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Original Article

A Geographical Analysis of Tubewell Irrigation Farming System in Gundlupet Taluk of Chamarajanagar District

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Abstract

The study presents a geographical analysis of tubewell irrigation in Gundlupet Taluk of Chamarajanagar District, highlighting spatial disparities in irrigation dependency and functionality across its hoblis. Agriculture in the region, characterized by a semi-arid climate, increasingly depends on groundwater extraction due to limited surface water sources. Secondary data from census records and district statistical handbooks were analyzed to examine the extent, distribution, and efficiency of tubewell irrigation. Results reveal that out of 16,565 tubewells in the taluk, 11,699 (70.6%) are functional and 4,866 (29.4%) are non-functional. Beguru hobli accounts for the highest share of working tubewells (30.45%), while Kasaba hobli records the largest proportion of non-working wells (36.29%), indicating groundwater stress. The findings underscore the growing dependence on groundwater and the pressing need for sustainable management practices. The study emphasizes the importance of integrating groundwater regulation, micro-irrigation, and recharge structures to ensure agricultural sustainability and resilience in Gundlupet Taluk.

Keywords: *Irrigation farming, Spatial analysis, Agriculture, GIS, Gundlupet.*

Introduction

Agriculture continues to be the backbone of rural livelihoods in India, and its performance is closely tied to the availability, reliability, and efficiency of irrigation systems. In water-scarce regions, particularly in semi-arid zones, irrigation plays a crucial role in enhancing agricultural productivity, stabilizing incomes, and reducing dependence on erratic monsoon rains. Karnataka, particularly its southern districts, has experienced uneven rainfall distribution and periodic droughts, which have made irrigation an indispensable factor for ensuring crop sustainability. Gundlupet taluk, located in the southwestern part of Chamarajanagar district, lies in the transition zone between the Western Ghats and the southern plateau. It is marked by undulating topography, red loamy soils, and a semi-arid climate with low to moderate rainfall. Due to its geographical setting, agriculture in Gundlupet is heavily reliant on man-made irrigation sources such as borewells, tanks, and canals. The region is also influenced by the presence of the Kabini reservoir and related canal systems, which serve as a major source of surface irrigation in selected villages of the taluk. However, groundwater has become the dominant source of irrigation over the past two decades due to the widespread adoption of borewell technology. The agricultural landscape of Gundlupet is characterized by a diversity of crops, including finger millet, groundnut, maize, sunflower, banana, and sugarcane. The choice of crops and cropping patterns is intrinsically linked to the availability and type of irrigation. Areas with assured canal irrigation tend to support high water-demanding commercial crops, while borewell-dependent regions fluctuate based on groundwater availability and the cost of extraction. The spatial disparity in irrigation infrastructure, access to water resources, and farmers' socio-economic status has resulted in uneven agricultural development across the taluk. In recent years, several challenges have emerged that threaten the sustainability of irrigation-based farming in Gundlupet.

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These include declining groundwater tables, increased energy costs for pumping water, drying traditional tanks, sedimentation issues, lack of desilting, and poor maintenance of canal systems. Furthermore, climate change-induced rainfall variability and prolonged dry spells have further exacerbated the stress on both surface and groundwater resources. This situation necessitates a scientific and spatially informed understanding of irrigation systems and their dynamics at the micro-regional level.This study, therefore, aims to provide a comprehensive geographical analysis of the irrigation farming system in Gundlupet taluk. Using tools such as Geographic Information System (GIS), remote sensing, and statistical analysis, the research maps the distribution of irrigation sources, examines the extent and nature of irrigated agriculture, and evaluates the socio-economic and environmental factors influencing irrigation efficiency. Particular attention is given to identifying spatial inequalities in irrigation access and the resultant cropping patterns.The findings of this study are expected to contribute valuable insights into regional irrigation planning, assist policymakers in formulating targeted interventions, and support local efforts aimed at promoting sustainable water resource management and climate-resilient agriculture. By integrating geographical analysis with field-level realities, the research aims to bridge the gap between policy frameworks and the ground-level irrigation needs of farming communities in Gundlupet taluk.

Objectives

1. To analyze the spatial distribution and efficiency of irrigation sources and their impact on cropping patterns in Gundlupet taluk of Chamarajanagar district.
2. To examine the spatial distribution and functional status of working and non-working tubewells at the hobli level for assessing groundwater irrigation patterns."

