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Floral Biodiversity and its Role in Rural Livelihood: A Case Study of Tatinapara Village in West Bengal, India

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Abstract

Floral biodiversity represents the diversity of plant species and their genetic variations within a particular region, playing a vital role in maintaining ecosystem balance and supporting the livelihoods of rural communities. It contributes significantly to ecological services such as soil conservation, climate regulation, and the provision of food, medicine, and fuel. This research focuses on assessing the current status of floral biodiversity and its role in sustaining rural livelihoods at Tatinapara village, located within the Bolpur Forest Range of Birbhum District, West Bengal, India. The primary objectives of the study are to document existing plant species, analyze their contribution to local livelihoods, and suggest strategies for sustainable management and conservation. The methodology adopted combines both qualitative and quantitative approaches, with primary data gathered through household surveys using structured questionnaires, and secondary data collected from official records, reports, and previous research studies. The data were systematically analyzed and interpreted to draw relevant conclusions. The findings reveal that the study area is still in a developing phase, with notable dependence of local communities on floral biodiversity for their everyday needs. However, there exists a significant lack of awareness among villagers regarding the importance of environmental conservation and biodiversity management. The study highlights the urgent need for awareness programs and sustainable livelihood initiatives to protect the region's rich biodiversity and promote ecological balance.

Keywords: Conservation, Ecosystem, Floral Biodiversity, Livelihoods, Species.

Introduction

Biodiversity refers to the vast variety of life forms on Earth, encompassing not only the different species of animals, plants, fungi, and microorganisms but also the genetic diversity within those species, along with the natural habitats and ecosystems they inhabit. It involves the intricate ecological processes and interactions that sustain life on our planet. Biodiversity is fundamental to maintaining the healthy functioning of ecosystems, as it provides essential services such as climate regulation, clean air and water, soil fertility, pollination, and nutrient cycling.

However, this valuable resource is increasingly under threat due to various human activities including habitat destruction, climate change, pollution, overexploitation of natural resources, and the introduction of invasive species. These disturbances disrupt ecological balance and jeopardize the survival of countless species, directly affecting both the environment and human well-being. Biodiversity is broadly categorized into genetic diversity, species diversity, and ecosystem diversity, each playing a crucial role in ecological stability. Floral biodiversity, a vital part of species diversity, refers specifically to the variety of plant species and their associated ecosystems, including the genetic variation within these plant species.

It supports critical ecological processes such as pollination, water regulation, soil fertility, and nutrient cycling, while also offering humans valuable resources like food, medicine, fuel, and raw materials. Unfortunately, the rich floristic diversity is being threatened by anthropogenic factors such as land-use changes, habitat fragmentation, overexploitation, environmental pollution, the spread of invasive species, and the impacts of climate change. The conservation of floral biodiversity, therefore, requires immediate and effective measures including habitat protection, sustainable agricultural practices, environmental awareness, and controlling the spread of invasive species.

The present study seeks to explore the current status and distribution of floral biodiversity in Tatinapara village, a specific rural area in West Bengal, while examining its significant role in supporting the environment and rural livelihoods. Through collecting and analyzing ground-level data, this research aims to identify existing challenges from physical, socio-economic, and environmental perspectives, and propose possible remedies to address them.

Although extensive research has been conducted on biodiversity from different viewpoints, in-depth, village-level investigations focusing on the direct relationship between floral biodiversity

and rural livelihood sustainability remain limited. This gap in localized, field-based studies has encouraged the undertaking of this research work, which aspires to contribute valuable insights into the conservation of rural floral biodiversity and its integral role in sustaining ecological balance and community livelihoods[1-5].

Objective of the study: i. To assess the current status of floral biodiversity in the Birbhum District within the study area. ii. To examine the role of floral biodiversity in supporting rural livelihoods in the study area. iii. To analyze the physical and socio-economic conditions of the study area. iv. To evaluate the level of environmental awareness among the villagers.

Hypothesis of the study: i. H_1. A higher number of plant species contributes to the creation of a more complex, stable ecosystem and enhances various ecosystem services essential for ecological balance. ii. H_2. The impact of plant diversity on ecosystem functioning is influenced by multiple factors, including the extent of environmental disturbances and the functional traits of individual plant species. iii. H_3. Floral biodiversity plays a significant role in supporting rural livelihoods by providing essential resources such as food, medicine, fuel, and income opportunities. H_4. Rural areas with lower anthropogenic pressure and a higher proportion of natural landscapes exhibit greater floral biodiversity compared to urban and suburban regions, owing to reduced habitat destruction, fragmentation, pollution, and disturbances.

Literature Review: Cocks et al. emphasized the importance of plant diversity in the livelihoods of rural communities in South Africa's Valley Bushveld. The study documents various uses of Non-Timber Forest Products (NTFPs), including the species utilized, quantities harvested, and their value across nine use categories. A total of 103 plant species were identified, but only 17 were regularly used by over 10% of households. The average gross direct use value of wild plant resources was $1591 per year per household. The use of NTFPs goes beyond utilitarian needs, with one-third of the species and over half of the total use value serving cultural purposes. This highlights the role of plant diversity in fulfilling the cultural needs of local communities, suggesting that biodiversity conservation programs should consider its cultural significance[1].

Smail et al. conducted a study in Bhairabpur village of Malda District, West Bengal, aiming to assess the socio-economic profile, food security status, and identify possible measures to address local challenges. Their research highlighted a growing awareness that certain rural areas have been left behind in the development process. Consequently, authorities are now promoting rural development initiatives to sustain local economies, generate employment, and support regional growth[2].

