AgriBio Innovations
(Published by Research Trend, Website: www.agribioinnovations.com)
ISSN NO. (Online): 3049-3862
Volume-2, Issue-1, Jan.-Dec., 2025 2(1): 77-86(2025)

Future Challenges and the Need for Seed Research in Food Security

Eshita Kundu and Sanjoy Kumar Bordolui*
Department of Seed Science and Technology,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia (West Bengal), India.

(Corresponding author Sanjoy Kumar Bordolui)*
(Received: 03 July 2025; Revised: 12 August 2025; Accepted: 28 August 2025; Published: 05 September 2025)
(Published by Research Trend)

DOI: https://doi.org/10.65041/abi.22

ABSTRACT: Food security measures how easily people can obtain food and how readily it is available. It has a strong correlation with socioeconomic status, disposable income, and household resources. Other issues like food prices, the changing global environment, water, energy, and the expansion of agriculture are also closely related to it. Seed security, however, is the foundation of sustainable agriculture since it ensures farmers have steady access to high-quality seeds of their preferred crop varieties. Both food and seed security shares key dimensions like availability, access, utilization, and stability. High-quality seeds directly influence crop yields, resilience to environmental stresses, and long-term food supply. The relationship between food and seed security is illustrated in this study, with a focus on the significance of seed quality, varietal suitability, and seed system resilience. It outlines the challenges in traditional farming practices such as seed dormancy, size, colour, and shattering, and highlights the role of biotechnologies in enhancing seed traits to adapt to climate change, pests and diseases. The impact of environmental, technological, and socio-political factors on agricultural productivity is also examined.

Hunger persists worldwide despite sufficient food production and is frequently caused by poverty, conflict, and environmental shocks. In order to combat hunger, policies that promote sustainable farming methods, education, and poverty alleviation must be implemented. Innovations in biotechnology and conservation of biodiversity are vital for future food systems. There is hope for creating resilient crops to guarantee food security thanks to seed banks and biotechnological developments.

Ultimately, the conclusion is that there is a need for integrated efforts from research and innovation to policy and community support to combat hunger, ensure food and seed security, and promote sustainable agricultural development in the face of growing global challenges.

Keywords: Food security, seed security, germination, vigour.

INTRODUCTION

Food security is the measure of the availability of food and individuals' ability to access it. It has a strong correlation with socioeconomic level, disposable income, and household resources. Other challenges like food pricing, the changing global climate, water, energy, and the expansion of agriculture are also closely related to it.

The most important input for agricultural production is seed, with high-quality seed, one can boost yield without significantly expanding the area under cultivation. The establishment, growth, diversification, and enhancement of crop output have all relied heavily on seeds. One of the main agricultural inputs and a channel for introducing new technologies to farmers is seed. They have been the main factor in the distribution of plant populations over time and geography.

Definition:

Definitions of food and seed security appear quite similar. Two widely-cited definitions, both from the FAO are,

Food security: "All people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO, 1998).

Seed security: "Farming households (men and women) having access to adequate quantities of quality seeds and plant materials of adapted varieties at all times - good and bad" (FAO, 1998).

These definitions illustrate the lack of universality, accessibility, adequate quantity, and suitable quality. Additionally, they outline ideal circumstances (Maxwell *et al*., 2008) and contend that concepts of vulnerability and coping with insecurity are part of the definition of food security. As a result, the definitions given above may be more helpful for outlining rights (FAO, 2005) than for identifying potential security flaws. (McGuire and Sperling 2014).

Objectives:

- To increase wheat, rice, and pulse productivity and production in a sustainable manner.
- To increase farmers' incomes by implementing improved farm management techniques and technologies.
- To guarantee the nation's food security.

Food and Seed Security Frameworks:

These dimensions of food security are:

-Food availability: People, especially the impoverished, should have access to adequate amounts of food of suitable quality, either through domestic production or imports (including food aid).

-Food access: It also highlights the fact that food security is a dynamic term, meaning that people's access to sufficient resources (entitlements) for purchasing the right foods for a healthy diet must remain constant throughout time.

-Utilization: In order to achieve a state of nutritional well-being when all physiological needs are satisfied, food must be used through a sufficient diet, clean water, sanitation, and medical attention. This highlights how crucial non-food inputs are to food security.

-**Stability:** A population, household, or individual must always have access to enough food in order to be considered food secure. They shouldn't take the chance of losing access to food due to cyclical occurrences (like seasonal food insecurity) or abrupt shocks (like an economic or climatic disaster). Therefore, the availability and access aspects of food security can also be referred to as stability.

