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The Geographical Analysis of Irrigation System in Haryana: A Case Study of Rohtak District

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ABSTRACT

Agriculture and irrigation is the significant movement in the territory of Haryana and huge volume of water is required to satisfy the irrigation needs of the crops developed. Be that as it may, there is restricted water accessibility in the state. Haryana gets water from Yamuna River and Bhakra system. Sowmelt, precipitation and groundwater are principle sources of water in the catchment. It is fundamental to coordinate the synthetic waterway system with hydrological system. In this paper we will study about the geographical analysis of irrigation system in Haryana case study of rohtak.

1. Introduction

Irrigation is characterized as "Misleadingly providing and systematically isolating of water for agriculture and cultivation so as to get higher or subjectively better production"(After Eijkelkamp Agrisearch Equipment). Water is fundamental to plant development and for millenniums. Fruitful farmers have utilized various strategies to apply water to their crops. This fake expansion of water is called irrigation. Irrigation is basically the counterfeit utilization of water to beat lacks in precipitation for developing crops (Cantor, 1967). Irrigation is a fundamental determinant of agriculture since its insufficiencies are the most dominant imperatives on the expansion of horticultural creation. In conventional agriculture, irrigation was perceived for its defensive job of protection against the caprices of precipitation and dry season. Be that as it may, presently, selection of high yielding assortments, concoction fertilization and different editing exceedingly utilized controlled irrigation for expanding efficiency.

1.1 Importance of Irrigation

In the following 35 to 45 years world nourishment generation should twofold to satisfy the needs of expanded populace. 90% of this expanded sustenance generation should originate from existing grounds and seventy percent of this expanded nourishment creation should originate from inundated land. Without irrigation cultivating is extremely constrained and if the precipitation diminishes to under 30cm, agriculture ends up inconceivable without irrigation (King, 1953). It expands harvest yield. It shields from starvation. It develops unrivaled crops with the water supply according to need of the crops. At last it helps in financial advancement. Irrigation water improves water conditions in the dirt, expands the water substance of plant filaments, breaks up supplements and makes them accessible to plants. Irrigation influences temperature conditions by controlling the temperature of the surface layer of the dirt and the ground layer of the air and additionally makes conceivable control of the development and advancement of plants and improvement of the nature of the collect. In natural product and berry crops that get ideal amounts of dampness, the sugar substance of the organic product increments and in oil crops the fat substance in the seeds is more prominent. For rice and wheat) with beneficial nitrogen encouraging), the protein content in the grain increments and for cotton the nature of the fiber is improved.

1.2 History Of Irrigation Development

Generally, civic establishments have been reliant on improvement of flooded agriculture to give agrarian premise of a general public and to enlarge the security of individuals (After Shirsath B. Paresh). Here history of irrigation advancement has been examined. Archeological examination has recognized proof of irrigation in Mesopotamia, Ancient Egypt and Ancient Persia (at present Iran) as far back as the sixth thousand years BCE (Before Christ Era) (Kang, S.T-1972).

In the „Zana" valley of the Andes Mountain in Peru, archeologists discovered survives from three irrigation canals radiocarbon dated from the fourth thousand years BCE, the third Millennium BCE and the ninth century CE (Christ Era). These canals are the soonest record of irrigation in the new world (Dillehay TD, Eling HH Jr, Rossen J 2005).

The Indus valley human progress in Pakistan and North India (from 2600 BCE) likewise had an early channel irrigation system. Huge scale agriculture was utilized with the end goal of irrigation. Complex irrigation and capacity systems were created, including the supplies worked at Girnar in 3000 BCE (Rodda, J.C 2004).

There is proof of antiquated Egyptian Pharaoh Amenemhet-III in the twelfth line (around 1800 BCE) utilizing the normal pool of the Faiyum Oasis as a repository to store surpluses of water for use during the dry seasons, the lake swelled yearly from flooding of the Nile (Amenemhet III. Britannica Concise). The Qanats, created in old Persia in around 800 BCE, are among the most established known irrigation techniques still being used today.

The system involves a system of vertical wells and delicately slanting passages crashed into the sides of bluffs and soak slopes to tap ground water. The irrigation works of antiquated Sri Lanka, the soonest dating from around 300 BCe, in the rule of King Pandukabhaya and under conditions advancement for the following thousand years, were one of the most intricate irrigation systems of the old world. Notwithstanding underground canals, the Sinhalese were the first to manufacture totally fake repositories to store water. The

system was widely reestablished and further stretched out during the rule of King Parakrama Bahu (1153-1186 CE).

