**Tackling Agriculture’s Modern Struggles**

**Abstract**: Agriculture today is confronted with a range of complex and interrelated challenges that threaten global food security and environmental sustainability. This review examined the recent obstacles facing the agricultural sector, including the impacts of climate change, resource limitations, technological constraints, and socio-economic pressures. It also explored issues related to policy and governance that influence agricultural practices and outcomes. The paper discussed potential solutions, such as climate-smart agriculture, precision farming, and sustainable intensification, which offered pathways to overcoming these challenges by conservation tillage, crop rotation and integrated pest management. By addressing these issues, the agricultural sector could adapt to the evolving landscape and continue to meet the demands of a growing global population. It also explored potential strategies and innovations that could help mitigate these challenges and ensure sustainable agricultural development. In addition to the solutions already mentioned, the review highlighted the importance of strengthening agricultural resilience through the promotion of diversified farming systems and ecosystem-based approaches. These strategies are essential for building adaptive capacity in the face of unpredictable climatic conditions and shifting environmental patterns. Incorporating biodiversity into agricultural landscapes can enhance the natural resource base, improve soil health, and reduce the vulnerability of crops to pests and diseases. Furthermore, the role of digital technologies in enhancing farm productivity was emphasized, with innovations such as data analytics, remote sensing, and AI-based decision-making tools providing farmers with more accurate insights for optimizing yields and reducing waste. These efforts can foster innovation, improve resource allocation, and ensure that agricultural systems remain both productive and environmentally responsible in the long term.

**Key words**: Climate change, Food security, Digital technologies, Resource limitations, Sustainable agriculture.

**Introduction**

Agriculture has always been a dynamic field, adapting to changing climates, populations, and technologies. However, the current era presents unique challenges that threaten to disrupt food production and distribution on a global scale. This review aims to provide a comprehensive analysis of these challenges, exploring their causes, impacts, and potential solutions. The goal is to offer insights into how the agricultural sector can adapt and thrive in this rapidly changing world.

Food security states to a condition where food availability improves, ensuring that individuals have access to enough and nutritious food, allowing them to avoid hunger over a given period (Anonymous, 2017). Data indicates that 149 million children worldwide suffer from food insecurity (Khadija et al., 2022), with one contributing factor being the lack of adequate nutritional intake essential for their growth and development. This remains a global issue to this day (Bailey et al., 2015).Agriculture, the backbone of global food production, is undergoing a profound transformation in response to a multitude of challenges that reflect the complexities of the modern world. In recent years, agricultural systems have had to adapt rapidly to environmental, economic, and technological changes, reshaping the way food is produced, processed, and distributed (Khan et al., 2021).

Climate change, characterized by erratic weather patterns and rising temperatures, poses significant risks to crop yields, soil fertility, and water availability (Lesk et al., 2022). Meanwhile, the increasing global population places heightened pressure on agricultural productivity to meet the growing demand for food, feed, and fibre (Ma et al., 2021).

The advent of new technologies, such as biotechnology, digital farming, and precision agriculture, offers promise but also introduces challenges related to regulation, accessibility, and ethical considerations (Lubogo, 2024). Furthermore, market volatility, trade uncertainties, and shifting consumer preferences present additional hurdles for farmers and agricultural enterprises (Nimy and Sudha, 2024). In navigating this evolving landscape, it becomes crucial to explore sustainable practices, innovative solutions, and interdisciplinary approaches that can enhance productivity while minimizing environmental impact.

This complex web of challenges requires a multifaceted approach that draws from science, policy, and local knowledge to ensure that agriculture remains resilient, productive, and capable of meeting the demands of the future (Mapiye and Dzama, 2024). Understanding the recent challenges in agriculture and their interconnected nature is critical to developing strategies that will sustain agricultural growth and food security in the coming decades (Mrabet, R., 2023).

Recent research indicates that agricultural production growth has considerably slowed down. The annual yield of key grain crops worldwide increases by only about 1%, which is far below the growth rate of the global population (Hemathilake and Gunathilake, 2022). Expanding cultivated land to meet future demands and feed the growing urban population with higher food needs is not a viable solution. Additionally, the rising global population is driving the demand for more land for settlement. Meanwhile, agricultural productivity is declining due to factors like climate change (Giller et al., 2021). Thus, enhancing agricultural productivity is the only viable solution.

