

## Climate Change, Agricultural Production, and Supply Chain Development in Agro-Based Industries

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### ABSTRACT

Climate change poses severe threats to agricultural production and agro-based industries through rising temperatures, erratic rainfall, and extreme weather events. These changes reduce crop yields, disrupt planting seasons, and increase pest outbreaks, directly impacting raw material availability for agro-industries. Lower crop yields trigger reduced supply and skyrocketing prices, pushing populations toward hunger while destabilizing supply chains. Climate change affects the entire food supply chain—from farm production to consumption—through increased weather-related natural disasters expected over the next 20 years. Supply chain development in agro-based industries requires climate-smart agriculture (CSA), an integrated approach managing cropland, livestock, forests, and fisheries to address interlinked challenges. Sustainable value chain management becomes essential for crop selection, mapping, and benefit optimization. Agro-based industries drive sustainable development in economies where agriculture forms the backbone, but must adapt to climate vulnerabilities. Regional variations in rainfall, temperature, soils, and cropping systems create uncertain climate sensitivity, demanding localized adaptation strategies. Investing in resilient infrastructure, diversified sourcing, climate-resistant crop varieties, and improved storage facilities strengthens supply chains. Without adaptation, extreme weather events will continue reducing worldwide crop productivity, threatening food security and industrial viability. Success requires integrating climate risk assessment into supply chain planning and fostering public-private partnerships for sustainable agricultural transformation. To effectively address climate change, it is crucial to make progress toward SDGs 2 and 6: ensuring food security and universal access to safe drinking water and sanitation. Issues like climate change, water scarcity, and the global food supply crisis are all interconnected. The agricultural industry has been utterly decimated by climate change. Because of the devastating effects of the drought on the agricultural industry, a food crisis has developed, and the prevalence of malnutrition has increased. The decrease in food production is a result of multiple factors, including flooding, cyclones, droughts, forest loss, and rising sea levels. Pollution and habitat loss have increased as a result of rapid and unplanned industrialization. Changes in precipitation patterns and the absence of groundwater recharge facilities due to deforestation both have an impact on the water cycle. We now use cutting-edge machinery and technology to grow our food, and with the aid of artificial intelligence, we're able to cultivate organic crops that need just 5% as much water as conventional ones. In order to achieve food security, sustainable water management resources must be developed in both soilless agriculture and urban farming in rural areas. Construction of water harvesting infrastructure, transformation of desert into farmlands, and automated recharge of groundwater via natural and technological

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means are all part of the strategies and plans being created. South Asia and sub-Saharan Africa are two regions where we are reverting to more traditional methods of harvesting and conservation while also adopting new methods through artificial intelligence to develop smart climate agriculture practices and expanding the use of green technology for irrigation. Renewable energy using the most advanced technology is essential to ending water and power outages. A significant impact on agricultural growth can be expected from this. Improved crop yields could be one outcome of using AI and ML in farming, along with other benefits like fostering the uptake of cutting-edge methods in urban agriculture and the advent of rooftop farms.

**Keywords:** Renewable energy , climate change , farming , water scarcity , climate change , food security

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### Introduction

Climate change has emerged as one of the most critical challenges facing agro-based industries worldwide, fundamentally disrupting their supply chains from farm to consumer. Rising global temperatures, unpredictable rainfall patterns, and increasing frequency of extreme weather events are severely impacting agricultural production, which serves as the foundation of these industries' operations.

Agro-based industries rely heavily on consistent crop yields and livestock productivity, both of which are increasingly vulnerable to climate variability. Droughts, floods, heatwaves, and shifting seasonal patterns reduce crop quality and quantity, creating supply shortages and price volatility. These disruptions cascade through the entire supply chain, affecting processing, storage, transportation, and distribution networks.

The interconnection between climate change and supply chain resilience has become increasingly apparent, as industries face mounting pressure to adapt their operations. From raw material procurement to final product delivery, every stage of the agro-based supply chain experiences climate-related risks. Understanding these impacts is essential for developing sustainable strategies that ensure food security, economic stability, and the long-term viability of agro-based industries in an increasingly uncertain climatic future.