In the Szechwan locale old China the Dujiangyan Irrigation System was worked in 250 BCE to inundate a huge zone and regardless it supplies water today (Encyclopedia Britannica, 1994). In fifteenth century Korea the world‟s first water measure was found in 1441 CE. The creator was Jang Young-Sil, a Korean architect of the Joseon Dynasty, under the dynamic course of the lord, Se Jong. It was introduced in irrigation tanks as a major aspect of an across the country system to gauge and gather precipitation for farming applications.

In the Americas, broad irrigation systems were made by various gatherings in ancient occasions. One model is found in the ongoing archeological unearthings close to the Santa Cruz River in Tucson, Arizona. They have found a town site dating from 4000 years back. The flood plain of the Santa Cruz River was broadly cultivated during the early Agricultural period, around 1200 BC to AD 150.

2. Formative aspects of irrigation in Haryana

Irrigation is drilled to keep up the diverse formative parameters. Those are:

- ✓ To compensate for the dirt dampness shortage.
- ✓ To guarantee an appropriate and continued development of crops.
- ✓ To make gather safe.
- ✓ To colonize the cultivable no man's land for even development of cultivation.
- ✓ To move from regular cultivation.
- ✓ To advance increasingly escalated cultivation by different trimming.
- ✓ To improve the degree of horticultural profitability by going about as an operator for appropriation of present day innovation.
- ✓ To diminish the provincial and size-class disparities in agrarian profitability that will lessen thus financial uneven characters.

3. Different types of irrigation system

Irrigation systems are regularly intended to amplify efficiencies and limit work and capital prerequisites. There are three wide classes of irrigation system:

1. Pressurized distribution.
2. Gravity flow distribution.
3. Drainage flow distribution.

1. **Pressurized distribution**: The pressurized systems incorporate sprinkler, stream, in which water is passed on to and disseminated over the fields through pressurized pipe systems.
2. **Gravity flow distribution:** This system passes on and conveys water at the field level by a free surface, overland flow system.
3. **Drainage flow distribution:** Irrigation by control of the drainage system sub irrigation isn't so normal however is intriguing. Generally enormous volumes of connected irrigation water permeate through the root zone and become a drainage or ground water flow. By controlling the flow at basic focuses, it is conceivable to raise the degree of the ground water to inside reach of the yield roots.

To supply water the whole field consistently so each plant would get adequate measure of water, there are different kinds of irrigation strategies that contrast in how the water acquired from the source is conveyed inside the field. These are:

1. **Surface Irrigation:** In this irrigation system water moves over and over the land by basic gravity flow so as to wet it and to penetrate into the dirt. Surface irrigation can be subdivided into wrinkle, fringe strip or bowl irrigation. It is regularly called flood irrigation when the irrigation brings about flooding or close flooding of the developed land.
2. **Ditch Irrigation**: This is the least difficult and most seasoned irrigation system and it is as yet normal in numerous pieces of the world. The main innovation basic is the labor or machines to burrow ditches or wrinkles between the columns of plants. Water is added to the ditches by methods for gravity flow, siphons and siphons.
3. **Localized Irrigation:** It is where water is circulated under low weight through a funneled system, in a pre-decided example, and connected as a little release.
4. **Drip Irrigation:** This is otherwise called stream irrigation. Water is conveyed at or close to the root zone of plants; drop by drop. This technique can be the most water effective strategy for irrigation.
5. **Overhead Irrigation:** This is the counterfeit use of water to crops from above. Focal rotate systems, which are in wide use in regions of level landscape, have sprinklers dispersed along long aluminum or steel pipes that stretch out in two ways from a focal supply point. Sprinkler systems are another normal overhead irrigation system. In these systems, water is channeled to a point inside the zone to be inundated.
6. **Sub-Irrigation:** This is likewise called as leakage irrigation utilized for a long time in the fields where water table is high. This strategy misleadingly raises the water table by enabling the dirt to be soaked from beneath the plants‟ root zone.
7. **Manual Irrigation:** This system has low necessities for framework and specialized gear yet needs high work contributions by utilizing basins or watering jars.

