

UNDERSTANDING RURAL MALNUTRITION THROUGH THE LENS OF SOCIAL DETERMINANTS: LAND POSSESSION, WATER RESOURCES, AND ECONOMIC STATUS

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Abstract

The 'Narva' initiative, a flagship water conservation program implemented by the Chhattisgarh government, represents a significant effort to restore natural water streams and improve groundwater levels across the state. This empirical study examines the ecological and socioeconomic impacts of this initiative on the Boramdeo Wildlife Sanctuary (BWS) and its surrounding landscape. Situated in the Kabirdham district and part of the critical Kanha-Achanakmar corridor in the Central Indian landscape, BWS faces complex conservation challenges involving biodiversity preservation, water resource management, and community livelihoods. Through comprehensive field surveys, hydrological assessments, biodiversity monitoring, and socioeconomic evaluations conducted from 2020-2024, this research documents tangible improvements in water availability, habitat quality, and wildlife populations following Narva interventions. The initiative has shown positive correlations with groundwater recharge, increased vegetation diversity, and enhanced wildlife sightings, particularly during dry seasons. Socioeconomically, local communities, including the indigenous Baiga and Gond tribes, have experienced improved agricultural productivity, reduced water scarcity, and new ecotourism opportunities. However, challenges remain in balancing conservation goals with community needs, particularly regarding potential land-use conflicts and ensuring equitable distribution of benefits. This study provides critical insights for adaptive management of integrated conservation-development initiatives in similar landscapes across India.

Keywords: *Water conservation¹, Wildlife ecology², Narva initiative³, Biodiversity⁴, Socioeconomic impact⁵*

1. Introduction

Background of the Narva Initiative and Boramdeo Wildlife Sanctuary

The 'Narva' initiative, a component of Chhattisgarh's broader 'Narva, Garva, Ghurva, Bari' (NGGB) rural development scheme launched in 2019, focuses on the rejuvenation of water streams ('Narva' in the local dialect) to enhance water conservation and availability throughout the state. This ambitious program aims to restore natural drainage systems, create water retention structures, and improve groundwater recharge through sustainable watershed management approaches. By 2023, the initiative had reportedly treated over 6,400 water streams across Chhattisgarh and established more than 119 million groundwater augmentation structures (The Week, 2023). The Boramdeo Wildlife Sanctuary (BWS), established in 2001 and covering approximately 352 square kilometers in the Kabirdham district of Chhattisgarh, represents a critical conservation area within the larger Central Indian landscape. Named after the 11th-century Boramdeo Temple (often called the "Khajuraho

of Chhattisgarh"), this sanctuary forms part of the vital Kanha-Achanakmar tiger corridor. BWS is characterized by diverse topography including undulating hills, dense forests, and seasonal streams, serving as the origin point for the Fen and Sankari rivers. The sanctuary hosts predominantly tropical moist and dry deciduous forests with valuable species like Sal (*Shorea robusta*), Saaj (*Terminalia tomentosa*), and Tendu (*Diospyros melanoxylon*), supporting wildlife including tigers, leopards, sloth bears, and numerous bird species.

Conservation Significance and Challenges

BWS occupies a strategically important position in the Central Indian conservation landscape, functioning as a crucial link between Kanha National Park in Madhya Pradesh and the Achanakmar Tiger Reserve in Chhattisgarh. This connectivity is vital for maintaining viable populations of wide-ranging species, particularly tigers, by facilitating genetic exchange and seasonal movements. The sanctuary's conservation significance extends beyond large mammals to include diverse flora, avifauna, and numerous ecosystem services provided to surrounding communities. Despite its ecological importance, BWS faces substantial conservation challenges. Water scarcity, particularly during dry seasons, has historically affected both wildlife and local communities dependent on forest resources. The sanctuary and surrounding areas have experienced pressures from habitat fragmentation, human-wildlife conflicts, and unsustainable resource extraction. Additionally, the region has witnessed periodic droughts impacting both natural ecosystems and agricultural productivity in peripheral areas. The indigenous Baiga and Gond tribal communities, classified as Particularly Vulnerable Tribal Groups (PVTGs), maintain traditional forest-dependent livelihoods but face increasing socioeconomic challenges.

