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Sources of irrigation in the state of Uttar Pradesh: A regional analysis

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Abstract

Agriculture is the primary occupation in India which supports by irrigation facilities. Irrigation sources are not even everywhere in the state of Uttar Pradesh. It has variations in terms of plenty of water supply and many parts of the state are facing scarcity. Assured irrigation plays important role in increasing the yield of any area. After the introduction of new agricultural technology within Uttar Pradesh has resulted in the advancement in the use of NPK fertilizers, insecticides, weedicides which has raised the demand for water supply for growing crops. However, overuse of groundwater has led to a significant drop in the water table in the state. The present paper has discussed the sources of irrigation such as canal irrigation, tubewell irrigation, etc. in the state of Uttar Pradesh by taking average values during the period from 1996-2000 and 2001-2005 and also highlighted the regional variations in the district of Uttar Pradesh.

Keywords: Agriculture, Technology, Irrigation, Water Supply, Ground Water.

1. Introduction

Water is an important input for successful agriculture. Water may be available to crops by rainfall, and it can also supply to fields through human efforts. The process of supplying water to crops by means of canals, well, tube-wells, tanks, ponds or tapping water from underground sources. Irrigation has been one of the most important factors which in increasing agricultural production, as the propagation green revolution technology was entirely dependent upon it. It is realized that assured and controlled water supply is an essential requirement for achieving the full potentials of high-yielding varieties (HYV) of seeds. It is estimated that, more than five tonnes of water is needed to grow one kilogram of rice. B.D. Dhawan (1980) has illustrated that the vast Gangetic basin of Eastern Uttar Pradesh is well known for its abundance of water resources, both surface water and ground water. New agricultural technology has increased groundwater irrigation many fold, with advancement in well-established canal irrigation system (Sivanappan, 1995).

2. Objectives

1. To categorize the state in into very high, high, medium, low and very low categories.
2. To highlight the areas to be focuss on.
3. To draw attention and suggest suitable measures for the purpose to improve weaker districts of the state.

3. Material and Methods

Present paper has discussed about the changing irrigation pattern during 1996 to 2000 and 2001 to 2005. It has been carefully tabulated for 10 year huge data, is divided into two periods of time from 1996-2000 and from 2001-2005 by taking average values. Final values have been calculated on the basis of percentage method. Present paper is based on secondary sources of data. Data were obtained from the Directorate of Agricultural Statistics and Crop Insurance (Krishi Bhawan), Lucknow, U.P.

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4. Results and Discussion

(a) Net irrigated area

Intensity of irrigation can be considered in terms of percentage share of net irrigated area to the net cropped area. The extent of net irrigated area shows an increase of 77.81 per cent during the period of 2001-05 as compared to 1996-2000 which was 77.19 per cent in the state. The highest intensity of irrigation is seen in the district of Hathras which has 97.35 per cent irrigated area and the lowest intensity of irrigation found in the district of Sonbhadra which has 24.81 per cent net irrigated area. The districts of the state were categorized for irrigation intensity into five categories of very high, high, medium, and low and very low intensity of irrigation area.

Table.1 shows that during 1996-2000 there were 15 districts

of Muzaffarnagar, Baghpat, Gaziabad, Bulandshahar, Aligarh, Mathura, Hathras, Etah, Firozabad, Mainpuri, Kannauj Rampur, Pilibhit, Mau and Chandauli having very high net irrigated area above 87.44 per cent. There were 19 districts of Saharanpur, Meerut, J. P. Nagar, G. B. Nagar, Bareilly, Budaun, Shahjahanpur, Farrukhabad, Agra, Barabanki, Lucknow, Kannauj, Raebareli, Azamgarh Ghazipur, Jaunpur, Pratapgarh, Kaushambi and S. R. Nagar characterized with high net irrigated area with a values in between 76.07 and 87.44 per cent.

Medium intensity of net irrigated area found in 15 districts of Bijnor, Moradabad, Hardoi, Kanpur (urban), Kanpur (rural), Lalitpur, Maharajganj, Kushi Nagar, Basti, S. K. Nagar, Gorakhpur, Deoria, Ballia, Sultanpur and Varanasi which have ranged in between 61.56 and 76.07 per cent.

Table 1: Net irrigated area in Uttar Pradesh - 1996-2000

Category	Index range	No. of districts	Name of the district
Very High	Above 87.44	15	Muzaffarnagar, Baghpat, Gaziabad, Bulandshahar, Aligarh, Mathura, Hathras, Etah, Firozabad, Mainpuri, Kannauj Rampur, Pilibhit, Mau and Chandauli
High	76.07- 87.44	19	Saharanpur, Meerut, J. P. Nagar, G. B. Nagar, Bareilly, Budaun, Shahjahanpur, Farrukhabad, Agra, Barabanki, Lucknow, Kannauj, Raebareli, Azamgarh Ghazipur, Jaunpur, Pratapgarh, Kaushambi and S. R. Nagar
Medium	61.56 - 76.07	15	Bijnor, Moradabad, Hardoi, Kanpur (urban), Kanpur (rural), Lalitpur, Maharajganj, Kushi Nagar, Basti, S. K. Nagar, Gorakhpur, Deoria, Ballia, Sultanpur and Varanasi
Low	31.4 - 61.56	15	Kheri, Sitapur, Shrawasti, Balrampur, Siddharthnagar, Goada, Faizabad, Etawah, Jalaun, Jhansi, Mahoba, Fatehpur, Banda, Allahabad and Mirzapur
Very Low	Below 31.4	6	Bahraich, Ambedkar Nagar, Auraiya, Hamirpur, Chitrakut and Sonbhadra

Low intensity of net irrigated area shown by 15 districts of Kheri, Sitapur, Shrawasti, Balrampur, Siddharthnagar, Goada, Faizabad, Etawah, Jalaun, Jhansi, Mahoba, Fatehpur, Banda, Allahabad and Mirzapur with ranged in between 31.4 and 61.56 per cent and very low net irrigated area found in the 6 districts of Bahraich, Ambedkar Nagar, Auraiya, Hamirpur, Chitrakut and Sonbhadra have net irrigated area below 31.4 per cent (Fig. 1).

During 2001-2005, Fig. 2 shows that the area under net irrigation has increased. There are 16 districts of

Saharanpur, Muzaffarnagar, Baghpat, Meerut, Ghaziabad, J. P. Nagar, Rampur, Pilibhit, Aligarh, Mathura, Hathras, Etah, Firozabad, Mainpuri, Ambedkar Nagar and Chandauli, characterized with very high area under net irrigation above 91.66 per cent.