Attri et al. carried out a study in Koti village of Chamba District, Himachal Pradesh, focusing on the diversity and uses of plant species. Based on field surveys, they documented a wide variety of cereals, pulses, oilseeds, vegetables, spices, condiments, and horticultural crops cultivated in the hilly region. Beyond commonly consumed vegetables in northern India, the study also recorded lesser-known wild plants used as vegetables by locals. This research emphasized the importance of documenting plant biodiversity and its varied uses, not only to preserve traditional knowledge but also to support biodiversity conservation and benefit future generations[3].

Bit et al. examined whether existing forest management policies effectively ensure biodiversity conservation while safeguarding the livelihoods of forest-dependent communities in Birbhum District, West Bengal. Through household surveys and socio-economic analysis, they applied OLS and LOGIT regressions to identify key factors affecting livelihood dependence and traditional knowledge conservation. Their findings revealed a cultural shift among forest-dependent populations, driven by resource scarcity and forest degradation, leading to increased engagement in mainstream economic activities over biodiversity conservation efforts[4].

Gupta et al. conducted a comprehensive assessment of key biological components across 20 wetlands in Birbhum District, West Bengal, between 2010 and 2014. The study recorded 26 families and 57 species of macrophytes, 25 species of birds, and 35 species of fishes belonging to 16 families and 7 orders. Among macrophytes, Cyperaceae (17%), Lemnaceae (15%), and Poaceae (15%) were the most abundant families. Within the wetland bird community, the family Anatidae, represented by six species, was found to be the most dominant. In terms of fish diversity, the majority of species were classified under the order Cypriniformes[5].

Chakraborty et al. conducted a study on the ethnomedicinal practices of tribal communities in Birbhum district, West Bengal. The research highlights that tribal medicine, an ancient therapeutic tradition, continues to serve as the primary healthcare system for these communities. Relying heavily on the local forest flora for both their livelihood and healthcare needs, the tribal people utilize various herbal remedies to treat common ailments and diseases. The study documented a total of 30 plant species from different families, all of which are traditionally used to manage and cure a range of human health conditions within these communities[6].

Pradhan et al conducted a study to assess the vegetation structure, composition, and plant diversity in three forest areas of Birbhum district- Illambazar, Chorchor, and Ghanpur - using standard ecological methods. The Importance Value Index (IVI) was calculated for 486 individual trees belonging to 20 species. Shorea robusta Gaertn. f. emerged as the dominant species with the highest IVI in all three forests, followed by Madhuca longifolia (Koenig) Macbride and Buchanania lanzan Spreng. The IVI values of the other 17 species were comparatively lower. The diameter classes of tree species ranged between 5–10 cm.

The Shannon-Wiener diversity index (H') varied from 0.11–0.48 in Illambazar, 0.08–0.50 in Chorchori, and 0.18–0.95 in Ghanpur. Tree density distribution patterns in ChorChori and Ghanpur exhibited a reverse J-shaped curve, indicating good regeneration, while Illambazar displayed an A-shaped curve. The ground vegetation included 6 shrub species, 8 herbs, 12 climbers, and saplings of 9 species[7].

Sarkar et al. observed that several tribal communities, including the Santhal and Konra, inhabit villages like Chaubatta, Kanta Pahari, Oal Pahari, Kolai Pahari, and Ghanga, all closely connected to the forest ecosystem. These areas are rich in valuable medicinal plant species, well-known to the tribal people who have traditionally used them to prepare herbal remedies for treating various illnesses. Additionally, local healers and practitioners from neighboring Jharkhand visit these forests, particularly during the monsoon season, to collect significant quantities of medicinal plants for trade. The study highlights how the local plant diversity not only supports rural healthcare practices but also contributes to the local economy. The research further emphasizes the importance of documenting these plant species for conservation purposes, as they hold ecological, medicinal, and economic value vital for both present and future generations[8].

Mondal et al. conducted an ethnobotanical survey among the tribal communities of Birbhum district, West Bengal, India — a region known for its rich biodiversity. The study emphasized the importance of exploring, identifying, and documenting the use of ethnobotanical resources to preserve traditional medicinal knowledge and ensure the conservation of valuable plant species. Birbhum holds a significant diversity of ethnomedicinal plants and a strong heritage of indigenous healthcare practices. Through their research, a total of 36 plant species from 34 different families were recorded, each used by local tribes to treat a variety of physical ailments and health conditions[9].

Methodology

The methodology of this study is designed to assess the status of floral biodiversity and its role in the rural livelihoods of Tatinapara village, located in the Bolpur Forest Range of Birbhum District, West Bengal, India. The study employs both qualitative and quantitative approaches, using field surveys, interviews, and secondary data analysis to gather comprehensive information. The following steps outline the methodology:

Study Area Selection: Location: Tatinapara village, situated in the Bolpur Forest Range of Birbhum District, West Bengal.Tatinapara is an agriculturally dependent village with rich biodiversity, making it an ideal location to study the role of floral biodiversity in rural livelihoods.

Data Collection: Primary Data: **Field Surveys**: A detailed field survey was conducted in the village from January to March 2025. The survey involved visiting households, observing local flora, and gathering firsthand data on the use of plants in daily life.

Semi-structured Interviews: Interviews were conducted with villagers, including farmers, artisans, local healers, and forest-dependent communities, to understand how floral biodiversity contributes to their livelihoods.

Questionnaires: Preformatted questionnaires were used to collect information about the plant species used in the region, their economic, medicinal, and cultural importance, and the level of awareness about biodiversity conservation.

Secondary Data: Literature Review: Relevant research papers, reports, and publications were reviewed to understand the broader context of floral biodiversity in the region.

Government and NGO Reports: Data from government and non-governmental organizations on local biodiversity conservation programs and rural development initiatives were analyzed.

