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Research Article

Crop Diversification in Nalgonda District, Telangana

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ABSTRACT
The Application of Geographic Information System (GIS) and Remote Sensing plays a pivotal role in modern agricultural studies. These technologies enable the identification of various land use and land cover types, as well as natural resources like water bodies, flora, agricultural fields, fallow lands, barren terrain, and residential areas. This data is particularly valuable for assessing the feasibility of crop diversification in regions like Nalgonda District, which has a high potential for agricultural development due to its established irrigation infrastructure, farmer interest, and the expanding agro-business sector. Despite this potential, many farmers remain hesitant to adopt crop diversification strategies due to perceived risks. This study examines how geospatial data can assist in overcoming these challenges by providing clear, knowledge-based insights into crop diversification. The research, based on field surveys, researcher observations, and a thorough review of existing literature, aims to provide decision-makers, particularly farmers, with actionable information on the benefits of crop diversification. The findings of this study are expected to benefit a range of stakeholders, including academic researchers, policymakers, geographers, and agricultural experts, by offering valuable insights into sustainable farming practices and regional agricultural planning.

Keywords: Nalgonda, Agricultural Productivity, GIS, Remote Sensing, Sustainability.

INTRODUCTION

Agricultural technology is one of the major vital elements for agricultural development in a region including population, irrigation infrastructure, size of land holdings, usage of chemical fertilizers, use of high-yielding seed varieties. These elements can be categorized as socioeconomic components which are most crucial for the development of agriculture.

In India almost 70% of people are involved in agricultural activities, either directly or indirectly. Thees agricultural activities support through the government policies, decision making to expand and increase modernized agriculture industry in the country. As a result, agriculture can be said that it is the foundation of Indian economy.

Among the mentioned elements, crop diversification and adaptation of technology are the most important factors for agricultural turnover, especially when the resources such as land and water are in short supply.

Therefore, the present paper demonstrates that the adaptation of new technologies is crucial in the study area, Nalgonda district, due to the spatial changes resulting from urbanization and the growth of built-up area. Since 2001, there has been a significant change in the land use and land cover of the Nalgonda District. The primary factors contributing to this change are the increase of population and the urbanization activities by the local authorities and people. These urbanization activities include complexes, shopping centers, electrical and communication infrastructure, and highway strip developments.

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Therefore, the adaptation of modern technologies, along with the diversification and combination of crops, can be an effective way to boost agricultural output in Nalgonda District, addressing the scarcity of cropland and meeting the demands of the population. This paper argues that the study area is one of the districts with the necessary agricultural infrastructure to utilize modern technologies and crop diversification, aiming to increase agricultural production throughout the year.

STUDY AREA

Nalgonda is located in the central part of the eastern coastline of the Indian Peninsula, within the state of Telangana. The district lies between longitudes 78° 40' and 80° 05'E, and latitudes 16° 25' and 17° 60'N. Covering an area of 2,449.79 square kilometers, Nalgonda has a population of 1,631,399 and consists of 31 mandals. It shares its borders with the Suryapet, Rangareddy, Yadadri, and Nagarkurnool districts, as well as with the state boundary. The district is traversed by several rivers, including the Krishna, Musi, Aleru, Peddavagu, and Dindi.

Nalgonda district is a key contributor to the national rice supply. It is part of the Southern Telangana Zone, as classified by the agriculture department. This zone includes the districts of Hyderabad, Rangareddy, Mahaboobnagar, and Nalgonda, with the Regional Agricultural Research Station (RARS) in Palem serving as the regional hub. The area receives between 700 and 900 mm of rainfall annually and accounts for 9.3% of the state's total rice cultivation area.

Regional Agricultural Research station, Palem, Mahboobnagar district is the lead center for dry land agriculture research in Southern Telangana Zone.

The district is divided into eleven tahsils, which together form a significant agro-economic zone. The Nalgonda administration is responsible for overseeing this district. Nalgonda is characterized by stark variations in geography, soil, climate, settlement patterns, and social identity. With an altitude range of 600 meters in the basin to the east and over 1200 meters in the peaks, along with a high plateau in the western part of the district, Nalgonda exhibits distinctive physiography. The area experiences a monsoonal climate. In the western region, the average annual rainfall ranges from approximately 600 mm to 500 mm.

Study Area Map

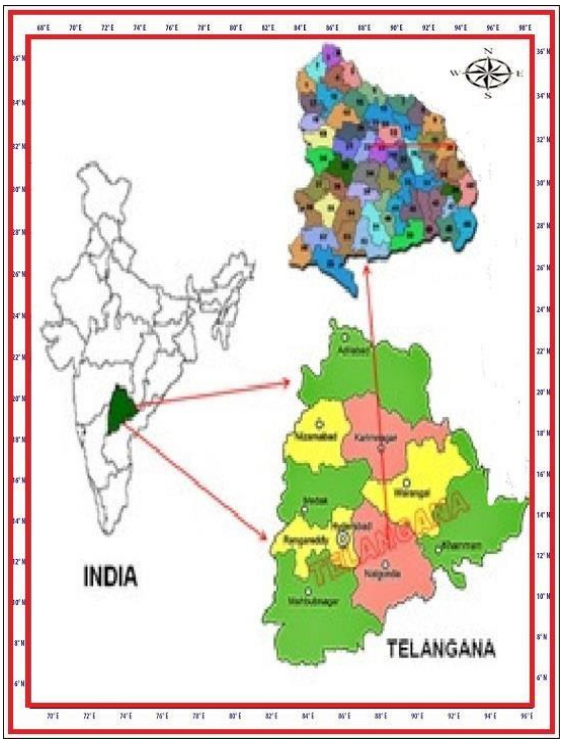


Figure: 1, Nalgonda District Map

GIS and Remote Sensing Role in Crop Diversification

Crop diversification is an essential method for improving agricultural productivity and sustainability, particularly in regions like Nalgonda District, Telangana. With the implication of this methods in the study area, farmers cultivate a variety of crops, including sugarcane, paddy, rice, and others. The integration of Geographic Information System (GIS) and remote sensing has significantly advanced agricultural planning and productivity in this region.

