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Climate change, migration and livelihood vulnerability in Costal Odisha: Emerging trends and policy challenges

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Abstract
The study aims to examine the interlinkages between climate change migration patterns and livelihood vulnerability in costal Odisha. It seeks to identify the drivers of climate induced migration assess the socio-economic challenges faced by migrant household and explore the policy gaps in addressing livelihood insecurity. The research relies exclusively on secondary data drawn from census reports government publications disaster management records and previous scholarly works. Statistical information on migration trends climate events and livelihood patterns has been systematically reviewed and interpreted to understand the nexus between climate stress and migration. The study indicates that migration while a coping mechanism cannot ensure long-term livelihood security. Secondary data show a growing dependency on migration as an adaptive response yet policy measures remain inadequate in providing sustainable livelihood alternatives. Strengthening costal infrastructure promoting skill development and diversifying income source are essential for building resilience in vulnerable communities. The findings suggest that recurrent cyclones floods and saline intrusion have adversely affected agriculture fisheries and wage labour in costal Odisha. Such livelihood disruptions have triggered significant outmigration particularly seasonal and industrial centers. Migrant households often face unstable incomes lack of social protection and heightened vulnerability in source and destination regions. Climate change is one of the most pressing challenges of the twenty-first century, affecting human mobility and livelihoods. Odisha, a coastal state in eastern India, is highly exposed to cyclones, floods, and salinity intrusion, which disrupt agriculture and fisheries, forcing migration. This study examines the relationship between climate change, migration, and livelihood vulnerability in coastal Odisha using secondary data from Census, NDMA, NIDM, Odisha Economic Survey, and World Bank reports. The analysis reveals increasing distress migration and the urgent need for policy interventions. Climate change has emerged as one of the defining challenges of the 21st century, with its consequences most acutely felt in vulnerable coastal regions. Odisha, located on the eastern coast of India, is highly exposed to the adverse impacts of climate variability such as cyclones, floods, and sea-level rise. These events disrupt local livelihoods and accelerate migration. This paper examines the interlinkages between climate change, migration, and livelihood vulnerability in coastal Odisha, using secondary data from Census 2011[1], NFHS-5, NSSO, UNDP, and IPCC reports. Findings reveal that climate-induced migration has become an adaptive livelihood strategy for households exposed to environmental stress. The study provides an in-depth analysis of migration patterns, livelihood shifts, and policy implications. It argues for comprehensive climate adaptation and migration governance frameworks to ensure sustainable development in the region.

Keywords: Climate, change, migration, livelihood, vulnerability, costal, odisha, climate, adaption, policy and challenges

Introduction

Climate change significantly affects human settlements, labor mobility, and livelihoods globally. In India, coastal regions face recurrent hazards including cyclones, floods, and sea-level rise, with Odisha being particularly vulnerable due to its long coastline along the Bay of Bengal. Odisha has experienced several devastating cyclones such as the 1999 Super Cyclone, 2013 Phailin, 2019 Fani, and 2021 Yaas, causing large-scale displacement and loss of livelihoods. Agriculture and fisheries, employing nearly half the workforce, are highly climate-sensitive. Vulnerable populations often resort to seasonal or permanent migration to cope with income loss and livelihood disruption. Climate change is no longer a distant threat but a lived reality in many regions of the world. Coastal zones, which are home to nearly 40% of the global population, face heightened risks due to rising sea levels, increasing frequency of extreme weather events, and changes in ecological systems. In India, the eastern coast, particularly the state of Odisha, has emerged as one of the most vulnerable hotspots of climate change. The state has witnessed recurring cyclones such as Phailin (2013), Fani (2019), and Amphan (2020), which have left millions, displaced and caused immense economic losses. Beyond the immediate destruction, these disasters have long-term impacts on food security, livelihoods, and social well-being.

Migration has increasingly emerged as a survival and adaptation strategy for households exposed to climate shocks. While migration has historically been driven by economic aspirations, the growing influence of environmental stressors cannot be ignored. Households in coastal Odisha, heavily dependent on agriculture, fisheries, and daily wage labor, face recurring livelihood disruptions. Migration to urban centers or other states has become a key coping mechanism, though often associated with precarious employment, poor living conditions, and social dislocation. This study focuses on analyzing the complex interplay between climate change, migration, and livelihood vulnerability in Odisha.

