



Existing Patterns of Irrigation in Rajasthan: 2014-15

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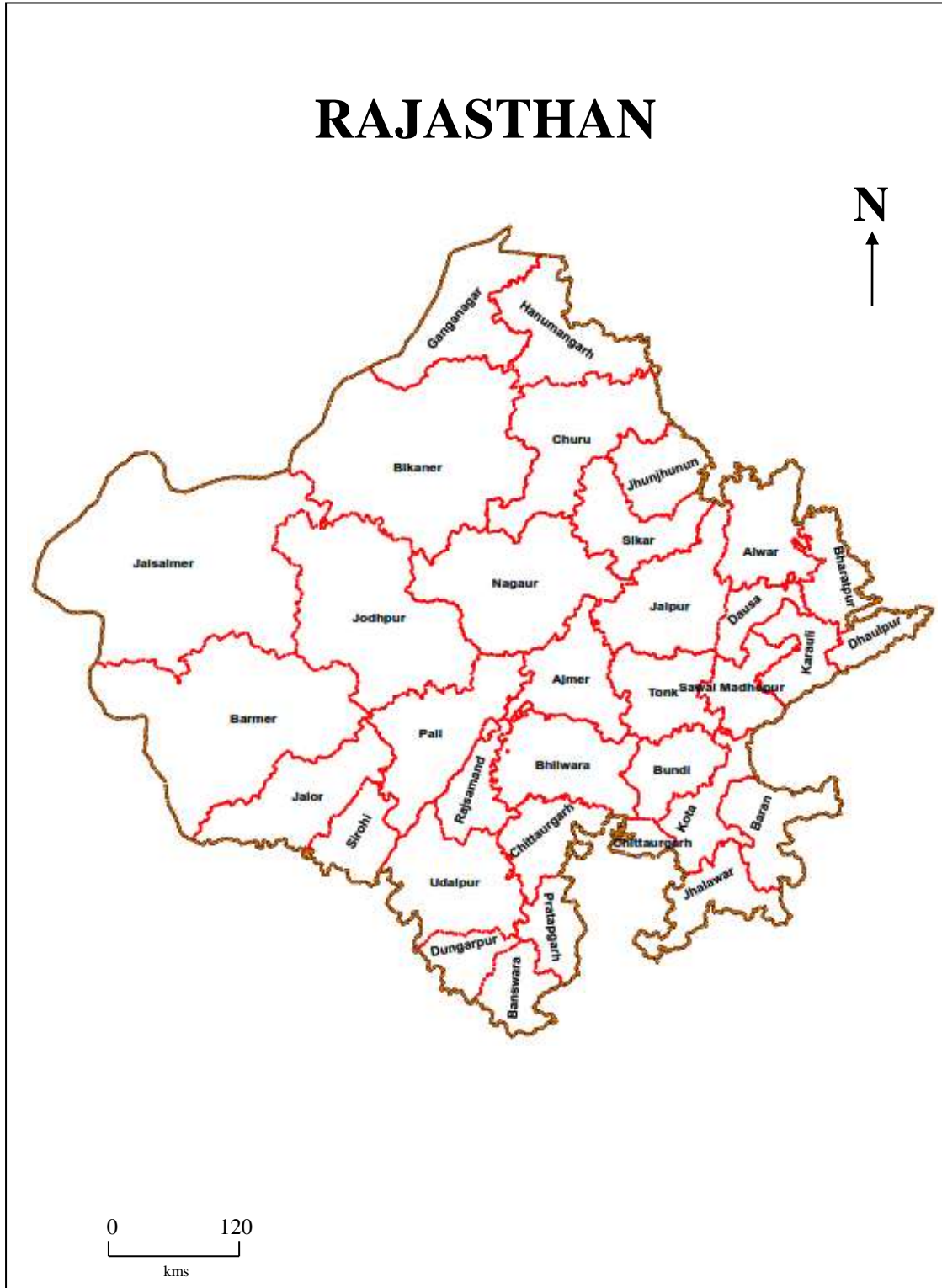
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Introduction

From time immemorial, irrigation has been practised in India and even mention of irrigation is in Vedas also. In India rainfall is erratic and peculiar in nature, thus for agricultural development irrigation is of vital significance (Dubey, 1991). Its importance become more vital, if co-efficient of variability in annual rainfall exceeds 20 percent and developed irrigation becomes a pre-requisite for successful crop farming (Williamsons, 1926). Irrigation is also basic input in agricultural transformation, because it works as sparking factor in extension of net sown area, use of farm machinery and chemical fertilizers, adoption of HYV seeds, to increase crop intensity as well as yield per hectare etc (Kumar, (1947) Irrigation plays significant role in agricultural development and can be assessed quantitatively as well as qualitatively (Sohal, 2003). The introduction of tube wells irrigation have led to increase in expansion of net sown area, intensity of agricultural land-use and also helped to introduce high yielding varieties of crops in India (Giri et. al, 1966). Developed irrigation has played an important role in increasing agricultural productivity in many areas in India (Anderson, 1982). In our country, rainfall is highly concentrated to few months of monsoons and irregular in nature also, thus, there is dire need to fulfill the water requirements of crops through artificial means of water (Cantor, 1967 and Sharma, 1997). Irrigation is an artificial application of water to overcome the deficiency of rainfall for growing of crops (Gurjar, 1987) Even developed irrigation in an agrarian system has become a synonym of agricultural development particularly in a country like India (Chauhan,

1991). In Rajasthan, irrigation becomes imperative for successful crop farming, because major areas are having low or erratic rainfall and frequently occurrences of drought. The study region receives irrigation water from various sources like groundwater, sub-soils water, rivers, tanks, etc. (<https://www.cdc.gov/healthywater/other/agricultural/types.html>).