Using satellite imagery and geospatial data, maps for different crops have been prepared, enabling the analysis of spatial patterns in cultivation and soil health. GIS helps identify suitable zones for crop diversification, while remote sensing monitors land use changes, water resource distribution, and crop growth. For example, mapping sugarcane and paddy fields aids in understanding irrigation needs and optimizing resource allocation.

This approach ensures efficient land use and contributes to sustainable agricultural development in Nalgonda. Therefore, GIS and remote sensing will remain indispensable in guiding informed agricultural decisions. These technologies not only support economic growth in rural communities but also contribute to long-term food security and environmental sustainability.

Irrigation in the Study Area

Irrigation is a crucial factor in the cultivation of High-Yielding Varieties (HYV) of seeds. It serves as an essential infrastructural component that drives agricultural development, influencing both crop selection and productivity, as well as cropping intensity. With reliable irrigation facilities, farmers can grow multiple crops throughout the year, benefiting from controlled water availability. The success of HYV seeds is largely dependent on timely and adequate irrigation, as these seeds and plants require water at specific stages of growth, including expansion and flowering.

In Telangana and Nalgonda district, however, farmers face challenges in cultivating crops year-round due to limited water availability during the summer season and dry climatic conditions, which are unsuitable for crop growth. Rainfall in the region is uneven and unpredictable, with droughts being a recurring issue. As a result, the risk of crop failure and damage during the summer months is high. Irrigation, particularly during the summer, is vital for successful crop cultivation and motivates farmers to intensify and diversify their farming practices. The adoption of HYV seeds and the use of fertilizers are directly influenced by the level of irrigation facilities available in an area.

The progress in agriculture in the region can largely be attributed to the irrigation inputs provided by the Department of Irrigation or by farmers themselves through private means. It has been observed that the percentage of area under irrigation was 15.47% in 1981 and steadily increased to 45.72% by 2019.

Table 1: Percentage of Area under Irrigation to Net Sown Area in Nalgondadistrict.

Sr. No.	Name of Mandal	1981	2019
1	Nalgonda	28.500	45.720
2	Suryapet	20.530	54.680
3	Thirumalgiri	11.200	40.700
4	Miryalguda	37.240	45.740
5	Bhongiri	9.130	13.940
6	Yadagirigutta	9.530	17.650
7	Mattampalle	6.890	35.100
8	Huzurnagar	10.620	34.750
9	Kodad	12.390	40.070
10	Garide Palle	8.140	29.930
11	Nered Cherla	15.990	35.870
12	District	15.470	35.830

Source: Socio-economic background of Nalgonda district.

In 1981, the percentage of area under irrigation as a proportion of net sown area ranged from 6.89% in Miryalguda Mandal to 37.24% in Bhongiri. The highest levels of irrigation were observed in the three tahsils of Miryalguda, Bhongiri, and Yadagirigutta. Medium levels of irrigation, ranging from 10% to 20% of the net sown area, were found in other regions. In contrast, areas with less than 10% of the net sown area under irrigation were recorded in certain mandals of Nalgonda district. Irrigation levels in Nalgonda district show significant regional variation, with some areas benefiting from better irrigation infrastructure, crucial for crop production.

Changes in land use in Nalgonda district overtime

Socioeconomic conditions, economic capacity, and market price fluctuations at local and regional levels often influence the decisions made by farmers. This study investigates the geographic distribution of crops, evolving cultivation patterns, and the changes in crop growth over time and space from 2001 to 2019. The research methodology involved transforming crop percentages into actual cultivated areas, categorizing them, and examining the spatial arrangement of primary crops within the study region (Bhatia, S.S., 1967).

The paper investigates the relationship between time and space, as well as the variations in agricultural land use patterns in Nalgonda district. The study covers a ten-year period to evaluate changes in crop cultivation over time. Factors such as human activity, fluctuations in market prices, purchasing power, transportation, socioeconomic conditions, traditions, and past experiences all significantly influence crop selection and production methods.

Various crops are cultivated in different forms across the Mandal. In 2001, the total cropped area was 115,449.5 hectares, but by 2019, it had reduced to 98,781.0 hectares. Changes in cropping patterns occur for a variety of reasons, which vary from one village to another and across different regions. Cropping systems are a vital aspect of agricultural practices, as the land area dedicated to each crop is continually evolving. Crop rotation, the practice of planting different crops on the same land over time to increase profits and maintain soil fertility, is essential for sustainable farming. The specific causes of these changes require further exploration (Brinkman & Smyth, 1973).

Meanwhile, this para argues that the agricultural patterns in Nalgonda are influenced by socioeconomic factors, market conditions, and environmental changes. Changing cropping systems emphasize the importance of adopting sustainable farming practices to maintain long-term agricultural productivity.

Distribution of Major crops in Nalgonda District

The distribution of irrigated land among various crops in the region is depicted in the figure. Wheat, Jowar, Pulses, Sugarcane, and other crops like Onion, Bajra, and Oilseeds are commonly cultivated. Rice, however, is the most prevalent crop grown on irrigated land. The diagram clearly shows how the land is allocated for different crops, highlighting the prominence of wheat, Jowar, pulses, and sugarcane. Other crops, such as bajra, oilseeds, and onions, also occupy significant areas in the irrigated zones.

It’s noteworthy that most farmers in the region are now adopting high-yielding pulse seed varieties, which contribute to improved crop productivity. In addition to organic farmyard manure, chemical fertilizers are commonly used to enhance soil fertility and crop yields.