Food security is a global challenge closely linked to several Sustainable Development Goals (SDGs), including SDG 1 - "No Poverty," SDG 2 - "Zero Hunger," SDG 3 - "Good Health and Well-being," SDG 13 - "Climate Action," and SDG 15 - "Life on Land." Tackling this issue effectively requires the integration of agriculture and technology, incorporating approaches like precision agriculture, sustainable farming practices, bio-economy, and advanced technologies such as machinery, artificial intelligence, machine learning, and geospatial technology (Pandey and Pandey, 2023). Recent global trends in food security have shown a growing adoption of these technological innovations. The SDGs related to food, natural resource management, and climate change can be achieved if there is a collective, global and local effort from key advocates of sustainable agriculture (Raihan et al., 2024). This requires the implementation and enforcement of policies, capacity building, technology integration, institutional frameworks, and reliable funding. Transitioning to healthier, plant-based diets and adopting a circular economy can accelerate progress toward regenerative, nutrition-sensitive agriculture and environmental sustainability (Mrabet R, 2023).

**1. Climate Change and Environmental Stresses**

Extreme weather events such as droughts, floods, and storms are increasingly disrupting agriculture, directly impacting crop yields and livestock productivity. Droughts leads to water scarcity, which stunts crop growth, particularly for rain-fed agriculture, and severely affects livestock health due to dehydration and lack of pasture. Floods, on the other hand, can wash away crops, erode soil, and destroy essential infrastructure, including irrigation systems and storage facilities (Raza et al., 2024). The unpredictability of these events makes it difficult for farmers to plan effectively, resulting in crop failures and economic losses. Similarly, severe storms like hurricanes and cyclones can uproot crops, damage farmland, and cause flooding, further diminishing agricultural productivity and disrupting food supply chains (Matthan, T, 2023).

The result of these extreme weather events is reduced food availability, driving up food prices and exacerbating food insecurity, especially in vulnerable regions. As crops and livestock suffer, the global food market experiences price fluctuations, affecting both local and international trade (Lesk et al., 2022). To cope with these challenges, farmers are turning to adaptive strategies like planting drought-resistant crops, adopting efficient irrigation techniques, and implementing climate-smart farming practices (Mpala and Simatele, 2024). These approaches help build resilience, ensuring more stable food production despite the increasing frequency of extreme weather events caused by climate change.

Soil degradation and desertification are growing concerns, particularly in arid regions, due to intensive farming practices, deforestation, and overgrazing. These activities disturb the natural balance of the soil, leading to erosion and the loss of vital nutrients necessary for plant growth (Rastgoo and Hasanfard, 2021). Over-farming depletes the soil’s organic matter, while deforestation removes the protective canopy that prevents soil erosion from wind and rain. Overgrazing by livestock also compacts the soil, reducing its ability to retain moisture and nutrients (Mitra et al., 2022). As a result, fertile land turns barren, contributing to desertification, which further exacerbates food insecurity and threatens the livelihoods of farmers and pastoral communities. The gradual loss of productive land due to these factors demands urgent attention and sustainable land management practices to restore soil health and prevent further environmental degradation (Goud et al., 2022).

Water scarcity is becoming a critical issue for agriculture due to the overuse of water resources for irrigation and changing rainfall patterns caused by climate change (Yanagi, 2024). In many regions, excessive groundwater extraction for irrigation depletes aquifers faster than they can be replenished, while inefficient irrigation systems waste valuable water. At the same time, altered rainfall patterns, with prolonged dry spells and unpredictable rainfall, create further uncertainty, making it difficult for farmers to plan crop schedules and water usage effectively (Yeleliere et al., 2023). This combination of overuse and unreliable water availability threatens agricultural sustainability, reducing crop yields and livestock productivity, and forcing farmers to adopt costly or unsustainable water management practices (Bwire et al., 2025). Addressing water scarcity requires efficient water use, investment in water-saving technologies, and better management of water resources to ensure long-term agricultural viability.

