THE NEGATIVE IMPACTS OF CLIMATE CHANGE ON AGRICULTURE AND DIGITAL TECHNOLOGIES THAT MITIGATE THESE IMPACTS (recommendation) GANJA 2025

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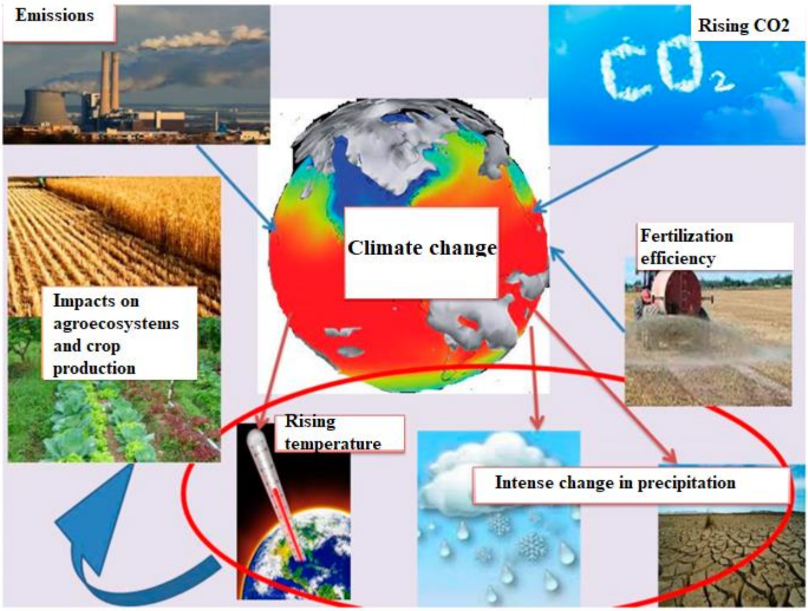

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The recommendation addresses the negative factors caused by climate change in agriculture, their effects on food products and production, as well as the effects of CO_2 carbon dioxide in the atmosphere and warming on crop production and natural resources.The digital technologies applied to reduce the negative effects of climate change are reflected.The recommendation can be used by farmers, entrepreneurs, as well as students, masters, doctoral candidates and teachers studying in this field.

Foreword

One of the main global problems that worries the world is climate change.The impact of climate change on fauna and flora is increasingly worrying the world community.The increasingly unstable weather conditions in the world are also being felt in our republic.Climate change is now an undeniable reality for all states.The widespread use of mineral fuels (oil, gas, coal, etc.) and the resulting increase in the volume of greenhouse gases emitted into the atmosphere have led to an increase in temperature in the world.As a result, events such as forest fires, floods, storms, landslides, and droughts have increased.The rapidly changing climate has created health problems for people.Many animal species are at risk of extinction. For these reasons, we can say that holding the largest COP in the world is not a unilateral issue.The international community places a great deal of work and responsibility on the countries of the world in the issue of climate change.

Azerbaijan, recognized as a reliable partner in the modern system of international relations, is not only the leading state of the South Caucasus, but also acts as the economic, political and humanitarian center of the region. Our country already has sufficient experience in holding international events.

This year, our state will organize COP 29, the 19th Meeting of the Parties to the Kyoto Protocol, and the 6th Session of the Meeting of the Parties to the Paris Agreement.For two weeks, the pulse of the world will beat in Baku, and the city will welcome approximately 70-80 thousand foreign guests.

This event will make a significant contribution to further enhancing Azerbaijan's international image and once again demonstrate that our country, as an integral part of the civilized world, has human values.

1.Impacts of climate change on agriculture

Climate change has numerous impacts on agriculture, many of which make it more difficult to ensure food security in agriculture.Rising temperatures, changing weather patterns, and freshwater shortages resulting from droughts and floods have led to lower crop yields.At the same time, pests and diseases have spread more rapidly. Livestock have been affected by heat stress and the lack of animal feed, which has led to the spread of infectious diseases and parasites (Figure 1.1).

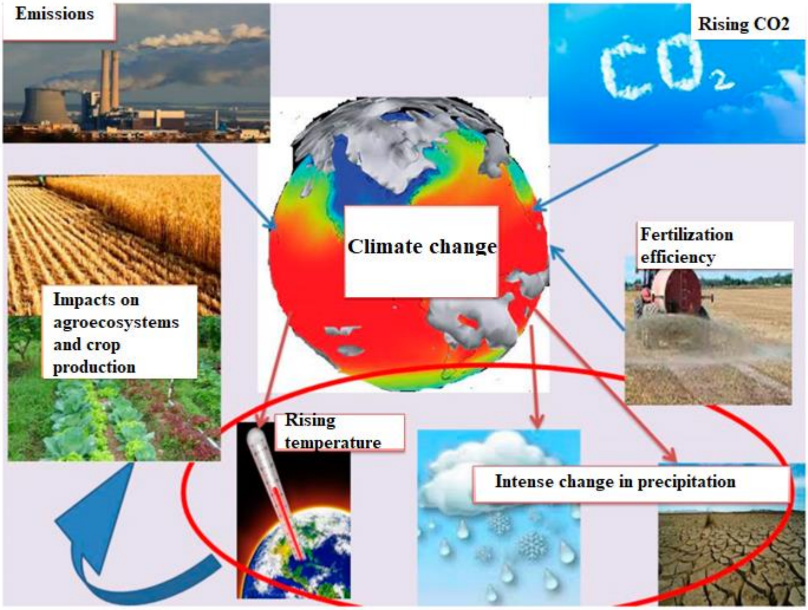

Figure 1.1 Impacts of climate change

As we know, in nature, plants absorb carbon dioxide (C_2) and exchange oxygen (O_2) as a result of photosynthesis.As a result of human activity, they consume more oxygen.Thus, with the presence of industrial plants, cars, and fuel heating systems, more CO_2 carbon dioxide gas is emitted into the environment. As a result, the percentage of carbon dioxide gas in the atmosphere increases.This affects plants as well as agricultural production.