The distribution of irrigated land reflects the dominance of key crops like rice, wheat, and sugarcane, while high-yielding pulse varieties and fertilizers contribute to increased agricultural productivity in the district

Table. 2: Crops and their Distribution in Ha

		2001-2002	**2018-2019**	**Percent of 2001 To 2019 Variation from**

S.no	Crops	Total area (in Ha)	Percentage of area	Total area (in Ha)	Percentage of area	Change in area %
1	Paddy	5539.20	4.80	8221.20	8.040	3.240
2	Fruits	2161.61	1.87	2854.4	2.79	0.920
3	Thec	9470.0	8.20	11775.0	11.510	3.310
4	Spices	252.60	0.220	283.50	0.280	0.060
5	Flowers	32990.0	28.580	25594.0	25.020	-3.560
6	Jowar	9470.0	8.2.0	11775.0	11.510	-3.560
7	Wheat	8221.20	8221.20	8221.20	4.260	1.070
8	Oil Seeds	2854.40	2854.40	2854.40	0.10	0.020
9	Pulses	1775.0	1775.0	1775.0	8.38.0	5.290
10	Fodder Crops	83.50	283.50	283.50	8.120	1.370
11	Vegetables	8.60	58.60	58.60	3.430	-1.090
12	Bajara	25594.0	25594.0	25594.0	8.010	-0.060
	Total	**98781**	**100**	**98781**	**100**	**00**

(Source: Directorate of Economics and Statistics Telangana)

Sugarcane Cultivation in Nalgonda District

In 2001, sugarcane was cultivated on 5,539 hectares, making up 4.8% of the total land area in Nalgonda. By 2019, this increased to 8,221 hectares. Villages in the Miryalaguda area, such as Alagadapa, Rayanpalem, and Mulkalkalva, had the largest sugarcane cultivation in 2001. Meanwhile, the Nalgonda Circle recorded the least land dedicated to sugarcane cultivation, accounting for only 1.45% in both 2001 and 2019 (Narayan, L.R.A., 1985).

The steady increase in sugarcane cultivation highlights its growing importance in Nalgonda's agriculture. However, the limited expansion in certain areas suggests the need for better resource management and irrigation facilities to maximize the region's agricultural potential.

Onion Cultivation in Nalgonda District

Onion farming in Nalgonda expanded from 9,470 hectares (8.20% of the land area) in 2001 to 11,775 hectares by 2019, showing an 11.51% increase. Narketpalle, Kattangur, and Shaligowraram regions had the highest concentration of onion crops, occupying 13.71% of land in 2001 and 14.60% in 2019. Conversely, the Miryalaguda and Nalgonda Circles consistently had the smallest onion cultivation areas during this period (Chorley, R.J., 1957)..

Fodder Crop Cultivation in Nalgonda District

In 2001, fodder crops, such as green grass and maize, covered 7,793 hectares, accounting for 6.75% of the total land area in Nalgonda. By 2019, this area grew to 8,305 hectares. These crops play a vital role in livestock farming and have steadily expanded, contributing significantly to the agricultural economy.

The steady increase in fodder crop cultivation reflects the growing importance of livestock farming in Nalgonda's economy. This growth highlights the region's focus on supporting sustainable agriculture and rural livelihoods. The significant growth in sugarcane, onion, and fodder crop areas in Nalgonda highlights the region’s agricultural transformation. These increases reflect improvements in farming practices and irrigation, enhancing productivity across multiple sectors.

Table .3. Major Crop Distribution

S.no	Different Type of Crops	Season wise Cropping
1	Onion	Kharif Onion crop
2	bajra	Bajara crop Kharif
3	Wheat	Math, gram, Tur.
4	Pulses	Chilli, Termaric, jira,
5	Bajara	The jawas, sunflower etc.Groundnuts, kardai,
6	Wheat	Jawar Rabbi
7	Pulses	Cash crop Kharif/Rabbi
8	Fruits	papaya, sweet lime, coconut, orange, mangoes, etc.Guava, Chikku, grapes,pomegranate,
9	Vegetables	The crop of tomato, methi brinjal. The crop of leafy vegetable ridge guard garlic coriander seeds etc Onion, cabbage, chilly, cauliflower
10	Flowers	Marigold, Mogra etc.Rose, Camomile, Jasmine,
11	Fodder Crops	The Grass and maize cropping.

(Source : Directorate of Economics and Statistics Telangana)

The table demonstrates that the research region covers all significant crops, grouped into 12 main categories. It includes information on onion production, along with crop data for every village in the study area from 2001-2002 through 2018-2019. Additionally, the table uses circular representations to display the land allocated to key crops.

Sugarcane

In 2001, sugarcane was cultivated on 5,539 hectares in Nalgonda district, making up 4.80% of the total area. By 2019, the area under sugarcane cultivation increased to 8,221.20 hectares, reflecting an 8.04% growth, as shown in Map No. 4.9. The Suryapet Circle had the largest area dedicated to sugarcane cultivation in both 2001 and 2019, while the Miryalaguda Circle had the least amount of land under sugarcane cultivation. This pattern was consistent in villages across Suryapet, Yadadri, and other areas during both years. Furthermore, progressive farmers have started to diversify their crops by introducing paddy cultivation.