A case study from Nalgonda District, Telangana, reveals that higher temperatures have reduced agricultural productivity, particularly in crops like cotton and pulses. Farmers are facing increased costs for irrigation and pest control (Pendyala and Kamraju, 2017)

**2. Resource Limitations**

Land Availability and Urbanization is common problem these days as the expansion of urban areas is reducing the amount of arable land available for agriculture, forcing farmers to produce more food on less land (Wang et al., 2021). Nutrient Depletion and Fertilizer Dependency is also a key threat as over-reliance on chemical fertilizers has led to nutrient imbalances in soils, reducing their productivity and increasing the need for costly inputs (Shrestha et al., 2021).

The crucial factor of present days is energy dependence, as the modern agriculture is heavily reliant on fossil fuels, both for machinery and for the production of synthetic fertilizers and pesticides (Khatri et al., 2024). This dependence makes the sector vulnerable to energy price fluctuations and contributes to greenhouse gas emissions (Fetisov et al., 2023).

A study conducted by ICRIER (Indian Council for Research on International Economic Relations) between 2020 and 2022 focused on post-harvest losses in crops like paddy, wheat, maize, and soybean in states such as Madhya Pradesh, Bihar, and Punjab. The research revealed that India suffers an annual food loss worth approximately ₹1.53 trillion (USD 18.5 billion). These losses are attributed to inadequate storage facilities, poor transportation infrastructure, and lack of mechanization at the farm level (Gulati et al., 2024).

**3. Technological and Innovation Challenges**

The primary challenge is limited access to advanced technologies where the precision agriculture, biotechnology, and digital tools have the potential to revolutionize farming, access to these technologies is often limited by cost, infrastructure, and knowledge gaps, particularly in developing countries (Mihret et al., 2025). Resistance to genetically modified organisms (GMOs) and new breeding techniques (NBTs) are also a key challenge as the public concerns and stringent regulations surrounding GMOs and NBTs hinder their adoption, despite their potential to enhance crop resilience and productivity (Adeel and Jones, 2024). The rise of big data in agriculture presents challenges in data collection, analysis, and integration, particularly for small-scale farmers who may lack the necessary resources and expertise (Osinga et al., 2022).

Fasal, an Indian agri-tech startup founded in 2018, has developed an IoT-based platform to address challenges in traditional farming practices, such as unpredictable weather, inefficient resource use, and limited market access. The platform uses sensors to monitor environmental conditions and provides farmers with real-time data, predictive analytics, and actionable insights tailored to specific crops. This technology has enabled farmers to optimize water usage, reduce input costs, and increase crop yields. Despite its success, Fasal faced challenges such as rural connectivity issues and barriers to adoption due to the high initial costs of IoT devices. The startup’s efforts to overcome these challenges include providing affordable solutions and training programs for farmers. Fasal’s impact has been significant, with users reporting a 20-30% increase in yields and a 40% reduction in water use (Arumai and Santhoshkumar 2023).

**4. Socio-Economic and Policy Issues**

Population Growth and Food Demand: The global population is expected to reach nearly 10 billion by 2050, putting immense pressure on agricultural systems to increase production sustainably (Khatri et al., 2024).

Economic Viability and Farm Incomes: Many farmers, especially smallholders, struggle with low and unstable incomes due to market volatility, rising input costs, and unfair trade practices. This economic pressure can lead to underinvestment in farm improvements and a reluctance to adopt new technologies (Samoggia and Fantini, 2023). Land Tenure and Access to Resources: Secure land tenure is crucial for sustainable agricultural development, yet many farmers, particularly in developing countries, lack clear legal rights to their land. This insecurity can prevent long-term investment in land improvement and conservation (Fischer et al., 2021).

**5. Sustainability and Environmental Impact**

There is an urgent need to promote sustainable farming practices that reduce environmental impacts, such as agro-ecology, conservation agriculture, and organic farming. However, these practices often require more knowledge, labor, and upfront investment than conventional methods (Akanmu et al., 2023). The expansion of monoculture cropping systems has led to a significant loss of agricultural biodiversity, making crops more vulnerable to pests, diseases, and climate change leading to biodiversity loss. Protecting and promoting biodiversity is crucial for building resilient agricultural systems (Belete and Yadete, 2023).