Research Objectives and Significance

This study aims to empirically assess the ecological and socioeconomic impacts of the Narva initiative on BWS and its surrounding landscape through the following specific objectives:

1. Evaluate changes in hydrological parameters, including groundwater levels, stream flow persistence, and water availability in critical wildlife habitats following Narva interventions.
2. Document shifts in floral and faunal diversity, with particular emphasis on indicator species and habitat quality assessments.
3. Analyze socioeconomic outcomes for local communities, including changes in agricultural productivity, resource access, and livelihood opportunities.
4. Identify implementation challenges, management gaps, and potential improvements for optimizing conservation outcomes.
5. Develop evidence-based recommendations for scaling similar integrated water-conservation and biodiversity initiatives across protected area landscapes.

This research addresses critical knowledge gaps regarding the effectiveness of landscape-level water conservation initiatives in achieving dual ecological and socioeconomic benefits. As climate change exacerbates water scarcity issues across India's wildlife habitats, understanding the outcomes of interventions like Narva becomes increasingly important for adaptive conservation management. Furthermore, this study contributes to the broader discourse on balancing conservation priorities with community development needs in socio-ecologically complex landscapes.

2. Survey of Literature

The interconnections between water resource management, ecological integrity, and community wellbeing have been extensively studied across diverse landscapes globally. This literature survey examines key research strands relevant to assessing water conservation initiatives like Narva in protected area contexts. Watershed-based conservation approaches have gained significant attention as integrative frameworks for addressing both ecological and human needs. Krishnaswamy et al. (2018) demonstrated that strategic watershed interventions in

the Western Ghats improved dry-season stream flows by 30-40% while enhancing forest regeneration. Similarly, Reddy et al. (2021) documented positive outcomes from watershed management programs in Andhra Pradesh, including improved agricultural yields, reduced soil erosion, and enhanced groundwater availability. However, Vaidyanathan (2019) cautioned that watershed interventions can produce uneven benefits and sometimes exacerbate existing inequalities without proper social safeguards. Water availability fundamentally influences wildlife distribution patterns and ecological processes in tropical dry forests. Long-term studies by Karanth and Sunquist (2020) in the Nagarhole-Bandipur landscape showed that artificial water source management significantly affected large mammal movements and predator-prey relationships. Kumar et al. (2022) found that strategic water augmentation in Ranthambore Tiger Reserve reduced wildlife movement into human-dominated areas during summer months by approximately 40%, potentially mitigating human-wildlife conflicts. However, Sankar and Acharya (2019) emphasized that poorly designed water interventions can create ecological traps by artificially altering habitat use patterns and disease transmission dynamics.

The socioeconomic dimensions of conservation interventions have received growing attention in conservation literature. Ghate and Nagendra (2021) analyzed 24 community-based conservation initiatives across Central India, finding that programs integrating livelihood benefits with conservation objectives achieved significantly higher community participation and compliance. Rai and Bawa (2023) specifically examined water conservation projects involving tribal communities in Odisha, demonstrating that successful initiatives incorporated traditional ecological knowledge and established clear benefit-sharing mechanisms. Importantly, Singh et al. (2020) identified that conservation initiatives often struggle with equity concerns, with benefits disproportionately accruing to certain community segments while costs are borne more broadly. In the Central Indian landscape specifically, research on ecological corridors has highlighted the critical importance of maintaining connectivity between protected areas. Qureshi et al. (2021) used long-term camera trapping data to document tiger movement patterns across the Kanha-Pench corridor, demonstrating that functional connectivity depends heavily on maintaining habitat quality in intervening forest patches. Sharma et al. (2023) found that dispersing tigers in Central Indian corridors selected routes based primarily on forest cover, water availability, and reduced human disturbance. These findings underscore the potential importance of initiatives like Narva in maintaining corridor functionality.

Studies focusing on the Baiga and Gond communities around protected areas have documented complex relationships with conservation interventions. Agarwal and Saxena (2019) recorded the traditional ecological knowledge of Baiga communities in Chhattisgarh, highlighting sophisticated understanding of forest-water relationships that could inform conservation planning. Padhi and Mishra (2022) documented shifts in Baiga livelihoods following conservation interventions, noting both adaptation strategies and vulnerabilities created by changing resource access regimes. Despite this rich literature base, significant gaps remain in understanding the specific impacts of water conservation initiatives like Narva within wildlife sanctuary contexts. Few studies have employed robust before-after-control-impact designs to isolate intervention effects from background trends. Additionally, most research has examined either ecological or socioeconomic outcomes separately, rather than analyzing their interactions within an integrated framework. This study addresses these gaps by employing a multi-dimensional assessment approach within the specific context of BWS.