Water and food scarcity have been the most pressing challenges of the twenty-first century as a result of climate change. Every day, millions of people throughout the world die as a result of hunger, a lack of access to clean water, and poverty. Climate change has had the greatest impact on developing and underdeveloped countries in South Asia, Sub-Saharan Africa, and Latin America. The global food supply and nutrition cycle have been disrupted. Nowadays, 820 million people lack access to three meals a day. Food and water crises are intertwined, as water scarcity equals food storage, affecting the entire agricultural process. Climate change has a significant impact on the arid and semi-arid regions. Droughts have the greatest impact on agriculture, affecting billions of people worldwide. Climate change and water are intricately intertwined. Water is becoming more scarce, unreliable, dirty, or all three as a result of extreme weather events. These effects endanger environmental sustainability, biodiversity, and people's right to clean water and sanitation throughout the water cycle. Flooding and rising sea levels can pollute water and land with seawater or feces, as well as destroy water and sanitation structures like waterpoints, wells, toilets, and wastewater treatment plants. Glaciers, ice caps, and snowfall fields are quickly vanishing. Several of the world's largest river systems are fed by meltwater. Turbulence in the cryosphere can have an impact on the management of freshwater resources for large populations in lowland locations. Droughts and fires are causing community destabilization, civil instability, and migration in numerous locations. Deforestation magnifies soil erosion and lowers groundwater recharge, causing water shortages and food poverty [1]. About 800 million people remain chronically malnourished in 2015, despite tremendous progress in eliminating poverty over the past several decades. There are around 161 million kids under the age of five who are stunted. 500 million people worldwide are overweight. There are two billion people who don't get

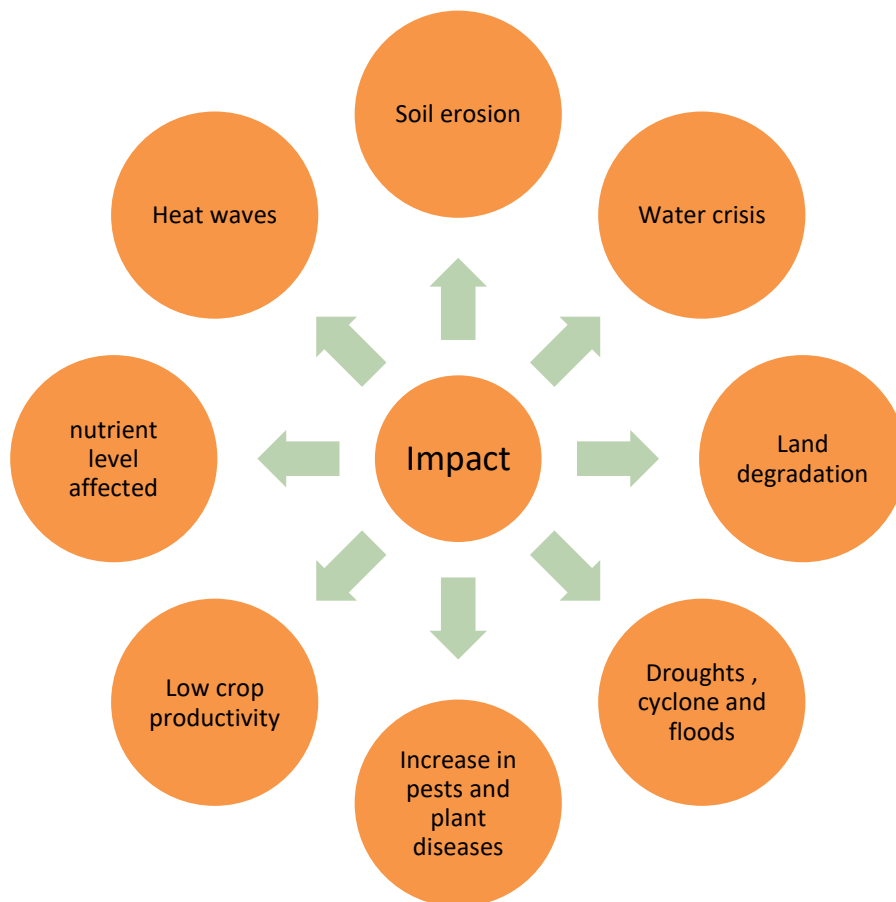
enough of the micronutrients they need to thrive.. According to FAO, food production will need to expand by 60% by 2050 to meet rising demand due to population growth and diet modification [2]. Agriculture is the major water user, contributing 50–90% of total water consumption. Farmers must constantly adjust to fulfill water demands for crops, fish, and cattle as the number of droughts and floods increases, threatening food security. Deployment of flood and drought-resistant crops, on-farm soil and water moisture conservation, irrigation and ocean technologies, or changing the timing of sowing and reaping to new seasonal rainfall have all proven to be advantageous in terms of water security and income. What is unclear about these remedies is whether they also lessen climate-related hazards [3]. Exploitation of natural resources, rising sea levels, deforestation, rapid urbanization, lack of access and availability of resources, unplanned construction in modern cities, such as inefficient drainage and canal systems, all contribute to the problem of water logging. Natural calamities such as floods, cyclones, and droughts occur on a regular basis. Food and water security are also impacted by war. Climate-smart agriculture practices are being adopted around the world to limit the impact of climate change on food and water crises, but there is still a long way to go. As the population grows, so does the rate of hunger.