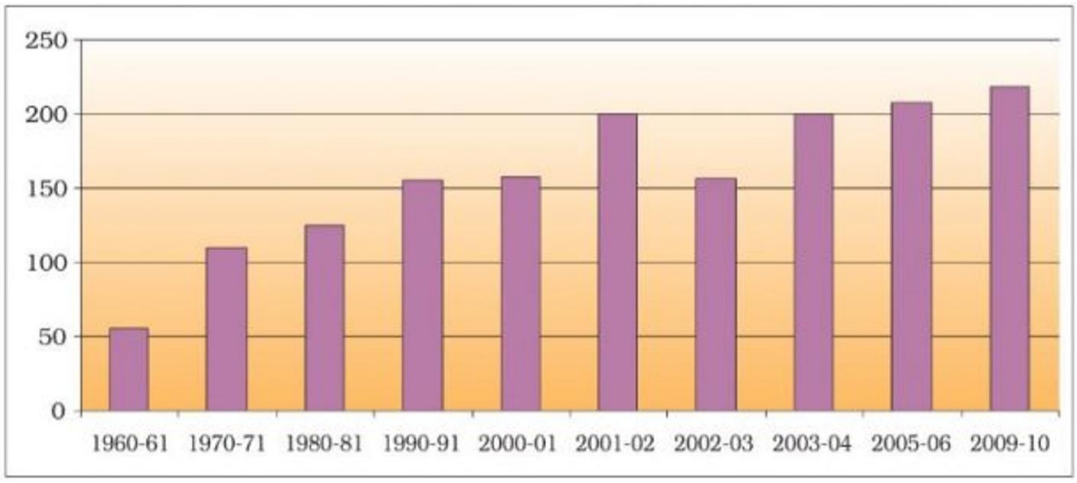

Fig. 1. Production of Food grains in India (Million Tonnes) (Source: Economic Survey, 2011-12).

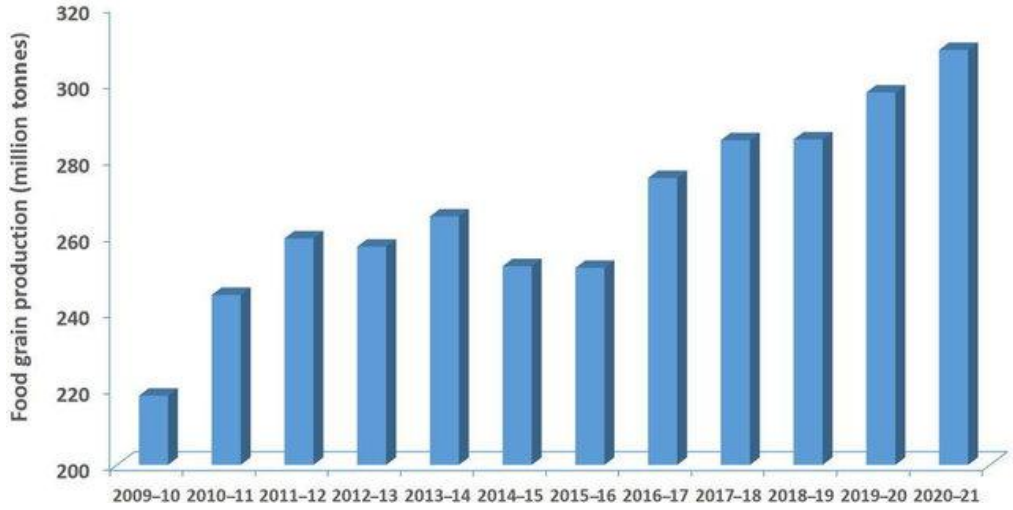

Fig. 2. Total food grain production trend in India during 2009–2010 and 2020–2021. (**Source:** Ministry of Agriculture & Farmers' Welfare, Government of India)

Fig. 3. India Achieves Record-High Food Grain Production in 2022-23 (Source: https://beyondindia.in/india-achieves-record-high-food-grain-production-in-2022-23/#google_vignette)

These dimensions of seed security are:

- **Seed security:** It prevails when both men and women in the household have adequate access to amounts of high-quality seed and planting materials of their favourite crop kinds throughout both good and bad cropping seasons.
- **Seed Availability:** It is the state in which local farmers' seed needs are met by a sufficient supply of seeds from various sources, including social networks, local marketplaces, the official seed industry, and seed aid suppliers (Bordolui *et al*., 2015). The farmer should be able to get the seed in time for sowing and it should be reasonably close.
- **Seed Access:** It exists when farmers can obtain seed via buying, borrowing, trading, bartering, or using their influence in social networks.
- **Seed Varietal Suitability:** It is the available seeds of crop varieties that farmers favour based on a variety of desired attributes. Look, flavour, aroma, storability, fodder production potential, high revenue potential, high production potential, resistance to pests and diseases, and whether or not there is extraordinary resistance in the fields are some examples of the qualities. Farmers need seeds that they know people prefer and that they know will increase yield and benefit. Since utilizing improved seed varieties alone can enhance crop yields by 20–30%, seed quality is a crucial factor in agricultural progress.
- **Seed Quality:** It includes the following technical factors: seed health, physical purity, varietal purity, and germination.
- **Resilience of the Seed System:** This is the seed system's ability to withstand, adjust to, and recover from biotic (disease and pest) and abiotic (drought, floods, water logging, etc.) stressors and shocks that endanger household income, food and nutrition security, and livelihoods. In both good and bad cropping seasons, the entire seed system should help ensure that there is always ample availability to appropriate amounts of adapted and favoured seed (Abebe and Alemu 2017).