4. Foundation of Rohtak district

Rohtak, a town of incredible relic, lies between north scope 28°54' and 75°35' east longitude and arranged around 70 kilometers from Delhi, Capital of India, in the north-western direction.1 The unearthings led at Khokhrakot expressly uncover that it was a major focal point of political and social qualities since the antiquated period. An enormous number of coins and coin molds of various periods which have been found at khokhrakot certainly illuminate the historical backdrop of Rohtak. The authorities occupied with unearthing works at this significant chronicled sight discovered coins, coin forms in huge number having a place with the Yaudheyas of second or first century B.C. Indian Archeologist, Birbal Sahni likewise discovered coins, coin molds, seals, fixing and different ancient pieces during his unearthing at this site The various materials recuperated from different destinations plainly feature the historical backdrop of Rohtak of various periods. An enormous number of coins were additionally recouped by Swami

Omanand Saraswati who has referenced about them in his book.

Rohtak region consistently affected the battles among the hopefuls for the sultanate of Delhi. The Hindu chieftains who attempted to declare their autonomy were held under tight restraints by the Muslim boss keeping their self-intererts in view. The individuals of Haryana all in all and Rohtak territory specifically could be a rampart or shortcoming to the Sultans of Delhi relying upon the political situa-tions and interests of the nobles.39 Few occurrences of such nature can be given here. Kaikhursav, grandson of Balban and an opponent of Sultan Kaiqubad, was killed at Rohtak in intrigue with some neighborhood chiefs.40 Secondly, before the intrusion of Tamurleng, the nobles of Delhi and Haryana varied on the purpose of adversary inquirers to the Delhi Sultanate. One gathering upheld Mahmud Shah at Delhi however the nobles of Firuzabad, Doab, Sambhal, Panipat, Jhajjar and Rohtak stretched out help to Nursat Shah who set-up an opponent court at Firuzabad, in the region of Delhi.

5. Area, its geography, geology and its river basin origins

The territory of Haryana, a land secured state north-west India was cut out from the past province of Punjab on November 1, 1966. Situated somewhere in the range of 27°37' and 30°35' N scope and 74°28' and 77°36' E longitude, it has an absolute territory of 43,689 sq km (1.37% of the country's geological region) and a populace of more than 2 crores (under 2% of India's populace). Haryana state shapes a partition between the Ganga and Indus water catchments.

Over 98% territory of the state is secured by the alluvial plain including western desertic landscape of sand hills. The state is limited by Siwalik slopes in the north, waterway Yamuna in the east and Aravalli slopes in the south. Waterways Yamuna and Ghaggar flood fields establish a huge piece of the state. It is seen that enormous piece of the Haryana fields establish a broadly dispersed topographic sorrow between the Siwalik slopes and the Aravali slopes which has made the average inward drainage conditions. Resultantly, while there is a falling ground water table zone in eastern and southern parts (Yamuna Nagar, Karnal, Panipat, Sonepat (part), Faridabad and Gurgaon locale) of the state there is a rising water table zone, prompting soil salinisation and corruption, in the focal and western parts. (Rohtak, Jhajjar, Jind, Bhiwani, Hisar, Sirsa and part of Sonepat regions) The state would thus be able to be extensively partitioned into two unmistakable zones.

The rising water table zone (52 % of the state) and the falling water table zone (eastern and southern parts). (Puri, undated) The state has an atmosphere that is bone-dry to semi-parched. Yearly precipitation midpoints 545 mm, going from in excess of 1000 mm in the outrageous north-east to under 300 mm in the dry west. Surface water originates from the Sutlej by means of the Bhakra trench system and from the Yamuna through the Western Yamuna Canal system.

The height in the state fluctuates from 700 to 3600 ft (200m to 1200 m) above mean ocean level.

6. History of Irrigation in Rohtak District

Irrigation advancement in Solapur region the absolute flooded territory is 7.47 percent to states watered region in 2004/05. This watered region is 1.3 lakh hectors in 1960, which is just 10.60 percent to net planted territory. In this period, irrigation innovation was not tasteful methods electric siphon sets or disel motors were missing in well, tank irrigation. The canals and bore-wells were not utilized for irrigation. After the green upheaval, inundated zone expanded hugely for example in 1980, irrigation region is 1.8 lakh hectors which contribute 14.71 percent to net planted zone. It arrived at 2.5 lakh hectors in multi year and spread 30 percent net planted territory. After that the irrigation region and offer in net planted zone diminished because of the diminishing normal precipitation of the area, the additional time nonappearance of power, ceaselessly going down water surface level and non-arranging irrigation use by farmers.