Fig.1



**Source: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.**

Study area (Fig.1)

Rajasthan is the largest state of india, covering 3,42,274 sq km area. Its latitudinal and longitudinal extent lies between 23°3' N to 30°12' N and 69°30' E and 78°17' E respectively. Its neighboring states are Punjab, Haryana, Uttar Pradesh, Madhya Pradesh and Gujarat. It forms international boundary with Pakistan in the west. The average annual rainfall of Rajasthan is 52cms. Its maximum temperature is of 53°C at Ganganagar during summers and minimum temperature of 4°C in winters at Churu. Its topography varies from sandy to rocky and varieties of soils are found. According to 2011 census, the average density of population is 200 persons per sq km. For administrative purposes, there are 33 districts.

Objectives

The study has the following two objectives;

1. To explain the spatial patterns of main sources of irrigation.
2. To highlight the spatial variations in extent of irrigation.

Methodology and Sources of Data

The study is empirical in nature and based on secondary data which is collected from various sources like Lal kitabs, Directorate of Agriculture, Rajasthan, various libraries, etc. Unit of study is district. Simple statistical method is used for deriving the results and cartographic technique is applied for mapping the results.

Discussion:

The study is divided into two parts:

- A. Sources of irrigation.
- B. Extent of irrigation.

A. Sources of irrigation: 2014-15

According to availability of surface and sub-soil water, type of relief, soil, rainfall, moisture requirement of crops, etc. The various sources of irrigation which are practised in Rajasthan are canals, tube wells & wells, tanks, etc. and these are discussed individually as follow:

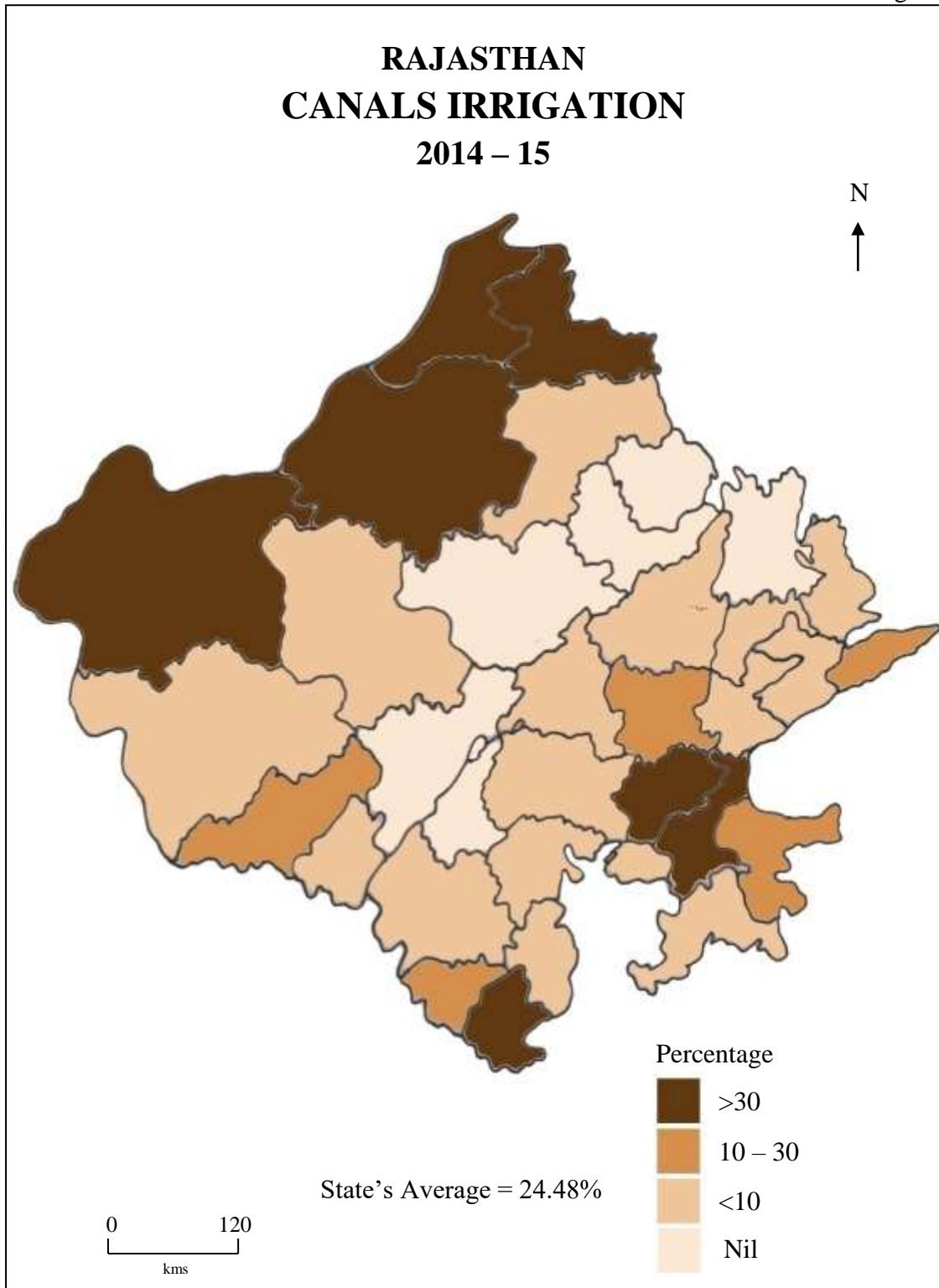
CANAL IRRIGATION (Fig.2)

Rajasthan has an average of 24.48 percent of net irrigated area under canal irrigation but varies from no canal irrigation in six districts namely Pali, Rajasmand, Nagaur, Sikar, Jhunjhunu and Alwar to highest of 98.87 percent in Ganganagar district. Fig. 2 is prepared for showing patterns of canal irrigation. Thus for discussing the spatial patterns of the canal irrigation, help is taken from fig. 2 and table no.1 which portraits four categories.