The increase in CO_2 carbon dioxide gas in the atmosphere creates a fertilization effect in crop production.Because as a result of the increase in carbon dioxide gas, plants absorb more carbon dioxide than normal.Thus, it compensates for some harmful effects affecting agriculture.However, it causes rapid development of plants.We can say that the presence of some agricultural lands on the sea and ocean shores carries significant risks, since the land will be lost as a result of rising sea levels, and the melting of glaciers results in floods and inundation.On the other hand, soil erosion or negative changes in fertility occur on a massive scale (Figure 1.2).

The negative impact of bacteria such as Salmonella or mycotoxin-producing fungi on food safety is also increasing with climate warming.

Global food demand will increase in the near future.However, natural resources, including soil erosion and the decline of freshwater resources, have reduced agricultural production.Overall, there is a consensus that global food security will change relatively little in the near term.

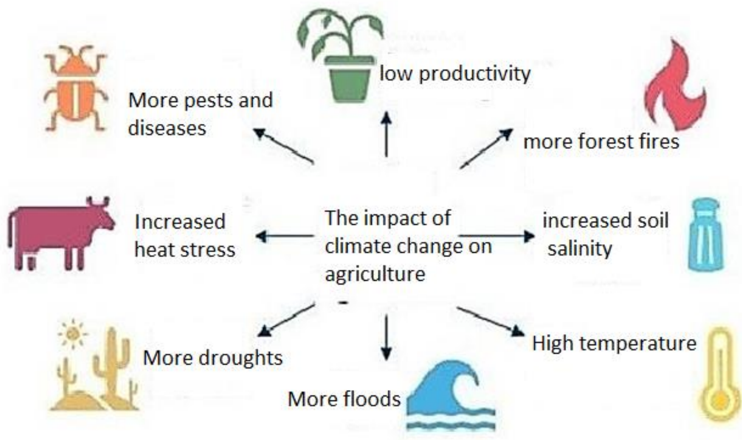

Figure 1.2 Negative impacts of climate change

In 2021, between 720 million and 811 million people worldwide were undernourished.200,000 people were at a critical level of food insecurity.This compares to an estimated 8-80 million people at risk of hunger each year by 2050 if climate change continues.Sustainable agricultural development is likely to improve food security for hundreds of millions of people by then.Climate change adaptation measures can reduce the risks of adverse impacts on agriculture.These measures include changes in management practices, agricultural innovation, institutional changes and climate-smart agriculture.These measures are considered essential to creating a sustainable food system, as are the changes needed to address global warming.

1.1 The effects of increased carbon dioxide in the atmosphere on plants

The increase in atmospheric carbon dioxide (CO_2) affects plants in various ways.The production of high amounts of CO_2 accelerates growth by increasing the rate of photosynthesis in plants, increasing productivity.The closure of stomata reduces water loss.The “fertilization effect” of CO_2 causes plants to limit leaf transpiration, increasing the rate of photosynthesis.The “fertilization effect” of CO_2 depends on the plant species, air and soil temperature, and the availability of nutrients in water and soil.As a result of the “fertilization effect” of carbon dioxide, an increase in crop yields is observed.Since 2000, there has been an average increase of 44% in total productivity. “Earth system models”, “Soil system models” and “Dynamic global vegetation models” are currently used to study and interpret vegetation trends related to the increase in atmospheric CO_2.

1.2 Effects of carbon dioxide in the atmosphere on the nutritional value of crops

The increase in atmospheric carbon dioxide has reduced the nutritional quality of some plants.It has been observed that the minerals protein, zinc, iron in the composition of cereals such as wheat, barley, oats, rice, etc. have decreased by 3-17% (Figure 1.3).As a result of the increase in atmospheric carbon dioxide expected in 2050, the nutritional value of cereals is at risk. At the same time, the nutritional quality of 225 different products, including vegetables, fruits, and melons, has decreased.The increase in the amount of carbon dioxide in the atmosphere is not limited to the above-mentioned plant categories and nutrients. A meta-analysis study conducted in 2014 showed that the minerals magnesium, iron, zinc, and potassium in various wild plants have decreased.This once again shows that herbivorous animals cannot absorb the necessary nutritional value.Because herbivorous animals must eat more grass than their feed norm to absorb the required protein.Otherwise, it negatively affects people's nutrition by reducing the nutritional value of meat, meat products, milk, and dairy products.