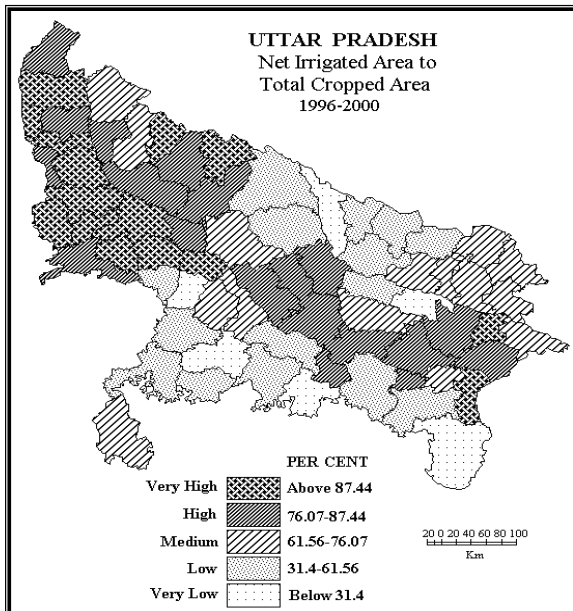
High net irrigated area spread in 14 districts of Bulandshahar, Budaun, Bareilly, Shahjahanpur, Haradai, Kannauj, Barabanki, Lucknow, Unnao, Mau, Azamgarh, Jaunpur, Pratapgarh and Varanasi with a value in between 84.66 and 91.66 per cent.

Table 2: Net Irrigated Area in Uttar Pradesh – 2001-2005

Category	Index range	No. of districts	Name of the district
Very High	Above 91.66	16	Saharanpur, Muzaffarnagar, Baghpat, Meerut, Ghaziabad, J. P. Nagar, Rampur, Pilibhit, Aligarh, Mathura, Hathras, Etah, Firozabad, Mainpuri, Ambedkar Nagar and Chandauli,
High	84.66- 91.66	14	Bulandshahar, Budaun, Bareilly, Shahjahanpur, Hardoi, Kannauj, Barabanki, Lucknow, Unnao, Mau, Azamgarh, Jaunpur, Pratapgarh and Varanasi
Medium	71.67 - 84.66	22	Bijnor, Moradabad, Kheri, Sitapur, Farrukhabad, Agra, Etawah, Auraiya, Kanpur (rural), Lalitpur, Faizabad, Sultanpur, Raebareli, Maharajganj, Kushi Nagar, S. K. Nagar, Gorakhpur, Deoria, Mau, Ghazipur, S. R. Nagar and Allahabad.
Low	48.94 - 71.67	11	Bahraich, Siddharth Nagar, Gonda, Basti, G. B. Nagar, Jalaun, Jhansi, Kanpur (urban), Fatehpur, Khushambi and Mirzapur
Very Low	Below 48.94	7	Shrawasti, Balrampur, Hamirpur, Mahoba, Banda, Chitrakut and Sonbhadra

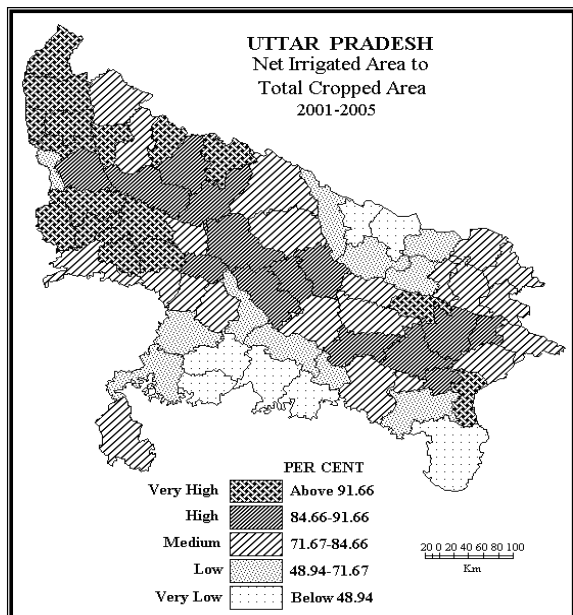
There were 22 districts of Bijnor, Moradabad, Kheri, Sitapur, Farrukhabad, Agra, Etawah, Auraiya, Kanpur (rural), Lalitpur, Faizabad, Sultanpur, Raebareli, Maharajganj, Kushi Nagar, S. K. Nagar, Gorakhpur, Deoria, Mau, Ghazipur, S. R. Nagar and Allahabad characterized with medium area under net irrigation with a value ranged in between 71.67 and 84.66 per cent. Low net irrigated area

with a value in between 48.94 and 71.67 per cent demarcated 11 districts namely Bahraich, Siddharth Nagar, Gonda, Basti, G. B. Nagar, Jalaun, Jhansi, Kanpur (urban), Fatehpur, Khushambi and Mirzapur and very low net irrigated area found in 7 districts of Shrawasti, Balrampur, Hamirpur, Mahoba, Banda, Chitrakut and Sonbhadra with a value below 48.94 per cent.



Source: Prepared by Author

Fig 1: Uttar Pradesh Net irrigated area to total cropped area 1996-2000



Source: Prepared by Author

Fig 2: Uttar Pradesh Net irrigated area to total cropped area 2001-2005

(b) Area under canal irrigation

Canals constitute an important source of irrigation in the state of Uttar Pradesh. The state is drained by perennial rivers originating in the snow covered Himalayan ranges and is blessed with fertile soils. Following are the main canals.

- i) Upper Ganga Canal
- ii) Lower Ganga Canal
- iii) Sharda Canal
- iv) Eastern Yamuna Canal
- v) Agra Canal
- vi) Betwa Canal.

(i) Upper Ganga canal

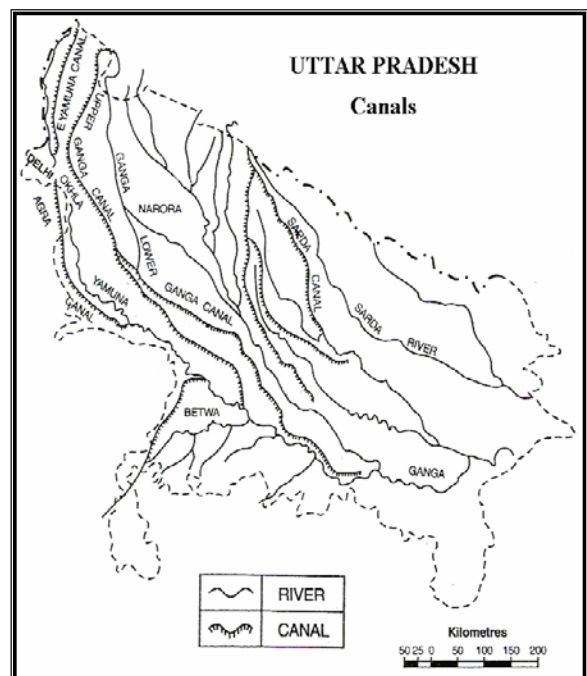
This Canal takes off from the Ganga river at Kankhal (Haridwar). The construction of the canal commenced in

1842 and completed in 1854 during the british period. Main canal is 342 km long, while the length of its distributaries is about 6,200 Km. It irrigates about 7 lakh hectares of land in the upper part of the Ganga-Yamuna doab. Districts of Saharanpur, Meerut, Gaziabad, Bulandshahar, Agra, Mathura, Etah, Kanpur, Mainpuri, Farrukhabad and Fatehpur get benefited from the canal.