1. High category of canal irrigation (over 30 percent)

Seven districts namely Ganganagar, Hanumangarh, Jaisalmer, Bikaner, Bundi, Kota and Banswara fall in this category. Reasons responsible for high canal irrigation in western districts are presence of Indira Gandhi Canal which provides irrigation facilities to these districts and secondly brackish aquifers of subsoil's water which are unfit for development of tube wells irrigation. While in districts of Banswara, Bundi and Kota, there is enough availability of canal water from Chambal and Mahi basins for irrigation purposes which leads to high percent share of canal irrigation in these districts.

Fig.2



**Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.**

Table no. 1

Per cent share of Canals, Tube wells & Wells and Tanks to Net Irrigated

Area in Rajasthan: 2014-15 (per cent)

Sr. no.	Districts	Canal	Tube wells & wells	Tanks	Other sources
1.	Ajmer	3.75	79.33	4.59	12.33
2.	Jaipur	0.80	98.70	0.00	0.50
3.	Dausa	0.20	99.56	0.00	0.24
4.	Tonk	29.87	58.76	1.65	9.72
5.	Sikar	0.00	100.0	0.00	0.00
6.	Jhunjhunu	0.00	100.0	0.00	0.00
7.	Nagaur	0.00	99.99	0.00	0.008
8.	Alwar	0.05	99.95	0.00	0.00
9.	Bharatpur	0.82	99.18	0.00	0.00
10.	Dhaulpur	10.22	89.38	0.30	0.10
11.	Sawai Madhopur	6.19	83.27	1.28	9.26
12.	Karauli	0.36	90.61	1.53	7.50
13.	Bikaner	42.43	57.57	0.00	0.001
14.	Churu	5.90	94.10	0.00	0.00
15.	Jaisalmer	43.51	56.49	0.00	0.00
16.	Ganganagar	98.87	1.13	0.00	0.00
17.	Hanumangarh	98.58	1.42	0.00	0.00
18.	Jodhpur	0.09	99.82	0.00	0.09
19.	Barmer	8.75	91.25	0.00	0.004
20.	Jalor	23.68	76.32	0.00	0.00
21.	Pali	0.08	91.62	8.23	0.07
22.	Sirohi	0.91	98.37	0.72	0.00
23.	Kota	50.22	49.18	0.01	0.59
24.	Baran	20.59	71.85	2.50	5.06
25.	Bundi	49.56	47.26	0.22	2.96
26.	Jhalawar	4.82	94.17	0.12	0.89
27.	Banswara	57.19	17.88	5.10	21.55
28.	Dungarpur	15.95	73.74	5.66	4.65
29.	Udaipur	3.59	84.01	11.32	1.08
30.	Pratapgarh	7.40	89.37	0.48	2.75
31.	Bhilwara	8.22	88.02	3.13	0.63
32.	Chittaurgarh	4.37	93.67	1.19	0.77
33.	Rajasmand	0.32	95.34	4.32	0.02
34.	Total	24.48	72.74	0.88	1.90

Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.

2. Moderate category of canal irrigation (10 to 30 percent)

This category is well scattered and found in districts of Dhaulpur, Jalor, Dungarpur, Tonk and Baran. The major factors identified for moderate canal irrigation are moderate share of tube wells & wells irrigation and availability of less water from canals.

3. Low category of canal irrigation (less than 10 percent)

Districts of Barmer, Jodhpur, Churu, Sirohi, Udaipur, Pratapgarh, Chittaurgarh, Bhilwara, Ajmer, Jaipur, Dausa, Sawai Madhopur, Karauli, Bharatpur and Jhalawar form low category. Here, hardly irrigation water is available from canals and farmers have to take water from wells & tube wells, tanks and other sources with exception of Barmer and Jodhpur districts where some canal water is available from Indira Gandhi Canal.

