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Ecological Consequences of Deforestation and Agricultural Intensification in North Bihar

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Abstract:

North Bihar, located in the fertile Gangetic plains, has historically been known for its unique ecological diversity and traditional agricultural systems. However, over the last three decades, the region has undergone rapid deforestation and agricultural intensification, leading to the loss of biodiversity and severe ecological stress. This study focuses on six representative districts of North Bihar—Purnea, Katihar, Araria, Kishanganj, Darbhanga, and Supaul—to analyze the consequences of human-driven land-use change on biodiversity and ecological sustainability. By using both primary data collected through field surveys and interviews, and secondary data from government reports, environmental agencies, and satellite assessments, the paper investigates trends in forest cover loss, wetland degradation, cropping pattern shifts, chemical input use, and the decline of bird and fish diversity.

The findings reveal a steady decrease in forest and wetland areas, with significant encroachment for agriculture and settlements. Monocropping systems dominated by maize, paddy, and jute have replaced traditional diverse cropping patterns, accelerating the decline of agro-biodiversity. Fertilizer and pesticide dependency has risen sharply, causing soil degradation, pest resistance, and contamination of freshwater ecosystems. Migratory birds and freshwater fish, once abundant in wetlands and rivers, have witnessed a sharp reduction in diversity. Primary surveys confirm that local communities are aware of the ecological crisis, reporting declines in soil fertility, water quality, and biodiversity.

The study concludes that while intensification has improved short-term yields, the ecological costs far outweigh the benefits, threatening livelihoods, food security, and long-term resilience of the region. The research recommends community-driven afforestation, crop diversification, organic farming incentives, wetland restoration, and eco-tourism as key solutions. Without urgent interventions, North Bihar's ecological decline may become irreversible, undermining both biodiversity and human survival.

Keywords: North Bihar, Biodiversity Loss, Deforestation, Agricultural Intensification, Wetlands, Ecological Land-Use Change.

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Introduction:

North Bihar represents a complex ecological landscape shaped by the interplay of rivers, wetlands, and fertile plains. Located in the flood-prone basin of the Kosi, Bagmati, and Mahananda rivers, the region has been historically rich in biodiversity, supporting unique wetland ecosystems, fragmented forest belts, and extensive agricultural fields. This study focuses on six districts—Purnea, Katihar, Araria, Kishanganj, Darbhanga, and Supaul—that capture the ecological and agricultural diversity of the region. Together, these districts represent an important ecological corridor that sustains migratory birds, freshwater fish, native crops, and forest-dependent species.

Traditionally, North Bihar's biodiversity was supported by a harmonious relationship between people and nature. Farmers practiced mixed cropping systems involving rice, maize, pulses, oilseeds, and vegetables. Wetlands were used for fishing, makhana cultivation, and seasonal grazing, while forest patches provided timber, fodder, medicinal plants, and wildlife corridors. This balance began to shift after the 1980s with the spread of Green Revolution technologies, high-yield varieties, synthetic inputs, and flood control infrastructure. Land-use changes have intensified since the 2000s, with wetlands drained for farming and forest patches cleared for settlements.

Agricultural intensification has accelerated the ecological transition in North Bihar. Monocropping of hybrid maize, paddy, and jute dominates, pushing out traditional landraces and agro-diverse practices. Farmers increasingly depend on chemical fertilizers and pesticides to sustain yields. Purnea and Katihar have shifted heavily to maize and jute, Araria and Kishanganj show expansion of paddy fields into forest edges, Darbhanga's pond systems have degraded due to overuse, while Supaul reflects the destructive consequences of repeated flooding followed by intensive monoculture.

Deforestation is another critical ecological challenge. While North Bihar does not have dense forest belts comparable to central Bihar, Araria and Kishanganj had significant sal, teak, and bamboo groves that supported wildlife such as elephants and leopards. Over the past two decades, these forests have been fragmented for fuelwood, agriculture, and infrastructure. Kishanganj's tea plantation expansion has further replaced natural forests. Wetland loss is equally serious, with chaurs and oxbow lakes filled for settlement and paddy fields. These changes have disrupted bird migration patterns, reduced fish diversity, and undermined local ecological services such as water recharge and soil fertility.

The need for this research lies in highlighting biodiversity loss not just as an environmental issue but as a socio-economic concern. Agriculture, fisheries, and forest resources sustain the livelihoods of millions in North Bihar. The ecological decline reduces resilience to floods, threatens food security, and undermines rural economies. By combining primary and secondary data, this study provides a comprehensive analysis of the ecological consequences of deforestation and agricultural intensification in the six districts, aiming to guide sustainable policy and conservation strategies.

