ACCENT JOURNAL OF ECONOMICS ECOLOGY & ENGINEERING
Peer Reviewed and Refereed Journal, ISSN NO. 2456-1037
Available Online: www.ajeee.co.in/index.php/AJEEE

FACTORS CONTRIBUTING TO THE WATERLOGGING ISSUE IN HARYANA

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Abstract - Water logging typically refers to a condition where the land surface becomes inundated with water due to inadequate drainage. However, in the context of agricultural science, the definition of water logging varies. 1. Fully waterlogged area: This is characterized by a water table depth of 0 to 1 meter from the surface. 2. Waterlogged area: This refers to a water table depth ranging from 1 to 2 meters. 3. Potential waterlogged area: This is defined as having a water table depth between 2 to 3 meters.
Keywords: Waterlogging, water table, agriculture, drainage, potential.

1 INTRODUCTION

In general terms, waterlogging refers to a condition where the land surface becomes inundated with water due to inadequate drainage. However, in the context of agricultural science, the definition of waterlogging differs. An area is considered waterlogged when the water table is located within 0 to 3 meters of the ground surface. In this scenario, groundwater rises, saturating the soil's pores with water. This upward movement of water can also transport salts to the surface, leading to salinization. Consequently, the issues of waterlogging and salinization often occur concurrently in a given area.

As noted by Singh (1978), land is classified as waterlogged when the soil pores in the root zones of crops become saturated with water, disrupting the normal air circulation essential for plant growth and ultimately diminishing crop yields.

The Ground Water Cell of Haryana classifies waterlogging into three categories:-

1. Fully waterlogged area: Where depth to water table is between 0 - 1 meter from the ground surface.
2. waterlogged area: Where depth to water table is between 1 to 2 meters
3. Potential waterlogged area: Where depth to water table is between 2 to 3 meters.

It is important to recognize that waterlogging in the first two categories is more detrimental than in the third category. The establishment of an irrigation network in India's arid and semi-arid regions has led to issues of waterlogging and salinity. Waterlogging is a challenge that affects nearly all irrigation projects across the country.

In particular, canal-irrigated regions with inadequate drainage and saline groundwater have seen this issue escalate significantly in India. The consequences of waterlogging impact land use in various ways.

The primary sector affected is agriculture, as increasing waterlogging renders more land unsuitable for cultivation. This leads to a significant shift in cropping patterns towards water-intensive crops. A notable example of this is the expansion of paddy cultivation into non-traditional areas, which negatively impacts soil quality and composition.

As noted by Joshi (1987), the initial phase sees a sharp decline in productivity levels in the affected regions. Without intervention, the land eventually becomes wasteland and is abandoned for cultivation. This situation results in the loss of natural resources, ecological imbalances, increased unemployment, regional disparities, and a rise in poverty and out-migration. In waterlogged areas,

excessive soil moisture hinders plant growth. Additionally, groundwater rises through capillary action and evaporates from the surface, leading to salt accumulation in the soil profile, a process referred to as salinization.

The issue of waterlogging in the state is closely linked to the accumulation of soluble salts within the soil profile. Salinity in the soil arises when salts concentrate in the upper layers; this occurs as groundwater rises and deposits salts at the surface following evaporation. Additionally, the excessive application of chemical fertilizers in agricultural practices contributes to salinity.

Rajan (1978) characterizes this type of saline land as having an excessive presence of soluble salts or exchangeable sodium, which significantly impedes crop production. Such soils are commonly referred to as salt-affected soils and are known locally by various names associated with fertile land.

Chopra (1989) notes that salinity can also develop independently of waterlogging, often exacerbated by the overuse of chemical fertilizers and pesticides.

Regions where precipitation is typically lower than evaporation, combined with topographical features that hinder drainage or groundwater conditions characterized by a high water table rich in soluble salts, are particularly susceptible to salt accumulation. The prolonged use of saline irrigation water under these circumstances further exacerbates soil salinity. The impact of canal irrigation varies based on local soil conditions, topography, climate, and water management practices. It has been observed that, despite generally good water quality, canal irrigation can lead to soil salinity in numerous regions. The canal water accumulates salts during its transit, adversely affecting the irrigated lands. This issue primarily stems from over-irrigation, poor irrigation management, seepage from canals, and rising water tables. Available data indicates that many areas that were once fertile and productive prior to the establishment of canal irrigation networks are now suffering from waterlogging and salinity issues.

Saline soils are widely distributed across India and are classified as interzonal soils, distinguished by their high salinity or sodium content, or both. It is estimated that these soils cover approximately 7 million hectares nationwide. In Haryana, around 440,000 hectares are affected, with the water table situated more than 3 meters below the surface. In Punjab, the affected area is about 250,000 hectares, while Maharashtra has 55,230 hectares, and Jammu and Kashmir has 45,000 hectares that are considered critical.

The issue of salinity is particularly pronounced in Haryana, where the districts most severely impacted include Karnal, Kurukshetra, Jind, Hisar, Sonipat, Jhajjar, and Rohtak.

Salinity also disrupts agricultural practices, leading to a significant decline in the cultivation of crops such as gram and oilseeds in these regions. Additionally, areas reliant on canal irrigation are experiencing waterlogging, which has caused the subsoil water levels to rise steadily, resulting in extensive tracts of land becoming uncultivated, especially in the Indo-Gangetic plains, which are characterized by flat terrain and inadequate drainage.

