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Development and Sustainability: A Case Study on Forest Resource Dependency of Tribal Communities in the Hilly Areas of Ajodhya Hill Region, Purulia, West Bengal

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Abstract
Sustainable tribal livelihoods encompass traditional practices, cultural values, and environmental stewardship that support tribal communities' economic well-being, cultural preservation, and environmental conservation. Tribal communities have an intrinsic connection with their environment, relying on forest resources for livelihood, cultural norms, and spiritual practices. Environmental sustainability is crucial for social and economic sustainability. Human activities, such as infrastructure development, dam construction, and tourism, contribute to forest degradation, affecting tribal livelihoods and biodiversity. The Ajodhya Hill Forest, inhabited by tribal communities like Santali and Munda, is facing degradation due to economic activities. This has shifted their dependency from forest resources to tourism and other sectors. Forest degradation has severe consequences, including loss of medicinal plants, air pollution, water scarcity, climate change vulnerability, and health problems. Tribal communities face environmental and socio-economic challenges, including food insecurity and social imbalance. This study focuses on sustainable tribal livelihoods, balancing economic growth with social equity and environmental conservation. It examines the impact of forest resources on tribal communities' socio-economic aspects, livelihood assets, and vulnerability. The research aims to inform strategies promoting sustainable livelihoods for tribal communities and contribute to sustainable development. It also seeks to provide valuable insights into the effectiveness of existing government policies for improving tribal sustainable livelihoods.

Keywords: Sustainable development, tribal livelihood, forest dependency, environmental conservation, forest degradation, socio-economic challenges.

1. Introduction

The concept of sustainable tribal livelihood encompasses the traditional practices, coping strategies, and cultural values that enable tribal communities to meet their economic needs while preserving their unique cultural heritage and harmonizing with their environment. Or, we can say that Sustainable tribal livelihood refers to the traditional ways of life, practices, and strategies that support tribal communities' economic

well-being, cultural preservation, and environmental stewardship. Tribal communities have a soul connection with the environment. For years, their existence, cultural norms, spiritual practices, and livelihood have relied on forest resources. Tribal communities' dependence on forest resources is a matter of livelihood sustainability, preservation of biodiversity, and cultural heritage. Environmental sustainability refers to a state of interconnectedness, resilience, and stability in which human society satisfies its own needs while neither overburdening the ability of its surrounding ecosystems to continue to renewable the services which is essential to meet those future needs (Morelli, 2011). environmental sustainability loss is a consequence of over-consumption or unrestrained use of natural resources, as a result, it reduces the effectiveness of crucial ecosystem services, including mitigation of erosion and climatic hazards, which leads to increased vulnerability to disasters and natural hazards, that can further cause environmental degradation. carbon dioxide emissions, Nitrogen dioxide emissions, deforestation, pollution, and land degradation in water are the five aspects of human-induced environmental degradation (Li, 2006). Sustainable development is a developmental condition in which human society meets its current needs without compromising the ability of future generations to satisfy their own necessities (WCED, 1987). We all know that for people's lives and livelihoods, forests are very important, and forests also play a crucial role in biodiversity and the climate crisis. Forests provide shade and shelter, food, air, timber, and medicine, and they act as a natural atmospheric purifier, helping in climate change vulnerability and sustainable biodiversity. The biggest impact of deforestation has been on the people who depend on the forest resources for their livelihood. We see the real picture of this among the tribal people of the hilly areas of Ajodhya Hill Region, Purulia, West Bengal. Environmental sustainability is a requirement for economic and social sustainability (Goodland, 1995). The Ajodhya Hill Forest area falls under the Purulia Forest Division and is classified as a Northern Tropical Dry Deciduous Forest. It is home to a diverse range of plant species, including Shorea robusta (Sal), Butea monosperma (Palash), Schleichera oleosa (Kusum), Madhuca indica (Mahua), Azadirachta indica (Neem), and Tectona grandis (Segun), which play an essential role in this region's ecological and socio-economic landscape. All those plant species are major sources of timber, poles, medicine, and firewood for local communities. The medicinal plant takes place of more than 100 species in this ecosystem and contributes significantly to traditional healthcare practices. The major inhabitant is scheduled cast and scheduled tribes, including Santali, Sarnath, Pahari, Addibassi, Munda, Saren, communities, etc. In this study area, an enormous number of residents incredibly depend on the forest resources for their daily life and livelihoods. However, due to commercial enterprises, government projects, and private interests for economic gains have driven deforestation in this hilly area. As a result, it has led to socio-economic challenges for the indigenous communities. In Ajodhya Hill, 97% of the local people depended on the forest resources for their subsistence, and due to a decrease in forest resources, the dependency on natural resources also shifted to earning from tourism and another sector (Palit et.al., 2021). The degradation of forest areas can be attributed to various factors, including infrastructure development, such as road construction and building projects, as well as the creation of dams and tourist facilities. Or, in an even more concise version, forest degradation is largely driven by human activities, including infrastructure development, dam construction, and tourism-related projects. Big dam construction projects contribute to the economic development of the nation but do not have the desired impact on the economic growth of the local inhabitants, rather in some cases, due to a major percentage of food requirements of their coming from the forests, it has been found to have a negative impact on their livelihood (Tewari 1989). Ajodhya hill plant is used for various medicinal purposes, although deforestation and climate change and biodiversity loss are responsible for