Its main branches are namely, Devbandh Anupshahar, Motta and Hathras. It joins with the Lower Ganga canal at Mainpuri from where the quantity of water in canal is considerably increased.

(ii) Lower Ganga canal

This canal was taken from the river Ganga near Narora (Bulandshahar) in 1878. The length of canal including its distributaries is about 6000 Km. Its main branches are known by the names of Etawah, Kanpur, and Fatehpur. It irrigates about 4.6 lakh hectares of agricultural lands in the districts of Bulandshahar, Farrukhbad Mainpuri, Aligarh, Etah, Etawah, Fatehpur, Kanpur and Allahabad.



Source: Khullar, D.R. (2006), India: A Comprehensive Geography, p.505

Fig 3: Uttar Pradesh canals

(iii) Sharda canal

This canal is taken from the Sharda river at Banbasa near the Indo-Nepal border. The construction work on this canal was completed in 1928. The total length of the main canal and its distributaries is 13, 624 Km. It is thus one of the longest canal systems of the world, and this system irrigates about 8 lakh hectares of land, mainly in the districts of Allahabad, Sultanput, Pilibhit, Bareilly, Hardoi, Shajahanpur, Sitapur, Lucknow, Barabanki, Raebareli, Unnao, Pratapgarh, and Kheri.

(iv) Eastern Yamuna canal

It takes off from the river Yamuna at Faizabad. It was constructed in 1831. the main canal and its distributaries cover a distance of 1,450 Km and irrigate about 2 lakh hectares of land in the districts of Saharanpur, Mazaffarnagar, Meerut and Ghaziabad. It again joins the

Yamuna river at Delhi, and irrigates a part of the Union Territory also.

(v) Agra canal

This canal is taken from the right bank of the Yamuna river at Okhla (Delhi). It was built in 1874 and irrigates about 1.5 lakh hectares in the districts of Agra and Mathura in U.P., Faridabad in Haryana state, Bharatpur in Rajasthan and some parts of Union Territory of Delhi.

(vi) Betwa canal

Built during the Third Five Year Plan, this canal takes off from the Betwa river about 56 Km southwest of Jhansi. It irrigates about 1.2 lakh hectares in Jhansi, Jalaun and

Hamirpur districts.

Apart from the above major canals, some other canals such as Ken, Chambal, Dhasan and Son also irrigate some areas in the southern parts of the state of Uttar Pradesh.

Area under canal irrigation in the state has declined from 25.15 per cent during 1996-2000 to 20.68 per cent during 2001-2005. During 1996-2000, there were only 5 districts of Jalaun, Banda, Chandauli, Mirzapur and Sonbhadra characterized with very high area under canal irrigation above 55.45 per cent. High percentage of area under canal irrigation in between 37.7 and 55.45 per cent is found in 12 districts of Mathura, Etawah, Kanpur (rural), Kanpur (urban), Jhansi, Hamirpur, Mahoba, Barabanki, Raebareli, Pratapgarh, Allahabad, and Varanasi.

Table 3: Canal Irrigated Area in Uttar Pradesh – 1996-2000

Category	Index range	No. of districts	Name of the district
Very High	Above 55.45	5	Jalaun, Banda, Chandauli, Mirzapur and Sonbhadra.
High	37.7 - 55.45	12	Mathura, Etawah, Kanpur (rural), Kanpur (urban), Jhansi, Hamirpur, Mahoba, Barabanki, Raebareli, Pratapgarh, Allahabad, and Varanasi.
Medium	22.21 - 37.7	16	Saharanpur, Muzaffarnagar, Pilibhit, Mainpuri, Auraiya, Lalitpur, Lucknow, Unnao, Fatehpur, Chitrakut, Maharajganj, Khushi Nagar, Sultanpur, Jaunpur, Ballia and Ghazipur.
Low	8.9 - 22.21	20	Baghpat, Meerut, Ghaziabad, G. B. Nagar, Bulandshahar, Aligarh, Hathras, Etah, Agra, Firozabad, Bareilly, Sitapur, Hardoi, Deoria Faizabad, Ambedkar Nagar, Azamgarh, Mau, Kashambi and S. R. Nagar
Very Low	Below 8.9	17	Bijnor, J. P. Nagar, Moradabad, Rampur, Badaun, Farrukhabad, Kannauj, Shahjahanpur, Kheri, Bahraich, Shrawasti, Balrampur Siddharth Nagar, Gonda, Basti, S. K. Nagar, and Gorakhpur

Medium percentage of area under canal irrigation ranged in between 22.21 and 37.7 per cent was marked in 16 districts of Saharanpur, Muzaffarnagar, Pilibhit, Mainpuri, Auraiya, Lalitpur, Lucknow, Unnao, Fatehpur, Chitrakut, Maharajganj, Khushi Nagar, Sultanpur, Jaunpur, Ballia and Ghazipur. There were 20 districts in which low percentage of irrigated area under canals ranged in between 8.9 and 22.21 per cent were namely, Baghpat, Meerut, Ghaziabad, G. B. Nagar, Bulandshahar, Aligarh, Hathras, Etah, Agra, Firozabad, Bareilly, Sitapur, Hardoi, Deoria Faizabad, Ambedkar Nagar, Azamgarh, Mau Kashambi and S. R. Nagar, and 17 other districts characterized with very low percentage of area under canal irrigation below 8.9 per cent were namely, Bijnor, J. P. Nagar, Moradabad, Rampur, Badaun, Farrukhabad, Kannauj, Shahjahanpur, Kheri,

Bahraich, Shrawasti, Balrampur Siddharth Nagar, Gonda, Basti, S. K. Nagar and Gorakhpur.