Fig. 4. Seed market value in India. Note: RSP= Retail Selling Price (Source: https://www.wm-strategy.com/news/india-nuts-and-seeds-market-to-grow-at-cagr-of-8-75-until-2025)

Market Size and Forecast:

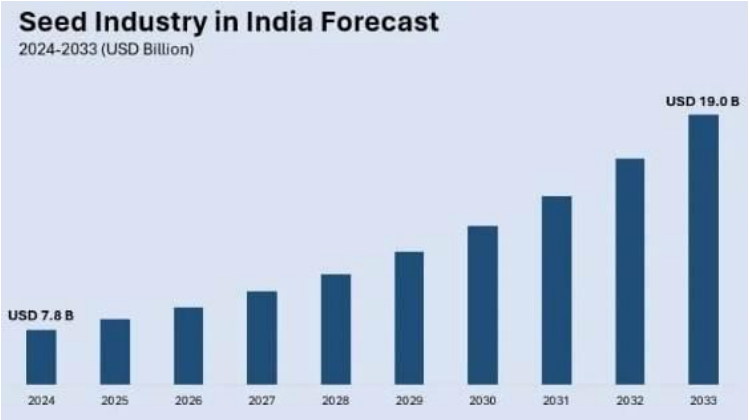

Fig. 5. The size of the seed industry in India reached USD 7.8 Billion in 2024 and the market is projected to reach USD 19.0 Billion by 2023, exhibiting a growth rate (CAGR) of 10.5% during 2025-2033 (Source: https://www.imarcgroup.com/seed-industry-in-india).

Food Security- world scenario

- As of 2024, 638-720 million people globally are estimated to be facing hunger. (FAO, IFAD, UNICEF, WFP and WHO, 2025).
- Approximately 2.3 billion people suffer moderate or severe food insecurity. (FAO, 2025)
- The cost of a healthy food is growing in many places due to supply chain shocks, inflation, and other factors, making it unaffordable for a significant section of the world's population (FAO, IFAD, UNICEF, WFP and WHO, 2024).

Food Security in India

- About 12% of India's population is undernourished (172 million people). In terms of undernourishment, India still ranks seventh in Asia and 48th internationally, despite an improvement from 243 million in 2006.
- A large share of people cannot afford a healthy diet. In India, ~42.9% of people cannot afford a healthy diet under current food price levels.

West Bengal Scenario

- To improve food security, West Bengal has its own state-level initiatives. One significant program is "Khadya Sathi", which covers over 8.5 crore (approximately 85 million) persons as of recent years.
- That's ~ 90% of the state's population. Under this scheme, food grains (rice, wheat) are provided at ₹2 per kg (rice or wheat) or half the market price for certain categories.

SEED SUPPLY CHAIN

The supply chains for inputs are extremely intricate, extending from the Ministry of Agriculture to the national seed agency, which provides the foundation seed, and then passing via outgrowers, distributors, wholesalers, retailers, and frequently numerous other channels before the farmer plants the seed.

The picture illustrates how informal and formal seed systems interact to provide farmers with seeds. The same broad phases or processes that occur in the formal sector during seed production processing also occur in the local system: variety selection, testing, introduction, seed multiplication, selection, distribution, and storage (Bordolui *et al.*, 2020). However, the informal system operates as a component of farmers' production systems rather than as separate endeavours (Chand and Kc 2020).

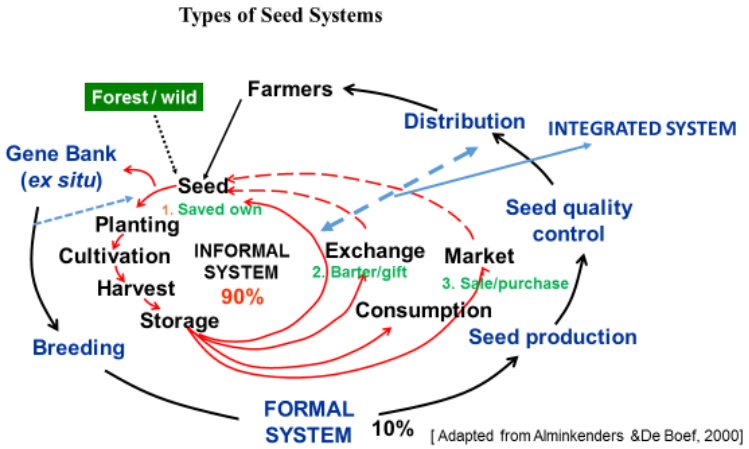

Fig. 6. Types of seed systems, Formal, Informal and Integrated Seed System (Gauchan and Shrestha 2020).

WHAT IS HUNGER?

The UN's Hunger Report states that the term "hunger" refers to times when people are severely food insecure, which means they go for days at a time without eating because they lack access to food, money, or other resources. Here are some widely accepted definitions:

-The discomfort brought on by a shortage of food is known as hunger. Less than 1,800 calories per day is the cutoff point for undernourishment, also known as food deprivation.

