



# DECLINING SOIL PRODUCTIVITY UNDER LONG TERM INTENSIVE CROPPING

Amreen Siddiqui<sup>1</sup>, Anupama Verma<sup>2</sup> and Ravindra Sachan<sup>3</sup>

<sup>1</sup>Department of Soil Science and Agricultural Chemistry, C.S.U.A.&T, Kanpur (U.P.) – 208002

<sup>2</sup>Department of Crop Physiology, C.S.U.A.&T, Kanpur (U.P.) – 208002

<sup>3</sup>Division of Agriculture Chemistry, National Sugar Institute, Kanpur (U.P.) - 208017

# What is Soil Productivity?

To understand the concept of soil productivity it is requisite to understand the concept of soil fertility first. So, the soil fertility is considered as an index of available nutrients to plants and defined as “an inherent capacity of soil to supply plant nutrients in adequate amount and in suitable proportions to sustain the growth and development of plants.” Soil fertility is the potential status of soil to produce crops and it is considered as one the most vital factor of crop production also, it depends upon physical, chemical and biological factors of soil.

Whilst soil productivity is a broader term used to indicate crop yields and defined as “the capacity of the soil to produce crops with specific systems of management of management of inputs and is expressed in terms of yields.” Soil productivity is the function of soil fertility, management and climate depending upon location, physical condition etc. Soil productivity is kind of like managing a budget. We look at what we put into the soil—like water, nutrients, different plant varieties, pest control, and labor—and compare that to what we get out of it, which is usually the crop yield. One way we measure productivity is by checking how efficiently we use those inputs, like how well we manage our water or nutrients. But there’s more to the story than just the yield. We also have to think about the side effects, like runoff, erosion, or nutrient leaching, which can affect the environment and nearby communities. These unintended consequences are important while evaluating the overall effectiveness besides soil fertility or say productivity.

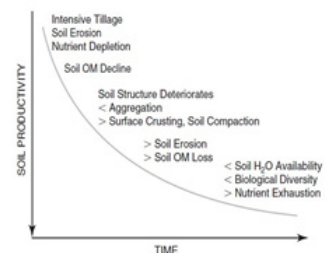
Though both soil fertility and productivity go hand in hand because a fertile soil can be or cannot be productive but all productive soils are fertile in nature. According to modern

usage, on top of soil fertility and productivity, soil health is also a predominant factor to be considered for better understanding of the ongoing concept and could be defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Healthy soil gives us clean air and water, bountiful crops and forests, productive grazing lands, diverse wildlife, and beautiful landscapes.

## What is Soil Productivity?

Intensive cropping is an agricultural method aimed at maximizing crop yield per unit area through high-input, high-output techniques. It involves frequent harvesting, use of chemical fertilizers, pesticides, and advanced irrigation systems, ensuring crops receive optimal nutrients and water. Mechanization plays a significant role, enhancing efficiency and reducing labour costs. Since India's intensive cropping trend has evolved significantly over the years. Traditionally focused on staple crops like rice and wheat, there's been a noticeable shift towards more diverse and high-value crops such as fruits, vegetables, and horticultural products. However, this shift also brings challenges despite of being simple in practice as compared to traditional approaches to cultivation, includes increased water demand, soil nutrient depletion, and the need for sustainable practices to maintain long-term soil health.

**Figure**  
Soil management practices that degrade soil health ultimately reduce the soils ability to support crop production.



# Why Soil Productivity is Declining:

There are various reasons which are responsible for continuously declining soil productivity but some of them worth mentioning are described below:

- **Nutrient Loss:** Long term intensive cropping is majorly responsible for nutrient deficient soils because continuous harvesting abruptly depletes existing soil organic matter hampering soil health. Minimal input of organic sources and imbalanced fertilization along with chemical buildup leads to nutrient losses.
- **Soil Erosion and compaction:** For preparing seed beds and frequent planting, extensive use of heavy machinery is a quite common practice in intensive agriculture which could be either for tillage purpose or may be for sowing, interculture operations and harvesting. Thus, due to the following reasons soil erosion and compaction trigger the soil productivity.
- **Chemical Build-up:** Since intensive cropping involves heavy fertilization which in one or the other way results in excessive growth of weeds and both the weeds and crops harbours pests

and diseases. Thus, to keep a check on them herbicides and pesticides are used heavily which ensue the accumulation of pesticides and herbicides in the soil over time.

- **Soil Acidification:** The continuous application of nitrogen-based fertilizers can lower soil pH, making it more acidic. Acidic soils can impair plant growth and reduce the availability of essential nutrients, particularly phosphorus. Acidification also affects microbial activity, further degrading soil health.
- **Salinization:** Irrigation, especially in arid and semi-arid regions, can lead to salinization when water evaporates and leaves salts behind. Without proper drainage, these salts accumulate in the soil, raising salinity levels to the point where they become toxic to plants. This process degrades the soil structure and reduces its fertility.
- **Reduced Biodiversity:** Intensive monoculture cropping reduces biodiversity both above and below ground. Diverse plant species contribute to a healthy soil ecosystem by supporting a wide range of soil organisms. Monocultures disrupt this balance, leading to a decline in soil microbial diversity and overall soil health.



# Sustainable Farming Practices:

The sustainable farming practices which helps to avoid the gradual decline of soil productivity under long term intensive cropping:

- **Crop Rotation and Diversification:** Rotating crops and including leguminous plants in the rotation can break pest cycles, improve soil structure, and enhance nutrient availability. Diversification also reduces the risk of soil-borne diseases.
- **Using Cover Crops:** Planting cover crops during off-seasons protects the soil from erosion, adds organic matter, and improves soil moisture retention. Cover crops like legumes can also fix nitrogen, enriching the soil.

- **Conservation Tillage:** Reducing tillage helps preserve soil structure, reduce erosion, and maintain organic matter. Techniques like no-till or reduced-till farming minimize soil disturbance and promote a healthy soil ecosystem.
- **Integrated Pest Management:** Using biological, cultural, and chemical methods to manage pests reduces the reliance on chemical pesticides, preserving soil health and biodiversity.
- **Organic Amendments:** Adding organic materials such as compost, green manure, and biochar improves soil fertility, water-holding capacity, and microbial activity. These amendments enhance soil health and resilience.

**Figure**  
Soil productivity is reduced by soil degrading processes and improved by soil conserving practices.



## Conclusion

Soil productivity under long-term intensive cropping presents a complex balance between maximizing agricultural yields and maintaining soil health. Since, long-term intensive cropping poses significant challenges and opportunities for soil productivity. Sustaining high crop yields over extended periods requires careful management of soil health to prevent degradation. Intensive cropping often leads to the depletion of essential nutrients, reduction in organic matter, and soil structure degradation due to continuous cultivation and limited crop diversity. To maintain soil productivity under these conditions, it's crucial to adopt sustainable agricultural practices.