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Issues and challenges of climate change in select districts of eastern Uttar Pradesh

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Abstract
In the fast changing scenario across the countries, the world is in a phase of inter-glacial era and cyclical variation in temperature has adversely affected the water resources and in turn it has also put impact on socio-economic activities of the society. The demand for the adoption of sustainable development approach has got evolved worldwide and for the future cause/security and protection of environment every nation of the world is willing to go with the sustainable development approach. It is also clear that any change in climatic/environmental conditions will definitely influence and put its impact on the culture and civilization of the society as, culture and civilization is also governed by the economic perspective and economic perspective is affected by climate change. This paper examines the key issues and challenges posed by climate change in select districts of Eastern Uttar Pradesh, highlighting its effects on agriculture, water resources, health, and socio-economic stability. The study also explores adaptive measures and policy interventions to mitigate the adverse effects of climate change in the region. The present research article attempts to highlights the adverse impact of climate change on epidemic, water quality, pollution, agricultural activities, flood, draught, depletion of ground water level and also emphasizes on the way forward to overcome these issues and how to retain/regain/improve the welfare of the society by ensuring sustainable development process in select districts of eastern Uttar Pradesh.

Keywords: Climate change, drought, sustainable development, flooding, environment

Introduction
Climate change is the serious issue for world and in turn for India and Uttar Pradesh also. Adverse impact of climate change can be seen on primary activity like agriculture, food grain production and food security, on availability of water resources, on small and marginal farmers and on existing ecosystem and in turn on the livelihood of rural/common people of the society. As, the adverse impact of climate change can be seen mainly on the small and marginal farmers of the rural region who solely depend on better monsoon and climatic conditions for higher rate of crop productivity and they are the mainly affected groups of the society. It is also needed that certain mechanism is to be promoted so that effectiveness of planning and management related to climate change can also be raised. Uttar Pradesh has tropical monsoon climate with high temperature in summer, high or low rainfall level and cooler winters; these climatic conditions put impact on natural resources, agriculture and human being. It has been seen that adversely affected group in Uttar Pradesh is small and marginal group of farmers, what else can be noted that rural area population who are living in a devastative environment has to face unfavorable impact of climate change in the form of drought, failure of crop, livestock loss and loss of forest produce. Pressure of population is continuously increasing on land. Continuous increasing population and expansion of urban area has put large scale pressure on land and on water resources.
One more major issue has come up in the form of change in demand for land and in urban areas and in rural areas. The alarming phase of climate change in turn hampers the growth of the economy, like productivity of crop goes down, which may cause scarcity of food and threat for subsistence living in less developed countries like India. India is agrarian economy where approximately 53% of its population is engaged in agricultural activities and agriculture also contributes approximately 15% in India's GDP. The concern is that though there is the rise in agricultural productivity

but availability of consumable food and nutritional input is still a major challenge for the government to deal with.

Climate change has become one of the most pressing environmental concerns worldwide. Rising temperatures, erratic rainfall, increased frequency of extreme weather events, and changing climatic patterns pose severe challenges to different sectors of the economy, particularly in agrarian regions in Uttar Pradesh. The region is characterized by high dependence on agriculture, frequent flooding, water scarcity, and socio-economic vulnerabilities that exacerbate the effects of climate change. This paper seeks to analyze the major climate change-related issues in select districts of Eastern Uttar Pradesh and propose strategic interventions to address them.

Impact of Climate Change on Key Sectors

Agriculture and Food Security Agriculture in Eastern Uttar Pradesh is highly vulnerable to climate variability. Rising temperatures and erratic rainfall patterns have led to significant reductions in crop yields, threatening food security in the region. The unpredictability of monsoons has disrupted traditional farming cycles, leading to frequent crop failures. Soil degradation, increased salinity due to excessive waterlogging, and pest infestations further compound agricultural distress. Small and marginal farmers, who form a substantial part of the agrarian economy, face the greatest challenges as they lack access to climate-resilient farming techniques and financial resources to invest in adaptive strategies.