Floral Biodiversity Assessment: Plant Species Identification: The plant species in Tatinapara village were cataloged using standard botanical identification methods, including field guides and expert consultation.

Quantitative Analysis: The number of plant species, their abundance, and distribution across different land-use types (agricultural, forest, and waste land) were recorded.

Floral Utilization: The economic, medicinal, and cultural uses of identified plant species were documented through local knowledge from the interviews.

Data Analysis: Qualitative Analysis: Data from interviews and surveys were coded and analyzed to understand the role of plant species in rural livelihoods, focusing on cultural practices, traditional knowledge, and community perspectives on biodiversity.

Quantitative Analysis: The collected data were analyzed statistically to calculate plant species richness, frequency, and diversity indices. Techniques like Shannon-Wiener Index and Simpson's Index were used to measure biodiversity in the region.

Ethical Considerations: Consent was obtained from all interview participants, ensuring their willingness to share information. The study ensured confidentiality of personal data provided by the villagers and local stakeholders.

Results and Discussion

Physical Setup to the study area: **Geological Setup:** Birbhum district lies on hard, non-porous crystalline rocks, Gondwana sediments, laterite, and alluvial soil.

The western ridges, capped with laterite, gradually transition into shallow valleys merging with the Indo-Gangetic plains. Tatinapara village was formed through this geological process[10-12].

Physiographic Status: The study area features an upland terrain sloping from northwest to southeast. Tatinapara village has an average elevation of 34 metres[10-12].

Drainage System: Situated in the Mayurakshi river basin, Tatinapara is drained by the perennial Kopai and Bakreswar rivers. These tributaries flow eastward, with Bakreswar joining Kopai at Patharghata, 4 km from the village. Seasonal tributary streams contribute to monsoon floods in surrounding areas[10-12].

Soil Structure: The soil, primarily older alluvium and loamy, varies across the village — clayey in the south and west, and sandy in the north and east. Soil pH ranges between 5.0 and 6.5.

Climatic Condition: Tatinapara experiences a tropical monsoon climate with extremely hot summers (max 45.5°C in June 2022) and cool winters (min 7°C in December). Southwest monsoons bring heavy rainfall in summer, while winter remains dry. The region occasionally experiences afternoon Kalbaisakhi storms in summer[10-12].

Natural Vegetation with Special Reference to Flora: Based on field surveys and topographical map analysis, natural vegetation covers approximately 3.6% of Tatinapara village's total area. Despite its tropical climate, the village supports two main types of natural vegetation: Tropical Dry Deciduous and Tropical Moist Deciduous forests. Common tree species include Rosewood (Shisham), Arjun, Mango, Berry, Palm, Sonajhuri, Bamboo, Eucalyptus, and Earleaf Acacia[10,11].

Table-1: Maximum and Minimum Temperature Distribution by Monthly of Tatinapara Village in Birbhum District[13].

Months	Maximum Temperature (c)	Minimum Temperature (c)
January	28	7
February	35	8
March	40	13
April	41	19
May	44	22
June	45.5	24
July	39	24
August	35	24
September	36	23
October	35	17
November	32	11
December	30	7

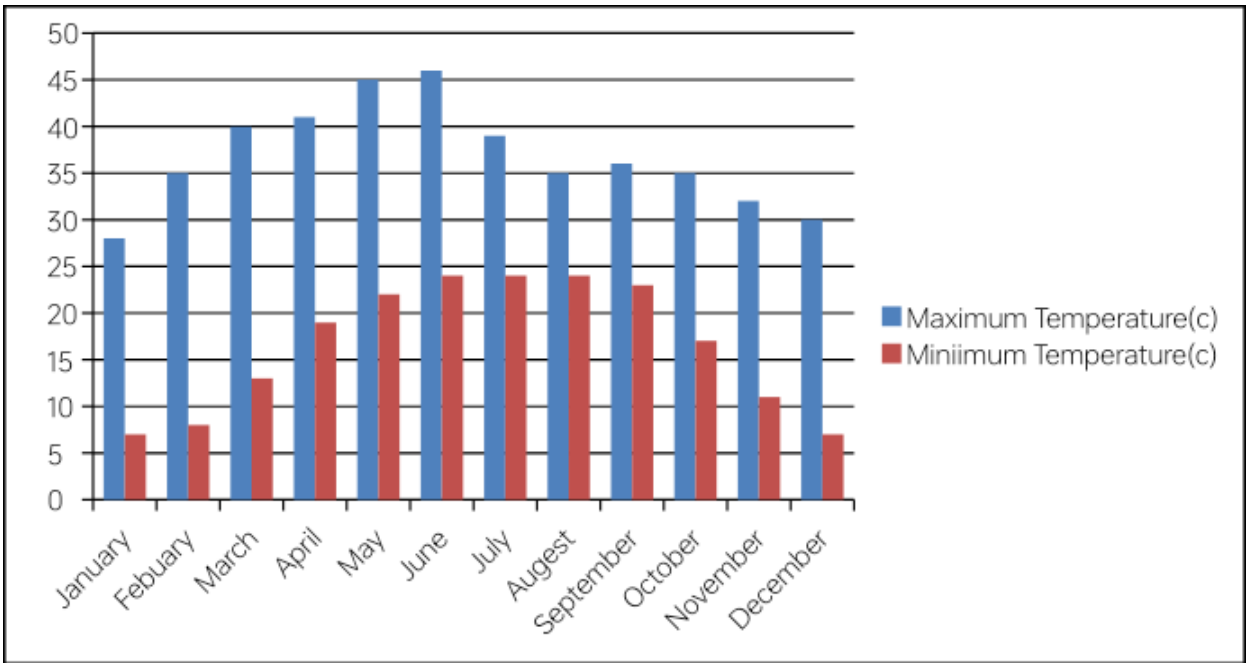

Figure-1: Graphical Representation of Maximum and Mininmum Temperature by month of Tatinapara Villagein Birbhum District[13].

