

# CHALLENGES AND OPPORTUNITIES IN MODERN AGRONOMY



**Diya<sup>1</sup>, Mohit Kashyap<sup>2\*</sup> and Ankit Saini<sup>1</sup>**

<sup>1</sup>Dr. KSG Akal College of Agriculture, Eternal University,  
Baru Sahib, Sirmaur, Himachal Pradesh, India

<sup>2</sup>Department of Soil Science, CSK HPKV, Palampur, HP,  
India-176062

In terms of any communication correspondence is pertained to:

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*[mmkashyap222@gmail.com](mailto:mmkashyap222@gmail.com)*

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Diya<sup>1</sup>, Mohit Kashyap<sup>2\*</sup> and Ankit Saini<sup>1</sup>

<sup>1</sup>Dr. KSG Akal College of Agriculture, Eternal University, Baru Sahib, Sirmaur, Himachal Pradesh, India

<sup>2</sup>Department of Soil Science, CSK HPKV, Palampur, HP, India-176062

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## Abstract

With the constantly increasing population and extended urbanization, people's migration toward cities and fragmentation of agricultural land is increasing day to day. This stands to be the biggest challenge faced by agriculture and mankind in the near future. The problems mentioned here in this article are considered to be modern agricultural challenges like climate change, development of resistance among species and subspecies, inflation etc. Apart from this, there is a complete change in the trend and tastes of the consumers regarding food and eating habits. Loss of biodiversity, decreasing underground water levels and land productivity are some of the results of the past actions by mankind. With the advent of newer technologies, there comes new problems too. Skillset and availability of skilled labour come under this category. Some of the solutions include Climate-Smart Agriculture, Adopting Ag-Tech, treated seeds & Genetically Modified Crops, protected agriculture & Precision Agriculture, Improved Management Practices, adopting new technologies like Data analysis, Big Data, Drone technology and others. A detailed set of challenges faced by the farmers in recent agriculture and the acts of solutions that can withhold and improve the state of agriculture and its dependents.

**Keywords:** Agronomy, climate change, precision farming, sustainability and resource efficiency

## Introduction

The global population is expected to reach 9.5 billion by 2030. Developing and underdeveloped nations will see a way bigger population surge. People moving from rural to urban areas for a better life puts finite resources in relatively smaller areas under crazy pressure. This messes with the economy of these nations and makes the challenges with sustainable agriculture production and land management even worse. Modern agriculture faces a bunch of challenges like climate change, soil management, keeping crops healthy, and boosting soil biodiversity worldwide. With population growth and urbanization happening fast, the land available for farming is shrinking like crazy. This brings up big questions about nutrition and food security for the growing population worldwide. Plus, people's lifestyles are changing, leaving them dealing with malnutrition issues. The farming community and research groups globally be on top of their game with lots of other factors. Here's what they are dealing with climate change, soil erosion, underground water levels dropping, biodiversity loss, population rising, urbanization, migration, labour availability and agricultural land shrinking.

## Climate change

Climate change refers to long-term shifts in global average temperatures and other weather patterns such as precipitation etc. The impact of global warming is causing climate change and the consequences are being felt around the world in different ways (IPCC, 2014). Consequently, some parts of the world are facing severe drought, whereas others are facing severe floods. Further, there is a chance of submergence in the coastline city and habitats too (Irrgang et al., 2022). Increases in temperature have been shown to decrease crop yields over time, while simultaneously encouraging the growth of weeds and pests, making agriculture highly susceptible to climate change (Malhi et al., 2021). Some major problems like methane mitigation in paddy fields, and livestock rearing has to be addressed with immediate effect. Agriculture, forestry and other land use cause 23% of the greenhouse emissions.

## Natural Calamities



Natural calamities pose a very big threat to agriculture. Some of the major natural calamities include floods, droughts, tsunamis etc. A large amount of fertile land suitable for cultivation may submerge under the water and there may be chances of soil erosion due to flash floods and tsunamis. Global warming and its consequences are one of the reasons for flash floods and submerging of coastal lands due to increased mean sea levels. Agriculture sector is extremely vulnerable to the natural catastrophes such as droughts, floods, storms and tsunamis in developing nations and could lose nearly a quarter of the total yield.

### Soil erosion

Soil erosion happens when water or wind breaks off and takes away soil particles, causing soil to degrade. This impacts how productive the soil is and whether it's sustainable for farming. Right now, only about 12% of the world's land is good for farming. Soil erosion hurts agriculture big time. The consequences include less productivity, lower yields, less efficient irrigation, and reduced land suitability. Recent studies show that the rate at which land is getting taken over by degradation is as high as the rate at which land is getting degraded.

### Land limitations

1. You can't grow every crop on any piece of land. Different soils have different things like structure, texture, fertility, water availability, and agrometeorological factors.
2. These things affect how productive the land and crops are, limiting what crops you can grow where.
3. Along with environmental factors, how farmers do things impacts soil quality. Soil degradation eats away at natural resources.
4. This means we need to take care of the soil so it stays productive.

### Opportunities in Modern Agronomy

1. **Precision Agriculture and Smart Farming:** Precision agriculture utilizes advanced technologies like GPS, IoT sensors, AI, and drones to optimize farming practices. Researchers are exploring ways to improve real-time monitoring, automated irrigation, and site-specific crop management to enhance productivity while minimizing

resource wastage.

**2. Climate-Resilient Crops:** With climate change threatening food security, scientists are developing drought-resistant, flood-tolerant, and heat-resistant crops through genetic modification and selective breeding. This research ensures stable crop production in extreme weather conditions.

**3. Vertical and Urban Farming:** The rising global population and decreasing arable land have led to innovative farming solutions like vertical farming and hydroponics. Researchers are focusing on sustainable urban agriculture to produce fresh food locally, reducing dependence on traditional farmland.

**4. Soil Health and Regenerative Agriculture:** Soil degradation is a critical issue, prompting research into regenerative farming practices such as cover cropping, no-till farming, and organic composting. These methods help restore soil fertility, increase microbial activity, and enhance carbon sequestration.

**5. Sustainable Pest and Disease Management:** Integrated pest management (IPM) strategies, including biopesticides, beneficial insects, and AI-driven early

detection systems, are being developed to reduce dependency on chemical pesticides and minimize environmental impact.

**6. Agri-Biotechnology and Genetic Engineering:** Advances in biotechnology, such as CRISPR gene editing, are enabling scientists to enhance crop resistance, improve nutritional content, and develop biofortified crops that combat malnutrition worldwide.

## Conclusion

The planet's needs and the expectations of the consumers are changing with time recently. The state of agriculture is to be changing with regard to meeting these. Simultaneously, the pressure over the sector to thrive through the challenges clouding stands to be an obligatory mission. For this purpose, the identification of problems and their solutions is important for meeting the basic necessities of the world. It concentrated on recognizing the most important challenges faced in the agriculture sector and the farmer community and also has discussed a few subjects which have the capability to resist the

challenging issues. Farmers face climate change, soil fertility loss, resource availability, urbanization, etc. However, there are aspects like, climate smart agriculture, GM crops, agriculture technologies etc., that can stand in par with these problems as solutions. Nevertheless, the outcomes for these solutions can be varying based on various factors like, type of soil, possible investment, sources available. Considering all these points, the agriculture sector has to be given a strength of push for it to stand tall and meet the par necessities of the population.

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