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Research Scholar, University
Department of Geography, Ranchi
Email: meghananishchal22@gmail.com

Address for correspondence:
Meghana Nishchal
Research Scholar, University
Department of Geography, Ranchi
Email: meghananishchal22@gmail.com

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Disaster Risk and Resilience in Resource - Sensitive Areas: A Case Study of Flood Impact on Purnea District

Meghana Nishchal

Abstract

Natural and man-made disasters pose a severe threat to resource-sensitive regions, particularly in developing countries such as India, where high population density and dependence on natural resources amplify risks. Purnea district in Bihar, situated in the flood-prone Kosi basin, frequently experiences devastating floods that result in large-scale damage to infrastructure, disruption of livelihoods, and deepening socio-economic vulnerabilities. Each flood event not only destroys standing crops and erodes fertile land but also undermines household resilience by causing loss of income, displacement, and food insecurity. This article presents a comprehensive risk assessment and mitigation analysis, drawing on a primary survey of 200 farmers across five blocks in Purnea district. The findings underscore the urgency for integrated disaster risk reduction strategies that combine structural measures with community-based approaches. Evidence highlights that socio-economic fragility; institutional gaps, poor infrastructure, and low disaster preparedness significantly contribute to heightened vulnerability. The recurrent nature of floods perpetuates cycles of poverty and restricts opportunities for sustainable development in the region.

The paper concludes by recommending a multi-tiered strategy for flood mitigation, which emphasizes community-level preparedness, strengthened local governance, and inclusive planning. Building adaptive capacities, improving institutional coordination, and promoting livelihood diversification are critical steps to enhance resilience in flood-prone areas. The study further stresses that climate change is likely to intensify risks in the coming decades, making proactive disaster management indispensable for safeguarding both lives and resources in regions such as Purnea.

Keywords: Flood vulnerability; Disaster risk reduction; Socio-economic resilience; Institutional preparedness; Climate change.

Introduction

Disasters, whether natural or man-made, pose one of the most significant threats to human life, economic stability, and sustainable development, particularly in resource-sensitive regions. These areas, which rely heavily on natural assets such as fertile soil, rivers, and forests, often lack the institutional capacity needed to respond effectively to crises. Among all natural hazards, floods remain the most frequent and destructive in South Asia, especially in India, where the complex interplay of monsoon variability, glacial-fed rivers, and land-use changes creates widespread vulnerability.

According to the National Disaster Management Authority (NDMA), over 12 percent of India's land area is flood-prone, affecting around 30 million people annually. In the eastern state of Bihar, the situation is particularly severe. The state lies in the floodplains of major rivers such as the Kosi, Ganga, Bagmati, and Mahananda, which frequently overflow during the monsoon season. Bihar accounts for nearly 17 percent of India's total flood-affected population, making it a high-priority region for disaster risk assessment and mitigation planning.

One of the most critically affected districts in Bihar is Purnea, located in the Kosi sub-basin. With over 80 percent of its population dependent on agriculture and related activities, even a single season of flooding can severely disrupt livelihoods, food security, and education. Despite being a disaster-prone area, Purnea remains under-resourced in terms of early warning systems, crop insurance coverage, disaster shelters, and local-level training. Socio-economic vulnerabilities such as low literacy rates, small landholdings, and high poverty levels further reduce the ability of rural communities to prepare for or recover from such disasters.

This study investigates flood risk and disaster mitigation in Purnea district through a case study based on primary data collected from 200 farmers across five of the most flood-prone blocks. The research aims to examine:

- The socio-economic and environmental factors contributing to flood vulnerability
- The effectiveness of institutional preparedness measures such as crop insurance and early warning systems
- The actual coping capacity of local communities during and after floods

By focusing on a highly vulnerable yet understudied region, the research highlights the importance of integrating local data into disaster planning and calls for a more inclusive and proactive approach to managing floods in rural India.

