-A case study from Uttar Banga Krishi Viswavidyalaya, West Bengal, India. *Acta Ecologica Sinica*, *39*(6), 431-437.

Taylor, A.F., Kuo, F.E. (2006). Is contact with nature important for health child development? State of the evidence. In Spencer, C., & Blades, M. (Eds.), *Children and Their Environments* (pp. 124–140). Cambridge University Press, Cambridge, UK.

Taylor, A.F., Kuo, F.E., & Sullivan, W.C. (2001). Coping with ADD: the surprising connection to green play settings. *Environment and Behavior*, *33*, 54–77.

TEEB (2010). *The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB.*

Ten Wolde, S.J. (1999). *Recreatie en gezondheid: effecten van beweging en natuurbeleving op de gezondheid* [Recreation and health: effects of physical activity and experiencing nature on health], Stichting Recreatie, Kennis-en Innovatiecentrum.

Thompson, C.W., et al. (2012). More green space is linked to less stress in deprived communities: evidence from salivary cortisol patterns. *Landscape and Urban Planning, 105*(3), 221–229.

Tisdell, C., & Wilson, C. (2002). World heritage listing of Australian natural sites: Tourism stimulus and its economic value. *Economic Analysis and Policy*, *32*(2), 27–49.

Tripathi, S. C., & Mall, T. P. (2018). Potent Nutrimental and Ethnomedicinal Horticultural Flora from North Central Terai Forests Of UP, India. *Sustainable Horticulture,* Volume 2*: Food, Health, and Nutrition*, 369.

Tsunetsugu, Y., et al. (2007). Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) in an old-growth broadleaf forest in Yamagata Prefecture, Japan. *Journal of Physiological Anthropology, 26*(2), 135–142.

Tsunetsugu, Y., et al. (2013). Physiological and psychological effects of viewing urban forest landscapes assessed by multiple measurements. *Landscape and Urban Planning, 113*, 90–93.

Tyrvainen, L., et al. (2014). The influence of urban green environments on stress relief measures: a field experiment. *Journal of Environmental Psychology, 38*, 1–9.

Tzoulas, K., et al. (2007). Promoting ecosystem and human health in urban areas using green infrastructure: a literature review. *Landscape and Urban Planning, 81,* 167–178.

Udayakumar, M., Selvan, B., & Sekar, T. (2020). Density, population structure and ethnobotanical uses of a medicinally important vulnerable tree (IUCN) in tropical

forests of Javadhu hills, South India. *Medicinal Plants-International Journal of Phytomedicines and Related Industries*, *12*(2), 290-300.

Ulrich, R.S. (1984). View through a window may influence recovery from surgery. *Science, 224*(4647), 420–421.

Ulrich, R.S., et al. (1991). Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology, 11*, 201–230.

Van Den Berg, A.E., & Custers, M.H. (2011). Gardening promotes neuroendocrine and affective restoration from stress. *Journal of Health Psychology, 16*(1), 3–11.

Vasiljevic, N., & Gavrilovic, S. (2019). Cultural ecosystem services. *Life on Land. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham*, 47-1.

Vasu, N.K. (2003). *Management Plan of Kaziranga National Park (2003-2013)*. Assam: Forest Department.

Vasu, N.K. (2013). Kaziranga Tiger Reserve (KZTR). *Kaziranga Tiger Reserve Tiger Conservation Plan (2013-14 to 2022-23)*.

Verma, M., Edgaonkar, A., Negandhi, D., Khanna, C., Agarwal, R., & Tiwari, C. (2017). *Valuation of Ecosystem Services from Tiger/Snow Leopard Landscapes: A manual on economic valuation approaches for practitioners*. Indian Institute of Forest Management.

Verma, M., Negandhi, D., Khanna, C., Edgaonkar, A., David, A., Kadekodi, G., Costanza, R., & Singh, R. (2015). *Economic valuation of tiger reserves in India: A value+ approach*. Indian Institute of Forest Management.

Villeneuve, P.J., et al. (2012). A cohort study relating urban green space with mortality in Ontario, Canada. *Environmental Research, 115*, 51–58.

Walsh, R. (2011). Lifestyle and mental health. *American Psychologist*, *66*(7), 579.

Ward, F.A., & Loomis, J.B. (1986). The travel cost demand model as an environmental policy assessment tool: A review of literature. *Western Journal of Agricultural Economics, 11*(2), 164-178.

Wassie, S. B. (2020). Natural resource degradation tendencies in Ethiopia: a review. *Environmental systems research*, *9*(1), 1-29.

Wells, N.M. (2000). At home with nature: effects of greenness on children's cognitive functioning. *Environment and Behavior, 32*, 775–795.

Wells, N.M., & Evans, G.W. (2003). Nearby nature: a buffer of life stress among rural children. *Environment and Behavior, 35*, 311–330.

Wells, N.M., et al. (2007). Environment, design and obesity. Opportunities for interdisciplinary collaborative research. *Environment and Behavior, 39*, 6–33.

West, M.J. (1995). Landscape Views and Stress Response in the Prison Environment, Department of Landscape Architecture, University of Washington, Seattle, WA.

Westphal, L.M. (2003). Urban greening and social benefits: a study of empowerment outcomes. *Journal of Arboriculture, 29*, 137–147.

Wheeler, B.W., et al. (2012). Does living by the coast improve health and wellbeing? *Health & Place, 18*(5), 1198–1201.

White, M., et al. (2010). Blue space: the importance of water for preference, affect, and restorativeness ratings of natural and built scenes. *Journal of Environmental Psychology, 30,* 482–493.

White, M.P., et al. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology, 35,* 40–51.

Wilker, E.H., et al. (2014). Green space and mortality following ischemic stroke. *Environmental Research, 133,* 22–28.

Williams, K., Harvey, D. (2001). Transcendent experience in forest environments. *Journal of Environmental Psychology, 21,* 249–260.

Willis, K.G., & Benson, J.F. (1989). Recreational values of forests. *Forestry, 62*(2), 93–110.

Wood, C.L., et al. (2014). Does biodiversity protect humans against infectious disease? *Ecology, 95*(4), 817–832.

Wood, C.L., Lafferty, K.D. (2013). Biodiversity and disease: a synthesis of ecological perspectives on Lyme disease transmission. *Trends in Ecology & Evolution, 28*(4), 239–247.

Wu, C.-D., et al. (2014). Linking student performance in Massachusetts elementary schools with the "greenness" of school surroundings using remote sensing. *PLoS ONE, 9*(10), e108548. http://dx.doi.org/10.1371/journal.pone.0108548.

Wyles, K.J., et al. (2013). Towards a marine mindset: visiting an aquarium can improve attitudes and intentions regarding marine sustainability. *Visitor Studies, 16*(1), 95–110.

Wyles, K.J., Pahl, S., Thompson, R.C. (2014). Perceived risks and benefits of recreational visits to the marine environment: Integrating impacts on the environment and impacts on the visitor. *Ocean & Coastal Management, 88,* 53–63.

Yadav, A., Verma, P. K., Chand, T., & Bora, H. R. (2018). Ethno-medicinal knowledge of Clerodendrum L. among different tribes of Nambor reserve forest, Assam, India. *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 1567-1570.

Yamaguchi, M., Deguchi, M., Miyazaki, Y. (2006). The effects of exercise in forest and urban environments on sympathetic nervous activity of normal young adults. *Journal of International Medical Research, 34*(2), 152–159.

Zameer, M. (2021). Tribal Life and the Environment of Jammu and Kashmir, India. *Asian Journal of Sociological Research*, 10-14.

Zandersen, M., & Tol, R. (2009). A meta-analysis of forest recreation values in Europe. *Journal of Forest Economics, 15*, 109–130.

Zhang, J.W., et al. (2014). An occasion for unselfing: beautiful nature leads to prosociality. *Journal of Environmental Psychology, 37,* 61–72.

Appendix 1: Questionnaire for People Living in the Vicinity of Kaziranga National Park

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective of survey: To assess the role of provisioning and cultural ecosystem services of Kaziranga National Park in supporting human health and well-being.

Date: Village: Distance from forest:

Condition of forest:

1. Name of the respondent-
2. Age-
3. Religion-
4. Caste-
5. Qualification-
6. Occupation-
7. Family Structure- Nuclear/Joint

Name	Age (years)	Sex	Relation with respondent	Education	Employment status	Income

I. QUESTIONS FOR INDIVIDUAL (Local people)

1. Please list the goods or products you extract from the park's surroundings, and specify their usage and quantity.

Forest Product	Y/N	Quantity extracted	Quantity used	Quantity sold	Income
Fuel wood					
Fodder					
Grazing					
Thatching					
Fruits					
Vegetables					
Medicinal plants					
Others					

2. Do you use plants from the national park or its surroundings for medicinal purposes?

   If yes, which plant is used and for treating which disease?

Medicinal plant extracted	Part of plant used	Season of extraction	Against which disease	Form in which consumed

3. Have you / your family member been to doctor for treatment within (1) last one week, (2) last 15 days, (3) last one month, (4) last two months, (5) last three months

Name	Age (yrs)	Visitation rate					Disease	Treatment	Expenditure
		1	2	3	4	5			

4. What is your method of treatment Home or local Vaidh or doctor treatment? Why?
5. Have your children vaccinated? Y/N If no, why? If yes, against which diseases-

a. DPT b. TT c. BCG d. OPV

6. If any case of child mortality-Y/N Age- Sex-Male/Female

Reason- Malnutrition/Lack of vaccination/Lack of antenatal care/Lack of medical help

7. Is there any death in the family during last one year? Y/N

Sex	Age (yrs)	Reason	
		Known	Unknown
Male/ Female		a. Old age b. Ailment c. Lack of treatment d. Suicide e. Accident	

8. Are you aware about HIV/AIDS? Y/N
9. Is there any case of mental illness in the family?
10. Do you think the forest, national park or protected areas have a positive role in maintaining a healthy Environment? Y/N Why?
11. Do you think forest and national park should be protected or conserved? Y/N If yes, why and how

a. It provides resources
b. It supports livelihoods
c. It provides water
d. It provides shelter to animals
e. Aesthetic value

12. What should be done to improve forest near your village?
13. What do you think about the forest (N.P.) near your village?

Forest should be cut and land should be used for agriculture	Yes/ No
Animals should be removed and forest should remain	
Present condition of forest is good and beneficiary so it shouldn't change	
More plantations should be done	

14. How do you perceive the park's impact on your community's well-being?
15. Do you visit local practitioner? What medicines do you take?
16. When did you or any of your family members last visited doctor? Reason.
17. What are the common diseases that generally occurs to you?
18. Do you or any of your family members have diabetes?
19. Do you smoke?
20. Do you have cattle/livestock? Do they suffer from any diseases?
21. Does visiting the national park / forests have a positive effect on your mental health? Y/N How?
22. What health benefits you feel that you get due to the presence of natural forest or protected area?
23. Do you think the pristine and natural environment of the place is due to the protection of forest areas and if the forests are not protected by the government, then it may be destroyed? State reasons.

Appendix 2: Questionnaire for Health Care Practitioners Near Kaziranga National Park

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective of survey: To assess the role of provisioning and cultural ecosystem services of Kaziranga National Park in supporting human health and well-being.

1. **Prevalent Diseases**: What are the most common diseases you treat in this region? Please specify if they vary seasonally.
2. **Seasonal Variations in Illness**: Which seasons experience higher illness rates? Can you attribute this to environmental factors?
3. **Airborne Diseases**: Annually, how many cases of airborne diseases do you encounter?
4. **Waterborne Diseases**: Annually, how many cases of waterborne diseases are reported in your practice?
5. **Respiratory Diseases**: What is the prevalence of respiratory diseases? Among these, how many cases are related to smoking?
6. **Forest Impact on Airborne Diseases**: Do you believe the presence of the forest impacts the incidence of airborne diseases? Please explain your reasons.
7. **Cattle/Livestock Diseases**: What are the common diseases affecting cattle/livestock in this area?
8. **Use of Natural Remedies**: Do you incorporate any natural remedies or medicinal plants from the park in your treatments?
9. **Mental Health**: Have you observed any effects of the park's environment on the mental health of your patients?
10. **Patient Demographics**: Are certain age groups more prone to environmental health conditions in this area?
11. **Awareness of Environmental Health**: How aware are the locals about health benefits or risks associated with the park?
12. **Seasonal Health Changes**: Have you noticed changes in health conditions correlating with different seasons?
13. **Comparative Health Assessment**: Can you compare health issues in communities living near the park with those living farther away?

14. **Perceived Impact of Conservation**: How do you think conservation efforts in the park affect public health?
15. **Observations on Health Trends**: Have you observed any significant changes in health patterns over time that could be linked to environmental changes around the park?
16. **Feedback and Suggestions**: Based on your experience, what recommendations would you give for improving public health in relation to the park's ecosystem?

Thank you for participating in this survey. Your insights are valuable in understanding the intricate connection between ecosystem services and human health in the vicinity of Kaziranga National Park.

Appendix 3: Questionnaire for forest department personnel

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective of survey: To assess the role of provisioning and cultural ecosystem services of Kaziranga national park in supporting human health and well-being.

