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# GROUNDWATER PROBLEMS IN PUNJAB WITH SPECIAL REFERENCE TO SRI MUKTSAR SAHIB DISTRICT

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**ABSTRACT**

***Punjab is gifted with rich reservoir of water resources but after the advent of Green Revolution, the scenario completely changed. Although Punjab became the bread basket of the entire country, the state started to face the new set of problems. The water level started to deplete in the central districts of Punjab whereas the southwestern part of the state became waterlogged due to the extensive canal network. The more and more usage of chemicals led to contamination of soil, air and water in the entire state. The present study is an attempt to focus on the issues of groundwater in Punjab with prime focus on the district of Sri Muktsar Sahib which is facing the problems of waterlogging, salinity and the poor quality of groundwater owing to the presence of various chemicals such as uranium, nitrate, chloride, fluoride, etc. The study will also mention about the laws and the ongoing programs on the conservation of groundwater.***

**KEYWORDS:** ***Groundwater, Groundwater Quality, Salinity, Waterlogging,***

## I. INTRODUCTION

Punjab is a small state which occupies 1.57% geographical area of the country. Although Punjab has a small area but it is blessed with the fertile lands and rich water resources. At present there are three rivers Ravi, Beas and Sutlej which flows through Punjab and has well developed 14500 kms long canal network spread throughout the state (Department of Water Resources, Punjab). Due to its abundant resources, Punjab has been at the forefront in adopting the Green Revolution and was the complete success. It contributes around 55% of the total production of the wheat and around 42% of the total production of the paddy to the central pool. But along with the benefits which Green Revolution brought, it has also brought the several ill effects from the ecological point of view. The Green Revolution demanded the heavy irrigation, chemicals, fertilizers, pesticides which although increased the productivity to the great extent but resulted in the several problems such as water depletion, waterlogging, poor quality of water and in turn several serious health issues in the state of Punjab.

## II. AREA OF STUDY

Sri Muktsar Sahib district is one of the 23 districts of Punjab and was carved out of Faridkot district on 7th November, 1995. Colloquially, it is known as Muktsar and is located in the southwest zone of Punjab. It lies between latitudes 29° 54' 15.95" and 30° 40' 9.57" N and longitudes 74° 14' 56.00" and 74° 49' 22.34". The district constitutes 5.19% of the area of the state with an area of 2615 sq km. The district is bounded by the state of Rajasthan and Haryana in the south, the district of Faridkot in the north and Ferozpur in the west and Bathinda in the east. The district is divided into three sub-divisions i.e. Muktsar, Malout and Gidderbaha sub-divisions. From the administrative point of view, the district is divided into blocks namely Muktsar, Malout, Gidderbaha and Lambi. There are four cities and 234 villages in the district. The district has hot and semi-arid type of climate with an annual rainfall of 430.7 mm. The seirozem and desert soils are the two soils found in the district.

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**Table 1. Muktsar District at a Glance**

| S. No. | Contents | Statistics |
|---|---|---|
| 1. | **GENERAL INFORMATION** | |
| | i. Geographical Area (sq. km.) | 2630 |
| | ii. Administrative divisions<br><br>(As per census 2011)<br><br>No. of Tehsils<br><br>No. of Blocks<br><br>No. of Villages | <br><br><br>3<br><br>4<br><br>234 |
| | iii. Population (As per census 2011) | 9,02,702 |
| | iv. Normal Annual Rainfall (mm) | 430.7 mm |
| 2. | **GEOMORPHOLOGY** | |
| | i. Major Physiographic Units | Alluvial plains and sand dunes |
| | ii.Major Drainage | South, south western direction |
| 3. | **LAND USE (Sq. Km.)** | |
| | i. Forest Area | 38 |
| | ii. Net area sown | 2260 |
| | iii. Cultivable Area | 2210 |
| 4. | **MAJOR SOIL TYPES** | Two, Seirozom soil and Desert soil |
| 5. | **AREA UNDER PRINCIPAL CROPS** | 416000ha |
| | (Wheat- 206000ha, Rice- 113000 ha, Cotton – 97000 ha) | |
| 6. | **IRRIGATION BY DIFFERENT SOURCES**<br><br>(Area and Number of Structures) | |
| | i. Dugwells | 25000ha |
| | ii. Tubewells/Borewells | 59145 No. Tubewells |
| | iii. Tanks/Ponds | -- |
| | iv. Canals | 200000 ha |
| | v. Other sources | -- |
| | vi. Net Irrigated Area | 225000 ha |
| | vii. Gross Irrigated Area | 434300 ha |
| | viii. Gross Cropped Area | 436000 ha |
| 7. | **NUMBERS OF GROUNDWATER MONITORING**<br><br>**STRUCTURES / WELLS OF CGWB** | |
| | i. Number of Dugwells | 8 |
| | ii. Number of Piezometers | 3 |
| 8. | **PREDOMINANT GEOLOGICAL FORMATIONS** | Alluvial |
| 9. | **HYDROGEOLOGY** | |
| | i. Major Water Bearing Formation | Sand |
| | ii. Pre-monsoon depth to water level | 0.67 mbgl to 7.3 mbgl |
| | iii. Post-monsoon depth to water level | 0.06 mbgl to 7.78 mbgl |
| | iv. Long-term water level trend in 10 yrs in m /yr (2002-2011) | Rise: 0.008 to 0.322 m/yr<br><br>Fall: 0.031 to 0.209 m/yr |

