Geographical Analysis of the Impact of the Ramganga River on the Economy of Moradabad District

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***Abstract*—Rivers constitute one of the most crucial natural resources influencing regional economic development, particularly in agrarian and industrial regions. The Ramganga River, a major tributary of the River Ganga, plays a significant role in shaping the economic landscape of western Uttar Pradesh. Moradabad district, located along the banks of the Ramganga, represents a classic example of a river-based regional economy. The present study offers a comprehensive geographical analysis of the impact of the Ramganga River on the economy of Moradabad district, with special emphasis on agriculture, irrigation, industry, urbanization, employment generation, and environmental sustainability. Spatial and descriptive-analytical techniques have been applied to understand the river economy relationship. The findings reveal that the Ramganga River has been instrumental in enhancing agricultural productivity, supporting industrial clusters particularly the brassware industry and facilitating urban growth. However, increasing pollution, flood hazards, and unsustainable water exploitation have emerged as serious challenges, threatening the long-term economic sustainability of the district. The study emphasizes the need for integrated river basin management and sustainable development strategies to preserve the economic benefits derived from the Ramganga River.**

***Index Terms*—Ramganga River, Moradabad District, River-based Economy, Agriculture, Industry, Urbanization, Sustainable Development**

I. INTRODUCTION

Rivers have historically served as the foundation of human civilization and economic development. From providing water for drinking and irrigation to facilitating trade, industry, and urbanization, rivers continue to play a vital role in shaping regional economies. In India, river systems form the backbone of both rural and urban livelihoods. The Ganga river system, in particular, supports one of the most densely populated and economically productive regions of the country. Among its important tributaries, the Ramganga River occupies a distinctive position due to its geographical extent and economic significance in northern India. In the contemporary era, this relationship has grown increasingly complex and paradoxical. While the Ramganga continues to be indispensable for agriculture irrigating vast tracts of sugarcane, wheat, and rice and for the brass industry, it also poses significant challenges. Rampant pollution from industrial effluent, notably from the metal finishing units, and urban sewage has degraded water quality, threatening public health and ecosystem services. Furthermore, issues of water allocation, seasonal variability, and the impacts of climate change on river flow introduce elements of risk and uncertainty for economic sustainability.

The Ramganga River originates from the Dudhatoli range of the Kumaon Himalayas in Uttarakhand and flows through several districts of Uttar Pradesh before joining the River Ganga. Moradabad district, situated in the upper Ganga plain, has evolved as a prominent agricultural and industrial region largely due to the presence of the Ramganga River. The district is internationally renowned for its brassware industry and is also characterized by fertile alluvial soils, intensive agriculture, and rapid urban growth.

Despite the economic advantages offered by the Ramganga River, increasing population pressure, unplanned urbanization, industrial pollution, and over-extraction of water resources have raised serious environmental and economic concerns. A geographical analysis that integrates physical, economic, and human dimensions is therefore essential to understand the changing role of the river in regional development. This study attempts to fill this gap by examining the multifaceted impact of the

Ramganga River on the economy of Moradabad district.

II. REVIEW OF LITERATURE AND RESEARCH GAP

Several studies have examined the role of rivers in agricultural development, industrial growth, and urbanization in India. Scholars such as R.L. Singh and Majid Husain have highlighted the importance of river systems in shaping regional economies in the Indo-Gangetic plain. Research on the Ramganga River has largely focused on water quality assessment, pollution levels, and ecological degradation, particularly in relation to industrial effluents and urban sewage.

However, a critical review of existing literature reveals a significant research gap. While environmental and hydrological studies on the Ramganga River are available, integrated geo-economic analyses focusing specifically on Moradabad district remain limited. Moreover, prior works seldom adopt a spatial temporal perspective to analyze variations in river flow, flood frequency, groundwater recharge, and their differential economic impacts on rural and urban areas. The role of the Ramganga in shaping land-use patterns, irrigation networks, industrial clustering, and urban expansion in Moradabad has not been adequately mapped or quantified using modern geographical tools such as GIS and remote sensing. In addition, micro-level field-based evidence reflecting the experiences of farmers, artisans, and informal workers dependent on the river economy is largely missing. Most studies treat agriculture, industry, and urbanization as separate entities, without examining their spatial interconnections through the river system. The present study addresses this gap by adopting an integrated geographical approach that links the physical characteristics of the Ramganga River with economic activities and development patterns in Moradabad district.