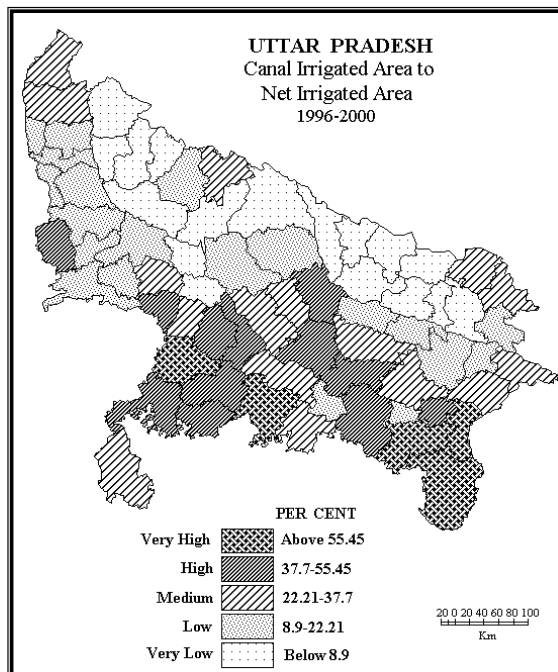
During the period 2001-2005, irrigated area under canals further declined. Very high percentage of irrigated area above 49.9 per cent under canals was found in the districts of Jalaun, Banda, Allahabad, Mirzapur Chandauli and Sonbhadra, and the districts of Mathura, Etawah, Kannauj, Kanpur (rural), Hamirpur, Jhansi, Kushi Nagar, Barabanki, Raebareli, Pratapgarh, and Chitrakut marked with irrigated area under canals ranged in between 32.3 and 49.9 per cent. Medium irrigated area under canals in between 19.67 and 32.3 per cent was shown by 13 districts of Muzaffarnagar, Pilibhit, Mainpuri, Lucknow, Unnao, Kanpur (urban), Fatehpur, Mahoba, Lalitpur, Sultanpur, Jaunpur, Azamgarh and Ghazipur.

Table 4: Canal Irrigated Area in Uttar Pradesh –2001-2005

Category	Index range	No. of districts	Name of the district
Very High	Above 49.9	6	Jalaun, Banda, Allahabad, Mirzapur Chandauli and Sonbhadra
High	32.3 - 49.9	11	Mathura, Etawah, Kannauj, Kanpur (rural), Hamirpur, Jhansi, Kushi Nagar, Barabanki, Raebareli, Pratapgarh, and Chitrakut
Medium	19.67- 32.3	13	Muzaffarnagar, Pilibhit, Mainpuri, Lucknow, Unnao, Kanpur (urban), Fatehpur, Mahoba, Lalitpur, Sultanpur, Jaunpur, Azamgarh and Ghazipur.
Low	7.97 - 19.67	24	Saharanpur, Meerut, Ghaziabad, G. B. Nagar, Bulandshahr, Aligarh, Hathras, Etah, Agra, Firozabad, Bareilly, Sitapur, Hardoi, Kannauj, Siddharthanagar, Maharajganj, Deoria, Faizabad, Ambedkar Nagar, Mau, Ballia Varanasi, S. R. Nagar and Kaushambi
Very Low	Below 7.97	16	Baghpat, Bijnor, J. P. Nagar, Moradabad, Rampur, Budaun, Shahjahanpur, Farrukhabad, Kheri, Bahraich, Shrawasti, Balrampur, Gonda Basti, S. K. Nagar and Gorakhpur

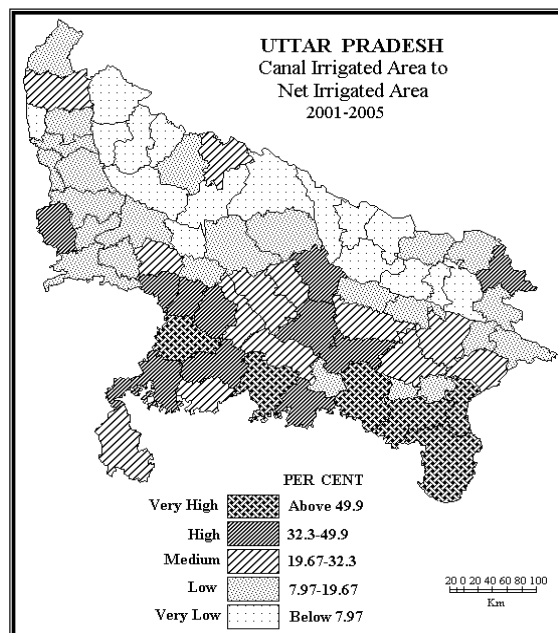
There were 24 districts characterized with low percentage of irrigated area in between 7.97 and 19.67 per cent were namely, Saharanpur, Meerut, Ghaziabad, G. B. Nagar, Bulandshahr, Aligarh, Hathras, Etah, Agra, Firozabad, Bareilly, Sitapur, Hardoi, Kannauj, Siddharthanagar, Maharajganj, Deoria, Faizabad, Ambedkar Nagar, Mau,

Ballia Varanasi, S. R. Nagar and Kaushambi and the districts of Baghpat, Bijnor, J. P. Nagar, Moradabad, Rampur, Budaun, Shahjahanpur, Farrukhabad, Kheri, Bahraich, Shrawasti, Balrampur, Gonda Basti, S. K. Nagar and Gorakhpur were having very low, irrigated area under canals below 7.97 per cent.



Source: Prepared by Author

Fig 4: Uttar Pradesh canal irrigated area to Net irrigated area 1996-2001



Source: Prepared by Author

Fig 5: Uttar Pradesh canal irrigated area to Net irrigated area 2001-2005

Table 5: Area under Sources of Irrigation in Uttar Pradesh-1996-2000 and 2001-2005

Name of district	Net Irrigated Area		Area under Canal Irrigation		Area under Tube-Well Irrigation		Area under Other Sources irrigation	
	1996-2000	2001-05	1996-2000	2001-05	1996-2000	2001-05	1996-2000	2001-05
Saharanpur	86.45	91.66	27.16	18.68	72.78	81.29	0.01	0.02
Muzaffarnagar	94.56	97.89	29.99	24.77	69.96	75.10	0.02	0.01
Meerut	81.33	94.51	21.49	19.45	81.97	93.81	0.01	0.02
Bagpat	96.72	96.25	10.66	6.14	78.10	80.46	0.08	0.08
Bulandshahar	89.26	89.16	15.22	12.21	76.19	67.68	0.26	0.05
Ghaziabad	95.98	92.86	17.75	15.33	89.40	65.96	1.15	4.57
G. B. Nagar	87.41	71.57	14.23	12.86	82.43	94.59	0.13	0.07
Aligarh	96.71	98.11	14.96	11.03	90.92	91.11	1.16	0.59
Hatharas	97.35	99.02	8.9	9.3	72.72	80.82	9.01	4.09
Mathura	93.36	98.09	41.38	38.74	73.60	68.20	0.07	0.60
Agra	79.07	84.08	16.05	10.41	91.33	92.63	0.09	0.07
Firozabad	91.94	96.51	12.88	10.54	83.22	85.93	6.39	0.31
Mainpuri	94.68	97.73	29.67	26.31	82.10	86.47	6.91	0.64

Etah	88.35	95.02	15.67	11.85	90.91	88.84	4.83	4.28
Bareilly	84.23	89.94	15.27	13.34	77.99	85.05	10.08	5.38
Budaun	85.46	90.5	0.06	0.02	69.42	75.53	8.07	7.46
Shahjahanpur	84.97	88.27	5.87	5.09	66.16	78.16	4.12	2.34
Pilibhit	90.24	96.43	25.82	23.54	42.43	52.26	0.90	1.78
Bijnor	74.97	82.87	2.2	3.67	80.08	82.28	1.23	0.06

Table 5: (contd.)

