

Dynamics Of Irrigation And Its Impact On Cropping Intensity Of Rajouri District, (J&K) India

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ABSTRACT

Irrigation is one of the basic ingredients for agricultural development because for the adoption of agricultural innovations like high yielding varieties of seeds, agro-chemicals and for preparation of land, adequate water supply is required. The present attempt has been made to investigate the role of irrigation in the cropping intensity of Rajouri district. The work has been conducted at both village and block level for the years 1980-81, 1999-2000 and 2014-15. The study envisaged that minor irrigation is an important sector in the area as no major irrigation network is available except Rajal canal which was completed during the year 1993-94 at the cost of Rs. 801.00lakh. Present study established that the region accounted for 26.8percent irrigated area to the total cultivated area in 1980-81 which increased to 38.2percent in 2014-15.

Key words: Irrigation, agriculture, intensity, khul , development.

INTRODUCTION

Water supply is very essential for the growth and cultivation of agricultural crops. It plays significant role in multiple cropping over an area. It is also largely responsible for intensification of cropping pattern of any area. Intensification of cultivation or intensity of cropping has been defined as a number of crops raised in succession on same piece of land during one agricultural year. It is a ratio between the gross cropped area and net cultivated area usually expressed in percent terms (Azam, 1990). Though water is available from natural resources like rainfall, snowfall etc. but the demand of water for crops is not completely fulfilled. For this, artificial supply of water is very much required. Thus, Irrigation is the basic ingredient for agricultural development because for the adoption of agricultural innovations like high yielding varieties of seeds, agro-chemicals and for preparation of land, adequate water supply is required (Sohi, 2005). Therefore, without irrigation, chemical fertilizers cannot be used with confidence and a surfeit of other inputs would be of no available. Keeping this in view, the present work has been formulated to assess the irrigational status and its influence on the cropping intensity of Rajouri district.

STUDY AREA

Rajouri district is situated at the foothills of snow clad Pir Panjal range and extends between $74^{\circ}15'$ and $75^{\circ}0'$ east longitude and $33^{\circ}0'$ and $33^{\circ}50'$ north latitude with an altitude of 600-3550 mts above mean sea level. The district is predominantly agrarian in character and industrially



backward with 78 percent of its total population residing in villages. The climate varies from semi-tropical in the southern part comprising Nowshera, Sunderbani and Kalakote to temperate in the mountainous northern part encompassing the areas of Rajouri, Manjakote, Darhal and Budhal blocks of the district. The sub-tropical region receives monsoons, whereas the northern part prone to hailstorms experiences excessive rains. The area is drained by Rajouri tawi and Ans river with countless tributaries.

OBJECTIVES

1. To identify the various sources of irrigation available in the area.
2. To calculate the irrigation intensity of the region.
3. To analyze the impact of irrigation in enhancing the cropping pattern in the area.
4. To identify the problems of irrigation water supply and suggest measures to improve it for maximizing its utility for agricultural growth and development in the region.

METHODOLOGY

The data has been collected from census department, department of irrigation and flood control, revenue records, agricultural department, located in Rajouri. All the data and information so collected treated statistically and cartographically to achieve the set objectives. Besides, Cropping Intensity and Irrigation Intensity have been computed by the following formulae:

$$\text{Irrigation intensity} = \frac{\text{Gross Irrigated Area}}{\text{Net Irrigated Area}} \times 100$$

$$\text{Cropping Intensity} = \frac{\text{Total Cropped Area}}{\text{Net Sown Area}} \times 100$$

FINDINGS AND RESULTS

1. Sources of Irrigation

Sources of irrigation depend upon various factors such as surface configuration, rock structure, water table, quality and quantity of ground water, proximity and extent of water potential, catchment area and soil profile of the land. (Singh and Dhillon, 2006)

The study region has vast potential of surface as well as ground water resources. Ground or sub-surface water is the most valuable and voluminous water resource of the area. This natural wealth is utilized for drinking, irrigational and other domestic purposes. The source of irrigation has been analyzed and presented in the table 1 for all the blocks of the district. The region accounted for 26.8percent irrigated area to the total cultivated area in 1980-81 which increased to 31.2percent in 1999-2000 and 38.2percent in 2014-15. The area irrigated by different sources in the region have been broadly classified into three types that include canals/khuls, wells and other sources like field to field channel, lift irrigation and zamindari khuls maintained by local farmers as well as rural development department. Small canal and water channels are locally called as khuls.