III. OBJECTIVES OF THE STUDY

The major objectives of the study are:

1. To analyze the geographical characteristics of the Ramganga River in Moradabad district.
2. To examine the role of the Ramganga River in agricultural development and irrigation.
3. To assess the contribution of the river to industrial growth and employment generation.
4. To study the influence of the river on urbanization and infrastructure development.
5. To identify environmental challenges associated with the river and their economic implications.

IV. STUDY AREA: MORADABAD DISTRICT

The present study is centered on Moradabad district of Uttar Pradesh, India, a region where the Ramganga River plays a vital role in shaping the hydrological framework, agricultural productivity, industrial development, and overall economic structure. Located within the fertile stretch of the Upper Ganga–Yamuna Doab and forming an important part of the Rohilkhand Plain, Moradabad represents a classic example of river-controlled economic development in the alluvial plains of northern India.

Geographically, the district lies approximately between 28°16′ to 28°54′ North latitudes and 78°04′ to 79°06′ East longitudes. The terrain is characterized by gently undulating alluvial plains, with an average elevation of about 198–200 metres above mean sea level. After the administrative reorganization following the formation of Sambhal district in 2011, Moradabad covers an area of nearly 3,493 square kilometres. It is bounded by Bijnor district to the north, Rampur to the east, Amroha to the west, and Sambhal to the south, providing both agricultural continuity and strong commercial connectivity.

The Ramganga River, a major tributary of the Ganga, originates from the Dudhatoli ranges of the Pauri Garhwal Himalaya (Uttarakhand) and is regulated upstream by the Kalagarh Dam. Entering Moradabad from Bijnor district, the river flows in a south-easterly direction, carving a broad alluvial corridor across the district. In several stretches, it forms a natural divide between the Thakurdwara and Kanth tehsils. Important left-bank tributaries such as the Dhela (near Bhojpur), Rajera (near Dalpatpur), Gangan, and Deoha, mainly originating from the Tarai belt, enrich its flow. The river passes through Moradabad city, largely along its right bank, before moving onward toward Rampur district.

Over time, the Ramganga has created extensive khadar zones with deep and fertile alluvial soils. These areas support intensive cultivation of wheat, rice, sugarcane, mentha, vegetables, and fodder crops, making

agriculture the backbone of rural livelihoods. Irrigation facilities are further strengthened by the Ramganga Canal system, enhancing agricultural reliability and productivity.

Administratively, the district comprises four major tehsils Moradabad (Sadar), Kanth, Thakurdwara, and Bilari along with several development blocks, where riverine influence is most prominent in the northern and central parts. According to the 2011 Census, Moradabad had a population of over 4.7 million, with recent estimates (2025) approaching 6 million due to rapid urbanization and rural expansion. Population density is particularly high along riverbanks and in the urban-industrial core.

Economically, Moradabad enjoys international recognition as India's "Brass City". Thousands of small and medium-scale units engaged in brass handicrafts, metalware, and export-oriented industries have historically developed along the Ramganga due to water availability, transport advantages, and settlement concentration. However, this industrial clustering has also resulted in environmental challenges, including river pollution from industrial effluents, sewage discharge, and solid waste.

Climatically, the district experiences a subtropical monsoon climate, with hot summers, humid monsoon rains, and cool winters. The average annual rainfall ranges between 800 and 1,000 mm, mainly received during the southwest monsoon. The river's flow regime partly regulated by upstream dams plays a crucial role in irrigation reliability, groundwater recharge, flood occurrence, and ecological balance. This dynamic interaction between the Ramganga River, floodplains, agriculture, industry, and settlements makes Moradabad district an ideal geographical setting for examining the economic impact of a river system on regional development.

The Ramganga River originates at an elevation of approximately 3,110 meters in the Dudhatoli range of the Himalayas. It flows for about 690 km before joining the River Ganga near Kannauj. In Moradabad district, the river follows a south-easterly course and functions as a major drainage channel.

The river contributes significantly to groundwater recharge through seepage and overbank flooding. Its floodplains are composed of rich alluvial soils, which enhance agricultural productivity. The spatial distribution of settlements, farmlands, and industrial units in Moradabad shows a close association with the river and its tributaries.

V. IMPACT OF THE RAMGANGA RIVER ON AGRICULTURE

5.1 Irrigation and Water Availability

Agriculture forms the backbone of Moradabad's rural economy. The Ramganga River supports agricultural activities through canal irrigation, lift irrigation, and groundwater recharge. Approximately 55–60 percent of the cultivated area in the district is directly or indirectly dependent on river-based irrigation systems. Tube wells located in the Ramganga floodplain zones provide reliable irrigation during dry seasons, reducing dependence on erratic monsoon rainfall. This has enabled farmers to adopt high-yielding crop varieties and modern agricultural practices.

