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SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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UNIT – II

SUSTAINABLE AGRICULTURE

Crops are plants that are cultivated by humans for food or other purposes. Crops are the primary component of most agroecosystems as they provide food for humans and animals, as well as raw materials for industries such as textiles, biofuels, pharmaceuticals and cosmetics. There are many types of crops in agroecosystems, ranging from cereals, legumes, roots and tubers, to fruits, vegetables, spices and herbs. It creates diversity among crops which refers to the variety of crop species that are grown in an agroecosystem. Crop diversity has many benefits for agroecosystem functioning and sustainability.

B. Livestock

Livestock are domesticated animals that are raised by humans for food or other purposes. These are another important component of many agroecosystems as they provide animal products such as meat, milk, eggs, honey, wool, leather and manure. There are many types of livestock in agroecosystems, ranging from ruminants such as cattle, sheep, goats and camels, to non-ruminants such as pigs, poultry, rabbits and bees. Some livestock are raised as grazers, meaning that they feed on grasses and other herbaceous plants in pastures or rangelands, while others are raised as browsers, meaning that they feed on shrubs and trees in woodlands or forests.

C. Soil

Soil is the upper layer of the Earth's crust that supports plant growth and provides various ecosystem services. It is a complex mixture of mineral particles, organic matter, water, air and living organisms. Soil is a vital component of agroecosystems as it influences crop production, water availability, nutrient cycling, carbon sequestration and biodiversity. Soil management practices for sustainable agriculture aim to enhance soil health by maintaining or improving soil quality and functions.

D. Water

Water is a scarce and essential resource for life on Earth. It is a key component of agroecosystems as it affects crop growth, livestock production, soil health and ecosystem services. Water availability and irrigation practices are crucial factors that determine the productivity and sustainability of agroecosystems. Water conservation and efficiency in agroecosystems are essential goals for achieving sustainable agriculture in the face of increasing water scarcity and competition. It aims to reduce water losses and waste and to increase water use efficiency and productivity.

2.3 Impact of Climate Change on Agriculture:

Climate change is any significant long-term change in the expected patterns of average weather of a region (or the whole Earth) over a significant period of time.

- i. Increased anthropogenic activities such as industrialization, urbanization, deforestation, etc. lead to emission of greenhouse gases due to which the rate of climate change is much faster.
- ii. From ancient times India's agriculture has been dependent on monsoons. Any change in monsoon trends drastically affects agriculture.

Impact of Climate Change on Agriculture

(i) Increasing temperature: Climate change is causing temperatures to rise, resulting in longer growing seasons and more intense heat waves. This can be beneficial for some crops, such as corn and soybeans, but can also create more stress on other crops, such as wheat and barley. Additionally, extreme heat can lead to decreased productivity, higher water requirements and increased risk of pest and disease outbreaks

(ii) Decreasing precipitation: There is changes in precipitation patterns, both in terms of the amount and timing of precipitation. These changes are making drought conditions more common and causing floods in many areas. This can lead to crop losses due to decreased water availability, soil erosion and increased weed and pest pressure.

Increased pests and diseases: Warmer temperatures and increased precipitation can lead to increased pest and disease pressure, leading to crop losses). For example, pests such as the maize stalk borer have been observed to be more active in warmer temperatures, leading to reduced yields in maize crops.

(iii) Increased costs for farmers: There are increased costs for farmers, due to the need for new equipment, increased labor costs, and increased costs for inputs such as fertilizers and pesticides. This can also result in food inflation.

(iv) Increased food insecurity: The food insecurity is increased due to changes in crop yields, increased costs for farmers, and changes in food prices. This can have serious implications for populations in developing countries, which are often more vulnerable to the impacts of climate change.

Weather Impacts on Agriculture

- Crops are impacted by rainfall variability and heat stress.
- Milk yield in livestock to be impacted during heat waves
- Changes in breeding season in marine fisheries with shift in seasonal catch
- Significant negative impact on commercial poultry due to heat stress
- High rainfall leads to greater loss of top soil due to erosion
- Rise in sea level may lead to loss of farmland by inundation and increasing salinity of groundwater in coastal areas.
- The major impacts of climate change will be on rain fed or un-irrigated crops, which are cultivated on nearly 60 percent of cropland.
- Increase in the mean seasonal temperature can reduce the duration of many crops and hence reduce final yield.
- Climate change has a direct impact on crop evapotranspiration.

