International Research Journal of Education and Technology
Peer Reviewed Journal, **ISSN 2581-7795**

Trends in Minor Irrigation in Rayalaseema Region

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1. Introduction

Minor irrigation sources are vital for agricultural development and also for providing livelihoods in drought-prone region of Rayalaseema. Minor irrigation schemes support regions outside the command areas of major and medium projects and dominate over these sources. Over time, groundwater irrigation in Rayalaseema has undergone dramatic changes. Generally the provision of water is a state subject. Hence, the development of major and medium irrigation systems is under the state's purview, while individual farmers (private sector) have made significant contributions to minor irrigation systems. Farmers have increasingly utilized groundwater irrigation, especially in rain fed and drought-prone region of Rayalaseema, with the private sector's role growing over recent decades.

Minor irrigation systems consist of surface water and all groundwater schemes. In surface water schemes, culturable command area is less than 2,000 hectares. Surface water schemes include surface flow schemes and surface lift schemes. Surface flow schemes often involve tanks, check dams, and structures used for water conservation and groundwater recharge, commonly found in hilly areas. Surface lift schemes are constructed in areas where topography prevents direct flow irrigation from rivers and streams, requiring the lifting of water into irrigation channels. These projects include pumps and pump houses.

Groundwater schemes encompass dug wells, shallow and medium tube wells, and deep tube wells. Dug wells are traditional open wells, predominantly used by individual farmers. Shallow tube wells are boreholes drilled to extract groundwater from permeable zones, typically not exceeding 25 meters in depth. Medium tube wells, introduced in the 5th Minor Irrigation Census (MIC), have depths ranging from 35 to 70 meters. Deep tube wells can reach depths of 70 meters or more.

2. Objectives

1. To analyse the minor irrigation across sources by districts in Rayalaseema Region.

2. To examine the Irrigation Potential Created (IPC) under Minor Irrigation in Rayalaseema.

3. To analyse the Area Irrigated under Minor Irrigation in Rayalaseema.

3. Methodology

This Study is based on secondary data only. Secondary data is collected from published sources. The main published sources are Statistical Abstracts, Directorate of Economics and Statistics, Hyderabad, Statistical Abstracts, Directorate of Economics and Statistics, Amaravati, AP, Minor Irrigation Censes Reports, Government of India.

4. Minor Irrigation Sources across Districts in Rayalaseema

Minor irrigation schemes accounting for a substantial share of irrigation needs especially in Rayalaseema. Therefore, a robust and reliable database on minor irrigation is necessary for effective planning and policy formulation. Accordingly, the Government of India has conducted six Minor Irrigation Censuses so far, which provide data on these irrigation types. The Table 1 represents the source wise minor irrigation across the districts in Rayalaseema under 4^{th} (2006-07), 5^{th} (2013-14), and 6^{th} (2017-18) MICs. The figures are categorized by irrigation type such as dug wells, shallow and medium tube wells, deep tube wells, surface flow irrigation, and surface lift irrigation. In 2006-07, Rayalaseema had a total of 460,354 irrigation units. Dug wells were the most common method, with 195,829 units, followed by shallow and medium tube wells with 115,900 units. Deep tube wells accounted for 130,580 units, surface flow irrigation had 14,739 units, and surface lift irrigation contributed 3,306 units. The total number of irrigation units increased over the years, with 474,198 units recorded in 2013-14 and 545,876 units in 2017-18. This rise reflects a shift in irrigation practices and improvements in infrastructure.

In 2006-07, Chittoor had the highest number of irrigation units, totaling 187,232. It had a substantial number of dug wells (91,101) and deep tube wells (69,440). Anantapur followed with a total of 115,722 units, dominated by shallow and medium tube wells (53,179). YSR Kadapa had 92,274 units, with a significant number of deep tube wells (36,464). Kurnool had 65,126 units, with a notable number of shallow and medium tube wells (27,141).