Table 4: Sugarcane Distribution by Division

S.NO	Circle	Sugarcane		
		Years		Change in volume %
		In 2001	In 2019	2001 to 2019

1	Nalgonda Division	12.030	18.910	1.160
2	Miryalaguda Divison	1.830	2.990	10.530
3	Suryapet Divison	17.760	28.300	6.880
4	Yadadri Divison	1.830	2.990	3.650
	Total distribution	1.830	2.990	2.750

(Source : Directorate of Economics and Statistics Telangana)

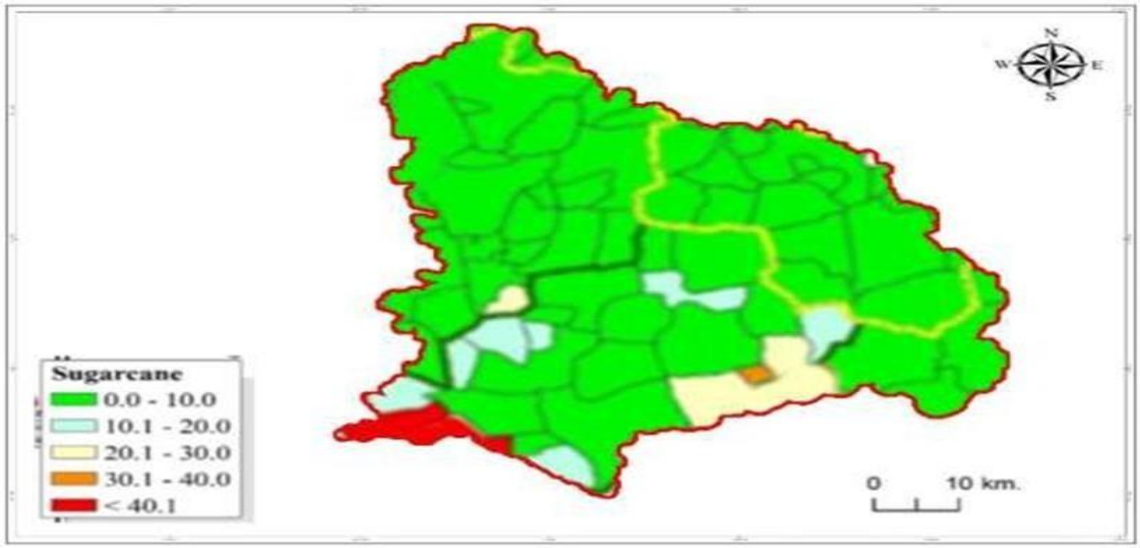
The map illustrates the geographical distribution of crops. Multiple sugarcane production facilities are situated in the Nalgonda and Miryalaguda Circles, with a concentration in the tehsil's southwestern region. Furthermore, the expansion of sugarcane farming in 2019 can be linked to the enhanced access to irrigation water from the Nagarjunasagar and Dindi rivers, which facilitated the growth of canal-based irrigation systems in the area..

Table .5. Division wise distribution of Fodder crops

Fodder Crop				
S.no	**Name of Divison**	**Area in %**		**Change in Volume %**
		2001	**2019**	
		8.830	9.140	0.310
1	Nalgonda Divison	5.980	7.300	1.320
2	Miryalaguda Divison	8.830	9.140	0.310
3	Suryapet Divison	5.980	7.300	1.320
4	Thirumalagiri Divison	9.040	9.730	0.690
	Total Distribution	5.980	7.300	1.320

(Source: TRAC)

Map depicting Sugarcane distribution in the study area

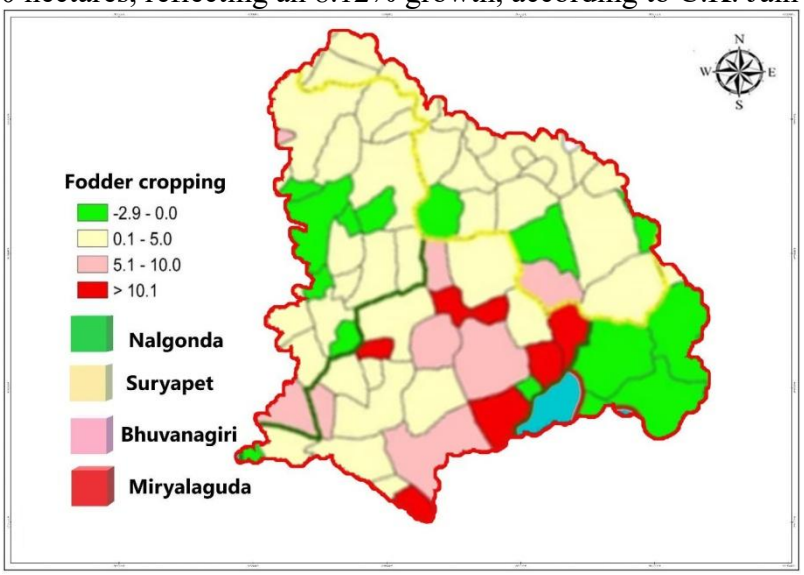

N
W
E
S
Sugarcane
0.0 - 10.0
10.1 - 20.0
20.1 - 30.0
30.1 - 40.0
< 40.1
0
10 km.

The Miryalaguda circle in Nalgonda district has the largest area dedicated to fodder crop cultivation. The establishment of a milk plant has contributed to the growth of fodder crop cultivation by 2019. Agriculture, dairy farming, and grazing are the primary activities for most people in the area. However, the land area allocated to fodder crops has undergone significant changes between 2001 and 2019, with some villages in the Nalgonda circle experiencing a decline, according to Sugunakar Reddy, M., 1982.

The growth of fodder crops in Miryalaguda highlights its agricultural importance, while the decline in some villages indicates the need for better resource planning to support farming and dairy activities.