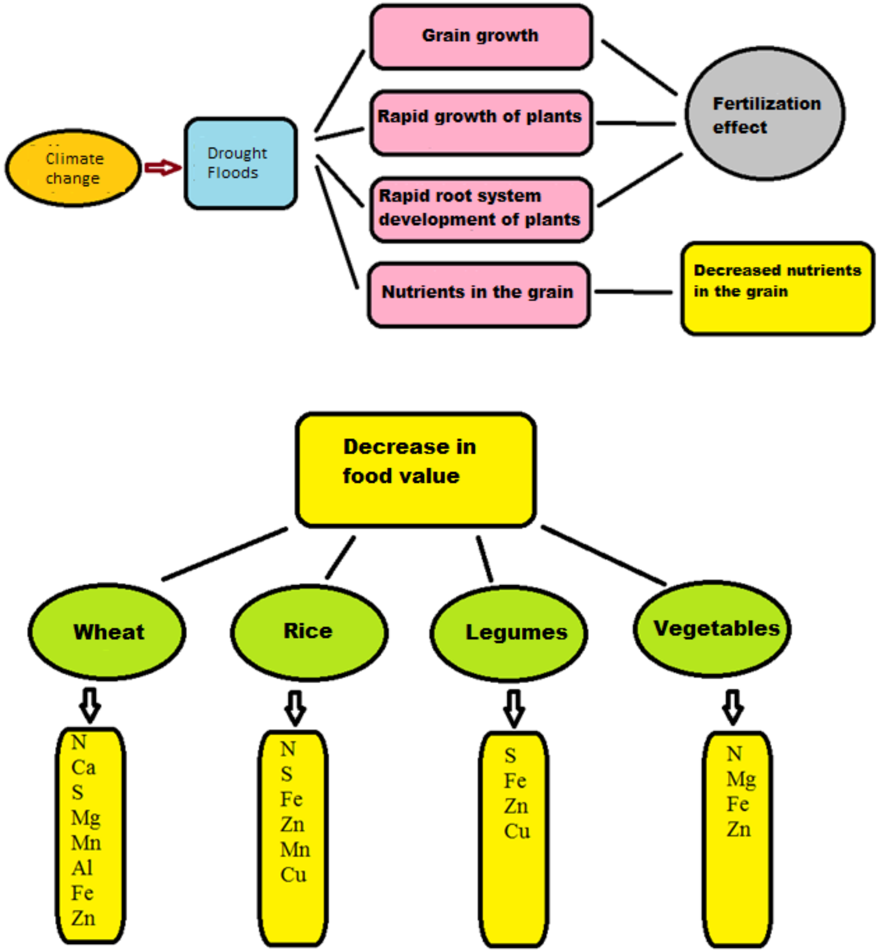

Figure 1.3 Effects of carbon dioxide on nutritional value

The increase in carbon dioxide in the atmosphere has also resulted in a decrease in the concentrations of many minerals in plant seeds.A 2-fold increase in the amount of carbon dioxide has resulted in an average decrease in the concentration of minerals by 8%. World researchers report that by 2050, as a result of the increase in carbon dioxide levels on Earth, 63 million people per year may become infected with diseases that cause zinc, iron, and protein deficiencies, leading to loss of life.In addition to the decrease in minerals, studies have shown that due to the effect of carbon dioxide, 6% of carbon, 15% of nitrogen, 9% of phosphorus and 9% of sulfur minerals in plants have decreased.The decrease in nitrogen minerals has directly affected the decrease in protein in plants.Nutrition is a key component in our lives and daily activities to obtain sufficient vitamins, minerals, proteins, carbohydrates and fiber.In conclusion, we can say that the increase in carbon dioxide has negatively affected people's food energy, biological metabolism and life activities.

1.3 The impact of carbon dioxide on cropland

Soil erosion and fertility. The warming of the atmosphere over the past decades has led to a dramatic increase in hydrological cycles, including extreme rainfall events.During such heavy rainfall events, soil is eroded or degraded.Global warming has had a negative impact on soil fertility. In agricultural landscapes, erosion caused by anthropogenic factors has increased by an average of 22%.Climate change has caused soil warming, which has led to a 40-150% increase in the population of soil bacteria.Elevated carbon dioxide has negatively affected the carbon cycle by accelerating the growth of plants and bacteria in the soil.

With the rise in sea level, agricultural lands have been lost.Thus, erosion or flooding of coastal lands has occurred.In addition to simply flooding agricultural lands, the rise in sea and ocean water levels has caused salt water to enter freshwater sources.After the salt water concentration exceeds 2-3%, freshwater sources become unusable.Thus, as a result of the increase in carbon dioxide in the atmosphere and global warming, agricultural lands and freshwater sources are decreasing and are at risk for the future.As a result of global warming, the increase in potential arable land may lead to the return of northern lands to crop rotation.Thus, as a result of global warming, frozen lands may thaw and become usable.

1.4 Changes observed in adverse weather conditions

Agricultural production is highly dependent on natural conditions.Natural events such as heat waves, droughts, or intense rainfall can cause significant crop losses in agriculture.

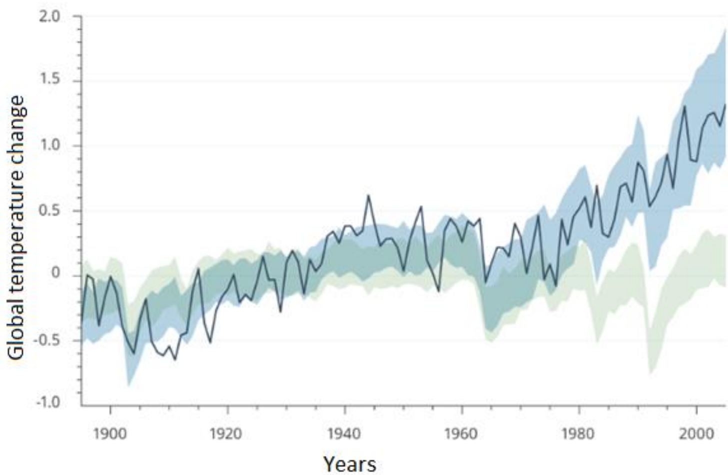

Figure 1.4 Global temperature increase over the years

As a result of the impact of climate change, the temperature in the atmosphere has increased by 2 C° over the years to date, according to comparative analyses (Figure 1.4). It is known that climate change is more prone to extremes, with predicted increases in the frequency of heat waves and intense precipitation. However, since the relevance of climate change is still a relatively new field, it is often difficult to distinguish specific natural phenomena, natural variability or climate change.