Table 1: Number of Minor Irrigation Schemes across districts in Rayalaseema

Districts	Dug well	Shallow& Medium Tube wells	Deep Tube wells	Surface flow irrigation	Surface Lift Irrigation	Total
2006-07 (4th MIC)						
Y.S.R Kadapa	36709	16585	36464	2351	165	92274
Kurnool	29403	27141	4905	560	3117	65126
Anantapur	38616	53179	19771	4155	1	115722
Chittoor	91101	18995	69440	7673	23	187232
Rayalaseema	**195829**	**115900**	**130580**	**14739**	**3306**	**460354**
2013-14 (5th MIC)						
Y.S.R Kadapa	17836	15477	58870	2348	601	95132
Kurnool	14554	27821	20579	527	3712	67193
Anantapur	18290	28785	78731	7778	2	133586
Chittoor	49700	33280	87644	7657	6	178287
Rayalaseema	**100380**	**105363**	**245824**	**18310**	**4321**	**474198**
2017-18 (6th MIC)						
Y.S.R Kadapa	11670	17395	75218	1914	568	106765
Kurnool	14572	26416	39683	844	3962	85477
Anantapur	8290	30257	113194	1689	58	153488
Chittoor	37019	29601	125807	7706	13	200146
Rayalaseema	**71551**	**103669**	**353902**	**12153**	**4601**	**545876**

Source: AP Minor Irrigation Census Reports: 4th MIC, 5th MIC & 6th MIC

By 2013-14, Chittoor continued to lead with 178,287 units, including an increase in deep tube wells (87,644). Anantapur's total grew to 133,586 units, with substantial increases in both deep tube wells (78,731) and shallow and medium tube wells (28,785). YSR Kadapa's total was 95,132 units, showing a rise in deep tube wells (58,870). Kurnool had 67,193 units, with increases in shallow and medium tube wells (27,821) and deep tube wells (20,579).

In 2017-18, Chittoor remained at the top with 200,146 units, with a significant rise in deep tube wells (125,807). Anantapur's total reached 153,488 units, with a major increase in deep tube wells (113,194). YSR Kadapa had 106,765 units, with a significant number of deep tube wells (75,218). Kurnool had 85,477 units, with notable increases in deep tube wells (39,683) and shallow and medium tube wells (26,416).

Table 2 shows the percentage share of minor irrigation sources across districts in AP during 4th MIC. The table outlines the distribution of different types of irrigation sources in Rayalaseema and its districts for the years 2006-07, 2013-14, and 2017-18. It provides percentages for various irrigation methods, including Dug Wells, Shallow Tube Wells, Deep Tube Wells, Surface Flow Irrigation, and Surface Lift Irrigation.

In Rayalaseema, the share of each irrigation type has changed over the years. In 2006-07, Dug Wells constituted 42.5% of the total irrigation sources, Shallow Tube Wells 25.2%, Deep Tube Wells 28.4%, Surface Flow Irrigation 3.2%, and Surface Lift Irrigation 0.7%. By 2017-18, the percentage of Dug Wells further reduced to 13.1%, Shallow Tube Wells increased to 19.0%, and Deep Tube Wells rose to 64.8%. Surface Flow Irrigation decreased to 2.2%, and Surface Lift Irrigation remained relatively stable at 0.8%. Overall, the total number of irrigation sources in Rayalaseema increased significantly from 460,354 in 2006-07 to 545,876 in 2017-18.

Table 2: Minor Irrigation under various sources by districts in Rayalaseema (%)

Districts	Dug well	Shallow Tube wells	Deep Tube wells	Surface flow irrigation	Surface Lift Irrigation	Total	Total (Number)
2006-07 (4th MIC)							
Y.S.R Kadapa	39.8	18	39.5	2.5	0.2	100	92274
Kurnool	45.1	41.7	7.5	0.9	4.8	100	65126
Anantapur	33.4	46	17.1	3.6	0	100	115722
Chittoor	48.7	10.1	37.1	4.1	0	100	187232
Rayalaseema	**42.5**	**25.2**	**28.4**	**3.2**	**0.7**	**100**	**460354**
2013-14 (5th MIC)							
Y.S.R Kadapa	18.7	16.3	61.9	2.5	0.6	100	95132
Kurnool	21.7	41.4	30.6	0.8	5.5	100	67193
Anantapur	13.7	21.5	58.9	5.8	0	100	133586
Chittoor	27.9	18.7	49.2	4.3	0	100	178287
Rayalaseema	**21.2**	**22.2**	**51.8**	**3.9**	**0.9**	**100**	**474198**
2017-18 (6th MIC)							
Y.S.R Kadapa	10.9	16.3	70.5	1.8	0.5	100	106765
Kurnool	17.0	30.9	46.4	1.0	4.6	100	85477
Anantapur	5.4	19.7	73.7	1.1	0.0	100	153488
Chittoor	18.5	14.8	62.9	3.9	0.0	100	200146
Rayalaseema	**13.1**	**19.0**	**64.8**	**2.2**	**0.8**	**100**	**545876**