the extinction of these medicinal plants (Sur, et al.,1992), (Dey & De,2010). This also affects not only their economic condition but also their social and cultural norms and structure, their health, their children's education, and many more. Livelihood strategies based on non-farming and farming activities of the rural household can be constrained by deforestation. Deforestation is also associated with various other issues that hinder the adaptation process to climate change (Paavola 2008). Deforestation can lead to air pollution, which may cause severe health diseases. Deforestation increases environmental pollution, which is related to health problems like heart disease, respiratory diseases, and some types of cancer. Pregnant women and children are at higher risk of health problems related to pollution. Water scarcity, climate change vulnerability, soil erosion, loss of biodiversity, and inadequacy of medicine are also related to deforestation. Tribal communities in the hilly areas of Ajodhya Hill often face environmental and socio-economic challenges due to their distinct cultural practices and geographical location. They are suffering from food insecurity, man-animal conflict, social imbalance, etc. as a consequence of environmental change. It is essential to understand their livelihood patterns and how they are being affected by development processes.

Sustainable tribal livelihood prioritizes economic development that is inclusive of marginalized communities and environmentally conscious. Through an assessment of the shifts in tribal livelihood patterns, this research aims to inform strategies that promote sustainable livelihoods for tribal communities in the studied regions. So, this study focuses on sustainable tribal livelihood, balancing economic growth with social equity and environmental conservation. By analyzing changes in tribal livelihoods, it aims to contribute to sustainable development in these communities. The government makes various forest conservation acts to protect forests and forest dwellers, but many people don't know about them. For improving tribal sustainable livelihoods this study can provide valuable insights into the effectiveness of existing policies of government. The study examines various key indicators like livelihood assets, diversified livelihood situations, livelihood vulnerability, and alternative sustainable livelihood opportunities. This research will conduct a comparative examination of various tribal communities within the study area, aiming to identify both the divergences and convergences in their livelihood strategies, as well as the underlying factors that shape these patterns. The main objective of this study is to find out the impact of forest resources on the socio-economic aspects of tribal communities in the hilly areas of Ajodhya hill, Purulia district, West Bengal. In this study, we used a primary set of data from the Ajodhya hill region of Purulia district of West Bengal to accomplish the main objective.

2. Study Area and Methodology:

2.1. The Study Area:

The field survey has been conducted in Ajodhya Gram Panchayet, which is under the Bagmundi C.D Block in the Purulia district of west Bengal, with geographical location lying between 23º09′00′′N - 23º18′00′′N Latitude to 86º01′00′′E - 86º12′00′′E longitude. The total population of Ajodhya gram panchayet is 11468 (census 2011), and the total scheduled tribe is 10806 (census 2011) which is 94.23% of its total population. Also, Ajodhya gram panchayat contained the highest tribal population among the other GPs of Baghmundi C.D Block. The total geographical area of this region is 9682.14 hector (census 2011). The total forest area is 3955.85 hectares (census 2011), which is 40.86 % of the total geographical region. The total household of this area is 2326 (census 2011). Ajodhya gram panchayet is a forest and hilly area located in Ajodhya Forest and hill reserve area under of Purulia forest division. It is also a part of the easternmost Chotonagpur Malbhumi region.

