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Impact of water resources on crop diversification in Sonipat district, Haryana

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Abstract
The Agricultural landscape had undergone considerable transformation during and after the Green Revolution. The most tangible expression of this transformation is found in the shift of the cropping patterns specific crop diversification. Crop diversification of any region is influenced by a number of factors. Compared with others, crop diversification is relatively more dependent on water resources. This research paper is to assess the impact of water resources on the changing pattern of crop diversification in Sonipat district during 1970-71 & 2000-01 and to analyse its changes. The present context of study is based on a combination of the land utilization and statistical approach. Village level data has been utilized to interrogate the changing crop diversification.

Keywords: Branch, distributary, minor, drain, sediments, community development block (CBD), Lal Kitab

Introduction

Crop diversification refers to the raising of a number of crops in a given area at a given time (an agricultural year).”The diversification of cropping patterns means raising a variety of crops for arable land, the keener the competition the higher the magnitude of diversification" (Singh, J. 1976) [2]. The knowledge of crop concentration and diversification in a region has been considered to be most useful in judicious agricultural land use planning. Agriculture land use planners have paid considerable attention to such studies (Ahmed and Siddique, 1967) [1].” Compared with other physical and non physical factors, crop diversification is relatively more dependent on water resources. Many geographers advocated techniques for measuring crop diversification. In present research work Gibbs- Martin index of diversification has been adopted for measuring the extent of diversification in cropping patterns in the study area.

The Study Area: The study area Sonipat district, is a part of Upper Yamuna Plain. It lies from 28˚48' 30" to 29˚17' 54" North Latitudes and from 76˚28' 30" to 77˚13' 40" East of Longitudes. Yamuna river marks its eastern boundary & shares with Uttar Pradesh. In the south National Capital Territory, Delhi and Jhajjar district, Panipat district in the north, Jind district in the north-west and west, and in the south-west Rohtak district is situated. The Sonipat district has a geographical area of 2122 square Kilometers. As per the 2001 Census data, Sonipat district having a population of 1279125 out of this 74.87% population are residents of rural areas. The study area is divided into seven community development blocks and contains 323 inhabitants and 13 uninhabited villages.

Literature Review: A number of studies are available world wide on the impact of water resources on cropping patterns. A very clear ecological change in types of food grains grown is discernible as rainfall decreases (Singh, 1976) [2]. Irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops (Cantor, 1967) [3] Many geographers such as Tress, Bhatia, Ayyar, Mavi, Jasbir and Gibbs & Martin advocated techniques for measuring crop diversification.

Aims and Objectives: The Research paper aims to provide valuable insight into the complex relationship between water resources and crop diversification.

The major objectives of this study are as follows:
(i) To interpret the crop diversification in the study area.
(ii) To assess the impact of water resources on crop diversification in the study area.

Hypothesis: In order to fulfill the above said objectives, the following hypothesis has been proposed. The study area has very limited water resources and its impact on crop diversification.

Data Collection: In present study analysis is based on secondary data, which have been collected from published and unpublished sources of various offices like the District Statistical Office, District Irrigation Office, Office of Deputy Director Agriculture Sonipat and Block Development offices. Data related to cropping patterns are available in Lal Kitabs (inventory books) prepared by the village patwaris. Some general data is collected from Sonipat District Gazetteer and population data is obtained from different series of District Census Handbooks.

Methodology: The study has been attempted at two levels-first all the seven C.D. Blocks of the area are treated as a basic unit. Second thirty five sample villages have been selected on the basis of stratified random sampling for analyzing crop diversification.

Water Resources: All crops obtain water and moisture from atmospheric water or surface water or underground water. Water resources available in the area are as:

Rainfall and Humidity: Sonipat district records (1996-2000 an average) annual rainfall of 5993 mm and about 73.45 of rainfall is received during June to September. The maximum rainfall is recorded in the month of August. Rainfall in the study area is adequate for the purpose of agriculture. Relative humidity in the study area is considerably low during the greater part of the year. The maximum relative humidity observed in 2 months for different season i.e. August and January. The low relative humidity is marked in the months of April and May.

Drainage System: The drainage system of the study area is analysed under following heads

1) The Yamuna River System: The Yamuna river enters the district in Bega village and flows along the eastern coast.

2) (2) **Western Yamuna Canal Drainage System:** Its origin is Tajewall headworks from Yamuna river. Following two branches of western Yamuna canal enters in this district.

