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What Shapes Farming in Kurnool? The Role of Soil, Rainfall and Groundwater

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The success of farming in the region depends upon the crops grown to match the local water and soil conditions. Farming in Kurnool district occurs in a semi-arid climate. This means that there is variation in the amount of water available for crops due to unpredictable rainfall, different soil types and difficult rock formations. While some areas have canal irrigation groundwater remains a vital source for providing water for crops. Different crops require different amounts of water and not all soils retain moisture. Groundwater is also not available in the same quantities or qualities throughout the district. This means that choosing suitable crops and managing water use are key areas for farming in Kurnool. Choosing appropriate crops for local conditions, efficient irrigation, monitoring groundwater quality and promoting rainwater harvesting with suitable recharge will help increase agricultural productivity and ensure water availability.

Keywords: Crop selection, Groundwater, Groundwater quality, Irrigation management, Kurnool, Rainfall variability, Rainwater harvesting, Soil and water resources.

Farming in a water limited landscape

The availability of water is the prime factor in agriculture, and it is tightly linked with the Kurnool. The district is spread over an area of around 7,977 km² and lies in the Rayalaseema region of Andhra Pradesh. The Tungabhadra River and its tributaries, the Hundri and the Hagari are an important part of the district's drainage network of the district. Agriculture is still a prominent land use with about 4.99 lakh ha of land being under net sown area and cropping intensity of 108%. Despite the presence of major irrigation systems, water availability is not uniform throughout the district. Canal water is also used for some agricultural fields and seasonal rainfall and groundwater are the main source of water for others. This variation is especially important in terms of the water available for crop selection. The knowledge of this relationship has been used as a basis for the discussions on adapting agriculture to the local conditions.

When the Monsoon is Uncertain

The district lies in a low rainfall area of Andhra Pradesh in a semi-arid climate. The annual rainfall recorded is around 607 mm based on 35 years of data. Most of the rainfall occurs during the southwest monsoon (June to September) with an average rainfall of 405 mm. Rainfall during the northeast monsoon (October to December) contributes approximately 130 mm. The highest average rainfall is recorded in September (127 mm) and contributes around 21% of the annual rainfall. Therefore, agricultural practices depend on the timely arrival of monsoons. But an adequate rainfall is not enough to ensure satisfactory water supply to the crops throughout the growing season. The study of rainfall data from 1988 to 2022 indicates that the climate of the area is variable with the annual rainfall ranging from 313 mm in 2018 to 902 mm in 1996. There is also a considerable variability in rainfall amounts in June and November. These variations can impact sowing decisions, establishment of crops, soil moisture availability at

critical periods. The temperature also affects the water requirement of agricultural practices. Based on the climatology data provided by the India Meteorological Department for the Kurnool station, the average maximum temperature ranges from 30.9°C in December to 40.7°C in May. The average minimum temperature ranges from 18.1°C in January and December, to 27.8°C in May. April and May are very hot months, therefore the atmospheric evaporative demand increases.

The Soil Beneath the Crops

The soils of Kurnool are varied and have great importance for agriculture. The most prominent soil type is moderately deep calcareous black soil which covers about 25.26% of the district. Gravelly clayey moderately deep soils and deep dark reddish-brown soils are also extensive. Black soils are more common in the North and West of the district, especially around the Hundri River. Red soils are mainly found in the South and East. The physical properties of the soils vary depending on the soil texture, depth and parent material. From soil samples taken in Kallur, Kurnool and Orvakal in 2021-2022, it was found that most soils were sandy clay loam in texture. The water holding capacity of the soils ranged from 49.52% to 60.22% and the bulk density ranged from 1.33 Mg m^{-3} to 1.52 Mg m^{-3}. Soils with a higher depth and clay content will have a higher water holding capacity. Deeper black soils can retain moisture for longer periods, which may support crop growth beyond the rainy season. However, the lighter red soils will often be used in rain fed cropping systems. The eastern red soil areas are reported to be suitable for jowar, cotton and pulses crops while the relatively fertile black soils in the central areas Kurnool and Patti Konda are reported to be suitable for Paddy and Bengal gram. However, crop suitability will depend on the depth of soil, amount of rainfall, availability of irrigation and land management.

What Lies Beneath the Fields?

Geologically, the area consists of a mixture of old crystalline and proterozoic sedimentary rocks. The crystalline rocks in the Tungabhadra basin consist mostly of granitic rocks such as granites, granitic gneisses and migmatites. In the west and south these are predominant, but granites enriched in potassium are also found in the north. There are small occurrences of sedimentary rocks such as quartzite, shale, limestone and dolomite in the northern east. The Cuddapah basin has a range of sedimentary rocks within the Kurnool sub-basin. These include Banaganapalle Quartzite, Narji Limestone, Owk Shale, Paniam Quartzite, Koilkuntla Limestone and Nandyal Shale. This means there is an alternation of sandstone, carbonate and shale rocks. These rock types affect the groundwater storage within the area. Crystalline rocks will mainly contain groundwater within weathered rock zones, joints and fractures. Structural analysis of the Cuddapah Basin has shown that there are a range of fault and fracture networks present within the area.