Study Area: An Overview of Purnea District

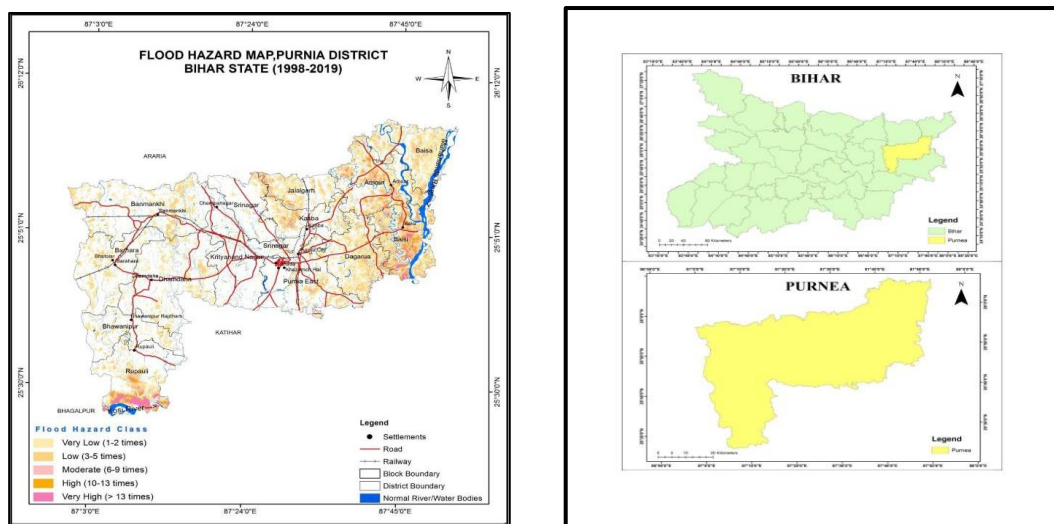
Purnea district is located in the northeastern part of Bihar, India. The district is geographically positioned between 25°13' to 26°53' North latitude and 86°59' to 87°52' East longitude and is part of the fertile Gangetic plains. The district is surrounded by Araria to the north, Kishanganj to the east, Katihar to the south, and Madhepura to the west. It forms a crucial part of the Seemanchal region and falls within the Kosi sub-basin, which is one of the most flood-prone zones in the state. The total geographical area of Purnea is approximately 3,229 square kilometers. According to the Census of India (2011), the district has a population of around 3.2 million, with more than 85 percent living in rural areas. The economy is predominantly agrarian, with a majority of households dependent on farming and allied activities for their livelihood. Major crops include paddy, maize, wheat, jute, and pulses. However, the district's agricultural output is highly vulnerable to monsoon-related flooding.

The region is traversed by several rivers including the Kosi, Mahananda, Parman, and Saura. The Kosi River, often referred to as the "Sorrow of Bihar," has a notorious history of changing its course and causing massive flooding in northern Bihar, including parts of Purnea. The topography of the district is characterized by low-lying floodplains with poor drainage, making it susceptible to water logging and prolonged inundation during the monsoon months of June to September.

The five blocks selected for this study—Dhamdaha, Banmankhi, Kasba, Baisa, and Jalalgarh—represent areas that are highly exposed to recurrent flooding. These blocks were chosen based on historical flood data, agricultural dependency, population density, and accessibility. Each of these blocks has reported repeated flood damage in recent years, affecting housing, crops, and infrastructure. The socio-economic condition of the population in these areas is also relatively poor, with high poverty rates, limited education, and weak institutional support.

In addition to natural vulnerability, human-induced factors such as deforestation, encroachment on riverbanks, inadequate embankment maintenance, and lack of proper land-use planning contribute to the flood risk. The absence of sustainable drainage systems and the frequent failure of embankments further exacerbate the problem.

In summary, Purnea district serves as an important case study for understanding flood risk in resource-sensitive regions. Its frequent exposure to hydrological hazards, combined with social and economic fragility, makes it an ideal location for analyzing the impact of natural disasters and the effectiveness of risk mitigation strategies.