Canal/ Khul source refers to the surface water which flows to the fields of the farmers by gravity without pumping. (Mohan, 2005)

Khul irrigation is the most prevalent and cheap mode of irrigation now-a-days and ground water exploitation in the form of wells are also being utilized since long and is the second most important source of irrigation in the region. It is important to note that the study area possessed only canal (Rajal canal) in Nowshera block measuring about 19.5km long with 12 distributaries and 10 direct outlets. It flows 60cusicwater and irrigates more than 15 villages of Nowshera and Sunderbani block. 660h area is being irrigated by this canal while the irrigation potential is 2417h. Apart from this, most of the paddy area located on the banks of the nallahs is irrigated through Khuls in Thanna, Behrote, Palma and main sources of irrigation are nallah Thanna, nallah Ans, river Rajouri and nallah Kalakote.

Table: 1 Area Irrigated by Different Sources (percent)

S. No.	Block	1980-81			1999-2000			2014-15		
		Khuls	Wells	Others	Khuls	Wells	Others	Khuls	Wells	Others
1.	Darhal	72.1	12.4	15.5	67.7	15.1	17.2	60.6	23.1	16.3
2.	Rajouri	64.0	8.6	27.4	61.7	16.6	21.7	56.5	25.3	18.2
3.	Manjakote	79.2	5.4	15.4	76.1	7.7	16.2	70.1	14.7	15.2
4.	Kalakote	65.2	18.3	16.5	60.2	19.7	20.1	60.8	21.7	17.5
5.	Budhal	76.7	0.1	23.2	73.2	5.5	21.3	67.8	12.9	19.3
6.	Nowshera	61.7	20.8	17.5	62.0	18.8	19.2	67.7	17.7	14.6
7.	Sunderbani	58.7	21.3	20.0	58.5	23.3	18.2	59.9	24.8	15.3
District		70.1	14.6	15.3	63.8	18.7	17.5	65.0	20.7	14.3

Source: J&K Revenue Department, Rajouri

The analysis of the table 1 revealed that over 50percent of total irrigated area has been served by Khuls in all the blocks. It has also been noticed that Khul irrigated area though with little variation is recorded highest in Manjakote (79.2percent) and Budhal (76.7percent) to the total irrigated area in 1980-81. While in Darhal block, Khuls served 72.1percent area followed by Rajouri (64percent), Nowshera (61.7percent) and Sunderbani (58.7percent). Further, the study documented that the extent of Khul irrigation has declined significantly in majority of the blocks with exception of Nowshera and Sunderbani blocks. As for example in Darhal and Rajouri blocks, Khuls accounted for 72.1 and 64percent of the total irrigated area in 1980-81 which decreased to 67.7percent and 61.7percent in 1999-2000 and further came down to 60.6percent and 56.5percent in 2014-15 respectively. Similarly, Khuls irrigated 79.2percent area in Manjakote and 65.2percent in Kalakote in 1980-81 that too decreased and fell down to 76.1percent and 60.2percent in 1999-2000 and 70.1percent and 60.8percent in 2014-15. Mismanagement of Khuls, seepage of water from source to field and lowering of river beds in these blocks may be responsible for its decreasing trend. Further Budhal recorded 76.7percent Khul irrigated area in 1980-81 which decreased to 67.8percent in 2014-15. Contrary to this, Nowshera and Sunderbani blocks recorded an increase in Khul irrigated area from 1980-81 to 2014-15. It is worthwhile to mention here that, although positive change has been witnessed in these blocks but the increase is much pronounced in Nowshera (6percent). This is due to the fact that Nowshera block has well developed canal system and thus large area is under canal irrigation. Besides, this canal has also contributed in Sunderbani block as it irrigates 5-7 villages of this block.



