A Study on Parameters related to intensity of irrigation in various districts of the state Haryana, India

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Abstract: Intensity of irrigation matter and particularly influences the intensity of cropping, the cropping pattern and the agricultural productivity. The intensity of irrigation is an indicator of irrigation efficiency. It is the ratio of gross area irrigated to net irrigated area in terms of percentage. The higher the index of intensity of irrigation, the higher the irrigation efficiency and lower the index, lower the irrigation efficiency. 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 seasons, types of crops grown and likewise. It also varies from place to place and time to time. Sometimes and several parts of agricultural world, these variation are very important such as India, where unreliability of rainfall continuous to be a feature. The benefits of intense irrigation are reflected in the cropping pattern, land use efficiency, methods of cultivation and yield. In an agricultural region, other things being equal, the intensity of irrigation tend to increase with decreasing rainfall and vice-versa. However, the intensity of irrigation will always remain low and negligible in rain fed areas where there is restricted surface water, limited fresh quality of ground water and hilly or undulating topography. The intensity of irrigation in Haryana has increased from 153.3 percent in the year 1969-70 to 199.18 percent in 2017-18. This increase of 30.65 percent in intensity of irrigation is very significant in state.
[Kalu Ram and Jai Singh. **A Study on Parameters related to intensity of irrigation in various districts of the state Haryana, India.** *Rep Opinion* 2019;11(5):21-25]. ISSN 1553-9873 (print); ISSN 2375-7205 (online). http://www.sciencepub.net/report. 4. doi:10.7537/marsroj110519.04.

Keywords: Parameters, Intensity of irrigation, Districts, Haryana, India

Introduction:

Moore C.V. (1961) a General Analytical Framework for Estimating the Production Function for Crops Using Irrigation Water' used linear programming techniques for a representative farm situation to examine the effect of variations in available irrigation water supply. Anderson et al. (1966) in their research work on 'Estimation of Irrigation Water Values in Western Oklahama' estimated the optimum allocation of alternative levels of available water among crops in West Oklahama using linear programming analysis on typical farms, with different water levels. Alternative crop systems, farms resource situations, systems of farming, rainfall conditions and rates of water application were analyzed. The results indicated that irrigation significantly increased farm income through the availability of adequate water supply. Heady et al. (1973) in the research paper on 'Agricultural Water Allocation, Land Use and Policy' employed linear programming models to determine optimal water and land allocation and agricultural water needs of the whole of the United States agriculture in the year 2000. They concluded that the problem facing the United States was not a water shortage for agriculture, but an improved allocation of this resource. Moorthi et al. (1973) work on 'Cost-Benefit Analysis of Irrigation on High Yielding Wheat in Nainital Tarai Region of Uttar Pradesh' highlighted the benefits of irrigation under scientific water management practices. The experimental findings led to the conclusion that it was not only the quantity of water which was important but the timing of irrigation at different stages of plant growth was also responsible for the crop yields. The study conducted by Shingakey M.K. and Sohoni D.K. (1973) conducted a study on 'Benefit Cost Analysis of Agricultural Projects' in Wardha District, Maharastra. The cost and returns of the beneficiaries and non-beneficiaries were used to estimate the benefits and associated cost after the commencement of the project respectively. The results showed that the cost-benefit ratio increased with increase in irrigation utilization.

Hedges T.R. (1974)53 in his research article on 'Water Supplies and Cost in Relation to Farm Resource Use Decisions and Profits on Sacraments Valley Farms' developed a series of linear programming models within the framework of 28 constraints and evaluated the potential effect of varying water quantities and prices on total farm net returns over variable expenses. The constraints were related to seasonal, total inter-seasonal water quantities available, total tillable land and the maximum acreage of individual crops within this total and harvested hours per season. He found that increase in the availability of total seasonal water quantities from zero to the maximum level was associated with