### **Climate change impact on the agriculture sector**

The developing world's tropical regions are particularly susceptible to the effects of climate change. Many people in South Asia and sub-Saharan Africa still rely on farming as their primary source of income. When temperatures rise and precipitation decreases, agriculture will be among the hardest-hit industries. The Green Revolution and other technological developments of the second half of the twentieth century notwithstanding, weather and climate continue to play a significant role in determining crop yields in most parts of the world. There will be significant effects on agricultural production potential due to the expected changes in temperature and rainfall patterns and their effects on water availability, pests, disease, and severe weather [4]. Pests and plant diseases spread as a result of climate change. The agricultural sector in South and Southeast Asia grew and prospered greatly because of the Green Revolution. Much of the world's freshwater is put to use in agriculture, and this region is no exception. Increasing deforestation is causing soil erosion and disrupting the normal recharge of groundwater. The fluctuating rains and dry spells have left us without enough water for farming.

Even though technology has improved in the 20th century, climate change has a linear and often negative effect on agricultural productivity. While climate change is a worldwide issue, South Asia is particularly vulnerable. Together, the countries of Afghanistan, Bhutan, Bangladesh, India, the Maldives, Pakistan, Sri Lanka, and Nepal make up one of the most populous areas on Earth and are critically reliant on agriculture for their economies. Nearly 60% of South Asia's population works in agriculture in some capacity, and 57% of the region's total land area is used for farming. Vulnerable small landholders are the primary participants, with women also playing an important role. According to statistics from the Food and Agriculture Organization, more than 60% of women in the agricultural industry are employed in India, Pakistan, Bangladesh, Nepal, Sri Lanka, and Bhutan. The region has to deal with food insecurity already, and the situation isn't improving because of factors including rising population, depleting natural resources, and widespread poverty [5] In Asia, where one-third of the world's population lives, most low-income households are farmers. Due to the wide variety of farming and cropping systems, each of which is uniquely dependent on climate, we can anticipate a correspondingly wide variety of negative impacts from climate change on the agriculture industry. Higher flood and drought risks render Asian agricultural output extremely vulnerable to climate change, as reported in the IPCC's sixth assessment report. Although there is little emission of greenhouse gases (GHG) in this region, climate change has already had an adverse effect on economic expansion and development in Asia. Even still, both India and China are among the world's top emitters of carbon

dioxide [6]. India is a developing country and has the largest population in the world. India is facing a tremendous water crisis, with 21 cities having no groundwater left. 70 percent of the people live in the rural region, completely dependent on agriculture and natural resources for their livelihood. Climate change is not just affecting the food and water crises but also the biodiversity and ecosystems.



**Figure 1 : Impact of climate change on the agricultural sector**

Many countries are turning to "climate-smart agriculture" to make it less likely that their people will go hungry and to save water. Food is now being grown without the need for human labor, in labs and confined environments, with the help of artificial intelligence, satellites, drones, robotics, and other technologies, all with the goal of lowering their environmental impact and speeding up their development rate.

