

A Geographical Study of Changes in Agricultural Production in Amroha District

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Abstract

This study analyzes agricultural change in Amroha after almost fifty years, representing the Indo-Gangetic alluvial plains of western Uttar Pradesh. It shows how the traditional subsistence farming system evolved into an input-intensive, commercial farming system. An integrated research framework that combines statistical analysis and trend evaluation, spatial analysis, and socio-economic and environmental evaluation is used to study long-term impacts on the structure of agriculture, land use, changes in productivity, and development of irrigation.

The analysis shows a greater focus on a fewer number of major crops such as sugarcane, wheat, rice, mentha, among others, and certain vegetables. The restructuring of agriculture was caused by a great number of inter-related factors, which include the private tube wells, the efforts of the farmers to ensure irrigation, the opening up of regional markets, the use of high-yielding varieties and an increasing reliance on chemical inputs, and the availability of government procurement policies and price support. These factors created a substantial farm output and farm income growth.

There are likewise challenges concerning sustainability from the process of intensification. Amongst the most serious of these are the impacts of intensive irrigation on aquifer decline. It is also problematic that the impacts of intensive crop irrigation are accompanied by declining soil quality and increased economic vulnerability of small and marginal farmers related to increasing inputs costs and erratic market returns. The report predicts that the continuation of the present development pathway will be detrimental to both the ecological and sociopolitical systems of rural livelihoods. Because of this, the report underscores the need for integrated efforts to improve sustainability within the limits of the trade-offs between increased productivity and resource use. Attention should be paid to efforts to speed up the increase in efficient irrigation practices and cropping diversification as well as differentiated policies based on local environmental and social political concerns to enhance agricultural resilience in the long-term.

Keywords: Amroha district, changes in land use, ground water irrigation, sugarcane specialization, agricultural transformation, challenges associated with the change of cropping systems.

1. Introduction

The Amroha district is situated on the fertile plains of Western Uttar Pradesh in India. The district's characteristics make it an ideal area for farming. The alluvial soil, the low relief terrain, and the tropical climate dominated by the monsoon typify the district, and have resulted in a long history of farming. Traditional agriculture has been the economic backbone of the district well into the twentieth century. However, there have been some major changes in the relationship between the district people and the land.

An agriculture revolution, known as the Green Revolution, brought high yielding seeds, fertilizers, some level mechanization, and irrigation to the district. The agricultural changes were sustained and enhanced by the liberalization of the economy. Surprisingly, these changes greatly impacted what farming was, and how it was practiced, from providing food for the district's people to providing cash crops on a large scale for a market economy.

In 1997, Amroha district was created based on the borders between 28° 90' north latitude and 78°04' east longitude, with 2,249 sq. km. As of the 2011 population census, Amroha has a population of over 1.84 million, with two-thirds living in rural areas. Although farming has been the economic backbone of the district, it also has the largest employer. Farming in Amroha produces higher agricultural output than ever before, but, farming as a livelihood continues to be unstable. The stresses farmers are being exposed to are caused primarily by shrinking resources, with small and marginal farmers being the most adversely affected.

This study analyzes agricultural changes in Amroha District over the last five to six decades. It focuses on changes in land use, the structure of cropping, yields, changes in irrigation systems, etc., and the variations in their corresponding patterns through the years. Contemporary agricultural landscapes are the results of the interplay of physical factors, technologies, institutions, and the market. Tube-well irrigation, improved seeds, price-related policies, and connectivity to other urban centers changed agricultural production and intensified the demands on soil and water.

Instead of measuring change in agriculture by its growth or decline, this study will analyze the influence of the overall development on the goals that were set during that period from a more local level. The author will demonstrate the challenges of groundwater depletion as well as soil degradation and economic disparity. The main goal of this study is to summarize the changes that happened in Amroha District in order to provide geographically appropriate strategies that promote productivity while integrating a more sustainable approach to the environment and the rural way of life.

2. Geographical Setting of Amroha District

2.1 Physical Environment

Amroha District is located on the upper Ganga Plain and has a terrain of almost level and gently undulating alluvial plains. Mostly fertile soil of a loamy or sandy loamy nature is deep and permeable, and it is suitable for growing both food and cash crops. The annual rainfall is 800 mm to 1000 mm, primarily by the monsoon rainfall, which occurs between the months of June to September. The district has winters that are cool and productive for Rabi season Crops. Summers, on the other hand, are hot, but there is scope to grow a short season Zaid crop in some of the irrigated areas of the district.