1. **General Attitude and Participation**:
    a) How do local communities perceive the National Park and the Forest Department?
    b) In what ways do locals participate or assist in conservation activities?
2. **Education and Awareness**:
    a) Does the Forest Department conduct educational programs about environmental benefits of protecting natural areas? Please describe these initiatives.
3. **Resource Use and Regulation**:
    a) What resources are locals allowed to harvest from the park's surroundings?
4. **Tourism Insights**:
    a) What is the annual tourist visitation to the park?
    b) What are the primary benefits (e.g., revenue generation) of tourism in the park?
    c) Which season experiences higher tourist numbers and why?
5. **Tourist Facilities and Trends**:
    a) What lodging arrangements are available for tourists?
    b) Have tourist numbers increased over the years? If so, why?
6. **Conservation and Wildlife Protection**:
    a) What specific wildlife conservation measures are in place in the park?
    b) How many poaching cases have been recorded in the past decade?
7. **Community and Conservation**:
    a) How have conservation efforts impacted local communities?
    b) What are the main challenges in park management and conservation?
8. **Health and Safety**:
    a) What health and safety measures are implemented for staff and tourists?
9. **External Factors Impacting the Park**:

a) How have external factors like climate change or political decisions affected the park?

10. **Feedback and Improvements**:
    a) Is there a system for collecting feedback from locals and tourists about the park?
    b) What future plans or projects are being considered for park enhancement?
11. **Sustainable Practices and Education**:
    a) Are sustainable practices employed in the park that benefit both the environment and locals?
    b) Could you describe any educational programs or awareness campaigns for conservation?

This questionnaire is designed to gather comprehensive insights from Forest Department personnel regarding the interaction between Kaziranga National Park's ecosystem services and human health, as well as the park's management and its impact on the local community and environment.

Appendix 4: Questionnaire for Assam Pollution Control Board Officers

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective of survey: To assess the role of provisioning and cultural ecosystem services of Kaziranga national park in supporting human health and well-being.

1. **Presence of Monitoring Stations**: Are there any established SPCB or CPCB monitoring stations near Kaziranga National Park for assessing air and water quality?
2. **Air Quality Assessment**: Can you provide the current air quality data for areas surrounding Kaziranga National Park? Are these within recommended safety limits?
3. **Air Quality Index (AQI) of Kaziranga**: What is the recorded Air Quality Index for Kaziranga National Park?
4. **Water Quality Analysis**: How would you describe the water quality around Kaziranga National Park?
5. **Ambient Air Quality Details**: Please provide information regarding the ambient air quality recorded in the national park.
6. **Comparison with Urban Air Quality**: How does the air quality of Kaziranga National Park compare to that of urban areas, such as Guwahati?
7. **Air Quality in Guwahati**: What is the status of Guwahati's air quality in terms of pollutant levels and AQI?
8. **Pollution Sources and Management**: What are the primary sources of pollution affecting Kaziranga, and what measures are in place to manage them?
9. **Impact of Seasonal Changes**: Do you observe any significant seasonal changes in air or water quality in the area?
10. **Influence of Tourism on Environmental Quality**: Has tourism in Kaziranga National Park shown any significant impact on local environmental quality?
11. **Environmental Policies and Enforcement**: How do local environmental policies impact the conservation and management of Kaziranga National Park?

This questionnaire aims to gather detailed insights from Assam Pollution Control Board Officers on environmental quality parameters affecting Kaziranga National Park and their implications on ecosystem services and human health.

Appendix 5: Questionnaire for Tourists and Visitors to Kaziranga National Park and Tiger Reserve

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective of Survey: To understand the impact of Kaziranga National Park on human health and well-being from a visitor's perspective, and to gather data using the Zonal Travel Cost Method.

Part A: General Questions

1. **Purpose of Visit**: What motivated your visit to Kaziranga National Park?
2. **Experience of Relaxation**: Do you feel more relaxed or experience mental well-being in the park's natural environment?
3. **Environmental Comparison**: How does the environment here compare to urban areas in terms of noise, air quality, and overall ambiance?
4. **Value of Nature**: What value do you find in spending time in natural settings?
5. **Conservation Perspectives**: Why do you think protecting natural areas is important?
6. **Perceived Health Benefits**: Describe any health benefits you believe you receive from visiting natural environments.
7. **Environmental Health Connection**: Do you think a healthy natural environment contributes to human health? If yes, how?
8. **Changes in Environment**: Have you noticed any changes in the park's environment over time?

Part B: Zonal Travel Cost Method (Tabular Format)

Question	Response Options
1. Home Location (City/Town)	[Text Field]
2. Distance to Kaziranga (in km/miles)	[Numeric Field]
3. Mode of Transportation Used	[Flight, Car, Bus, Train, etc.]
4. Total Travel Cost (including fuel, tickets, etc.)	[Numeric Field]
5. Number of Visits to Kaziranga per Year	[Numeric Field]
6. Duration of Stay (in days)	[Numeric Field]
7. Accommodation Cost per Day	[Numeric Field]

8. Average Daily Expenditure (Food, Activities, etc.)	[Numeric Field]
9. Purpose of Visit (e.g., Recreation, Research)	[Subjective]
10. Willingness to Pay for Conservation Efforts	[Numeric Field]

Instructions for Respondents: Please provide accurate information to the best of your knowledge. This data is crucial for understanding the economic value of the park's ecosystem services and for supporting conservation efforts.

This questionnaire aims to capture both qualitative and quantitative aspects of visitors' experiences and perceptions, as well as gather crucial data for the application of the Zonal Travel Cost Method, which helps in estimating the recreational value of the park.

Appendix 6: Questionnaire For Perceived Health Benefits of People Living in the Vicinity of and Visitors to Kaziranga National Park

"Role of Provisioning and Cultural Ecosystem Services of Protected Area in Supporting Human Health"

Questionnaire

Objective: To assess the role of Kaziranga National Park's ecosystem services in supporting human health and well-being.

Section 1: For Residents

1. **Interaction with the Park**
    1. How often do you visit or use resources from the park? (Daily, Weekly, Monthly, Rarely, Never)
2. **Physical Health Benefits**
    1. Have you noticed any physical health benefits from living near the park? (Yes/No)
    2. If yes, please specify: _____
3. **Mental Health Benefits**
    1. Does living near the park contribute to your mental well-being? (Significantly, Moderately, Slightly, Not at all)
4. **Cultural Services**
    1. How do cultural activities related to the park affect your sense of community? (Positively, Negatively, No impact)
5. **Access to Medicinal Resources**
    1. Do you use medicinal plants or resources from the park? (Frequently, Occasionally, Rarely, Never)

Section 2: For Visitors

1. **Motivation for Visit**

    1. What is your primary reason for visiting the park? (Wildlife watching, Hiking or physical activity, Relaxation or stress relief, Cultural interest, Other: _____)
2. **Perceived Health Benefits**
    1. Do you feel health benefits from your visit? (Yes/No)
    2. If yes, please describe: _____
3. **Nature Interaction**
    1. Which activities do you engage in at the park? (Wildlife watching, Hiking, Photography, Picnicking, Other: _____)
4. **Mental and Emotional Well-being**
    1. How does the park visit affect your mental and emotional health? (Positively, No significant change, Negatively)
5. **Value of Conservation**
    1. How important is conservation of places like Kaziranga for public health? (Extremely important, Somewhat important, Not important)

Instructions: Please select the most appropriate option or provide detailed answers where specified. Your insights are crucial in understanding the health benefits associated with ecosystem services of Kaziranga National Park. Thank you for your participation.

The Role and Benefits of Natural Resources of Kaziranga National Park in Supporting the Economic Well-Being, Physical and Mental Health, and Positive Perception Towards Protected Area Conservation of Local Communities

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Abstract

The current study deals with the (1) perspectives of and (2) benefits to local communities neighbouring the Kaziranga National Park to various aspects of ecosystem services. The study involved interviewing participants to know their perspective on utilities of services provided by the protected area in their daily living, health, psychology, and livelihood. The above-mentioned investigation was carried out between the years 2018 and 2021. It consisted of 749 semi-structured interviews carried out in 21 different villages in the Bokakhat and Kaliabor Circle adjacent to Kaziranga National Park. Every household served as a sampling unit. The villages were chosen based on how likely they were to use non-timber forest products and how dependent they were on the ecosystem services of the forest to support their livelihood. Through group discussions and semi-structured interviews, the eldest members of the household provided most of the information on the use of NTFP extraction and perceptions of the benefits of ecosystem services. The respondent's demographic information was also recorded. Results showed a very positive attitude of locals towards protecting and conserving the protected area for better livelihood, health, and psychological benefits. Based on this study, this paper also discusses the role of Provisioning and Cultural Ecosystem Services of Kaziranga National Park in supporting human health and well-being.

Keywords: *Provisioning services, cultural services, medicinal plants, ethnomedical use,mentalhealth, perception towards*

OVERVIEW

Ecosystem Services (ES) are significant contributors to the health and well-being of human beings. It is broadly categorized as Provisioning Services, Regulating Services, Supporting Services, and Cultural Services (MEA, 2005) with the majority being offered by forest variations. Provisioning services such as NTFPs (food, seeds, fruits, fodders, fuel wood, medicine, natural fibres, etc.) and timbers delivered by the forest act as a resource to local communities to sustain a livelihood, whereas cultural services (such as spiritualism, entertainment, aesthetics, etc) improve the quality of life of the communities. Regulating services supports humans by regulating the key components or processes of the ecosystem such (as carbon sequestration, climate modulation, water cycle, amelioration of infectious diseases, etc.) while forests also provide supporting services that significantly support humans by promoting production and/or maintenance of all other ecosystem services. These are the fundamental processes that support the services and functioning of any ecosystem. Forest ecosystem services (FESs) promote natural ecosystem health and improve the health and well- being of the human population residing in the vicinity.

Although, forests are spread across all terrestrial biomes of the earth, *viz*., Tropical Forest Biomes, Savanna, Desert, Grassland, Temperate Deciduous Forest Biome, Mediterranean Climate Biomes, Northern Coniferous Forest Biome, and Tundra (Forseth, 2010), yet,

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Tropical forests are known to be major contributors of forest ecosystem services (FES), specifically, genetic resources and water cycling (Anderson and Bojo, 1992). Briefly, it may be stated that all four types of ES are vital for the functioning of the ecosystem and maintain the health and well-being of local communities. (MEA, 2005)

Threat to Forests

Besides, forests account for 2/3rd of the gross primary production of the terrestrial biome (MEA, 2005) providing not only oxygen for respiration but various provisions to sustain life on earth. It is alarming that in 2010 the global forest cover was 30% (3.92Gha) of the earth's land mass, with 93% natural forest and only 7% plantation, which depleted by 6.3% between 2002-2020 (FAO, 2010; TEEB, 2010; Hansen et al., 2013; UMWRI, 2021). According to the Sustainability Consortium (SC), from 2001-2020 annually 411Mha of tree cover vanished globally. Commodity-driven deforestation was reported as the dominant driver of global annual tree cover loss in 2001-2019 among others as urbanization, shifting agriculture, and wildfire (SC, 2021). This depleting forest cover in the recent climate change scenario is expected to drastically affect FES and human livelihood and well-being. This is a pressing concern as it is well established that any change in the basics of land (such as forest cover, habitat alterations, water balance, etc) directly affects the capacity of the ecosystems to deliver FES and ecosystem functions (Costanza et al., 1997; Lambin et al., 2001, Balthazar et al., 2015) which would not only impact human wellbeing and health but also the entire biodiversity and production of the landscape. Thus, to maintain the well-being and health of local communities it would be mandatory to conserve forest cover and reduce dominantdrivers causing permanent loss of forest and tree cover, globally.

Protected areas in support of Forest ecosystem services

Protected areas have the potential to support all categories of ecosystem services although provisions of services and functions may vary with different types of ecosystems. Conservation of protected areas directly preserves FES of the landscape as evident from numerous studies globally (Antonio et al., 2015; Manolaki and Vogiatzakis 2017) but entails upgrading traditional conservation approaches. Preserving provisioning and cultural FES to protect the benefits derived for human health and well-being gets complicated, in today's scenario, as the traditional conservation plans were not designed to preserve regulating services (such as pollination, decomposition, disease control, climate regulation, air, and water decontamination, soil erosion, flood control, and carbon storage, etc.) (Kremen and Ostfeld, 2005; Zorrilla-Miras et al., 2014) but rather focused on species and habitat conservation. This also poses a challenge to the integrated conservation of ecosystem services. Additionally, most of the studies conducted worldwide tend to explore individual ecosystem services studied at wide scales (Naidoo et al., 2008; Tang et al., 2011) rather than considering the entire system at lessened spatial resolution. Very few studies have represented spatial-scale ecosystem services as protected areas (Duran et al., 2013). Few studies as one in a semi-arid ecosystem of Spain showed carbon stocking and groundwater recharge to be the most delivered and supported FES of protected areas networks (Antonio et al., 2015). The current study also resonates similarly and enlists the most important FES used by neighbouring communities of Kaziranga National Park. Briefly, the protected area benefits local communities with major livelihood opportunities that support them in sustaining life.

Protected areas control air quality

The average air quality index (AQI) (2021), the protected area had a satisfactory air quality index value of 100 with PM_{10} as the main pollutant and CO of 950.0 μg/m³ (AQI 47) (CPCB, 2021). This is comparatively healthier than cities such as Delhi (AQI 215-500), Kolkata (AQI 100-255), Mumbai (AQI 108-500), etc where forest cover is comparatively low. Besides with the closure of seventy industries in the "non-developmental zone" of the protected area as per the National Green Tribunal (NGT) the air quality and habitat quality are expected to improve with a reduction in pollution from sulphur and untreated effluents discharges (Down to Earth, 2012).