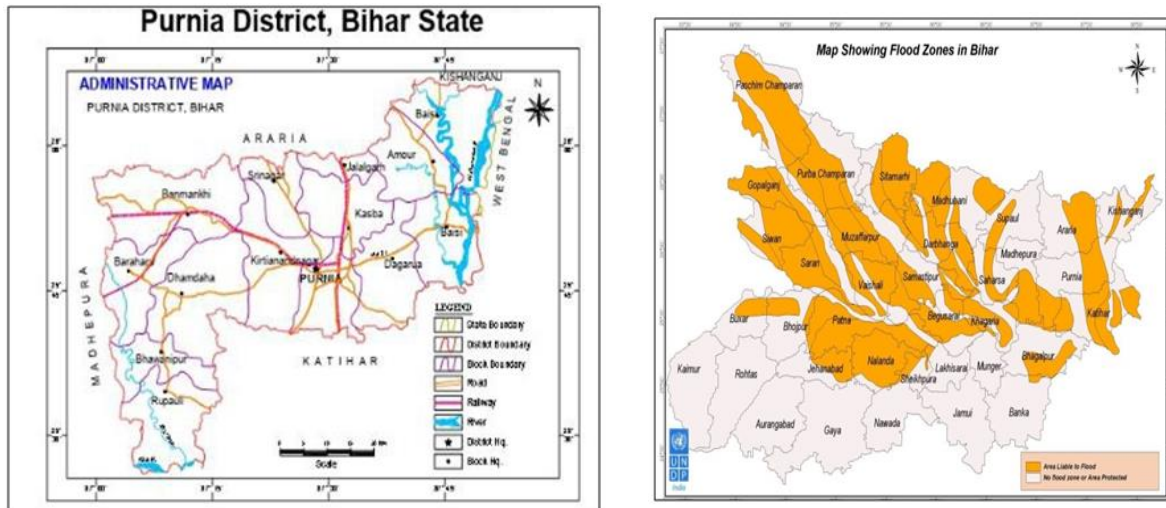


Study Area Map

Objectives

The primary objective of this study is to assess the risk and impact of natural and man-made disasters—specifically floods—on resource-sensitive rural communities in Purnea district, Bihar. The study is based on primary data collected from 200 farmers across five flood-prone blocks of the district.

1. To evaluate the socio-economic profile of farmers in flood-affected areas of Purnea.
2. To identify the factors contributing to vulnerability during flood events.
3. To analyze the role of institutional mechanisms (insurance, early warnings, relief efforts) in disaster preparedness and recovery.
4. To examine the level of awareness, coping strategies, and mitigation efforts adopted by farmers.
5. To recommend practical measures for strengthening flood resilience at the community and policy levels.



Research Design and Methodology

This study follows a descriptive and analytical research design. It aims to assess the socio-economic vulnerability of farmers and the effectiveness of mitigation strategies against recurrent floods in resource-sensitive regions, with a specific focus on Purnea district in Bihar. The research is based on both primary and secondary data, and adopts a mixed-methods approach, combining quantitative data with qualitative insights. The design enables a detailed examination of the factors influencing flood risk, preparedness levels, institutional interventions, and local response strategies.

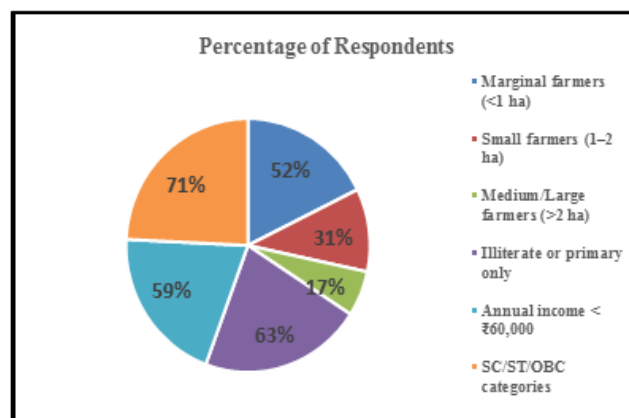
Five blocks of Purnea district—Dhamdaha, Amour, Kasba, Baisa, and Jalalgarh—were purposively selected for this study. These blocks have consistently experienced frequent and high-intensity flooding events and represent a cross-section of the district's flood-vulnerable rural population. A multi-stage sampling technique was used: Five flood-prone blocks were selected based on historical vulnerability, agricultural dependency, and demographic indicators and a sample of 200 farmers (40 from each block) was selected using simple random sampling to ensure representation of small, marginal, and medium landholders.

Primary and secondary data were used for the study.