3. Methodology

The study adopted a mixed-methods research design integrating quantitative ecological assessments with qualitative socioeconomic evaluations to comprehensively analyze the impacts of the Narva initiative in the Boramdeo Wildlife Sanctuary (BWS) and its 5 km buffer zone covering 27 tribal villages. A modified Before-After-Control-Impact (BACI) framework was applied, comparing pre-implementation (2018–2019) and post-implementation (2020–2024) data, with control sites established in non-intervention areas to distinguish Narva-specific effects. Hydrological data were gathered through quarterly monitoring of 35 wells, stream flow observations using v-notch weirs, and rainfall records from automated weather stations. Ecological data included vegetation surveys across stratified plots, wildlife monitoring using camera traps, line transects, and

bird point counts, complemented by habitat quality assessments. Socioeconomic data were obtained through household surveys, interviews, and focus group discussions to capture community perceptions and livelihood changes. Agricultural productivity was evaluated through crop yield analysis across multiple seasons. Analytical methods integrated statistical models such as ANOVA, mixed-effects, and multivariate analyses for ecological data, while thematic analysis using NVivo structured qualitative insights under the Sustainable Livelihoods Framework. A composite impact assessment matrix synthesized ecological and socioeconomic outcomes, ensuring rigorous validation through sensitivity testing and data triangulation to evaluate conservation-development trade-offs effectively.

4. Data Collection and Analysis

Hydrological Impact Assessment

Groundwater monitoring revealed significant positive changes in areas where Narva interventions were implemented. Table 1 presents comparative groundwater level data from treatment and control sites across different seasons over the study period.

Table 1: Mean Groundwater Level Changes (in meters below ground level) Before and After Narva Interventions

Site Category	Pre-monsoon (Apr-May)			Post-monsoon (Oct-Nov)		
	Before (2018-19)	After (2022-23)	Change	Before (2018-19)	After (2022-23)	Change
Treatment Sites (n=20)	12.34 ± 2.41	9.57 ± 1.89	-2.77*	7.26 ± 1.36	5.13 ± 1.22	-2.13*
Control Sites (n=15)	11.98 ± 2.17	11.45 ± 2.06	-0.53	7.01 ± 1.42	6.78 ± 1.37	-0.23

*Statistically significant (p<0.01) Note: Negative change values indicate rising water levels (improvement)

Statistical analysis showed that treatment sites experienced significantly greater groundwater level improvements compared to control sites (F=18.42, p<0.001), with mean water level rises of 2.77m during pre-monsoon and 2.13m during post-monsoon periods. This improvement was most pronounced in watersheds where comprehensive treatment including both upstream and midstream interventions had been implemented. Stream flow persistence measurements revealed extended flow durations in treated streams. Table 2 illustrates the changes in dry season flow persistence before and after interventions.

Table 2: Dry Season Stream Flow Persistence (Days with Active Flow, February-May)

Stream Category	Before Intervention (2019)	After Intervention (2023)	Percent Change
Treated Streams (n=8)	42.3 ± 12.7	78.6 ± 15.4	+85.8%*
Control Streams (n=4)	40.1 ± 13.2	43.2 ± 11.9	+7.7%

*Statistically significant (p<0.01)

Water quality parameters also showed improvements in treated streams, with reduced turbidity (mean reduction 37.6%) and increased dissolved oxygen levels (mean increase 22.3%) during dry seasons, indicating more stable aquatic ecosystems. These hydrological improvements created cascading ecological effects throughout the sanctuary ecosystem.

Biodiversity Impact Assessment

Vegetation surveys documented significant changes in plant community structure following hydrological improvements. Table 3 presents vegetation diversity metrics across treatment and control sites.

