IIT KHARAGPUR

NPTEL ONLINE
CERTIFICATION COURSES

Organic Farming for Sustainable Agricultural Production

Dr. Dillip Kumar Swain, Associate Professor

Agricultural and Food Engineering Department

Lecture 08 : Key Indicators of Sustainable Agriculture

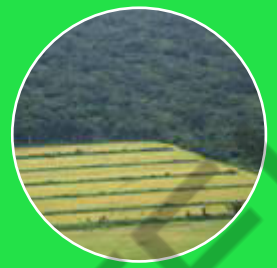
"Key Indicators"- What are they?

- As a man's health is judged by his physical and mental attributes, similarly the well-being of the ecosystem is primarily estimated by some parameters. These parameters are called the "Key Indicators".
- **Indicators enable** policymakers, farmers, businesses, and civil society to **better understand** current conditions, **identify** trends, set **targets**, **monitor** progress, and **compare** performance among regions and countries.

Key Indicators of Sustainable Agriculture

WATER

SOIL HEALTH



LAND CONVERSION

POLLUTION

CLIMATE CHANGE

Indicators

1. WATER

Agriculture accounts for 70 percent of the world's freshwater withdrawals and for 80 to 90 percent of its freshwater consumption. Water availability in future climate is going to be limited.

2. SOIL HEALTH

- Soil plays a key role in maintaining a balanced ecosystem and producing quality agricultural products. However, soil erosion and degradation continue to threaten the availability and productivity of land for growing food.
- Soil is being lost 10 to 40 times faster than it is being replenished, which poses a threat to long-term human food security. Furthermore, in many places, soil's capacity to retain nutrients, retain moisture, and maintain a healthy pH is declining.

Indicators

3. LAND CONVERSION

- Since the dawn of the first agricultural revolution 8,000 to 10,000 years ago, growing crops and raising livestock have been the primary causes of loss and degradation of natural ecosystems.
- Today, 37 percent of the planet's landmass outside of Antarctica is dedicated to growing food; 12 percent is in croplands and 25 percent is in grazing lands.
- The majority of current land-use change in the world is forests, wetlands, and grasslands being converted into farms and grazing pastures.

Indicators

4. POLLUTION

A. Nutrients:

- Maintaining balanced soil nutrient levels is critical to both production and environmental health: a deficiency in nutrients can reduce soil fertility and limit production, while surplus nutrients can lead to ecosystem degradation if they are lost to water or air.
- Impacts of excess nutrients on the environment include eutrophication of surface waters, impairment of groundwater, and emissions of harmful greenhouse gases, particularly nitrous oxide.

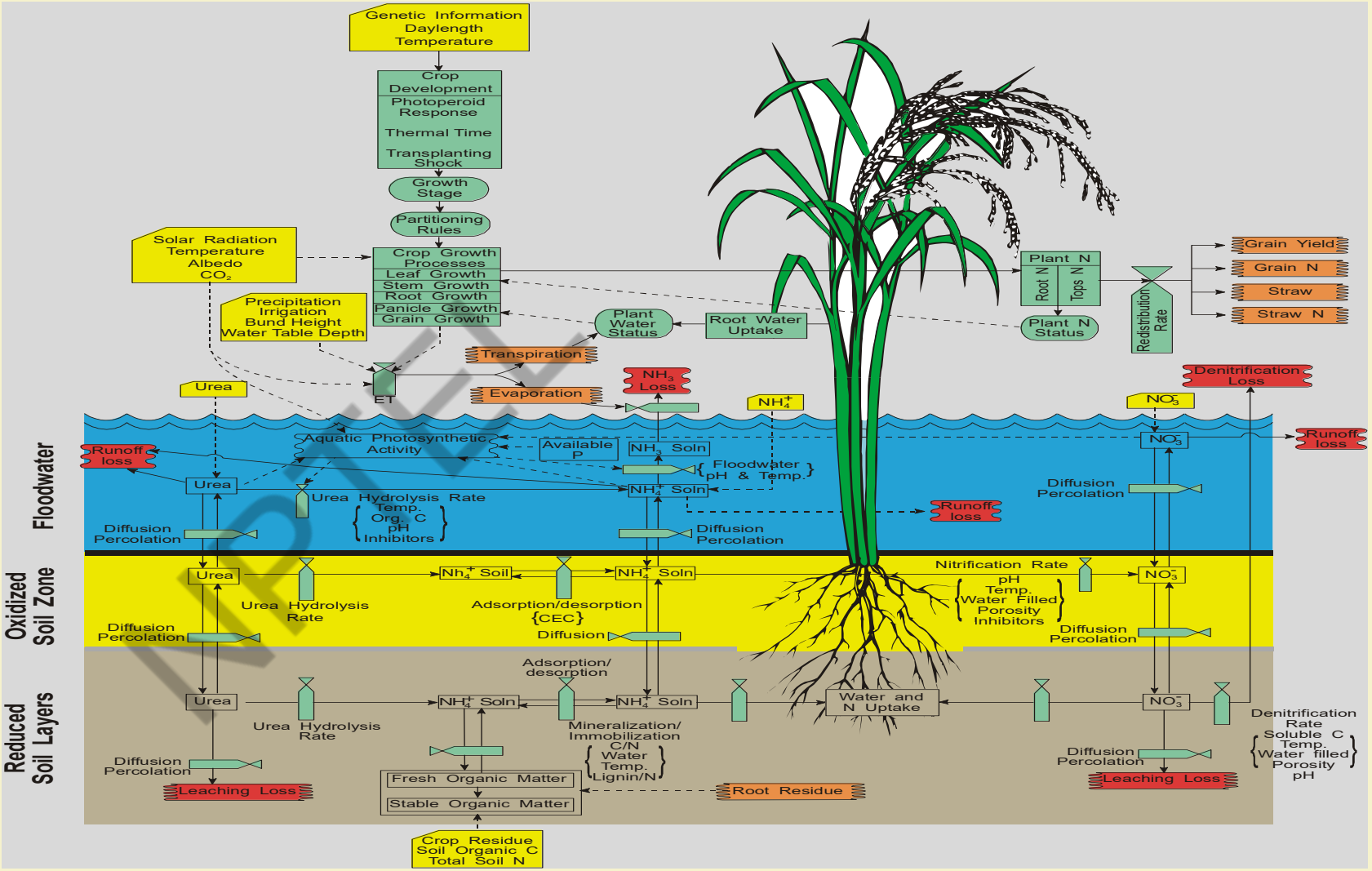
B. Pesticides:

Chemical pesticides—while beneficial for preventing crop losses to insects and other pests— can have detrimental effects on human health, wildlife, water quality, and other environmental factors depending on the toxicity of the constituent chemicals and the application conditions.

Indicators

5. CLIMATE CHANGE

About 13 percent of global anthropogenic greenhouse gas emissions came from agricultural production, most notably from ruminants, manure, fertilizers, rice, and on-farm energy use. Land use change, most of which is triggered by agriculture, contributed another 11 percent of global greenhouse gas emissions



Indicators: Policy, Practice and Performance analysis

	Water	Climate Change
Policy	Existence of policies requiring measurement of agricultural water withdrawals (Yes/No)	Existence of policies promoting low greenhouse gas (GHG) from agricultural development (Yes/No)
Practice	Share of irrigated cropland area with efficient irrigation practices in place (%)	Share of farm area with agricultural GHG emissions management practices (%)
Performance	• Crop production per drop of water withdrawn (kilograms of crop produced per cubic meter of water per year) • Water stress ratio (water demand/ water supply in cubic meters)	Food production per unit of GHG emissions (tons of food produced per year per ton of CO_2 equivalent), i.e. Global Warming Potential

Indicators: Policy, Practice and Performance analysis

	Land Conversion	Soil health
Policy	Existence of policies limiting conversion of natural ecosystems to agriculture (Yes/No)	Existence of policies that promote agricultural soil conservation practices (Yes/No).
Practice	Share of agricultural land enrolled in agricultural preserve programs (e.g., zoning to preserve production) (%)	Share of arable land under soil conservation practices (%)
Performance	• Conversion of natural ecosystems (e.g., forests, wetlands) to agricultural land (crop and pasture) (hectares of converted land per year) • Share of agricultural land over X years that was stable, share that shifted to natural land, and share that grew from natural land conversion (%).	• Share of agricultural land affected by soil erosion (%) • Soil organic matter (carbon) content (tons of carbon per hectare).

Indicators: Policy, Practice and Performance analysis

	Pollution	
	Nutrients	**Pesticides**
Policy	Existence of policies promoting nutrient management practices (Yes/No).	Actions to ban or restrict pesticides and toxic chemicals for use in agriculture (Yes/No)
Practice	Share of agricultural land under efficient nutrient management practices (%)	Share of cropland under Integrated pest management (%)
Performance	Nutrient input balances on agricultural land Fertilizer applied per unit of arable land (tons of nutrients per hectare of arable land)	Pesticide use per unit of cropland (tons of active ingredient applied per hectare)

Sources: *World Resources Institute report, 2017*