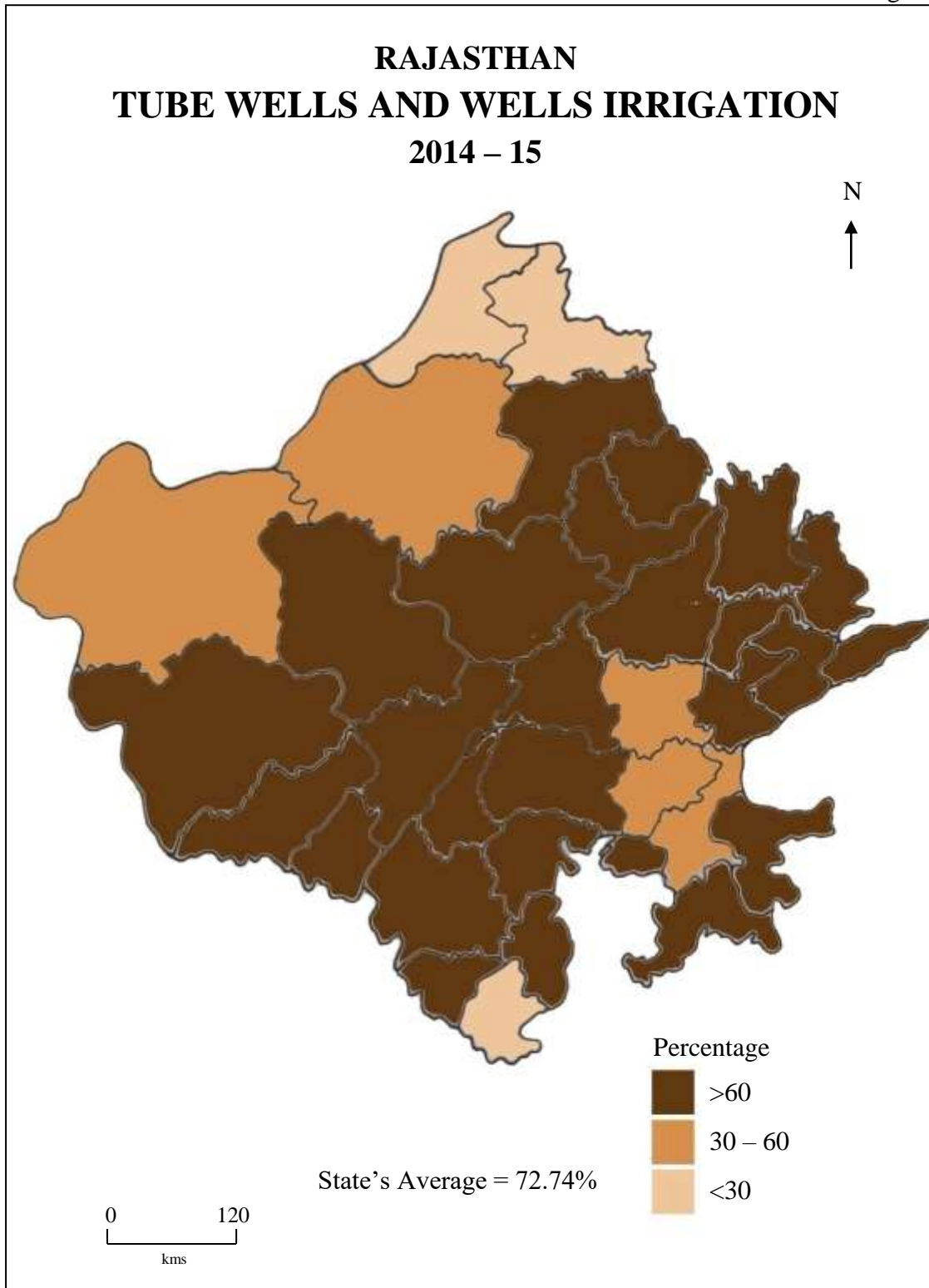
4. Category of no canal irrigation

This category covers six districts, lying in central parts of the study area. These are Alwar, Jhunjhunu, Sikar, Nagaur, Pali and Rajasmand. In all these districts, reason for no canal irrigation is absence of canals.

TUBE WELLS & WELLS IRRIGATION (FIG.3)

Tube wells and wells irrigation locally called Chahi. In Rajasthan, it is the main source of irrigation, because 72.74 percent of the net irrigated area is irrigated by this source. It is prevalent in all districts of the state, but with different percent share, ranging from lowest of 1.13 percent in Ganganagar district to 100 percent in Sikar district, both laid in northern parts of the study region. For explaining the spatial variations in wells & tube wells irrigation, fig.3 is mapped which displays three categories.

Fig.3



Sources: Directorate of Agriculture, Rajasthan, Jaipur.

Districts wise Lal Kitabs of Rajasthan.

1. Districts with high share of tube-wells & wells irrigation (over 60 percent)

This category mainly lies in central parts of the study region, forming two belts. First belt contains 23 districts namely Churu, Jhunjhunu, Sikar, Nagaur, Jaipur, Alwar, Bharatpur, Dhaulpur, Karauli, Sawai Madhopur, Dausa, Ajmer, Jodhpur, Barmer, Jalor, Sirohi, Udaipur,

Dungarpur, Pratapgarh, Chittaurgarh, Bhilwara, Pali and Rajasmand. Factors responsible for high per cent share in all these areas are the low to moderate share of canal irrigation and secondly, where alluvial soils exist, farmers try to either dig wells or sink tube wells for irrigation purposes. The second belt is small in size and covers districts of Jhalawar and Baran. Here because of absence of canal irrigation in Jhalawar and low in Baran, supplemented by favourable conditions for sinking of tube wells and consequently farmers mainly depend on tube wells and wells irrigation, which lead to its high share.

2. Districts with moderate share of tube-wells and wells irrigation (30 to 60 percent)

Five districts fall in this category and form two belts. Out of five districts, two lie in first belt covering western parts of Rajasthan namely Bikaner and Jaisalmer. Here, though canal irrigation is available yet alluvium nature of soil and availability of sub-soil water permit the farmers to dig wells and sink tube wells. Thus, Chahi irrigation has emerged as first source of irrigation. While second belt has remaining three districts which lie in eastern parts of the study region and are namely Kota, Bundi and tonk. Here also due to availability of canal irrigation, its share is noted moderate.

3. Districts with low share of tube wells and wells irrigation (less than 30 percent)

There are three districts in this category. Among these districts, two lie in extreme northern parts namely Ganganagar and Hanumangarh and the remaining one confines to extreme southern tip of Rajasthan namely Banswara. Major source of irrigation in Ganganagar and Hanumangarh districts is canal, which serves over 98 percent of the net irrigated area and consequently the share of wells and tube wells irrigation come down to less than 2 percent which is very meager. But in Banswara district, predominance of both canal and tank irrigation leads to low share of wells and tube wells irrigation.