1.5 The impact of climate change on plant diseases, pests, and weeds.

As we know, climate change has most affected the decline in the productivity of wheat, soybeans and corn.Global warming has changed the reproduction and distribution of pests, diseases and weeds in the territory.Warmer temperatures have increased the metabolic rate of insect populations and the number of reproduction cycles. Usually, cold temperatures during the winter months at night kill insects, bacteria and fungi.Warmer, wetter weather conditions have accelerated the northward spread of rust diseases in wheat and soybeans.Increased floods or heavy rainfall have positively affected the development of pests and diseases in crop production, creating the need to use more agrochemicals.

Impact on pollinating insects. Climate change has had a negative impact on many insects.Thus, their distribution has significantly decreased and there is a risk of extinction.As we know, approximately 9% of agricultural production depends in some way on insect pollination.

It is widely accepted that the impact of climate change has a major impact on the cultivation of agricultural crops, as well as on insect pests associated with them.Some of the uncertainties regarding the various aspects of climate change relevant to insect pests include the consequences of climate change as factors (increasing temperature, increasing atmospheric CO_2, changes in precipitation, relative humidity, etc.).Given the great heterogeneity of insect species and global climate change, mixed responses of insect species to global warming are expected in different parts of the world.The impact of climate change on insects is complex, as climate change affects the development of some insects well and negatively affects others.At the same time, it affects their distribution, diversity, reproduction, development, growth and phenology.In addition, there is an expected general increase in the number of different insects and pests.Insects are likely to expand their geographical distribution (especially northwards).Some pests will also increase in number due to increased overwintering survival and the ability to produce more offspring. Invasive pest species are likely to spread more quickly into new areas, resulting in more insect-borne plant diseases.Another potential negative consequence of climate change is the reduction in the effectiveness of biological control agents – natural enemies.This could be a major challenge for future pest control programmes.If climate change factors create favourable conditions for pest infestation and crop damage, then we could face significant economic losses and food security risks for people.A proactive and scientific approach will be required to address this challenge.Therefore, there is a great need to plan and formulate adaptation and mitigation strategies in the form of modified IPM tactics, climate and pest monitoring and the use of modelling tools.

1.6 Effects of increasing atmospheric temperature on crop production

Changes in temperature and weather conditions have led to a shift in the areas specialized in agriculture. Temperatures of 1-2 º C above the optimum for crop production have resulted in a decrease in productivity.The search for new targets for plant specialization in soils has faced experts.Many cultivated plants are extremely sensitive to heat.Thus, they die when the air temperature rises above 36 º C. An example of this is the soybean plant.In some regions, the increase in air temperature during winter, the presence of frost-free days, or the flowering time of some plants and trees causes phenological mismatch during the pollination period.Their reproductive status is jeopardized.Thus, successfully pollinated flowers result in a faster vegetation period in the long run.

Figure 1.4 Negative effects of increasing temperatures in the atmosphere

1.7 Impact of climate change on changes in the availability and reliability of irrigation water for crop production

Both drought and floods are the main causes of reduced agricultural production.On average, climate change increases the total amount of water in the atmosphere by 7% for every 1° C increase in temperature (Figure 1.6). Thus, the amount of precipitation increases.However, precipitation is not evenly distributed across the globe.The intensive increase in the circulation of water in the atmosphere has resulted in increased rainfall and downpours in different areas.In some cases, intense hail and rain fall, causing floods.At the same time, water losses by plants through evotranspiration have occurred due to rising air temperatures. Although the CO_2 “fertilization effect” of carbon dioxide also reduces such losses by plants, which effect will prevail depends on the climate of the areas.

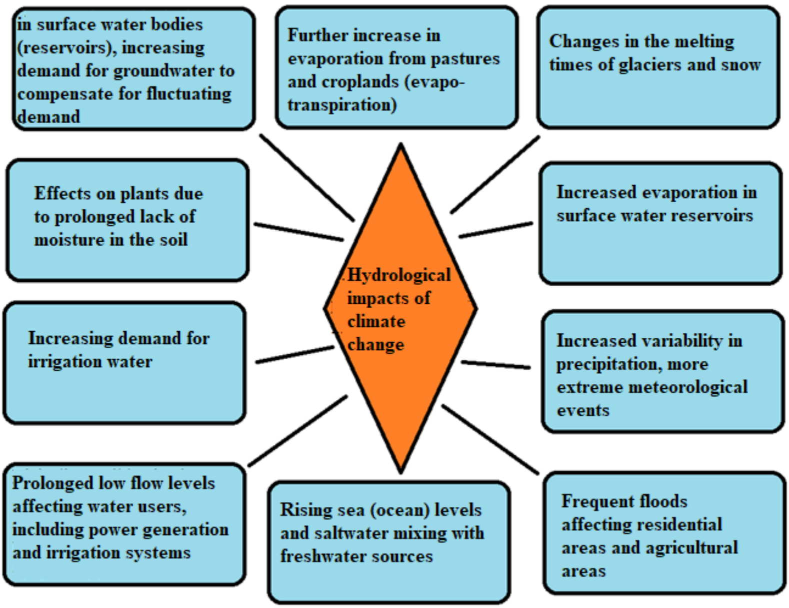

Figure 1.6 Hydrological impacts of climate change

Overall, this means that droughts are becoming more frequent than average due to climate change.Africa, southern Europe, the Middle East, much of the Americas, Australia, and South and Southeast Asia are the parts of the world where droughts will become more frequent and intense, despite a global increase in precipitation.Droughts and precipitation disrupt the balance of evaporation and moisture in the soil.The result is water scarcity, which leads to crop failures and the loss of grazing land for livestock.In many developing countries, it exacerbates pre-existing poverty, leading to food shortages and potential famine.