### **Effect of climate change on the food and water shortages**

South Asia is home to a quarter of the global population and is projected to see a 40 percent increase in residents by 2050. . In the past five years, South Asia has become the fastest-growing region in the world, with a population of about 1.8 billion people, most of whom reside in India, Pakistan, and Bangladesh. According to climate experts, global warming makes it even more difficult to feed South Asia's expanding population. In the future, it will be very difficult to provide food for a growing population. South Asia has significant rates of population increase and natural resource degradation, as well as continuing elevated rates of poverty and food insecurity, making it one of the most vulnerable regions to climate change. Even though South Asian countries have made significant socioeconomic

development over the past decade, they still confront challenges such as decreasing poverty and hunger and guaranteeing food security for the people to enjoy a good quality of life and healthy lifestyles. Despite the region's tremendous economic growth after the year 2000, South Asian countries have the highest proportion of hungry and poor people. South Asia has not made significant progress towards the Millennium Development Goals. The SDGs were accepted by countries in 2015, and targets numbers 2 and 3 are directly tied to the issue of food security. Goal 2 of the Sustainable Development Agenda is to "eliminate hunger, establish food security and enhanced nutrition, and encourage sustainable agriculture," all while aiding the poor and those whose conditions are quickly deteriorating. Health and well-being promotion is the third Sustainable Development Goal. In addition, the SDGs are accountable for advances in stable food security because they are all connected to agriculture and food production in some way [7]. South Asia is dealing with an unprecedented confluence of shocks on top of the remaining scars of the COVID-19 epidemic, including the economic crisis in Sri Lanka, the catastrophic floods in Pakistan, a global downturn, and the repercussions of the war in Ukraine, leading to a rise in food and water crises.

The Food and Agricultural Organization reports that rising sea levels in the Bay of Bengal and Pacific Ocean are having a significant impact on rice agriculture in Bangladesh and Vietnam. In addition to causing nutrient deficiencies, climate warming also destroys agricultural soils. The levels of protein, iron, and zinc have all dropped significantly. The analysis estimates that by 2050, 175 million individuals will be zinc deficient and 122 million will be protein deficient. Changes in climate also degrade the health of livestock. The fishery industry in South and Southeast Asia is a particularly stark example of the effects of the climate catastrophe. Increasing temperatures and precipitation amounts may cause agricultural waste to accumulate after harvesting as well. Due to an increase in the rate of degradation at high temperatures, most of the crop is lost between the field and the market in the developing countries of South and South-East Asia. Damaged by the flood's waste water, harvested crops such as rice, wheat, etc. rot on the field. Also, agricultural degradation caused by waste results in the release of greenhouse gases [8].

There are a number of threats to the world's food supply. Although the Russian invasion of Ukraine is the primary cause of rising food prices, other factors are also at play, such as the ongoing coronavirus disease (COVID-19) pandemic, which has disrupted food supply chains, as well as macro-economic challenges and the intrusion of trade restrictions by some countries, which have all had an impact on the availability of a variety of food commodities. Climate change, a greater challenge than any of these problems individually, is already having profound and long-lasting effects on agricultural production. For example, recent research found that temperature extremes reduced worldwide farming productivity by 21%. Extreme flooding in many parts of the planet, particularly East and South Asia, and scorching heat waves in important growing zones in the northern latitudes during the summer of 2022 are alarming symptoms of a deteriorating climate catastrophe [9].

Both natural and anthropogenic disasters pose a serious threat to South Asia. Millions of people, mainly children and the most vulnerable groups, are displaced and suffer needlessly every year as a result of natural disasters including floods, cyclones, droughts, and earthquakes. There is an increase in water-borne infections and a delay in the recovery of the affected population due to a lack of safe drinking water, sanitation facilities, and proper hygiene practices. During the past half century, policies have effectively allowed for unrestricted groundwater exploitation, and as the situation has worsened, no one has done anything to address it.

India consumes more groundwater than both China and the United States put together, with estimates placing its usage at about a fifth of the global total. The water table has dropped as much as 4 meters in some areas due to the groundwater pumping that has been made possible thanks to electricity subsidies given to farmers. The unrestrained use of groundwater sources has increased during the previous two decades. Upwards of 600 million Indians rely on agriculture for their survival, and despite continued

pumping, particularly in rural regions, Mother Nature is often the difference between a good year and a terrible one. It has been disastrous to count on monsoon rains without employing any kind of irrigation or drainage system. Several of India's authorities have been slow or unable to adjust to emerging technologies or develop cohesive plans to solve the concerns, although incompetence and corruption often grab the most headlines. Dams have emerged as a major issue in the water crisis, with absences of groundwater recharge systems, poor urban irrigation systems, and a lack of government policies and funds in every region. Unplanned development, such as an inefficient canal system, an improper irrigation system, and unsmart waterways, has also contributed to the problem.