Moradabad	67.33	84.03	5.33	3.79	77.70	79.68	0.00	0.03
J. P. Nagar	87.08	95.04	0.05	0	75.82	76.65	0.49	0.01
Rampur	87.44	93.6	4.88	1.4	7.25	12.75	0.32	1.97
Farrukhabad	82.1	82.28	6.15	2.74	8.72	0.30	6.85	7.43
Kannauj	89.27	90.52	6.5	10.86	19.08	21.29	3.00	8.38
Etawah	54.56	81.98	54.94	49.6	43.43	45.71	1.34	2.21
Auraiya	0	81.44	30.69	43.76	15.63	25.57	16.99	19.48
Kanpur (urban)	73.73	68.54	37.7	24.01	18.45	25.84	6.11	4.79
Kanpur (rural)	66.44	73.29	52.92	40.44	0.81	1.41	19.66	19.95
Fatehpur	61.08	64.06	29.97	22.73	3.84	4.15	7.99	7.93
Allahabad	61.52	71.67	54.24	49.9	13.97	17.33	1.25	2.14
Kaushambi	82.97	68.99	10.91	16.1	48.71	55.97	0.13	0.22
Pratapgarh	78.11	85.76	42.91	43.25	44.15	49.98	0.19	0.20
Jhansi	48.11	61.26	48.3	42.71	81.43	88.44	0.63	0.33
Lalitpur	66.51	80.13	33.27	32.17	58.32	61.18	0.20	0.05
Jalaun	45.21	53.24	80.47	74.42	84.03	88.71	0.08	0.04
Hamirpur	25.43	33.66	46.1	34.71	49.60	45.72	15.65	0.61
Mahoba	49.76	44.11	43.66	30.26	86.89	88.04	0.27	0.09
Banda	31.4	34.28	67.87	62.43	90.18	94.43	3.51	1.08
Chitrakut	25.09	27.59	32.94	34.55	92.67	85.97	3.19	0.67
Varanasi	72.92	84.66	46.48	11.48	84.14	97.81	10.41	1.17
Chandauli	89.2	92.84	55.45	84.25	87.22	85.72	0.06	0.02
Ghazipur	76.97	82.91	23.57	23.14	82.69	80.14	0.06	0.10
Jaunpur	77.7	86.76	27.75	27.94	52.33	86.24	0.54	0.13
Mirzapur	59.48	56.51	74.87	63.11	81.75	80.15	0.22	0.03
Sonbhadra	24.81	24.06	82.57	85.95	69.86	71.99	2.38	0.05
S. R. Nagar	76.07	79.75	10.53	18.85	64.70	72.28	0.09	0.06
Azamgarh	83.06	90.35	17.09	19.67	56.87	56.62	0.05	0.08

Table 5: (contd.)

Mau	88.52	88.13	12.69	11.64	80.57	83.64	0.08	0.17
Ballia	71.35	78.1	22.21	17.25	84.93	97.79	12.52	0.44
Gorakhpur	74.57	80.37	5.4	3.65	84.92	84.01	0.07	0.12
Maharajganj	71.34	79.89	29.43	18.04	55.84	67.26	0.35	0.10
Deoria	61.56	84.42	18.09	13.29	49.33	53.75	0.28	0.06
Kushi Nagar	66.65	74.85	31.82	36	68.97	76.80	0.67	0.43
Basti	65.15	63.19	2.94	0	32.02	35.94	4.70	4.58
Siddharth Nagar	55.32	66.05	5.37	15.97	71.78	85.58	12.01	0.75
S. K. Nagar	66.51	83.05	1.6	2.3	80.01	82.32	0.53	0.22
Lucknow	82.82	89.41	27.84	20.55	71.33	78.86	0.66	0.32
Unnao	82.83	89.53	33.92	25.69	64.25	73.29	1.70	0.44
Raebareli	80.86	84.65	50.3	46.18	60.89	74.93	0.92	0.30
Sitapur	54.64	78.03	15.28	7.97	46.60	58.96	0.36	0.10
Hardoi	76.02	87.93	18.44	16.35	90.71	92.88	0.49	0.08
Kheri	59.24	77.66	8.27	6.68	88.21	88.54	0.24	0.08
Faizabad	46.98	84.34	14.99	15.8	66.68	73.65	0.17	0.01
Ambedkar Nagar	0	94.08	12.73	14.27	87.10	89.05	0.03	0.05
Sultanpur	72.46	80.64	35.11	27.62	85.15	90.68	0.00	0.00
Barabanki	78.86	88.31	42.39	32.3	72.82	60.69	1.85	2.15
Gonda	51.65	67.7	0.98	0.81	91.91	88.47	8.01	3.59
Balrampur	37.42	37.8	5.96	6.16	79.43	81.39	3.37	0.48
Bahraich	28.05	48.94	5.58	5.06	67.03	78.05	2.52	0.01
Shravasti	55.12	39.74	0.44	1.01	1.58	10.90	27.73	22.85
Uttar Pradesh	70.19	77.81	25.15	20.68	67.79	71.57	3.13	1.70

Source: Data obtained from the Directorate of Agriculture, U.P., Lucknow

(c) Area under tube-well irrigation

Well is a hole dug in the ground to obtain subsoil water. Tube-well irrigation is most important among the sources of

irrigation. Intensity of irrigation through tube-well has exceeded from 67.79 per cent during 1996-2000 to 71.57 per cent during 2001-2005 in the state. (Fig. 6.)