1.8 Higher productivity in crop production due to the "fertilization effect" of carbon dioxide

The results of scientific studies conducted around the world in 1993 show that a doubling of carbon dioxide in the atmosphere affected the rapid development of 156 different plant species by an average of 37%.While it had a positive effect on the productivity of some plants, it had a negative effect on others.

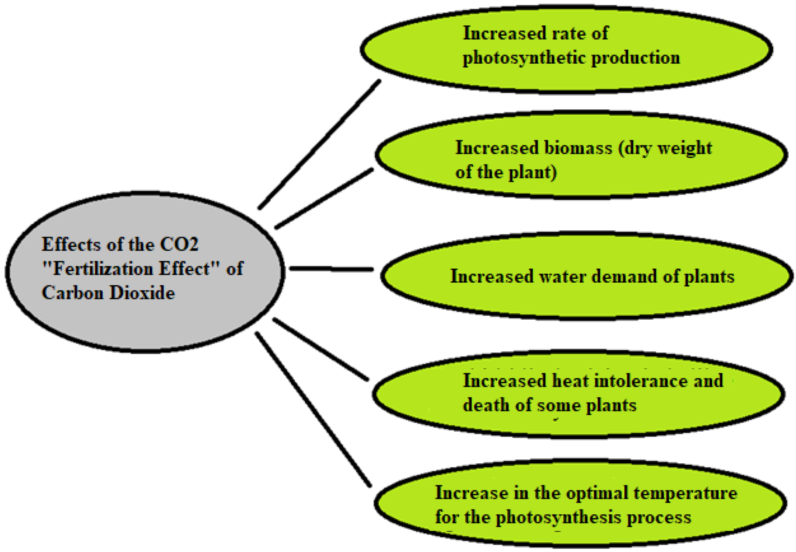

Figure 1.7 Effects of the "fertilization effect" of carbon dioxide

In 2005, the average yield of leguminous crops in crop production increased by 17% worldwide compared to previous years.As a result of satellite measurements, crop production in crop production in different years was compared.Thus, the vegetation cover area in the world increased from 25% to 50%, as revealed in the vegetation index NDVI maps.Thus, it can be said that the "fertilization effect" of carbon dioxide has had a positive effect on the greening of the planet.

2. DIGITAL INFORMATION TECHNOLOGIES IN CLIMATE CHANGE

2.1“Google Flood Hub” technology.

“Google Flood Hub” is an information technology platform used to obtain detailed information about floods, their consequences, impacts, and measures to prevent them.

This technology allows you to detect flood-prone areas early and access information via any device with the internet (Notebook, Netbook, Mobile Android phones, iPad, etc.).Farmers can use this technology to obtain early information about floods and inundations and use emergency services and aid organizations.This technology can help provide early warnings of extreme weather events and prevent livestock losses from events.

2.2 Artificial intelligence (intelligence) technology.

Artificial intelligence (AI) technology has the potential to predict and detect extreme events, including natural disasters, early.AI (AI) models can analyze large amounts of data to project future scenarios for long-term events, such as regionalized sea level rise.This technology can help plan for the impact of future extreme events and take early action.For sudden extreme events, such as hurricanes, AI can provide real-time information about the trajectory, intensity, and potential impacts of a storm.This technology helps emergency and relief organizations make data-driven decisions and allocate resources more effectively.Predictive models powered by AI can help identify areas at higher risk of natural disasters, enabling proactive evacuations and targeted preparedness measures.

3. CLIMATE ADAPTATION DIGITAL TECHNOLOGIES IN AGRICULTURE IN CLIMATE CHANGE

The following climate adaptation digital technologies can be used to protect agricultural production from radical changes in climate change (Figure 3.1).

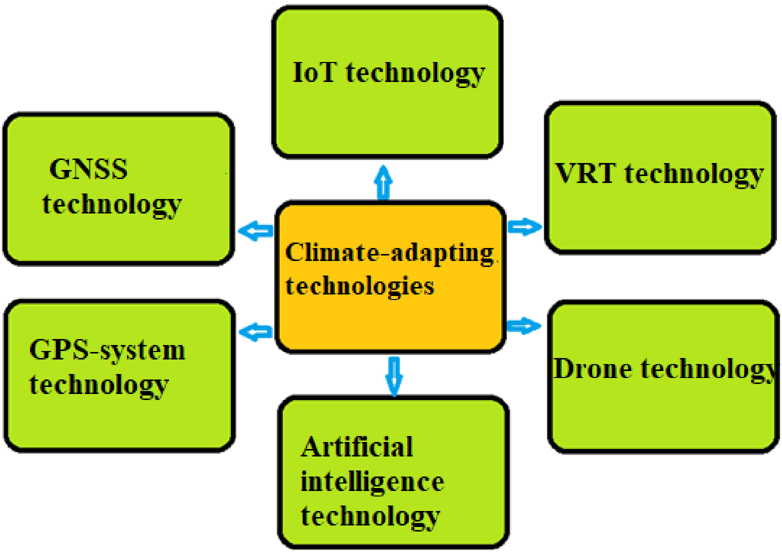

Figure 3.1 Climate-adapting digital technologies

These technologies can be used to counteract, compensate for, or minimize radical impacts.