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| | | |
|---|---|---|
| 10. | **GROUNDWATER EXPLORATION BY CGWB** | |
| | i. Number of wells drilled<br>Exploratory Well<br>Observation Well<br>Piezometer<br>Slim Holes | <br><br>2<br><br>3 |
| | ii. Depth Range (m) | 332-422 m |
| | iii. Discharge (liters per minute) | 3.5 lpm |
| | iv. Storativity (S) | 0.00157 |
| | v. Transmissivity(m2/day) | $3.13 \times 10^{-2}$ |
| 11. | **GROUNDWATER QUALITY** | |
| | i. Presence of chemical constituents more than the permissible limit | |
| | EC, in micromhos | 336-5980 |
| | F, in mg/l | 0.08-6.11 |
| | As, in mg/l | nd-0.0035 |
| | Fe, in mg/l | nd-0.973 |
| | ii. Type of water | Ca- Mg- HCO3 & Na mixed anions |
| 12. | **DYNAMIC GROUNDWATER RESOURCES (MCM)** | As on 31. 03. 2011 |
| | i. Annual Replenishable Groundwater resources | 779.14 MCM |
| | ii. Net Annual Groundwater Draft | 540.85 MCM |
| | iii. Projected Demand for Domestic and Industrial uses upto 2025 | 24.60 MCM |
| | Stage of Groundwater development | 69 |
| 13. | **AWARENESS AND TRAINING ACTIVITY** | Nil |
| 14. | **EFFORTS OF ARTIFICAL RECHARGE AND RAINWATER HARVESTING** | Nil |
| 15. | **GROUNDWATER CONTROL AND REGULATION** | |
| | i. No. of Over Exploited blocks | Nil |
| | ii. No. of Critical blocks | Nil |
| | iii. No. of Semi Critical blocks | Nil |
| | iv. No. of blocks notified | Nil |
| 16. | **MAJOR GROUNDWATER PROBLEMS AND ISSUES** | Salinity and Water logging |

Source: Central Ground Water Board, 2013

## III. GROUNDWATER ISSUES IN PUNJAB

Punjab is an agrarian state and its rate of success lies in the availability of abundant irrigation facilities. Groundwater is the chief source of irrigation water and further the facility of free electricity has put the increased burden on the groundwater of Punjab. There is 170% development of groundwater in Punjab whereas the development index for India is 58%. It clearly indicates towards the extremely critical situation of groundwater in Punjab. The table 2 explains about the status of groundwater resources in Punjab. It also talks about the critical and over exploited blocks. Further the table also points towards the deterioting groundwater quality of Punjab and mentions about the presence of various chemicals in the groundwater of different districts of Punjab. Around 2,00,000 hectares of area of Punjab is waterlogged which is mostly the problem of southwest Punjab which mainly comprises the districts of Bathinda, Faridkot, Fazilka and Muktsar. These districts also face the issue of salinity which has rendered the water unsuitable for drinking as well as for irrigation purposes. On the other hand, the water table is declining at an alarming rate in the remaining Punjab. As the water table is declining, the farmers are shifting to submersible pumps and digging more deep to extract more and more groundwater, adding further to the already critical situation.