The ground water source in the form of wells revealed that high proportion of well irrigated land is registered in Sunderbani (21.3percent) and Nowshera (20.8percent) blocks while Budhal recorded least share of 0.1percent well irrigated area in 1980-81. Moreover, well irrigated area though not comparable with Khul irrigated area but has witnessed a positive trend in all the blocks except Nowshera block where declining trend has been observed as it registered 17.7percent area in 2014-15 as against 20.8percent in 1980-81. This may be attributed to the lowering of ground water level due to the excessive utilization of water. However, Rajouri, Budhal and Darhal blocks have significantly increased their well irrigated area which is associated with the exploitation of ground water. Similarly, Manjakote, Kalakote and Sunderbani blocks also showed increase in well irrigated area where Kalakote and Sunderbani have increased only about 3percent area.

It has been found that 15.3percent of the total irrigated area is served by other sources in 1980-81 which fluctuated from 17.5percent in 1999-2000 to 14.5percent in 2014-15. Rajouri is the leading block and recorded more than 18percent area in all the study periods. Moreover, all the blocks have recorded remarkable decrease though with minor fluctuations. The dominance of other sources of irrigation like Khuls and wells in Budhal and Kalakote blocks and drying of bawalies (small springs) in Sunderbani and Nowshera blocks are responsible for its decrease. In Darhal and Manjakote, insignificant change in the status of irrigation by other sources has been attributed to the fact that no other source is in a position to overcome these resources due to their perennial character like springs etc. Remaining block like Rajouri showed downward trend which is directly related to lowering of water in the springs due to the large scale extraction of water from ground water by means of wells and installation of hand pumps for drinking and domestic purposes.

2. Irrigation Intensity

Irrigation intensity is the ratio between the gross irrigated and net irrigated area usually expressed in percent terms. It gives a more exact idea about the utilization of irrigation facilities (Azam, 1985). The intensity of irrigation is not uniform in any agricultural region. In fact, it is controlled by various factors such as source of irrigation, quantity and quality of water supply, density of network of water channels, cropping season, types of crops grown etc. In an agricultural region, other things being equal, the intensity of irrigation will increase with decrease of rainfall and negligible in rain fed areas where there is restricted surface water, limited salt ridden sub-soil water and hilly or undulating topography etc.

The intensity of irrigation of 380 villages of the region has been calculated and clubbed together in three categories termed as high irrigation intensity (>400percent), moderate irrigation intensity (300-400percent) and low irrigation intensity (<300percent) and are presented in table 2 . The study of the table revealed that irrigation intensity of above 400percent has been registered in 26.1percent of the total villages of the district in 1980-81 which rose to 35.5percent in 2014-15. However, moderate and low concentration categories recorded 32.6 and 41.3 percent villages in 1980-81 that decreased to 30.8 and 33.7 percent in 2014-15 respectively.