### **Sustainable management of water , food and agriculture sector**

A number of projects have been undertaken across the globe to resolve the problem of the water crisis and adopt sustainable water management systems so that during the dry season we have enough water for cultivation and drinking. Due to climate change, there has been a change in the pattern of rainfall, which is affecting the agriculture sector. Today, both men and women are working together to resolve the problem of water resources management. Watershed development, water harvesting infrastructure, check dams, percolates, and continuous contour trenches in the Garvadi region are some of the projects that have been implemented to address the issue of water crisis management in the villages of Maharashtra, India. Several permaculture initiatives have been launched to implement new methods of water management. The villages can't survive without the groundwater. Stable groundwater recharge, like that occurring in the Velu district [10], is essential to meeting the region's demand for a reliable water supply. In Africa, in the sub-Saharan region of Niger, the desert is converted into farmland to promote agriculture and reduce the food crisis through Farmers Managed Natural Regeneration (FMNR). Arvari River Restoration in Rajasthan; Chikuama Project in Africa; Turning forest pruning in California into biochar; in East Africa, more than 20 million trees have been planned to reduce carbon footprints.



**Figure 2 : Ways towards sustainable management of water resources**

### **Climate Smart Agriculture**

Today, the world is adopting climate-smart agriculture to reduce the problem of water and food crises, along with dealing with climate change. Food security and climate change are inextricably related problems, and climate-smart agriculture (CSA) is an interconnected method to manage landscapes (cropland, livestock, forests, and fisheries). CSA is designed to accomplish three goals at once.

One way to help the 75% of the world's poor who live in poor areas and depend mostly on agriculture to survive is to increase agricultural production by making more and better food. Secondly, increased resilience means being less susceptible to climate-related hazards and shocks like drought, pests, and diseases and having a greater ability to adapt to and thrive in the face of longer stresses like shorter seasons and irregular weather patterns. Third, we must take steps to reduce emissions by reducing the amount of carbon dioxide released into the atmosphere for every calorie or pound of food produced, stopping the destruction of forests for agricultural purposes, and finding new technologies to soak up carbon dioxide. CSA is similar to sustainable agriculture in many respects, but it also has some key differences. Its primary goal is to combat global warming. Second, CSA takes into account the interdependencies and complementarities of productivity, adaptation, and mitigation in a methodical manner. After all is said and done, CSA's ultimate goal is to fill the investment gap by seizing fresh financial possibilities [11].

This method makes it easier to include agribusiness, climate change, food security, and land use in policy, planning, investing, and coordinating between institutions. It is crucial to have robust local institutions that serve to empower, enable, and motivate farmers. Strengthening national policymakers' involvement with local government authorities and preparing them to take part in international policy on climate change are both necessary steps. One of the most effective approaches to CSA implementation is the use of creative financing methods that integrate public and private sector investments in agriculture with climate change adaptation funding. Farmers have extensive expertise in matters pertaining to their region's ecology, agroecosystems, crops, livestock, and climate. Local farmers' expertise, needs, and priorities should inform any CSA adjustments [12]. Improved feeding techniques, animal health, breeding, manure and waste management, and low-emission technologies for activities like milk chilling and transport are all part of a larger effort in Bangladesh to make livestock farmers more resilient in the face of climate change.

Green technology has helped to adopt smart farming practices. Smart agricultural solutions based on cutting-edge technologies like AI, ML, IoT, cloud computing, etc. make it easier to optimize resource utilisation, manage waste sustainably, and reduce greenhouse gas emissions [13].

While vertical farming, hydroponics, and aquaponics are all making strides towards food security and minimizing water use in cultivation, many areas of Africa and Asia are returning to more conventional methods of farming, such as natural and organic methods, in an effort to reduce water use, minimize waste, and maximize yield. More tree planting for water conservation and natural groundwater recharge via check dams. By turning desert into farmland, we can repair the ecosystem, enhance our food supply, and boost our economy all at the same time. Women bear the brunt of the repercussions of climate change, which have a disproportionately negative impact on their well-being compared to that of men. The conflict between Russia and Ukraine has exacerbated a worldwide food shortage.