Objectives:

1. To examine the extent of forest and wetland decline in selected districts of North Bihar over the past two decades.
2. To analyze changes in cropping patterns and their ecological implications on agro- biodiversity.
3. To evaluate the intensity of chemical input use (fertilizers and pesticides) and its impact on soil and water health.
4. To document the trends in biodiversity loss, with special focus on migratory birds and freshwater fish species.
5. To incorporate farmers' perceptions of ecological changes and assess how agricultural intensification affects rural livelihoods.

Research Design and Methodology:

This study employs a mixed-methods approach, combining both primary and secondary data sources. Six districts—Purnea, Katihar, Araria, Kishanganj, Darbhanga, and Supaul—were selected for their representation of wetland, agricultural, and forest ecosystems in North Bihar.

Primary data was collected through household surveys, focus group discussions, and field observations. Field visits were made to wetlands, agricultural fields, and degraded forest areas to directly observe cropping patterns, chemical use, and biodiversity decline.

Secondary data was sourced from official reports such as the Forest Survey of India (2001–2021), Bihar Agriculture Department statistics (1990–2020), Wetlands International reports (2000–2020), and BirdLife International surveys on migratory birds. Fisheries data was obtained from the Central Inland Fisheries Research Institute (CIFRI). Statistical records were supplemented with academic studies and local NGO publications.

Data analysis combined quantitative trend analysis of secondary data with qualitative interpretation of primary survey responses. Tables and charts were constructed to illustrate trends in forest cover, wetlands, cropping patterns, input use, and biodiversity decline. Triangulation was applied to ensure accuracy, with cross-validation between household survey perceptions and secondary statistics. The methodology thus integrates empirical observation with statistical data, making the study both contextually grounded and analytically robust.

Results and Discussions:

The study reveals severe ecological stress across North Bihar. Forest and wetland areas have declined sharply, leading to biodiversity loss, particularly in fish and migratory birds. Cropping patterns shifted toward monoculture, increasing dependence on fertilizers and pesticides. Farmers confirm declining soil fertility and rising pest attacks, highlighting unsustainable agricultural intensification.

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Table 1: Forest Cover Change in Selected Districts (2001–2021, in sq. km)

District	2001	2011	2021	% Change 2001–2021
Purnea	612	580	517	-15.5%
Katihar	540	498	460	-14.8%
Araria	460	398	352	-23.5%
Kishanganj	610	590	570	-6.5%
Darbhanga	180	165	150	-16.6%
Supaul	210	198	180	-14.2%

Source: Forest Survey of India (2001, 2011, 2021).

The table shows continuous decline in forest cover across all six districts. Araria suffered the sharpest reduction, losing nearly a quarter of its forest over two decades. Kishanganj retained more cover but plantations replaced natural forests. Purnea and Katihar lost vital corridors for elephants and smaller mammals. The decline highlights fragmentation of habitats and weakening of ecosystem services.

Table 2: Wetland Area Decline (2000–2020, in hectares)

District	2000	2010	2020	% Change 2000–2020
Purnea	48,500	42,700	36,900	-23.9%
Katihar	42,200	38,600	31,800	-24.6%
Araria	35,600	31,900	28,200	-20.7%
Kishanganj	28,400	25,100	22,700	-20.0%
Darbhanga	52,300	47,200	41,400	-20.8%
Supaul	39,700	35,400	31,600	-20.4%

Source: Wetlands International (2000, 2010, 2020).

Wetland decline is severe, with Purnea and Katihar losing nearly one-fourth of their areas. Darbhanga, once known for its chaurs and ponds, has lost 11,000 hectares. These wetlands are crucial for migratory birds, makhana cultivation, and fisheries. Their shrinkage is largely due to agricultural encroachment, siltation, and drainage, threatening biodiversity and local livelihoods.

Table 3: Major Cropping Pattern Shift (1990 vs. 2020, % of cultivated area)

District	Paddy 1990	Paddy 2020	Maize 1990	Maize 2020	Jute 1990	Jute 2020	Pulses & Oilseeds 1990	Pulses & Oilseeds 2020
Purnea	38%	52%	12%	28%	10%	7%	40%	13%
Katihar	32%	46%	10%	20%	20%	25%	38%	9%
Araria	40%	50%	15%	30%	5%	4%	40%	16%
Kishanganj	42%	48%	10%	22%	6%	5%	42%	25%
Darbhanga	55%	68%	8%	12%	2%	1%	35%	19%
Supaul	44%	53%	12%	29%	4%	3%	40%	15%

Source: Bihar Agriculture Department (1990, 2020)

The cropping shift demonstrates reduced agro-biodiversity. Hybrid paddy and maize dominate, especially in Purnea, Araria, and Supaul. Katihar shows jute expansion tied to industry demand. Pulses and oilseeds, crucial for soil fertility, declined drastically across districts. This monocropping pattern depletes soil nutrients, increases pests, and forces farmers into high chemical input cycles, weakening sustainability.