Table 6: Tube-well Irrigated Area in Uttar Pradesh –1996-2000

Category	Index range	No. of districts	Name of the district
Very High	Above 85.15	13	Moradabad, Rampur, Badaun, Hathras, Firozabad, Farrukhabad, Kannauj, Kheri Shrawasti, S. K. Nagar, Gorakhpur, Ambedkar Nagar and Mau
High	73.6 - 85.15	21	Baghpat, Meerut, Bijnor, J. P. Nagar, Bulandshahar, Aligarh, Agra, Pilibhit, Shahjahanpur, Hardoi, Bahraich, Balrampur, Gonda, Basti, Deoria, Faizabad, Azamgarh, Ballia, Ghazipur, Kaushambi and S. R. Nagar
Medium	56.87- 73.6	17	Saharanpur, Muzaffarnagar, Ghaziabad, Mathura, Etah, Mainpuri, Bareilly, Sitapur, Lucknow, Unnao, Kanpur (urban), Fatehpur, Siddharth Nagar, Maharajganj, Sultanpur, Pratapgarh and Jaunpur.
Low	19.08 - 56.87	11	G. B. Nagar, Etawah, Auraiya, Kanpur (rural), Hamirpur, Barabanki, Raebareli, Kushi Nagar, Varanasi, Mirzapur and Allahabad
Very Low	Below 19.08	8	Jalaun, Jhansi, Lilitput, Mahoba, Banda, Chitrakut, Chandauli and Sonbhadra.

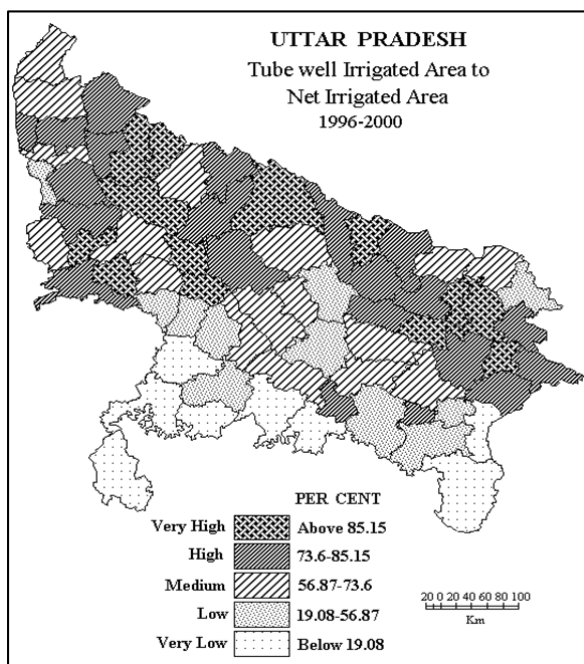
Districtwise variations in tube-well irrigation can be seen from Figs. 6.3 and 6.4. During 1996-2000, there were 13 districts namely, Moradabad, Rampur, Badaun, Hathras, Firozabad, Farrukhabad, Kannauj, Kheri Shrawasti, S. K. Nagar, Gorakhpur, Ambedkar Nagar and Mau in them irrigation was provided above 85.15 per cent with the help of tube wells.

There were 21 other districts of Baghpat, Meerut, Bijnor, J. P. Nagar, Bulandshahar, Aligarh, Agra, Pilibhit, Shahjahanpur, Hardoi, Bahraich, Balrampur, Gonda, Basti,

Deoria, Faizabad, Azamgarh, Ballia, Ghazipur, Kaushambi and S. R. Nagar characterized with high irrigated area under tube well ranged in between 73.6 and 85.15 per cent. Medium irrigated area by tube wells in between 56.87 and 73.6 per cent was found in 17 districts of Saharanpur, Muzaffarnagar, Ghaziabad, Mathura, Etah, Mainpuri, Bareilly, Sitapur, Lucknow, Unnao, Kanpur (urban), Fatehpur, Siddharth Nagar, Maharajganj, Sultanpur, Pratapgarh and Jaunpur.

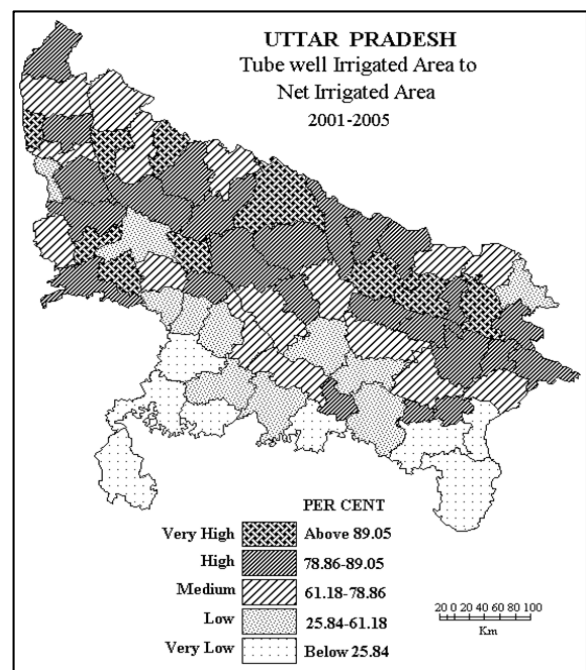
Table 7: Tube-well Irrigated Area in Uttar Pradesh –2001-2005

Category	Index range	No. of districts	Name of the district
Very High	Above 89.05	10	Baghpat, J. P. Nagar, Rampur, Hathras, Kheri, Farrukhabad, Firozabad, Gonda, Basti and Gorakhpur
High	78.86 - 89.05	25	Saharanpur, Meerut, Bulandshahar, Aligarh, Agra, Bareilly, Badaun, Shahjahanpur, Sitapur, Hardoi, Kannauj, Lucknow, Bahraich, Shrawasti, Balrampur, S. K. Nagar, Deoria, Faizabad, Ambedkar Nagar, Azamgarh, Mau, Ballia, Varanasi, S. R. Nagar and Kaushambi.
Medium	61.18 - 78.86	16	Muzaffarnagar, Bijnor, Moradabad, Ghaziabad, Mathura, Pilibhit, Mainpuri Barabanki, Unnao, Kanpur (urban), Fatehpur, Siddharthnagar, Maharajganj, Sultanpur, Jaunpur and Ghazipur.
Low	25.84 - 61.18	11	G. B. Nagar, Etah, Etawah, Aurauja, Kanpur (rural), Haminpur, Banda, Kushi Nagar, Raebareli, Pratapgarh and Allahabad
Very Low	Below 25.84	8	Jalaun, Jhansi, Lalitpur, Mahoba, Chitrakut, Chandauli, Mirzapur and Sonbhadra.



Source: Prepared by Author

Fig 6: Uttar Pradesh Tube well irrigated area to net irrigated area 1996-2000



Source: Prepared by Author

Fig 7: Uttar Pradesh Tube well irrigated area to net irrigated area 2001-2005

As many as 11 districts of G. B. Nagar, Etawah, Auraiya, Kanpur (rural), Hamirpur, Barabanki, Raebareli, Kushi Nagar, Varanasi, Mirzapur and Allahabad marked with low irrigation intensity in tube-well irrigated area, which ranged in between 19.08 and 56.87 per cent. Very low irrigated area under tube-well irrigation below 19.08 per cent was seen in 8 districts of Jalaun, Jhansi, Lalitpur, Mahoba, Banda, Chitrakut, Chandauli and Sonbhadra.