Source: AP Minor Irrigation Census, 4th MIC (2006-07)

For Y.S.R Kadapa, Deep Tube Wells rose substantially from 39.5% in 2006-07 to 70.5% in 2017-18. Shallow Tube Wells saw a slight increase from 18% to 16.3%, while Dug Wells decreased significantly from 39.8% to 10.9%. Surface Flow Irrigation remained stable at around 2.5%, and Surface Lift Irrigation stayed relatively low at 0.5%. In Kurnool, Shallow Tube Wells remained a major source but slightly decreased from 41.7% in 2006-07 to 30.9% in 2017-18. Deep Tube Wells saw a significant rise from 7.5% to 46.4%. Dug Wells decreased from 45.1% to 17.0%, and Surface Lift Irrigation increased from 4.8% to 4.6%.

Anantapur's irrigation sources show a clear shift towards Deep Tube Wells, which increased dramatically from 17.1% in 2006-07 to 73.7% in 2017-18. Shallow Tube Wells decreased from 46% to 19.7%, and Dug Wells fell sharply from 33.4% to 5.4%. Surface Flow Irrigation decreased slightly from 3.6% to 1.1%. In Chittoor, Deep Tube Wells rose from 37.1% in 2006-07 to 62.9% in 2017-18. Shallow Tube Wells decreased from 10.1% to 14.8%, while Dug Wells fell from 48.7% to 18.5%. Surface Flow Irrigation remained relatively steady at around 4%, and Surface Lift Irrigation remained negligible.

5. IPC and Area Irrigated under Minor Irrigation by Districts in Rayalaseema

The Table 3 reveals the IPC and area irrigated during 4th and 5th MIC district wise in Rayalaseema. The table details irrigation performance in the Rayalaseema region for the 4th MIC (2006-07) and the 5th MIC (2013-14). It covers the total area under irrigation projects (IPC) and the percentage of that area actually irrigated for each district and the region as a whole. In the 4th MIC (2006-07), Rayalaseema had a total of 12.5 lakh hectares of IPC, with 5.45 lakh hectares irrigated, representing the total irrigation data for that period. By the 5th MIC (2013-14), the total IPC was 10.89 lakh hectares, with 5.61 lakh hectares irrigated, reflecting the updated figures for that period.

For Y.S.R Kadapa, the 4th MIC reported 2.89 lakh hectares of IPC and 1.21 lakh hectares irrigated, making up 23.2% of the total IPC and 22.3% of the total irrigated area in the region. By the 5th MIC, the area covered by irrigation projects had decreased slightly to 2.77 lakh hectares, but the irrigated area increased to 148,656 hectares. This represented 25.5% of the total IPC and 26.5% of the total irrigated area.

In Kurnool, the 4th MIC data showed 189,700 hectares of IPC with 133,280 hectares irrigated, which was 15.2% of the total IPC and 24.4% of the total area irrigated. By the 5th MIC, the area under irrigation projects had decreased to 184,344 hectares, with the irrigated area remaining almost unchanged at 133,170 hectares. This represented 16.9% of the total IPC and 23.7% of the total irrigated area.

Anantapur's data from the 4th MIC indicated 334,822 hectares of IPC and 110,954 hectares irrigated, accounting for 26.8% of the total IPC and 20.3% of the total irrigated area. By the 5th MIC, the area under irrigation projects had reduced to 264,067 hectares, while the irrigated area increased to 128,621 hectares, which was 24.2% of the total IPC and 22.9% of the total irrigated area.