Table 3: Changes in Vegetation Diversity Indices Before and After Narva Interventions

Parameter	Treatment Sites		Control Sites	
	Before (2019)	After (2023)	Before (2019)	After (2023)
Shannon-Wiener Diversity (H')	2.31 ± 0.24	2.86 ± 0.31*	2.29 ± 0.27	2.37 ± 0.29
Species Richness (per 100m ²)	18.7 ± 3.4	25.3 ± 4.2*	19.1 ± 3.6	20.2 ± 3.5
Basal Area (m ² /ha)	15.4 ± 2.7	17.8 ± 2.9*	15.1 ± 2.5	15.6 ± 2.6
Regeneration Density (saplings/ha)	1250 ± 215	1876 ± 247*	1285 ± 226	1342 ± 231

*Statistically significant (p<0.05)

Species composition analysis revealed notable increases in moisture-dependent understory species in treatment areas, with certain indicator species like *Adhatoda vasica* and *Mimosa pudica* showing 45-60% greater abundance. Riparian vegetation showed particularly pronounced recovery, with enhanced structural complexity and species diversity. Wildlife monitoring documented shifts in habitat use patterns and increased species detections in areas with improved water availability. Table 4 presents camera trap data for key wildlife species before and after Narva interventions.

Table 4: Camera Trap Detection Rates (captures/100 trap nights) Before and After Narva Interventions

Species	Treatment Areas		Control Areas	
	Before (2019)	After (2023)	Before (2019)	After (2023)
Tiger (<i>Panthera tigris</i>)	0.42 ± 0.11	0.87 ± 0.18*	0.45 ± 0.12	0.51 ± 0.14
Leopard (<i>Panthera pardus</i>)	1.21 ± 0.24	1.84 ± 0.31*	1.18 ± 0.22	1.26 ± 0.25
Sloth Bear (<i>Melursus ursinus</i>)	0.87 ± 0.17	1.32 ± 0.26*	0.92 ± 0.19	0.98 ± 0.20
Sambar (<i>Rusa unicolor</i>)	3.64 ± 0.54	5.82 ± 0.78*	3.58 ± 0.51	3.71 ± 0.55
Wild Boar (<i>Sus scrofa</i>)	4.12 ± 0.62	5.47 ± 0.71*	4.05 ± 0.59	4.21 ± 0.61

*Statistically significant (p<0.05)

Occupancy modeling indicated that water availability was a significant predictor of habitat use for most species, with greatest effects observed during dry seasons. Bird diversity showed similar positive responses, with riparian specialists and water-dependent species showing 32% higher richness in treated areas by 2023 compared to 2019 baselines.

Socioeconomic Impact Assessment

Household surveys revealed multidimensional socioeconomic impacts across communities surrounding BWS. Table 5 summarizes key socioeconomic parameters before and after Narva interventions.

Table 5: Changes in Key Socioeconomic Parameters in Villages Near Narva Intervention Sites

Parameter	Before (2019)	After (2023)	Percent Change
Average Annual Agricultural Income (INR)	42,560 ± 8,740	58,420 ± 9,650	+37.3%*
Average Crop Yield (Paddy, quintals/ha)	18.3 ± 3.2	24.7 ± 3.8	+35.0%*
Households Reporting Water Scarcity (%)	67.8%	31.4%	-53.7%*
Average Time Spent Collecting Water (hrs/day)	2.8 ± 0.6	1.3 ± 0.4	-53.6%*
Households with Kitchen Gardens (%)	23.6%	56.8%	+140.7%*
Households Reporting Wildlife Conflicts (%)	58.4%	41.2%	-29.5%*

*Statistically significant ($p < 0.05$)

Qualitative data from interviews and focus groups revealed more nuanced impacts. Improved water availability reduced women's labor burden significantly, with reduced time spent collecting water translating to increased engagement in productive activities, education, and community affairs. Community members reported perceived improvements in forest health, linking revitalized water sources with better overall ecosystem conditions: "The forest feels alive again; we see more animals near our village but they don't come for our crops as much because they have water in the forest" (Male Baiga respondent, 54 years). Ecotourism opportunities increased in villages near revitalized water bodies, with six new community-led tourism initiatives established between 2020-2023, generating supplementary income for approximately 120 households. Interestingly, 72% of surveyed community members expressed increased support for conservation efforts following Narva interventions, citing tangible benefits from improved ecosystem services. However, benefits were not uniformly distributed. Households with landholdings in closer proximity to recharged aquifers reported greater agricultural improvements. Additionally, some tensions emerged regarding water access rights and management responsibilities between upstream and downstream communities. Forest Department officials reported reduced incidences of illegal resource extraction, attributing this partly to improved livelihood conditions but acknowledging continued challenges in certain areas.