3.1 Internet of Things (IoT) technology.

Monitoring and control. IoT technology can be applied to monitor and manage resource use and provide early warnings for climate risks.IoT technology can play a crucial role in irrigation of crops. Thus, sensors measure soil moisture and transmit the data to a cloud-based platform, which analyzes the data and triggers irrigation by providing notifications.This technology allows for more efficient use of water, electricity and mineral fertilizers.In addition, IoT technology can provide early warnings about climate risks by helping farmers take measures to protect crops and livestock or make decisions about when to harvest crops.

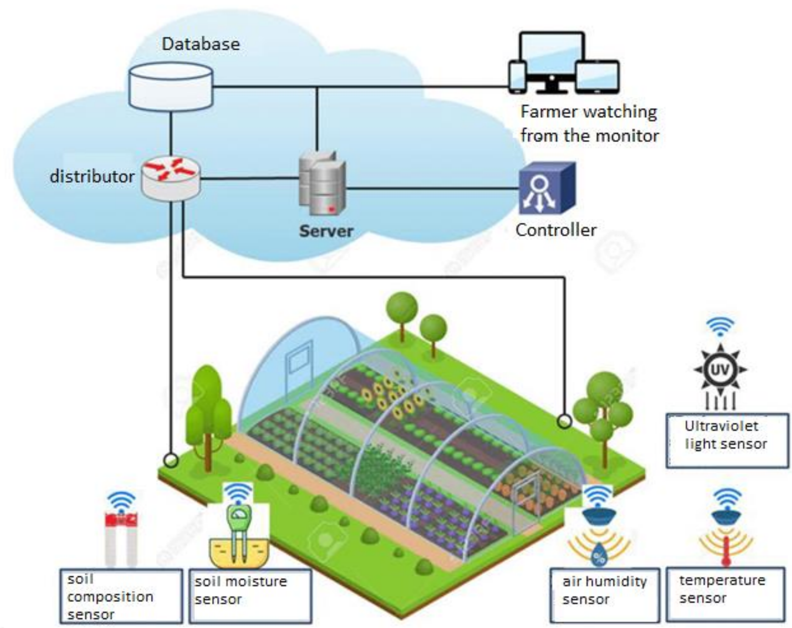

Figure 3.2 IoT irrigation technology

IoT technology can positively transform the industrialization of agriculture by making it more efficient, sustainable, and sustainable.By using IoT technology, farmers can optimize resource use, minimize waste, and make informed decisions.As IoT technology becomes more widely deployed, we can expect more innovations, problem-solving, and useful applications that can help solve the most pressing problems facing our planet.

3.2 Drone technology

Drones or UAVs can be widely used to reduce the negative effects of climate change or to take early measures.It performs visual control in monitoring crop fields, managing irrigation, conducting soil erosion analysis, determining the amount of crops planted and productivity in the field, detecting early pests and diseases in plants, etc. operations.

Figure 3.3 Walkera Voyager 4 drone

Spectral cameras and sensors on drones produce images of very wide or narrow bands in the electromagnetic spectrum.The combination of these spectral sensors with drones and the technology being used has created a new perspective on agricultural surveillance.

Thermal imaging can be used to identify potential plant damage, diseases, pests, and plant transpiration.Thermal imaging cameras have great potential for data-driven or agricultural applications.Thermal imaging provides accurate results in assessing plant temperature in relation to plant water status.Thermal imaging allows for better monitoring of stomatal conductance.Stomatal conductance can be used to monitor plant response to dry soil conditions, as well as to monitor the reduction in stomatal conductance, regardless of the plant water deficit.

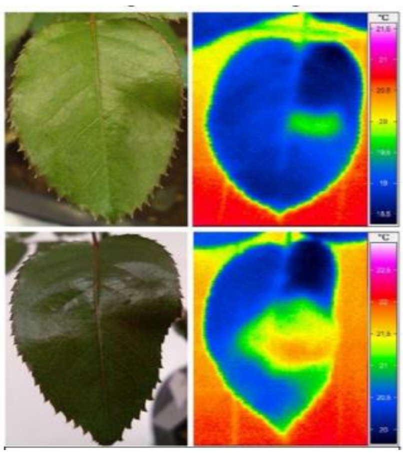

Figure 3.4 Leaf view of camera and sensors

Determining changes in the transpiration rate of a plant is considered one of the valuable data.Thus, pathogens such as leaf spots and rust are among the indicators of variability.Soil pathogens such as Rhizoctonia solani or Pythium spp affect the transpiration rate and the plant's ability to absorb water. Thermal imaging can be used to achieve the goal of timely detection of such problems. Multispectral cameras are effective in mapping and predicting plant classification, plant development stages, detection of weeds and diseases, and integration of photosynthetic pigment images obtained in mineral deficiency cases into systems.

Hyperspectral cameras are used to detect plant pathogens that appear as rust and powdery spots on leaves and provide information with images at early development stages.