Study area

Gundlupet taluk lies between 11°45' to 12°45' N latitude and 77°00' to 77°46' E longitude, covering an expanse of 1380.71 sq. km. With an average rainfall of 835 mm above mean sea level (MSL) as per District Glance (2020-21), Gundlupet sits adjacent to the foothills, maintaining an elevation of about 835 MSL. Positioned on a plateau, it is enveloped by mountains from nearly all sides, except the northeast.

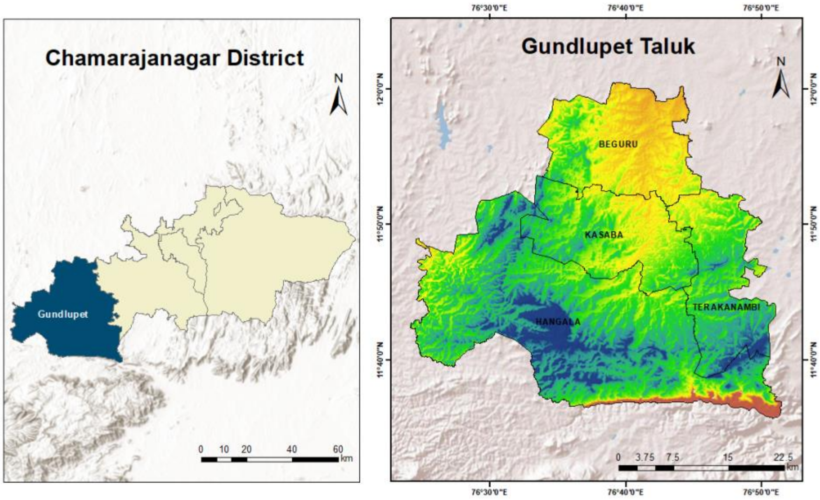

Figure 1: Location map of the study area

Research methodology

The current study is on combination of primary and secondary data sources. Primary data were collected through questionnaire-based surveys conducted at selected sample locations while secondary data were obtained from reliable sources such as the Census of India (2011), the District Statistical Handbook, and the Zilla Panchayath 2022-23. Trend analysis helped assess the impact of groundwater irrigation on agriculture. The methodology provides insights into spatial patterns, sustainability, and irrigation efficiency in the region. Primary data collection was carried out in four hoblis Beguru (110), Hangala (75), Terakanambi (89), and Gundlupete (102) using the systematic random sampling method. In total, 376 respondents from both rural and urban areas were interviewed. The dataset captures detailed, individual-level information relevant to the utilization and management of tubewell irrigation.

Results and discussions

The analysis of tubewell irrigation in Gundlupet Taluk reveals that groundwater has emerged as the dominant source of irrigation, supporting a large proportion of the cultivated land. Out of 16,565 tubewells in the taluk, 11,699 (70.6%) are functional, while 4,866 (29.4%) are non-functional. This clearly indicates a dual challenge: while groundwater irrigation sustains agricultural productivity, its over-reliance has simultaneously led to well failures, aquifer stress, and declining water tables. The functional wells reflect the continuing vitality of tubewell irrigation, but the high percentage of non-functional wells is a warning sign of unsustainable practices.

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At the hobli level, spatial variations in the distribution of tubewells are quite evident. Beguru Hobli accounts for the highest number of functional tubewells (3562; 30.45%) and contributes significantly to irrigated crop production. However, it also shows a considerable share of non-working wells (1249; 25.67%), indicating that although groundwater availability is relatively high, it is under mounting pressure. Kasaba Hobli follows with 2747 working tubewells (23.48%), but stands out as the most stressed region, with 1766 non-functional wells (36.29%). This reflects both over-extraction of groundwater and possible aquifer depletion, raising concerns about long-term irrigation sustainability in the hobli. In contrast, Terakanambi Hobli has 2971 functional tubewells (25.40%) and a lower proportion of non-functional wells (19.13%), suggesting a more balanced utilization pattern. Hangala hobli records the lowest share of working tubewells (2419; 20.68%) with 920 non-functional wells (18.91%), showing moderate dependence on groundwater and relatively stable use.

The cropping patterns in these hoblis are directly linked to irrigation availability. Hoblis with higher functional tubewell density, such as Beguru and Terakanambi, have encouraged the cultivation of water-intensive commercial crops, including maize, cotton, and turmeric. Meanwhile, hoblis with higher non-functional wells, such as Kasaba, face growing uncertainty in sustaining such crops, forcing farmers to either reduce cropping intensity or shift to less water-demanding crops. This uneven distribution of irrigation resources results in socio-economic disparities among farming households, influencing income levels, productivity, and migration trends.