- Primary data:** Structured interviews and pre-tested questionnaires were used to collect data directly from farmers. The questionnaire included both closed- and open-ended questions, covering:
 - Socio-economic background (such as landholding size, income, and education)
 - Experience and losses during recent flood events
 - Access to institutional support (crop insurance, early warning systems, relief)
 - Coping strategies and household-level mitigation practices
 - Awareness about disaster preparedness and climate change.
- Secondary data:** Secondary data was collected from multiple sources, including:
 - Government documents and reports (e.g., District Disaster Management Plan, Agriculture Department records)
 - Census of India (2011)
 - Reports from NDMA, UNDP, and Bihar State Disaster Management Authority (BSDMA)
 - Peer-reviewed journal articles, local news reports, and published NGO assessments

Results and Discussions

- Socio-economic Profile of Respondents** (The analysis of 200 farmers across five severely flood-affected blocks reveals the following:)

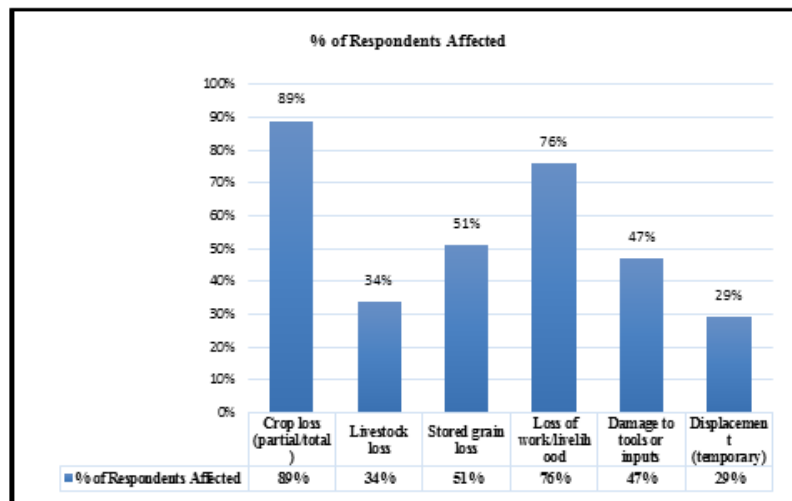


Socio-economic category	Percentage of Respondents
Marginal farmers (<1 ha)	52%
Small farmers (1–2 ha)	31%
Medium/Large farmers (>2 ha)	17%
Illiterate or primary only	63%
Annual income < ₹60,000	59%
SC/ST/OBC categories	71%

The majority of respondents were small and marginal farmers with low educational attainment and income. These groups are disproportionately affected by floods due to limited assets, weak institutional linkages, and dependence on a single cropping cycle. Many lack the resources to adopt flood-resilient infrastructure or diversify livelihoods.

2. Impact of Flood on Agriculture and Livelihood

Impact Area	% of Respondents Affected
Crop loss (partial/total)	89%
Livestock loss	34%
Stored grain loss	51%
Loss of work/livelihood	76%
Damage to tools or inputs	47%
Displacement (temporary)	29%



Floods in the region primarily affect agriculture—the main source of livelihood. Nearly 90% of respondents reported partial or total crop loss. Many had stored food grains washed away. For marginal farmers, such events result in deep debt cycles and food insecurity. Displacement due to waterlogging was common, especially in Jalalgarh and Baisa.

3. Institutional Support and Awareness

Indicator	Percentage (out of 200)
Awareness of government relief	44%
Actually received relief	38%
Enrolled in crop insurance	14.8%
Access to early warning	30.2%
Received agricultural extension help	18%
Attended disaster training	9%

The analysis of institutional support and awareness among the 200 farmers surveyed in the most flood-affected blocks of Purnea district reveals a concerning gap between available government mechanisms and their reach on the ground. As shown in Table 3, only 44% of the respondents were aware of government flood relief programs, and an even smaller share 38% reported actually receiving any form of relief during recent flood events.

This gap suggests not just a lack of awareness but also administrative or logistical shortcomings in the delivery of essential support.

One of the most striking findings is the extremely low coverage of crop insurance; only 14.8% of the farmers were enrolled under schemes such as the Pradhan Mantri Fasal Bima Yojana. This indicates that a vast majority of small and marginal farmers in this high-risk region remain financially unprotected against recurring crop damage. Similarly, access to

early warning systems was limited to just 30.2% of the respondents, often due to a lack of mobile connectivity, illiteracy, or poor dissemination mechanisms. This leaves the majority vulnerable to sudden inundation without time to prepare or move assets.