Chittoor had the largest share of IPC in the 4th MIC, with 437,181 hectares and 179,724 hectares irrigated. This represented 34.9% of the total IPC and 32.9% of the total area irrigated. By the 5th MIC, the area covered by irrigation projects decreased to 363,260 hectares, and the irrigated area dropped to 150,633 hectares, making up 33.3% of the total IPC and 26.8% of the total irrigated area.

Table 3: IPC and Area Irrigated under Minor Irrigation across Districts in Rayalaseema (Hectares)

Districts	4th MIC (2006-07)				5th MIC (2013-14)			
	IPC	%	Area Irrigated	%	IPC	%	Area Irrigated	%
Y.S.R Kadapa	289757	23.2	121861	22.3	277945	25.5	148656	26.5
Kurnool	189700	15.2	133280	24.4	184344	16.9	133170	23.7

Anantapur	334822	26.8	110954	20.3	264067	24.2	128621	22.9
Chittoor	437181	34.9	179724	32.9	363260	33.3	150633	26.8
Total	**1251460**	**100**	**545819**	**100**	**1089616**	**100**	**561080**	**100**

Source: AP 4th and 5thMinor Irrigation Census Reports, Government of India.

6. IPC under Minor Irrigation across Sources in Rayalaseema

The table 4 shows the district-wise Irrigation Potential Created (IPC) during the 4th and 5th Minor Irrigation Census (MIC) by different irrigation sources in Rayalaseema. In the 4th MIC, the total IPC was 1,251,460 hectares, with groundwater accounting for 73.1% and surface water 26.9%. Of the groundwater irrigation, dug wells contributed 27.5%, shallow and medium tube wells 21.6%, and deep tube wells 24%. For surface water, 25.7% came from Surface Flow Irrigation and 1.2% from Surface Lift Irrigation Schemes. Chittoor had the highest IPC (437,181 hectares), with 30.6% from dug wells, 8.7% from shallow and medium tube wells, 28% from deep tube wells, and 32.7% from Surface Flow Irrigation. Surface Lift Irrigation had a minimal contribution in Chittoor. Kurnool had the lowest IPC (189,700 hectares), with 35.8% from dug wells, 35.7% from shallow and medium tube wells, 9% from deep tube wells (totaling 80.5% from groundwater), 13.2% from Surface Flow Irrigation, and 6.3% from Surface Lift Irrigation.

Table 4: IPC under Minor Irrigation Sources by Districts in Rayalaseema (%)

Districts	Dug Wells	Shallow and Medium Tube wells	Deep tube wells	**Total Ground Water**	Surface Flow Irrigation	Surface Lift Irrigation	**Total Surface Water**	**Total**
4th MIC								
Y.S.R Kadapa	23.7	17.1	39.4	**80.2**	18.8	1	**19.8**	100 (289757)
Kurnool	35.8	35.7	9.0	**80.5**	13.2	6.3	**19.5**	100(189700)
Anantapur	22.1	34.2	14.1	**70.4**	29.6	0	**29.6**	100(334822)
Chittoor	30.6	8.7	28	**67.3**	32.7	0	**32.7**	100(437181)

TOTAL	27.5	21.6	24.0	**73.1**	25.7	1.2	**26.9**	**100(1251460**
5th MIC								
Y.S.R Kadapa	11.2	13.2	55.7	**80.1**	18.7	1.2	**19.9**	100(277945)
Kurnool	19.1	33.3	24.4	**76.8**	14.9	8.3	**23.2**	100(184344)
Anantapur	5.9	17.8	52.3	**76.0**	23.9	0.1	**24.0**	100(264067)
Chittoor	15.6	14.2	33.2	**63.0**	37.0	0.1	**37.1**	100(363260)
Total	12.7	18.1	42.1	**72.9**	25.4	1.7	**27.1**	**100 (1089616)**

Source: AP 4thMinor Irrigation Census Report, Government of AP.
Note: Figures in brackets indicate the IPC in hectares