The significance of this study lies in highlighting the dual nature of migration—as both an adaptation strategy and a source of new vulnerabilities. On one hand, remittances

support household survival; on the other, migration exposes families to risks such as labor exploitation, child labor, and the breakdown of traditional social support systems. Policymakers must therefore strike a balance between enabling safe migration and strengthening in-situ adaptation measures. This article contributes to the literature by examining migration patterns through the lens of climate vulnerability, with a particular focus on coastal Odisha. It also identifies critical policy gaps and suggests pathways for resilience building. This study aims to examine the dynamics of climate-induced migration and livelihood vulnerability in coastal Odisha, identify emerging trends, and suggest policy measures for enhancing resilience.

Review of Literature

Climate change and migration are interlinked in complex ways. Black *et al*. (2011) [6] argue that environmental changes interact with social political and economic factors to influence migration decisions. In India Deshingkar & Aktar (2009) [4] highlights distress migration among rural households facing climate shocks. In Odisha Mohaptra & Singh (2003) documented long-term livelihood disruptions following the 1999 Super Cyclone. World Bank (2018) [5] Projects South Asia could see 40 million internal climate migrants by 2050 with Odisha as a hotspot. NIDM (2021) [7] highlights the compounded effects of repeated cyclone on household vulnerability. Gender dimensions are critical: women left behind face increased household and agricultural responsibilities. Despite existing research there is limited integrated analysis of climate vulnerability livelihood security and migration in Odisha which this study addresses.

Global literature increasingly links climate variability with migration dynamics. According to the IPCC sixth Assessment Report (2011) climate-induced migration is expected to intensify particularly in South Asia. Studies by Black et.al (2011) [6] and McLeman (2014) have conceptualized migration as an adaption to climate change while also cautioning against its long-term social implications. In the Indian context Deshingkar (2019) emphasizes the role of distress migration in shaping rural livelihood whereas jha *et al*. (2018) highlight the vulnerability of costal population. Specific to Odisha UNDP (2020) [10] and Government of Odisha climate Action Plan (2022) [2] report increased out-migration from disaster-prone districts such as Kendrapara Jagatsinghpur and Balasore. However empirical studies remain limited particularly in terms of integrating climate change livelihood vulnerability and migration governance in to a single analytical framework.

Objectives

The Study has the following three Objectives:

1. To analyze climate-induced migration trends in costal Odisha.
2. To examine livelihood vulnerability in disaster-prone districts.
3. To assess policy frameworks and identify adaptation gaps.

Methodology

This study uses secondary data from:

- Census of India (1991, 2001 and 2011) [1] for migration statistics
- Odisha Economic Survey (2021–22) for sectoral livelihood data
- NDMA and NIDM for cyclone impact assessments
- World Bank (2018) [5] Groundswell Report for climate migration projections

Data were analyzed using descriptive statistics percentages and trends. Graphs and tables illustrate migration trends cyclone impacts and workforce distribution. Qualitative insights complement.

Data Analysis

Table 1: Migrant Population in Odisha (1991–2011)

Census Year	Total Migrants (in lakhs)	% of State Population	Major Reasons Reported
1991	46.2	14.8%	Marriage, work, displacement
2001	61.7	17.2%	Marriage, work, natural calamities
2011	74.3	18.9%	Marriage, work/employment, climate shocks

Source: Census of India (1991 2001 and 2011) [1] office of the Register General and Census Commissioner New Delhi

The migrant population increased steadily from 46.2 lakh in 1991 to 74.3 lakh in 2011. Migration percentage rise from 14.8% to 18.9% showing that social and environmental factors including climate shocks are increasingly driving migration.