Table-2: Distribution of Average Monthly Rainfall and Actual Rainfall of Tatinapara Village in Birbhum District.

January	9.7	5.6
February	23.2	9.3
March	23.4	30.4
April	40.7	91.2
May	88.7	69.8
June	234.2	304
July	324.5	695.56
August	295.7	289.2
September	258.2	113.2
October	105.4	37.4
November	17.5	4.26
December	9.4	3.5
Total	1430.6	1653.42

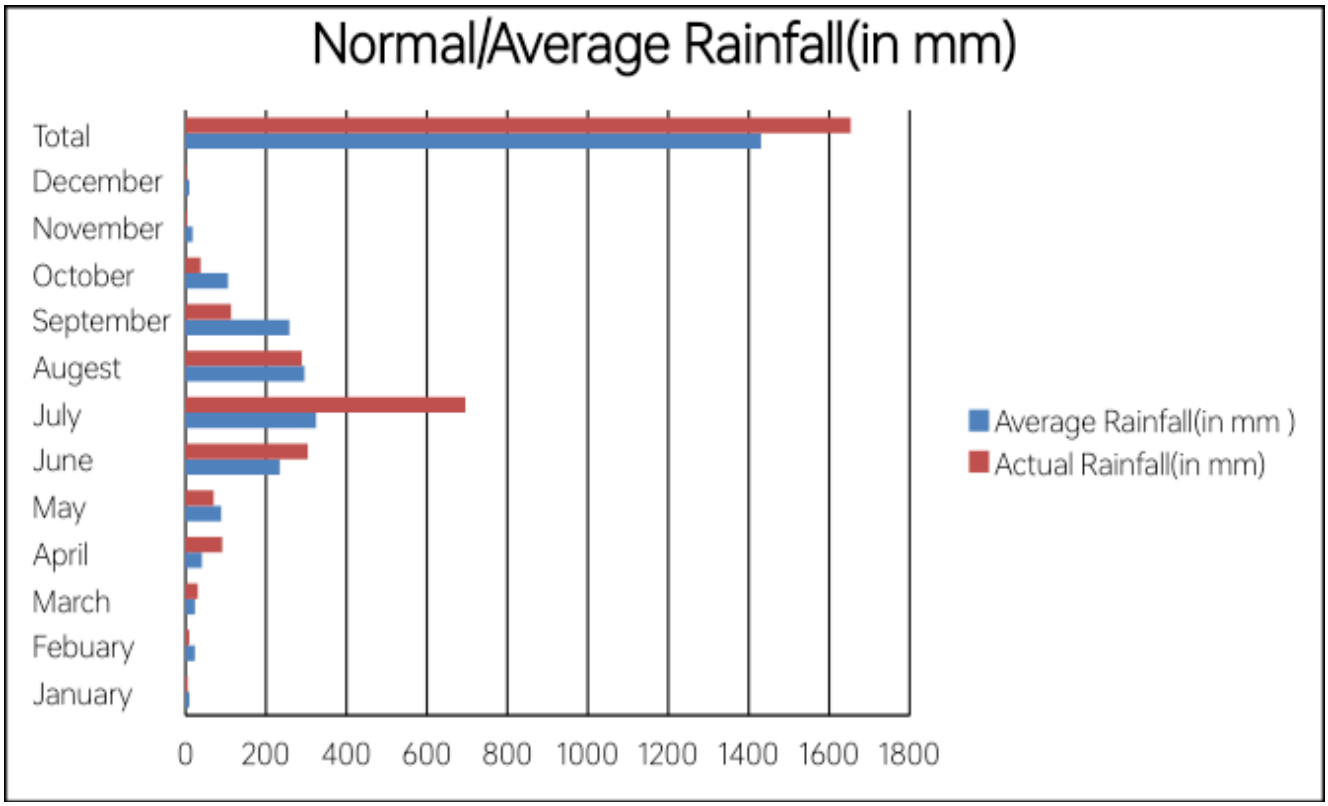

Figure-2: Graphical Representation of Average Monthly Rainfall and Actual Rainfall of Tatinapara Village in Birbhum District[13].

Table-3: Some Important Ethnobotanical Plants/Flora in the Study Area.

Sl No	Image of The Plant/ Flora	Local/ Name & Habit	Scientific Name	Status according to IUCN	Uses
1.		Neem (Tree)	Azadirachta indica Juss	Categories -4: Lower Risk: Conservation Dependent(CD)	Young leaves used as vegetables. Neem stick used as a toothbrush to prevent caries. Leaf juice used in diabetes.
2.		Basak (Tree)	Justicia adhatoda	Categories -4: Lower Risk: Conservation Dependent(CD)	Leaf juice is used as an expectorant to treat Asthma.
3.		Kalmi sak (Herb)	Ipomoea aquatica Forsk	Categories -4: Lower Risk: Least Concern(LC)	Young twigs and leaves used as vegetables. Leaf and stem juice used in insect bites.
4.		Kulekhara (Herb)	Hygrophila schulli	Categories -4: Lower Risk: Least Concern(LC)	Leaf used as a vegetable. Leaf extract used to treat anemia.
5.		Dumur (Tree)	Ficus hispida	Categories -4: Lower Risk: Conservation Dependent(CD)	Fruits used as vegetables. White milky latex used in urethritis
6.		Dhoney (Herb)	Coriandrum sativum.	Categories -4: Lower Risk: Least Concern(LC)	Young leaves used as vegetables. Seeds are used for cooking. Fruits are used as digestive stimulants and anti-vomiting agents.
7.		Kalmegh (Herb)	Andrographis paniculata	Categories -4: Lower Risk: Conservation Dependent(CD)	Whole plant or leaf extract used for diabetes. Young leaf used as a vegetable.
8.		Bel (Tree)	Aegle marmelos (L.)	Categories -4: Lower Risk: Conservation Dependent(CD)	Ripe fruits and young fruits are edible. Fruit and seed used in stomach.