The eastern section of the district is bound by the Ganga River, whereas the southwestern section is drained by Ramganga Stream. They used to help shape the drainage patterns and used to enrich the land with their sediments. Nowadays, farming is mostly done with groundwater resources, while direct use of these rivers is very rare.

2.2 Administrative and Socio-economic Features

Amroha District, part of Moradabad Division in Uttar Pradesh, was formed on 15 April 1997, and has 4 tehsils and 6 development blocks. Agriculture employs 72.71% of workers (as deemed cultivators and agricultural laborers). In Amroha District, most land holdings are small and marginal (90.12%), and are highly unequitable.

As of the 2011 Census, this District had a population of roughly 1,840,000 persons with a density of 793 persons per km². In terms of demographic data, the Census showed a sex ratio of 907 female persons per 1,000 male persons, and a literacy rate of 65.7%. Approximately 25% of the District's population resides in Urban areas. Cane

and cereal crop cultivation, both of which are important to rural areas of the District, are the mainstay of the rural economy. Amroha District also has many cottage and small scale industries and rural economy support systems, including handloom weaving, furniture making, and beedi crafts, and others.

2.3 Irrigation and Infrastructure

The integration of private tube-wells over the last several decades has improved the irrigation of almost 94% of the net cropped area. This has been the primary means of irrigation used to cover almost 90 percent of the irrigated land. In the eastern extremities of the district, the Ganga Canal system still supports irrigation. Large-scale mechanization coupled with the introduction of high yielding crops and a distribution system of chemical fertilizers, coupled with improved seeds, have increased the production of multiple crops (i.e. a greater cropping intensity).

3. Research Objectives

1. To document long-term changes in land use patterns and cropping systems in Amroha district.
2. To examine trends in area, production, and productivity of major crops over recent decades.
3. To identify the principal physical, technological, economic, and institutional factors driving agricultural change.
4. To evaluate the social and environmental consequences of current farming practices.
5. To suggest practical pathways toward more sustainable and inclusive agricultural development.

4. Methodology

This research combines secondary statistical data, spatial analysis, as well as field-based qualitative data.

Key primary data sources are:

- District Statistical Handbooks
- Uttar Pradesh Agricultural Statistics
- Central Ground Water Board reports
- Census of India and Krishi Vigyan Kendra reports

Time series data for the important years (1970s-present) and more specifically 2010-2018, have been analyzed for cropped area, production and yield data. Cropping intensity, diversity and variability have been assessed.

Spatial analysis used satellite based ground truth data of land use/cover change (LULC) and groundwater data to assess changes in Tehsils. Field data were collected from farmers and extension personnel through interviews.

5. Evolution of Land Use and Irrigation

The region has deep alluvial soils that provide high agricultural potential. However, rapid population growth, economic growth and the absence of clear land property rights transformed land use and irrigation systems over the last two decades.

Between 2010–11 and 2017–18 net sown area has increased from 79.21% to 80.73% of total area as fallow land and cultivable wastelands decreased. Fallow land decreased from 1.96% to 0.25%, and non-agricultural uses increased from 8.0% to approximately 9.0%, reflecting an increase in services and settlement. The majority (90%)

of land holdings are of the marginal and small size variety. The cropping intensity has been stabilized at approximately 155%, and the cropped area under wheat and sugarcane has increased, along with an increase in the rice and potato crops, and an increase in the area under vegetable, pulse and oilseeds crops.

There are distinct features of irrigation in the intensification of agriculture. Therefore, between 2017 and 2018, irrigated area accounted for 98% of sown net area (about 172,000 hectares) almost entirely through private tube wells. During this time, there was marked growth (almost doubled) in the use of electricity for agriculture, and in medium and deep tube wells. However, data from the 2021-2022 component of watershed development shows a contrasting picture. Of the planned area for the watershed, only 1,765.8 hectares are irrigated, while 3,314.97 hectares are still rainfed. This pattern shows highly irrigated areas juxtaposed with dry areas, an ominous sign on the excessive use of ground water, which is now in the critical phase.

There are few improving modernization efforts. 4,013 hectares have been covered by the Per Drop More Crop program since 2015-2016 with other augmenting irrigation programs. Current Madhya Ganga Canal projects, along with minor irrigation works and head regulators, continue to rely on surface water. Some efforts to manage groundwater include mapping NAQUIM aquifers and the proposed construction of 744 recharge structures, along with no efforts to implement these.