Table 2: Irrigation Intensity

S. No.	Block	Category	%	1980-81		1999-2000		2014-15		Change 1980-81 to 2014-15
				No. of village s	%	No. of villages	%	No. of village s	%	
1	Darhal	Low	<300	22	51.2	20	46.5	15	34.9	-16.3
		Medium	300-400	10	23.3	12	27.9	10	23.3	0.0
		High	>400	11	25.6	11	25.6	18	41.9	16.3
		Total Intensity		159.8		204.0		210.5		50.7
2	Rajouri	Low	<300	41	48.2	35	41.2	23	27.1	-21.1
		Medium	300-400	30	35.3	27	31.8	30	35.3	0.0
		High	>400	14	16.5	23	27.1	32	37.6	21.1
		Total Intensity		169.2		178.7		205.2		36.0
3	Manjakote	Low	<300	13	43.3	12	40.0	12	40.0	-3.3
		Medium	300-400	08	26.6	10	33.3	08	26.6	0.0
		High	>400	09	30.0	08	26.6	10	33.3	3.3
		Total Intensity		129.7		140.2		200.1		70.4
4	Kalakote	Low	<300	36	52.9	37	54.4	31	45.6	-7.3
		Medium	300-400	27	39.7	26	38.2	30	44.1	4.4
		High	>400	05	7.4	05	7.4	07	10.3	2.9
		Total Intensity		182.9		186.9		215.5		32.6
5	Budhal	Low	<300	31	54.4	33	57.9	26	45.6	-8.8
		Medium	300-400	10	17.5	12	21.1	14	24.6	7.1
		High	>400	16	28.1	12	21.1	17	29.8	1.7
		Total Intensity		127.0		127.0		144.7		17.7
6	Sunderbani	Low	<300	05	11.9	04	9.5	10	23.8	11.9
		Medium	300-400	20	47.6	23	54.8	13	30.9	-16.7
		High	>400	17	40.5	15	35.7	19	45.2	4.7
		Total Intensity		162.4		230.3		242.9		80.5
7	Nowshera	Low	<300	09	16.4	04	7.3	11	20.0	3.6
		Medium	300-400	19	34.5	24	43.6	12	21.8	-12.7
		High	>400	27	49.1	27	49.1	32	58.2	9.1
		Total Intensity		194.0		198.6		213.4		19.4
District		Low	<300	157	41.3	145	38.2	128	33.7	-7.6
		Medium	300-400	124	32.6	134	35.3	117	30.8	-1.8
		High	>400	99	26.1	101	26.6	135	35.5	9.4
		Total Intensity		160.6		183.3		193.4		32.8

Source: J&K Revenue Department, Rajouri

There is marked spatio-temporal variation in the intensity of irrigation in different blocks of the study area. To be specific, Nowshera and Sunderbani blocks have recorded higher percentage of villages (49.1percent and 34.5percent) and (40.5percent and 47.6percent) in high and moderate categories in 1980-81. But high concentration category of Nowshera block has continuously increased the share and thus registered 58.2percent villages in 2014-15 as against fluctuation in Sunderbani block but ultimately recorded 45.2percent villages in the same year. The share of villages in medium category of both the blocks have fluctuated and consequently decreased 12.7percent and 16.7percent villages in Nowshera and Sunderbanirespectively. While Kalakote



block registered only 7.4 percent villages in high class in 1980-81 and 1999-2000 which increased to 10.3 percent villages in 2014-15. Similarly, Rajouri and Darhal blocks have shown significant positive change in the high category and medium category of blocks have recorded minor fluctuation in percent share of villages but remained static in 2014-15 as it was in 1980-81.

Further, low share of irrigation intensity has been reported from 41.3 percent villages in 1980-81 which reduced to 38.2 percent in 1999-2000 and 33.7 percent villages in 2014-15. This category has shown great spatio-temporal variation as Budhal and Kalakote blocks have registered more than 50 percent of their villages and less than 20 percent villages are found in Nowshera and Sunderbani blocks in 1980-81 and 1999-2000. In 2014-15, all the blocks except Nowshera and Sunderbani have declined their percent share with the significant change of 21.1 percent villages in Rajouri block but Kalakote and Budhal remained in their previous rank and registered 45.6 percent villages each. Fluctuations of water resource and mismanagement of sources of irrigation are largely responsible for such variations.

The average irrigation intensity in the region recorded 160.6 percent in 1980-81 that increased to 183.3 percent in 1999-2000 and 193.4 percent in 2014-15. With respect to spatial distribution, it has been found that Nowshera leads other blocks in 1980-81 and registered 194 percent irrigation intensity but replaced by Sunderbani block which registered 230.3 percent irrigation intensity in 1999-2000 and 242.9 percent in 2014-15. On the other hand, Budhal block has shown the least irrigation intensity throughout the study period. The main reason for high irrigation intensity in Sunderbani and Nowshera blocks are well developed canal irrigation system, gentle gradient and developed agricultural infrastructure.