-Deficits in energy, protein, and/or vital vitamins and minerals are indicated under nutrition, which goes beyond calories.

-Undernutrition and overnutrition (issues with imbalanced diets) are both considered forms of malnutrition.

-The availability, accessibility, and use of food are all related to food security. A person is said to be food secure if they consistently have access to enough safe and nourishing food to sustain an active and healthy life.

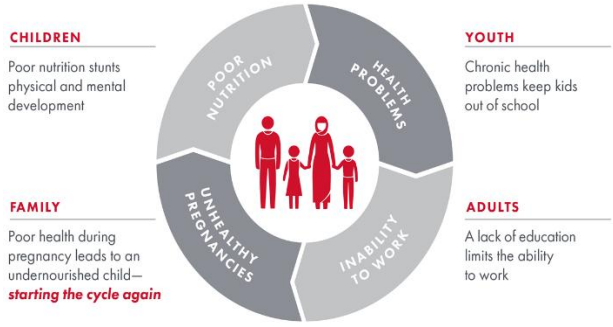

Fig. 7. Hunger (Source: World Hunger).

WHAT CAUSES HUNGER?

Hunger and poverty are closely related, and they are influenced by a variety of social, political, demographic, and societal factors. Food insecurity in the home, improper care practices, and unsafe living conditions with poor access to clean water, sanitary conditions, and hygiene, as well as limited availability of health care and education, are all common among those living in poverty and all contribute to hunger.

The UN Security Council acknowledged in May that conflict is a major cause of serious food problems, including famine. Long-term conflicts and weak institutions are significantly more conducive to hunger and undernutrition. Conflicts are becoming more frequent, with some being made worse by shocks brought on by climate change. More than ever, individuals and groups fighting hunger need to adopt conflict-sensitive strategies. Food insecurity has increased as a result of weather-related catastrophes, which are partly linked to climate change. These disasters have also affected the supply of food in many nations. Food availability and accessibility have also been impacted by economic downturns in nations that rely on the export of key commodities, such as oil.

-The cycle of hunger

Hunger can keep people stuck in a cycle of need and poverty in a variety of ways. This is how it can affect a person for the rest of their life and be passed down to the following generation.

KEY FACTS ABOUT GLOBAL HUNGER

-Even though there is more than enough food produced worldwide to sustain everyone, up to 811 million people still die hungry.

-World hunger, which affects 9.9 percent of people worldwide, is increasing after a ten-year decline.

-The COVID-19 pandemic, violence, and climate change were the main causes of the 161 million increases in the number of undernourished individuals between 2019 and 2020.

-The UN released a report outlining global progress towards that objective in 2015.In the world, the percentage of undernourished individuals has decreased from 15% in 2000–2004 to 8.9% in 2019.

- A new set of Sustainable Development Goals (SDGs) was mapped out by world leaders in 2015. By 2030, "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" is the second of these goals.

Problems and remedies for Traditional Farming:

-Germination and Dormancy

For an integrated study of seed biochemistry, physiology, taxonomy, and crop economy, further investigation and analysis are required before making broad generalisations that can appropriately relate to different elements of seed quality, including longevity (Choudhury and Bordolui 2023). For instance, light is necessary for the germination of certain lettuce kinds' seeds. For this reason, seeds that are buried deeply in soil or covered with soil stay dormant (Choudhury and Bordolui (2022). By using growth regulators or breeding, this light requirement can be removed.

-Seed Size, Hardness, Color, and Vigor

During harvesting and postharvest processes, the soft, starchy seeds of sorghum and maize can sustain mechanical damage that impairs their storability. The seed size has an impact on the size and health of seedlings. The dry weight of the seedling and the seed weight are directly correlated (Chakraborty and Bordolui 2021). A seedling can emerge from deeper soil thanks to large seeds. For small-seed crops like grasses and forage legumes, larger seeds are especially crucial. For improved emergence, these seeds must be placed shallowly; as a result, they risk drying out in the top soil layers and losing their vitality. It is possible to plant large seeds deeply enough for the roots of the seedlings to reach damp soil before the top layer of soil dries out. However, several food crops, such watermelon, eggplant, tomatoes, okra, and cucurbits, have big seeds that consumers find unacceptable. To increase the planting value of these vegetable crops, few attempts may be made to develop types

with larger seeds. There has been some success in research attempts to cross farmed sweet clover with recently introduced large-seeded annual plants.

Crop establishment is hampered by the existence of hard seeds that take a long time to germinate, such as lucerne, sweet clover, and genuine clover. Additionally, compared to the softer-seeded variants of cotton, maize, and sorghum, the hard or corneous seeds of these crops are more resilient to seed rots and seedling blights. In Canada, selection for a higher proportion of hard seed in legumes has occasionally resulted in decreased plant vigour.