Water Resources

Water resources in Eastern Uttar Pradesh are under considerable strain due to changing climatic conditions. Groundwater depletion, exacerbated by over-extraction for irrigation, poses a serious threat to water availability. The contamination of drinking water sources, particularly arsenic contamination in districts like Ballia, poses a significant public health risk. Flooding, a recurrent problem in the region, leads to the destruction of water infrastructure, disrupting irrigation systems and reducing agricultural productivity. The increasing frequency of droughts has further heightened the need for efficient water conservation and management strategies to ensure sustainable access to clean water.

Human Health

Climate change has a profound impact on public health in Eastern Uttar Pradesh. Rising temperatures contribute to the increased prevalence of vector-borne diseases such as malaria and dengue. The intensification of heatwaves has led to higher incidences of heat strokes and dehydration, particularly among vulnerable populations such as the elderly and laborers. Poor air quality, exacerbated by dust storms and increased industrial pollution, has led to a rise in respiratory illnesses, including asthma and chronic bronchitis. Additionally, food insecurity resulting from declining agricultural yields has led to malnutrition and weakened immune systems, increasing susceptibility to infections and diseases.

Socio-Economic Stability

The socio-economic stability of Eastern Uttar Pradesh is at risk due to climate-induced challenges. The agrarian economy, which supports a large portion of the population, is suffering due to declining crop yields and water scarcity, leading to increased migration in search of alternative livelihoods. Many farmers and rural laborers are forced to leave their villages and migrate to urban areas, straining existing urban infrastructure. Traditional industries such as fishing and animal husbandry are also facing disruptions due to changing climatic conditions. Furthermore, the rising cost of disaster recovery efforts, including rebuilding homes and infrastructure after floods or droughts, places an additional financial burden on both the government and local communities.

Critical Issues of Climate change in Uttar Pradesh

Uttar Pradesh has the high density of rivers, fertile soil, favorable climatic conditions and landscape which is also smooth and all these parameters lead it to become one of the populous region of the world and it is facing aftereffects of climate change and ignorance of natural & scientific facts in the form of drought, flood, problem of potable water, challenge of epidemic spread out, issue of rising pollution, downfall of agricultural productivity and affected rivers.

Effect on agricultural productivity- Uttar Pradesh is a large state with 9 distinct agro climatic zones and along with this if data is being analyzed then it is revealed that per capita availability of cereals, vegetables, fruits is more than the demand which exceeds the dietary provision suggested by Indian council of medical research whereas per capita availability of nutritious food items like protein rich pulses, and milk is less than the demand. Uttar Pradesh is the agrarian state and also has the highest cropped area of 25,785,000 hectare.

The major crops grown in Uttar Pradesh are maize, wheat, sugarcane, rice, mustard, gram, barley, and groundnut. There is rise in the production of food grain in Uttar Pradesh in 2001, and was 43 million ton, which was increased to 47 million ton in 2011, increased to 49 million ton in 2016-17, increased to 51 million ton in 2017-18 and increased to the level of 601 lac MT (or 60 million ton) in 2020-21. Cereals are grown on an area of 178.34 lac hectare and results in the production of 598.11 lac mt during 2021-22, along with this coarse cereals were grown on 20.25 lac hectare and there is the production of 47.03 lac mt, pulses production in 2017-18 was 2,208.0 thousand ton and presently was grown on 24.1 lac hectare of land and there is the production of 26.22 lac mt. When normalized yield difference method is considered for prediction analysis of crop yield on seasonal basis, observation shows that rise in temperature to higher level may cause downfall in yield of paddy crop in eastern. Uttar Pradesh by 1.0 to 1.1% per hectare by 2020. In the similar way, downfall of temperature to minimum level may decrease the yield of rice by 1.5 to 1.9% per hectare in eastern Uttar Pradesh

Drought: The long lasting dry and warm season months lead to the drought like conditions, and also turn fertile land areas to the barren land holdings. The adverse impact of climate change and almost nil rain falls is as such that Gangetic plain region of Uttar Pradesh and the fertile regions of the Maharashtra, Madhya Pradesh, Haryana and Punjab has also turned into the barren dry patches.