3. Cropping Intensity

The cropped area as a percentage of net area sown gives a measure of land use efficiency. Thus, if one crop is growing on a field either as kharif or as rabi crop in one agricultural year, the index of cropping is 100 percent and it can be termed as single cropping, if two crops a year are produced as kharif and rabi crops, the intensity index will be 200 percent and such a case can be designated as double cropping; if three crops a year are produced as kharif, rabi and zaid, the intensity of cropping will be 300 percent. Therefore, the higher the index of intensity of cropping higher is the land use efficiency and vice-versa. The intensity of cropping is calculated and resulted values have been presented in table 3. The table showed that high concentration category of more than 160 percent cropping intensity recorded minimum proportion of villages i.e. 29.2 percent of the total villages in 1980-81. This proportion rose to 33.2 percent in 1999-2000 and further increased to 35.5 percent in 2014-15, thereby recorded an increase of 6.3 percent villages in this category. These villages are mainly confined in south-western part and covered Nowshera and Sunderbani blocks to a large extent. The high cropping intensity of such villages is largely associated with well-developed source of irrigation, uniform terrain and fertile soil etc. While other categories comprising 120-160 percent and less than 120 percent intensity recorded as many as many as 35 percent and 35.8 percent villages in 1980-81 respectively which showed downward trend and stood at 32.9 and 33.9 percent in 1999-2000 and 32.4 and 32.1 percent villages in 2014-15.



Table 3: Cropping Intensity

S. No.	Block	Category	%	1980-81		1999-2000		2014-15		Change 1980-81 to 2014-15
				No. of villages	%	No. of villages	%	No. of villages	%	
1	Darhal	Low	<120	17	39.5	14	32.6	12	27.9	-11.6
		Medium	120-160	15	34.9	13	30.2	10	23.3	-11.6
		High	>160	11	25.6	16	37.2	21	48.8	23.2
		Total Intensity		148.5		168.9		189.6		41.1
2	Rajouri	Low	<120	37	43.5	35	41.2	32	37.6	-5.9
		Medium	120-160	32	37.6	30	35.3	32	37.6	0.0
		High	>160	16	18.8	20	23.5	21	24.7	5.9
		Total Intensity		166.4		185.7		193.7		27.3
3	Manjakote	Low	<120	10	33.3	11	36.6	10	33.3	0.0
		Medium	120-160	13	43.3	13	43.3	12	40.0	-3.3
		High	>160	07	23.3	06	20.0	08	26.6	3.3
		Total Intensity		160.1		169.5		165.4		5.3
4	Kalakote	Low	<120	29	42.6	30	44.1	31	45.6	3.0
		Medium	120-160	26	38.2	22	32.4	20	29.4	-8.8
		High	>160	13	19.1	16	23.5	17	25.0	5.9
		Total Intensity		182.7		188.7		195.6		12.9
5	Budhal	Low	<120	25	43.9	23	40.4	24	42.1	-1.8
		Medium	120-160	16	28.1	17	29.8	19	33.4	5.3
		High	>160	16	28.1	17	29.8	14	24.6	-3.5
		Total Intensity		157.2		162.5		164.9		7.7
6	Sunderbani	Low	<120	07	16.7	06	14.3	05	11.9	-4.8
		Medium	120-160	11	26.2	08	19.0	09	21.4	-4.8
		High	>160	24	57.1	28	66.7	28	66.7	9.6
		Total Intensity		195.3		190.0		196.3		1.0
7	Nowshera	Low	<120	11	20.0	10	18.2	08	14.5	-5.5
		Medium	120-160	20	36.4	22	40.0	21	38.2	1.8
		High	>160	24	43.6	23	41.8	26	47.3	3.7
		Total Intensity		192.1		195.8		199.7		7.6
District		Low	<120	136	35.8	129	33.9	122	32.1	-3.7
		Medium	120-160	133	35.0	125	32.9	123	32.4	-2.6
		High	>160	111	29.2	126	33.2	135	35.5	6.3
		Total Intensity		178.9		181.8		189.9		11.0

Source: J&K Revenue Department, Rajouri

Analysing the distribution of villages at block level it has been found that in high category, Sunderbani and Nowshera blocks have recorded the highest percentage of 57.1 and 43.6 percent



villages to the total villages of blocks in 1980-81 followed by Budhal (28.1 percent), Darhal (25.6 percent), Manjakote (23.3 percent), Kalakote (19.1 percent) and Rajouri (18.8 percent). Almost all the blocks have registered continuous increase in their villages and Darhal has witnessed maximum increase of 23.2 percent. On the other hand, Budhal has decreased just 3.5 percent villages in this high category. Working on dissimilar trend, very low category which recorded the highest share of villages in most of the blocks have adopted downward trend in five out of seven blocks.