Protected areas in psychological wellbeing

Protected areas preserve and conserve natural habitats with occasional restoration activity that support the recovery of natural habitats and forest succession. This helps maintain the ecological balance by increasing overall forest and tree cover. Human benefits in economy, health, psychology, and various other aspects from these green lungs of nature. However, environmental conditions have been proven to have a differential effect on the attitude of individuals in forested and urban areas (Park et al., 2011). Urban life brings along with loads of stress involving work pressure, pollution, interpersonal relationships, and various other stressors while also limiting people to closed rooms and clumped-up spaces irritating the state of mind, as observed in daily life. All these drives the urge of urban citizens to escape into the wilderness for therapeutic health benefits and relief from anxiety and strain (Knopf, 1983; Ulrich et al., 1991; Kaplan, 1995; Frumkin, 2001; Lee et al., 2011, 2019; Mao et al., 2012; Tsunetsugu et al., 2013; Ochiai et al., 2015; Bang et al., 2017; Velarde et al., 2007; Neff et al., 2018; Song et al., 2018; Yu et al., 2018; Lyu et al., 2019; Kim at al., 2020). Natural environments also provide an improved physiological and emotional environment improving human attitude or mood than urban scapes (Hartig & Staats, 2003; Morita et al., 2006). Chiang et al. (2017) reported a positive response of human psychology to landscape locality and forest density. It has also been reported to improve the work performance of individuals and even on the automatic nervous system of hypersensitive people (Shin, 2007; Song et al., 2015). Even progresses in mental health in psychologically challenged or disturbed patients have also been seen in numerous studies (Poulsen et al., 2016; Bielinis et al., 2020) alongside boosting immunity (Li et al., 2008; Park et al., 2010)) promoting the therapeutic utility of aesthetic profits of natural sites in psychological treatments. Also, Kobayashi et al. (2021) have recently reported an increase in vigour and a reduction in fatigue, depression, dejection, anxiety, tension, and confusion with walking and viewing forests. Summarising, it may be stated that forests or natural habitats have positive psychological assistance to human well-being both in virtual and first-hand experience. Thus, as also evident from the current study, conserved forests or protected areas have a high potential of delivering psychological bonuses or acting therapeutically to the well-being of local communities and people visiting the landscape.

Nature's pharmacy

Forests have traditionally served as reservoirs of herbal medicines globally with 70-95% of the population in developing countries relying on traditional medicines for primary healthcare (Robinson and Zhang, 2011). Herbal medicinal therapy, also known as Ayurveda, has been practiced in India and globally for ages. It is known to have originated in India more than 3000 years back and still remains a commendable healthcare source in the eastern world, specifically in Asia (Britannica,2019). Herbal medicines are widely practiced among Indian ethnic communities (Silambarasan et al., 2017; Singh et al., 2017) even in the modern era of allopathic and advanced medicine. According to Senthilkumar and Murugesan et al. (2012), almost 44% of known species in India are used in traditional medical practices. Manifold approaches in the conservation of medicinal plants and their habitats are also practiced in India (Udayakumar et al., 2020). Research on ethnomedicines in Western Ghats, south India, North-eastern India, and other parts of India has revealed the potential of new drug developments and economic benefits to the livelihood of the local community from natural plant resources (Balamurugan et al., 2018; Raj et al., 2018; Tripathi & Mall, 2018; Silambarasan et al. 2017; Jaganmohan et al., 2018; Archana 2019; Hussain et al., 2019; Tamang et al., 2019; Zameer, 2021). Numerous studies in Assam similarly showcase the rich resource of medicinal plants in the wilderness of the region specifically in the protected areas (Baro et al., 2017; Yadav et al., 2018; Borah et al., 2020). Some of the studies also emphasize on ethnomedical utilization of medicinal plants among indigenous tribes such as Karbi, Sonowal Kachari, etc. (Swargiary et al., 2019; Baidya et al., 2020; Dutta & Barooah, 2021). Briefly, medicinal plant resources of forests in and outside protected areas are significant for the derived medicinal and economic benefits besides contributing to the traditional and cultural integrity of the local communities. It is crucial that biodiversity conservation and management approaches are integrated

with planning for the conservation of FES to carefully maintain the ecosystem functions and services of nature while benefiting human health and wellbeing.

OBJECTIVES OF THIS STUDY

The objective of this paper are to study

NTFPs (Non-Timber Forest Products) and fuelwood derived from the forests andadjoining areas that are of economic benefit to local people.

The attitude and perception of people towards mental health and other benefitsfrom protected areas.

The ethnomedical utility in disease control, health, and well-being of localcommunities.

STUDY AREA

The current study was conducted in Kaziranga National Park and adjoining landscape in the state of Assam in India. It is a UNESCO world heritage site (Bhaumik, 2007) and a major attraction for national park visitors to the region. It is a major conservation site for great one- horned rhinoceroses housing two-thirds of the world population of the species (Dutt, 2018).

Forest ecosystem services of Kaziranga National Park and the adjoining landscape are documented through a few studies focusing on ecosystem goods and services (Hussain at al., 2012; Das & Hussain, 2016; Geethaljani, 2017; Hazarika et al., 2019). Though, as per IIFM- NTCA reports the protected area generated a revenue of INR 9.8 billion (INR 0.95 lakh/hectare) annually with some vital ecosystem services such as wildlife habitat and refugia generating INR 5.73 billion per year and gene-pool protection yielding INR 3.49 billion per year; it has a recreation value of INR 21 million per year, a biological control value of INR 150 million per year and carbon sequestration worth INR 17 million per year. This supports the conservation funding of the park and the economic well-being of its local communities while also contributing to the state's gross domestic demands.

METHOD

Participatory survey

The current study was conducted from 2018 to 2021 with 749 semi-structured interviews conducted in 21 selected villages in Bokakhat and Kaliabor Circle adjoining Kaziranga National Park.

Table 1 List of villages surveyed in Bokakhat Circle with the number of households pervillage

Name of Village	Number of households
Haldibari	27
Kaziranga N.C.	23
Hatikhuli T.E.	39
No. 2 Silidubi	30
No. 1 Silidubi	25
Halowa N.C.	15
No. 1 Kohora	27
No. 2 Kohora	24
Mohpora	25
Halowa Gaon	30

Table 2 List of villages surveyed in Kaliabor Circle with the number of households pervillage

Name of Village	Number of households
Sakmuthi T.E. No. 1	28
Sakmuthi T.E. No. 2	27
Sakmuthi T.E. No. 3	19
Sakmuthi T.E. No. 4	30
Kalangmukh N.C.	24
Hatimura No. 2	25
Seconee T.E. No. 1	27
Seconee T.E. No. 3	36
Seconee T.E. No. 4	25
Bihdubi No.1	24
Bihdubi No.3	29
Dakhin Deopani N.C.	25
Baghmari	24
Malini Grant T.E.	23
Harmoti No. 1	19
Kuthari Na-Basti	17
Rangaloo	29
Hathoukhat	26
Bamunigaon	27

Information and opinion of respondents were collected using a semi-structured questionnaireregarding the objectives mentioned above viz.

NTFPs (Non-Timber Forest Products) and fuelwood derived from the forests andadjoining areas that are of economic benefit to local people.

The attitude and perception of people towards mental health and other benefits from protected areas.

The ethnomedical utility in disease control, health, and well-being of local communities.

Each household was a sampling unit. The villages were selected based on their potential usage of non-timber forest products and dependency on forest ecosystem services in sustaining livelihood. During the survey, 749 households were surveyed with 1-2 respondents per household. Information on NTFP extraction use and perceptions of ecosystem service utilities were mostly collected from the eldest members of the household through group discussions and semi-structured interviews. The demographic data of the respondents were also noted. Suitable statistical tools were used to derive the conclusions.

FINDINGS

Dependency on Forest Ecosystem Services (FES)

The current study focused on the human well-being and health of the local communities of Kaziranga National Park. The study revealed fuel wood, fodder, leaf litter, wood (construction material), medicinal plants, and tourism to be the direct benefits of provisioning and recreational services to locals, provided

by the protected area. Also, indirect services were summarised as water retention, nutrient retention, air purification, prevention of land erosion, wild genetic resource, aesthetics, and spiritual and religious worth. Information gatheredthrough surveys revealed that neighbouring communities' livelihood and finance depended on FESs.

Fuelwood and Non-Timber Forest Products extracted from the forest by neighbouringcommunities of Kaziranga National Park

Fuelwood

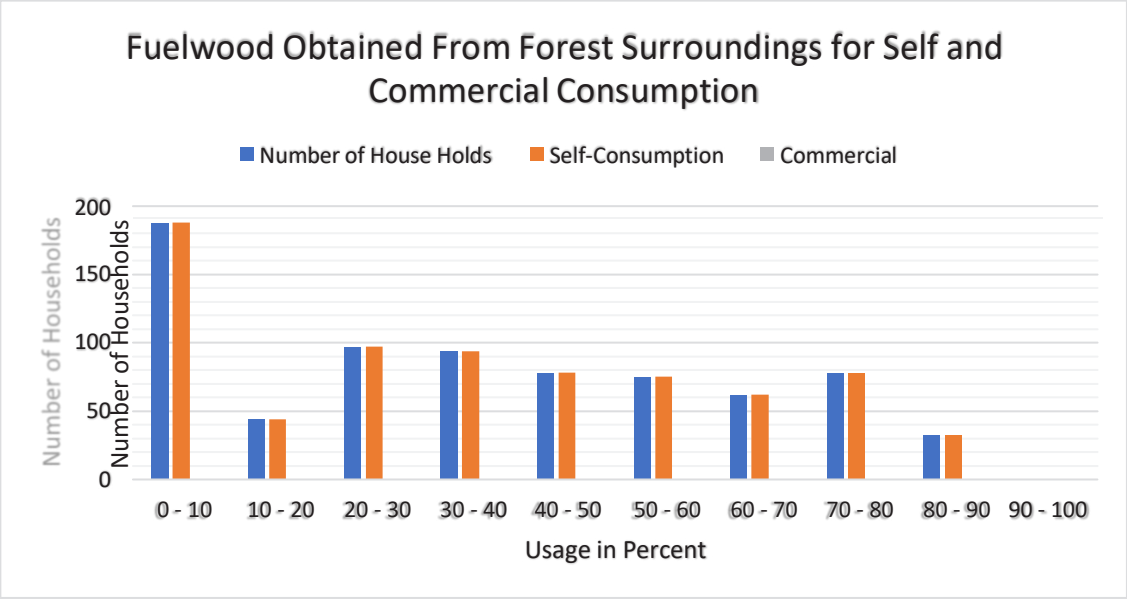

Figure 1 Household-wise fuelwood usage from the surrounding of Kaziranga National Park