The construction of infrastructural projects and privatization create accelerated changes in land use. The Ganga Expressway has resulted in the acquisition of approximately 2,200 bighas of land for an industrial green corridor. This is despite the fact that only 65% of the construction has been completed and has been halted by the farmer's protests against the circle rates. The land along the shifting course of the Ganga in Tigris has been converted from land used for agriculture on a seasonal basis to private farmhouses built with permanent structures and farmhouses with caretakers for commercial farming over the last 15 to 20 years. The land has now been diverted to industrial use.

From a productive standpoint, land is well suited to industrial corridors. In Amroha, there are three challenges: the state's intense yet difficult land acquisition for industries, challenging state land acquisition for industry, and the informal privatization of ecologically sensitive floodplains. Organic farming clusters and agroforestry, combined with solar pumps, have created a paradigm shift to sustainability. It is anticipated that in the not too distant future organized agriculture in the district will depend on the integration of sustainable market infrastructure, groundwater management, and land governance, rather than on intensive agriculture.

6. Transformation of Cropping Patterns

6.1 Long-Term Shifts

Before 1960, mixed rain-fed cropping systems grew coarser cereals and pulses along with some wheat and rice. The introduction of modern irrigation and high yielding wheat and rice variants developed wheat-rice and even wheat-sugarcane rotations.

From the 1990s, farming systems dominated by the market took over. Sugarcane became the main cash crop. In some situations this was followed by mentha and even the cultivation of vegetables and potatoes near urban centers. Coarse cereals and pulses were nearly completely absent from major cropped regions.

6.2 Current Spatial Patterns

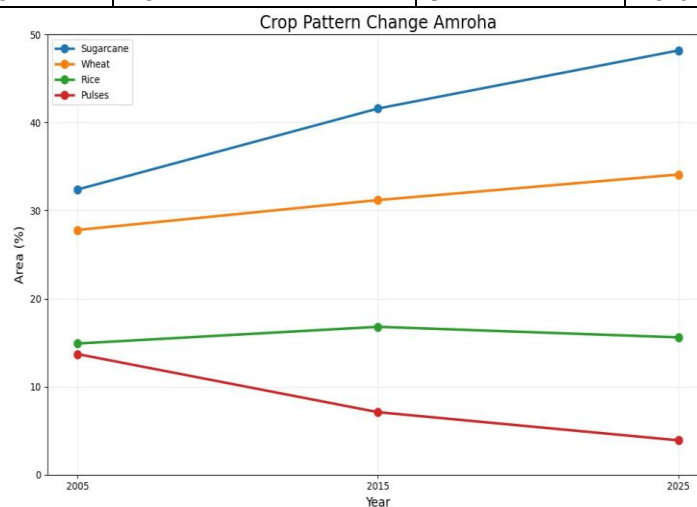
- Eastern tehsils (Hasanpur): Sugar cane-wheat dominance
- Central and northern areas (Dhanaura, Gajraula): Important mentha - potato - wheat systems
- Western areas: More rainfall influenced, more mixed cropping.

More specialized cropping systems have given rise to different soil, groundwater, markets and industrial processing units in different areas.

7. Trends in Crop Production and Productivity:

Pattern Table

S.No.	Year	Sugarcane	Wheat	Rice	Pulses
1	2005	32.4	27.8	14.9	13.7
2	2015	41.6	31.2	16.8	7.1
3	2025	48.2	34.1	15.6	3.9



There have been considerable increases in the absolute production of sugarcane, wheat, and potatoes, with considerable increases in sugarcane and potatoes and rapid increases in the production of potatoes. Mentha production has been important in some blocks.

There have been greates increases in the yield of sugarcane and potatoes, moderate increases in the production of wheat, and almost no increases in the production of pulses. Variability in the production of commercial horticultural crops is significant due to pests, weather, and changes in market prices.

One-quarter of the total cropped area is dominated by the economic importance of sugarcane due to its high income potential.

8. Key Drivers of Agricultural Change

- Technology-Little irrigation tubewells, High Yield Variety (HYV) seeds, chemical fertilizers, tractors
- Economics-Sugarcane and higher prices paid for mentha, nearness to Delhi - National Capital Region (NCR)
- Institutions-Subsidized Agricultural Electricity, Guaranteed Sugar Mill Procurement, Subsidized Fertilizers
- Society-Expectations of farmers, falling labor, and preference for less labor intensive crops.