TANK IRRIGATION (FIG.4)

In 2014-15, the share of tank irrigation to net irrigated area in the study region is 0.88 percent which varies from no tank irrigation in 14 districts to as high as 11.32 percent in

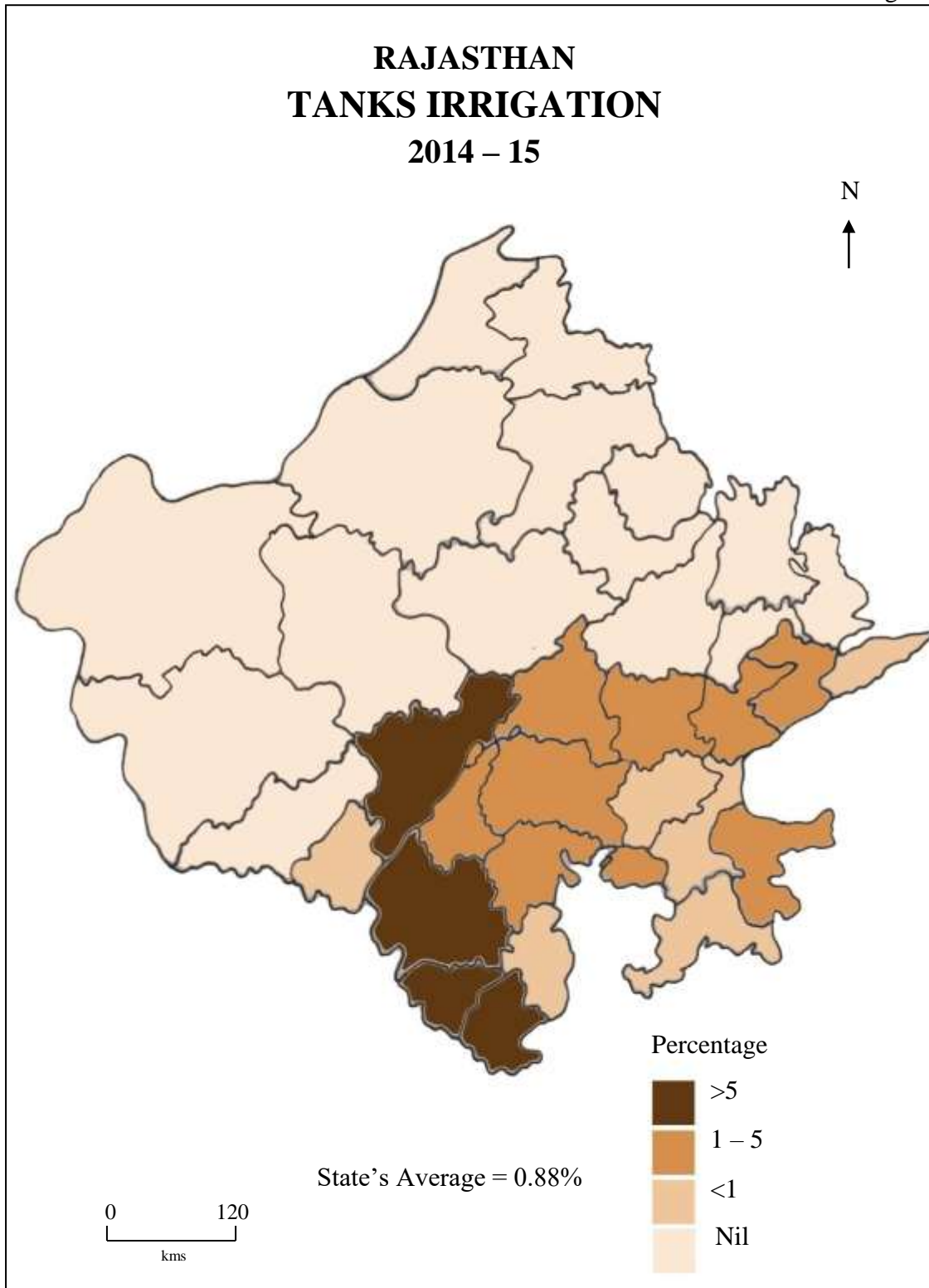
Udaipur district. A bird's eye view of fig.4 reveals that tank irrigation is mainly confined to south-eastern parts of Rajasthan. Therefore, to investigate the spatial distribution of tank irrigation and factors responsible, fig.4 is mapped which exhibits four categories.

1. Category of high tank irrigation (over 5 percent)

Four districts form this category and these are Pali, Udaipur, Dungarpur and Banswara. Reasons for high tank irrigation are comparatively high rainfall, stony relief due to presence of Aravalis, etc. which help to build tanks, because stoniness does not allow the water to percolate into sub-soil and consequently the share of tanks irrigation is noted high.



Fig.4



**Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.**

2. Category of moderate tank irrigation (1 to 5 percent)

It has one belt and one patch. The belt contains districts of Ajmer, Bhilwara, tonk, Sawai Madhopur, Karauli, Rajasmand and Chittaurgarh. Owing to Aravalis, some parts of these districts have stony relief which is ideal for developing tanks irrigation. Therefore, farmers store rainwater in these tanks and use it for irrigation purposes. The patch of this category includes Baran district, which has also the same geo-climatic conditions as in case of the belt of this category.

3. Category of low tank irrigation (less than 1 percent)

It includes six districts and comprises of 18.18 percent of total occurrences. It is well scattered in southern parts of the study region, forming two belts and two patches. Districts fall in this category are Dhaulpur, Bundi, Kota, Jhalawar, Pratapgarh, and Sirohi. Here canal, wells & tube wells are more predominant, thus share of tank irrigation is noted low.

