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A Status on Cropping Intensity, Irrigation Intensity and Crop Diversification Indices in Dharmapuri, Namakkal and Salem Districts of the North Western Agro-climatic Zone in Tamil Nadu, India

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ABSTRACT

Natural disasters easily drain surface water. Currently, groundwater is the most important source of freshwater in all of the world. In 2020, the proportion of extractable groundwater usage in the world (69 percent), India (62 percent) and Tamil Nadu (76 percent) for agriculture purposes only; the remaining share was obtained by the domestic and industrial sectors. The present study was conducted with the objective of examining the interaction of irrigation on cropping intensity and crop diversification in the north western agro-climatic zone. Statistical data pertaining to the sources of irrigation, cropping area and irrigation area were obtained from the Season and Crop Report of Tamil Nadu for the period of 2005-06 to 2019-20. The findings show that groundwater is the primary irrigation resource, and that with the adoption of modern agricultural practices, irrigation intensities are decreasing, despite increasing crop intensity and diversification in the north western agro-climatic zone.

Key words: *Groundwater, Irrigation intensity, Cropping intensity, Crop diversification.*

Introduction

Irrigation based agriculture has grown dramatically in the past five decades (Intizar, 2004) and now it's playing a driving force behind crop production (Prasenjit, 2017). Surface water sources are not available for irrigation throughout the year due to natural calamities, but groundwater sources have the ability to be available during all cropping periods, so they have been a prime source for agriculture (Sandipan, 2016). In 2020, the proportion of extractable groundwater availability in the world (69 percent), India (62 percent) and Tamil Nadu (76 percent) for agriculture purposes only, remaining share was obtained by domestic and industrial sectors (DGRAI, 2021). Excessive utilization is leads to excessive depletion of groundwater, agriculture and other sectors are highly dependent on groundwater, but its availability is decreasing day-to-day. If the current trend continues, the groundwater resource will be called into question. The agriculture sector is a major consumer of groundwater, and the future development of agriculture depends on the adoption of modern irrigation practices throughout the year. Cropping intensity and crop diversification statistics were used to estimate irrigation intensity in the region. With this background, the present study was conducted with the objective of examining the

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interaction of irrigation on cropping intensity and crop diversification in the north western agro-climatic zone.

Materials and Methods

Study Area

The study was conducted in the north western agro-climate of Tamil Nadu. In this zone, districts are highly dependent on groundwater as a source of irrigation. With this, Dharmapuri, Namakkal and Salem districts are purposefully selected for study.

Sampling design

The agriculture sector uses out of three fourth groundwater sources in Tamil Nadu. Groundwater is used for more than 90 percent of irrigation in the districts of Dharmapuri, Namakkal, and Salem. Statistical data pertaining to the sources of irrigation, cropping area and irrigation area were obtained from the Season and Crop Report of Tamil Nadu for the period of 2005-06 to 2019-20.

Data analysis

1. Herfindahl Index (HI)

The square of the acreage proportion of each crop in the aggregate cropped area is applied to estimate the Herfindahl index.

$$HI = \sum_{i=1}^{N} P_i^2$$

Where,

P_i = Proportion of area under i^{th} crop.

$P_i = A_i / \Sigma A_i$

In which A_i = Area under i^{th} crop and ΣA_i = Total cropped area

The HI index ranges in value from zero to one. In the event of perfect specialisation, it is one, while in the event of perfect diversification, it is zero (Kalaiselvi, 2012).

2. Simpson Index (SI)

The Simpson Index (SI) is the best indicator for evaluating diversification in a given geographic area.

$$SI = 1 - \Sigma_{i=1}^{N} P_i^2$$

Where,

$P_i = A_i / \Sigma A_i$ is the proportion of the i^{th} activity in acreage.

If the Simpson Index is close to zero denotes specializing, and close to one signifies fully diversifying.

3. Cropping Intensity (CI)

Cropping intensity is estimated as the ratio of gross cropped area to net sown area in the research area (Deshmukh *et al.*, 2017).