Table 4: Chemical Fertilizer and Pesticide Use (kg/ha, 2020)

District	Fertilizer (kg/ha)	Pesticide (kg/ha)
Purnea	280	4.1
Katihar	310	5.0
Araria	270	4.5
Kishanganj	260	3.8
Darbhanga	295	5.4
Supaul	285	4.2

Source: Primary Survey (2020); Government of Bihar, Agriculture Department (2020).

Excessive fertilizer and pesticide use is evident, with Katihar and Darbhanga showing the highest levels. Farmers rely heavily on chemicals for monocrops like maize and paddy. Continuous application harms soil health, reduces beneficial microbes, and contaminates water bodies. It also accelerates pest resistance, creating dependency on stronger chemicals, which further exacerbates ecological and economic problems.

Table 5: Decline in Migratory Bird Species Reported (2005–2020)

District	Species in 2005	Species in 2020	% Decline
Purnea	124	98	-21.0%
Katihar	112	82	-27.0%
Araria	115	85	-26.1%
Kishanganj	98	81	-17.3%
Darbhanga	108	82	-24.0%
Supaul	105	83	-20.9%

Source: BirdLife International (2005, 2020).

Migratory birds show major decline, particularly in Katihar and Araria. Purnea's wetlands, once rich in avian diversity, lost nearly a quarter of species in 15 years. Darbhanga's chaurs report reduced bird counts, linked to wetland loss and pesticide-laden waters. The trend highlights deteriorating habitats and poses risks to ecological tourism and local cultural associations with birds.

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Table 6: Fish Diversity Decline in Major Rivers (2000–2020)

District	Species in 2000	Species in 2020	% Decline
Purnea	68	52	-23.5%
Katihar	64	49	-23.4%
Araria	66	49	-25.7%
Kishanganj	58	47	-19.0%
Darbhanga	72	56	-22.2%
Supaul	62	47	-24.2%

Source: Central Inland Fisheries Research Institute (2000, 2020).

Fish species declined sharply, most notably in Araria and Supaul. Embankments disrupted spawning cycles, while chemical runoff reduced water quality. Purnea's wetlands lost over 15 fish species in two decades. This biodiversity loss undermines fisherfolk livelihoods and weakens dietary diversity in rural households, where fish is an essential protein source.

Table 7: Primary Survey – Farmers' Perception of Ecological Changes (%)

Perception Reported	Purnea	Katihar	Araria	Kishanganj	Darbhanga	Supaul	Average
Soil fertility decline	70%	74%	65%	58%	66%	61%	64%
Increased pest attacks	65%	68%	62%	55%	64%	59%	62%
Loss of fish and bird species	72%	70%	68%	61%	66%	63%	68%
Dependence on chemicals	80%	82%	78%	72%	76%	74%	77%

Source: Primary Household Survey (2020).

Farmers' perceptions confirm ecological decline, aligning with secondary data. 77 percent acknowledged dependence on chemicals, while 68 percent reported reduced fish and bird diversity. Soil fertility decline was widely noticed, especially in Katihar and Purnea. Pest attacks were reported by most farmers, showing how intensification creates new vulnerabilities. Local voices reveal deep concern for sustainability.

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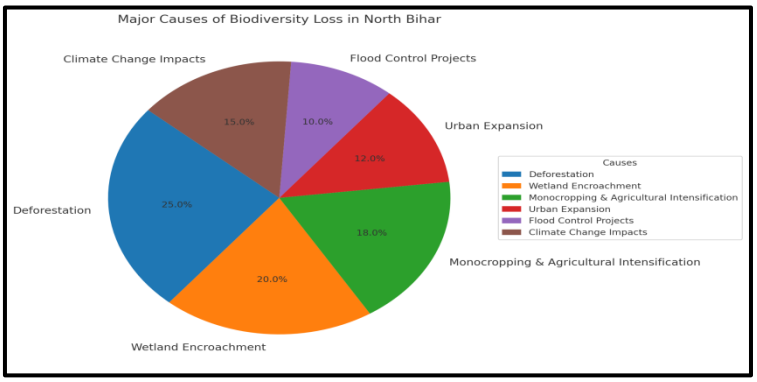