5.2 Cropping Pattern and Productivity

The fertile alluvial soils deposited by the Ramganga support a diversified cropping pattern. Major Kharif crops include rice, maize, and sugarcane, while Rabi crops mainly consist of wheat, mustard, and pulses. The availability of assured irrigation has promoted double cropping, significantly increasing agricultural productivity and farm incomes.

5.3 Allied Agricultural Activities

The river also supports livestock rearing, dairy farming, and inland fisheries. These allied activities provide supplementary income to rural households and enhance livelihood security, particularly for small and marginal farmers.

VI. INDUSTRIAL DEVELOPMENT AND THE ROLE OF THE RIVER

6.1 Brassware Industry

Moradabad is globally recognized as the "Brass City of India." The brassware industry is highly water-intensive, requiring water for casting, polishing, electroplating, and cooling processes. The Ramganga River and the groundwater system recharged by it supply essential water resources to thousands of small and medium industrial units.

6.2 Other Industries

In addition to brassware, the district hosts sugar mills, paper mills, textile units, dyeing industries, and electroplating units. These industries are spatially

concentrated near water availability zones, highlighting the geographical importance of the river in industrial location decisions.

6.3 Employment Generation

River-supported industries generate large-scale employment for skilled artisans, semi-skilled laborers, and migrant workers. It is estimated that more than 30 percent of Moradabad's urban workforce is directly or indirectly dependent on river-based industrial activities.

VII. URBANIZATION AND INFRASTRUCTURE DEVELOPMENT

The city of Moradabad developed along the banks of the Ramganga due to the availability of water, fertile land, and favorable transport conditions. The river supports municipal water supply, construction activities, and various urban services. However, rapid urban expansion has increased pressure on the river, particularly in terms of sewage disposal and solid waste management.

VIII. RESEARCH QUESTIONS AND HYPOTHESES

Research Questions:

1. To what extent has the Ramganga River influenced agricultural productivity in Moradabad district?
2. How has water availability from the river affected industrial location and growth?
3. What are the economic consequences of river pollution and environmental degradation?

Hypotheses: H1: Areas closer to the Ramganga River exhibit higher agricultural productivity than distant areas. H2: Industrial units in Moradabad are more concentrated in zones with better access to river-based water resources. H3: River pollution has adversely affected agriculture, fisheries, and public health, leading to economic losses.

IX. METHODOLOGY

The study is based on a descriptive and analytical research design. Secondary data were collected from Census of India reports, District Statistical Handbooks of Moradabad, agricultural and industrial department publications, and research articles for the period 2011–2023. Spatial analysis was used to examine the relationship between river proximity and economic activities. Techniques such as percentage analysis, comparative analysis, and cause–effect interpretation were applied to derive meaningful conclusions.

X. RESULTS AND DISCUSSION

The analysis indicates that river-proximate blocks in Moradabad district have higher irrigation intensity, crop yields, and industrial density. The Ramganga River has played a decisive role in transforming the district into an agriculturally prosperous and industrially vibrant region. However, industrial effluents and untreated urban sewage have severely degraded water quality. While industrial growth has generated short-term economic benefits, the long-term environmental costs threaten agricultural sustainability and public health, thereby undermining overall economic development.

XI. ENVIRONMENTAL CHALLENGES AND ECONOMIC IMPLICATIONS

Major environmental challenges associated with the Ramganga River include water pollution, seasonal flooding, and declining water availability. Floods cause periodic damage to crops and infrastructure, while pollution affects soil quality, fisheries, and human health. Unsustainable groundwater extraction has further aggravated water scarcity during lean seasons, posing risks to both agriculture and industry.

XII. CONCLUSION AND POLICY IMPLICATIONS

The Ramganga River has been a vital driver of economic development in Moradabad district by supporting agriculture, industry, urbanization, and employment. However, unchecked industrialization, environmental degradation, and poor water management threaten the sustainability of this river-based economy. The study underscores the need for integrated river basin management, strict enforcement of pollution control measures, modernization of irrigation systems, and community participation in river conservation. Sustainable management of the Ramganga River is essential not only for ecological

balance but also for ensuring long-term economic stability in Moradabad district.

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