(i) P. D. Branch: It enters the district in Bali Kutubpur village. Near Khubru village in the left side the Rajpura distributary, the Sardana distributary and in the right side the J. L. N. canal / feeder the Bhalout sub branch, the Bhainswal distributary, the Bajana distributary and the Dubheta distributary take off and the remaining part called Delhi Branch. In the left side of Delhi Branch, Sonipat, Kakroi, Harsana, Nahri, Laambpur distributary and in the right side Juan and Pai Distributary takes off in order to go north to south. Rithal distributary takes off from Bhalaut sub-branch and Rohtak distributary takes off from J.L.N. canal.

(ii) Butana Branch: Before entering the district boundary, Gangageshar Distributary and Butana Distributary take off from the left and Sunder Sub-branch takes off from the right side of Butana Branch. After entering in the district it shares the water with Bhiwani Sub -branch and Kanhaur Distributary.

Drains: The main drains in the study area are: In the eastern part of the study area Drain no. 6 runs from north to south. Narain Drain, Hulana Drain, Shekhpura Drain, Mahara Drain & East Juan Drain confluence it and it finally falls in Drain No. 8. West Jaun Drain runs with the Jaun Distributary and falls in Drain No. 8. Drain No. 4 runs in the upper part with J.L.N. canal and in the southern with Rohtak Distributary and falling in Drain No. 8 near Gohana. Drain No. 3 runs in the Mundalana C.D. block, Shamri Drain falls in it and finally falls in Drain No. 8 in the north of Gohana. Drain No. 8 is the largest Drain of Sonipat district which starts from the north western part of the district and falls in the Yamuna river in the south east.

Underground Water: Maximum area of Sonipat district lies between the contours having depth 3 mts to 10 mts barring a few patches. The C.D. blocks Kathura, Mundlana, Gohana and Sonipat are also under this category. The second patch extending from north to south to the west of the Yamuna River shows the maximum depth 10 mts to 20 mts of the groundwater. In the middle of this, a very small circular pocket emerges showing the maximum depth (30 mts) of ground water in Sonipat block. The reason for this highest depth is the seepage of groundwater towards the Yamuna river on the fringe of the Khadar. The pockets of lowest depth of underground water is noted in the south and south west of Kathura C.D. block in the west of Gohana C.D. block, south-west of Kharkhoda C.D. block and mid-south of Sonipat C.D. block indicating the depth 1.5-3.00 mts.

Underground Water Quality: Potential of the district was estimated at about 514 million cubic meters in 1981-82 and 68 per cent of this reserve was fresh water (DCHB, 2011 Sonipat) [5]. A rectangular shaped area, lying in the west along the Yamuna river has fresh water and is useful for irrigation. A strip extending from mid-north to southeast has a marginal type of water. To the west of this belt, 50% of Sonipat district has saline and very saline water. The western part of C.D. block Kharkhoda and northern part of C.D. block Mundalana are having patches of high saline water.

Fluctuation of groundwater: In the study area the analysis of behavior of groundwater has been made on the basis of maps obtained from the Ground Water Cell Rohtak. Post monsoon (October), there is a temporary rise in the level of groundwater. The variations in the rise of ground water table are also due to soil texture, topography and drainage system. The eastern part of the study area has a maximum rise in ground water table and is above 2 meters. The north-western part has a medium rise in ground water table from 1 to 2 meters. The central southern part including the eastern part of Rai C.D. block, nearby Kharkhoda town and central southern part of Sonipat C.D. block having minimum rise in ground water table and is below 1 meter. Two more patches lie in the southern part of Kathura C.D. block and near

Gohana town are having minimum rise in ground water table.

Fluctuation of groundwater from June 1970 to June 2000 has also been studied in the study area. The water table rises significantly during the monsoon period, which may be of short-term nature and such a study will be of limited use for understanding the water balance in the region concerned. The study of the area attracts our attention toward the increasing problem of groundwater. The north-western part of the area shows the fall ground water 2 to 4 mts. but in the north-west in Gohana C.D. block, there is a fall of ground water up to 9 mts. Furthermore the striking thing has been noted in the south-west in Rai block in Jakhauli sample village near the Yamuna river where a very surprising fall i.e. 16mts is noted which may cause serious problems of irrigation in near future. It may raise the cost of installing the tube wells due to the replacement of ordinary pumps to submersible pumps to pump out the water from the lowest water level. Furthermore, the north along the Yamuna river in Ganaur and Sonipat C.D. blocks the fall of groundwater is noted 2mts to 4mts. On the contrary, the rise in the level of ground water from 1 mt to 2 mts is noted in the mid-south on the border of the district in Kharkhoda C.D. block.

Irrigation: Irrigation is essentially the artificial application of water to overcome deficiencies in rainfall for growing crops, (Cantor, 1967) [3]. Irrigation affects the change in cropping pattern (Singh, 1976) [7]. The proportion of irrigated area under each crop to total irrigated area indicates how the respective growth is beneficial due to irrigation. During 1970-71 to 2000-01, there was a 58.25% increase in total irrigated area; the mode of irrigation has also been found to be changing in favor of tubewells. Only 12.86% increase in canal irrigated area and 693.76 percent increase in tubewells irrigated area is noted.