Hyperspectral imaging is used to detect mycotoxins in cereal crops.Mycotoxins are secondary metabolites produced by microfungi that can cause disease and death in humans and animals.Early detection of mycotoxins is extremely important for producers and consumers. Fusarium ssp. infects cereal crops such as wheat, barley, rye, and oats by producing mycotoxins.The use of hyperspectral sensors is suitable for early detection of damage to spikes (root rot disease).These cameras and sensors allow us to see physiological changes in plants and implement timely plant protection measures in the field.

3.3 LIDAR technology

LIDAR technology is carried out using drones.Since LIDAR sensors are used by installing them on drones. LIDAR imaging is unique compared to other spectral sensors. LIDAR uses its own light.LIDAR technology can be used to create three-dimensional digital models in agriculture.Accurate maps can be created for the accurate use of natural resources in agriculture.Due to landscape characteristics, soil moisture levels and natural fertility are variable.LIDAR is widely used to observe, measure and prepare maps of variable soil properties on slopes, mountainous areas, and highlands.It is a leader in drawing accurate topographic maps that are very useful for agriculture.Soil erosion is a widespread environmental problem that many farmers face today.Soil is exposed to the effects of water and wind during natural phenomena.As a result, the topsoil is washed away or blown away, causing the topsoil to be lost and ravines to form.Useful nutrients of the soil are washed away.LIDAR technology is used to determine the extent of erosion problems in agriculture and to draw maps. The world-famous “Revised Universal Soil Loss Equation” RUSLE allows you to predict the state and conditions of water flow for the purpose of land use for a long time.LIDAR technology is indispensable in drawing up a planned map of the direction of water flow and the measures taken in advance as a result of heavy rainfall (downpour). Currently, soil monitoring and erosion detection are being carried out in agriculture using LIDAR technology using drones.In this area, drawing and preparation of topographic maps, as well as their correct analysis, are successfully underway.

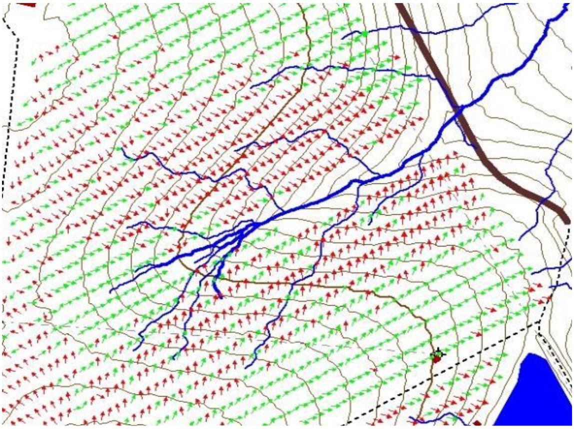

Figure 3.5 Map of orchards using LIDAR sensor

During heavy rain, the water flow lines and the direction of water flow are reflected in green at the base of each tree or red along the tree line, which is colored to indicate that the water flows down the tree line.

3.4 GPS system technology for managing the aggregate

In agriculture, the use of GPS-controlled tractors is appropriate to optimize the use of machinery in agricultural fields.Thus, optimized plowing paths are used for low carbon dioxide emissions.This intelligent system allows farmers to accurately map fields, plan efficient plowing, and minimize overlaps during operations.As a result, fuel consumption is reduced, which leads to lower emissions of carbon dioxide (CO_2), a major greenhouse gas.In addition, these technologies also help to carry out timely and targeted actions such as irrigation and fertilization, which ultimately further reduces energy and resource consumption.

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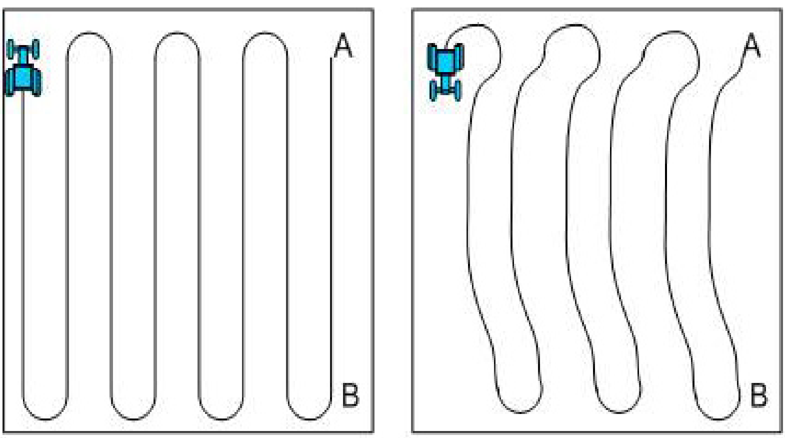

a) b)

Figure 3.6 a) Autopilot plowing with GPS system, b) plowing led by tractor driver

3.5 GNSS, GIS technology

This technology can be used to eliminate the negative consequences of climate change and take early measures. For example, it can be used to obtain visual images of cultivated areas and create NDVI maps.With this technology, all operations carried out in the planning of cultivated areas, irrigation management, early detection of pests and diseases, monitoring of cultivated areas, productivity assessment, application of fertilizers, etc. are applied to counteract the negative effects of climate change and detect new variables.

