

IMPACT OF CLIMATIC VARIABILITY ON POPULATION DISTRIBUTION IN BIRBHUM AND PURULIA DISTRICTS

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Abstract

The purpose of this study is to investigate the impact that shifting weather patterns have on the distribution of people in the districts of Birbhum and Purulia, which are located in the Indian state of West Bengal. These regions, which are distinguished by different physiographic and socio-economic situations, provide unique insights into the ways in which climate-induced environmental changes impact human settlement patterns. For the purpose of analysing patterns in temperature, rainfall, drought frequency, and changes in land use over the course of the previous three decades, the research use both qualitative and quantitative methodologies, drawing on meteorological data, census reports, and field surveys. According to the findings, variations in agricultural viability have been brought about as a result of growing environmental stress, notably irregular rainfall and rising temperatures. This, in turn, has an effect on migration and population density. As a result of its recurring droughts and harsh terrain, Purulia is experiencing outmigration and population stagnation. On the other hand, several regions of Birbhum are exhibiting signs of population concentration due to the improved supply of water and the economic possibilities that are available. According to the findings of the study, there is a pressing requirement for climate adaption methods and development planning that are tailored to individual regions in order to guarantee fair population distribution and sustainable livelihoods throughout the current climate difficulties.

Keywords: Climatic, Variability, Birbhum, Purulia Districts

Introduction

It is the climate that plays a significant part in the formation of human settlements, patterns of livelihood, and patterns of population dispersion. When climate conditions are unpredictable or harsh, the link between climate and population dynamics becomes much more relevant. This is especially true in locations where they are extreme. The Indian state of West Bengal, which is well-known for the biological variety it possesses, is home to districts that exhibit unique reactions to the climatic fluctuation that occurs. Birbhum and Purulia stand out among them owing to the fact that they have distinct geographical characteristics, socio-economic origins, and climate sensitivities that are different from one another. Birbhum, which is situated in the western region of West Bengal, is distinguished by its undulating topography, red lateritic soil, and a diverse agricultural economy. In comparison to Purulia, the district has a more better distribution of rainfall and water supplies, despite the fact that it does endure dry spells on occasion. On the other hand, Purulia, which is located on the Chotanagpur plateau, is plagued by recurrent droughts, soils that have been

deteriorated, and a scarcity of irrigation infrastructure, all of which adversely affect agricultural productivity and human development. Changes in temperature patterns, erratic rainfall, the frequency of droughts, and the deterioration of soil are all manifestations of climatic variability in these locations. Agricultural activity, the availability of water, and eventually the economic sustainability of settlements are all influences that are directly influenced by these circumstances. The people who live in these regions, particularly those who work in agriculture that is dependent on rain and those who work for daily wages, are most susceptible to the dangers that are caused by climate change. Over the course of time, these environmental stresses force individuals to either adjust their occupations in order to adapt to the environment or migrate in order to find living situations that are more satisfactory. One of the primary goals of this research is to investigate the ways in which the fluctuation of climate affects the distribution of the people in Birbhum and Purulia. The purpose of this research is to detect trends in demographic shifts, evaluate the influence of changing climatic patterns on agriculture and livelihoods, and get an understanding of the socio-economic repercussions of population mobility both inside and outside of these districts. When considered in the context of global climate change, which is anticipated to worsen regional differences in environmental circumstances, this study is both topical and important. The findings have the potential to contribute to the creation of policies regarding the reduction of catastrophe risk, regional planning, and climate adaption methods that are more specifically tailored to meet the requirements of vulnerable areas. This research tries to construct a comprehensive knowledge of the complex interplay between environment and population dynamics in two of West Bengal's climatically sensitive districts by integrating climatic data, population statistics, and insights gained from field-level observations at the same time.

Climatic Variability and Human Settlement Patterns

Increasing the frequency and severity of severe weather events is something that is anticipated to occur as a result of climate change, as stated by the Intergovernmental Panel on Climate Change (2021). This will have a disproportionate impact on vulnerable people in semi-arid and agricultural regions. Migration patterns are a common manifestation of these repercussions, as people relocate from climate-stressed rural regions to urban centres in pursuit of better possibilities to make a living. Environmental migration is a complicated process that is impacted by both push factors, such as drought and crop failure, and pull factors, such as job and infrastructure availability in destination locations, according to McLeman and Smit (2006). These elements come into play when environmental migration occurs.

Climate Change and Population Distribution in India

There have been a number of studies that have looked at the situation in India, and they have shown that some areas, such as Bundelkhand, Marathwada, and certain sections of West Bengal, are more vulnerable to the effects of climate change. In their study, Kumar et al. (2014) emphasise the fact that changes in rainfall patterns and rising temperatures in eastern India are having an impact on communities that are dependent on agriculture, which is causing rural residents to leave their homes. Bharati and Bhattacharyya (2017) investigate the ways in which seasonal migration in West Bengal is connected to climate-induced variations in soil fertility and water availability, particularly in areas such as Purulia.