4. Category of no tank irrigation

About 45.45 percent of the study area falls in this category and has 15 districts. These areas are free from Aravalis with exception of Alwar, Bharatpur, Jaipur and Dausa districts. From geo-climatic point of view, these are not suitable for tank irrigation, because of the predominance of alluvial soil, low to moderate rainfall, etc.

OTHER SOURCES OF IRRIGATION (FIG.5)

Only 1.90 percent of net irrigated area is under other sources of irrigation during 2014-15 in Rajasthan, but it varies greatly as is evident from fig.5. Ten districts are marked with no irrigation by other sources. In rest of the districts, it varies from as low as 0.001 per cent to as high as 21.55 percent in Banswara district. Following points are drawn from fig.5:

1. Six districts, comprising 18.18 percent of the total occurrences, have noted over 5.0 percent of the net irrigated area under other sources. These districts are Banswara, Baran, Karauli, Sawai Madhopur, tonk and Ajmer.
2. Districts having moderate share of irrigation by other sources are Udaipur, Dungarpur, Pratapgarh, and Bundi. Here its share varies between 1.0 and 5.0 percent.
3. The category with less than 1.0 percent irrigated area with other sources of irrigation contains 13 districts and 39.39 percent of total occurrences. These districts are well scattered in the study region. Districts fall in this category are Bikaner, Nagaur, Jodhpur, Barmer, Pali, Jaipur, Dausa, Dhaulpur, Rajasmand, Bhilwara, Chittaurgarh, Kota and Jhalawar.
4. Areas with absences of other sources of irrigation are found in different parts of the study region, but their main concentration is in northern parts of Rajasthan. This category has one belt and two patches. The belt covers districts of Ganganagar, Hanumangarh,

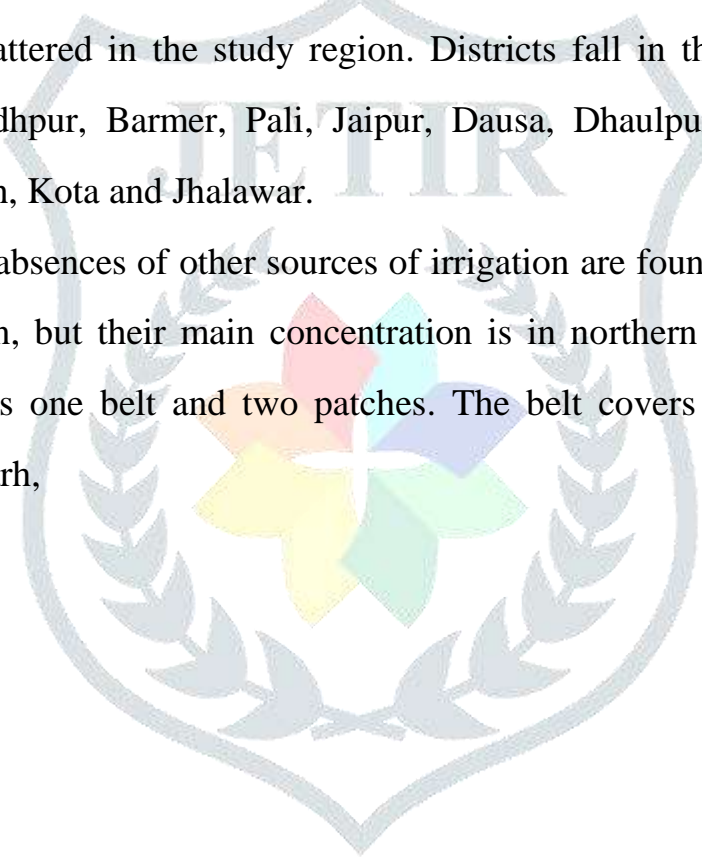
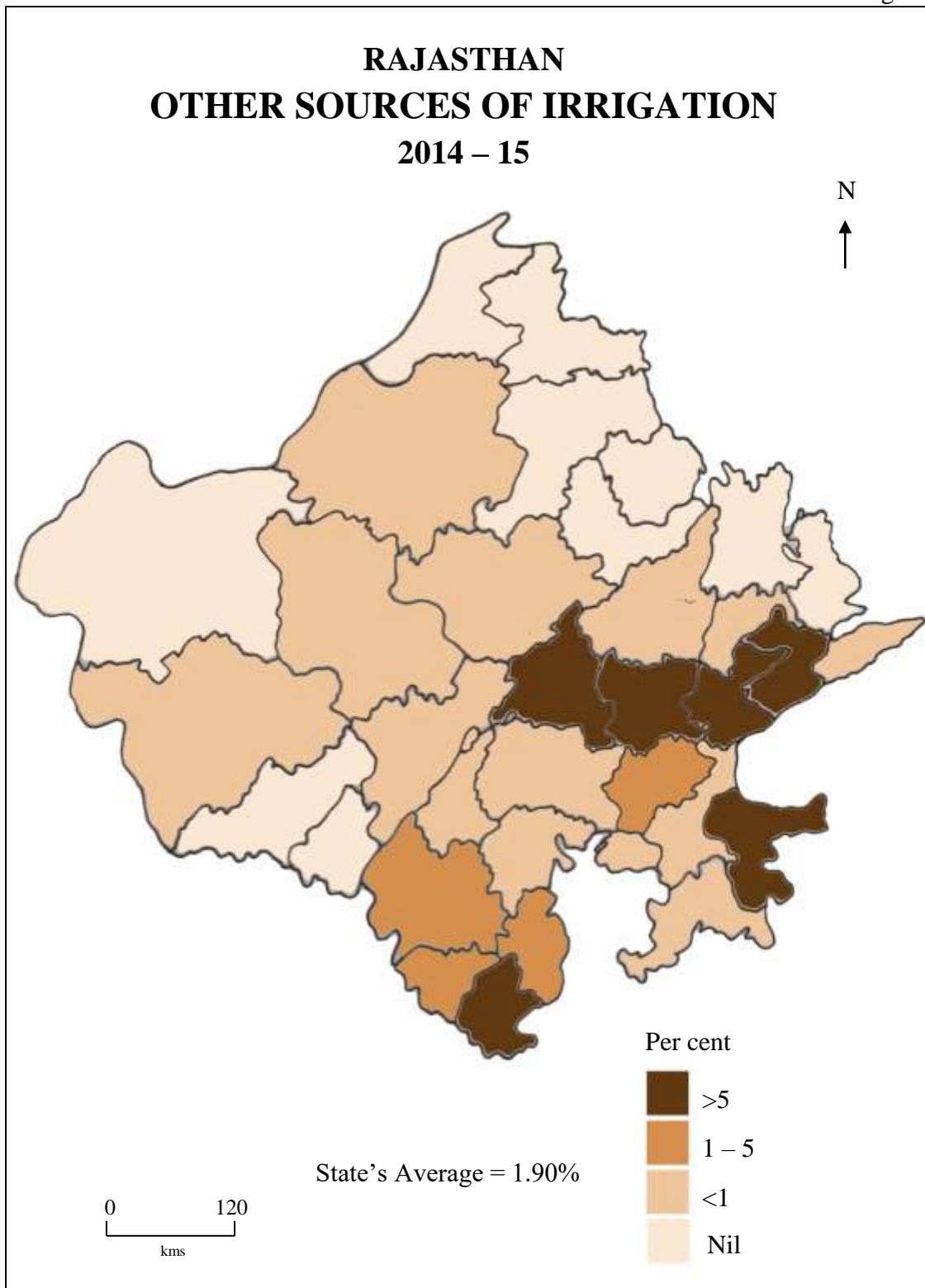