increase in net returns. Thomas Wickham (1975) in his research paper on 'Predicting Yield Benefits in Lowland Rice through a Water Balance Model, Water Management in Philippines Irrigation System: Research and Operations Manila' explained the adequacy of water service and the efficiency of the system as the most important parameters of water management. The former was a measure of how completely the system served its farms, while the latter was a measure of water wastage which, if saved, could be used to irrigate a larger area. The farmer in general would look at water adequacy, while irrigation research concentrated on efficiency. Sivanappan R.K. and Balasubramanian M. (1976) in their article on 'Water Management Practices in Rice Fields Coimbatore' defined water management as a practice which included the integrated process of intake, conveyance, regulation, measurement, distribution, application and use of irrigation water in farms and removal of excess water from farms with proper amounts and at the right time for the purpose of securing maximum crop production and water economy. The author advocated land levelling, proper irrigation and drainage system and control of water through well laid out control system as measure of water management. Charan A.S. (1978) in his article on 'Economic Evaluation of an Irrigation Project: A Study of the West Banas Project' revealed that the introduction of irrigation in the region had helped primarily the agricultural sector in fairly estabilizing agricultural production first, and through increased use of inputs in increasing production. The cost-benefit ratio was greater than one. This clearly proved the economic feasibility of the project.

Materials and Methods:

Intensity of irrigation matter and particularly influences the intensity of cropping, the cropping pattern and the agricultural productivity. The intensity of irrigation is an indicator of irrigation efficiency. It is the ratio of gross area irrigated to net irrigated area in terms of percentage. The higher the index of intensity of irrigation, the higher the irrigation efficiency and lower the index, lower the irrigation efficiency.

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 seasons, types of crops grown and likewise. It also varies from place to place and time to time. Sometimes and several parts of agricultural world, these variation are very important such as India, where unreliability of rainfall continuous to be a feature. The benefits of intense irrigation are reflected in the cropping pattern, land use efficiency, methods of cultivation and yield. In an agricultural region, other things being equal, the intensity of irrigation tend to increase with decreasing rainfall and vice-versa. However, the intensity of irrigation will always remain low and negligible in rain fed areas where there is restricted surface water, limited fresh quality of ground water and hilly or undulating topography.

Also the relative information like Intensity of irrigation in the districts of state Haryana from the ten year span of the time from 1966-67 and 2017-18 were observed from primary data of the irrigation department of Haryana.

Results and Discussion:

Intensity of irrigation matter and particularly influences the intensity of cropping, the cropping pattern and the agricultural productivity. The intensity of irrigation is an indicator of irrigation efficiency. It is the ratio of gross area irrigated to net irrigated area in terms of percentage. The higher the index of intensity of irrigation, the higher the irrigation efficiency and lower the index, lower the irrigation efficiency.

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The intensity of irrigation in Haryana has increased from 153.3 percent in the year 1969-70 to 199.18 percent in 2017-18. This increase of 30.65 percent in intensity of irrigation is very significant in state.

Table 1 to 6 depicts the changing trends in the intensity of irrigation in the districts of Haryana. Table 4.15 to 3, from 1969-70 to 2017-18, depicts the spatial variations in the level of intensity of irrigation. The districts have been classified into 4 categories of irrigation intensity as the areas of low intensity (less than 125), areas of high intensity (150-175) and the areas of very high irrigation intensity (175 and above).

Table 1: During the year 1969-70, intensity of irrigation in the districts of state Haryana.

Sr. No.	Districts	Gross A.I.	Net A.I.	Irrigation Intensity
1	Hisar	770	494	155.9
2.	Rohtak	289	226	127.0
3.	Gurgaon	160	146	109.6
4.	Karnal	614	371	165.5
5.	Amabala	73	39	127.2
6.	Jind	214	99	216.2
7.	Mahendergarh	40	33	121.2
	Haryana	2158	1408	153.3

In the year 1969-70, described by table 1 low intensity of irrigation was recorded in southern parts of state i.e. Mahendergarh, Gurgaon districts. The moderate intensity was recorded in Rohtak district. High & very high irrigation intensity was found in Hisar, Karnal, Ambala and Jind districts.

As shown by table 2, low irrigation intensity existed in Bhiwani, Rohtak, Mahendergarh and Sirsa districts. The moderate intensity was found in Hisar, Karnal and Sonepat districts. High intensity was noted in Jind and Faridabad districts, very high intensity of irrigation was noted in Ambala, Kurukshetra and Gurgaon districts in 1979-80.

During 1989-90, table 3 shows, the intensity of irrigation was low in Gurgaon, Rewari and Mahendergarh districts. The moderate Irrigation intensity was found in Rohtak and Bhiwani districts. High Irrigation-Intensity areas were Yamunanagar, Kurukshetra, Kaithal, Hisar, Panipat, Sonepat and Faridabad districts whereas very high intensity of irrigation found in Ambala, Karnal, Jind and Sirsa districts.

Table 2: During the year 1979-80, intensity of irrigation in the districts of state Haryana.