Crops and Farming Pattern

The district has a variety of cropping systems due to the variability in seasonal rainfall, soil types and access to irrigation. Cotton, groundnut and red gram are major kharif crops, while Bengal gram and jowar are important post-monsoon crops. Paddy is mainly grown in regions with access to canal and ground water irrigation. Irrigation also affects the kinds of crops grown by the farmer. Paddy is cultivated during Kharif season in the watered areas in the Tungabhadra Project Low-Level Canal (TULC). In other parts of the district, farmers depend more on rainfall or borewells, making the reliability of water supply an important consideration when planning their crops. This demonstrates that there are other factors to consider when choosing which crops to grow. The availability of irrigation water during the growing season is also an important factor to take into consideration. The main field crops grown are cotton (1.98 lakh ha), pigeon pea (0.64 lakh ha), groundnut (0.54 lakh ha), gram (0.43 lakh ha) and paddy (0.17 lakh ha) based on recent data from 2024-25.

Where Does the Irrigation Water Come From?

The agricultural sector is well supported by various irrigation sources including canal networks, lift irrigation schemes, minor irrigation tanks and groundwater. Major irrigation sources include the Kurnool-Cuddapah (KC) canal, Tungabhadra project low level and high-level canals, Handri-Neeva Sujala Sravanthi, Rajolibanda Diversion Scheme, Guru Raghavendra Lift Irrigation Scheme and Gajuladinne Project. Despite this, groundwater is the main source of irrigation in the region, especially where canal infrastructure is limited. Kurnool's groundwater resources are influenced by the geology, recharge and extraction. The 2025 groundwater assessment found that there was around 680.7 Million Cubic Meters (MCM) of recharge per annum, and overall groundwater extraction was 197.3 MCM per annum. This means that the groundwater extraction level was 30.51% and all assessment units were found to be safe. However, there are variations within the district which shows that not all areas will have suitable groundwater for irrigation. Variations in the water quality, including electrical conductivity, sodium adsorption ratio and residual sodium carbonate, can affect the suitability of groundwater for irrigation. These differences highlight the importance of considering both groundwater availability and its suitability for irrigation. Conditions may also vary between individual wells, even within the same assessment unit.

Table: Contribution of different irrigation sources to gross irrigated area in Kurnool district (2024-2025)

Irrigation Source	Gross Irrigated Area (ha)	Share (%)
Canals	25,023	21.7
Tanks	2086	1.8
Tube wells	77208	66.8
Dug wells	315	0.3
Lift irrigation and other sources	10939	9.4
Total	115571	100

Source: Directorate of Economics and Statistics, Government of Andhra Pradesh. (2024–25).

Challenges and management perspectives

A crop-water assessment carried out for Kurnool estimated net irrigation requirements under its modelled conditions of 200 mm for cotton, 220 mm for maize, 150 mm for sorghum and 1423.2 mm for sugarcane. These estimates rest on the study's climate and crop assumptions rather than on current field measurements across the district, yet they show how strongly the choice of crop can affect irrigation demand. Tackling these challenges calls for management decisions that fit local farming conditions. Scheduling irrigation according to crop growth stage, soil moisture and effective rainfall, together with appropriate drip or sprinkler systems, can improve control over water application. Even so, greater irrigation efficiency at field level does not by itself guarantee water conservation at the broader groundwater or river-basin scale; it should be backed by proper groundwater monitoring and by attention to the crops being grown. Testing groundwater quality periodically, especially electrical conductivity and sodium-related indices, can help in assessing its suitability for irrigation. Rainwater harvesting and artificial recharge structures should be considered in places where local geological and hydrogeological conditions are favourable for infiltration.

Choosing crops with the land and water in mind

In a semi-arid region like Kurnool every resource factors will influence the agriculture farming productivity and sustainability. Black and red soils differ in their ability to retain moisture, while the hard-rock formations beneath the district influence where groundwater is found and how readily it is available. Local conditions are significant in planning agricultural activities due to these and other factors, as well as to differences in crop water needs and groundwater quality. The selection of the crop should, therefore, take into account the soil properties, seasonal water resources, borewell performance, and appropriateness of groundwater resources for irrigation purposes. Under water scarcity conditions, crops that require relatively less water

may be considered as alternatives, if they are agronomically appropriate and economically sustainable. These will be supported by efficient irrigation scheduling, suitable water application and locally appropriate recharge measures. Improving irrigation water management is only part of the solution; more broadly, sustainably farming within Kurnool requires making choices that are based on the soil and water resources found in each site.

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