9.		Puin sak (Shrub)	Basella alba Stewart	Categories -4: Lower Risk: Least Concern(LC)	Root used to treat tuberculosis. Leaf is use as vegetable
10.		Akanda (Shrub)	Calotropis procera	Categories -4: Lower Risk: Least Concern(LC)	Leaves used to treat wounds
11.		Genda (Shrub)	Tagetes erecta l	Categories -4: Lower Risk: Least Concern(LC)	Leaf juice applied on cuts.
12.		Thankuni (Shrub)	Centella asiatica	Categories -4: Lower Risk: Conservation Dependent(CD)	Leaves used to treat diarrhea, Cold & cough
13.		Tulsi (Shrub)	Ocimum sanctum L.	Categories -4: Lower Risk: Least Concern(LC)	Leaves are used in cough and cold. Young leaf bud used vegetable
14.		Ghritkumari (Shrub)	Aloe vera	Categories -4: Lower Risk: Conservation Dependent(CD)	Aloe vera has been used for many years for various ailments, and is perhaps most popular for its soothing effects for sunburn. But aloe vera has many other potential benefits to the skin, as well, including fading dark spots and stretch marks, managing acne and slowing the signs of aging.
15.		Datura (Shrub)	Datura stramonium L	Categories -4: Lower Risk: Conservation Dependent(CD)	Seed used to treat dog bite.
16.		Nayantara (Shrub)	Catharanthus roseus (L.)	Categories -4: Lower Risk: Least Concern(LC)	Flowers are used for Puja. Whole plant or leaf extract used to treat diabetes

17.		Jaba (Herb)	Hibiscus rosa-sinensis L.	Categories -4: Lower Risk: Conservation Dependent(CD)	Leaves used to treat burning sensation, fatigue, skin diseases.
18.		Aada (Shrub)	Haigeng (Meich) Zingiber officinale Rosc.	Categories -4: Lower Risk: Least Concern (LC)	Rhizome used as vegetable. Rhizome paste used to treat bone fracture and is digestive and stimulant.
19.		Narkel (Tree)	Cocos nucifera	Categories -4: Lower Risk: Least Concern (LC)	Fruit used as vegetable. Used for the treatment of liver complaints, to treat diseased skin, teeth.
20.		Tentul (Tree)	Tamarindus indica L	Categories -4: Lower Risk: Least Concern (LC)	Young and rip Fruits and Seeds are used for food. Ash of stem bark used to cure wounds.
21.		Santi sak (Herb)	Alternanthera philoxeroides (Mart.)	Categories -4: Lower Risk: Least Concern (LC)	Young twig used as vegetable. Leaf used in eye and hair problems.
22.		Sushini sak / Water clover (Herb)	Marsilea quadrifolia	Categories -4: Lower Risk: Least Concern (LC)	Shusni sak are very useful for age-related skin problems. It reduces hair loss problems, and increase hair quality and texture.
23.		Sojne Sak (Herb)	Moringa Oleifera	Categories -4: Lower Risk: Least Concern (LC)	The greens (leaves) are one of the finest sources of minerals like calcium, iron, copper, manganese, zinc, selenium, and magnesium. Drumstick contains 18 amino acids which helps in treating many diseases
24.		Piyara (Tree)	Psidium guajava L	Categories -4: Lower Risk: Least Concern (LC)	Fruit used as a vegetable. Ripe fruits are edible. Bark used to prevent child dysentery

Interpretation: According to field surveys and data from various sources, natural vegetation in Tatinapara village currently covers approximately 3.6% to 4% of the total area. While the overall vegetation cover has declined over the years, most existing plant species fall under the 'Lower Risk' category of the IUCN Red List. However, due to limited awareness among villagers, trees are being cut down for personal use without plans for replantation, raising concerns about the future availability of vegetation and the potential disruption of ecological balance.

In the south-western part of the village, several traditional tree species have been planted collectively along pond banks. Many villagers are also engaged in vegetable cultivation, either on their own land or through sharecropping. Major crops in the study area include paddy, wheat, and mustard, while sugarcane, once cultivated here, is no longer grown.

The south-east and south-west regions of Tatinapara maintain relatively higher vegetation cover, supported by favourable conditions like flat land, ample water resources, and fertile soil. Natural disasters, particularly cyclones in recent years, have damaged many trees. Nonetheless, being a rural area, Tatinapara retains more vegetation than nearby urban settlements, which helps regulate temperature, support rainfall patterns, and mitigate environmental risks.

Socio-economic profile of the study Area: Demographic Status: Demographic characteristics play a crucial role in shaping the socio-economic development of any region. Based on field surveys, Tatinapara village has a total population of 759, comprising 392 males and 366 females. The total geographical area of the village is 145.32 hectares, resulting in a population density of approximately 5 persons per hectare. There are 191 households in the village. The sex ratio stands at 936 females per 1000 males, as per the latest field data. Among children in the 0–6 years age group, the child sex ratio is 894 girls per 1000 boys. These demographic figures reflect both the population structure and social indicators of the area[10-12].