4. Farmers' Coping and Mitigation Strategies

Strategy Used	Percentage of Respondents
Raised grain/fodder storage	22%
Shifted livestock before flood	19%
Took loans after flood	63%
Used traditional knowledge	28%
Built elevated bamboo platforms	11%
No significant coping strategy	42%

5. Change in Crop Yield and Income

Indicator	Pre-Flood	Post-Flood
Paddy yield (quintals/acre)	15.4	7.2
Maize yield (quintals/acre)	12.8	5.9
Vegetable yield (quintals/acre)	18.2	8.5
Gross household income/year (₹)	₹74,000	₹41,000
Agricultural input cost (₹/season)	₹12,500	₹14,800
Market access days/month	20 days	11 days

Table 4 shows that most farmers rely on short-term or informal coping strategies after floods. About 63% had to take loans to recover, often from informal sources, pushing them into debt. Only 22% used raised storage for grains, and just 19% managed to move livestock before floods. Traditional knowledge was used by 28% of respondents, but its reliability varies. Very few (11%) had any form of physical flood-proofing like bamboo platforms. Most concerning is that 42% had no coping strategy at all, showing a clear lack of preparedness and support. This highlights the need for training, awareness, and better access to formal support systems.

Table 5 clearly illustrates the economic toll that floods have on farming households. Crop yields for paddy, maize, and vegetables dropped by over 50% after the flood, primarily due to water logging, crop rot, and soil siltation. Such drastic yield reductions have a direct impact on the livelihoods of small and marginal farmers. The average annual income of the surveyed farmers decreased from ₹74,000 to ₹41,000—a nearly 45% loss—pushing many families into debt and food insecurity. At the same time, the cost of agricultural inputs increased by about 18%, as farmers needed to re-buy seeds, fertilizers, and pesticides after flood-induced losses. Additionally, the number of days they could access the market dropped by almost half due to damaged roads, submerged markets, and disrupted supply chains.

This data supports the argument that **floods not only damage standing crops but also disrupt the entire economic ecosystem of rural households**—from production to market access, creating a prolonged recovery period and increasing their dependence on external aid or informal credit. This table directly strengthens both hypotheses by showing how socio-economic vulnerability and weak mitigation infrastructure intensify the flood impact.

Conclusion

This study demonstrates that floods in Purnea district have a severe and recurring impact on the livelihoods of small and marginal farmers, especially in blocks like Dhamdaha, Baisa, Jalalgarh, Amour, and Kasba. The findings confirm both hypotheses: that socio-economic vulnerability such as low income, limited landholding, and lack of education increases the severity of flood impacts, and that institutional preparedness significantly reduces the risks and facilitates faster recovery.

The research shows a strong correlation between access to insurance, early warnings, and disaster training with reduced crop and income losses. In contrast, those without such support were more likely to suffer prolonged damage and fall into debt. It is evident that the current coping strategies are inadequate and largely reactive. There is a critical need to shift towards anticipatory planning and community-based disaster risk reduction.

The way forward lies in building local capacities, expanding institutional coverage, and investing in both structural and non-structural measures to reduce vulnerability. Only then can resource-sensitive regions like Purnea become more resilient to future climate and disaster risks.

Recommendations

Based on the findings of this study, the following recommendations are made to reduce flood risk and improve resilience in resource-sensitive and vulnerable regions like Purnea:

1. **Strengthen institutional access:** Improve awareness and enrollment in crop insurance, and ensure timely disbursement of compensation. Local panchayats and NGOs should be supported to reach last-mile communities effectively.
2. **Develop and maintain early warning systems:** Expand community-based flood forecasting and ensure alerts are available in local languages through mobile phones, radio, and village meetings.
3. **Promote disaster preparedness training:** Regular training and mock drills should be conducted, especially in high-risk blocks, targeting farmers and women's groups.
4. **Build and maintain critical infrastructure:** Construction of raised platforms for livestock and grain storage, better drainage systems, and flood shelters must be prioritized.

5. **Encourage climate-resilient agriculture:** Promote flood-tolerant crop varieties, alternate cropping patterns, and integrated farming systems.
6. **Enhance local capacity:** Empower farmers through self-help groups, cooperatives, and local disaster management committees to take charge of local risk mitigation efforts.
7. **Improve post-disaster recovery systems:** Ensure rapid response through mobile units, fair distribution of relief, and support for rehabilitating agricultural land.

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Conflicts of interest

The author declares that they have no conflicts of interest related to this research.

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