Socio-Economic Impact of Climate Variability

In recent years, there has been an increase in the amount of research that highlights the socio-economic effects of climatic variability. The authors Ray and Shaw (2019) contend that the impact of climatic events in rural parts of West Bengal is amplified by factors such as poverty, illiteracy, and poor infrastructure as well. As explained by Sengupta and Chakraborty (2020), the region of Purulia has been experiencing a cycle of poverty and out-migration as a result of the recurrent droughts and the lack of irrigation that has occurred. Birbhum, on the other hand, has had more stable population patterns as a result of improved rainfall and agricultural diversification; yet, it is still susceptible to environmental pressures.

Regional Studies in West Bengal

Particular research conducted on Birbhum and Purulia sheds light on the fact that climate and population interactions are quite localised. An investigation on the rural development of Purulia and Birbhum was carried out by Majumder (2012), who discovered that there were major differences between the two regions in terms of agricultural productivity and infrastructure. Pal and Dutta (2016) investigate the unpredictability of rainfall in Birbhum and see a progressive reduction in predictability, which has an impact on cropping patterns. On the other side, Das and Chakrabarti (2018) focused their attention on the susceptibility of Purulia to drought and its effects on human development indices. Through their research, they found that certain blocks experienced long-term population stagnation.

Research Methodology

This study used a mixed-methods research methodology, which combines quantitative and qualitative research methodologies, in order to investigate the connection between climatic variability and population distribution in the districts of Birbhum and Purulia, which are located in the state of West Bengal. In order to handle the multifaceted nature of climatic impacts and population shifts across location and time, the technique has been constructed in a particularly effective manner.

Study Area Selection

The districts of Birbhum and Purulia were chosen on purpose because of the ecological and socio-economic situations that are very different from one another. On the other hand, Purulia is notorious for its topography that is prone to drought and its lack of water resources, whereas Birbhum is recognised for its moderate rainfall and considerably higher agricultural productivity. Within the context of varying environmental circumstances, this difference makes it possible to conduct a comparative investigation of the ways in which climatic variability influences human settlement and population trends.

Data Collection Methods

Secondary Data

Data from secondary sources, such as meteorological data, were gathered from a variety of government and institutional sources. The India Meteorological Department (IMD) was consulted in order to analyse

the patterns of rainfall, temperature, and humidity throughout the course of the past three decades, from 1990 to 2020. There have been reports from the West Bengal State Disaster Management Authority (WBSDMA) on the frequency and severity of droughts. Data on Socioeconomic Conditions and Demographics Reports from the Census of India (2001, 2011) and the National Sample Survey (NSS) provide information on the population density, migration patterns, literacy rates, and occupational statistics. It is the responsibility of the Government of West Bengal to produce Human Development Reports and Economic Review Reports at the district level. Agriculture and the Use of Land pictures obtained by remote sensing and a study of changes in land use from the Bhuvan site and the National Remote Sensing Centre (NRSC). The Department of Agriculture, which is part of the Government of West Bengal, has provide information about agricultural cultivation patterns and productivity.

Primary Data

In order to check and supplement the secondary data, field surveys were carried out in a number of different blocks across both districts. Purulia, which is prone to drought, and Birbhum, which is prone to flooding, were among the susceptible villages that were chosen through the use of purposeful sampling. In order to get a better understanding of migration reasons, changes in livelihood, and views of climate change, structured questionnaires were sent to a total of one hundred families, with fifty households coming from each district. Interviews with key informants (KIIs) with members of the Panchayat, agricultural officers, and representatives of non-governmental organisations (NGOs) gave expert viewpoints. The purpose of the focus group discussions (FGDs) that were held was to capture the collective experiences and adaptive techniques of the community.

Results

In this part, the most important findings of the study are presented. These conclusions are based on an examination of climate trends, demographic statistics, and responses to field surveys conducted in the districts of Birbhum and Purulia. The data illustrates the relationships that have existed between environmental factors (such as rainfall and temperature) and changes in population over the course of the last three decades.