Sr. No.	Districts	Gross A.I.	Net A.I.	Irrigation Intensity
1	Hisar	562	397	141.6
2.	Sirsa	302	287	105.2
3.	Bhiwani	124	108	114.8
4.	Gurgaon	108	61	177.0
5.	Faridabad	135	89	151.7
6.	Jind	311	178	174.7
7.	Mahendergarh	120	117	102.6
8.	Ambala	165	79	208.9
9.	Karnal	418	270	154.8
10.	Kurukshetra	469	260	180.4
11.	Rohtak	228	199	114.6
12.	Sonepat	189	129	146.5
	Haryana	3131	2174	144.0

Table 3: During the year 1989-90, intensity of irrigation in the districts of state Haryana.

Sr. No.	Districts	Gross A.I.	Net A.I.	Irrigation Intensity
1	Ambala	157	79	198.7
2.	Yamunanagar	149	93	160.2
3.	Kurukshetra	238	147	161.9
4.	Kaithal	356	211	168.7
5.	Karnal	297	152	195.4
6.	Panipat	235	150	156.7
7.	Sonepat	154	99	155.5
8.	Rohtak	364	286	127.3
9.	Faridabad	185	109	169.7
10.	Gurgaon	155	126	123.0
11.	Rewari	109	97	112.4
12.	Mahendergarh	89	83	107.2
13.	Bhiwani	239	160	149.4
14.	Jind	344	185	185.9
15.	Hisar	751	441	170.3
16.	Sirsa	431	239	180.3
	Haryana	4253	2657	160.1

There was very low intensity of irrigation in Mahendergarh district in 1999-2000 as shown by table 4. In Panchkula the irrigation intensity was moderate and rest of Haryana had high and very high intensity of irrigation.

Table 4: During the year 1999-2000, intensity of irrigation in the districts of state Haryana.

Sr. No.	Districts	Gross A.I.	Net A.I.	Irrigation Intensity
1	Ambala	175	95	184.2
2.	Panchkula	19	13	146.1
3.	Yamunanagar	170	103	165.0
4.	Kurukshetra	271	147	184.3
5.	Kaithal	380	196	193.9
6.	Karnal	379	207	183.1
7.	Panipat	181	97	186.6
8.	Sonepat	269	174	154.6
9.	Rohtak	183	110	166.4
10.	Jhajjar	167	111	150.4
11.	Faridabad	220	116	189.6
12.	Gurgaon	176	76	231.6
13.	Rewari	132	84	157.1
14.	Mahendergarh	143	119	120.2
15.	Bhiwani	363	208	174.5
16.	Jind	429	220	195
17.	Hisar	502	271	185.2
18.	Fatehabad	387	208	186.0
19.	Sirsa	578	333	173.6
	Haryana	5124	2888	177.4

As shown by table 5, in 2005-06, low intensity exists in Mahendergarh district. The moderate intensity is found in Bhiwani, Rohtak and Rewari districts, high intensity is noted in Ambala and Yamunanagar districts whereas rest of Haryana having very high intensity of Haryana.

Table 5: During the year 2005-06, intensity of irrigation in the districts of state Haryana.

Sr. No.	Districts	Gross A.I.	Net A.I.	Irrigation Intensity
1	Ambala	184	116	158.6
2.	Panchkula	22	4	550.0
3.	Yamunanagar	186	113	164.6
4.	Kurukshetra	277	150	184.7
5.	Kaithal	376	196	191.8
6.	Karnal	387	195	198.5
7.	Panipat	186	93	200.0
8.	Sonepat	271	141	192.2
9.	Rohtak	183	132	138.6
10.	Jhajjar	179	99	180.8
11.	Faridabad	240	117	205.1
12.	Gurgaon	197	90	218.9
13.	Rewari	156	110	141.8
14.	Mahendergarh	150	121	124.0
15.	Bhiwani	430	287	149.8
16.	Jind	431	223	193.3
17.	Hisar	530	227	233.5
18.	Fatehabad	411	205	200.5
19.	Sirsa	638	335	190.4
	Haryana	5434	2954	183.9

During the present study in the year 2017-18, low intensity exists in the Nuh, Mewat, Palwal and Mahendergarh districts of the state Haryana. Like year 2005-06, the moderate intensity is found in Bhiwani, Rohtak and Rewari districts, high intensity is noted in Ambala and Yamunanagar districts whereas rest of Haryana having very high intensity of Haryana (Table 6).

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5/23/2019