Fodder Crops

Fodder crops are cultivated during both the Kharif and Rabi seasons in the study area, serving as feed for cattle, goats, sheep, horses, poultry, and pigs. These crops are grown on a variety of soil types throughout the region, with seeds such as summer Jowar, grass, lasoon ghass, ginni, and others being commonly planted. In Nalgonda district, the main fodder crops include paddy, green grass, and maize. In 2001, the area under fodder crops in Nalgonda covered 7,793.40 hectares, or 6.75% of the total area. By 2019, the total area of fodder cropland in the district is projected to increase to 8,305.50 hectares, reflecting an 8.12% growth, according to C.K. Jain (1980)



Map depicting Fodder Crop distribution

The study area grows various fruit crops, including bananas, grapes, chiku, guava, orange, and mango. In 2001, the area under fruit crops in Nalgonda district was 2,161.61 hectares, or 1.87% of the total area. By 2019, this figure increased to 28.54 hectares, or 2.89% of the total area. The highest percentage of land dedicated to fruit crops was in the Nalgonda district circle, with 2.93% in 2001 and 3.97% in 2019. Conversely, the Miryalaguda circle had the smallest proportion of land for fruit crops, with 1.50% in 2001 and 2.10% in 2019. Progressive farmers have started harvesting these fruit crops.

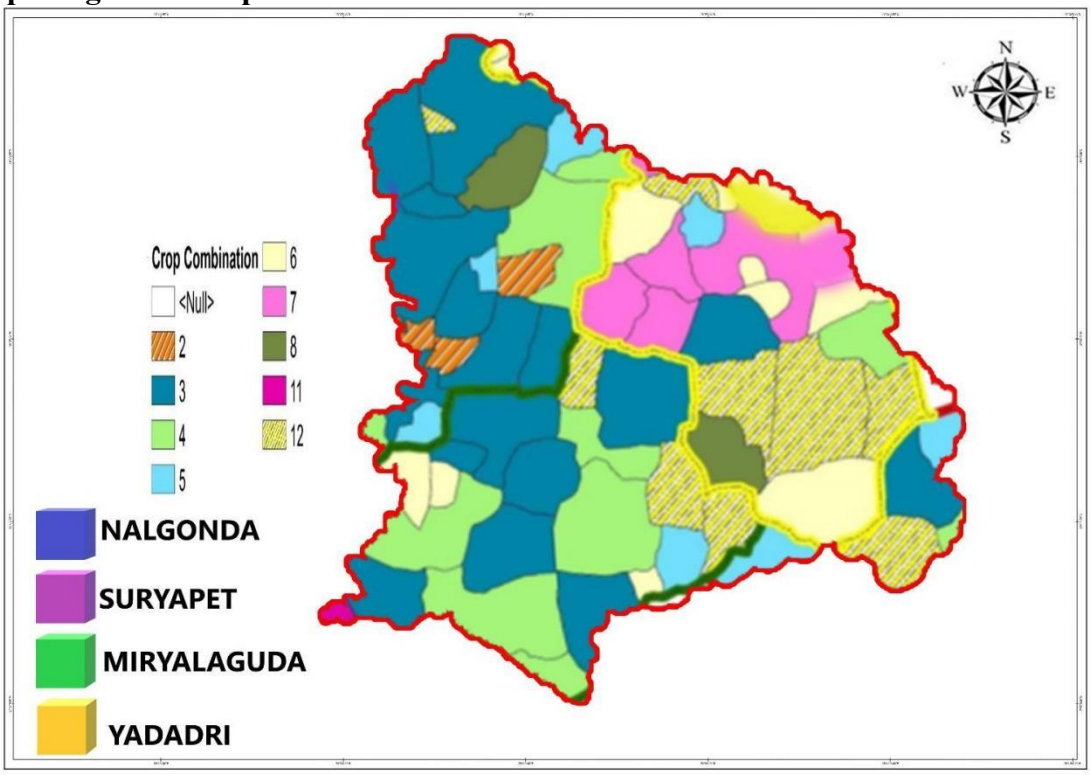
Table.6. Fruit Crop Distribution

Crop of Fruit			
S.No	Circle	**Year**	**Volume**

		2001	2019	2001 to 2019
1	Nalgonda	3.970	1.040	3.970
2	Suryapet	2.840	0.930	2.840
3	Miryalagud	2.930	3.970	1.040
4	Yadadri	1.910	2.840	0.930
	Total	1.540	2.090	0.550

(Data compile by the researcher)

Map depicting Fruit Crop Distribution



Fruit Distribution

Fruit crops such as bananas, grapes, chiku, guava, orange, and mango are cultivated in the study area. In 2001, the area allocated for fruit crops in Nalgonda district was 2,161.61 hectares, accounting for 1.87% of the total area. By 2019, this area had increased to 28.54 hectares, representing 2.89% of the total area. The Nalgonda district circle recorded the highest proportion of land dedicated to fruit crops, with 2.93% in 2001 and 3.97% in 2019. On the other hand, the Miryalaguda circle had the least amount of land for fruit crops, with 1.50% in 2001 and 2.10% in 2019. Progressive farmers are actively harvesting these fruit crops.