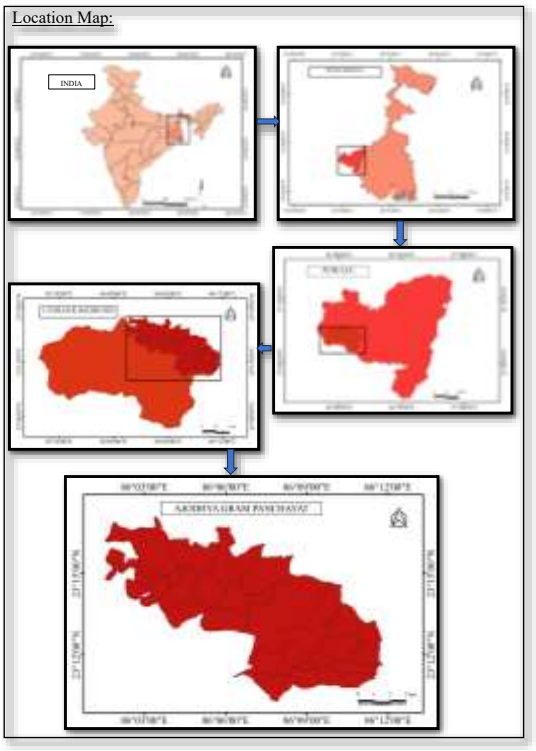

Fig. 1: Location map of the study area

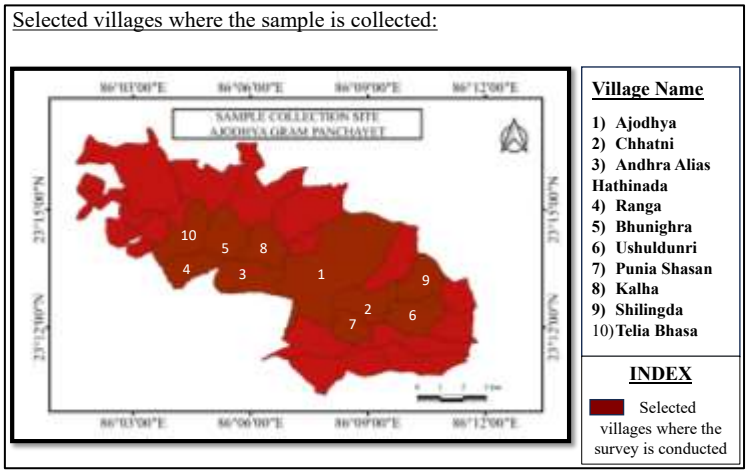

Fig. 2: Selected villages where the sample is collected

2.2. Sampling framework:

We conducted a primary survey of 10 villages in Ajodhya Gram Panchayat, which is under the Bagmundi C.D. Block in the Purulia district of West Bengal. The total number of households in this area is 1295 (census 2011), of which 203 households were surveyed, which is 15.66 % of the total households of the study area. In social science research, in the case of large populations, a 10% sample size is considered valid and reliable. A 10% sample size can provide valid insights for the large population, and when sampling is taken randomly (Neuman, 2014). For large populations, 10% sampling may amply the representation of the population for generalize findings (Babbie, 2010; Punch,2005). 10% sampling intensity is often adequate for reliable results for both practically and methodological.

2.3. Data collection:

This study integrates primary field research, using surveys, observations, and focus groups, with secondary data from online sources, journals, and government websites, including the Census of India 2011 and WBFD. Primary data was gathered through a comprehensive field survey, employing a structured questionnaire, household surveys, stratified random sampling, and face-to-face interviews. Additional insights were obtained through observational field notes, focus group discussions, and in-depth conversations with local residents and experts, leveraging their extensive knowledge and experience.

Supplementary data was sourced from various online platforms, academic journals, research papers, district handbooks, newspapers, and government websites, such as Census of India 2011 and the West Bengal Forest Department (WBFD).