6.1 Need of Irrigation in Rohtak District

Irrigation is fundamental for effective agriculture especially in the territory, where precipitation is deficient dubious, and erratic. Irrigation is essential in customary agriculture to beat dry seasons shortage of precipitation. It comprises one of the best specialized methods for the bringing rural generation up in the creating nations. Where there irrigation by gravity is conceivable, much work of introducing offices can be completed by manual work, through there is a conspicuous monetary points of interest even in nations with extremely low pay level are utilizing specialized guides in the constructional and earth moving works where the water important. The power of gravity can be brought to the land to be flooded gradually, it is vital use siphoning establishment. Mechanical wellspring of intensity has impressively expanded the productivity of water siphoning and have broadened the utilization of irrigation by making. It conceivable to utilize ground water situated at significant profundity and with the guide of sprinkling course of action, to carries irrigation to zones that, could some way or another not have been brought under cultivation aside from at uneconomically surprising expense. There is as yet an extremely huge potential field for advancement by methods for this system. It is distinguished as an unequivocal factor in Indian agriculture because of high fluctuation and insufficiency of precipitation.

6.2 Major Crops And Land Use Pattern In Rohtak

In Rohtak locale, the prevailing existing cultivating system is Agriculture + Animal Husbandry pursued by Agriculture + Animal Husbandry + Horticulture. The major trimming system under the current cultivating systems is principally rice-wheat editing with bison. In the region, bajra, guar, paddy and cotton are the significant crops in kharif season, though, wheat, mustard and sugarcane are in rabi season. The primary feed harvest is jowar and group bean. Aside from this, kharif vegetables, onions, turmeric, cucumber and so forth are developed as minor crops. The net planted territory of the region is 126268 ha and complete harvest zone is 215786 ha with trimming power of 171%. The woodland lies roughly on 4475 ha region. Absolute operational land possessions in the locale are 165441, out of which 52% holding are involved by peripheral and little farmers (up to 1 ha). Normal size of landholdings in the region is 1.81 ha.

6.3 Present Irrigation Status In Rohtak

Out of the complete topographical territory (166847 ha) of Rohtak area, 141877 ha was developed during the year 2009-

10. The components of bowl hydrological system like groundwater invasion, drainage, surface stockpiling and so forth are initiated distinctly by precipitation. Profundity of water table in the vast majority of the region (approx. 98 %) of locale is accounted for inside 10 meters from the ground surface and by and large it is demonstrating rising pattern. Out of absolute inundated territory (97900 ha) of the area, 66900 ha is flooded by canals and 31000 ha is watered by cylinder wells. Jawahar Lal Nehru feeder and Bhalaut subbranch are the two principle canals which are spreading a system of sub-branches, minors and distributaries. Other than this, Bhiwani sub-branch and Kalanaur distributaries bolsters some zone of Kalanaur, Meham and Lakhan Majra squares.

7. Ground water quality for irrigation in Rohtak

7.1 Electrical Conductivity (Ec) Of Groundwater

In Rohtak locale, EC extended from 0.40 to 9.38 dS/m with a mean of 2.52 dS/m. The most minimal EC of 0.40 dS/m in water tests was seen in town Bhalout of Sampla square, while, the most noteworthy EC of 9.38 dS/m was found in town Lakhan Majra of Lakhan Majra square. The examination uncovered that 84.45 % of the examples indicated EC esteems under 4 dS/m. It was seen from the spatial variable guide that the EC of groundwater is profoundly dispersed and no specific pattern is available. In the guide, the EC esteems are isolated into 10 classes and reflected by various hues. Strength of yellow shading in the guide demonstrates that EC of groundwater is for the most part running between 2-3 dS/m. Next commanding shading in the guide is green which demonstrates the EC scope of 1-2 ds/m. The most noteworthy EC scope of 9-10 dS/m can be seen at one spot in Lakhan Majra square of the locale.

7.2 Sodium Adsorption Ratio (Sar) Of Groundwater

In Rohtak region, SAR went from 3.82 to 34.04 (m mol/l)1/2 with a mean of 11.21 (mmol/l)1/2. The most reduced SAR of 3.82 (m mol/l)1/2 in water tests was seen in town Nond of Sampla square and its greatest worth 34.04 (m mol/l)1/2 was found in town Kherari of Kalanaur square. In the spatial variable guide, the SAR esteems are isolated into 10 classes and reflected by various hues. Strength of blue shading in the guide demonstrates that SAR of groundwater is for the most part extending between 8-12 (m mol/l)1/2. Next overwhelming shading in the guide is yellow which demonstrates the SAR scope of 12-16 (m mol/l)1/2. The most astounding SAR scope of 36 to 40 (m mol/l)1/2 was seen at one spot in Kalanaur square of the area.