Another important dimension is the environmental and hydrological impact. The increasing dependence on tubewells has led to continuous groundwater exploitation, threatening the sustainability of the resource base. Areas like Kasaba, where non-functional wells are highest, reflect the severity of over-extraction and declining water tables. The situation is further exacerbated by erratic rainfall and climate variability, which reduce the rate of natural recharge. Unless corrective measures such as recharge pits, percolation tanks, and regulated pumping are adopted, the agricultural system of Gundlupet Taluk will face serious risks.

In conclusion, the results highlight the contrasting dynamics of tubewell irrigation: on the one hand, it remains the backbone of irrigation and agricultural growth in the taluk, but on the other hand, unregulated dependence has created sharp regional imbalances and sustainability concerns. Addressing these challenges requires a multi-pronged approach: promoting micro-irrigation systems like drip and sprinkler to improve water-use efficiency, regulating borewell drilling, encouraging crop diversification based on water availability, and investing in groundwater recharge structures. Policymakers and planners need to integrate these strategies with GIS-based spatial monitoring to ensure that irrigation resources are managed equitably and sustainably across all hoblis of Gundlupet Taluk.

Table.1: Distribution of working and non-working tubewells

S.N	Name of the Hobli's	working	Not working	Total	Percentage
1	Beguru	3562	1249	4811	29.04
2	Kasaba	2747	1766	4513	27.24
3	Terakanambi	2971	931	3902	23.56
4	Hangala	2419	920	3339	20.16
	Total	**11699**	**4866**	**16565**	**100.000**

Source: Zilla Panchayath 2023-24

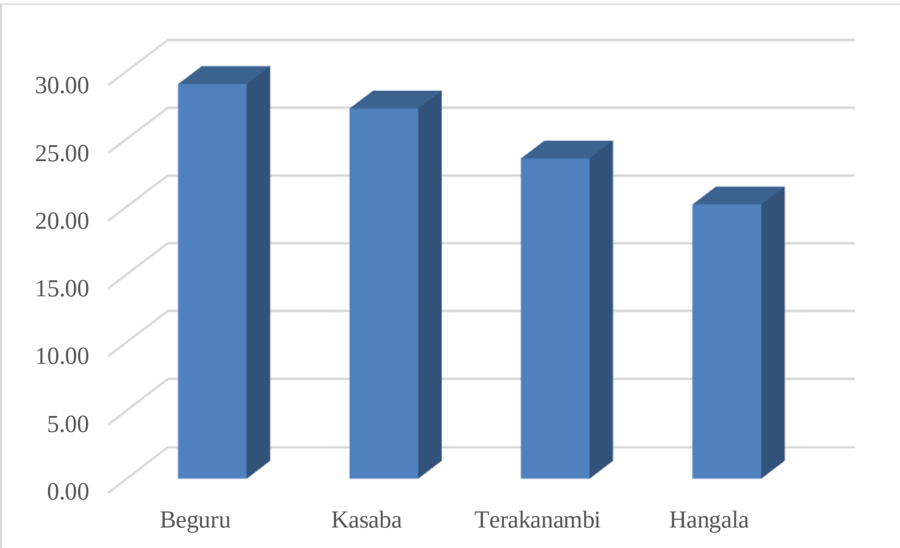

Figure.2: Distribution of Tubewell irrigation

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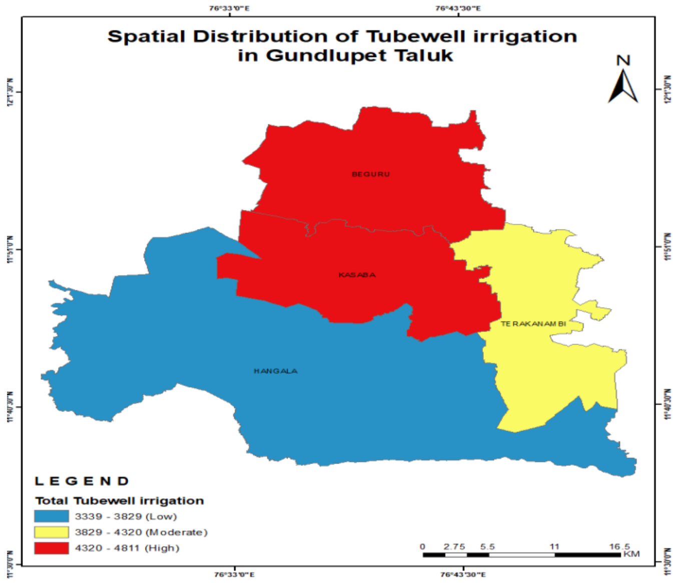