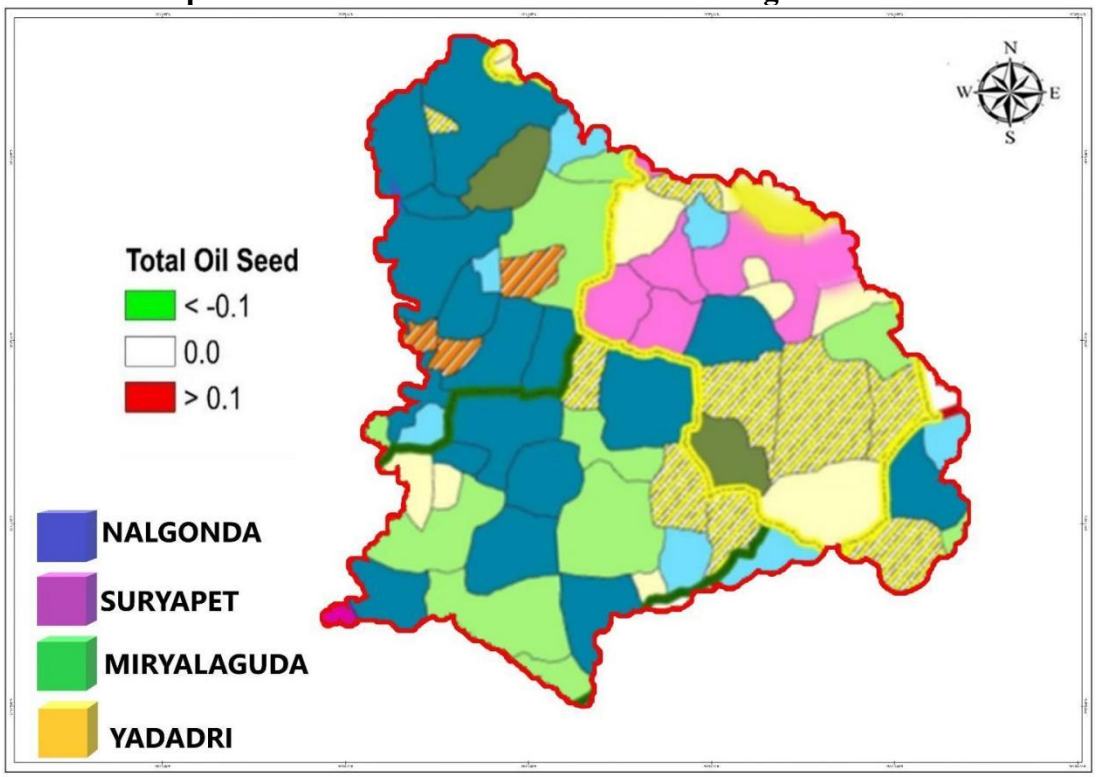
The map above shows the distribution of fruit cropland. Miryalaguda and Suryapet circles are the primary areas for fruit cultivation in Nalgonda. The area under fruit crops expanded in 2019, with significant growth observed in Nagarjuna Sagar and neighboring villages. However, the area for fruit crops in Nalgonda city declined slightly by 0.1% from 2001 to 2019.

Table.7. shows Oil distribution

Seed Oil Total				
Sr. No.	**Circle**	Year		of change (Percent)Volume
		2001	2019	2001-2019
1	Nalgonda	0.220	0.260	0.030
2	Miryalaguda	0.060	0.070	0.010
3	Suryapet	0.010	0.020	0.000
4	Bhuwanagiri	0.080	0.090	0.01.50
	Total	0.380	0.430	0.050

Compiled by researcher.

Map shows Oil Seed Total Distribution in Nalgonda District



Vegetable Distribution

Vegetable farmers are encouraged to use shade net structures to enhance crop growth. These shade net enclosures are typically built-in clusters to reduce initial construction and cultivation costs. This approach enables small farmers to adopt high-value crops, optimizing land and water use to produce superior-quality products. Discussions on establishing marketing agreements with retail platforms are also underway.

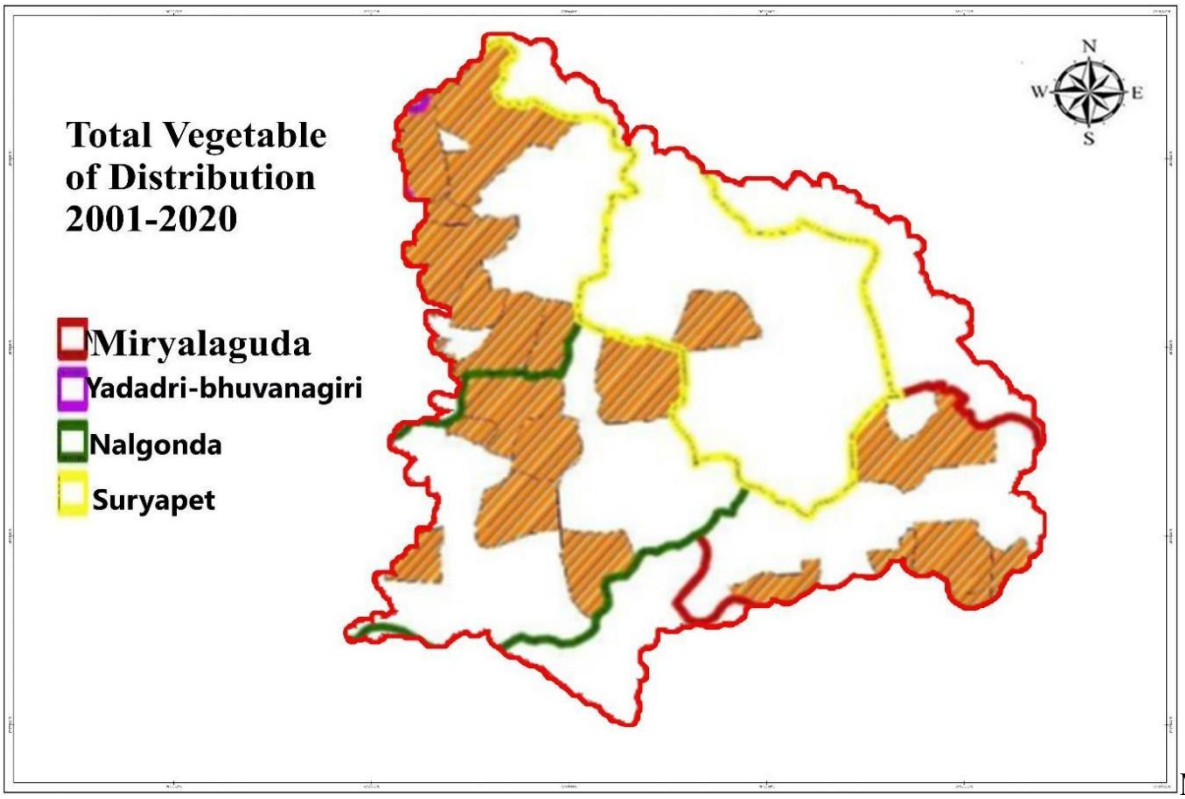
One method for intensive vegetable farming is relay cropping, where a new crop is planted beneath an existing one. Intensive cropping is preferred in the study area due to the short growing season for vegetables, which typically lasts between 90 to 120 days (3 to 4 months). A wide variety of vegetables, including potatoes, sweet potatoes, bitter gourd, bottle gourd, cucumbers, tomatoes, okra, cabbage, chilies, brinjal, cauliflower, vetch, radishes, peas, and luffa, are cultivated in both small and large plots in the research area. While rice, cereal crops, and cash crops are produced on a larger scale, vegetables are grown in smaller quantities. Irrigation methods such as lift irrigation, canal, well, and tube wells are commonly used to support crop cultivation (Vink, A.P.A, 1975).