In the 5th MIC, the total IPC in Rayalaseema was 1,089,616 hectares. Groundwater sources contributed 72.9% of this, with 12.7% from dug wells, 18.1% from shallow and medium tube wells, and 42.1% from deep tube wells. The remaining 27.1% came from surface water sources, with 25.4% from Surface Flow Irrigation and 1.7% from Surface Lift Irrigation. Chittoor again had the highest IPC (363,260 hectares), with 63% from groundwater (15.6% from dug wells, 14.2% from shallow and medium tube wells, and 33.2% from deep tube wells) and 37.1% from surface water sources (37% from Surface Flow Irrigation and 0.1% from Surface Lift Irrigation). Kurnool had the least IPC (184,344 hectares), with 76.8% from groundwater (19.1% from dug wells, 33.3% from shallow and medium tube wells, and 24.4% from deep tube wells) and 23.2% from surface water sources (14.9% from Surface Flow Irrigation and 8.3% from Surface Lift Irrigation).

Chittoor, as in the 4th MIC, had the highest irrigated area with 150,633 hectares. Groundwater irrigated 87% of this area, and surface water provided for 13%. Within groundwater sources, Dug Wells irrigated 13.4% of the area, Shallow and Medium Tube Wells 23.8%, and Deep Tube Wells 49.8%. For surface water sources, Surface Flow Irrigation accounted for 13%, and Surface Lift Irrigation for 0%. Anantapur had the least irrigated area with 128,621 hectares, with groundwater contributing 94.5% and surface water 5.5%. Deep Tube Wells irrigated 67.9% of the area, Shallow and Medium Tube

Wells 25%, and Dug Wells 1.5%. The remaining 5.5% was irrigated by Surface Flow Irrigation. Groundwater continues to be the major source of irrigation in all four districts in the Rayalaseema region.

7. Area Irrigated under Minor Irrigation across Districts in Rayalaseema

Table 5 shows the district-wise area irrigated during the 4th and 5th Minor Irrigation Census (MIC) by different irrigation sources. During the 4th MIC, a total of 545,819 hectares was irrigated. Groundwater sources irrigated 90.9% of this area, with 23.4% by Dug Wells, 31.2% by Shallow and Medium Tube Wells, and 36.3% by Deep Tube Wells. Surface water sources accounted for the remaining 9.1%, including 1.9% by Surface Flow Irrigation and 7.2% by Surface Lift Irrigation.

Chittoor had the highest irrigated area among the four districts. Out of 179,724 hectares irrigated in Chittoor, groundwater sources contributed 88.8%, while surface water sources contributed 11.2%. Within groundwater sources, Dug Wells accounted for 29.9%, Shallow and Medium Tube Wells for 15.3%, and Deep Tube Wells for 43.6%. For surface water sources, Surface Flow Irrigation accounted for 11.2%. Anantapur had the least irrigated area with only 110,954 hectares. Groundwater sources irrigated 97.7% of this area, with Dug Wells accounting for 16.8%, Shallow and Medium Tube Wells for 55.5%, and Deep Tube Wells for 25.4%. Surface water sources accounted for the remaining 2.3%. Similar trends were observed in the other two districts.

According to the 5th MIC, a total of 561,080 hectares was irrigated, an increase from the 4th MIC. Groundwater sources contributed 89.1%, while surface water sources accounted for the remaining 10.9%. Within groundwater sources, Dug Wells irrigated 8.9% of the total area, Shallow and Medium Tube Wells 25.5%, and Deep Tube Wells 54.7%. From surface water sources, Surface Flow Irrigation irrigated 2.5% of the area, and Surface Lift Irrigation 8.4%.

Chittoor, as in the 5th MIC, had the highest irrigated area with 150,633 hectares. Groundwater irrigated 87% of this area, and surface water provided for 13%. Within groundwater sources, Dug Wells irrigated 13.4% of the area, Shallow and Medium Tube Wells 23.8%, and Deep Tube Wells 49.8%. For surface water sources, Surface Flow Irrigation accounted for 13%, and Surface Lift Irrigation for 0%. Anantapur had the least irrigated area with 128,621 hectares, with groundwater contributing 94.5% and surface water 5.5%. Deep Tube Wells irrigated 67.9% of the area, Shallow and Medium Tube Wells 25%, and Dug Wells 1.5%. The remaining 5.5% was irrigated by Surface Flow Irrigation. Groundwater continues to be the major source of irrigation in all four districts in the Rayalaseema region.