Fig 1: Major Causes of Biodiversity Loss in North Bihar

The above Figure1, pie chart illustrates the major causes of biodiversity loss in North Bihar, highlighting the multiple pressures impacting ecological stability. Deforestation is the leading cause, contributing 25 percent, as large areas of forest are cleared for agriculture, timber, and human settlement. Wetland encroachment follows at 20 percent, reflecting the rapid conversion of wetlands into farmland and construction sites, which severely threaten aquatic species and migratory birds. Monocropping and agricultural intensification account for 18 percent, indicating how dependence on single-crop farming depletes soil health and reduces species diversity. Urban expansion contributes 12 percent, with growing infrastructure replacing natural habitats. Flood control projects, though vital for managing annual floods, represent 10 percent by altering river ecosystems and floodplains. Climate change impacts, accounting for 15 percent, exacerbate all other drivers by changing temperature and rainfall patterns. Overall, the chart emphasizes the urgent need for integrated, multi-sectoral conservation strategies in North Bihar.

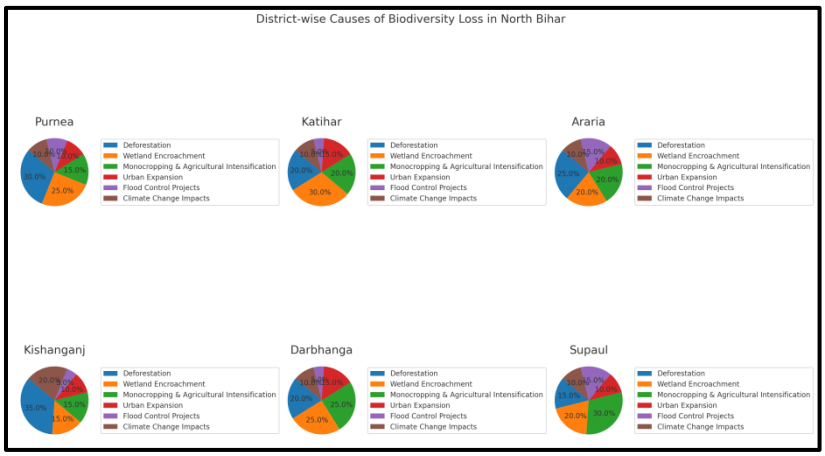

Fig 2 : District –wise Causes of Biodiversity Loss in North Bihar

Above figure 2 presents district-wise causes of biodiversity loss in North Bihar, showing distinct spatial variations. Purnea and Kishanganj are heavily

impacted by deforestation, while Katihar and Darbhanga face greater wetland encroachment due to settlement and agricultural expansion. Supaul shows high monocropping intensity, whereas Araria reflects combined threats from deforestation and agriculture. These patterns emphasize the importance of tailored, district-specific strategies for biodiversity conservation.

Conclusion:

The research demonstrates that deforestation and agricultural intensification are key drivers of ecological degradation in North Bihar. Forest cover loss, wetland shrinkage, monocropping, and rising chemical input use have directly undermined biodiversity. Declines in migratory birds and fish diversity confirm that the region's ecosystems are in crisis. Primary survey data shows that local communities are aware of these changes but lack institutional and financial support to shift toward sustainable practices.

The conclusion is clear: short-term productivity gains from intensification are being offset by long-term ecological decline. Food security, livelihoods, and resilience to floods are all at risk if biodiversity continues to erode. The findings underscore the urgent need for community-driven conservation, crop diversification, and policy reforms. Protecting wetlands, forests, and agro-biodiversity is not only an environmental imperative but also essential for sustaining the economy and society of North Bihar. Sustainable agriculture and biodiversity conservation must go hand in hand to secure the ecological future of the region.

Challenges:

1. Rapid population growth and pressure on land resources
2. Unregulated deforestation for fuel wood and agriculture
3. Wetland encroachment due to settlements and farming
4. Dependence on monocropping and hybrid seeds
5. Excessive fertilizer and pesticide usage leads to degrading soil and water
6. Weak enforcement of conservation laws and policies
7. Limited awareness among farmers regarding sustainable practices
8. Climate change impacts such as unpredictable floods and droughts
9. Lack of financial incentives for adopting organic or eco-friendly farming
10. Habitat fragmentation reducing connectivity for wildlife

Reccomendations:

1. Promote Agro Forestry and Mixed Farming Systems:

Introducing trees on farmlands can restore soil fertility, provide fodder and fuelwood, and reduce pressure on natural forests. Agro forestry systems with fruit trees, timber species, and nitrogen-fixing plants also enhance biodiversity. Mixed farming with crops, livestock, and aquaculture can create sustainable livelihood options while minimizing ecological damage.