Fodder

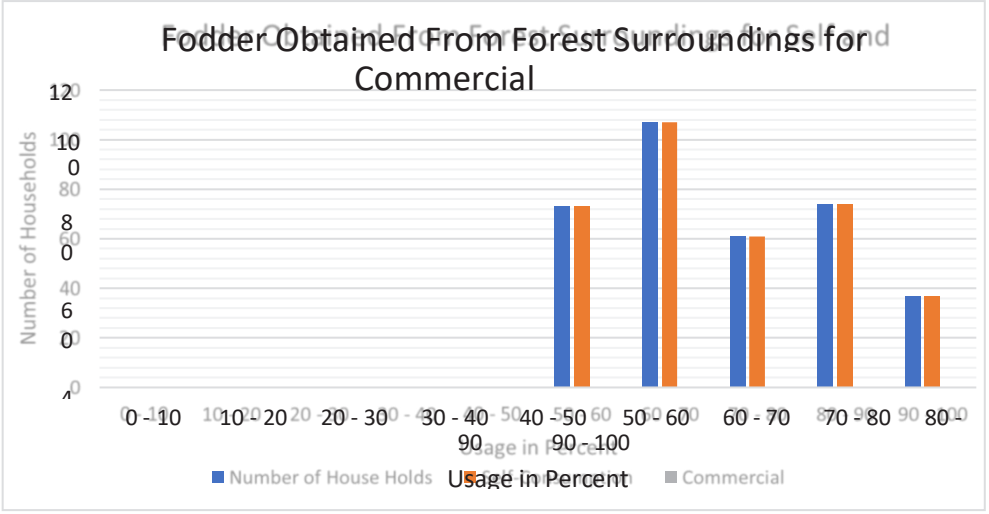

Figure 2 Fodder obtained from the surrounding of Kaziranga National Park

Grazing

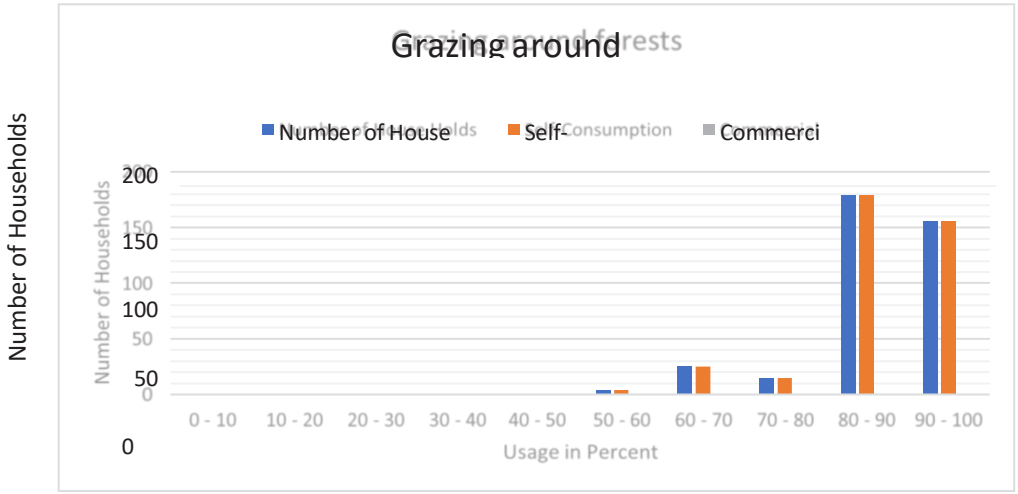

Figure 3 Grazing livestock around Kaziranga National Park

Thatching

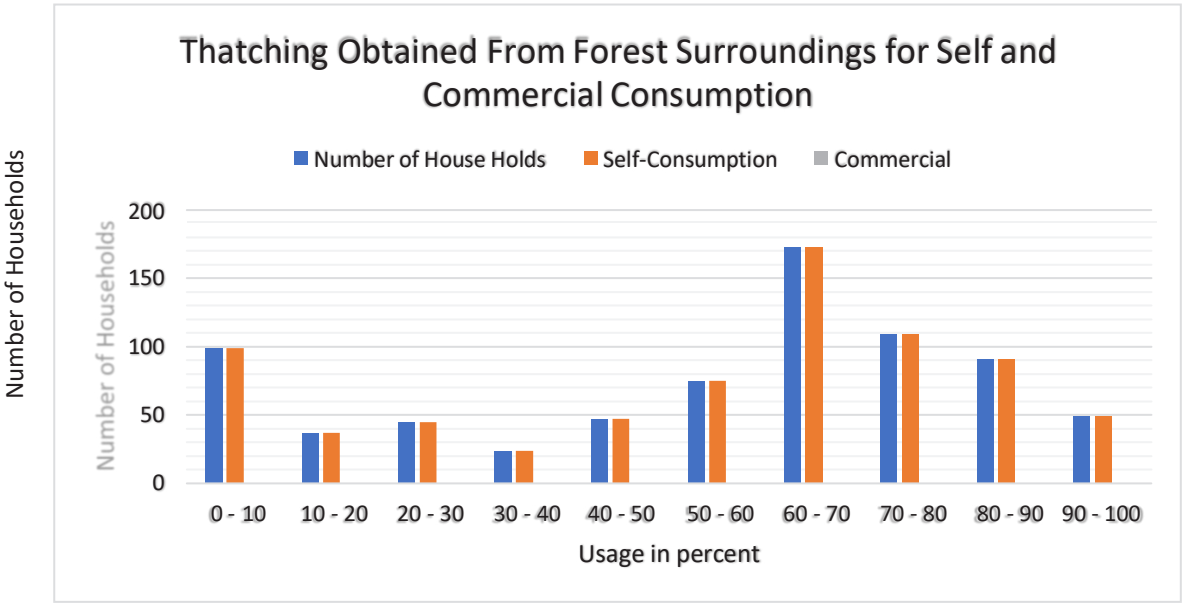

Figure 4 Thatching materials obtained from the surrounding of Kaziranga National Park

Fruits

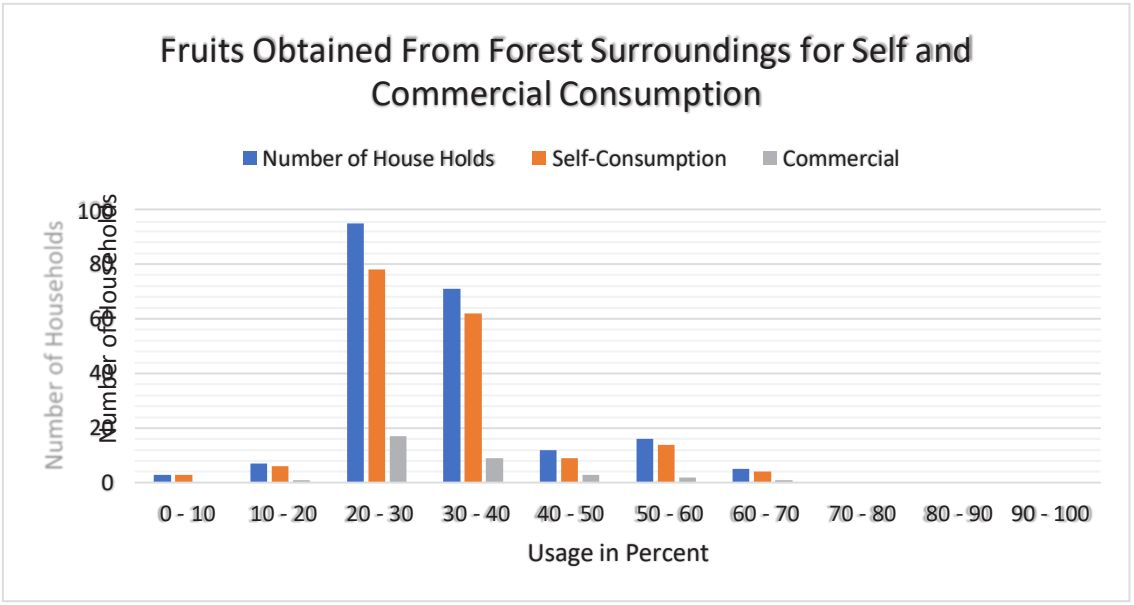

Figure 5 Fruits obtained from the surrounding of Kaziranga National Park

Vegetables

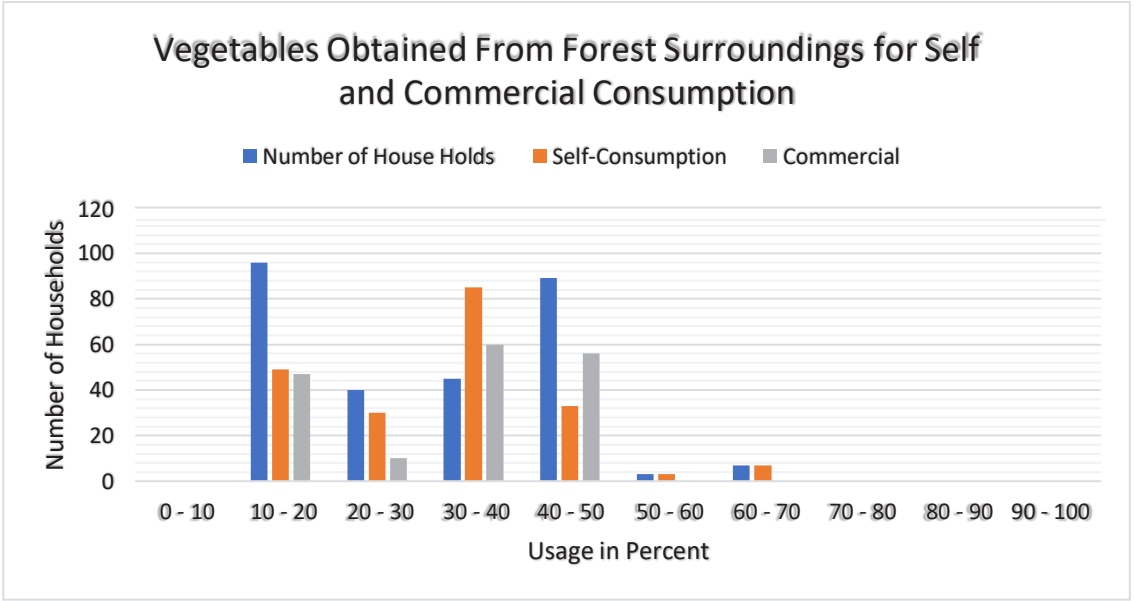

Figure 6 Vegetables obtained from the surrounding of Kaziranga National Park

Medicinal Plants

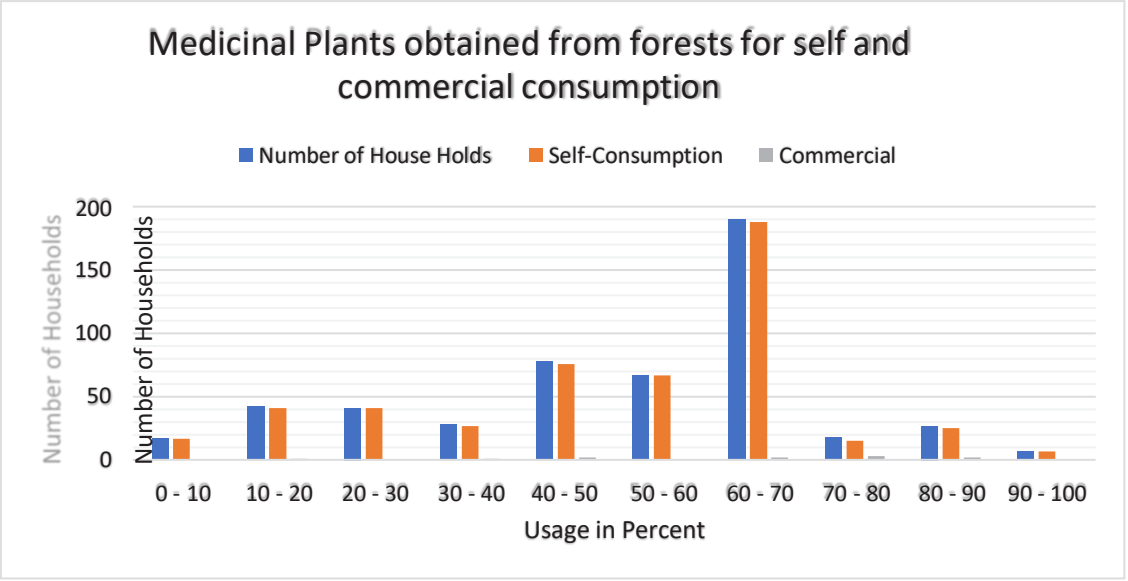

Figure 7 Medicinal plants obtained from the surrounding of Kaziranga National Park

Table 3 Weighted average of the NTFPs used by the neighbouring communities ofKaziranga National Park

Forest Product	**Percent Extracted Per Household (Weighted Average*)**	**Remarks**
Fuelwood	55.27	Used for domestic purposes
Fodder	50.70	
Grazing	66.01	
Thatching	82.13	
Fruits	Self-Consumption-11.32	Used for both domestic and commercial purposes
	Commercial-2.13	
Vegetables	Self-Consumption-13.13	
	Commercial-11.5	
Medicinal plants	Self-Consumption-51.82	In general, not used forfinancial gain
	Commercial- 1.33	

***The weighted average was calculated using the formulae-**

$$Weighted\ average = \square\{frequency * mid\ of\ \%\ range\}/\square\{mid\ of\ \%range\}$$

Table 4 Primary-income-source-wise distribution of households

Source	Number of households generating income (main source)
Agriculture	525
Selling of NTFPs	157
Tourism	143

As seen from the above table 525 out of 749 households i.e., approximately 70% of the households depended primarily on agriculture as their primary source of income.

Local community perception of Mental health benefits of living in the vicinity of Protected Area (Kaziranga National Park)

The local community near the Kaziranga National Park had a very positive attitude and perception toward the protection of the national park and the environment in general. 89% of total respondents agreed to have positive psychological feedback or mood on visiting, viewing, or witnessing the natural environment and greenery of the national park. Only <10% of people had no views or negative views on the same, although, life stage, lifestyle, and livelihood demands may be speculated to be behind such responses. 93% of respondents agreed to have experienced the positive role of forests and natural habitats in maintaining a healthy environment and human well-being. Besides, 91% of the respondents were in favor of the protection and conservation of the natural environment. Most of the respondents felt that living near the vicinity of the park and visiting natural areas had a positive impact on their minds and they benefitted from it.

Table 5 Attitude and perception of people living in the vicinity of Protected Areas towards benefits from Protected Area

Psychological Health Benefits	Number of Households Reporting Positive Benefits	Percentage
Attitude towards the Protection of nature andprotected areas	682	91
The mood on visiting, viewing, or witnessing the natural environment of the national park	667	89
Perception on the positiverole of forests in human well-being	697	93

Ethnomedical utility in disease control, health, and wellbeing

20% of total NTFPs extracted from forests per household were plants of medical value used for treating general and daily ailments such as dysentery, diarrhoea, pain, cramps, open wounds, inflammations, sprains, cough-cold, asthma, fatigue, blood pressure, diabetes, mild skin conditions, microbial or fungal infections, etc. Respondents used medicinal plants for daily mild to chronic ailments. Some of the frequently used medicinal plants and their common use in the daily life of the respondents are mentioned in **Table 6**. Ethnomedical use of wild herbs and plants was reported to be very common among the respondent households although they resorted to modern medicine as applicable and affordable. Respondents, in general, used more than 90% of medicinal plants extracted from forests for maintaining personal health and well-being.