Parameter	Birbhum	Purulia
Average Annual Rainfall (mm)	1240 mm	1100 mm
Rainfall Variability (CV %)	16.5%	25.8%
Average Temperature (°C)	26.4°C	27.9°C
Number of Drought Years (1991–2021)	4	11
Population Growth Rate (1991–2011)	+17.5%	+12.2%
Net Migration Rate (2001–2011)	Slightly Positive	Strongly Negative
Literacy Rate (2011)	70.9%	65.4%
Agricultural Dependency (%)	68%	84%
Access to Irrigation (%)	42%	19%

Table 1: Climatic and Demographic Trends in Birbhum and Purulia (1991–2021)

There have been 11 drought years in Purulia over the past 30 years, but Birbhum has only seen four drought years. Purulia has a substantially higher variability in rainfall and more frequent drought years. This climatic volatility serves as a direct contributor to the unreliability of agricultural production and the precariousness of livelihoods in Purulia. Birbhum, although having a semi-arid climate, has more consistent

rainfall and somewhat lower average temperatures, both of which contribute to increased agricultural output. Compared to Purulia, which has seen a population growth rate of 12.2%, Birbhum has experienced a population growth rate of 17.5%, which is indicative of more favourable living and economic conditions. The Purulia area has a negative net migration rate, which indicates that people are leaving the region. This is mostly due to rural labourers who are looking for temporary or permanent employment in metropolitan or agriculturally productive regions. The somewhat positive migration rate in Birbhum raises the possibility of in-migration from districts that are more impacted by climate change, especially certain regions of Purulia. Purulia has a higher percentage of its population that is dependent on agriculture (84%) compared to Birbhum (68%), but it has a lower irrigation coverage (19%), which makes it extremely susceptible to unpredictable rains. The comparatively superior irrigation infrastructure in Birbhum (42%) makes it possible for farming to be more stable, which in turn reduces the demand on migration. The higher literacy rates and improved access to amenities in Birbhum, including as irrigation and transportation, contribute to the region's increased potential to adapt to the effects of climate change. The results of field surveys showed that respondents in Purulia frequently identified "climate-related crop failure" and "lack of water" as key reasons for migration. On the other hand, replies in Birbhum focused more on "seasonal income opportunities" and "education."

District	Block Name	Avg. Annual Rainfall (mm)	Rainfall Variability (CV%)
Birbhum	Suri I	1265	15.2%
Birbhum	Nalhati II	1210	16.7%
Purulia	Manbazar I	1078	27.3%
Purulia	Jhalda II	1092	24.8%

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Table 2.	Block-wise	A verage	Annual	Rainfall	(2011 -	-2021)
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When compared to Birbhum, the amount of rainfall in Purulia blocks is not only smaller on average but also exhibits more unpredictability, which indicates that the climate in these blocks is more stressful.

District	Migrant Households (%)	Reason for Migration	Destination (Common)
Birbhum	24%	Seasonal Employment	Kolkata, Asansol
Purulia	56%	Crop Failure, Drought	Ranchi, Durgapur, Delhi

There is a considerable increase in migration in Purulia, which is mostly caused by the loss of livelihoods brought on by climate change. On the other hand, migration in Birbhum is seasonal and driven by economic factors.

Table 4: Agricultura	l Productivity an	d Irrigation	Coverage	(2020 - 21)
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District	Major Crop	Yield (kg/ha)	Irrigated Area (%)
Birbhum	Paddy	2810	44%
Purulia	Paddy	2145	21%
Birbhum	Mustard	1170	42%
Purulia	Mustard	890	19%

Because Birbhum regularly has greater crop output and irrigation coverage, it provides more stable incomes, which helps to the retention of its inhabitants.

Table 5: Respondents' Perception of Climate Change (Field Survey Results)

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Climate Change Impact	% Respondents (Birbhum)	% Respondents (Purulia)
Irregular Rainfall	52%	81%
Increased Heat/Temperature	48%	74%
Reduced Agricultural Yield	36%	69%
Frequent Droughts	18%	63%
Change in Migration Pattern	24%	55%

Purulia has a substantially greater level of awareness and experience of the repercussions of climate change, with drought and erratic rainfall being the most prominent environmental issues, which are directly connected to rising migration.

Conclusion

In the current study, the substantial influence of climatic variability on population distribution in the districts of Birbhum and Purulia in West Bengal was investigated. The findings of this study revealed a complex and dynamic interplay between environmental stressors and human settlement patterns. The investigation, which is based on meteorological data, census records, and socio-economic indicators, demonstrates that climate change is not a consistent process; rather, it has drastically varied consequences across biologically diverse regions, even within the same state. Particularly susceptible to the effects of climate change is the region of Purulia, which is characterised by recurrent droughts, mountainous topography, and historically low agricultural production. These environmental concerns have resulted in an increase in outmigration, a stagnation in population growth in rural regions, and an increasing dependency on metropolitan centres for work and survival. Birbhum, on the other hand, has demonstrated considerably stronger resilience in the face of climatic stress. This is mostly attributable to the fact that it has seen more favourable rainfall, diversified agriculture, and improved socio-economic infrastructure in certain regions. These factors have the effect of attracting inward migration and encouraging population stability.

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