Consequences

- Higher temperatures and changing precipitation patterns will severely affect the production patterns of different crops.
- All these changes will increase the vulnerability of the landless and the poor.
- In many parts of India Farmers committed suicide from stress-related issues arising from the vagaries of monsoon.
- The World Bank report warned that by the 2040s, India would see a significant reduction in crop yields because of extreme heat.
- Depleting water availability due to changes in precipitation levels and falling groundwater tables.

Strategy to Adapt to Climate Change

- Strategic research to address long term climate change

- Farmers can adapt to climate changes by shifting planting dates, choosing varieties with different growth duration, or changing crop rotations.
- Capacity building of different stakeholders for greater awareness and community action
- Interventions related to soil health, water harvesting, improved drainage in flood prone area, artificial ground water recharge and water saving irrigation methods.
- Drought / temperature tolerant varieties, water saving paddy cultivation methods (SRI, aerobic, direct seeding),
- An Early warning system should be put in place to monitor changes in pest and disease outbreaks.
- Preventive measures for drought that include growing of pulses and oilseeds instead of rice
- Investment in R&D is needed to spur innovations in sustainable climate-friendly and climate-proof productivity, and the private sector can help.
- Financial incentives can encourage farmers to adopt measures that have high costs, or that are socially beneficial but costly at the private level.
- Develop climate-smart agriculture practices
- To cope with the impact of climate change on agriculture and food production, India will need to act at the global, regional, national and local level.

Improved Crop Varieties: As climate conditions change, farmers need to adjust their crops accordingly. This includes selecting varieties that are more tolerant of extreme temperatures and droughts. For example, maize varieties in Africa that have been bred specifically for heat tolerance have been shown to offer a yield advantage of up to 10%.

Irrigation: A well-managed irrigation system can be a powerful tool for limiting the effects of climate change on agriculture. By decreasing the dependence on rainfall, farmers are able to ensure that their crops are receiving the water they need to thrive, even during periods of prolonged drought.

Precision Agriculture: Precision agriculture uses technology to monitor crop growth and soil health in order to make more informed decisions about planting and fertilization. This can help farmers optimize their yields and reduce their environmental impact.

Agroforestry: Agroforestry combines traditional agricultural practices with tree cultivation. This helps to reduce soil erosion and increase carbon sequestration, while also providing a source of income for farmers.

Water Harvesting: Water harvesting is a simple and effective way to capture rainfall and store it for future use. This can be especially helpful for farmers in areas prone to long periods of drought.

Climate-Smart Agriculture: Climate-smart agriculture is a set of practices that aim to increase agricultural productivity while also reducing greenhouse gas emissions. This includes practices such as the use of improved crop varieties, efficient irrigation systems, and sustainable land management.

FOOD GRAIN PRODUCTION AT STATE LEVEL:

India's food grain production is a vital aspect of its agricultural sector. Here's a breakdown of the top food grain-producing states in India:

Top Food Grain-Producing States –

- i. **Uttar Pradesh:** Ranks first in total food grain production, accounting for a significant portion of the country's wheat, barley, sugarcane, potato, and lentil production .
- ii. **Punjab:** Known as the "Granary of India," Punjab is a leading producer of wheat and rice, contributing significantly to the country's food grain production .
- iii. **Madhya Pradesh:** A major producer of soybeans, wheat, and pulses, Madhya Pradesh plays a crucial role in India's food grain production .
- iv. **Rajasthan:** The largest producer of bajra (pearl millet) in India, Rajasthan also produces significant amounts of wheat, pulses, and oilseeds .
- v. **Bihar:** A major producer of rice, wheat, and maize, Bihar contributes significantly to India's food grain production .

Food Grain Production Data According to the Ministry of Agriculture and Farmers Welfare, India's total food grain production for 2022-23 was estimated at 3296.87 lakh tonnes, with the top crops being

- i. Rice: 1357.55 lakh tonnes