The colour of the seed is also crucial. In general, coloured seeds germinate and grow more vigorously than white seeds. Lima beans and garden peas have green cotyledon instead of yellow. It is challenging to determine the proper harvest maturity since it is hard to visually evaluate green seeds to determine their level of maturity. Seed colour and pattern inheritance is frequently complex. A dominant inhibitor can repress a few fundamental genes that are responsible for the expression of anthocyanin colours. For all seeds that are directly eaten, the seed coat's tenderness is crucial. Thin seed coats are typically linked to tenderness, whereas as crops mature, their thickness increases.

-Bolting Resistance

Certain biennial crops such as beets, cabbage, celery, onion, and spinach tend to produce seed during the crop season. Such plants use food and energy to produce a seed stalk, making the root or top worthless for harvest. It is essential to breed slow bolting varieties of such crops. However, the plants must be able to bolt during the seed-producing season. The genetic make-up of the plant determines its response to light and temperature, but treatment with growth regulators like gibberellins may induce plants to bolt. More research is required to understand the biochemistry and physiology of bolting in crop plants.

-Prevention of Seed Shattering

Most seed crops are challenging to harvest as they take a long time to mature and break readily when handled and harvested (Kumar *et al.*, 2023). Low yields of forage crops like birds foot trefoil, lupines, and reed canary grass are primarily caused by large shattering losses before all of the plant's seeds are fully grown. Efforts to reduce seed cracking in grasses like phalaris have included the development of specialized harvesting tools, the application of sprays to bind inflorescences and prevent seed drop, and selection for more compact and rigid inflorescences. However, the most successful approach has been to identify and select non-shedding natural mutants with a strong, non-brittle rachilla that anchors the seed in the spikelet at maturity. In terms of genetic regulation, they are different from their wild counterparts because they have mutations that resemble those in main cereals. Many other grass species and crops, including beans and peas, may have mutations similar to those seen in phalaris that prevent seeds from breaking. However, because these mutations are at a selective disadvantage in the wild, their frequency in natural populations will be minimal.

-Plant Growth regulators and their novel uses

In case of crop growth and development, biochemical modification is a very successful method for greatly increasing agricultural crop seed yields (Dandapat and Bordolui 2025; Ray *et al*., 2023). However, commercial application of these chemicals to herbage seed crops (e.g., ancymidol in grasses) is not feasible due to their high cost. Reduced yields of herbage seed crops are frequently associated with unfavourable anthesis and harvest weather conditions. If growth regulators like cycocel (CCC) and other growth inhibitors can prevent lodging of forage and other crops, it may be possible to promote yield stability and raise these crops' yields for the long-term economy (Elavarasan *et al*., 2023). The development of an adequate growth-regulating chemical also requires the establishment of other pertinent elements (Ray *et al*., 2023; Mukherjee *et al*., 2022).

-Weed and Pollination Control

It has been advantageous to test novel herbicides for weed control in crop production. The development of new herbicides has mostly taken place in arable environments. In the future, seed producers will be more sympathetic to the weed-control strategies used by grassland farmers. Herbicides are crucial, but we shouldn't overlook other options. Research on cultural weed control techniques in grass seed crops, like *Lolium* sp., has been scant. It is impossible to overstate the value of crop rotation in weed management for cereal crops or the necessity of proper seed crop establishment and maintenance after planting in order to lessen the issue of grass weed invasion.

With the right selection methods, auto tetraploid crops like red clover can significantly increase their seed-setting ability. However, a significant improvement in pollination conditions will be necessary to fully utilize the seed-setting potential. Due to their extreme variability and declining population, bumble bees are not dependable pollinators. In order to increase honeybee pollination, either plants should be bred to be more appealing or bees should be encouraged to visit bigger forage crop regions.

Relationship between food security and seed security:

1. Seed security is the foundation of food security

- Without quality seed, farmers cannot produce enough food.

- Good seeds increase yield, resilience to pests/diseases, and tolerance to climate stress leading to stable food supply.

2. Varietal diversity ensures dietary diversity

- Seed security provides farmers with diverse crop varieties (cereals, pulses, vegetables, fruits).
- This diversity translates into more nutritious diets and reduced dependency on a single crop.

3. Climate resilience

- Seed security promotes availability of drought-tolerant, flood-resistant, or heat-tolerant seeds
- This ensures food production continues even under adverse climate conditions → safeguarding food security.

4. Economic link

- Farmers' income depends on productive crops, which come from quality seeds.
- Higher income = better access to food → strengthening household food security.

5. Community resilience

- In emergencies (drought, floods, war), both seed and food systems collapse.
- Restoring seed security (through seed banks, local seed systems) is critical for rebuilding food security.

Here are some examples showing the link:

- Kenya's hybrid maize program (Western Seeds) offered improved seeds to farmers who had not been using them and the average yields increased by ~25 % in mid altitude zone. (Bird *et al*., 2020)
- In Tanzania Improved varieties raised production from about 1.7 tons/ha (local) to 3.5 to 4 tons/ha with improved seeds (Kadigi, 2025). Also in simulations, improved seed users had 33% probability of yield > 2 t/ha vs ~11% for local seed users.
- India has brought ~10 million hectares under biofortified varieties in recent years (wheat, rice, pearl millet, mustard, and lentil) as per government replies, which help to treat micronutrient deficiencies (hidden hunger) (Yadava *et al*., 2018).