Fig. 7 clearly shows that area under tube-well irrigation increased during 2001-2005. Very high percentage of area under tube-well irrigation with a value above 89.05 per cent was in 10 districts of Baghpat, J. P. Nagar, Rampur, Hathras, Kheri, Farrukhabad, Firozabad, Gonda, Basti and Gorakhpur and a high percentage of tube well irrigated areas in between 78.86 and 89.05 per cent was in 25 districts of Saharanpur, Meerut, Bulandshahar, Aligarh, Agra, Bareilly, Badaun, Shahjahanpur, Sitapur, Hardoi, Kannauj, Lucknow, Bahraich, Shrawasti, Balrampur, S. K. Nagar, Deoria, Faizabad, Ambedkar Nagar, Azamgarh, Mau, Ballia, Varanasi, S. R. Nagar and Kaushambi. Medium irrigation intensity by tube-wells in between 61.18 and 78.86 per cent was marked in 16 districts of Muzaffarnagar, Bijnor, Moradabad, Ghaziabad, Mathura, Pilibhit, Mainpuri Barabanki, Unnao, Kanpur (urban), Fatehpur, Siddharthnagar, Maharajganj, Sultanpur, Jaunpur and Ghazipur.

Low percentage of area under tube-well irrigation in

between 25.84 and 61.18 per cent was for 11 districts of G. B. Nagar, Etah, Etawah, Aurauja, Kanpur (rural), Haminpur, Banda, Kushi Nagar, Raebareli, Pratapgarh and Allahabad and very low percentage below 25.84 per cent for 8 southern districts of the state namely, Jalaun, Jhansi, Lalitpur, Mahoba, Chitrakut, Chandauli, Mirzapur and Sonbhadra.

(d) Area under other sources of irrigation

Irrigation by other sources is provided in crop cultivation where canals and tube-wells do not constitute as the source of irrigation. Other sources which provide irrigation are tanks, lakes, ponds, and other wells. Area under other sources of irrigation in the state declined from 3.13 per cent during (1996-2000) to 1.70 per cent during (2001-2005).

During 1996-2000, very high percentage of area irrigated by other sources above 12.52 per cent was marked in 5 districts of G. B. Nagar, Gonda, Lalitpur, Mahoba and Chitrakut.

High percentage of area under other sources of irrigation in between 6.91 and 12.52 per cent was seen in 8 districts of Bareilly, Budaun, Sitapur, Baraich, Balrampur, Siddharthnagar, Basti, and Jhansi. Medium irrigation intensity under other sources in between 4.12 - 6.91 found in 6 districts of Shahjahanpur, Bahraich, Maharajganj, Hamirpur, Banda and Soubhdra and low in 9 district of Ghaziabad, Bulandshahar, Etah, Unnao, S. K. Nagar, Gorakhpur, Jaunpur, Allahabad and Mirzapur ranged in between 1.34 and 4.12 per cent.

Table 8: Other Sources Irrigated Area in Uttar Pradesh –1996-2000

Category	Index range	No. of districts	Name of the district
Very High	Above 12.52	5	G. B. Nagar, Gonda, Lalitpur, Mahoba and Chitrakut
High	6.91 - 12.52	8	Bareilly, Budaun, Sitapur, Baraich, Balrampur, Siddharthnagar, Basti, and Jhansi
Medium	4.12 - 6.91	6	Shahjahanpur, Bahraich, Maharajganj, Hamirpur, Banda and Soubhdra
Low	1.34 - 4.12	9	Ghaziabad, Bulandshahar, Etah, Unnao, S. K. Nagar, Gorakhpur, Jaunpur, Allahabad and Mirzapur
Very Low	Below 1.34	42	Saharanpur, Muzaffarnagar, Baghpat, Meerut, Bijnor, J. P. Nagar, Moradabad, Rampur, Pilibhit, Kheri, Aligarh Mathura, Hathras, Agra, Firozabad, Mainpuri, Farrukhbad, Hardoi, Kannauj, Auraiya, Etawah, Jalaun, Kanpur (rural), Kanpur (urban), Barabanki, Lucknow, Raebareli, Fatehpur, Kushi Nagar, Faizabad, Ambedkar Nagar, Sultanpur, Pratapgarh, Kaushambi, Deoria, Azamgarh, Mau, Ballia, Ghazipur, Sant Ravidas Nagar, Varanasi and Chandauli.

Very low area below 1.34 per cent under other source irrigation spreads over the 42 districts of Saharanpur, Muzaffarnagar, Baghpat, Meerut, Bijnor, J. P. Nagar, Moradabad, Rampur, Pilibhit, Kheri, Aligarh Mathura, Hathras, Agra, Firozabad, Mainpuri, Farrukhbad, Hardoi, Kannauj, Auraiya, Etawah, Jalaun, Kanpur (rural), Kanpur (urban), Barabanki, Lucknow, Raebareli, Fatehpur, Kushi Nagar, Faizabad, Ambedkar Nagar, Sultanpur, Pratapgarh, Kaushambi, Deoria, Azamgarh, Mau, Ballia, Ghazipur, Sant Ravidas Nagar, Varanasi and Chandauli.

During 2001-2005 as visible from Fig. 9 that only 4 districts having very high area under other sources of irrigation above 8.38 per cent are namely, Mahoba, Lalitpur, Chitrakut and Mirzapur; area belonging to high category in between 5.38 and 8.38 per cent was seen in 4 districts of Balrampur, Siddharthnagar, Jhansi, and Sonbhadra having area in medium category in between 2.34 and 5.38 per cent in 7 districts of Moradabad, Bareilly, Badaun, Bahraich, Maharajganj, Hamirpur and Banda, Low area in between 0.75 and 2.24 per cent in 8 districts of Etah, Jalaun, Sitapur, Kushi Nagar, Basti, Gorakhpur, Allahabad and Chandauli.