2.4. Quantitative framework:

Logistic Regression Model (LRM) was used to examine the socio-economic dependency on forest resources and its impact on their livelihood. The Logistic Regression Model was used diversely in socio-economic studies. J.Hussain et al. (2019), Jannat et al. (2018), Jain and Sajjad (2016), Adam and El Tayyeb (2014), are used this model to analyze the demographic and economic variables and their impacts.

Education level, age, gender, income, occupation, and distance from the forest are taken as explanatory variables to determine the socio-economic dependency of the tribal population on forest resources. All of these explanatory variables are used in different literature to estimate forest dependency.

Education – Baiyegunhi et al. (2016), Jannat et al. (2018), Hussain et. al (2019), Doley (2022),

Age – Jain & Sajjad (2015), Gareake et al (2017), Jannat et al. (2018), Hussain et. al (2019), Doley (2022).

Gender – Doley (2022).

Occupation – Jannat et al. (2018), Hussain et. al (2019),

Distance from forest – Julia et al (2015), Aji & Rahut (2018), Hussain et. al (2019), Doley (2022).

income– Nelson et al. (2015), Hussain et. al (2019).

Table 1: Selected explanatory variable and expected Hypothesis

explanatory variable	Expected hypotheses
Education	negative
Age	Positive
Gender	positive
Occupation	positive
Distance from forest	negative
income	positive

Table 1: explanatory variables and expected hypotheses

Table 2: Demographic characteristics of households in selected villages of the study area.

Sl. No	Village name	population	households	Total tribal population	% of tribal population	Tribal Male population	Tribal Female population
1	Ajodhya	1648	327	1237	75.06%	627	610
2	Chhatni	823	165	820	99.63%	408	412

3	Andhra Alias Hathinada	724	145	719	99.30%	346	373
4	Ranga	726	145	714	98.34%	361	353
5	Bhunighra	505	99	498	98.61%	263	235
6	Ushuldunri	476	93	467	98.10%	213	254
7	Punia Shasan	430	82	428	99.53%	212	216
8	Kalha	422	79	422	100%	208	214
9	Shilingda	369	82	369	100%	195	174
10	Telia Bhasa	367	78	367	100%	191	176

Table 2: Source: Census of India (2011)

2.5. household income computation and income sources:

household income estimated based on pokhriyal et al. (2010), J. Hussain et al. (2019) approach.

Total household income = Σ (forest income + agriculture income + livestock income + off-farm income).

Forest income sources: fuelwood, lumbering, medicinal herbs, honey, nuts, and fruit, kendu lives, tobacco lives, and other narcotics, and other forest products.

Agriculture income: annual income from cultivation on forest land, and cultivation on other land.

livestock income: commercial grazing, non-commercial grazing.

off-farm income: labor, seasonal labor, govt. service and others.

3. Result and discussion:

3.1. Households' characteristics:

The study surveyed 203 households, representing 15.66 % of the total 1295 households in the area (Census 2011). The respondents comprised 52% females and 48% males.

3.1.1. Education Level

The education level of household heads revealed that an enormous percentage (47.92%) were illiterate, while 14.58% had primary education, 15.1% had upper primary education, 15.6% household heads had secondary education, and a minimal percentage (6.82%) had higher secondary education or above. This highlights a significant proportion of illiterate individuals and those with low educational attainment.

3.1.2. Occupation

The primary occupations among households were lumbering (32%), farming (29%), laboring (18%), and processed narcotics (16%), indicating a strong reliance on forest resources and agricultural activities. Alternative job opportunities for tribal people appear limited.

3.1.3. Monthly Household Income

The monthly household income distribution showed that 77.6% earned less than ₹6,000, 21.9% earned ₹6,000-12,000, and only 0.5% earned more than ₹12,000, reflecting the poor economic conditions in the study area.

3.1.4. Distance from Forest

The data revealed that 55.7% of households resided within 1 km of the forest, 22.4% within 1-2 km, 11.5%

within 2-3 km, 6.3% within 3-4 km, and 4% more than 5 km away. Notably, 89.6% of households lived within 3 km of the forest, indicating a strong dependence or reliability on forest resources for their daily necessities, livelihood, and economic condition, which may influence forest-based occupations.