With its effects on soil fertility, rainfall patterns, crop yields, agricultural production, meal and anti-nutrient composition, and nutrient bioavailability, climate change exacerbates the problems associated with unsustainable food systems. The availability of macro- and micronutrients in the world's food supply has decreased as a result of these shifts. Indirect effects, such as pests, enhance spoilage and food safety threats across the food chain, beginning with primary production and continuing through post-harvest protection and final consumption, adding further complexity. All of these things have the potential to harm people's diets. Human health outcomes from the intricate and reciprocal relationship

between food systems and climate change are particularly difficult to measure, especially in light of the added complexity introduced by pandemics [14]. It is anticipated that, as climate changes, foods will become less nutritious. This is a major problem because previous attempts to solve malnutrition through agricultural advancements have only addressed calorie sufficiency, while hundreds of millions of people continue to be malnourished due to insufficient intakes of micronutrients and protein. Increases in the prevalence of diseases like diabetes, thyroid disease, heart disease, and cancer can be directly attributed to food and water scarcity, another negative impact of climate change on human health.

Growers are being forced to get creative as they tackle challenges like climate change and water shortages. In many nations, wastewater is a significant and mostly unexplored resource. After appropriate processing, it can benefit agriculture, agroforestry, and forestry while also contributing to food security. Nutrient-rich wastewater can be used as fertilizer.

Today, India has emerged as the country with the largest population. For the agriculture industry in India, "smart farming" has become an urgent necessity. Comparatively, this type of farming is significantly more effective. By utilizing sensors and adopting automated irrigation techniques, "smart farming" can aid in the monitoring of farmland, temperature, soil humidity, etc. Farmers could keep an eye on their crops from anywhere with this. More so, smart farming can aid the integration of physical and digital infrastructures that would be useful to small farmers. Increasing income for India's small and marginal farmers has been hampered by their inability to effectively combine digital and physical infrastructures. Startups in the agribusiness sector can reach out to farmers and provide them with access to solutions that are both practical and affordable. In an effort to improve the state of the environment and lower greenhouse gas emissions, India is gradually adopting climate-smart farming practices. Farmers in the Gujarati village of Dhundi, for instance, have adopted the use of renewable energy sources such as solar electricity for water pumping. Farmers gain in two ways from the solar power program: The farmers that participate in the scheme are compensated for adding their electricity production to the regional grid. To lessen their reliance on the annual monsoon rains, farmers can diversify their crops with the use of smart farming techniques.

One such example is salt-resistant rice. In addition to its widespread use as a staple food in Asia and Africa, rice is a major cash crop in India. Weather extremes, such as increasing sea levels, which lead to inland salinization, can have a devastating effect on rice cultivation. Increases in yield have resulted from the use of 'climate-smart' rice in places that are particularly vulnerable to the effects of climate change stress, such as the poorest agricultural

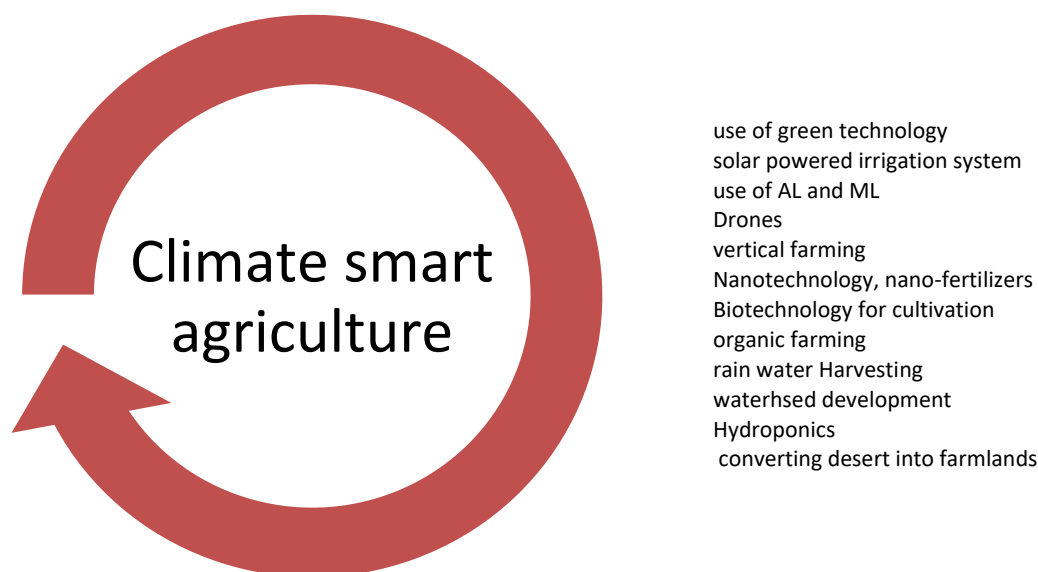


Figure 3 : Climate smart agriculture practises

### Future Perspective

Many initiatives have been launched around the world to address the issue of climate change, which has had the greatest impact on the water and food sectors. Every nation is working to implement "climate smart agriculture practices," including the use of cutting-edge technology and science to mitigate the issue and the introduction of novel farming methods to meet the needs of a rapidly expanding population. With the ongoing conflict between Russia and Ukraine, however, the world's already dire food shortages have worsened dramatically.