5. Result and Discussion

Integrated Ecological Outcomes

The empirical findings demonstrate that Narva interventions have catalyzed significant positive ecological changes within Boramdeo Wildlife Sanctuary. The documented improvements in groundwater levels (mean rise of 2.77m during critical dry periods) and extended stream flow persistence (85.8% increase in treated streams) have created cascading effects throughout the ecosystem. These hydrological improvements have directly influenced vegetation dynamics, with treatment areas showing markedly higher Shannon-Wiener diversity indices (2.86 vs. 2.37 in control sites) and improved regeneration rates (1876 vs. 1342 saplings/ha).

Table 6: Comparison of Key Ecological Indicators in Treated vs. Control Areas (2023)

Parameter	Treated Areas	Control Areas	Difference (%)	Statistical Significance
Mean Soil Moisture (%)	28.3 ± 3.6	19.7 ± 3.1	+43.7%	$p < 0.001$
Plant Species Richness	25.3 ± 4.2	20.2 ± 3.5	+25.2%	$p < 0.01$
Mammalian Species Richness	17.2 ± 2.4	13.8 ± 2.1	+24.6%	$p < 0.01$
Bird Species Richness	64.3 ± 7.8	52.1 ± 6.9	+23.4%	$p < 0.01$
Average Detection Rate (all species)	26.4 ± 4.2	20.5 ± 3.8	+28.8%	$p < 0.01$

These findings align with previous research on water-mediated ecological responses in similar landscapes. Kumar et al. (2022) found comparable impacts in Ranthambore, where strategic water interventions led to 25-30% increases in wildlife detection rates. Our results also confirm the theoretical model proposed by Krishnaswamy et al. (2018), which predicted that localized hydrological interventions could produce broader landscape-level ecological benefits through interconnected watershed processes. Particularly notable is the differential wildlife response during dry seasons. Camera trap data revealed that treatment areas maintained 43% higher large mammal detection rates during peak summer months (April-May) compared to control areas, suggesting that improved water availability is mitigating seasonal bottlenecks for wildlife populations. These findings support the "landscape supplementation" hypothesis proposed by Vaidyanathan (2019), wherein targeted resource augmentation can significantly influence wildlife distribution patterns and reduce stress during resource-limited periods. The ecological improvements documented in this study are especially significant given BWS's position within the larger Kanha-Achanakmar corridor. Enhanced habitat quality within the sanctuary

likely strengthens its functionality as a stepping-stone habitat for dispersing wildlife, particularly wide-ranging species like tigers. This aligns with findings from Sharma et al. (2023), who identified water availability as a key factor influencing corridor use by dispersing tigers in Central India.

Socioeconomic Dimensions and Community Perspectives

Narva interventions have generated multifaceted socioeconomic outcomes for communities surrounding BWS. The 37.3% increase in agricultural income and 35.0% improvement in paddy yields represent substantial material benefits, particularly for small-scale farmers who constitute the majority of the local population. The dramatic reduction in water scarcity reports (67.8% to 31.4%) indicates improved basic resource security for households.

Table 7: Statistical Analysis of Key Socioeconomic Indicators

Parameter	Chi-Square/t-value	p-value	Effect Size (Cohen's d)
Agricultural Income Change	t = 8.74	<0.001	0.76 (Medium-Large)
Water Availability Perception	$\chi^2 = 32.6$	<0.001	$\phi = 0.64$ (Large)
Conservation Attitude Shift	$\chi^2 = 24.9$	<0.001	$\phi = 0.58$ (Medium)
Wildlife Conflict Reports	$\chi^2 = 16.3$	<0.01	$\phi = 0.47$ (Medium)
Livelihood Diversification	t = 6.38	<0.001	0.59 (Medium)

These findings support the "conservation-through-development" model proposed by Ghate and Nagendra (2021), which posits that tangible material benefits can enhance community support for conservation initiatives. The significant reduction in wildlife conflict reports (-29.5%) suggests that improved resource availability within natural habitats may be reducing wildlife dependency on agricultural areas, creating a positive feedback loop between ecological and social outcomes. Particularly encouraging is the gendered dimension of benefits. The reduction in water collection time (2.8 to 1.3 hours daily) disproportionately benefits women and girls, who traditionally bear water collection responsibilities in these communities. Focus group discussions revealed that women have redirected this time toward education, economic activities, and community leadership roles, potentially shifting gender dynamics within households. These findings align with Rai and Bawa's (2023) conclusions that water-focused conservation initiatives can produce disproportionately large social benefits when they address fundamental resource constraints. However, our results also confirm Singh et al.'s (2020) caution regarding equity considerations, as benefits have not been uniformly distributed across all households and communities.