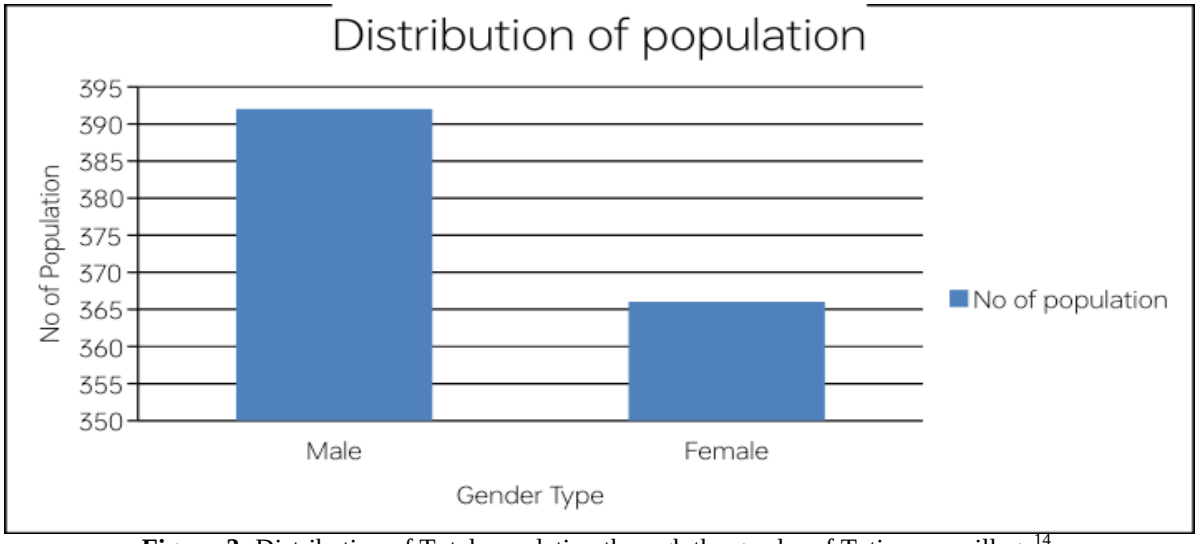

Figure-3: Distribution of Total population through the gender of Tatinapara village[14].

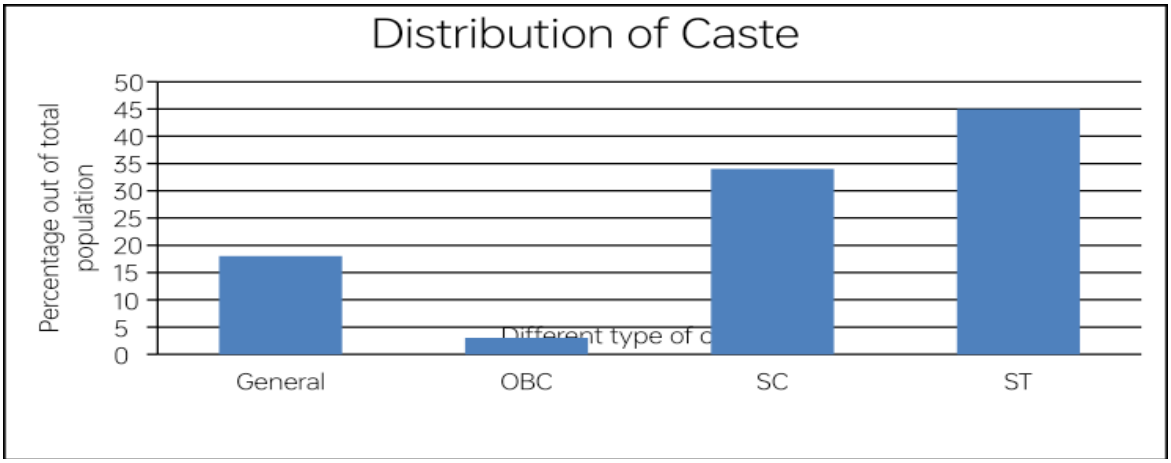

Figure-4: Distribution of caste among the total population of Tatinapara village.

Economic Status: As per the field survey, Tatinapara village has a total population of 759 residing in 191 households. The economic condition of the village is predominantly low, with approximately 85% of households falling under the low-income category, earning less than □10,000 per month. Around 8% of households have a monthly income between □10,000–□20,000, while 5% fall within the □20,000–□30,000 income range. Only 2% of households earn above □30,000 per month. These figures indicate a largely agrarian, labour-dependent economy with limited access to higher income opportunities[14,15].

Table-4: Distribution of Income level (Per month) of Tatinapara village.

Income group(per month)	Percentage out of total population
Below 10000	85
10000-20000	8
20000-30000	5
Above 30000	2

Educational Status: Tatinapara Village, being a rural settlement, lacks many of the amenities available in urban areas. According to the field report, out of the total population, 415 individuals are literate, comprising 242 males and 173 females. The overall literacy rate of the village stands at 61.94%, with male literacy at 70.14% and female literacy at 53.23%[10,12,14,15].

Settlement Pattern: In rural areas, the presence of water bodies and road networks plays a crucial role in determining settlement patterns. Based on the field survey, around 80% of the households in Tatinapara Village are clustered along roadsides and near accessible water sources, while the remaining 20% of households are scattered in various locations based on personal preferences[10,12,14,15].

Health Condition: The overall health condition of the village is modest. There is only one healthcare center within the village, which lacks adequate facilities and is limited to providing basic first-aid services. For more serious medical needs, residents rely on Labpur Rural Hospital, which itself suffers from insufficient infrastructure and manpower. As a result, patients are frequently referred to Sian Subdivision Hospital or Suri Sadar Hospital for proper treatment due to the lack of essential healthcare services and resources in the nearby facilities[10,11,12,14,15].