Table 9: Other Sources Irrigated Area in Uttar Pradesh –2001-2005

Category	Index range	No. of districts	Name of the district
Very High	Above 8.38	4	Mahoba, Lalitpur, Chitrakut and Mirzapur.
High	5.38 - 8.38	4	Balrampur, Siddharthnagar, Jhansi, and Sonbhadra
Medium	2.34 - 5.38	7	Moradabad, Bareilly, Badaun, Bahraich, Maharajganj, Hamirpur and Banda
Low	0.75 - 2.24	8	Etah, Jalaun, Sitapur, Kushi Nagar, Basti, Gorakhpur, Allahabad and Chandauli
Very Low	Below 0.75	47	Saharanpur, Muzaffarnagar, Bijnor, Baghpat, Meerut, J. P. Nagar, Ghaziabad, G. B. Nagar, Bulandshahar, Aligarh, Mathura, Hathras, Agra, Firozabad, Mainpuri, Farrukhabad, Etawah, Kannauj, Aurauja, Rampur, Pilibhit Shahjahanpur, Kheri, Bahraich, Hardoi, Barabanki, Lucknow, Unnao, Kanpur (rural), Kanpur (urban), Gonda, S. K. Nagar, Deoria, Faizabad, Ambedkar Nagar, Azamgarh, Mau, Ballia, Sultanpur, Jaunpur, Ghazipur, Raebareli, Fatehpur, Pratapgarh, Kaushambi, Sant Ravidas Nagar and Varanasi

Very low area under other source of irrigation below 0.75 per cent which cover more than half of the districts is found in 47 districts of Saharanpur, Muzaffarnagar, Bijnor, Baghpat, Meerut, J. P. Nagar, Ghaziabad, G. B. Nagar, Bulandshahar, Aligarh,

Pratapgarh, Kaushambi, Sant Ravidas Nagar and Varanasi which covered more than half of the districts of the state.

4. Conclusion

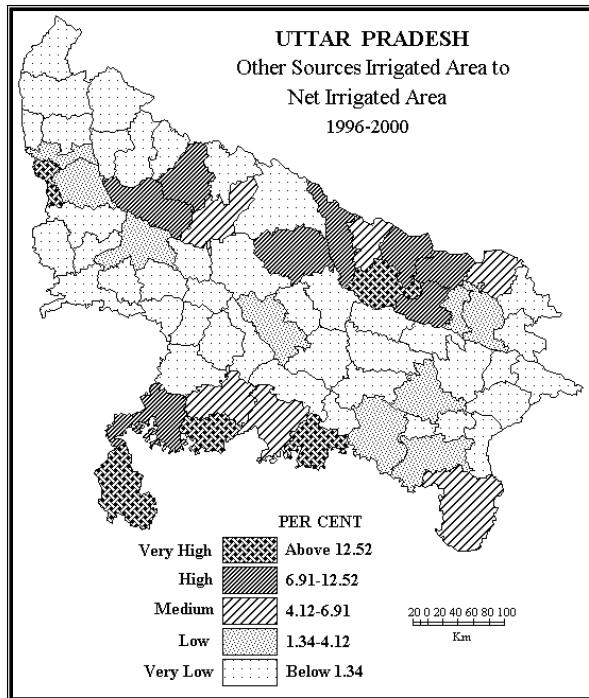
Present paper has discussed area under canal irrigation, area under tubwell irrigation and area under other source irrigation during 1996-2000 and 2001-2005 with respect to the net irrigated area. Western Uttar Pradesh has high availability of water for irrigation than Eastern Uttar Pradesh. Area under canal irrigation is marked high in the district of Jalaun, Banda, Chandauli, Mirzapur, Sonbhadra, Mathura, Etawah, Kanpur (rural), Kanpur (urban), Jhansi, Hamirpur, Mahoba, Barabanki, Raebareli, Pratapgarh, Allahabad, and Varanasi and Tube-well irrigation in Baghpat, J. P. Nagar, Rampur, Hathras, Kheri, Farrukhabad, Firozabad, Gonda, Basti, Gorakhpur Saharanpur, Meerut, Bulandshahar, Aligarh, Agra, Bareilly, Badaun, Shahjahanpur, Sitapur, Hardoi, Kannauj, Lucknow, Bahraich, Shrawasti, Balrampur, S. K. Nagar, Deoria, Faizabad, Ambedkar Nagar, Azamgarh, Mau, Ballia, Varanasi, S. R. Nagar and Kaushambi. It has been clear from above discussion that the districts of Bahraich, Siddharth Nagar, Gonda, Basti, G. B. Nagar, Jalaun, Jhansi Kanpur (urban), Fatehpur, Khushambi, Mirzapur Shrawasti, Balrampur, Hamirpur, Mahoba, Banda, Chitrakut and Sonbhadra needs attention to improve irrigation facilities.

5. Suggestions

- Government should take step to provide continuous electricity supply in rural areas for exploitation of groundwater irrigation in Eastern Uttar Pradesh.
- Groundwater recharge through rain water harvesting would help the farmers to grow their crops timely.
- Dry farming techniques in low rainfall and water scarcity areas can avert the ill effects of droughts.
- Area under irrigation should be expended can greatly increase agricultural productivity.
- The government should introduced some policies and programmes for the proper management and conservation of water resources in weaker districts of the state Uttar Pradesh.

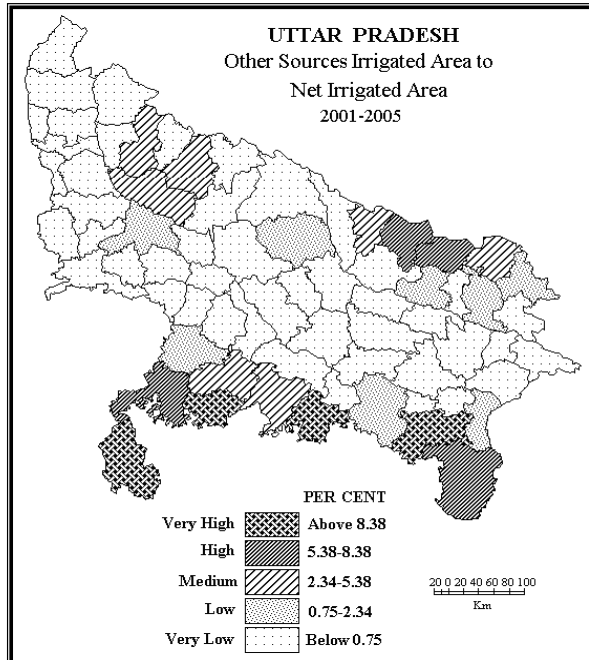
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Source: Prepared by Author

Fig 8: Uttar Pradesh other sources irrigated area to net irrigated area 1996-2000



Source: Prepared by Author

Fig 9: Uttar Pradesh other sources irrigated area to net irrigated area 2001-2005

Mathura, Hathras, Agra, Firozabad, Mainpuri, Farrukhabad, Etawah, Kannauj, Aurauja, Rampur, Pilibhit Shahjahanpur, Kheri, Bahraich, Hardoi, Barabanki, Lucknow, Unnao, Kanpur (rural), Kanpur (urban), Gonda, S. K. Nagar, Deoria, Faizabad, Ambedkar Nagar, Azamgarh, Mau, Ballia, Sultanpur, Jaunpur, Ghazipur, Raebareli, Fatehpur,

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