

Impact of Excessive Irrigation on Soil Health in Agriculture: A Case Study of the Marathwada Region

Dr. Khakre R.D.

Dept. of Geography,
Jaikranti Arts Senior College, Latur.

Abstract

The Marathwada region of Maharashtra, characterized by its semi-arid climate, faces significant challenges in agricultural sustainability due to excessive irrigation practices. This paper examines the adverse effects of over-irrigation on soil health, encompassing physical, chemical, and biological aspects, and proposes sustainable water management strategies to mitigate these impacts.

Introduction

Marathwada's agriculture heavily relies on irrigation, especially in the absence of consistent monsoon rains. While irrigation has bolstered crop production, excessive water application has led to soil degradation, threatening long-term agricultural productivity.

Aims and Objectives

Aim:

To assess and analyze the impact of excessive irrigation on the physical, chemical, and biological health of soils in the Marathwada region and to recommend sustainable irrigation practices for long-term agricultural productivity.

Objectives:

1. To study the effects of prolonged over-irrigation on soil physical properties such as texture, structure, bulk density, and porosity.
2. To analyze changes in soil chemical properties, including salinity, sodicity, pH, and nutrient dynamics due to excessive water application.
3. To evaluate the impact of over-irrigation on soil microbial diversity and biological activity.
4. To document the effects of excessive irrigation on crop yield and overall agricultural productivity in selected districts of Marathwada.

5. To identify traditional and modern irrigation practices prevalent in the region and assess their efficiency.
6. To suggest appropriate water management and soil conservation strategies suitable for the climatic and soil conditions of Marathwada.

Research Methodology

1. Study Area:

The research is conducted in the **Marathwada region of Maharashtra**, encompassing districts such as Aurangabad, Beed, Jalna, Latur, Nanded, Osmanabad, Parbhani, and Hingoli. The region is semi-arid and frequently experiences drought, making irrigation a critical factor in agriculture.

2. Research Design:

This is an **exploratory and analytical study**, combining both **quantitative and qualitative** research methods.

3. Data Collection:

➤ Primary Data:

- **Soil Sampling:** Collected from farms in selected talukas using random sampling techniques across irrigated and non-irrigated plots.
- **Farmer Interviews:** Structured interviews and surveys with 150+ farmers across different districts to gather insights on irrigation practices and soil health perceptions.
- **Field Observations:** Physical inspection and documentation of visible signs of

soil degradation such as salinity crust, waterlogging, or compaction.

➤ **Secondary Data:**

- District-level agricultural reports from Maharashtra State Agriculture Department
- Scientific publications, government reports (ICAR, CRIDA), and soil health card data
- Remote sensing data (where available) to assess land use and irrigation pattern

Soil Physical Properties Affected by Excessive Irrigation

1 Soil Compaction and Bulk Density

Continuous over-irrigation leads to soil compaction, increasing bulk density and reducing porosity. This impairs root penetration and water infiltration, leading to poor aeration and root health.

2. Alteration in Soil Structure

Excessive water application can disrupt soil structure, leading to the formation of hardpans and reduced permeability. This results in surface waterlogging and hinders the movement of air and water within the soil.

3. Soil Chemical Properties and Nutrient Dynamics

3.1 Salinization and Sodification

Over-irrigation can cause the accumulation of soluble salts in the soil, leading to salinization. This increases soil pH and electrical conductivity, adversely affecting nutrient availability and crop growth.

3.2 Nutrient Imbalance and Leaching

Excessive water application can lead to nutrient leaching, depleting essential nutrients like nitrogen, phosphorus, and potassium from the root zone. This results in nutrient imbalances and reduced soil fertility.

4. Biological Impacts on Soil Microorganisms

Over-irrigation can alter the soil's microbial community, reducing biodiversity and activity. This diminishes the soil's natural fertility and its ability to suppress soilborne pathogens, leading to increased reliance on chemical inputs.

5. Crop Yield and Productivity

While short-term yields may not immediately reflect the adverse effects of over-irrigation, long-

term impacts become evident. Studies have shown that crops such as sugarcane and maize exhibit decreased yields in soils subjected to prolonged excessive irrigation. This decline is attributed to the combined effects of altered soil physical, chemical, and biological properties.

6. Water Management Practices and Their Role

6.1 Traditional vs. Modern Irrigation Techniques

Traditional flood irrigation methods are often inefficient, leading to water wastage and soil degradation. Modern techniques like drip and sprinkler irrigation offer more precise water delivery, reducing the risk of over-irrigation.

6.2 Role of Water Conservation Practices

Implementing water-saving practices such as rainwater harvesting, mulching, and soil moisture management can help in reducing the adverse effects of over-irrigation and promote sustainable agriculture.

7. Regional Case Studies

7.1 Amravati District

Research indicates that the irrigation water used in Amravati contains high levels of soluble sodium ions, leading to severe drainage problems in the shrink-swell soils of the district. These soils, being highly clayey and smectite, have low permeability, exacerbating the adverse effects of over-irrigation.

7.2 Krishna Valley

A study in the Krishna Valley found that high levels of calcium carbonate in the root zone adversely affected crop growth. Soils with high exchangeable sodium percentage (ESP) and low hydraulic conductivity were found to be less suitable for agriculture, highlighting the need for improved water management practices.

8. Mitigation Strategies and Sustainable Practices

8.1 Adoption of Efficient Irrigation Systems

Encouraging the use of efficient irrigation systems like drip and sprinkler irrigation can help in precise water delivery, reducing the risk of over-irrigation and promoting water conservation.

8.2 Soil Health Management Practices

Incorporating organic amendments, crop rotation, and cover cropping can improve soil structure, enhance nutrient availability, and promote microbial activity, leading to improved soil health.

8.3 Policy Interventions

Implementing policies that promote sustainable water management practices, provide incentives for adopting efficient irrigation systems, and offer training programs for farmers can help in mitigating the adverse effects of over-irrigation.

9. Conclusion

Excessive irrigation poses significant risks to soil health in the Marathwada region, with implications for food security and environmental sustainability. By understanding these impacts and implementing sustainable practices, it is possible to mitigate the adverse effects and ensure the long-term viability of agricultural systems.

References

1. Puri, A.N., *Soil Science: An Introduction to Principles of Soil Science*, Indian Council of Agricultural Research
2. G.L. Asawa, *Irrigation and Water Resources Engineering*, New Age International Publishers
3. S.S. Singh, *Soil Fertility and Nutrient Management*, Kalyani Publishers
4. Basak, N.N., *Irrigation and Drainage Engineering*, McGraw Hill Education
5. R. Suresh, *Soil and Water Conservation Engineering*, Standard Publishers Distributors
6. Gundlur, S. S., Dasar, G. V., & Halagalimath, S. P. (2020). *Impact of Different Periods of Irrigation on Soil Properties and Crop Yield in Vertisols of Ghataprabha Command Area*. Journal of the Indian Society of Coastal Agricultural Research.
7. Padekar, D., Bhattacharyya, T., Ray, S. K., Tiwary, P., & Chandran, P. (2016). *Influence of Irrigation Water on Black Soils in Amravati District, Maharashtra*. Current Science, 110(9), 1740-1755.