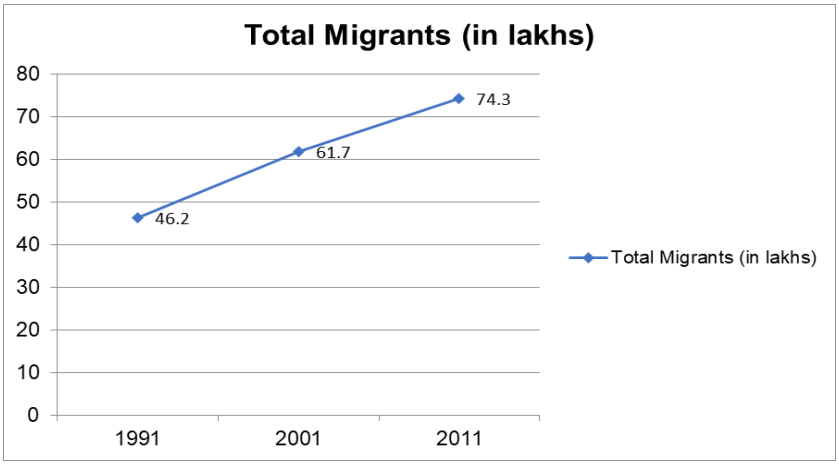


Fig 1: Year

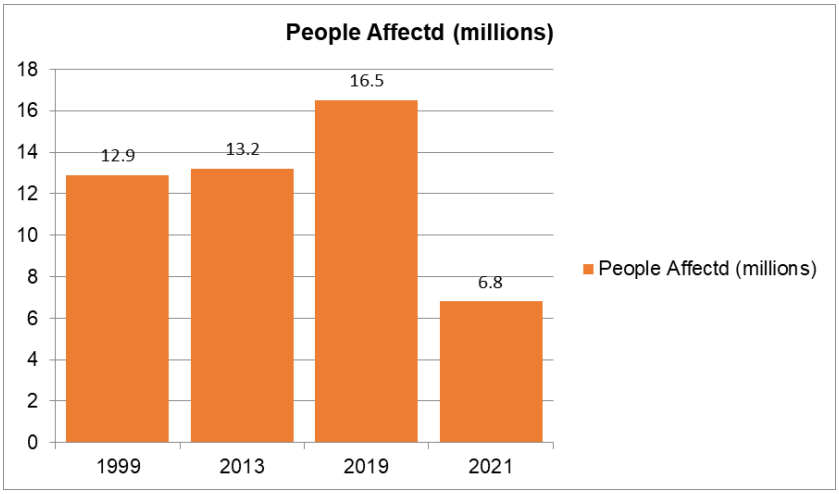
The analysis of migration patterns in coastal Odisha reveals a steady increase in out-migration over the past three decades. The figure – 1 shows that households increasingly depend on migration as a survival strategy. The main drivers are recurrent cyclones saline intrusion in farmlands and seasonal unemployment. Unlike permanent migration observed in earlier decades the current trend is dominated by short term and seasonal migration particularly of young male workers. This reflects a coping mechanism rather than a sustainable livelihood choice.

Recurrent cyclones affect millions of people in Odisha. The 1999 super cyclone caused the highest facilities. Later cyclones show fewer deaths due to improved disaster preparedness but livelihood continue to be disrupted forcing migration.

Table 2: Major Cyclones Affecting Odisha (1999–2021)

Cyclone	Year	Districts Affected	People Affected (millions)	Fatalities
Super Cyclone	1999	Jagatsinghpur, Kendrapara, Puri, Cuttack	12.9	9,887
Phailin	2013	Ganjam, Khordha, Gajapati	13.2	45
Fani	2019	Puri, Khordha, Cuttack	16.5	64
Yaas	2021	Balasore, Bhadrak, Kendrapara	6.8	12

Source: NDMA NIDM and government of Odisha Cyclone reports (1999 – 2021) [7]



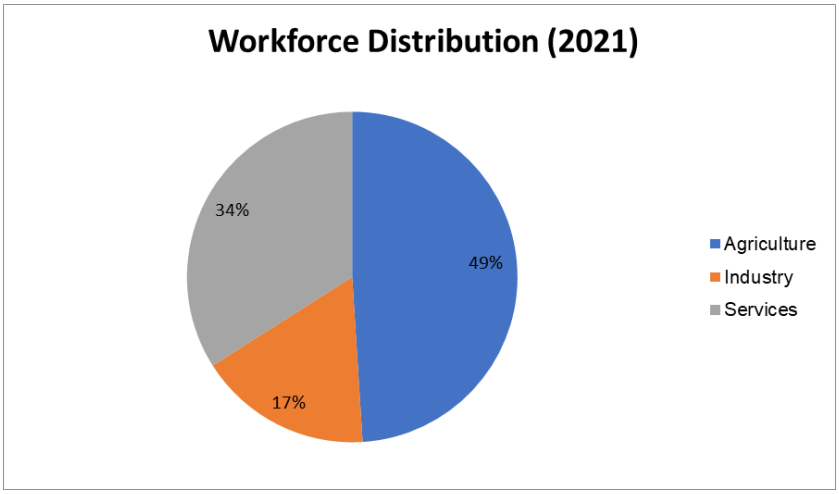
This figure – 2 shows that people affected in different cyclone from 1999 to 2021. The highest people affected in fani in 2019 followed by phailin 2013 super cyclone 1999 and yass 2021. The highest Fatalities in super cyclone 1999 followed by fani 2019 phailin 2013 and 2021yass.