Table 6 List of Medicinal Plants extracted from forests and adjoining areas with reportedutility

Local Name	**Scientific Name**	**Medicinal utility (as reported by the local residents)**
Mani Muni (Indian Pennywort)	*Centella asiatica*	Gastrointestinal disorders, relieve menstrualpain. memoryenhancement, anti-convulsant, anti- depressant, wound healing, anti- bacterial activity
Neem	*Azadirachta indica*	Immune-modulatory, anti-inflammatory, antihyperglycemic, antifungal, antibacterial, antiviral
Tulsi (Basil)	*Ocimum tenuiflorum*	Fever, cough-cold, skin disease,insect bites, respiratory problems,indigestion, ear infection, Immune-modulatory
Pudina (Mint)	*Mentha spicata*	Stomach pain, acidity, flatuation
Dupor bon tenga (Goethe plant)	*Bryophyllum pinnatum*	Kidney stones treatment, earache,burns, abscesses, ulcers, piles,diarrhoea, Lithiasis, insect bites, killing head lice, gastric ulcers, urinary issues, cholesterol
Doron bon	*Leucas aspera*	Snakebite, common cold, intestinal worm infection, asthama, malaria,Sinusitis, pharyngitis, decay of tooth, loss of appetite, headache, body ache,
		influenza
Jilmil saak (White goosefoot)	*Chenopodium album*	Supplements for Protein, Vitamin A, Calcium, Phosphorus, Potassium, blood iron; constipation, arthritis, rheumatism, enlargement of the spleen and bile related diseases
Brahmi saak	*Bacopa Monnieri*	Improve cognition, reduces depression-anxiety
Tengesi tenga	*Tengesi tenga*	Vitamin C supplement, insect bites, lower back pain, urinary tract infections, high blood pressure, diabetes, dysentery, fever, headache and loss of appetite
Musondori saak	*Hottuynia cordata*	Gastrointestinal problems, strengthens muscles

Mati Kanduri	*Alternanthera sessilis*	Diuretic, laxative, improves lactation, skin problems, night blindness
Bhedailota (Stink vine)	*Paederia foetida*	Gastrointestinal problems,rheumatism pain, infertility, paralysis, urinary bladder stones, urinary retention
Narasingha (CurryLeaves)		Vitamin A, B, C, B2, Calcium, iron supplement; dysentery, diarrhoea, diabetes, morning sickness,
		queasiness, boost digestion, bloodcirculation
Bhatou Phul	*Vanda coerulea*	Glaucoma, cataract
Red Vanda	*Renanthera imschootiana*	Gonorrhoea, optical sore
Chota chand	*Rauvolfia serpentina*	Anxiety, sedation
Agarwood	*Aquilaria mallaccensis*	Snake bite, diarrhoea, constipation, astringent
Usipak	*Hibiscus manihot*	Tuberculosis, diabetes
Talishpatra	*Abies spectabilis*	Asthma, bronchitis
Bon Khopa	*Abroma augusta*	Headache, diabetes
Pera-petari	*Abutilon indicum*	Diuretic,anti-inflammatory, astringent
Mukuta-manjari	*Acalypha indica*	Burns, scabies, syphilis, centipede bites
Hati-huria	*Achyranthes aspera*	Dysentery, piles ulcer,
Bos	*Acorus calmus*	Chronic diarrhoea, dysentery

DISCUSSION

It was found that 55.27% of fuelwood per household was extracted from the vicinity ofthe protected area.

It was noted that 50.70% of the fodder requirement of every household was fulfilled bythe protected area.

66.01% of the grazing requirement per household's livestock was fulfilled by theprotected area.

82.13% of the thatching requirement per household was met by the protected area.

For self-consumption 11.32% of households relied on forests for fruits, while 2.13% ofhouseholds sell fruits derived from the vicinity of forests.

13.13% of households depended on the protected area for vegetables for self- consumption, while 11.5% of households sold the vegetables for commercial gains.

51.82% of households used medicinal plants from the vicinity of the protected area for treating their own ailments, while 1.33% of households sold it for commercial gains. Medicinal plants extracted from the adjoining areas of the Kaziranga National Park were found to be used for treating a number of ailments such as anti-depressant, anti- inflammatory, fever, stomach pain, earache, snake bites, vitamin and mineral supplements, high blood pressure, etc.

It was found that 525 or approximately 70% of household income was dependent on agriculture, 157, or approximately 21% of household income was dependent on the selling of NTFPs (Non-Timber Forest Products), and 143, or approximately 19% of household's income was dependent on tourism from

Kaziranga National Park.

91% of the household had a positive attitude towards the protection of nature and natural resources. 89% of the household reported having positive effects on their mood after visiting, viewing, or witnessing the natural environment of the National Park. Around 93% of the household held a positive perception of the role of forests in humanwell-being.

CONCLUSION

The people living around The Kaziranga National Park were enjoying the Provisioning and Cultural ecosystem services provided by the Protected Area.

The Provisioning services that the people obtained from the surrounding of Kaziranga National Park were fuelwood, fodder, grazing, thatching, fruits vegetables, and medicinal plants.

The Provisioning Ecosystem Services also helped the people generate income. 21% of household income was dependent on the selling of Non-Timber Forest Products. 19% of household income was found to be dependent on the tourism of Kaziranga National Park. 70% of households' income was dependent on agriculture, fishing, poultry farming, etc.

The study showed that locals were particularly aware of and dependent on wild bees for honey, bee wax, and agricultural pollination. Also, awareness of their dependency on rain for agriculture and water source was also very evident through the surveys. Locals were reliant on wild plants for aesthetic, medicinal, and nutritional values, although, the use of modern medicines is as well in practice. Based on user reports, on average, households of respondents were mostly dependent on forests for medicinal plants, fuelwood, fodder, thatching, and grazing of livestock

The Cultural Ecosystem Services of the protected area provided positive psychological well-being to the people.

The Provisioning and Cultural ecosystem services of Kaziranga National Park were found to have a positive role in supporting human health and well-being.

References

Bhaumik, Subir (17 April 2007). "Assam rhino poaching 'spirals'". BBC News. Archived from the original on 22 November 2008. Retrieved 10th September 2021.

Dutt, Anonna (30 March 2018). "Kaziranga National Park's rhino population rises by 12 in 3 years". *Hindustan Times*. Retrieved on 20th August 2021.

IIFM-NTCA reports 2015. https://web.archive.org/web/20160826050803

/http://www.iifm.ac.in/sites/default/files/Newspdf/IIFM-NTCA-REPORT.compressed- min.pdf Retrieved form original on10th September 2021.

Das, D., & Hussain, I. (2016). Does ecotourism affect economic welfare? Evidence from Kaziranga National Park, India. *Journal of Ecotourism*, *15*(3), 241-260.

Hazarika, A. K., & Kalita, U. (2019). Conservation and Livelihood Conflict of Kaziranga National Park: A World Heritage Site of Assam, India. *Space and Culture, India*, *7*(3), 224-232.

Hussain, S. A., Barthwal, S. C., Badola, R., Rahman, S. M. T., Rastogi, A., Tuboi, C., & Bhardwaj, A. K. (2012). An analysis of livelihood linkages of tourism in Kaziranga National Park, a natural world heritage site in India. *Parks*, *18*(2), 32-43.

Geethanjali, M. (2017). Ecosystem Goods and Services Provided by'Beels' in Kaziranga. *Indian*

Forester, *143*(12), 1249-1254.

Anderson, T and J Bojo. 1992. 'The Economic Value of Forests' *in* Anil Agarwal (edt.), *The Price of Forests,* CSE, New Delhi.

Archana, G. R. (2019) Traditional herbal remedies for management of female reproductive disorders by tribes of Aryankavu forests of Kollam district, Kerala. "*Rescue and Restoration of Selected RET Medicinal Plants of Western Ghats"*,107.

Baidya, S., Thakur, B., & Devi, A. (2020). Ethnomedicinal plants of the sacred groves and their uses by Karbi tribe in Karbi Anglong district of Assam, Northeast India.

Balamurugan, S., Vijayakumar, S., Prabhu, S., & Yabesh, J. M. (2018). Traditional plants used for the treatment of gynaecological disorders in Vedaranyam taluk, South India-An ethnomedicinal survey. *Journal of traditional and complementary medicine*, *8*(2), 308-323.

Balthazar, Vincent; Vanacker, Veerle; Molina, Armando; Lambin, Eric F. (2015). *Impacts of forest cover change on ecosystem services in high Andean mountains. Ecological Indicators, 48(), 63–75.* doi:10.1016/j.ecolind.2014.07.043

Bang, K. S., Lee, I., Kim, S., Lim, C. S., Joh, H. K., Park, B. J., & Song, M. K. (2017). The effects of a campus forest-walking program on undergraduate and graduate students' physical and psychological health. *International journal of environmental research and public health*, *14*(7), 728.

Baro, D., & Borthakur, S. K. (2017). Climbing Angiosperms of Manas National Park, Assam: Diversity and Ethnobotany. *Bioscience Discovery*, *8*(2), 158-165.

Borah, D., Tangjang, S., Das, A. P., Upadhya, A., & Mipun, P. (2020). Assessment of non-timber forest products (NTFPs) in Behali Reserve Forest, Assam, Northeast India. *Ethnobotany Research & Applications*, *19*(43), 1-15.

Britannica, The Editors of Encyclopaedia. "Ayurveda". *Encyclopedia Britannica*, 15 Nov. 2019, https://www.britannica.com/science/Ayurveda. Accessed 26 September 2021.

Castro, A. J., Martín-López, B., López, E., Plieninger, T., Alcaraz-Segura, D., Vaughn,

C. C., & Cabello, J. (2015). Do protected areas networks ensure the supply of ecosystem services? Spatial patterns of two nature reserve systems in semi-arid Spain. *Applied Geography*, *60*, 1-9.

Chiang, Y. C., Li, D., & Jane, H. A. (2017). Wild or tended nature? The effects of landscape location and vegetation density on physiological and psychological responses. *Landscape and Urban Planning*, *167*, 72-83.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R., Sutton, P., van den Belt, M. (1997) The value of the world's ecosystem services and natural capital. Nature 387, 253–260.

Downtoearth (2012) https://www.downtoearth.org.in/news/polluting-units-shut-in-kaziranga-39094).

Dura´n AP, Casalegno S, Marquet PA, Gaston KJ (2013) Representation of Ecosystem Services by Terrestrial Protected Areas: Chile as a Case Study. PLoS ONE 8(12): e82643. doi:10.1371/journal.pone.0082643

Dutta, M., & Barooah, M. S. Consumption and Utilisation of Indigenous Herbal Plants among the Sonowal Kachari Tribes of Assam–A Review.

E. Bielinis, A. Jaroszewska, A. Łukowski, N. Takayama (2020) The effects of a forest therapy

programme on mental hospital patients with affective and psychotic disorders. Int. *J. Environ. Res. Public Health*, 17 (1), p. 118

EEB. 2010. *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*, London and Washington: Earthscan.

FAO. 2010. Global Forest Resources Assessment-2010, Forestry Paper 163, FAO, Rome.

Forseth, I. (2010) Terrestrial Biomes. *Nature Education Knowledge* 3(10):11

Frumkin, H. (2001). Beyond toxicity human health and the natural environment. American Journal of Preventive Medicine, 20(3), 234–240. doi:10.1016/S0749- 3797(00)00317-2

Gogoi, S. (2020). ETHNOMEDICINAL PRACTICES AMONG THE LOCAL COMMUNITIES IN DIBRUGARH DISTRICT OF ASSAM. *Journal Of Natural Remedies*, *21*(8), 65-68.

H.J. Lee, Y.H. Son, S. Kim, D.K. Lee (2019) Healing experiences of middle-aged women through an urban forest therapy program. *Urban For. Urban Gree.*, 38 (2019), pp. 383-391

H.J. Lee, Y.H. Son, S. Kim, D.K. Lee (2019) Healing experiences of middle-aged women through an urban forest therapy program. *Urban For. Urban Gree.*, 38 (2019), pp. 383-391.

Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. "High-Resolution Global Maps of 21st-Century Forest Cover Change." Science 342 (15 November): 850–53. Data available on-line from: http://earthenginepartners.appspot.com/science-2013-global-forest.

Hartig, T., & Staats, H. (2003). Restorative environments. Journal of Environmental Psychology, 23(2), 103–107. doi:10.1016/S0272-4944(02)00108-1 [special issue]

Hussain, J., Zhou, K., Akbar, M., Raza, G., Ali, S., Hussain, A., ... & Ghulam, A. (2019). Dependence of rural livelihoods on forest resources in Naltar Valley, a dry temperate mountainous region, Pakistan. *Global Ecology and Conservation*, *20*, e00765.

Jaganmohan, M., Vailshery, L. S., Mundoli, S., & Nagendra, H. (2018). Biodiversity insacred urban spaces of Bengaluru, India. *Urban Forestry & Urban Greening*, *32*, 64- 70.

Kaplan, S. (1995). The restorative benefits of nature. Journal of Environmental Psychology, 15(3), 169–182. doi:10.1016/0272-4944(95)90001-2

Kim, J. G., Khil, T. G., Lim, Y., Park, K., Shin, M., & Shin, W. S. (2020). The psychological effects of a campus forest therapy program. *International journal of environmental research and public health*, *17*(10), 3409.

Knopf, R. C. (1983). Recreational needs and behavior in natural settings. In I. Altman, & J. F. Wohlwill (Eds.), Behavior and the natural environments (pp. 205–240). New York: Plenum.

Kobayashi, H., Ikei, H., Song, C., Kagawa, T., & Miyazaki, Y. (2021). Comparing the impact of forest walking and forest viewing on psychological states. *Urban Forestry &Urban Greening*, *57*, 126920.

Kremen, C., & Ostfeld, R. S. (2005). A call to ecologists: measuring, analyzing, and managing ecosystem services. *Frontiers in Ecology and the Environment*, *3*(10), 540- 548.