EXPECTATIONS FROM NEWER BIOTECHNOLOGIES

1. Future Prospects:

Recombinant DNA and *in vitro* biological methods, such as micro-propagation, synthetic seed technology, and the creation of genetically modified or transgenic plants, are referred to as new biotechnology. The three main areas in which these techniques will be useful are (a) effective tools for traditional breeding methods, (b) a way to create transgenic plants, animals, and other beneficial organisms, and (c) a way to incorporate beneficial microorganisms into different agricultural production systems, like industrial and agricultural waste management. Indeed, the new biotechnology that has been applied to agriculture over the past few decades has created new opportunities. Its accomplishments to date have already surpassed earlier projections.

- The main tenets of agricultural biotechnology are biodiversity and environmental concerns. Industrial and financial organisations have taken notice of the fundamental need to preserve natural germplasm variability and safeguard it from potential extinction. The World Monetary Fund (WMF) announced at the 1996 World Congress on Biodiversity in Buenos Aires, Argentina, that 100 million US dollars would be allocated for three years to preserve biodiversity. This was the clear result of the 1992 Rio de Janeiro convention, in which 162 states agreed to preserve the biodiversity of germplasms, species, and ecosystems.
- Biodiversity gives developing nations a rare chance to build lucrative enterprises based on rare genotypes and recently discovered substances that are unique to their areas. Another example of how biodiversity may benefit human health is the neem tree, which was used for many years in India to control fertility in agriculture and is now being processed industrially for the same purposes in developed nations. Palclitaxel (Taxol), which is taken from South American rain forest trees and used as an anticancer medication, is another example. In order to establish a compensation agreement between the sources of biodiversity and the accessors who transform these sources into an economic commodity, significant legal concerns are raised, including how to protect the rights of both developed and developing nations.

2. Environmental Considerations

-The effects of many environmental conditions, both separately and in combination, on seed development and germination are well documented. To some degree, we also understand the biochemical processes that sense environmental circumstances (e.g., phytochrome) and control the plant's reaction. Understanding the synthesis and breakdown of certain macromolecules in seeds, the function of enzymes in cellular metabolism, and genetic and hormonal regulatory systems is progressing.

-Before broader ecological ramifications are taken into account, much more needs to be understood about the genetics, biochemistry, and physiology of seeds in all environments. To select plant species based on their natural distribution, a more recent method is required, one that necessitates a deep understanding of their ecology. Comparative studies involving species with different levels of environmental tolerance should be tried whenever feasible. All ecologists will eventually gain from this basic understanding since it will provide them some degree of control over the growth and development of crop seeds and seedlings.

-Agriculture in many nations, including India, is still heavily reliant on the whims of monsoon rainfall, which lowers crop yield. There hasn't been much development in drought proofing. The interesting tasks that lie ahead include breeding crops to be resistant to biotechnology. Other concerns of the future agricultural scenario include changes in the global temperature, CO_2, and biotic pressures including drought, salinity, alkalinity, frost, cold, and heat through the new and ozone layer. A changing crop complex combined with weather extremes like heavy rains and severe droughts could lead to the emergence of new insect pests and abiotic issues (Rao *et al*., 2023). To guarantee enough food for all populations, it is becoming more and more crucial to find and develop improved agricultural crop seeds using newer biotechnological techniques, such as trade culture, in vitro micro-propagation, and transgenic technology that can withstand drought, heat, and cold as well as the threat of diseases and insect pests. The key to the continuation of human life is agricultural crop plants, and the main component of this endeavour is seed.

3. Biosecurity

The policy and regulatory frameworks (including tools and actions) that evaluate and manage risks in the areas of food safety, animal and plant life, and health, as well as related environmental risk, are all part of the strategic and integrated approach known as biosecurity. The introduction and release of genetically modified organisms (GMOs) and their products, zoonoses, plant pests, animal pests and diseases, and the occurrence and control of invasive alien species and genotypes are all included in the concept of biosecurity. A comprehensive idea, biosecurity has a direct bearing on food safety, agricultural sustainability, and environmental preservation, including biodiversity.