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**Table 2. Status of Groundwater Resources of Punjab**

| | |
|---|---|
| **Dynamic Ground Water Resources** | |
| Net Annual GW Availability | 20.35 BCM |
| Annual Ground Water Draft | 34.66 BCM |
| Ground Water Deficit | 14.31 BCM |
| Stage of Water Development | 170% |
| **Ground Water Development & Management** | |
| Over Exploited | 64 blocks in 1964; 110 Blocks out of 138 blocks in 2009 |
| Critical | 3 Blocks in 2009 |
| Semi-Critical | 2 Blocks |
| **Additional Ground water problems** | |
| Water logged area | 2,00,000 ha |
| Salinity (EC > 3000 µS/cm at 25 ° C) | Firozepur, Faridkot, Bathinda, Mansa, Muktsar, Sangrur(Area ~1 million ha) |
| Fluoride (>1.5 mg/l) | Amritsar, Bathinda, Faridkot, Fatehgarh Sahib, Firozepur, Gurdaspur, Mansa, Moga, Muktsar, Patiala, Sangrur |
| Chloride (> 1000 mg/l) | Firozepur, Muktsar |
| Iron (>1.0 mg/l) | Bathinda, Faridkot, Fatehgarh Sahib, Firozepur, Gurdaspur, Hoshiarpur, Mansa, Rupnagar, Sangrur |
| Nitrate (>45 mg/l) | Bathinda, Faridkot, Fatehgarh Sahib, Ferozepur, Gurdaspur, Hoshiarpur, Jalandhar, Kapurthala, Ludhiana, Mansa, Moga, Muktsar, NawanShaher, Patiala, Rupnagar, Sangrur |

Source: Punjab State Action Plan on Climate Change, 2014

Some of the major issues that need to be addressed in the state of Punjab are outlined by Rajni Sharma (2014). They are as mentioned below:

- Depleting Ground Water
- Water Logging in Southwest Punjab
- Saline / Brackish Water
- Scope of Ground Water Development in Flood Plains and Hilly areas
- Shortage of water in Urban Areas
- Contamination of Ground Water

### 3.1 Groundwater issues in Muktsar

**a) Groundwater Development:** The groundwater resource potential was assessed for all the blocks of the district using the GEC 97 methodology in the year 2011. It was found that all the blocks have the development of below 100% (Malout 61%, Muktsar 78%, Gidderbaha 101%, and Lambi 41%) which reveals that all the blocks fall in the safe category of groundwater development. Overall the development index of the district is 69% (CGWB 2013).

**b) Salinity:** The groundwater is alkaline in nature. It is moderate to highly saline with the Electrical conductivity of EC 336 to 5980 µS/cm (CGWB 2013). There are various other constituents that are present in the groundwater in the varying degrees. There are certain elements which are more than the permissible limit which makes the water of the district unpotable. It was found that 75% of the groundwater was not suitable for drinking as well as domestic purposes. The waters of the district fall in the classes of C3S1, C3S3, C3S4, C4S1, C4S2 and C4S4. The water of classes C3S1 and C4S1 cause the salinity hazards and the water of class C3S3 cause both salinity and sodium hazards. These classes of water can be used to irrigate salt tolerant crops. The classes C3S4 and C4S4 should be avoided at all the costs as they lead to high salinity and sodic hazards.

**c) Waterlogging:** The whole of the district is facing the problem of waterlogging which becomes more severe in the post monsoon period. There are various causes which are responsible for waterlogging as mentioned by Sukhdeo Singh (2013).

- Due to cracks in lining of twin canals of Rajasthan and Sirhind Feeder which runs parallel to the east of Muktsar, there is constant seepage which results in the rise of water table.
- Poor drainage system has further added to the problem. At first place the drains are not constructed and where they are constructed they are not cleaned regularly.
- The quality of groundwater is poor so it remains unused and causes the water table to rise.
- There is huge network of distribution and field channels which are unlined and result in the seepage as well as the back flow of water during the time of irrigation.

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The waterlogging has caused the change in the cropping pattern of the district from wheat-cotton to wheat-paddy as cotton is very sensitive to waterlogging. The same is the case with sugarcane and sarson as they can also not tolerate the excesss water. The waterlogging has also affected the productivity of the crops. (Sukhdeo Singh 2013)

**d) Chemical Pollution:** The traces of several heavy metals have been found in the groundwater of Muktsar which is above the permissible limits and are causing the serious health issues in the district. These have been mentioned in the table 3.