Flooding: Though flood cases less loss to property, life in comparison to other natural disasters like earthquakes, cyclone and drought but is responsible for causing damage

to the cultivated cop, high incidence of injuries and also causes homelessness. It is estimated that about 30 districts of this state are flood prone districts and frequent affected area is eastern Uttar Pradesh, which is occupied by rivers like kuwana, great gandak, Ghaghara, chhoti gandak and rapti. It has been proved that the socio-economic development of an area depends on the hydrological resources available in the region. In Uttar Pradesh because of rapid rate of growth of population and rising environmental pollution in has deteriorated the aquifer to a major extent during the last two to three decades of time.

Emerging Options in Uttar Pradesh

To overcome the challenges arisen because of climate change the Uttar Pradesh government needs to take the necessary steps like- a) greenhouse gases to be reduced- Co_2 of the air can be reduced by means of a forestation drive in Uttar Pradesh.

Remedial measures in countering Drought

By recharging aquifers: Under this process excess surface water is lead to the ground by three methods

1. By surface spread,
2. By means of recharge wells,
3. To replenish an aquifer making changes in natural conditions for more penetration.

Uttar Pradesh government has announced policy for ground water management, harvesting of rain water and recharge of ground water. The prime objective of this policy is to regulate ground water exploitation and to promote optimum use of ground water on sustainable basis.

Harvesting of Rainwater

it is a method used for the collection and storage of rainwater drops into natural water bodies, reservoirs or tanks, in other words it is the infiltration of surface water into the sub surface aquifers.

Flood District Management

To regulate devastative and destructive strength of flashing floods number of small flood retention reservoirs of appropriate capacity should be built on or near each river. The river system has been changed/altered because of rapid rise in the density of population and rise in human intervention.

Adoption of Best Practices in Eastern Uttar Pradesh

Best Practices that can be considered and adopted by the government of Uttar Pradesh for overcoming issues of climate change

1. Government of Uttar Pradesh need to promote and provoke afforestation and reforestation drive for the conservation of biodiversity. Here, the need of the hour is to enhance afforestation drive along with the conservation and sustainable management of tree resources.
2. Government of Uttar Pradesh also needs to increase the participation of local people in the drive of growing trees and planting of these trees. At India level environment must be a development agenda.
3. Construction of artificial levee and embankment are considered as most popular method to control the flood; whereas on practical basis it has been found that artificial levee and embankment cannot control flood fully and for that very purpose remote sensing technique can be used for the identification of flood affected area and small flood retention reservoirs of suitable capacity need to be constructed in nearby region of river so that devastative impact of floods downstream can be regulated.
4. Along with that semi-arid regions of Uttar Pradesh can also be utilized for the cultivation of crops like oilseeds, cotton and pulses which require less irrigation and in turn will improve production of food grain at state level.

Innovative Actionable ideas

It is known that nature has provided natural resources free of cost and in its pure form where as human being to fulfill his greed and lust has made them hazardous and chemically contaminated. Now, it is revealed that foolproof solution to this problem is protection not prevention. Government of Uttar Pradesh need to reduce loss/damage by means of preparedness, mitigation and framed recovery program. In this regard to reduce flooding and lateral erosion impact structural and non-structural control measures can be taken.

There is the need for the formulation of the policy so that no one can encroach with permanent settlement in the peril zone of the river. In general at world level GIS and Remote sensing techniques are used as nonstructural mitigation measures.

The untreated water deteriorates the quality of river water adversely and also puts devastative impact on surrounding environment of river and on people who make use of that water. Government of Uttar Pradesh is continuously working on developing via media to overcome after effect of recurrent droughts on agriculture and livelihoods of common people, impounded by climate change in Bundelkhand region of western UP.

Government need to develop coordination among nongovernmental organizations, local authorities and charity donors so that effective steps can be taken. Government need to promote dry farming techniques in these rain scarce regions.

Challenges in Addressing Climate Change

Despite recognizing the impacts of climate change, several challenges hinder effective mitigation and adaptation in Eastern Uttar Pradesh.

Lack of Awareness

Many farmers and local communities lack adequate knowledge about climate-resilient practices. Limited awareness regarding alternative agricultural techniques, sustainable resource management, and early warning systems results in continued dependence on traditional methods that may no longer be viable under changing climatic conditions. Enhancing outreach and education initiatives is crucial to equipping farmers with the knowledge and tools necessary for climate adaptation.