Table 3: Work force Distribution by sector

Sector	Percentage of Workforce
Agriculture	49%
Industry	17%
Services	34%

Source: Odisha economic Survey 2021 – 2022 Planning & Convergence Department Government of Odisha

Agriculture employs nearly half of the workforce making rural people highly vulnerable to climate variability. Industry and service employ 17% and 34% respectively highlighting the importance of livelihood diversification.



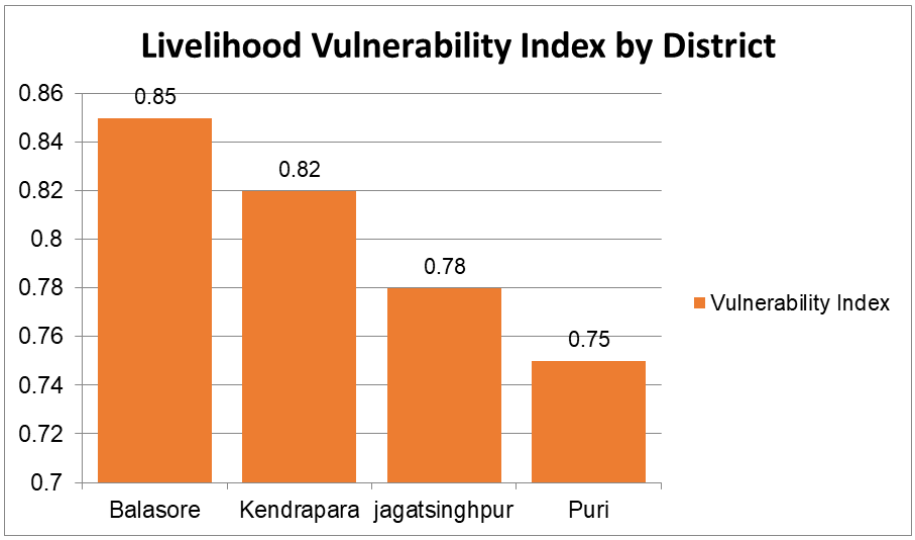
Nearly 50% of the workforce depends on agriculture making it highly vulnerable to climate variability. 34% of population depends on industry for their livelihood and 17% population depends on service sector for their livelihood.

Table 4: Livelihood Vulnerability Index by District

District	Vulnerability Index	Major Risks
Balasore	0.85	Cyclone floods
Kendrapara	0.82	Cyclone salinity intrusion
Jagatsinghpur	0.78	Cyclone coastal erosion
Puri	0.75	Cyclones flood prone areas

Source: NIDM (2021) [7] Cyclone Reports NDMA (2019) [8] OSDMA Annual Reports

Districts like Balasore Kendrapara and Jagatsinghpur show the highest livelihood vulnerability due to repeated cyclones and floods. This highlights the need for targeted adaptation and livelihood resilience programs.



The vulnerability index shows that Jagatsinghpur (0.85) and Kendrapara (0.81) are highly vulnerable followed by Balasore and Bhadrak. Puri district while relatively less vulnerable still faces risks from coastal erosion and saltwater intrusion. These differences highlight that vulnerability is not uniform across districts; it is shaped by exposure socio-economic resilience and adaptive capacity. Policies therefore must be district-specific rather than one-size-fits all. For instance, Jagatsinghpur requires cyclone resilient infrastructure while Balasore may need livelihood strategies.

Findings and Discussion

Climate change has emerged as one of the most critical challenges to the socio-economic stability of coastal Odisha. Secondary sources clearly reveal that the state has been experiencing recurrent extreme weather events such as cyclones, floods, saline intrusion, and sea-level rise over the last few decades. These climatic shocks have disrupted traditional livelihood systems, particularly agriculture, fisheries, and wage labor, which form the backbone of the rural economy. Coastal districts like Kendrapara, Jagatsinghpur, Puri, and Ganjam are among the most vulnerable, as they are repeatedly exposed to natural disasters such as Cyclone Phailin (2013), Fani (2019), and Amphan (2020). The consequences of these events go beyond immediate loss of life and property; they generate long-term livelihood insecurity that forces affected households to seek survival strategies, including migration.

Agriculture in coastal Odisha is heavily dependent on rainfall and fertile land, both of which have been severely affected by climatic changes. Floods and saline intrusion have rendered large tracts of land uncultivable, leading to declining crop productivity and food insecurity. Small and marginal farmers, who constitute the majority, are unable to recover from recurrent losses and often fall into debt cycles. Fisheries, another vital livelihood source, have also been impacted by erratic weather patterns and changing coastal ecosystems.

Rising sea levels and increase frequency of cyclones damage fishing equipment and reduce fish catch, making the occupation less viable. As secondary reports suggest, many young people from fishing communities are abandoning Traditional practices and seeking wage employment elsewhere.