Figure.3 : Spatial distribution of tubewell irrigation

Overall, out of 16,565 tubewells in the taluk, 11,699 (70.6%) are functional and 4,866 (29.4%) are non-functional. This indicates that while tubewell irrigation remains a crucial source for agriculture in Gundlupete, there is a significant proportion of wells that are drying up or abandoned, especially in Kasaba hobli. Effective groundwater management strategies are essential to sustain irrigation in the long term.

Table.2: Spatial distribution of Tubewell irrigation at Hobli's

S.N.	Name of the Hobli's	Working	% Working	Not Working	% Non Working
1	Beguru	3562	30.45	1249	25.67
2	Kasaba	2747	23.48	1766	36.29
3	Terakanambi	2971	25.40	931	19.13
4	Hangala	2419	20.68	920	18.91
	Total	11699	100	4866	100

Source: Primary data

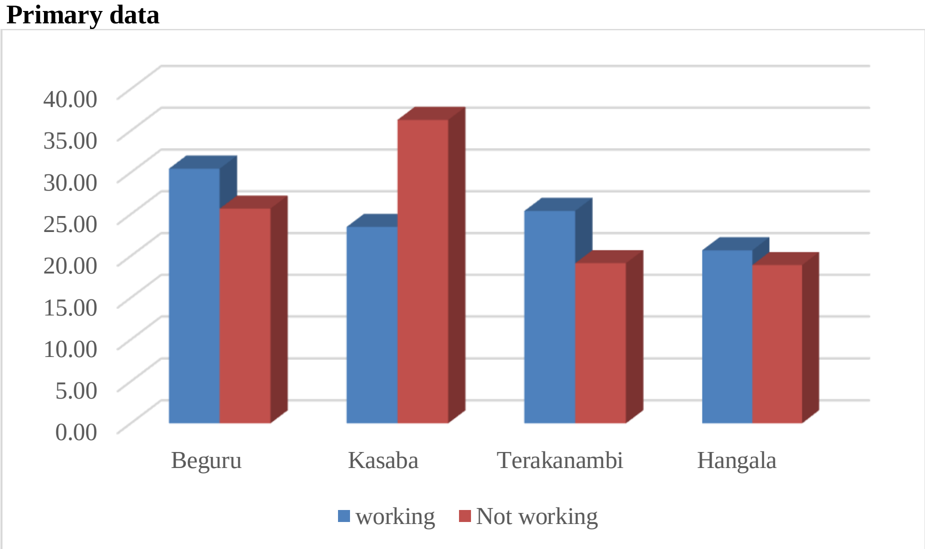

Figure.4: Distribution of tubewell irrigation at the hobli level

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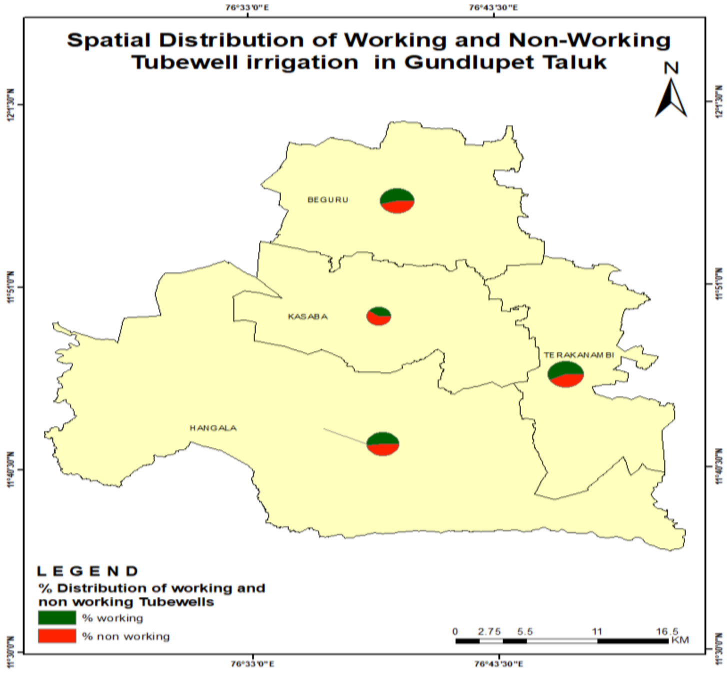