9. Key Sustainability Challenges

A. Rapid depletion of critical ground water

B. Reduction in soil quality, growing micronutrient deficiencies, and declining organic soil

C. Increasing economic risk from high concentration of income from crops with high economic risk, and uncertain payments from mills

Social Inequality: Better water availability concentrates benefits to a few farmers

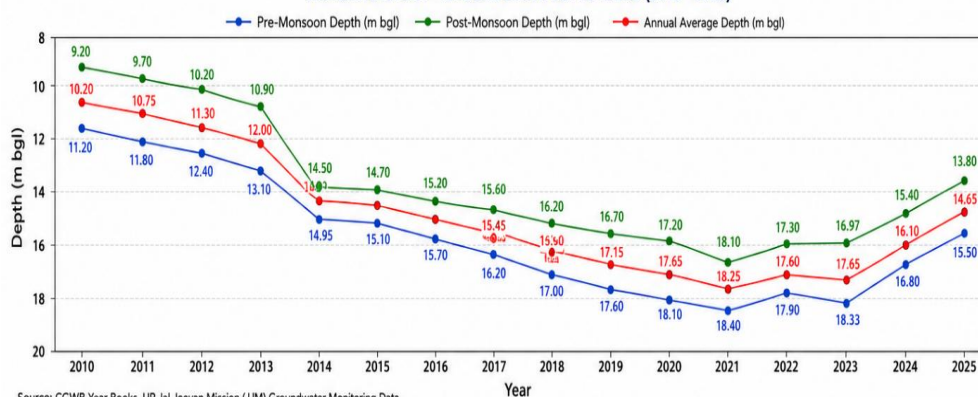
Climate Change: Variable rainfall, and rising temperatures and heat stress

AMROHA DISTRICT – GROUNDWATER DEPTH (WELL DATA) (2010 – 2025)

Year	Pre-Monsoon Depth (m bgl)	Post-Monsoon Depth (m bgl)	Annual Average Depth (m bgl)	Remarks
2010	11.20	9.20	10.20	CGWB (Gajraula DBW)
2011	11.80	9.70	10.75	CGWB (Gajraula DBW)
2012	12.40	10.20	11.30	CGWB (Gajraula DBW)
2013	13.10	10.90	12.00	CGWB (Gajraula DBW)
2014	14.95	14.50	14.73	JJM (Amroha Station)
2015	15.10	14.70	14.90	JJM (Amroha Station)
2016	15.70	15.20	15.45	JJM (Amroha Station)
2017	16.20	15.60	15.90	JJM (Amroha Station)
2018	17.00	16.20	16.60	JJM (Amroha Station)
2019	17.60	16.70	17.15	JJM (Amroha Station)
2020	18.10	17.20	17.65	JJM (Amroha Station)
2021	18.40	18.10	18.25	JJM (Amroha Station)
2022	17.90	17.30	17.60	JJM (Amroha Station)
2023	18.33	16.97	17.65	JJM (Amroha Station)
2024	16.80	15.40	16.10	CGWB (Range/Observation)
2025	15.50	13.80	14.65	CGWB (Range/Observation)

Note: Depth in metres below ground level (m bgl)

AMROHA DISTRICT – GROUNDWATER DEPTH TREND (2010 – 2025)



Source: CGWB Year Books, UP Jal Jeevan Mission (JJM) Groundwater Monitoring Data

10. Pathways Toward Sustainable Agriculture

- Promote the use of micro-irrigation (drip and sprinkler irrigation) to grow sugarcane and mentha
- Improve support for oilseeds, pulses and millets with the guarantee of purchase and improvement of market access
- Implement solar-based irrigation to minimize the use of fossil fuels
- Focus on the health of the soil through checks and optimal use of organic input
- Use integrated based crop and water techniques and establish crop blocks

Facilitate small and marginal farmers to have access to cooperative marketing and cooperative borewells and to have credit facilities.

11. Conclusion

Amroha is an illustrative example of the positive and negative impacts of agricultural intensification in the North Indian region. Amroha has benefited from the private groundwater development coupled with market integration and government support for cash crops.

Water intensive monoculture has growing pains of inequality and ecological sustainability in the agricultural system. This is a threat to the progress recently attained. If drastic measures are not taken, we will lose the basic resources from which the progress was made.

The balance in demand for the economy, water, soils, diversity of crops, and equity should be geographically informed. The case of Amroha offers grounds for lessons on the pressures of intensification that will be seen in most other districts of the Indo Gangetic Plain.

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