Table 8. shows Vegetable Distribution

Total Vegetable				
S. NO	**Circle**	**Year**		**Volume**
		2001	2019	2001 to 2019
1	Nalgonda	3.610	4.560	0.960
2	Suryapet	19.520	22.910	3.390
3	Miryalaguda	3.530	4.320	0.790
4	Yadadri	3.610	4.560	0.960
	Total	19.520	22.910	3.390

(Source by TRAC)

The map below illustrates the distribution of land used for vegetable cultivation. The key areas for vegetable farming in Nalgonda are the Suryapet, Miryalaguda, and Yadadri Circles. The development of irrigation systems in these regions has significantly boosted vegetable crop production. Additionally, the watershed management plan, the construction of dams, and the Nala bonding are all easily accessible in these areas.



Map Depicts Vegetable Crop Land Distribution

Bajra Distribution

In 2001, Bajara cultivation was widespread in several circles, with the highest volume in the Miryalaguda Circle (19.55%) and the lowest in Suryapet and Yadadri Circles (13.79%). The total area under Bajara cultivation in the district was 19.55%. By 2019, Bajara cultivation had seen a slight increase in Miryalaguda Circle, rising to 19.83%, while other circles like Suryapet and Yadadri experienced a decrease, with a decline of -2.94% and -0.25%, respectively. The most significant drop was observed in the Suryapet Circle, where Bajara cultivation decreased by 2.94%.

The distribution of Bajara in Nalgonda district has remained relatively stable, with some areas showing slight increases, while others experienced reductions. Miryalaguda Circle saw the most consistent growth, reflecting favorable conditions for the crop.

Onion Distribution

Onions are a major cash crop in Nalgonda district, with a significant increase in area under cultivation from 2001 to 2019. In 2001, onions covered 9,470 hectares, or 8.20% of the total area. By 2019, the area under onion cultivation had risen to 11,775 hectares, a notable increase of 11.51%. The highest concentration of onion cultivation was in Suryapet Circle, where areas such as Isthalapur, Kandagatla, Kota Pahad, Maktha Kotha Gudem, Midthan Palle, and Mukkudeu Devi Palle recorded substantial onion farming. This increase indicates the growing importance of onion cultivation as a cash crop in the region.

The onion crop is well-suited to the district's climate, especially its drought-tolerant nature, making it a popular choice during the kharif season. The area devoted to onions in 2001 was 13.71%, which increased to 14.60% by 2019, reflecting the crop's economic significance. This expansion is indicative of improved farming techniques, better market access, and increased demand for onions in both local and regional markets.

Onion cultivation in Nalgonda district has expanded over the last two decades, driven by favorable growing conditions, increased demand, and improved farming practices, solidifying its role as a key cash crop in the region.

Conclusion

This technology is vital for evaluating crop diversification feasibility in regions like Nalgonda, which has significant agricultural potential due to its robust irrigation infrastructure and growing agro-business sector. However, many farmers hesitate to diversify due to perceived risks, highlighting the need for clear, data-driven insights.

This study demonstrates how geospatial data can address these challenges, offering actionable information to farmers and policymakers. By combining field surveys, observations, and literature review, the research provides valuable insights into sustainable farming and regional planning. The study of agricultural land use and cropping patterns in the Nalgonda district from 2001 to 2019 highlights significant shifts in land use, crop distribution, and farming practices. It is observed that the agricultural land is gradually being converted into residential and urban areas due to the region's growth and development, leading to a decrease in agricultural land use. Despite this, certain crops, particularly during the Kharif and Rabbi seasons, such as Bajara, Onion, Pulses, Oilseeds, Fodder, Sugarcane, and various fruits, have shown notable cultivation across different seasons. Additionally, irrigation-based crops such as Groundnut and Sugarcane are predominantly grown in areas with available water resources.

Farmers in the study area have increasingly adopted modern agricultural technologies, such as drip irrigation systems, high-yielding varieties (HYV) of seeds, and improved farming techniques for sugarcane, fruits, vegetables, and food grains. The availability of infrastructure, including composting facilities, machinery, and a strong network of agricultural services, has contributed to the improved agricultural productivity of the region. However, the study also reveals that there is considerable variation in land use and cropping patterns during the study period, suggesting a need for effective land use management.

The application of Geographical Information System (GIS) and Remote Sensing technologies has been instrumental in analyzing and mapping the spatial distribution of crops, irrigation facilities, and land use changes. These technologies allow for precise monitoring of agricultural trends, enabling better planning and decision-making for sustainable agricultural development. Through GIS and Remote Sensing, the present study identified areas of high agricultural potential, monitor changes in crop patterns over time, and assess the impact of environmental and human factors on land use of the study area.