Role of Floral Biodiversity on livelihood: i. Biodiversity ensures a diverse range of food sources including fruits, vegetables, fish, meat, and grains, which are crucial for food security. In rural areas like Tatinapara village, most residents fulfill their daily needs for food grains and vegetables through their own agricultural practices. This self-sufficiency significantly supports their sustenance and nutrition. ii. Biodiversity underpins a variety of income-generating activities such as agriculture, forestry, fisheries, and ecotourism. In Tatinapara, around 80% of the local economy is agriculture-based, allowing villagers to enhance their standard of living through the cultivation of food crops and other plant-based resources. iii. Natural ecosystems like forests and grasslands contribute to carbon sequestration and regulate the Earth's climate. In Tatinapara, the presence of rich vegetation acts as an important climate regulator, making the area environmentally stable and suitable for human habitation. iv. Medicinal Resources: Biodiversity provides valuable medicinal plants that have been used for generations to treat various ailments. In Tatinapara village, several ethnobotanical and medicinal plant species are scattered across the area and serve as vital resources for primary healthcare and traditional remedies.

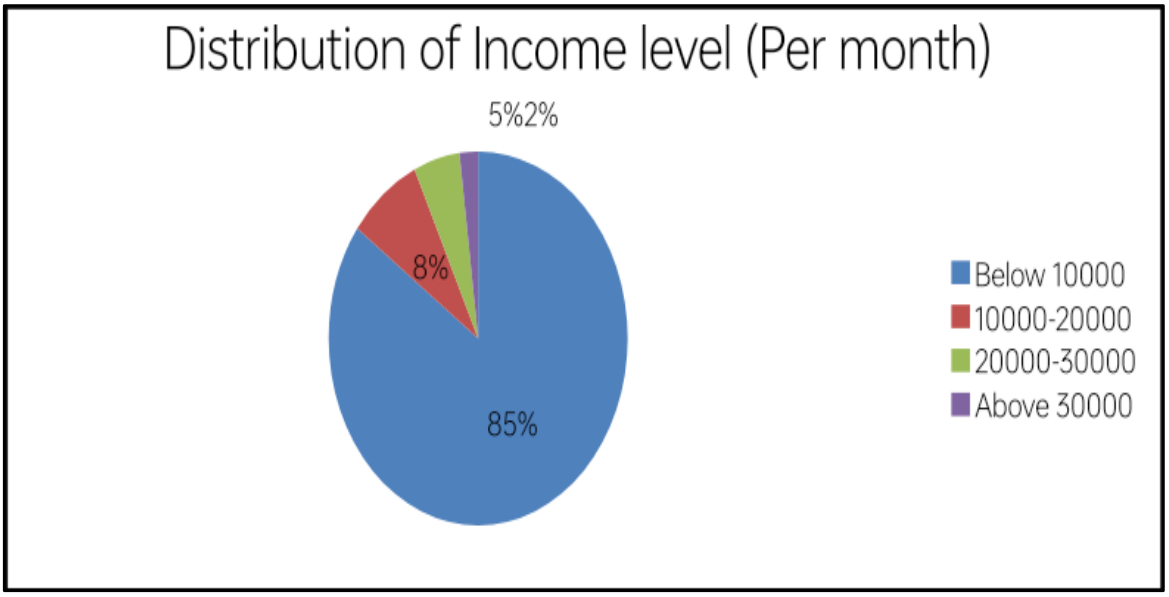

Figure-5: Distribution of Income level (Per month) of Tatinapara village.

Major Threats to Floral Biodiversity in the Study Area: Tatinapara village in West Bengal, known for its rich floral diversity including several rare and endemic species, is currently facing multiple threats: i. Rapid urbanization, agricultural expansion, and settlement growth are leading to habitat destruction and fragmentation, disrupting plant populations and reducing genetic diversity. ii. Excessive harvesting of medicinal and commercially valuable plants, especially non-timber forest products like sal leaves, is causing population decline in several species. iii. Increasing temperatures, irregular rainfall, and frequent extreme weather events are impacting plant distribution, abundance, and growth cycles. iv. Aggressive invasive like water hyacinth and lantana are spreading, displacing native flora and disturbing ecological balance. v. Limited public awareness and inadequate management practices hinder effective conservation efforts, putting local floral biodiversity at further risk.

Method of Floral Biodiversity conservation: i. Documentation is the initial step in biodiversity conservation is documenting the existing floral species within a given area. This includes preparing a comprehensive floral inventory detailing the distribution and abundance of plant species. Equally important is recording traditional knowledge associated with these plants, covering their uses in medicine, food, fiber, and cultural practices. ii. Identification is crucial to identify endemic, rare, and threatened plant species for effective conservation. This process involves accurately verifying species' identities, ideally with the expertise of botanists and plant taxonomists. iii. Continuous monitoring is vital in assessing the status of plant species over time. Regular surveys help detect changes in distribution and population dynamics, evaluate the success of ongoing conservation efforts, and identify areas needing further attention. iv. Restoring degraded habitats is an important strategy for preserving floral biodiversity. This involves ecological rehabilitation efforts aimed at reviving native plant species in areas affected by human activity or environmental degradation. v. Ex-situ Conservation involves protecting plant species outside their natural habitats, such as in botanical gardens, seed banks, or conservation parks. Ex-situ conservation ensures the preservation of genetic diversity, which can later support restoration and reintroduction initiatives. vi. Organizing awareness programs and educational initiatives is essential for promoting floral biodiversity conservation. Engaging local communities and stakeholders through workshops and outreach can foster sustainable resource use and environmental stewardship. vii. People's Biodiversity Register (PBR) a PBR is a community-prepared document that records information about local biodiversity, including the flora and fauna of an area, traditional knowledge of plant and animal uses, and conservation practices adopted by the local population[16]