Crop Diversification: "The diversification of cropping patterns means raising a variety of crops for arable land, the keener the competition the higher the magnitude of diversification". (Singh, J. 1976) [7]. The index of diversification provides a method for generalizing the relationship between the relative strength and the number of crops grown (Bhatia 1965)². Gibbs - Martin in 1962 devised the formula for calculating the index of Crop Diversification i.e.: $1\text{-}EX^2/(EX)^2$

where: X means the percentage of total cropped area occupied by each crop in hectares under individual crops. The index values range from 0.00 to 0.99, where the value 0.00 indicates that there is no diversification. But on the other hand, value 0.99 indicates maximum crop diversification. In the present paper an attempt has been made to study crop diversification in Sonipat district 1970-71 and 2000-01 and its changes.

Result and Discussion: Five types of area of crop diversification during 1970-71 and 2000-01 having an index value (i) the areas of very high diversification (more than 0.81), (ii) the areas of high diversification (0.79 to 0.81), (iii) the areas of moderate diversification (0.76 to 0.78), (iv) the area of low diversification (0.73 to 0.75), (v) the areas of very low diversification (less than 0.73).

Areas of very high diversification were concentrated during 1970-71 in nine sample villages where the index value varied from a minimum of 0.82 in village Tajpur and Kailana to a maximum of 0.87 in Garhi Ujalekhan and Ahmadpur Majra. The areas of high crop diversification was concentrated in eight sample villages, where the index value varies from a minimum 0.79 in Khanpur Kalan and Kathura villages to a maximum of 0.81 in chandauli and Teha villages. The areas of moderate crop diversification was concentrated in only four sample villages. Where the index value varies from a minimum of 0.76 in Puthi village to a maximum of 0.78 in Panchi Jatan villages. The areas of low crop diversification was concentrated in six villages, where the index value ranges from minimum of 0.73 in Pinana, Bidhalan and Rindhana villages to a maximum of 0.75 in Bagru and Mundalana villages. The areas of very low crop diversification was concentrated in eight sample villages, where the index of crop diversification varies from a minimum of 0.69 in Jakhauli village to a maximum of 0.72 in Bhakarpur, Sahoti and Rampur villages of the study area. The index of very high crop diversification 0.82 during 2000-01 is found in only Garhi Ujalekhan sample village. The areas of high crop diversification are found in only two sample villages i.e. Issapur Kheri 0.80 and Jawari 0.81.The areas of moderate crop diversification are found in three villages varying from minimum 0.76 in Nisf Garhi, Bakhtwarpur village to a maximum of 0.78 in Puthi village.

The areas of low crop diversification are scattered Ahemadpur Majra villages. The areas of very low crop diversification are concentrated in seventeen villages, where the index value varies from a minimum of 0.61 in Shia Khera and Rindhana villages.

Two types of changes: increase and decrease found in the area during 1970-71 and 2000-01. The increase in the index of crop diversification is noticed in three categories (i) the areas of high increase (more than 0.04), (ii) the areas of moderate increase (0.02 to 0.04) and (iii) the areas of low increase less than (0.02). There are only three villages where the index of crop diversification increases. The degree of increase varies from a minimum of 0.02 in Puthi village to a maximum of 0.05 in Akbarpur Barota village. Another village namely Bayyapur noted in medium category and having 0.03 degree of increase. The decrease in the index of crop diversification is found in three categories (i) the areas of low decrease (less than 0.04, (ii) The area of moderate decrease (0.05 to 0.08), (iii) the areas of high decrease more than 0.08. There are thirty-two sample villages where the index of crop diversification decreases. The degree of decrease varies from a minimum of 0.01 in Rampur, Sehri and Rindhana villages to a maximum decrease of 0.18 in Siha Khera village.

Conclusion

In the end, it is concluded that according to Gibbs Martin technique the study area was highly diversified during 1970-71 but during 2000-01 the rate of diversification has decreased to some extent. Geographical distribution of crop diversification may help in future planning and development of agriculture in the study area. Few suggestions for a better future for the rural community are: the farmers should be given information about availability of water resources and its judicious use because the water table is very deep in the area & approximately half area of Sonipat district has saline and very saline water so irrigation facilities should be improved with innovative methods like sprinklers. The government should provide technical and financial help to the farmers to grow those crops which need minimum water resources. By understanding the impact of water availability, farmers and policymakers can make decisions on crop selection and enhance water use efficiency.

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