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

4. Irrigation Intensity (II)

Irrigation intensity of the study region is truly reflecting in agricultural development which is calculated on the basis of the formulae (Sakila, 2015).

$$\text{Irrigation Intensity} = \frac{\text{Gross Irrigated Area}}{\text{Gross Cropped Area}} \times 100$$

Results and Discussion

Crop Diversification statistics

The Herfindahl index and Simpson index were used to analyse and estimate the degree of district level agricultural diversification in the research area for three time periods: 2005–2010, 2010–2015, and 2015–2020. Table 1 depicts the indices values, which were calculated independently for each district.

Table 1. Indices of crop diversification in Dharmapuri, Namakkal and Salem districts

S. No.	Districts	Period	Herfindahl Index (HI)	Simpson Index (SI)
1.	Dharmapuri	Period I	0.202	0.798
		Period II	0.184	0.816
		Period III	0.197	0.803
2.	Namakkal	Period I	0.182	0.818
		Period II	0.204	0.796
		Period III	0.254	0.746
3.	Salem	Period I	0.178	0.822
		Period II	0.176	0.824
		Period III	0.221	0.779

Note: - Period I: 2005-06 to 2009-10, Period II: 2010-11 to 2014-15 and period III :2015-16 to 2019-20.

In Dharmapuri district, revealed HI values are 0.202, 0.184, 0.197 and revealed SI values are 0.798, 0.816 and 0.813, respectively. It could be quite high or quite low in relevant periods.

The predicted HI indices of Namakkal district are 0.182, 0.204, 0.254 and the SI values are 0.818, 0.796

and 0.746, respectively. The index values illustrate that crop diversification was initially pretty high and that it was progressively declining over time.

The HI range of the Salem district is 0.178, 0.176, 0.221, and SI is 0.822, 0.824, and 0.799, respectively, Diversification was relatively low and progressively rising during the aforementioned three periods.

As a result, crop diversification was found to be high in the northwestern agro-climatic zone, with Dharmapuri district leading the way for many years.

Source-wise irrigation in Dharmapuri, Namakkal and Salem districts

Irrigation share of the north western agro-climatic zone was presented in Table 2.

Dharmapuri district show that the share of irrigated area under surface water is decreasing from 18.10 percent to 1.13 percent, while the share from groundwater is increasing from 81.89 percent to 98.97 percent and other sources are remains zero.

The proportion of Namakkal district area under irrigation by surface water is marginal, going up from 7.27 percent to 8.01 percent, contrary to groundwater, which goes down from 92.73 percent to 89.82 percent, here contribute zero to 2.17 percent of total irrigation.

In the Salem district, the proportion of irrigated land by surface water is increasing from 3.35 percent to 4.10 percent, while groundwater dependence is decreasing from 96.65 percent to 95.60 percent and other sources remain zero.

It identifies groundwater as the primary source of irrigation in irrigated areas in the districts of the north western agro-climatic zone. Namakkal district has minimal use of other source irrigation; surface irrigation was found to be high in Namakkal and Salem districts, but Dharmapuri district shows high groundwater usage in agriculture.

Cropping Intensity (CI) and Irrigation Intensity (II) of Dharmapuri, Namakkal and Salem districts

Monsoon played a critical role in increase or decrease on irrigation water. Table 3, enumerate cropping intensity and irrigation intensity of selected districts in reference years.

Cropping intensity in Dharmapuri district increased from 120.64 percent to 149.98 percent in respectable years, while irrigation intensity decreased from 39.85 percent to 35.48 percent.

Cropping intensity in Namakkal district is improving from 116.52 percent to 137.49 percent, and irrigation intensity is decreasing from 42.85 percent to 38.57 percent in over the past few years.

Salem district cropping intensity increased from 115.16 percent to 148.61 percent and irrigation intensities also declined from 47.79 percent to 42.99 percent, respectively.