Figure.5: distribution of working and non-working tubewells

The distribution of tubewell irrigation across the hoblis of Gundlupete Taluk shows clear spatial variations. Beguru hobli has the highest share of working tubewells (3562; 30.45%), reflecting its greater dependence on groundwater irrigation, while Kasaba hobli follows with 2747 working tubewells (23.48%). Terakanambi hobli accounts for 2971 working tubewells (25.40%), indicating relatively balanced utilization. In contrast, Hangala hobli reports the lowest number of working tubewells (2419; 20.68%), suggesting lesser reliance on this source. In terms of non-working tubewells, Kasaba hobli has the largest proportion (36.29%), pointing to over-exploitation and possible groundwater stress. On the other hand, Hangala (18.91%) and Terakanambi (19.13%) show fewer non-functional wells, indicating relatively sustainable use.

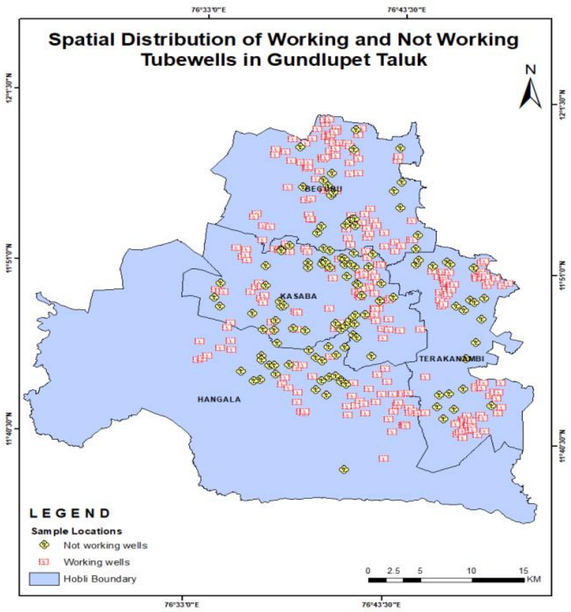

Figure.6: Spatial distribution of tubewell samples

Based on the spatial distribution of tubewell irrigation across the hoblis, Beguru hobli records the highest number with 81 working and 29 non-working tubewells, reflecting its strong dependence on groundwater irrigation. It is followed by Kasaba hobli, which has 62 working and 40 non-working tubewells, indicating substantial reliance as well. Terakanambi hobli accounts for 68 working and 21 non-working tubewells, showing a relatively balanced utilization pattern. In contrast, Hangala hobli reports the lowest figures, with 54 working and 21 non-working tubewells, suggesting comparatively lower dependence on this irrigation source.

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Conclusion

The present study reveals that the irrigation farming system in Gundlupet taluk is characterized by significant spatial disparities, both in terms of water source availability and agricultural productivity. Groundwater, particularly through borewells, has emerged as the primary mode of irrigation, especially in the central and southern parts of the taluk. While this has enabled year-round cultivation in many villages, over-dependence on borewells has led to rapid groundwater depletion, increased cultivation costs, and long-term sustainability concerns. This uneven access to irrigation infrastructure has resulted in distinct differences in cropping patterns, crop yield, and farmers' income across the taluk. The study emphasizes that improving irrigation efficiency and promoting equitable access to water resources are crucial for enhancing agricultural sustainability in the region. Strengthening canal networks, rejuvenating tanks, regulating groundwater usage, and encouraging the adoption of micro-irrigation systems are essential steps toward achieving this goal. Furthermore, integrating GIS-based spatial planning with farmer-centric policies can aid in developing localized irrigation strategies that align with the region's agro-climatic conditions and socio-economic realities. Promoting regulated tubewell irrigation with micro-irrigation techniques (like drip and sprinkler) can reduce excessive groundwater extraction in Gundlupet's dry land areas. Constructing recharge pits and percolation tanks near tubewells can enhance natural groundwater recharge. Crop planning based on water availability can ensure sustainable use of borewell water. Community-led water budgeting and monitoring will help balance usage and recharge in vulnerable regions.

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