Table 5: District-wise Area Irrigated across Sources under Minor Irrigation

Districts	Dug Wells	Shallow and Medium Tube wells	Deep tube wells	**Total Ground Water**	Surface Flow Irrigation	Surface Lift Irrigation	**Total Surface Water**	**Total**
4th MIC								
Y.S.R Kadapa	7.5	23.8	63.7	**95.0**	4.0	0.9	**4.9**	100(121861)
Kurnool	34.8	38.9	10.4	**84.1**	8.9	7.0	**15.9**	100(133280)
Anantapur	16.8	55.5	25.4	**97.7**	2.2	0	**2.2**	100(110954)
Chittoor	29.9	15.3	43.6	**88.8**	11.2	0	**11.2**	100(179724)
Rayalaseema	23.4	31.2	36.3	**90.9**	1.9	7.2	**9.1**	**100(545819)**
5th MIC								
Y.S.R Kadapa	3.2	18.1	73	**94.3**	4.5	1.2	**5.7**	100(148656)
Kurnool	17.4	36.0	26.9	**80.3**	10.6	9.1	**19.7**	100(133170)
Anantapur	1.5	25.0	67.9	**94.5**	5.5	0	**5.5**	100(128621)

Chittoor	13.4	23.8	49.8	**87.0**	13.0	0	**13.0**	100(150633)
Rayalaseema	8.9	25.5	54.7	**89.1**	2.5	8.4	**10.9**	**100(561080)**

Source: AP 4th &5th Minor Irrigation Census Report, Government of AP.
Note: Figures in brackets indicate the IPC in hectares

8. Conclusions

Minor and groundwater irrigation are crucial for agriculture in Rayalaseema. There has been significant growth in minor irrigation in Rayalaseema during the the last two decades. The potential of groundwater irrigation has grown and become the primary source of irrigation in Rayalaseema in recent decades. The number of minor irrigation sources in Rayalaseema has steadily increased. Farmers have shifted to minor irrigation, particularly groundwater irrigation, due to issues with the canal irrigation system, such as its untimely availability. Despite its importance, groundwater irrigation in Rayalaseema is nearing a crisis due to over exploitation, leading to declining water levels, drying shallow wells, and increased energy costs for water extraction. It's crucial to explore diverting surface water through canals or pipes to replenish dried-up tanks in over-exploited areas. Rainwater collection systems like contour bunding, percolation tanks, check dams, and agricultural ponds should be implemented. Artificial recharge structures should be built on a watershed basis to avoid depriving downstream areas. Modern irrigation techniques like drip and sprinkler irrigation should be used to reduce stress on the groundwater system and increase resource availability.

References

Government of Andhra Pradesh : Statistical Abstract of Andhra Pradesh (Various years), Directorate of Economics and Statistics, Hyderabad.

Government of Andhra Pradesh : Statistical Abstract of Andhra Pradesh (Various years), Directorate of Economics and Statistics, Amaravathi.

Anil B. Mandavia (1999) Modernization of Irrigation System Operational Management by way of Canal Automation in India, Benchmark Studies on Modernization, Food and https://www.fao.org/4/x6626e/x6626e06.htm.

Central Ground Water Board (2013) Ground Water Year Book 2013-14 Andhra Pradesh, Ministry of Ware Resources River Development and Ganga Rejuvenation, Government of India.

Chand, S. et all, (2020) "Potential, Adoption and Impact of Micro Irrigation in Indian Agriculture" Policy Paper 36, ICAR-National Institute of Agricultural Economics and Policy Research (NIAP), New Delhi.

Chandrasekhara Rao, M (2006) "Groundwater Depletion in Papagani Catchment" Economic and Political Weekly , Feb. 18-24, 2006, Vol. 41, No. 7.

Dinesh Kumar. M et All (2011), Groundwater Management in Andhra Pradesh: Time to Address Real Issues, Occasional Paper No. 4-0211,February – 2011, Institute for Resource Analysis And Policy, Hyderabad.

Government of India (2006-07), Ministry of Water Resources, 4th Minor Irrigation Census.

Government of India (2013-14), Ministry of Water Resources, 5th Minor Irrigation Census.

Government of India (2017-18), Ministry of Water Resources, 6th Minor Irrigation Census.