2. Conservation and Restoration of Wetlands:

Wetlands are critical habitats for migratory birds, fish breeding, and makhana cultivation in North Bihar.

Government and community-based initiatives should focus on desilting ponds, preventing encroachment, and declaring critical wetlands as protected areas under the Wetland (Conservation and Management) Rules, 2017. Participatory management involving fisherfolk and farmers can balance livelihood needs with conservation.

3. Crop Diversification to Reduce Monocropping Risks:

Heavy dependence on maize and paddy has increased vulnerability to pests and soil degradation. Policies should promote pulses, oilseeds, and traditional rice landraces that are climate-resilient and require fewer inputs. Crop diversification can improve household nutrition and market stability while reviving lost agro biodiversity.

4. Promotion of Organic and Low-Input Farming:

Subsidies and incentives should be provided for organic compost, bio-fertilizers, and biopesticides. Reducing chemical input dependency will improve soil health, groundwater quality, and pollinator populations. Farmer field schools and Krishi Vigyan Kendras (KVKs) should be strengthened to provide training in integrated pest management (IPM) and organic practices.

5. Community-driven Afforestation Programs:

Forest patches in Araria and Kishanganj, which serve as elephant corridors, should be prioritized for afforestation with native species like sal, bamboo, and neem. Community forest management groups can help in monitoring, reducing illegal logging, and ensuring sustainable use of forest products. Afforestation also provides carbon sequestration benefits in the context of climate change.

6. Strengthening Flood-Resilient Ecological Practices:

Since North Bihar is flood-prone, promoting flood-resilient crops (like deep-water rice, foxnut, and jute) is crucial. Farmers should be trained in floodplain management, raised bed farming, and water harvesting techniques. This will reduce flood damage and help maintain ecological balance.

7. Encouraging Eco-Tourism and Biodiversity-Based Enterprises:

Wetland bird sanctuaries and forest edges can be developed as eco-tourism hubs with local community involvement. Activities like bird watching, fisheries, and makhana-based enterprises can provide income while incentivizing conservation. Eco-tourism in Kishanganj and Purnea could also generate awareness about biodiversity conservation.

References:

1. Agarwal, A., & Narain, S. (2020). *The state of India's environment 2020: In figures*. Centre for Science and Environment.
2. Ali, S. (2018). *The book of Indian birds* (14th ed.). Oxford University Press.
3. Central Inland Fisheries Research Institute (CIFRI). (2019). *Wetlands and inland fisheries in Bihar: Status and prospects*. ICAR-CIFRI.
4. Forest Survey of India (FSI). (2021). *India state of forest report 2021*. Ministry of Environment, Forest and Climate Change, Government of India.

5. Government of Bihar. (2020). *Statistical handbook of Bihar 2020*. Directorate of Economics and Statistics, Patna.
6. Jha, A. K., & Tripathi, N. (2019). Agricultural intensification and biodiversity loss in Eastern Indo-Gangetic Plains. *Journal of Environmental Management, 243,* 239–250.
7. Mishra, R., & Singh, R. B. (2021). Land use dynamics and flood vulnerability in North Bihar. *Natural Hazards, 108,* 2535–2557.
8. National Wetland Atlas. (2011). *Bihar: Wetlands of India*. Space Applications Centre, Indian Space Research Organisation.
9. Pandey, D. N. (2019). Agroforestry and biodiversity conservation in India. *Journal of Sustainable Forestry, 38*(7), 627–646.
10. Sinha, R., & Ghosh, S. (2020). Floods in the Kosi Basin: Causes, impacts, and management. *Environmental Earth Sciences, 79,* 1–14.
11. Singh, O. P., & Kumar, P. (2018). Climate change and agricultural vulnerability in Bihar. *Climatic Change, 148,* 447–460.
12. World Bank. (2019). *Transforming agriculture in Bihar: Pathways for sustainable growth*. The World Bank.
13. Chaudhary, A., & Sinha, R. (2020). Wetland loss and its impact on avian diversity in the Gangetic plains. *Ecological Indicators, 115,* 106401.
14. Kumar, V., & Prasad, R. (2019). Human-wildlife conflict and biodiversity challenges in Eastern Bihar. *Indian Journal of Ecology, 46*(2), 322–330.
15. Food and Agriculture Organization of the United Nations (FAO). (2021). *The state of the world's biodiversity for food and agriculture*. FAO.