Fig.5



**Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.**

Churu, Jhunjhunu, Sikar, Alwar and Bharatpur. While two patches of this category include three districts namely Jaisalmer, Jalor and Sirohi.

5. Thus it shows that the significance of irrigation by other sources is negligible in the study region with the exception of 10 districts.

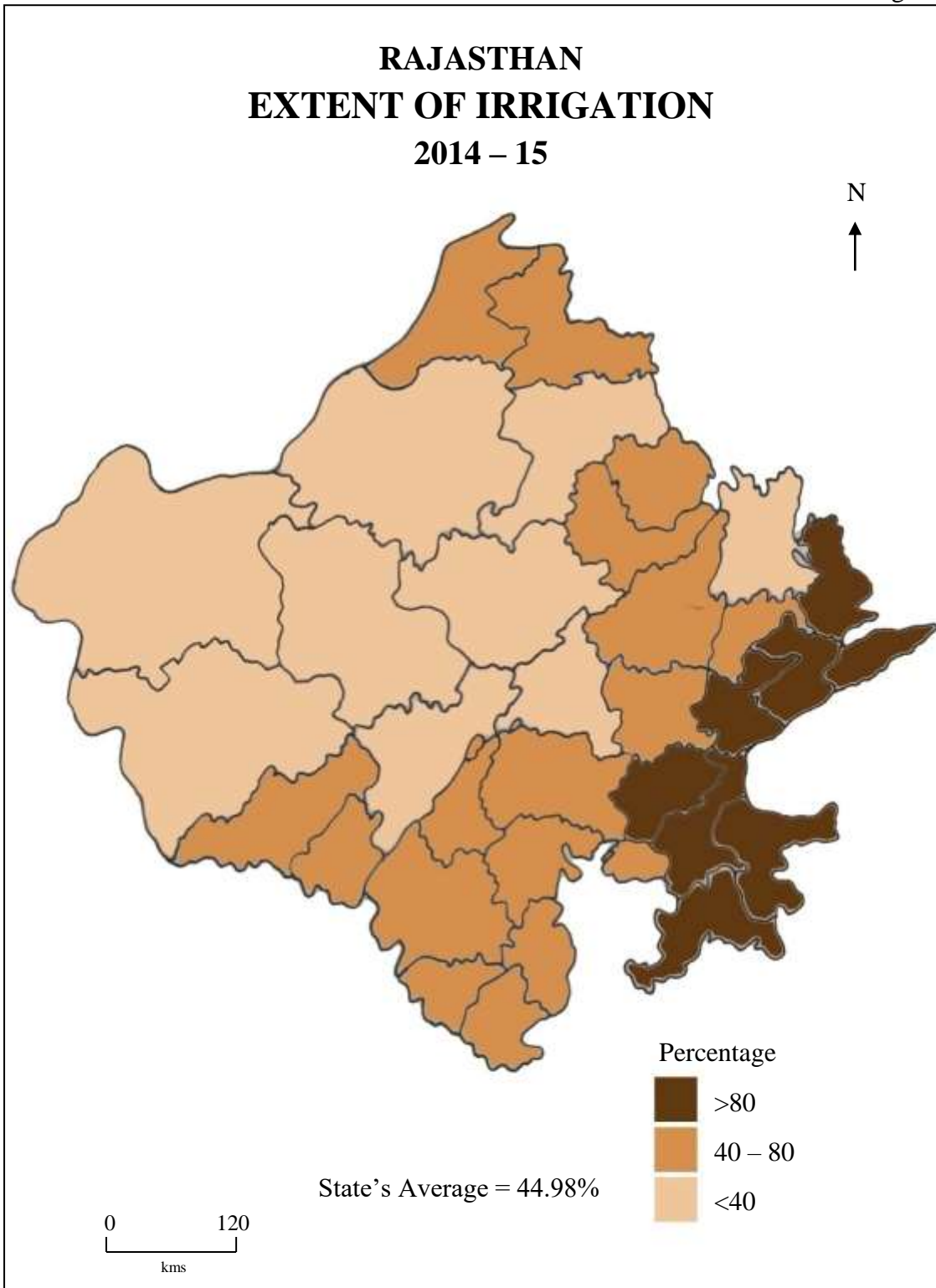
EXTENT OF IRRIGATION: 2014-15 (FIG.6)