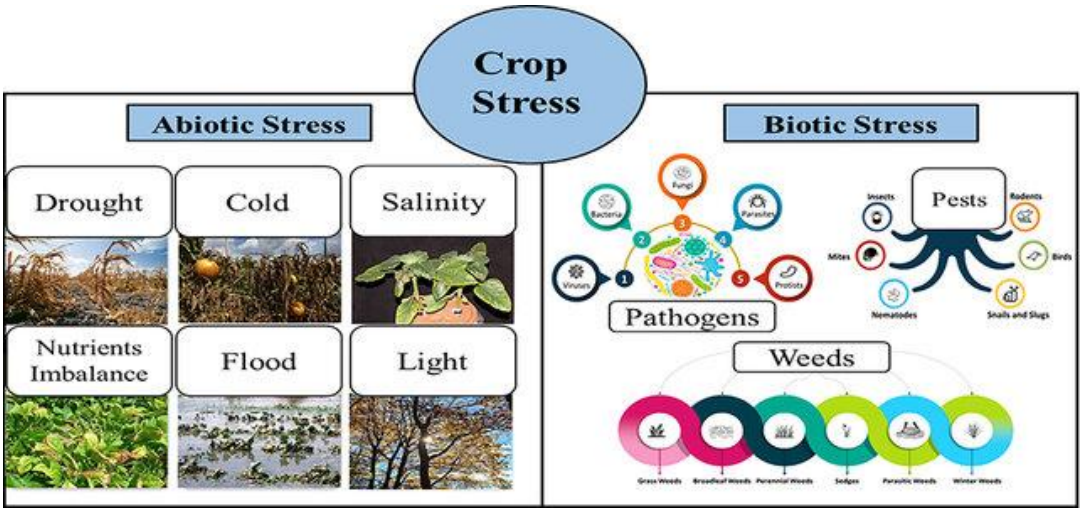

Fig. 8. Classification of plant stress: Abiotic and biotic stress (Sharma and Sharma 2025).

4. Threat of Antiscience Zealotry

The most pressing question now is whether farmers will be allowed to adopt agricultural biotechnology, even though we currently have the capability to feed the 8.3 billion people that are expected to exist in the next 25 years. For many individuals in the industrialised countries, GM crops have become the latest manifestation of wicked bio technology that sacrifices both humans and the environment. People who are adamant that genetically modified crops are a threat to biodiversity and human health are on one side of the contentious debate, while scientists who are certain that GMOs are a technology with enormous potential to increase food and fibre production in an environmentally friendly manner make up the other side. Environmental movement extremists, mostly from wealthy, developed countries and/or affluent societies in developing countries, have fuelled anti-biotechnology zealots' propaganda and vandalism activities. Some scientists have even joined this extreme environmental movement, even though many of them should or do know better.

Food security and hope

A seed is an investment in hope for whoever planted it. That's one of the things that make seeds appealing. The gardener might be hoping for a lovely flower or even a tasty zucchini squash. The harvests of this year's cash crops, fodder, or produce are our farmers' only hope. All seeds have the capacity to produce new life, regardless of their size or shape.

Additionally, seeds are essential to the human population's food security (Mukherjee and Bordolui 2022). In case of an emergency, scientists store seeds in seed banks (Ray and Bordolui 2021). To create novel, disease-resistant crops, they use seeds from various varieties. The genetic material in seeds is the first step towards other traits for new types, such as drought resistance and longer shelf life. The vast bulk of our crops' genetic information is found in seeds, but occasionally other methods must be used to preserve genetic diversity.

CONCLUSIONS

A nation must have food security in order to guarantee that food is always available and prevent situations similar to hunger. While those who are better affluent may experience food insecurity at times of famine, tragedy, or calamity, those who are below the poverty line may experience food insecurity all the time. Additionally, in terms of seed security, they can restore and boost agricultural productivity by providing high-quality seed of suitable types, which will lessen or completely eliminate reliance on food aid after the next harvest.

Hunger and food insecurity have persisted throughout history. The government has taken action to assist those in need during periods like the Great Depression.

Even though the issue of hunger is no longer evident, many people are nevertheless in comparable circumstances today. The government continues to work to help people in need, and the problem of food insecurity is becoming more widely known as a result of studies and media attention. Scientists and communities are also fighting social stigmas and helping individuals who are hungry.

FUTURE SCOPE

There is scope for research on increasing the quantity and quality of seeds to lessen food insecurity.

Acknowledgement. The authors express gratitude to the Bidhan Chandra Krishi Viswavidyalaya's Department of Seed Science and Technology, Mohanpur, Nadia, West Bengal, 741252.

Conflict of Interests. None.

REFERENCE

Abebe, G. and Alemu, A. (2017). Role of improved seeds towards improving livelihood and food security at Ethiopia. *International journal of research grant haalayah*, *5*(2), 344-346.

Bird, S. S., Carter, M. R., Lybbert, T. J., Mathenge, M. and Njagi, T. (2022). Filling a niche? The maize productivity impacts of adaptive breeding by a local seed company in Kenya. *Journal of Development Economics, 157*, 102885.

Bordolui, S. K., Biswas, S. and Chattopadhyay, P. (2020). Seed village Programme – A New Vista for Strengthening the Integrated Seed System. *Research and Reviews: J. of Environmental Sciences*, *2*(1), 1-7.

Bordolui, S. K., Sadhukhan, R. and Chattopadhyay, P. (2015). Participatory evaluation of some folk rice genotypes. *Journal Crop and Weed, 11*(2), 59-62.

Chakraborty, A. and Bordolui, S. K. (2021). Impact of Seed Priming with Ag-Nanoparticle and GA_3 on Germination and Vigour in Green gram. *Int. J. Curr. Microbiol. App. Sci*., *10*(03), 1499-1506.

Chand, H and Kc, B. (2020). Quality seeds for food security and food self -sufficiency during havoc of covid-19 in Nepal, *Tropical Agroecosystems (Taec)*, *1*(2), 71-78.