Poor Implementation of Policies

Government schemes on climate adaptation and disaster risk reduction often face bureaucratic hurdles. Delays in fund allocation, lack of coordination among various departments, and inefficient execution of climate policies hinder the effectiveness of these initiatives. Although numerous programs exist to promote sustainable agriculture, water

conservation, and disaster preparedness, their on-ground implementation remains weak, limiting their reach and impact.

Limited Financial Resources
Small and marginal farmers struggle to adopt climate-smart agriculture due to financial constraints. The high cost of drought-resistant seeds, advanced irrigation systems, and soil conservation techniques makes it difficult for economically weaker sections to implement these measures. Furthermore, inadequate access to institutional credit prevents farmers from investing in necessary infrastructure improvements. Expanding financial support through subsidies and low-interest credit schemes can help bridge this gap.

Inadequate Infrastructure
Poor drainage systems, weak embankments, and outdated irrigation facilities increase climate vulnerability. Many regions in Eastern Uttar Pradesh experience frequent flooding due to ineffective flood control measures, leading to loss of lives and property. Similarly, water scarcity during dry spells is exacerbated by the absence of efficient water storage and distribution systems. Strengthening infrastructure resilience through better flood management, improved irrigation networks, and enhanced rural road connectivity is essential to mitigate climate risks.

Adaptation and Mitigation Strategies
To address the challenges posed by climate change, a multi-faceted approach involving policy intervention, community participation, and technological advancement is necessary.

Climate-Resilient Agriculture
The adoption of drought-resistant crop varieties, precision farming, and conservation tillage can help farmers cope with changing climatic conditions. Training programs should be introduced to educate farmers about sustainable agricultural practices, efficient water use, and soil conservation techniques.

Sustainable Water Management
Strategies such as rainwater harvesting, groundwater recharge, and efficient irrigation techniques must be promoted. Encouraging afforestation and the restoration of wetlands can help maintain water balance and mitigate the adverse impacts of droughts and floods.

Strengthening Disaster Preparedness
Developing and enhancing early warning systems for floods, droughts, and extreme weather events is crucial for minimizing damage. Infrastructure improvements such as flood-resistant housing and well-maintained embankments can reduce vulnerabilities. Establishing local disaster management teams will help communities respond effectively to climate-related disasters.

Health Interventions
Strengthening healthcare facilities and improving access to medical services in rural areas will help manage climate-related health issues. Public awareness campaigns on heat stress, waterborne diseases, and respiratory illnesses can improve preparedness. Expanding vaccination programs and improving sanitation can also reduce health risks associated with climate change.

Policy and Governance Reforms
Strengthening environmental policies and ensuring their effective implementation is crucial. Encouraging local governance structures to participate in climate adaptation planning can improve community resilience. Integrating climate adaptation into rural development plans and increasing financial support for climate initiatives through government and private sector partnerships will help sustain long-term efforts.

Conclusion
Climate change is a pressing issue affecting multiple aspects of life in Eastern Uttar Pradesh. The region's vulnerability to extreme weather events, shifting agricultural patterns, and socio-economic disruptions underscores the need for immediate and sustained action. Addressing climate change requires a comprehensive approach that integrates policy reforms, scientific innovations, and community-driven initiatives.

Building climate resilience in the region necessitates investment in sustainable agriculture, water conservation, and early warning systems. Government agencies, local communities, and private stakeholders must collaborate to ensure effective implementation of climate adaptation strategies. Strengthening infrastructure, improving disaster preparedness, and promoting renewable energy sources can help mitigate the long-term impacts of climate change.

Education and awareness campaigns should be prioritized to empower farmers and local populations with knowledge about climate-smart agricultural practices and resource conservation. In addition, financial support through subsidies and credit access can enable small farmers to adopt climate-resilient technologies.

Ultimately, climate change mitigation and adaptation in Eastern Uttar Pradesh require a concerted effort at multiple levels-policy, research, and community engagement. By adopting a proactive and integrated approach, the region can build resilience against climate change, ensuring sustainable development and a better quality of life for its inhabitants.

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