3.2. Major source of income:

The data reveals that households in the Ajodhya Hill region primarily rely on forest-based activities for their livelihood and economic sustainability. The main sources of household income are lumbering (32%), farming (29%), laboring (18%), and processed narcotics (15.5%). A negligible percentage of households are engaged in government services (0.5%) or other activities (5%).

Among those dependent on forest resources, the majority of their income comes from:

- Lumbering (60.85%)
- Collecting and selling forest-based narcotics (29.72%)
- Collecting and selling medicinal herbs (5.19%)
- Collecting and selling honey, nuts, and fruits (3.30%)
- Other forest-related activities (0.9%)

The findings highlight a substantial dependence on forest-based activities, underscoring the economic vulnerability of these households. The sustainability of forest resources directly impacts their income, emphasizing the need for sustainable forest management.

3.3. Utilization of forest resources among the tribal population:

The study area's tribal population relies heavily on the forest for various essential purposes. The primary uses of forest resources among the tribal population can be categorized into different activities:

1. Fuelwood and Dry Wood Collection (34.3%): The enormous number of the tribal population in this study area collects fuelwood and dry wood from the forest for domestic purposes, such as cooking and heating. This activity is essential for their daily survival and is a critical component of their livelihood.
2. Livestock Grazing (29.9%): A significant proportion of the tribal population in this study area engages in livestock grazing and relies on the forest as a source of fodder. This activity is vital for their livelihood, as it provides them with a source of income and sustenance.
3. Cultivation on Forest Land (16.7%): A smaller but still significant proportion of the tribal population in the aforesaid study area cultivates crops on forest land, often using traditional farming practices. This activity provides them with a source of food and income and is an important part of their cultural heritage.
4. Processing narcotic using forest products (13.7%): A number of tribal populations in the study area processed narcotic by using tendu leaves (mainly used for bidi making), tobacco leaves, for earning purpose.
5. others (5.4%): In this category Collecting wild berries and fruits (2%), collecting honey (1.7%), collecting medicinal herbs (1.5%), are significant and some others (0.2%) uses are not significant.

These findings highlight the importance of forest resources for the livelihood and well-being of the tribal population in the study area. The forest provides them with essential goods and services, including fuelwood, fodder, and land for cultivation.

3.4. Characteristics of livelihood dependency on forest resources:

The study revealed that 81% of households in the study area depend on forest resources for their livelihood, emphasizing the vital role forests play in their way of life and subsistence. Notably, households with lower incomes and education levels tend to exhibit a higher dependency on forest resources.

Dominant Forest-Based Livelihoods:

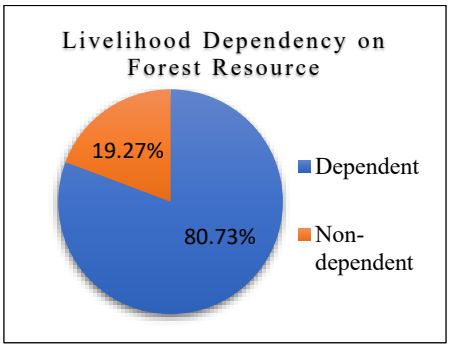

Fig 3: Livelihood Dependency on Forest Resource

1. Lumbering: Lumbering is the primary source of income for 60.85% of tribal households, indicating a significant reliance on this activity for economic sustenance.
2. Non-Timber Forest Products (NTFPs): 29.72% of tribal households depend on collecting and selling tendu leaves, tobacco leaves, and other narcotics, highlighting the substantial involvement in the trade of forest-based NTFPs.
3. Medicinal Herbs: 5.19% of tribal households rely on collecting and selling medicinal herbs, demonstrating a limited but notable dependence on traditional medicine and herbal trade.
4. Forest-Based Food Products: 3.30% of households depend on collecting and selling honey, nuts, and fruits, suggesting that while these products contribute to their income, they are not a primary source of livelihood.
5. Other Forest-Based Activities: Only 0.94% of households engage in other forest-based activities, indicating that the majority of households' economic dependence on forests falls within the aforementioned categories.