The cumulative impact of these disruptions has been an increase in migration, both seasonal and permanent, from coastal Odisha. Migration patterns observed in government and academic studies indicate that men, particularly from poor households, migrate to urban centers such as Bhubaneswar, Cuttack, Surat, and Hyderabad in search of construction work, industrial labor, and low-paid service sector jobs. This trend is largely distress-driven rather than opportunity-driven, reflecting the lack of sustainable options in the home regions. Migrants often face precarious working conditions, low wages, lack of job security, and absence of social protection in the destination areas. The COVID-19 pandemic further exposed these vulnerabilities, as large numbers of migrant workers from Odisha were forced to return home without savings or support. Women and marginalized groups face a disproportionate share of livelihood stress in this migration context. With male members migrating, women are left to manage households under increasing economic and social strain.

Studies show that women often take on additional agricultural or informal sector work to compensate for the absence of men, but with limited access to resources and decision-making power, their capacity to cope remains restricted. Caste and class hierarchies further aggravate the situation, as marginalized communities have fewer assets and less access to institutional support, making them more dependent on migration and simultaneously more vulnerable to exploitation. While, migration provides some temporary relief through remittances and additional income, it does not resolve the long-term livelihood crisis. Instead, migration creates a cycle of dependency and insecurity. Secondary data highlight that returned migrants frequently struggle to reintegrate into rural economies due to the lack of productive assets and opportunities. Moreover, the loss of human capital from coastal villages weakens local social structures and reduces community resilience against future climatic shocks. Migration, therefore, should be understood not only as an adaptive strategy but also as a symptom of deeper structural vulnerabilities linked to climate change, poverty, and inadequate policy support.

The discussion points to the need for a multidimensional approach to address climate-induced migration and livelihood vulnerability in coastal Odisha. Strengthening disaster management systems, investing in climate-resilient agriculture, promoting sustainable fisheries, and diversifying livelihood opportunities are essential strategies to reduce distress migration. Skill development programs tailored to local needs can enable workers to secure better employment, whether within Odisha or outside. In addition, enhancing social protection measures such as health insurance, migrant worker registration, and housing schemes can help safeguard the rights of migrants. At the community level, empowering women through access to resources, credit, and decision-making platforms is critical for building resilience.

In conclusion, the findings demonstrate that climate change has emerged as both an environmental and socio-economic crisis in coastal Odisha, with migration serving as an immediate coping mechanism but failing to ensure sustainable security. Without proactive state intervention and comprehensive adaptation policies, the cycle of climate vulnerability and distress migration will continue to deepen. The discussion underscores that addressing the nexus of climate change, migration, and livelihoods requires integrated efforts involving government, civil society, and local communities to ensure resilience and long-term sustainability.

Policy Implications

The findings of this study underscore the urgent need for comprehensive policy interventions to address the dual challenges of climate change and migration in coastal Odisha. Since migration is largely distress-driven, policies should focus on strengthening local livelihood systems to reduce dependency on migration. Investment in climate-resilient agriculture, including salt-tolerant crops, improved irrigation facilities, and crop insurance schemes, can help small and marginal farmers cope with recurring climatic shocks. Similarly, promoting sustainable fisheries through modern equipment, early warning systems, and market linkages can secure the livelihoods of coastal fishing communities. At the same time, diversification of income sources through the development of non-farm employment, small-scale enterprises, and skill-based training programs is critical to building economic resilience. For migrants who move out in search of work, effective labor policies, registration mechanisms, and social protection measures such as health insurance and housing support must be strengthened to ensure dignity and security at the destinations. Community participation and women's empowerment should be central to policy frameworks, as women bear disproportionate burdens in climate-affected households. Finally, coordination between state, local governments and civil society is essential for implementing integrated adaptation and migration policies that not only provide immediate relief but also create long-term pathways toward sustainable development and resilience in coastal Odisha.

Conclusion

The study concludes that climate change is intensifying migration and livelihood vulnerability in coastal Odisha. Migration, while serving as a coping mechanism, brings its own set of risks. Unless supported by strong policy frameworks, migration will continue to deepen socio-economic inequalities. Building climate-resilient infrastructure, promoting sustainable livelihoods, and ensuring safe migration practices are essential for achieving sustainable development goals in Odisha. Climate change and migration are closely interlinked in Odisha's coastal regions. Long-term livelihood security remains fragile, and integrated strategies addressing disaster management, livelihood diversification, gender, and migration governance are essential.

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