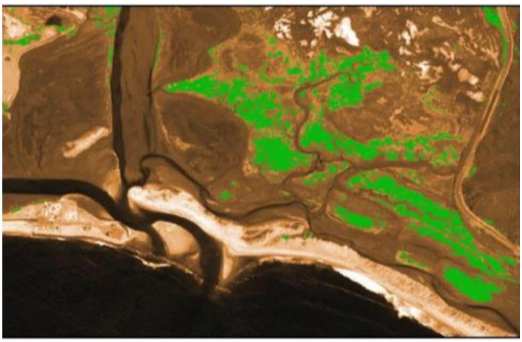

Figure 3.7 Satellite image of a crop field

3.6 VRT Variable Rate Technology

It is known that climate change affects the soil and plants. To compensate for these effects, we can use VRT Variable Rate Technology.Variable rate technology applies new variable rates (fertilizer, seeds, water, etc.) in accordance with changing factors (soil composition, physical-mechanical properties, climatic conditions, etc.) in the field of cultivation.It is intended to apply mineral nutrients and water in the soil in the required norm.This technology combines physical and digital technologies. The development stages of the plant are adjusted to favorable conditions by taking into account the composition of the soil, humidity, climatic conditions, etc. factors, and the complex parameters are adjusted to favorable conditions, creating fertile conditions for the cultivated plant.Reduces labor costs by preventing product, time, water energy losses.VRT technology fills the gaps in the technological line by applying them to moving and stationary parts using drones and GPS, GNSS systems, sensors, digital processors.

The following operations can be applied to VRT technology.

- *in applying mineral fertilizers and lime to the soil*
- *in applying organic fertilizers*
- *in sowing seeds*
- *in irrigation*
- *in analyzing the field soil*
- *in controlling weeds and diseases*

Figure 3.8 VRT Variable Rate Technology Application to Field Standards

VRT technology is widely used in landscape analysis using electronic maps, economical use of soil and water resources, analysis of soils for cultivation, etc.VRT variable rate technology, which meets the negative factors occurring in crop rotation in climate change, will be used continuously today and in the future.

3.7 Application of Agrobots to Agriculture

Agrobots can be used to minimize the negative effects of climate change on crop production.Thus, in crop production, they are successful in monitoring arable land, early detection of pests and diseases, mechanical weed control, precise seed and mineral fertilizer sowing, and application of agrochemicals (herbicides, pesticides). Agrobots analyze the environment using sensors based on LIDAR, GPS, GNSS, IoT, RTK technologies.One of the negative effects of climate change is the change in nutrients in the soil.With the help of agrobots, it is possible to accurately apply the necessary mineral fertilizers by analyzing the soil fraction.

"Dina" is used in agrochemical control, "FD-20" is used for seed and fertilizer spreading, "Agbot" is autonomous, "Anatis" is used for mechanical weeding, "GEN-2" is used for mechanical weeding, "Avo" is used for herbicide and fungicide application, "Vinbot" is used for monitoring vineyards, "Vinerobot" is used for monitoring plant development, "Vitirover" is used for weeding, "NAIO OZ" is used for mechanical weeding between rows, etc. agrobots are produced.

Figure 3.9 FD 20 agrorobot spreading seeds and fertilizers

Agrobots integrate into the system by applying LIDAR, GPS, GNSS, IoT technologies through an artificial intelligence system.As a result, they create conditions for taking measures by detecting signs of newly started diseases and newly developing pests that are invisible and undetectable to the human eye.In addition, by monitoring plants, they analyze the status of their water and nutrient supply and do not put plants under stress.Agrobots, which have laid the foundation of smart agriculture and entered a new stage of development leading to the future, have laid the foundation for unmanned agriculture with "Artificial Intelligence" technology.In the future, agrobots, which will replace qualified agronomists, will be programmed to detect pests and diseases, automatically diagnose them, and take measures using "Artificial Intelligence".

4. Application of digital technologies in sustainable agriculture

Table 4.1

s/s	**Conducting operations**	**Applied digital technologies**
1.	Economical use of soil and water	GNSS,GPS
2.	Field monitoring and planting planning	GIS,GNSS,Drone
3.	Protecting soil fertility and preventing salinization	Drone,LİDAR
4.	Early detection of pests and diseases	GNSS,GIS,Drone,Agrobot
5.	Determination of topographic and vegetation models	Drone,LİDAR
6.	Predicting and preventing soil erosion	Drone,LİDAR,GIS
7.	Detection and restoration of nutrient deficiencies in the soil	VRT,Drone,GPS,GNSS
8.	Irrigation management and monitoring	IOT,Drone
9.	Saving on agrochemicals and precise application	VRT,Drone
10.	Providing plants with a continuous supply of water and nutrients during the growing season	IOT,VRT
11.	Efficient use of mineral fertilizers	İOT,VRT
12.	Mechanical weed control	Agrobot
13.	Determining productivity in the field	GNSS,Drone
14.	Precision seeding	VRT,GPS,Agrobot

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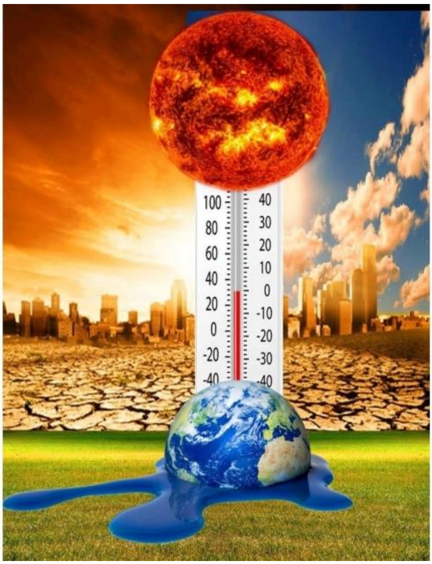
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