Lambin, E.F., Turner, B.L., Geist, H., Agbola, S., Angelsen, A., Bruce, J.W., Coomes, O., Dirzo, R., Fischer, G., Folke, C., George, P.S., Homewood, K., Imbernon, J., Leemans, R., Li, X., Moran, E.F., Mortimore, M., Ramakrishnan, P.S., Richards, J.F., Skånes, H., Steffen, W., Stone, G.D., Svedin, U.,

Veldkamp, T., Vogel, C., Xu, J., 2001. The causes of land-use and -cover change: moving beyond the myths. Glob. Environ. Change 11, 261–269.

Lee, J., Park, B. J., Tsunetsugu, Y., Ohira, T., Kagawa, T., & Miyazaki, Y. (2011). Effect of forest bathing on physiological and psychological responses in young Japanese male subjects. *Public health*, *125*(2), 93-100.

Lyu, B., Zeng, C., Deng, S., Liu, S., Jiang, M., Li, N., ... & Chen, Q. (2019). Bamboo forest therapy contributes to the regulation of psychological responses. *Journal ofForest Research*, *24*(1), 61-70.

Manolaki, P., & Vogiatzakis, I. N. (2017). Ecosystem services in a peri-urban protected area in Cyprus: a rapid appraisal. *Nature Conservation*, *22*, 129.

Mao, G. X., Lan, X. G., Cao, Y. B., Chen, Z. M., He, Z. H., Lv, Y. D., ... & Jing, Y. A.

N. (2012). Effects of short-term forest bathing on human health in a broad-leaved evergreen forest in Zhejiang Province, China. *Biomedical and Environmental Sciences*, *25*(3), 317-324.

MEA (Millennium Ecosystem Assessment). 2003. *Ecosystems and Human Well- Being: A Framework for Assessment,* Island Press, Washington, DC

Morita, E., Fukuda, S., Nagano, J., Hamajima, N., Yamamoto, H., Iwai, Y., et al. (2006). Psychological effects of forest environments on healthy adults: Shinrin-yoku (forest-air bathing, walking) as a possible method of stress reduction. Public Health, 121(1), 54–63. doi:10.1016/j.puhe.2006.05.024

Naidoo R, Balmford A, Costanza R, Fisher B, Green RE, et al. (2008) Global mapping of ecosystem services and conservation priorities. Proceedings of the National Academy of Sciences of the United States of America 105: 9495–9500.

Neff, K. D., Long, P., Knox, M. C., Davidson, O., Kuchar, A., Costigan, A., ... & Breines, J. G. (2018). The forest and the trees: Examining the association of self- compassion and its positive and negative components with psychological functioning. *Self and Identity*, *17*(6), 627-645.

Ochiai, H., Ikei, H., Song, C., Kobayashi, M., Miura, T., Kagawa, T., ... & Miyazaki,

Y. (2015). Physiological and psychological effects of a forest therapy program on middle-aged females. *International journal of environmental research and public health*, *12*(12), 15222-15232.

Park, B. J., Furuya, K., Kasetani, T., Takayama, N., Kagawa, T., & Miyazaki, Y. (2011). Relationship between psychological responses and physical environments in forest settings. *Landscape and Urban Planning*, *102*(1), 24-32.

Park, B. J., Kasetani, T., Tsunetsugu, Kagawa, T., & Miyazaki, Y. (2010) The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest

bathing): Evidence from field experiments in 24 forests across Japan. *Environmental Health and Preventive Medicine*, 15(1), 18–26. doi:10.1007/s12199-009-0086-9

Poulsen, D. V., Stigsdotter, .. K., Djernis, D., & Sidenius, U. (2016). 'Everything just seems much more right in nature': How veterans with post-traumatic stress disorder experience nature-based activities in a forest therapy garden. *Health psychology open*, *3*(1), 2055102916637090.

Raj, A. J., Biswakarma, S., Pala, N. A., Shukla, G., Kumar, M., Chakravarty, S., & Bussmann, R. W. (2018). Indigenous uses of ethnomedicinal plants among forest- dependent communities of Northern Bengal, India. *Journal of ethnobiology and ethnomedicine*, *14*(1), 1-28.

Ramachandra T. V., Divya Soman, Ashwath D. Naik and M. D. Subash Chandran, 2017. Appraisal of

Forest Ecosystems Goods and Services: Challenges and Opportunities for Conservation, Journal of Biodiversity, 8(1): 12-33 (2017), DOI: http://10.1080/09766901.2017.1346160

Robinon, M. R. & Zhang, X. (2011). The World Medicine Situation (TraditionalMedicines: Global Situation, Issues and Challenges). Geneva. World Health Organization, Geneva, Switzerland.

SC (The Sustainability Consortium), World Resources Institute, and University of Maryland. "Tree Cover Loss by Driver." Accessed through Global Forest Watch on 10/09/2021. www.globalforestwatch.org.

Senthilkumar, N. & Murugesan, S. (2012). Bioprospecting the renewable forest resources, an overview. Curr Biotica, 5, 522-540.

Silambarasan, R., Sureshkumar, J., Krupa, J., Amalraj, S., & Ayyanar, M. (2017). Traditional herbal medicines practiced by the ethnic people in Sathyamangalam forestsof Western Ghats, India. *European Journal of Integrative Medicine*, *16*, 61-72.

Singh, R. S., Ansari, I., Singh, R. K., Singh, S. K., & Debjit, P. A. L. (2017). Ex-situ conservation of medicinal Plants and its therapeutic in mine impacted lands in dry tropical forests of Jharkhand, India. *Eurasian Journal of Forest Science*, *5*(2), 44-69.

Song, C., Ikei, H., Kobayashi, M., Miura, T., Taue, M., Kagawa, T., ... & Miyazaki, Y. (2015). Effect of forest walking on autonomic nervous system activity in middle-aged hypertensive individuals: A pilot study. *International journal of environmental research and public health*, *12*(3), 2687-2699.

Song, C., Ikei, H., Park, B. J., Lee, J., Kagawa, T., & Miyazaki, Y. (2018). Psychological benefits of walking through forest areas. *International journal of environmental research and public health*, *15*(12), 2804.

Swargiary, A., Roy, M. K., & Daimari, M. (2019). Survey and documentation of ethnobotanicals used in the traditional medicines system of tribal communities of Chirang district of Assam against helminthiasis. *Biomedical and Pharmacology Journal*, *12*(4), 1923-1935.

Tamang, B., Sarkar, B. C., Pala, N. A., Shukla, G., Patra, P. S., Bhat, J. A., ... & Chakravarty, S. (2019). Uses and ecosystem services of trees outside forest (TOF)-A case study from Uttar Banga Krishi Viswavidyalaya, West Bengal, India. *Acta Ecologica Sinica*, *39*(6), 431-437.

Tang Z, Fang J, Sun J, Gaston KJ (2011) Effectiveness of protected areas in maintaining plant production. Plos One 6.

Tripathi, S. C., & Mall, T. P. (2018). Potent Nutrimental and Ethnomedicinal Horticultural Flora from North Central Terai Forests Of UP, India. *Sustainable Horticulture,* Volume 2*: Food, Health, and Nutrition*, 369.

Tsunetsugu, Y., Lee, J., Park, B. J., Tyrväinen, L., Kagawa, T., & Miyazaki, Y. (2013).Physiological and psychological effects of viewing urban forest landscapes assessed bymultiple measurements. *Landscape and Urban Planning*, *113*, 90-93.

Udayakumar, M., Selvan, B., & Sekar, T. (2020). Density, population structure and ethnobotanical uses of a medicinally important vulnerable tree (IUCN) in tropical forests of Javadhu hills, South India. *Medicinal Plants-International Journal of Phytomedicines and Related Industries*, *12*(2), 290-300.

Ulrich, R. S., Simons, R. F., Losito, B. D., Fiorito, E., Miles, M. A., & Zelson, M. (1991). Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology, 11(3), 201–230. doi:10.1016/S0272-4944(05)80184-7.

UMWRI (University of Maryland and World Resources Institute). "Global Primary Forest Loss". Accessed through Global Forest Watch on 10/09/2021 from www.globalforestwatch.org.

Velarde, M. D., Fry, G., & Tveit, M. (2007). Health effects of viewing landscape— Landscape types in environmental psychology. Urban Forestry & Urban Greening, 6(4), 199–211. doi: 10.1016/j.ufug.2007.07.001

Yadav, A., Verma, P. K., Chand, T., & Bora, H. R. (2018). Ethno-medicinal knowledge of Clerodendrum L. among different tribes of Nambor reserve forest, Assam, India. *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 1567-1570.

Yu, C. P., Lee, H. Y., & Luo, X. Y. (2018). The effect of virtual reality forest and urban environments on physiological and psychological responses. *Urban forestry & urban greening*, *35*, 106-114.

Zameer, M. (2021). Tribal Life and the Environment of Jammu and Kashmsir, India. *Asian Journal of Sociological Research*, 10-14.

Zorrilla-Miras, P., Palomo, I., Gomez-Baggethun, E., Martín-L opez, B., Lomas, P. L., & Montes, C. (2014). Effects of land-use change on wetland ecosystem services: a casestudy in the Donana marshes in southwestern Spain. ~ Landscape and Urban Planning, 122, 160e174.

CPCB (2021). https://cpcb.nic.in//upload/Downloads/AQI_Bulletin_20211022.pdf

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Technology as the Panacea for Monitoring of Protected Areas

The study highlights the use of technology in ensuring the protection of conservation sites such as forests and heritage sites. In this regard, the research utilizes a qualitative approach to assure that the latest technological advancements have a significant role to play in the monitoring and analysis of protected areas. Thus, the research outlines significant technologies, latest innovations, and upcoming plans to present the importance of technology in improving the monitoring of protected areas. In this context, the research adopts a qualitative research approach by interviewing conservation scientists, forest personnel, environmental researchers and managers of renowned technology companies, manufacturing innovative products that are sold for monitoring protected areas. The findings highlight the efficacy of technology in the conservation of natural resources. Additionally, certain recommendations concerning further improvement of monitoring of protected areas are also provided in the research paper.

Key words: Technological advancement, Natural Resource Conservation, Ecological Monitoring, illegal practices

Unlocking the power of technology: Enhancing protected area monitoring through innovative solutions.

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Introduction

Global Forest Watch (GFW) was demonstrated at the 2014 World Parks Congress (Davis *et al.*, 2014). It uses cloud computing, satellite technology, and others to provide current forest information. Satellite images have improved in spatial resolution over time. The Digital Global-promoted Worldview-3 satellite can view Earth at 30-centimeter resolution (Hively *et al.*, 2019). Images can distinguish people and species. Several technology companies are also launching shoebox-sized micro-satellites into space to take regular images of Earth.

Park rangers worldwide are increasingly using cell phones to acquire real-time conservation hotspot data (Palmer, 2018). This helps countries develop more conservative policies by sharing protected area status information. Global Forest Watch uses satellite data to analyze and monitor forest cover change in real time. Users can sign up for mobile alerts for local tree cover decline. The Jane Good all Institute and Google have worked with the GFW to make forest data available via mobile apps (Zhang *et al.*, 2020). For instance, Tanzanian and Ugandan rangers are testing a new app that alerts users about the current forest clearing and allows them to share photographs and observations (Pintea *et al.*, 2021). Users can capture evidence of unlawful poaching or logging and offer it to law enforcement.

Geospatial technologies include a wide range of software and hardware tools and data connected to GPS, GIS, and remote sensing, according to Gwal (2021). The increased accessibility of such technologies has allowed their use beyond geomatics experts, allowing them to be applied to wildlife management. In Massachusetts, remote

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sensing, GPS, GIS, and integrated spatial database management have helped the Department of Environmental Protection (MassDEP) track and prosecute illegal wetlands alterations (Barry, 2017). Additionally, Brazil's long-standing deforestation program uses geolocation technologies linked with enforcement criteria. After manual identification, the Brazil-China CBERS satellite and Landsat images digitally maps deforestation locations >1ha (Araújo and Vieira, 2019).

Community participation is another vital area where technology protects and sustains life. Technologies can engage professionals, amateurs, and ignored conservation groups like local populations, Indigenous peoples, and visitors. An Australian start-up company named Crosschecker developed an app that allows users from tourists to local communities to perform an extensive search on any property, returning all fauna and flora with relevant pictures and descriptions (Queensland Government, 2019). The App compares technology data to laws, rules, and compliance requirements. It is then displayed to alert viewers about protected plant life and highlight the natural heritage site. Mexico's Gulf of California acoustic monitoring has shown a decline in vaquita numbers (Palminteri, 2018). Passive acoustic monitoring devices at spawning sites have enabled researchers to estimate fish numbers without catch data. Thus, new technology may aid ecosystem knowledge and preservation.

Biodiversity is life's infrastructure. Global ecological imbalance is producing climatic shifts and planetary destabilization (Jiménez López and Mulero-Pázmány, 2019). Technology and technological developments maintain conserved places worldwide. Innovation aids conservation. Hyperspectral landscape imagery provides detailed information on a variety of geological, chemical, and biological processes in aquatic and terrestrial systems, thanks to advances in data analysis, imaging, and deployment (Marvin *et al.*, 2016). Thus, this study examines how new technology protects natural resources and provides immediate alert systems for ecological imbalance.

Methodology

Research aims and objectives

The research aims to highlight the significance of technology in monitoring protected areas such as conservation sites or any natural resources. The research objectives are stated as follows:

- To analyze the importance of preserving natural resources such as forest, marine areas and others
- To outline the significance of technology in monitoring conservation sites
- To evaluate any issue evident in utilizing technology-based monitoring for protected areas
- To recommend accurate strategies to eliminate such issues

Research question

The research question is based on the use of technology and its significance in monitoring protected sites. Thus, the research question is highlighted as "What is the importance of technology in monitoring protected areas and how such technologies are implemented to ensure that the conservation sites are safe and secured?"