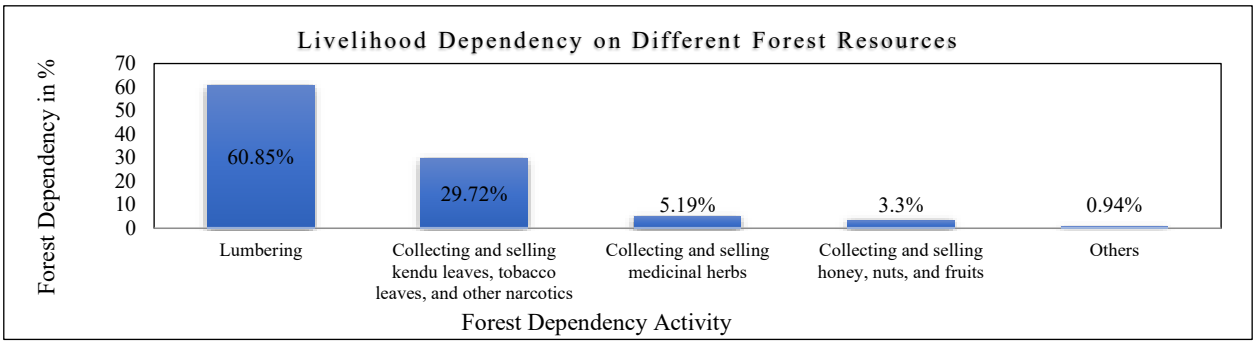

Fig.4: Livelihood Dependency on Different Forest Resources

3.4.2. Gender Roles in Forest Dependency:

Results show that both genders depend highly on forest resources for their livelihood. Compared to males, females are more dependent on the forests for economic needs. 81.37 % of the female population is dependent on the forests for their livelihood whereas 79.21 % of the male population is dependent on the forest resources.

3.5. Factors affecting livelihood dependency on forest resources:

Table 3: Factors affecting livelihood dependency on forest resources

Variable	Coefficient	Std. err	p> I z I	95%confidence	Odds ratio
Intercept	0.450	0.1717	0.009	0.1135	1.568
Gen (Gender)	0.007	0.5029	0.885	-0.0913	1.007
Edu (Education)	-0.014	0.0186	0.459	-0.0503	0.986
Age	-0.001	0.0018	0.736	-0.0041	0.999
Occ1 (Farmer)	0.151	0.0463	0.001	0.0599	1.163
Occ2 (Lumbering)	0.523	0.0484	0.000	0.4284	1.687
occ4 (Labour)	0.019	0.0458	0.686	-0.0712	1.019
Inc (Income)	-0.038	0.0455	0.401	-0.1274	0.963
Dff (Distance from forest	-0.018	0.0179	0.326	-0.0527	0.982

Table no. 3: Factors affecting livelihood dependency on forest resources:

The analysis identified significant variables that impact dependency on forest resources:

- Occupation: Farmers (Occ1) and lumbering (Occ2) exhibit a higher dependency on forest resources. This is likely due to the benefits forests provide, such as fuelwood, timber, and supplementary income.

In contrast, the following variables did not show a significant effect:

- Demographic factors: Gender, education, and age
- Economic factors: Labor (Occ4), income, and distance from the forest

The intercept (_cons) revealed a significant effect, indicating that other underlying factors may influence livelihood dependency on forest resources.

This analysis highlights the critical role of occupation in shaping dependency on forest resources, particularly for farmers and lumbering.

3.6. Factors affecting forest degradation:

The study's findings indicate that an overwhelming majority (93%) of the tribal population in the study area perceives a significant change in forest resources over the past few decades. Furthermore, 91% of the tribal population attributes this change to deforestation, highlighting the severe impact of human activities on the forest ecosystem.

Key Factors Contributing to Forest Degradation

The tribal population identified the following primary factors contributing to forest degradation:

- Tourism (25%): The increasing influx of tourists in the region has led to the degradation of forest resources, primarily due to the construction of infrastructure, such as hotels, roads, and other facilities.
- Lumbering (25%): The harvesting of timber and other forest products has resulted in widespread deforestation, contributing significantly to forest degradation.
- Cultivation of Forest Land (20%): The expansion of agricultural activities into forest areas has led to the clearance of forests, further exacerbating forest degradation.
- Construction of resort (19%):
- construction of roads (4.8%):

- grazing animal (2%):
- others (4%):

3.7. Acknowledgment of forest policy among the tribal population:

The study's results reveal a concerning lack of awareness about forest policy among the tribal population. Approximately 44% of the tribal population is aware of forest policy, while a significant majority (56%) lacks knowledge about it. This highlights the need for increased awareness and education about forest policy and its implications.