Comparative Analysis with Previous Conservation Approaches

When compared to previous conservation interventions in BWS and similar landscapes, the Narva initiative demonstrates several distinctive characteristics and outcomes worth noting.

Table 8: Comparative Analysis of Narva Initiative with Previous Conservation Approaches

Parameter	Traditional Protected Area Management	Previous Community-Based Conservation	Narva Initiative Approach
Primary Focus	Species protection through enforcement	Forest protection with limited use rights	Watershed restoration with multiple benefits
Community Role	Primarily recipients of restrictions	Participants in forest protection	Co-implementers across multiple activities

Ecological Impact Timeframe	Often delayed (5-10 years)	Moderate (3-7 years)	Relatively rapid (2-4 years)
Benefit Distribution	Often limited to tourism sector	Village-level with internal inequities	More spatially distributed but variable
Sustainability Mechanism	Enforcement-dependent	Depends on continued incentives	Potentially self-sustaining through natural processes

Traditional protected area management in BWS historically emphasized enforcement-based approaches with limited attention to water resource dynamics or community needs. The Narva initiative represents a more integrated approach addressing fundamental ecological processes (hydrological cycles) while simultaneously addressing critical community needs. This integration appears to generate stronger positive feedbacks between social and ecological outcomes than previous conservation models documented in the literature. Unlike some previous community-based conservation initiatives that focused primarily on forest protection activities, the Narva approach engages communities in reshaping fundamental landscape processes through water management. This appears to generate more diverse benefit streams and potentially stronger sustainability mechanisms, as many interventions become self-reinforcing through natural hydrological and ecological processes once established. The relatively rapid ecological responses documented in this study (significant changes within 2-4 years) contrast with longer timeframes often associated with traditional conservation approaches. This finding aligns with emerging literature suggesting that hydrological interventions may offer more immediate returns on conservation investments in water-limited landscapes compared to other intervention types (Reddy et al., 2021).

6. Conclusion

This empirical study provides evidence that the Narva initiative has generated substantial positive impacts on both ecological conditions within Boramdeo Wildlife Sanctuary and socioeconomic wellbeing in surrounding communities. Key findings demonstrate measurable improvements in groundwater levels, stream persistence, vegetation diversity, wildlife habitat use, agricultural productivity, and community livelihoods following water conservation interventions. The research reveals important synergies between ecological and socioeconomic outcomes, with improved water availability simultaneously addressing critical wildlife needs and community resource constraints. Particularly noteworthy is the initiative's effect on dry-season resource availability, which appears to mitigate a key ecological bottleneck while reducing community vulnerabilities. The initiative has contributed to strengthening BWS's functionality within the larger Kanha-Achanakmar corridor, potentially enhancing landscape connectivity for wide-ranging species. However, several challenges remain for optimizing conservation outcomes. Benefit distribution across communities shows spatial variability, with households closer to intervention sites generally experiencing greater improvements. Management responsibilities and water governance arrangements require further refinement to ensure long-term sustainability. Additionally, while wildlife conflicts have decreased, continued human-wildlife interface management remains important.

The study provides several actionable recommendations for conservation practitioners and policymakers:

1. Integrate watershed-based approaches as fundamental components of protected area management, particularly in water-limited landscapes, rather than treating them as supplementary interventions.
2. Strengthen institutional arrangements for collaborative water governance involving both forest departments and local communities to ensure sustainable management of created assets.
3. Develop explicit benefit-sharing mechanisms to ensure equitable distribution of gains across different community segments, with particular attention to landless households.
4. Expand systematic monitoring of both ecological and socioeconomic parameters to enable adaptive management and optimize intervention effectiveness.

5. Scale similar integrated approaches across the broader Central Indian landscape, prioritizing critical wildlife corridors and areas with high conservation-development potential.

This research contributes to the growing evidence base for integrated conservation approaches that address fundamental ecological processes while simultaneously meeting community needs. The Narva initiative demonstrates that targeted watershed interventions can catalyze positive cascading effects across both natural and social systems when appropriately designed and implemented. As climate change increasingly affects water availability across India's wildlife landscapes, such approaches may become increasingly important for sustainable conservation outcomes.

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