The average index of intensity of cropping for the region is 178.9 percent in 1980-81 which increased and settled at 181.8 percent in 1999-2000 and 189.9 percent in 2014-15. The spatial analysis revealed great variation and found that the highest cropping intensity has been reported from Sunderbani in 1980-81 (195.3 percent) and Nowshera in 1999-2000 (195.8 percent) and 2014-15 (199.7 percent). The reasons for high intensity of cropping in Sunderbani and Nowshera blocks are developed sources of irrigation, flat terrain, fertile soil etc. All these favourable factors motivated the farmers to maximize the reuse of net sown area which ultimately led to high index of intensity of cropping. Contrary to this, the lowest of 148.5 percent intensity has been observed in Darhal block in 1980-81 but replaced by Budhal block in subsequent years which registered 162.5 percent in 1999-2000 and 164.9 percent in 2014-15. The dissected and undulating topography, hill brown soil and less irrigation potential are responsible for low cropping intensity in Budhal.

PROBLEMS AND SUGGESTIONS

1. Draught resistant crops should be cultivated in the area where irrigation is least possible.
2. The various means of communication and publicity should be used to create awareness among the farmer about the importance of water so that they may make a joint effort to conserve as much water as they can.
3. In Rajouri district no institution has been established which can impart training to farmers about irrigation and management and conservation of water. Therefore an institution should be established without further delay which can organize training, exhibition and demonstrations etc. for farmer so that they learn the methods of water management. Moreover, some active social workers and intellectuals should be associated with this institution that can create, among the farmer, a willingness to organize and work for water management.
4. In order to obtain farmers participation in water management it is essential to implement a water distribution system throughout the khuls/canal area in the district
5. In order to be able to practice the proper irrigation water management, the farmer must be acquainted with crop pattern.
6. Education for farmer and women should be given the top priority in order to create awareness among the farmer and other general masses regarding the judicious management of water resources in the district.
7. Education and training in water resources management for the professional and technicians should also be given the top priority.



8. Training institute should be established for the farmer and other general masses at the grass root level in order to boost the economic activities of the general masses with the proper management of water resources in the district.
9. Khuls/canals which should be lined in order to reduce seepages loose. Khuls/Canals should be lined for the following purposes.
 - A. To improve capacities of existing channels.
 - B. To reduce seepage losses and extend irrigation with the water, so as to saved or the prevent water logging.
 - C. To reduce the cross-section (lined canals have higher velocities and a smaller regosity) land acquisition and cost of canal structure can also be reduced to same extent.
 - D. To provide additional stability on the channel side.
 - E. To ensure conditions operation of canals without annual closures for silt clearance etc. and reduced the maintenance cost.

CONCLUSION

Irrigation has made significant impact on the growth of agriculture and contributed by expanding the area under cultivation. Khul irrigation is the most prevalent mode of irrigation and over 50percent of irrigated area has been served by Khuls in the blocks. The intensity of irrigation has increased from 160.6 percent in 1980-81 to 193.4 percent in 2014-15. The study revealed that irrigation technology has increased the net sown area, irrigated area and thereby has helped in enhancing cropping intensity.

It has also been established that Nowshera leads other blocks in 1980-81 with 194percent irrigation intensity but replaced by Sunderbani block in 2014-15 and accounted for 230.3percent intensity. The main reason for high irrigational intensity in Sunderbani and Nowshera blocks are well developed canal irrigation system, gentle gradient and developed agricultural infrastructure. All these factors have motivated the farmers to maximize the reuse of net sown area in s-western part of the area covering Sunderbani and Nowshera blocks to a large extent and thus leads to high index of Intensity of cropping. Contrary to this, hill brown soil and less irrigation potential are responsible for low cropping intensity in Budhal block.

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