Problem statement

Technology is increasingly important in biodiversity conservation. Many nations prioritize using technology to monitor conservation areas (Mascia *et al.*, 2017). Satellite tracking technology is useful for analyzing and visualizing data on inaccessible species. To identify regions that need conservation practices. New technologies improve study on human-wildlife conflict, migration, relocation, predator-prey interaction, and species reintroduction. The research emphasizes the need of using technology to monitor conservation sites so the government may maintain a strategic approach in biodiversity hotspots to avoid human interference (Bruno *et al.*, 2019).

Research rationale

Dunn *et al.* (2018) noted that technology is changing ecosystem restoration. High-tech companies have started making conservation site drones to show what species are needed and where. Such data helps conservation sites replant, reforest, and repair. However, several nations favor technology-natural infrastructure alignment. Such developments may improve adaptive capability, resilience, and climate change vulnerability (Gillespie *et al.*, 2018). Thus, the paper describes global technical advances for monitoring natural resources, conservation locations, and biodiversity hotspots.

Research philosophy

Research philosophy emphasizes data gathering, analysis, and interpretation. Interpretivism research philosophy was applied in this naturalistic study (Goduka, 2012). The research can analyze technology's rise and biodiversity conservation advantages using interpretivism. Interpretivism has enabled the researcher to gather information from research participants on the latest conservation site monitoring tools.

Research approach

The research approach describes how the researcher collects and presents data. This study used inductive research. Inductive research outlines observable patterns to develop explanations and theories (Azungah, 2018). Inductive research lets the

researcher generate theories from participants' replies about the importance of new technologies for monitoring conservation sites.

Research design

Research design describes how the study proceeds. Exploratory research designs develop, validate, and provide a specific set of actions (Jones *et al.*, 2013). Exploratory study approach was correct since the research evaluated a specific technical breakthrough that uses the latest technology to monitor conservation sites. Exploratory research has enabled the researcher assess diverse technical areas to fit with the participants' viewpoint to ensure that technology advances biodiversity conservation.

Research strategy

This study included qualitative interviewing of individuals. The research technique (Ponto, 2015) allowed the researcher to conduct open-ended interviews with chosen participants to get insight into the usage of new technology in monitoring protected areas. The qualitative research technique helps the researcher dig deep into the literature on new innovations and technology to determine if they had helped conserve natural resources.

Data Collection

Sampling describes the selection of appropriate study subjects. Selective sampling was utilized in this research (Barratt *et al.*, 2015). This is because this qualitative research included managers from global technology companies that designed and manufactured monitoring equipment for conservation sites worldwide, conservation scientists, forest employees, and researchers. This study included 46 participants who were emailed interview questions and interviewed in person. Before the interview, individuals gave informed consent so they knew why they were participating and how their comments would help the research. The research's reliability and validity were assessed by examining relevant publications and articles.

A questionnaire survey comprising the following main categories of questions was analyzed quantitatively. Each area featured specific questions to gain deeper insights, as listed under the question category below:

1. **Do you agree that new technologies have reduced illegal practices such as logging and poaching? Kindly clarify it.**

In the personal interview, a set of insightful questions were posed to gain a comprehensive understanding of the application and impact of specific technologies used in the interviewee's area to monitor illegal activities such as logging and poaching. This category had further sub-questions where the interviewee was asked about the measures used to quantify the impact of these technologies on curbing illegal practices and their effectiveness compared to traditional methods of prevention and detection. Further questions centered on the accessibility, cost-effectiveness, and potential barriers to implementing these technologies in Protected Areas. There was also a probing inquiry about whether technology could eventually replace traditional methods entirely. Lastly, to gauge the societal implications, the interviewee was asked about the local community's reaction to the deployment of these technologies, along with any unexpected benefits or challenges that have surfaced. The answers to these questions served as invaluable data for the research.

2. **What are the latest technologies developed to support the conservation of natural resources? Kindly provide examples.**

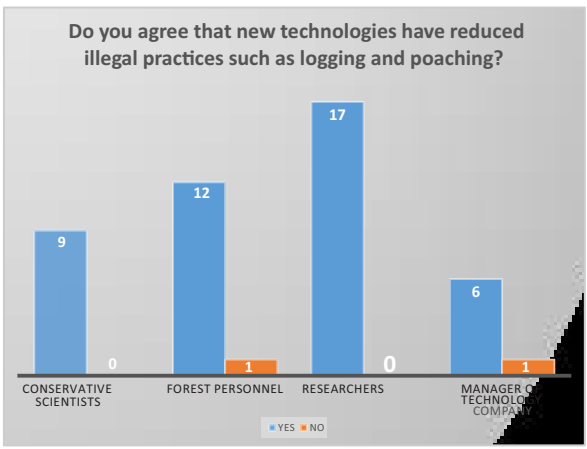
Under this question, the researchers delved into several key questions that sought to better understand the nuances and implications of the latest technologies used in conservation efforts. The interviewee was first asked to elucidate how these modern technologies improve upon or differ from previous conservation tools and technologies. The conversation then transitioned to how these state-of-the-art technologies have influenced the day-to-day operations involved in natural resource conservation. A question regarding the scalability of these technologies followed, focusing on their suitability for various scales of application, from small to large. The interviewee was then asked about the accessibility of these technologies for various stakeholders, including local communities, researchers, and conservationists. Further discussions led to how these technologies reshape the roles and responsibilities of those working in the conservation sector. Lastly, their insights into any current challenges or limitations associated with these technologies, as well as the steps being taken to address such issues were asked. These questions were instrumental in forming a comprehensive understanding of the topic at hand.

3. **Do you agree that the coming years will witness additional advancements in technological solutions that will further reduce illegal activities in protected areas? If so, explain how.**

During the personal interview, a variety of forward-looking questions were posed to the interviewee, aiming to shed light on the future implications of technological advancements in conservation. For this sectionthe interview started by asking how the interviewee envisioned these advancements improving upon the existing technologies in use. Further questions aimed to explore the intersection of these anticipated technologies with community engagement and the local attitudes towards conservation. To understand the potential shift in professional competencies, targeted queries about the impact of these advancements on the training needs of staff working in Protected Areas were

also made. An important aspect of the discussion revolved around the potential negative implications of these advancements, thereby trying to capture a balanced view of future scenarios. Lastly, in a bid to gauge the sustainable footprint of these technologies, the interviewee was asked about ways to ensure that these technological advancements are both sustainable and environmentally friendly. These thought-provoking questions added significant depth to the conversations and the insights gathered through them.

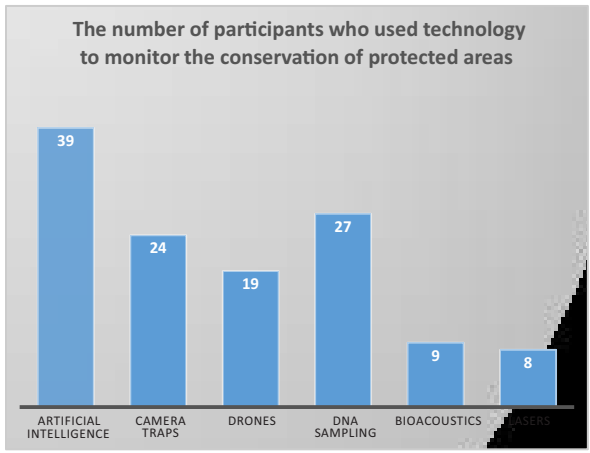
Data Analysis



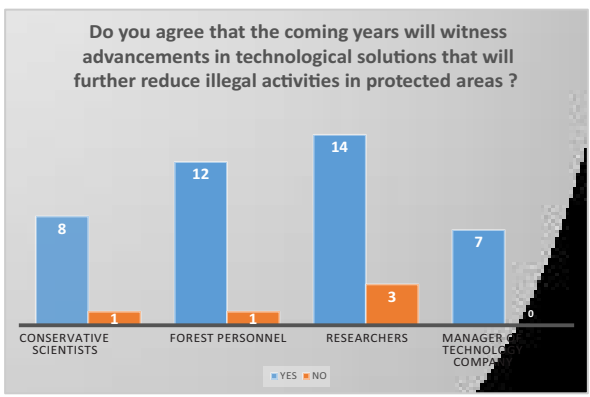
1. **Do you agree that new technologies have reduced illegal practices such as logging and poaching? Kindly clarify it.**

Conclusion- Around 95% of the participants opined on the fact that new technologies have reduced illegal practices such as logging and poaching. For further clarification, most of the respondents stated that GPS and drones are extremely valuable technologies that have helped in the real-time monitoring of the species, both plants, and animals in the protected areas. The respondents of technology companies stated that their companies are committed to inventing new technologies and investing extensively in R&D to generate the best solutions for biodiversity conservation. It is noted that some participants accounting for approximately 17% of the total managers revealed that only technological advancements are not efficient to track down illegal practices in conservation sites. This requires adequate manpower in the conservation sites and biodiversity hotspots to monitor illegal practices efficiently and effectively. Hence, it can be stated that the emergence of new technologies has helped conservation departments around the world to protect conservation sites, thereby, decreasing illegal practices such as logging and poaching.

2. **What are the latest technologies developed to support the conservation of natural resources? Kindly provide examples.**



Conclusion- Most of the participants positively consented to the utilization of different technologies such as AI (artificial intelligence), drones, camera traps, GPS, and other sensory and telemetry technologies to monitor the protected areas. From their responses, the widely used technologies that were noted were AI, drones, camera traps, bioacoustics, lasers, and DNA analysis. The interviewees revealed that AI is efficiently used to track deforestation and the most common example of deforestation monitoring is in Latin America. The respondents stated that Terra-i is an artificial intelligence program that provides real-time data regarding green habitats. Additionally, the interviewees revealed that drones have helped conservationists to monitor rare vultures in the rural and remote steppe of Eastern Mongolia, as well as the evaluation of Caribbean coral reefs. The respondents highlighted that their companies receive bulk orders for drones and AI software that can be efficiently used to track and monitor the happenings around the world in different conservation sites.



3. **Do you agree that the coming years will witness additional advancements in technological solutions that will further reduce illegal activities in protected areas? If so, explain how.**

Conclusion- Around 89.2% of the interviewees agreed

to further reduction in illegal activities in protected areas with the introduction of advancements in technological solutions in the coming years. Most of the respondents stated that camera traps have a prospective future. They highlighted that the companies are designing and manufacturing high mega-pixel cameras that can monitor nocturnal creatures from a very long distance. Additionally, they revealed that innovation will be brought into the cameras that will help the conservationists to spy on the species evident in the conservation sites from a very long distance. Moreover, the interviewees revealed that bioacoustics also possesses a prospective and advanced future. Researchers across the world are experimenting with different bioacoustics aspects so that companies can develop such technologies to meet a bulk order within the time frame.

Results and Discussion

Existing technologies in natural resources conservation

Most participants positively consented to the utilization of different technologies such as AI (artificial intelligence), drones, camera traps, GPS, and other sensory and telemetry technologies to monitor the protected areas. From their responses, the widely used technologies that were noted were AI, drones, camera traps, bioacoustics, lasers, and DNA analysis. The interviewees revealed that AI is efficiently used to track deforestation and the most common example of deforestation monitoring is of Latin America. The respondents stated that Terra-i is an artificial intelligence program that provides real-time data regarding green habitat. Additionally, the interviewees revealed that drones have helped the conservationists to monitor rare vultures in the rural and remote steppe of Eastern Mongolia, as well as evaluation of Caribbean coral reefs. The respondents highlighted that their companies receive bulk orders for drones and AI software that can be efficiently used to track and monitor the happenings around the world in different conservation sites.

New technologies boosts reduction in illegal practices

95% of the participants opined on the fact that new technologies have reduced illegal practices such as logging and poaching. For further clarification, the majority of the respondents stated that GPS and drones are extremely valuable technologies that have helped in real-time monitoring of the species, both plants and animals in the protected areas. The respondents stated that their companies are committed to invent new technologies and invest extensively in R&D to generate best solutions for biodiversity conservation. It is noted that some participants accounting for approximately 11% of the total managers revealed that only technological advancements are not efficient to track down illegal practices in conservation sites. This requires adequate manpower in the conservation sites and biodiversity hotspots to monitor the illegal practices efficiently and effectively. Hence, it can be stated that emergence of new technologies has helped the conservation departments around the world to protect the conservation sites, thereby, decreasing illegal practices such as logging and poaching.

Future of technological advancements in conservation and legal violations

Around 89.2% of the interviewees agreed to further reduction in illegal activities in protected areas with introduction of advancements in technological solutions in coming years. The majority of the respondents stated that camera traps have a prospective future. They highlighted that the companies are designing and manufacturing high mega-pixel camera that can monitor nocturnal creatures from a very long distance. Additionally, they revealed that innovation will be brought into the cameras that will help the conservationists to spy on the species evident in the conservation sites from a very long distance. Moreover, the interviewees revealed that bioacoustics also possesses a prospective and advanced future. The researchers across the world are experimenting on different bioacoustics aspects so that the companies can develop such technologies to meet a bulk order within the time frame.