8. Classification of groundwater

In general in Rohtak region, 60, 57, 41, 27, 24, 17 and 12 tests were found in great, hardly saline, high SAR saline, high antacid, barely soluble base, salt and saline, individually (Table 4.1). The most astounding percentage (25.2) of the groundwater in the area is under the great class and the least percentage (5.1) is under saline classification. Diminishing pattern of the water quality under various classifications is shown.Percent tests in saline classes for example barely saline, saline and high SAR saline classes were 24.0, 5.1 and 17.2, individually. Percent tests in soluble base classes for example barely antacid, soluble base and high salt classes were 10.1, 7.1 and 11.3, individually. Based on present investigation, map for spatial distribution of groundwater quality status of Rohtak locale was readied. Diverse classification of the groundwater tests are introduced by various shading in the guide. There is minimal presence of saline water class which could be seen at five dispersed areas in the guide with little specks, speaking to exceptionally less zone. By examining the territory under various shapes of groundwater quality in the region through GIS, it was discovered that out of three principle classifications (high SAR saline, barely saline and high soluble base), the most extreme zone (638.2 sq km) of the area was assessed under high SAR saline classification, trailed by insignificantly saline (451.6 sq km) and high salt (316.76 sq km) class. Predominance of these three classifications can be unmistakably found in the guide. By overlaying the shape maps of EC of groundwater and water table profundity, it was discovered that the tubewells introduced close to the canals and in shallow water-table (1.5 to 3 m) are of good quality as ceaseless revive from the waterway is occurring in these regions.

Table 1: Number of samples categorized in different classes of water quality for Rohtak district

AICRP Classification	Number of samples	Per cent sample
Good	60	25.2
Marginally saline	57	24.0
Saline	12	5.1
High SAR saline	41	17.2
Marginally alkali	24	10.1
Alkali	17	7.1
High alkali	27	11.3
Total	238	

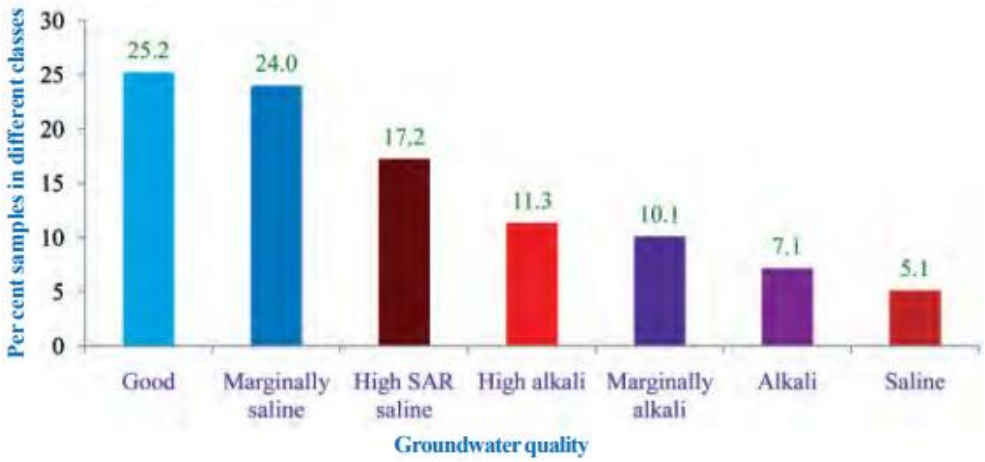

Fig. 1: Per cent samples of groundwater in different water quality of Rohtak district

9. Conclusion

Haryana has an extra-customary assorted variety in alleviation. The extraordinary north-east is described by precipitous territory of the Himalayan system while south and southwest is known for relicts of old Aravalli system. It is honored with broad level land wealthy in rural base, which structures heartland of the state and it comprises of the old alluvial plain and the flood plain. It incorporates the areas of Kamal, Ambala, Kurukshetra, Kaithal, Jind, Panipat and Sonipat that are agronomically wealthy locale. Haryana state utilizes lion's share of water resources in agriculture area. The state gets surface water from Yamuna, Sutlej, Ravi and Beas streams according to different interstate water sharing understandings. The state does not have any perpetual waterway. The Western Jamuna Canal (WJC) system and Bhakra system are the two fundamental waterway systems flooding 2.97 million hectare region. The power of waterway irrigation isn't uniform all through the state because of exceedingly slanted distribution of channel water in various directions. A few territories are getting more water and the others getting less due to limit and different limitations.

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