Extent of irrigation as a measurement means net irrigated area as percent of net sown area. Rajasthan has an average extent of irrigation of 44.98 percent in 2014-15 which varies from 9.23 percent in Alwar district to 96.78 percent in Baran district. Thus, to understand high variations in spatial patterns of extent of irrigation and factors responsible, figure 6 is mapped which shows three categories.

1. High category (over 80 percent)

It confines to eastern parts of the study region and embraces eight districts and 24.24 percent of total occurrences. Districts in this category are Bundi, Kota, Baran, Jhalawar, Sawai Madhopur, Karauli, Dhaulpur and Bharatpur. The reasons identified for high extent of irrigation are adequate irrigation facilities from tube wells & wells, canals and tanks, because eastern Rajasthan plains are suitable for sinking of tube wells, digging of wells, construction of canals etc.

Fig.6



**Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.**

Table no. 2**Extent of irrigation in Rajasthan: 2014-15**

Sr. no.	Districts	Extent of irrigation (Per cent)
1.	Ajmer	32.79
2.	Jaipur	48.38
3.	Dausa	74.54
4.	Tonk	71.54
5.	Sikar	47.77
6.	Jhunjhunu	55.87
7.	Nagaur	22.05
8.	Alwar	09.23
9.	Bharatpur	87.30
10.	Dhaulpur	80.92
11.	Sawai Madhopur	88.94
12.	Karauli	80.36
13.	Bikaner	26.07
14.	Churu	11.36
15.	Jaisalmer	18.55
16.	Ganganagar	77.01
17.	Hanumangarh	49.17
18.	Jodhpur	29.15
19.	Barmer	15.87
20.	Jalor	46.69
21.	Pali	21.45
22.	Sirohi	47.80
23.	Kota	95.67
24.	Baran	96.78
25.	Bundi	93.83
26.	Jhalawar	85.44
27.	Banswara	48.51
28.	Dungarpur	40.24
29.	Udaipur	42.92
30.	Pratapgarh	63.27
31.	Bhilwara	54.51
32.	Chittaurgarh	75.80
33.	Rajasmand	45.90
34.	Total	44.98

Sources: Directorate of Agriculture, Rajasthan, Jaipur.
Districts wise Lal Kitabs of Rajasthan.

2. Moderate category (40-80 percent)

The study region's average of 48.49 percent falls in this category which lays between high and low categories. Moderate category runs continuously from Banswara to Ganganagar

districts with exception of Churu district and has two belts. The first belt covers fourteen districts namely Jalor, Sirohi, Udaipur, Dungarpur, Banswara, Pratapgarh, Chittaurgarh, Rajasmand, Bhilwara, Tonk, Dausa, Jaipur, Sikar and Jhunjhunu. Though Aravalis pass through this belt, yet there are certain plain areas where farmers sink tube wells or dig wells for irrigation purposes, even some areas are also irrigated by tanks and canals. Thus, these are the factors responsible for moderate proportion of extent of irrigation. Second belt includes districts of Ganganagar and Hanumangarh and found in north-western parts of the study region. Here availability of canal irrigation from Indra Gandhi Canal and some tube wells irrigation in the old Ghagger belt are responsible for moderate extent of irrigation.

3. Low category (< 40 percent)

Nine districts form this category which has one belt and one patch. It covers 45 percent of the total geographical area of the state. Reasons identified for low extent of irrigation in this category are inadequate canal, wells & tube wells and tanks irrigation.

CONCUSION

The study has deduced that Rajasthan has an average of 24.48 percent of net irrigated area under canal irrigation which varies from no canal irrigation in six districts to 98.87 percent in Ganganagar district. It is found that western and eastern parts of the state have more canal irrigation as compare to central parts, owing to availability of canal water. In Rajasthan, tube wells & wells are identified main source of irrigation, because 72.74 percent of the net irrigated area is irrigated by this source. Though, it is prevalent in all districts yet its percent share ranges from lowest of 1.13 percent in Ganganagar district to 100 percent in Sikar district, both laid in northern parts of the study region. Share of tank irrigation in the net irrigated area in Rajasthan is noted 0.88 percent and it varies from no tanks irrigation in 14 districts to highest of 11.32 percent in Udaipur district. Other sources of irrigation, in Rajasthan contain 1.90 percent share in net irrigated area. There are 10 districts with no irrigation by other sources to as high as 21.55 percent of the net irrigated area in Banswara district. The study has also deduced that in the state, average extent of irrigation is 44.88 percent but varies from 11.36 percent in Churu district to 96.78 percent in Baran district.

Generally, the extent of irrigation in the study region decreases from east to west. It is observed that patterns of extent of irrigation are largely depend on nature of relief, existence of Aravalis, depth and quality of aquifers of sub soil water, availability of canal water etc.

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