Approximately 11% of the Earth's land surface is arable, with around one-fifth of this area being irrigated. Presently, waterlogging and salinization pose significant threats to numerous regions worldwide, especially in arid zones that rely on artificial irrigation. Countries such as India, Pakistan, China, and Australia experience irregular and unpredictable rainfall patterns, necessitating irrigation for agricultural purposes. Estimates from 1988 indicated that 10% of the world's irrigated land was affected by

waterlogging, while one-third faced issues related to salinization. This challenge is particularly severe in Pakistan, as well as in Iraq, India, Argentina, Mexico, Mali, North Africa, and the western United States. Reports from 1988 revealed that salinization diminished agricultural productivity on 25% to 35% of irrigated land across seventeen western states in the U.S. Another estimate suggested that by the year 2000, 50% to 65% of the world's irrigated land experienced reduced productivity due to excessive soil salinity. In irrigated croplands, this issue annually impacts crop yields on a quarter of the global cropland. In Canada, waterlogging significantly hampers crop production in the humid arable regions of the eastern provinces, while salinity is prevalent in the dry and irrigated farming areas of the southern western provinces, including Manitoba, Saskatchewan, Alberta, and British Columbia. Approximately 2.5 million acres of farmland in Alberta are affected by these issues, although data for other regions remains scarce. In Egypt, only 3% of the total land area (2.5 million hectares) is designated for agriculture, primarily situated in the Valley and delta regions. Agricultural productivity in these areas has declined over time due to soil salinity.

In Australia, the agricultural sectors in the southeastern and western regions have been significantly impacted by various challenges, especially within the Murray-Darling Basin, where approximately 96,000 hectares of land have suffered damage due to salinity, with an additional 500,000 hectares potentially at risk in the future. In neighboring India, it is estimated that around 7 million hectares are affected by salinity, a figure that is anticipated to rise. Similarly, in Iraq, the Tigris and Euphrates basins, known for their ancient irrigated agricultural practices, have experienced substantial degradation due to inadequate soil drainage, resulting in extensive waterlogged and saline areas. Comparable issues are observed globally in countries that engage in irrigated agriculture, where natural drainage has been significantly disrupted by various human activities. Waterlogging adversely affects plant growth and development, which, while internal processes, are influenced by environmental factors such as light, moisture, temperature, nutrients, and gases. The optimal availability of these inputs at the right concentrations and timing is crucial for healthy plant growth. Any deviation from these ideal conditions can lead to various stresses on plants.

Nearly a century ago, the water table was situated at considerable depths, ranging from 30 to 70 meters, under the naturally arid conditions that prevailed before the establishment of a canal network. The groundwater at these depths was saline and unsuitable for agricultural use. To enhance agricultural productivity, a canal network was implemented in Haryana, particularly during the post-Green Revolution era, which provides a brief overview of the factors contributing to waterlogging in Northwestern India.

2 POOR DRIANAGE SYSTEM

The landscape of the waterlogged region is characterized by flat and gently rolling sandy and alluvial plains. In the southern section of northwestern India, the terrain inclines northward due to its topographical features. Generally, the northern areas slope southward, creating a bowl-shaped basin in central Haryana. The inadequate drainage system results in prolonged surface water retention. Additionally, the construction of roads and canals impedes the natural flow of water, acting as barriers. Furthermore, the overflow from outlets adjacent to the canal contributes to the waterlogging issues in these regions.

3 CLIMATE

Northwestern states are characterized by arid and semi-arid climatic conditions,

which typically experience significant rainfall deficits across most of the region.

The lack of adequate rainfall and water scarcity necessitates the implementation of irrigation systems to support the agricultural economy in these areas. Unfortunately, the quality of groundwater is often poor in many parts. Consequently, the reliance on canal irrigation in these arid and semi-arid regions has led to issues of waterlogging.

For instance, the Indira Gandhi Canal irrigation project in Rajasthan has transformed a substantial area into saline and waterlogged land. Similarly, the Sharda Sahayak irrigation project has resulted in a nearly 50% reduction in productivity in saline and waterlogged areas compared to that of normal soil.

4 MAN-MADE FEATURES

Canal Seepage: In response to the adverse climatic conditions and the poor quality of groundwater, a canal irrigation system was established to enhance agricultural productivity. This network of canals has significantly raised the water table in the region, with most canals being constructed above ground level. Consequently, areas adjacent to the canals experience more severe waterlogging compared to those located further away.

Transportation Infrastructure: The issue of waterlogging is exacerbated by artificial barriers, such as the network of roads and canals, which impede the natural drainage of water.

5 CONCLUSION

Almost a hundred years ago, the water table was significantly deep, ranging from 30 to 70 meters, in the naturally arid environment that existed prior to the establishment of the canal network. The groundwater at these depths was saline, rendering it unsuitable for agricultural use. To enhance agricultural productivity, a canal system was implemented in Haryana, especially during the period following the Green Revolution. This also provides a brief overview of the factors contributing to waterlogging in Northwestern India. Salinity has a considerable impact on crop selection, with estimates indicating that high salinity levels have led to a minimal presence of crops such as Gram and Oilseed in these regions.

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