Floral biodiversity indices are important for several reasons: i. These indices assist in identifying areas and plant species rich in biodiversity that require urgent conservation efforts. They serve as a foundation for setting conservation priorities and monitoring the effectiveness of protective measures over time. ii. Floral biodiversity indices are valuable tools for evaluating the impact of various agricultural practices on plant biodiversity. They help determine which crops and farming systems are most compatible with maintaining biodiversity, promoting eco-friendly and sustainable agriculture. iii. For ecologists, floral biodiversity indices offer a quantitative means to measure plant diversity within ecosystems. They support hypothesis testing, enable comparisons across different ecosystems, and help identify factors influencing biodiversity patterns. iv. These indices can quantify the economic and social value of plant biodiversity. They highlight the ecosystem services plants provide, the potential for bioprospecting, and the cultural, medicinal, and aesthetic significance of diverse flora.

Calculation of Floral Biodiversity Index at Tatinapara Village:

Table-5: Number of Major Plants in Tatinapara Village.

Name of Plants (Species)	Number (Abundance)
Mango Tree	121
Black Berry Tree	13
JackFruit tree	32
Ashwath tree	6
Rosewood Tree	72
Sonajhuri Tree	86
Arjun Tree	43
Palmyra palm tree	80
Date palm tree	26
Neem Tree	50
Guava tree	76
Banana Tree	95
River tamarind	34
Tamarind tree	38
Indian bael tree	18
Jujube tree	22
Coconut	73
Hog plum tree	21
Elephant Wood Apple	8
Others Plants (Natural Vegetation)	103
Others Plants (Vegetables)	71

Table-6: Calculation of Floral Biodiversity Index at Tatinapara Village through Shannon-Wiener diversity index method.

Name of Plants (Species)	Number of In dividual (n)	Proportion pi=n/N	In (pi)	pi*in (pi)
Mango Tree	121	0.12284264	-2.096851096	-0.25758272
Black Berry Tree	13	0.01319797	-4.327692284	-0.05711675
Jack Fruit tree	32	0.03248731	-3.426905738	-0.11133095
Ashwath tree	6	0.006091371	-5.100882172	-0.03107136
Rosewood Tree	72	0.073096447	-2.615975522	-0.19121852
Sonajhuri Tree	86	0.087309645	-2.438294345	-0.21288661
Arjun Tree	43	0.043654822	-3.131441525	-0.13670252
Palmyra palm tree	80	0.081218274	-2.510615006	-0.20390782
Date palm tree	26	0.026395939	-3.634545103	-0.09593723
Neem Tree	50	0.050761421	-2.980618636	-0.15130044
Guava tree	76	0.07715736	-2.561908301	-0.19767008
Banana Tree	95	0.096446701	-2.33876475	-0.22556614
River tamarind	34	0.034517766	-3.366281117	-0.11619651
Tamarind tree	38	0.03857868	-3.255055481	-0.12557574
Indian bael tree	18	0.018274112	-4.002269883	-0.07313793
Jujube tree	22	0.022335025	-3.801599188	-0.08490881
Coconut	73	0.074111675	-2.6021822	-0.19285208
Hog plum tree	21	0.021319797	-3.848119203	-0.08204112
Elephant Wood Apple	8	0.008121827	-4.813200099	-0.03909198
Others Plants (Natural Vegetation)	103	0.104568528	-2.257912653	-0.2361066
Others Plants (Vegetables)	71	0.072081218	-2.629961764	-0.18957085
Total	985			-3.01177277

Shannon-Wiener diversity index formula: $H=-\sum[(pi)\times\log(pi)]$.

Where: H- Shannon diversity index, pi – Proportion of individuals of i-th species in a whole community, ∑- Sum symbol, log – usually the natural logarithm, but the base of the base of the logarithm is arbitrary (10 and 2 based logarithms are also used), n – individuals of a given type / species. Abundance: 985 Species Richness: 21. Biodiversity (Floral) index: 3.01177277.

Major Findings: i. Trees are often felled without discretion, with the aim of generating income through the sale of fuel, furniture, and timber for livelihood purposes. ii. Villagers are reluctant to replant trees after cutting down mature ones. iii. There is inadequate care and maintenance of existing plants in the study area. iv. Trees are cut down indiscriminately due to limited space for settlement, road construction, and other development activities. v. There is a lack of awareness regarding the ecological importance of plants, particularly in terms of their contribution to livelihoods.

Recommendations: i. Alternative resources should be utilized to meet livelihood needs instead of cutting down trees. ii. After felling mature trees, the area should be replanted with saplings to ensure regeneration. iii. Living plants should receive proper care and regular maintenance to promote healthy growth. iv. Public awareness should be raised about the importance of vegetation for both the environment and livelihoods. v. Government actions should be carefully planned and effectively implemented. vi. Government initiatives are necessary to address the basic needs and improve the living conditions of the underserved populations in the study area.

Conclusion

The findings of the study indicate that the physical and socio-economic conditions of Tatinapara village are poor, with 85% of the population living below the poverty line. A significant portion of the villagers rely on agriculture, construction, and brick-making as daily labor to earn a living, which results in their inability to meet basic needs. The lack of proper education among many residents contributes to a general unawareness about environmental issues, leading to activities that harm the local ecosystem. Despite these challenges, the floral diversity in the area is satisfactory. However, it is crucial that both government authorities and local communities take proactive measures to conserve the area's floral biodiversity in a scientific and sustainable manner. Collective action is needed to address the socio-economic difficulties of the villagers while ensuring the long-term preservation of the natural environment. Education and awareness campaigns could also play a vital role in fostering environmental responsibility among the villagers.

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