Meanwhile the agricultural landscape in Nalgonda district has undergone changes, the adoption of modern agricultural practices, coupled with modern technologies and tools, offers promising solutions to sustain agricultural productivity in the face of urbanization and land use shifts. This study emphasizes the importance of integrating technology with traditional farming to ensure long-term agricultural sustainability.

References

1. Neelima, T. L., & Murthy, V. B. B. (2008). Growth and yield attributes of rice as influenced by N fertilizer and differential incorporation of sunn hemp green manure. Journal of Rice Research, 2(1), 45-50.
2. Ahmed, G. Enayat, 1945. “The Scope of Land Utilization Survey of India.” *Indian Geographical Journal*, 1945.
3. Ali, 1949. “Land Utilization Survey of India.” *The Geographer*, Vol. 2, No. 1.
4. Arunachalam, B., 1959. “Land Classification and Possibilities of Re-planning Land Use in Vanamadevi Village.” *Bombay Geographical Magazine*, Vol. VI-VII, September, No. L, p. 19.
5. Adiecan, E., 1967. "The Geography of Irrigation in Tamil Nadu." *Indian Geographical Journal*, Vol. 42.
6. Bhatia, S.S., 1967. "A New Measure of Agricultural Efficiency in Uttar Pradesh." *Economic Geography*, Vol. 43, No. 3, pp. 244-248.
7. Basu, S.R., & Kar, N.R., 1968. “Meandering, Migration and Alluvial Terraces in Lower Bhagirathi Valley, West Bengal.” *Abstract, 21st International Geographical Congress*, New Delhi.

8. Agarwal, M., 1972. “Morphometric Analysis of Some Drainage Basins of Jabalpur Plateau.” *National Geographical Journal of India*, XVIII(3&4): 148-168.
9. Brinkman, R., & Smyth, A.J., 1973. “Land Evaluation for Rural Purposes.” *Wageningen*, Publication 17.
10. Agarwal, P.C., & Khan, Z.T., 1983. “Spatial Analysis of the Level of Regional Development in Madhya Pradesh.” In Pandey, Ed., *Modern Geographical Trends*, New Delhi: Today & Tomorrow’s Printers, pp. 315-324.
11. Ahsan, M., & Hasan, M., 1985. “An Analysis of Land Use Patterns in Assam.” *Geographical Review of India*, 47(3): 163-175.
12. Chatterjee, A., 1991. “Land Use and Agricultural Development in the Eastern Himalayas.” *Economic Geography*, 60(2): 203-221.
13. Joshi, M., 1994. “Agricultural Productivity and Irrigation Development in Rajasthan.” *Indian Journal of Geography*, 48(2): 145-157.
14. Kumar, P., & Singh, R., 1996. “Impact of Irrigation on Crop Production in Uttar Pradesh.” *Geographical Journal of India*, 57(3): 122-134.
15. Sharma, S., 1998. “Changes in Land Use and Irrigation in the Ganga Basin.” *Indian Journal of Applied Geography*, 6(1): 57-71.
16. Patil, S., 2000. “Irrigation and Agricultural Growth in Maharashtra.” *Journal of Indian Geography*, 49(1): 89-101.
17. Singh, H., & Rani, M., 2002. “Water Use Efficiency and Crop Yield in Haryana.” *Indian Economic Journal*, 50(4): 197-208.
18. Mishra, A., 2003. “Hydrological Changes and Irrigation Systems in Central India.” *Geographical Journal of India*, 58(2): 235-247.
19. Mehta, R., 2005. “Land Use Transformation and Agricultural Sustainability in Punjab.” *Geographical Studies*, 34(2): 50-62.
20. Kumar, S., & Verma, R., 2006. “Irrigation and Agricultural Growth in Western India.” *Indian Geographical Journal*, 62(1): 13-25.
21. Jha, N., & Kumar, R., 2007. “Sustainable Agricultural Practices and Water Management in Bihar.” *Agricultural Geography Review*, 53(3): 173-185.
22. Gupta, A., 2008. “Land Use Changes in the Drought-prone Regions of Rajasthan.” *Geographical Review*, 74(1): 98-112.
23. Singh, A., 2009. “Water Management and Irrigation in Semi-arid Regions.” *Geographical Journal of India*, 63(2): 201-214.
24. Das, S., 2010. “Challenges of Irrigation and Agricultural Growth in Eastern India.” *Indian Journal of Rural Development*, 22(4): 254-266.
25. Pandey, M., 2011. “Role of Irrigation in Enhancing Agricultural Productivity in Uttar Pradesh.” *Journal of Agriculture and Rural Development*, 48(1): 98-110.
26. Sharma, P., & Soni, R., 2012. “Impact of Irrigation on Agricultural Output in Rajasthan.” *Indian Journal of Geography and Environment*, 59(3): 243-255.
27. Yadav, S., 2013. “Agricultural Productivity and Water Usage in Haryana.” *Economic Geography Review*, 45(2): 119-132.
28. Thakur, V., 2014. “Spatial Patterns of Irrigation and Agricultural Production in Madhya Pradesh.” *Journal of Geographical Studies*, 64(1): 101-113.
29. Reddy, S., & Rao, S., 2015. “Water Use Efficiency in Agriculture in Andhra Pradesh.” *Indian Agricultural Journal*, 72(3): 56-68.
30. Tripathi, V., & Srivastava, P., 2016. “The Role of Irrigation in Sustainable Agricultural Development in Bihar.” *Geographical Journal of India*, 78(4): 331-343.
31. Joshi, P., & Singh, M., 2017. “Agricultural Trends and Irrigation Development in Punjab.” *Geography and Environment*, 21(2): 122-134.
32. Kumar, R., 2018. “Water Resource Management and Crop Yield in Tamil Nadu.” *Indian Journal of Agricultural Economics*, 40(1): 101-113.