Currently, efforts are being made to address the problem of climate change through initiatives including building water harvesting structures in rural areas, turning desert into farmland, creating wetlands, planting trees, and recharging the groundwater system. Agriculture, food production, and water all depend on one another. While progress is being made in both industrialized and developing countries when it comes to using AI to maximize crop yields while minimizing water consumption, it will take some time for digital infrastructure to spread over all of South Asia, sub-Saharan Africa, and Latin America.

We need to get rid of electricity and water shortages by using the most cutting-edge technology to bring in renewable energy. This will have a profound effect on the expansion of the agricultural economy. Artificial intelligence and machine learning could be used in agriculture to boost crop yields, as well as to encourage the use of cutting-edge technology in urban farming and the development of rooftop farms. Agro-scientists and international assistance are needed to establish an agro-school that would attract students with an interest in agriculture and farming as a career option. Encourage community-based farming, kitchen gardens, and the cultivation of drought-tolerant crops; instruct farmers on modern farming methods.

A yield management system that uses smart technology to detect and eliminate water and soil contamination on-site. Monitoring and managing soil and crops using AI and IoT models Analysis of plant photosynthesis efficiency using artificial intelligence to inform agricultural biology Using

Nanoorganic Compositions and Methods for Growing Functional Crops Machine-learning-based approaches to forecasting the quality of groundwater for irrigation purposes

Conservation of soil and water, management and budgeting of water resources, improvement of soil quality and health, expansion of tree cover and forest growth, establishment of protected grasslands of edible and nutritious grasses, and the establishment of a foundation for each family to raise their income are all necessary components of a sustainable village designed to combat the water crisis, food shortage, and climate change. Because of the correlation between poverty and food insecurity.

## **Conclusion**

Climate change poses existential threats to agricultural production and the supply chains of agro-based industries, demanding urgent and comprehensive action. The interconnection between rising temperatures, declining crop yields, and disrupted supply chains creates a cascading effect that threatens food security, economic stability, and industrial viability worldwide.

The evidence is clear: climate change reduces agricultural productivity through erratic rainfall, extreme weather events, and increased pest infestations, directly impacting the raw material availability that agro-based industries depend upon. Supply chains face mounting challenges including transportation disruptions, storage losses, price volatility, and reduced quality of agricultural inputs.

However, viable solutions exist. Climate-smart agriculture, resilient infrastructure development, diversified sourcing strategies, and improved storage facilities can strengthen supply chains against climate shocks. Public-private partnerships, investment in climate-resistant crop varieties, and integration of climate risk assessment into supply chain planning are essential for adaptation. The future of agro-based industries depends on their ability to transition toward sustainable, climate-resilient operations. Without immediate action, climate change will continue undermining agricultural productivity and supply chain stability. Success requires collective commitment from governments, industries, and farmers to build adaptive capacity and ensure long-term sustainability in an increasingly uncertain climate future. By 2050, the population of the Earth is projected to reach about 10 billion. The worldwide demand for food may increase by between 59% and 98% due to the addition of 3.4 billion people to the world's population and the rising demand for meat and dairy among the emerging world's middle class. This necessitates a rise in agricultural output and harvests everywhere in the world. Roughly 10% of crops cultivated in the world's largest food-producing regions receive irrigation with non-renewable groundwater. That is, aquifers are losing water at a faster rate than they are being replaced, and as the planet continues to warm, the situation is only expected to worsen. As water pollution and conflicts heat up, the marine and fishing industries are suffering. Employment will be created, water and food security will be enhanced, and the impact of climate change will be mitigated if we work together with international organizations to transfer energy to developing nations, build water-harvesting infrastructure, adopt innovative farming techniques like soilless crop production, encourage as much as possible to be grown using chemical-free fertilizers, and so on. A climate-smart agricultural system is a necessity.

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