3.8. Tribal communities' participation in decision-making on forest resource management:

The study's findings indicate that 56% of the tribal population expresses interest in participating in decision-making processes regarding forest resource management. However, a substantial proportion remains uninterested in participating in such decision-making processes. This underscores the need for inclusive and participatory approaches to forest resource management, ensuring that the concerns and interests of tribal communities are taken into account.

4. Recommendation:

Recommendations for Sustainable Forest Management and Tribal Livelihoods:

To address the intricate challenges faced by tribal communities and promote sustainable forest management, the following comprehensive recommendations are proposed:

4.1. Diversify Livelihood Options:

Encourage alternative livelihood opportunities to reduce dependence on forest resources, thereby mitigating the pressure on forests. This can be achieved by:

- Providing training and capacity-building programs for tribal communities to engage in alternative livelihoods such as eco-tourism, handicrafts, and sustainable agriculture.
- Establishing market linkages to support the sale of tribal products and promote economic empowerment.
- Encouraging entrepreneurship and innovation among tribal youth to develop sustainable livelihoods.

4.2. Empower Tribal Communities:

Foster tribal community participation in forest resource management by:

- Recognizing and acknowledging forest rights and policies, ensuring that tribal communities have a stake in decision-making processes.
- Building capacity through awareness programs, enhancing their ability to manage forest resources sustainably and make informed decisions about their livelihoods.
- Supporting community-led conservation initiatives and providing resources to strengthen tribal institutions and governance structures.

By implementing these recommendations, we can promote sustainable forest management, reduce poverty, and enhance the livelihoods of tribal communities, ultimately contributing to a more equitable and environmentally conscious future.

5. Conclusion:

The Vital Importance of Forest Resources in Sustaining Tribal Livelihoods:

The findings of this study unequivocally underscore the critical role of forest resources in sustaining the livelihoods of tribal communities in the Ajodhya hill region of Purulia district, West Bengal. A substantial

majority of the tribal population (approximately 80%) relies heavily on forest resources for their livelihood, rendering them extremely vulnerable to changes in forest resources.

Key Takeaways

1. High Dependence on Forest Resources: The tribal population's high dependence on forest resources highlights the crucial role forests play in their lives and livelihoods.
2. Gender Dynamics in Forest Dependency: Both men and women exhibit a high level of dependence on forest resources, with women displaying a higher level of dependence compared to men.
3. Perceived Decline in Forest Resources: A significant proportion of the tribal population perceives a substantial decline in forest resources over the past few decades, attributing this decline primarily to tourism, lumbering, and cultivation on forest land.
4. Knowledge Gap and Disinterest in Forest Policy: A remarkable proportion of the tribal population lacks awareness about forest policy and exhibits limited interest in participating in decision-making processes regarding forest resource management.

Implications and Future Directions:

The study's findings have significant implications for policymakers, practitioners, and researchers. To promote sustainable tribal livelihoods, it is essential to:

1. Recognize and Address the Knowledge Gap: Implement awareness and education programs to enhance knowledge about forest policy and promote participation in decision-making processes.
2. Foster Community-Led Conservation Initiatives: Support community-led conservation initiatives and provide resources to strengthen tribal institutions and governance structures.
3. Promote Alternative Livelihood Opportunities: Encourage alternative livelihood opportunities to reduce dependence on forest resources and mitigate the pressure on forests.
4. Address Gender Dynamics in Forest Resource Management: Consider gender dynamics in forest resource management and promote gender-equitable access to forest resources and decision-making processes.

By addressing these challenges and opportunities, we can promote sustainable tribal livelihoods, reduce poverty, and enhance the overall well-being of tribal communities, ultimately contributing to a more equitable and environmentally conscious future.

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