Table 2. Source-wise irrigation pattern in Dharmapuri, Namakkal and Salem districts from 2005-06 to 2019-20

(In percentage)

S. No.	Year	Dharmapuri			Namakkal			Salem		
		SW	GW	OS	SW	GW	OS	SW	GW	OS
1	2005-06	18.10	81.89	0.01	7.27	92.73	0.00	3.35	96.65	0.00
2	2006-07	10.33	89.59	0.07	8.45	84.84	6.71	4.15	95.66	0.19
3	2007-08	6.12	93.88	0.00	9.02	84.68	6.30	5.04	94.96	0.00
4	2008-09	6.61	93.39	0.00	6.38	86.62	7.00	2.57	97.40	0.02
5	2009-10	4.02	95.98	0.00	6.90	87.39	5.71	1.77	98.23	0.00
6	2010-11	4.18	95.82	0.00	3.76	91.66	4.58	1.01	98.99	0.00
7	2011-12	1.70	98.30	0.00	3.00	93.14	3.86	0.76	99.24	0.00
8	2012-13	2.42	97.58	0.00	3.98	91.31	4.71	0.29	99.71	0.00
9	2013-14	1.38	98.62	0.00	1.20	94.18	4.62	0.39	99.61	0.00
10	2014-15	1.49	98.51	0.00	6.59	92.32	1.09	0.21	99.79	0.00
11	2015-16	1.85	98.15	0.00	6.51	92.03	1.46	1.39	98.61	0.00
12	2016-17	1.72	98.28	0.00	6.52	92.60	0.88	0.13	99.87	0.00
13	2017-18	1.45	98.55	0.00	6.24	92.89	0.88	0.17	99.83	0.00
14	2018-19	1.81	98.19	0.00	7.19	89.29	3.52	4.93	95.07	0.00
15	2019-20	1.13	98.87	0.00	8.01	89.82	2.17	4.40	95.60	0.00

Source: Season and crop report of Tamil Nadu (2005-06 to 2019-20)
Note: SW: Surface Water, GW: Ground Water and OS: Other Sources

Table 3. Cropping Intensity and Irrigation Intensity of Dharmapuri, Namakkal and Salem districts from 2005-06 to 2019-20

(In Percentage)

S. No.	Year	Dharmapuri		Namakkal		Salem	
		Cropping Intensity	Irrigation Intensity	Cropping Intensity	Irrigation Intensity	Cropping Intensity	Irrigation Intensity
1	2005-06	120.64	39.85	116.52	42.85	115.16	47.79
2	2006-07	117.67	41.50	119.21	41.61	109.69	49.63
3	2007-08	113.89	42.05	115.38	43.58	107.02	49.27
4	2008-09	112.67	44.09	114.22	47.53	123.19	52.20
5	2009-10	120.08	43.92	112.31	48.51	119.73	50.31
6	2010-11	114.62	48.07	131.02	46.10	133.64	47.77
7	2011-12	125.01	49.81	122.75	51.90	142.17	52.21
8	2012-13	119.92	39.89	128.43	42.52	134.02	49.59
9	2013-14	162.30	33.63	135.34	40.49	140.15	46.68
10	2014-15	139.42	33.66	141.44	44.41	139.69	42.00
11	2015-16	149.85	41.26	133.25	40.95	138.44	41.92
12	2016-17	124.92	39.39	114.16	41.42	120.69	36.54
13	2017-18	139.26	37.86	137.06	40.78	137.86	43.13
14	2018-19	137.08	29.24	135.25	38.89	135.87	40.27
15	2019-20	149.98	35.48	137.49	38.57	148.61	42.99

Source: Season and crop report of Tamil Nadu (2005-06 to 2019-20)

The result shows, an increase in cropping intensities, contrary to a reduction in irrigation intensities. Salem district has high crop intensity in the north western agroclimatic zone.

Conclusion

The research reveals that groundwater is the predominant source of irrigation in agriculture compared to surface water and other sources of irrigation. Cropping intensity and crop diversification are showing an increasing trend, whereas irrigation intensity has been decreasing in the north western agro-climatic zone. Excessive dependence on irrigation by groundwater is a cause for depletion of the groundwater supply. The government of Tamil Nadu provides micro irrigation and free electricity policies for agriculture to do effective farming with available farm resources and increase agricultural production. The research concluded that irrigation is responsible for crop intensities and diversification, and modern technologies support its effective utilization.

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