Choudhury, A. and Bordolui S. K. (2022). System of Biological Approaches to Interpret Seed Dormancy and Germination. *International Journal of Environment and Climate Change*, *12*(11), 2454-2481.

Choudhury, A., and Bordolui, S. K. (2023). Concept of seed deterioration: reason, factors, changes during deterioration and preventive measures to overcome seed degradation. *American International Journal of Agricultural Studies*, *7*(1), 41-56.

Dandapat, S. and Bordolui, S. K. (2025). The Effective Use of Phytohormones for Seed Priming: A Successful Method for Improving Germination and Vigour in Rice. *International Journal on Emerging Technologies, 16*(1), 63–67.

Elavarasan E., Kamaraj, A., Sunil Kumar, B., Satheesh Kumar, P. and Suganthi, S. (2023). Effect of Bio-Stimulant Application on Seed Yield and Seed Quality in Rice (*Oryza sativa* L.). *Biological Forum – An International Journal, 15*(10), 493-497.

FAO (1998). Seed and Plant Genetic Resources Service, 'Developing seed security strategies and programs for food security in developing countries', Proceedings of the International Workshop on Seed Security for Food Security: Contributions for the development of seed security strategies in disaster-prone regions, Florence

FAO (2005). Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. Rome: FAO.

FAO, IFAD, UNICEF, WFP and WHO. (2024). The State of Food Security and Nutrition in the World 2024 – Financing to end hunger, food insecurity and malnutrition in all its forms. Rome.

FAO, IFAD, UNICEF, WFP and WHO. (2025). The State of Food Security and Nutrition in the World 2025 – Addressing high food price inflation for food security and nutrition. Rome

Gauchan, D. and Shrestha, R. B. (2020). Community Based Seed Systems for Agrobiodiversity and Resilient Farming of Smallholder Agriculture in South Asia. In book: *Strengthening Seed Systems and Farmers' Rights for Improving Food & Nutrition Security in South Asia*. Publisher: SAARC Agriculture Centre (SAC), 29-54

Kadigi, L. I. (2025). Improved Seeds and Rice Productivity in Tanzania: Policy Insights from National Sample Census Data. 10.21203/rs.3.rs-7280225/v1.

Kumar, R., Jamwal, A., Rawat, P., Sharma, S. and Singh Negi, P. (2023). Seed Collection, Extraction and Processing of Important Woody Species of Western Himalayan Region of India. *Biological Forum –An International Journal, 15*(2), 504-513.

Maxwell, D., Sadler, K., Sim, A., Mutonyi, M., Egan, R. and Webster, M. (2008). Emergency Food Security Interventions. 145, London

McGuire, S. and Sperling L. (2014). The links between food security and seed security: Facts and fiction that guide response. *Development in Practice*, *21*(4 –5), 493-508

Mukherjee, A. and Bordolui, S. K. (2022). Eminent Roles of Micro-nutrients in Quality Seed Production. *International Journal of Plant & Soil Science*, *34*(23), 324-342.

Mukherjee, A., Bordolui, S. K. and Sadhukhan, R. (2022). Stimulatory Effect of Different Plant Growth Regulators on Cosmos seed Production in

New Alluvial Zone. *Biological Forum – An International Journal*, *14*(2), 137-142.

Rao, D., Chaithanya G., Dawar, R., Chandi, R. and Sahoo, M. (2023). Improving Seed Quality by Seed Priming under Abiotic Stress Condition: A Review. *Biological Forum – An International Journal, 15*(5), 875-885.

Ray, J. and Bordolui S.K. (2021). Role of Seed Banks in the Conservation of Plant Diversity and Ecological Restoration. *Research and Reviews: J. of Environmental Sciences*, *3*(2), 1-16.

Ray, J., Bordolui, S. K. and Murmu, K. (2022). Influence of seed priming and foliar application of GA_3 on tomato seed production in West Bengal, India. *Scientist*, *1*(3), 3458-3471.

Ray, J., Bordolui, S. K. and Murmu, K. (2023). Influence of seed priming and foliar application of GA_3 on fruit morphology and biochemical composition of tomato in Gangetic Alluvial Zone. *Theoretical Biology Forum*, *12*(2), 1-14.

Remington, T., Marok, J., Walsh, S., Omanga, P. and Charles E. (2002). Getting of the Seeds and tools Treadmill with CRS Seed Vouchers and Fairs. *Disasters*, *26*(4), 316–328.

Sharma, P. and Sharma, A. (2025). Deep learning to improve plant biosecurity and agriculture sustainability: A systematic literature review. CABI Review, *20*(1), 0009.

Web: https://twitter.com/faostatistics/status/566226121499627520

Yadava, D. K., Hossain, F. and Mohapatra, T. (2018). Nutritional security through crop biofortification in India: Status & future prospects. *Indian J. Med. Res*., *148*, 621-631.

How to cite this article: Eshita Kundu and Sanjoy Kumar Bordolui (2025). Future Challenges and the Need for Seed Research in Food Security. *AgriBio Innovations, 2*(1): 77-86.