**Table 3. Contaminants in groundwater of Muktsar and their effects**

| Contaminant | Presence in Muktsar district | Permissible limit (WHO Standards) | Effects |
|---|---|---|---|
| Uranium | 43 µg/L | 30 µg/L | • Neurological disorders<br>• Damage to kidneys |
| Nitrate | >100 mg/L | 5o mg/L | • Weakness<br>• Excess heart rate<br>• Fatigue<br>• Dizziness |
| Flouride | >1.5 mg/L | 1.0 mg/L | • Dental fluorosis<br>• Skeletal fluorosis<br>• Impacts development of brain in young children |
| Arsenic | >50 µg/L | 10 µg/L | • Liver, kidney and skin damage.<br>• Decrease blood haemoglobin.<br>• Chronic and acute toxicity.<br>• Can cause various forms of cancers.<br>• Hindrance of children's development. |
| Chloride | >1000 mg/L | 250 mg/L | • Changes in drinking water taste.<br>• At high levels, it can deteriorate water heaters, municipal pipes, pumps and works equipment |

Source: Various sources

## IV. LEGISLATION ON GROUNDWATER POLLUTION

### a) The Punjab Preservation of Subsoil Water Act, 2009

The state government came up with The Punjab Preservation of Subsoil Water Act, 2009 to mitigate the problem of declining water table in the state. It is "An Act to provide for prohibition of sowing nursery of paddy and transplanting paddy before the notified dates, and for the matters connected therewith or incidental thereto"(Department of Agriculture and Farmer Welfare). As per the provisions of the act, the farmers could not sow the nursery before 10$^{th}$ may and transplantation of paddy could not be done before 10$^{th}$ june. Its main aim is the conservation of groundwater by mandatory delay in the nursery and transplantation of paddy so that the severe phase of evapotranspiration is over. The act also provides for the destruction of the crop and penalty in case of the violation of the provisions of the act. The impact of the act can be seen as it has resulted in the reduction in rate of decline of water table from 0.9 m (2000-2008) to 0.7 m (2008-2012) (Tripathi et al. 2016).

### b) The Punjab Water Resources (Management and Regulation) Act, 2020

This is "an act to provide for the management and regulation of water resources of the State for ensuring the judicious, equitable and sustainable utilization and management thereof, and for matters connected therewith or incidental thereto" (Government of Punjab 2020). The Punjab Water Regulation and Development Authority have been established under the Section 3 of this act which is responsible for management and regulation of water. The act also provides for the establishment of an Advisory Committee on Water Resources which shall be consulted by the Authority on the questions of policy and directions that need to be given to the

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general public. The government has also established the Punjab State Council for Water Management and Development in May 2020 under the Section 13 of the act. The main function of the Council is to approve the policies and programmes for the quality water supply. The council is also responsible for reviewing, modifying and approving the State Water Policy and Integrated State Water Plan. The act also provides for the several other provisions like appointment of the enquiry officers, penalties and investigations, powers of the Authority, etc.

## V. ONGOING PROGRAMMES

There are some programmes ongoing to check waterlogging and groundwater quality. Few of them are mentioned below:

- Relining of the twin canals of Rajasthan and Sirhind Feeder
- Installation of Reverse Osmosis systems in the villages
- Reclamation of the waterlogged areas
- Programmes under NABARD XXVIII and Jal Jeevan Mission are underway with the Department of Water Supply and Sanitation
- Groundwater Recharge programmes
- Cleaning of drains is done every year
- Sub-Surface Scheme

## VI. RECOMMENDATIONS

Some of the recommendations are provided below:

i. There is need of crop diversification. The state government should provide incentives to the farmers who cultivate the other crops. Also the procurement facilities of the other crops need to be improved.
ii. There should be the conjunctive use of canal water and groundwater.
iii. There is a need to improve the drainage system to improve the situation of waterlogging.
iv. Drip irrigation should be promoted as it will solve both the problems of depleting water table and waterlogging.
v. Salt resistant crops, fish farming and prawns farming should be encouraged in areas affected by waterlogging and salinity.
vi. There is need to generate more awareness among the masses regarding the importance of precious resource.
vii. The suitable management measures should be used to improve the quality of groundwater.

## VII. CONCLUSION

As we have studied, Punjab is going through a very critical phase and if necessary steps are being not taken on time it would lead to the water crisis. There are several issues such as depleting groundwater, waterlogging, salinity and chemical pollution which need to be addressed immediately. If we talk about Muktsar district, the line "water, water everywhere and not a drop to drink" from Samuel Taylor Coleridge's poem, 'The Rime of the Ancient Mariner' very well suits the situation. There is abundance of water in the district owing to the high water table but its saline and of poor quality and is not suitable for drinking as well as irrigation purposes. Although the government is taking several initiatives to solve the problem, a lot more needs to be done to improve the situation and provide people with the safe and clean drinking water.

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