Carbon Footprint and Greenhouse Gas Emissions: Agriculture is both a contributor to and a victim of climate change. Reducing the carbon footprint of farming practices, such as by improving soil carbon sequestration and reducing methane emissions from livestock, is a key challenge for the sector (Basheer et al., 2024).

In a study examined the adoption of sustainable agricultural practices among rural farmers in Himachal Pradesh. The research highlighted the practices of organic farming, crop rotation, and integrated pest management contributed to improved soil quality, water conservation, and biodiversity. Farmers reported reduced dependency on chemical fertilizers and pesticides, leading to healthier ecosystems and long-term productivity. The study also emphasized the challenges faced by farmers, such as limited access to organic inputs and the need for training in sustainable methods. Policy recommendations included government support for organic certification and subsidies for sustainable farming practices.

**6. Policy and Governance Challenges**

First challenge is inconsistent agricultural policies as inconsistent and sometimes contradictory agricultural policies at the national and international levels can create confusion and hinder progress toward sustainable agricultural development (Even et al., 2024). The next challenge is trade barriers and market access here the trade barriers, tariffs, and subsidies can distort markets, making it difficult for farmers to compete globally and access new markets (Sukanya, R. 2024). At last but not the least the food security and nutrition as to ensure food security and improving nutrition require coordinated efforts across multiple sectors, including agriculture, health, and education. However, policy fragmentation and lack of coordination often undermine these efforts (Aivalli et al., 2024).

**7. Potential Solutions and Innovations**

Climate-smart agricultural practices, such as conservation tillage, crop rotation, and integrated pest management, can help farmers adapt to climate change while reducing environmental impacts. Crop rotation involves planting different crops in a specific sequence over multiple seasons. This strategy helps break pest and disease cycles, reduces the build-up of weeds, and improves soil fertility by varying the types of nutrients that are taken up and replenished in the soil (Wangchuk et al., 2022). For instance, legumes like peas or beans can fix nitrogen in the soil, reducing the need for synthetic fertilizers. Additionally, crop rotation can help farmers adapt to unpredictable weather patterns, as different crops have varying resilience to droughts, floods, or extreme temperatures. Climate-smart agriculture includes improved water management practices to address changing rainfall patterns and increasing water scarcity (Bhutto et al., 2024). Techniques such as drip irrigation, rainwater harvesting, and soil moisture monitoring can help farmers use water more efficiently, ensuring crops get the right amount of water while minimizing waste. These practices not only increase crop yields in water-stressed regions but also reduce the risk of crop failure due to erratic weather patterns (Suna et al., 2023).

The use of precision agriculture technologies, such as GPS-guided machinery, remote sensing, and data analytics, can optimize input use, reduce waste, and increase productivity (Nath, S. 2024). Sustainable intensification involves increasing agricultural productivity on existing farmland while minimizing environmental impacts. This can be achieved through practices such as intercropping, agro-forestry, and the use of improved crop varieties (Raj et al., 2021). To address the global challenges facing agriculture, there is a need for policy reform and greater international cooperation. This includes creating supportive frameworks for sustainable agriculture, removing trade barriers, and investing in agricultural research and development (Barrett, C.B. 2021).

**Conclusion:** The challenges facing modern agriculture are not only complex but also interconnected, these challenges requires a multifaceted approach, where solutions are to involve a collaborative effort across various sectors, including agriculture, technology, policy, and education. Promoting sustainable practices, like crop diversification, agroecology, and water-efficient irrigation systems, could help safeguard resources for future. Continued investment in research and development is essential to create solutions and adapt to changing agricultural conditions. By fostering integrated, forward-thinking approach, the agricultural sector can overcome its challenges and provide a sustainable and secure future. Despite all these the limitations like disconnection between research finding and actual implication on farms, lack of access to advance technologies, training to farmers and unpredictable climate patterns may introduce the risks and hence the future research should be focused on developing region-specific, climate-resilient agricultural practices and enhancing the scalability of sustainable technologies. Emphasis should also be placed on integrating digital tools and policy frameworks to support widespread adoption and long-term impact

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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