Overcoming Technological Constraints in Protected Areas: Pathways to Enhance Conservation Strategies

The use of technology in protected areas has revolutionized conservation efforts, providing tools to monitor, maintain, and restore the integrity of these vital habitats. However, several limitations currently hinder the full potential of these technologies:

1. **Limited Connectivity and Infrastructure:** Many protected areas are in remote locations where there is little to no internet connectivity or even basic infrastructure. This makes it difficult to utilize digital technology, such as IoT devices, drones, or remote sensing equipment, for real-time monitoring and data collection.
2. **Energy Constraints:** Technologies often require power sources, yet protected areas frequently lack a reliable energy supply. This limitation restricts the deployment of continuous monitoring systems.
3. **Cost:** High-quality technology and its maintenance can be expensive, a significant barrier for many conservation organizations that often operate on tight budgets.
4. **Data Management and Analysis:** The use of technology often results in vast amounts of data, but without adequate skills or resources to manage and interpret this data, its value remains unrealized.

5. **Regulatory Issues:** In some cases, regulations can restrict the use of technologies such as drones, especially in areas with wildlife that could be disturbed.

Addressing these limitations requires a multifaceted approach:

1. **Improving Connectivity:** Encouraging partnerships with telecom companies could help improve connectivity in remote areas. Low-orbit satellite technology can also provide internet coverage in such areas.

2. **Energy Solutions:** Developing and deploying low-energy devices or renewable energy solutions, such as solar-powered sensors, can help overcome the energy constraints.

3. **Funding and Collaboration:** Securing funding for technology implementation is crucial. This could involve partnerships with tech companies, government grants, or crowdfunding campaigns.

4. **Capacity Building:** Training staff in data management, interpretation, and technological operation can help maximize the use of technology in conservation. Furthermore, automating data analysis using machine learning or AI can be a useful approach.

5. **Policy Advocacy:** Engaging with policymakers to ensure regulations adapt to the advancing technological landscape can facilitate the use of technologies like drones for conservation purposes.

6. **Real time dedicated data management systems:** Investing in real time data analysis and management can go a long way in preventing mishaps like forest fires etc.

By addressing these challenges, we can make better use of technology in protected areas, ultimately improving our ability to conserve the planet's most valuable and vulnerable ecosystems.

Human intervention vs technology-based monitoring

Technology is currently playing a significant role in the monitoring of protected areas, but human intervention is just as crucial. Some respondents, including forest employees and managers of technology companies, had the strong opinion that manual human intervention was more crucial for the supervision of protected areas. Technology can effectively support the management team of protected areas in monitoring and reining in wildlife crimes. Therefore, to properly manage, protect, and conserve a protected area both technological and human intervention is required.

Conclusion

The current research emphasized on the vital roles that new technologies play in monitoring and conservation of protected areas, supported by real time data. It was noted that AI, drones, bioacoustics, laser and several other technologies have marked their ways into the conservation system, thereby, providing real-time data to track illegal practices. The emergence of technology has created a positive impact on conservation of biodiversity and the conservationists were able to reduce logging and poaching in the biodiversity hotspots. The technological companies invest extensively in R&D to generate bulk amount of tracking software and other innovative solutions to the clients who are mainly different countries trying to protect their natural resources. Hence, notably, the respondent's views were in alignment with the published articles and journals that shed light on the significance of technology in monitoring and conservation of protected areas globally. Innovative technology is regarded as the valuable support to conservation. Thus, the current research scrutinized the significance of new technology in protecting natural resources while providing rapid alert systems considering ecological imbalance.

Recommendations

Based on the data gathered through detailed investigations, some basic technological protocols which a typical Protected Area must follow for effective long-term monitoring are as follows-

1. **Use of Remote Sensing Technology:** Implement remote sensing protocols to collect information about the park's landscapes and wildlife populations. This could include the use of satellite imagery or aerial photography to monitor changes in land use, vegetation cover, and other ecosystem indicators.

2. **Application of Camera Traps:** Develop a systematic approach for deploying and monitoring camera traps. These devices can provide vital data about wildlife populations, behavior, and movements, especially for elusive or nocturnal species. Guidelines should be in place for where and how to set up these traps, as well as how to analyze and store the data they capture.

3. **Deployment of Drones:** Establish protocols for the use of drones, which can quickly cover large areas and provide high-resolution images. They can be particularly useful for monitoring wildlife populations or for rapid assessment after natural disasters or reports of illegal activity. Protocols should include guidelines for flight paths, altitudes, times, and methods of data analysis.

4. **Acoustic Monitoring Systems:** In areas with significant bird, insect, or amphibian populations, or where noise pollution may be a concern, consider using acoustic monitoring systems. Clear procedures should be established for their deployment, data collection, and data analysis.

5. **GIS and Spatial Data Management:** Geographic Information System (GIS) is crucial for effective

monitoring. A protocol should be developed for regular GIS mapping and spatial data management, including data collection, updating, storage, and analysis.

6. **Climate Monitoring:** Protocols for regular monitoring of climatic conditions can help track changes over time and their effects on ecosystems. This could involve both on-site weather stations and the use of broader climate data sources.
7. **Cybersecurity Measures:** As technology use increases, so does the risk of cyber threats. Protocols should be put in place to ensure data security, including regular system updates, strong password policies, and secure data backup.
8. **Real time Data Sharing, Analysis and Reporting:** Regular reporting is crucial for long-term monitoring. Clear protocols should be established for how and when data should be compiled, analyzed and reported, and to whom. In some cases, it may be appropriate to share data with other organizations, researchers, or the public, while in other cases data may need to be kept confidential.
9. **Technology Maintenance and Upgradation:** Finally, ensure that there are protocols for regular maintenance and upgradation of all technology used. This can help prevent data losses and keep the monitoring systems as accurate and efficient as possible.

It is hereby recommended that further research concerning the similar topic must also include quantitative research approach involving survey questionnaires. This will help the researcher to gain a broad idea regarding different aspects of technological advancements related to conservation practices. Additionally, the sample size of the research work is small. This creates a drawback for this research. Hence, it is recommended that future research work will include a larger sample size so that each and every respondent's viewpoint can be critically analyzed. Additionally, future research should present a graphical representation of the survey responses so that an in-depth evaluation regarding the topic can be carried out efficiently and effectively.

संरक्षित क्षेत्रों की निगरानी के लिए प्रौद्योगिकी रामबाण के रूप में

शशांक शेखर, रूचि बडोला और प्रज्ञान पुष्पांजलि

सारांश

अध्ययन वनों और विरासत स्थलों जैसे संरक्षण स्थलों की सुरक्षा सुनिश्चित करने में प्रौद्योगिकी के उपयोग पर प्रकाश डालता है । इस संबंध में अनुसंधान यह सुनिश्चित करने के लिए गुणात्मक दृष्टिकोण का उपयोग करता है कि नवीनतम तकनीकी प्रगति की संरक्षित क्षेत्रों की निगरानी और विश्लेषण में महत्वपूर्ण भूमिका है । इस प्रकार अनुसंधान संरक्षित क्षेत्रों की निगरानी में सुधार के लिए प्रौद्योगिकी के महत्व को प्रस्तुत करने के लिए महत्वपूर्ण प्रौद्योगिकियों, नवीनतम नवाचारों और आगामी योजनाओं की रूपरेखा तैयार करता है। इस संदर्भ में अनुसंधान संरक्षण वैज्ञानिकों, वनकर्मियों, पर्यावरण शोधकर्त्ताओं और प्रसिद्ध प्रौद्योगिकी कम्पनियों के प्रबंधकों का साक्षात्कार करके गुणात्मक अनुसंधान दृष्टिकोण अपनाता है, जो संरक्षित क्षेत्रों की निगरानी के लिए बेचे जाने वाले नवीन उत्पादों का निर्माण करते हैं। निष्कर्ष प्राकृतिक संसाधनों के संरक्षण में प्रौद्योगिकी की प्रभावकारिता पर प्रकाश डालते हैं। इसके अतिरिकत शोध पत्र में संरक्षित क्षेत्रों के निगरानी में और सुधार के संबंध में कुछ सिफारिशें भी दी हुई हैं।

Reference

Araújo R. and Guimarães Vieira I.C. (2019). Deforestation and the ideologies of the frontier expansion: the case of criticism of the Brazilian Amazon monitoring program. *Sustainability in Debate/Sustentabilidadeem Debate*, **10**(3): 354-365.

Azungah T. (2018). Qualitative research: deductive and inductive approaches to data analysis. *Qualitative Research Journa*l, **18**(4): 383-400. https://doi.org/10.1108/QRJ-D-18-00035.

Barratt M.J., Ferris J.A. and Lenton S. (2015). Hidden populations, online purposive sampling, and external validity: Taking off the blindfold. *Field Methods*, **27**(1): 3-21.https://doi.org/10.1177/1525822X14526838.

Barry T.W.I.V. (2017). When Trash Costs Money: Analyzing the Impact of Pay-As-You-Throw Programs in Massachusetts. *Journal of Environmental and Resource Economics at Colby*, **4**(1): 3.https://digitalcommons.colby.edu/jerec/vol4/iss1/3.

Bruno J.F., Côté I.M. and Toth L.T. (2019). Climate change, coral loss, and the curious case of the parrotfish paradigm: why don't marine protected areas improve reef resilience? *Annual review of marine science*, **11**(1): 307-334. https://doi.org/10.1146/annurev-marine-010318-095300.

Davis C., Petersen R. and Thau D. (2014). *New Technology Can Help Ensure that Protected Areas Stay Protected.* [online] World Resources Institute. Available at: <https://www.wri.org/insights/new-technology-can-help-ensure-protected-areas-stay-protected> [Accessed 18 August 2021].

Dunn D.C., Jablonicky C., Crespo G.O., McCauley D.J., Kroodsma D.A., Boerder K., Gjerde K.M. and Halpin P.N. (2018). Empowering high seas governance with satellite vessel tracking data. *Fish and Fisheries*, **19**(4): 729-739. https://doi.org/10.1111/faf.12285.

Gillespie T.W., Ostermann-Kelm S., Dong C., Willis K.S., Okin G.S. and MacDonald G.M. (2018). Monitoring changes of NDVI in protected areas of southern California. *Ecological Indicators,* **88**: 485-494.https://doi.org/10.1016/j.ecolind.2018.01.031.

Goduka N. (2012). From positivism to indigenous science: A reflection on world views, paradigms and philosophical assumptions. *Africa Insight*, **41**(4): 123-138. Available at https://hdl.handle.net/10520/EJC119962.

Gwal P., Lodhiyal N. and Rawat Y.S. (2021). Assessment of Biomass Storage, Net Accumulation and Carbon Sequestration in ChirPine (Pinus roxburghii Sarg.) Dominated Community Forests of Kumaun Himalaya in relation to Climate Change. *Indian Forester*, **147**(7): 607-614.

Hively W.D., Shermeyer J., Lamb B.T., Daughtry C.T., Quemada M. and Keppler J. (2019). Mapping crop residue by combining Landsat and WorldView-3 satellite imagery. *Remote Sensing*, **11**(16): 1857.https://doi.org/10.3390/rs11161857.

Jiménez López J. and Mulero-Pázmány M. (2019). Drones for conservation in protected areas: present and future. *Drones*, **3**(1): 10.https://doi.org/10.3390/drones3010010.

Jones T.L., Baxter M.A.J. and Khanduja V. (2013). A quick guide to survey research. *The Annals of The Royal College of Surgeons of England*, **95**(1): 5-7.https://doi.org/10.1308/003588414X13824511649454.

Marvin D.C., Koh L.P., Lynam A.J., Wich S., Davies A.B., Krishnamurthy R., Stokes E., Starkey R. and Asner G.P. (2016). Integrating technologies for scalable ecology and conservation. *Global Ecology and Conservation*, **7**: 262-275. https://doi.org/10.1016/j.gecco.2016.07.002.

Mascia M.B., Fox H.E., Glew L., Ahmadia G.N., Agrawal A., Barnes M., Basurto X., Craigie I., Darling E., Geldmann J. and Gill D. (2017). A novel framework for analyzing conservation impacts: evaluation, theory, and marine protected areas. *Annals of the New York Academy of Sciences*, **1399**: 93-115.http://doi.org/10.1111/nyas.13428.

Palmer C. (2018). *Can technology save life on Earth?* [online] World Economic Forum. Available at: <https: //www.weforum.org/agenda/2018/09/can-technology-save-life-on-earth/> [Accessed 18 August 2021].

Palminteri S. (2018). 10 top conservation tech innovations from 2017. [online] *Mongabay Environmental News*. Available at: <https://news.mongabay.com/2018/01/10-top-conservation-tech-innovations-from-2017/> [Accessed 18 August 2021].

Pintea L., Jantz S.M. and Wich S.A. (2021). From the cloud to the ground: converting satellite data into conservation decisions. In: Conservation Technology (S. A. Wich and A. K. Piel, Eds.), Oxford Press, pp. 13-34.

Ponto J. (2015). Understanding and evaluating survey research. *Journal of the Advanced Practitioner in Oncology*, **6**(2): 168-171.PMID: 26649250; PMCID: PMC4601897.

Queensland Government (2019). *Technology helps maintain our natural biodiversity*. [online] Advance Queensland. Available at: <https://advance.qld.gov.au/whats-happening/stories-about-innovation/technology-helps-maintain-our-natural-biodiversity> [Accessed 18 August 2021].

Zhang D., Wang H., Wang X. and Lü Z. (2020). Accuracy assessment of the global forest watch tree cover 2000 in China. *International Journal of Applied Earth Observation and Geoinformation*, **87**: 102033.https://doi.org/10.1016/j.jag.2019.102033.

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