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Conservation Agriculture: A Solution to the Problems of Conventional Agriculture

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With the use of HYVs, intense input utilization, extensive tillage, and irrigation, India's food grain output has grown fourfold since 1950-51. Soil, water, vegetation, and other natural resources have all been degraded as a result of intense farming. In this environment, global conservation agriculture (CA) has ushered in a new era, since its basic concepts have the ability to improve resource use efficiency, water productivity, and climate change mitigation.

Rainfed agriculture accounts for 87 million hectares of India's total cultivable land, accounting for 44% of total food production, while irrigated agriculture accounts for 55.2 million ha, accounting for 56% of total food production. Various land degradation issues have an impact on the cultivable area. The total degraded area is 120.7 million hectares, with 73.3 million hectares impacted by water erosion, 12.4 million hectares by wind erosion, 6.64 million hectares by salinity and alkalinity, and 5.7 million hectares by soil acidity. These issues with land degradation are the result of poor land management methods.

The reasons for poor soil quality and productive capacity of soil are:-

1. Topsoil and organic matter erosion caused by intense and deep tillage.
2. Monoculture and insufficient fertilizer application lead to nutritional imbalance and poor nutrient utilization efficiency, resulting in a variety of losses.
3. Inadequate use of organic manures such as FYM and compost, as well as little recycling of agricultural leftovers since they are used as feed and fuel.
4. No or little green manuring since it competes for resources with the ordinary crop.
5. Water logging, salinity, alkalinity, and acid soils, among other things.

What is Conservation Agriculture?

Conservation agriculture (CA) is defined as "a resourcesaving agricultural crop production strategy that aims for acceptable earnings as well as high and sustained output levels while also safeguarding the environment" (FAO, 2007).

The following are the four conservation agricultural principles:

1. Minimal mechanical soil disturbance: This approach emphasizes causing the least amount of soil disturbance as possible. As a result, the phrase "conservation tillage" was coined to describe a variety of tactics and procedures for establishing crops in the leftovers of a previous crop that are purposefully left on the soil surface. Conservation tillage has two main advantages: greater rainwater conservation and reduced soil erosion.

2. Permanent organic soil cover: This refers to the use of cover crops and crop rotation strategies to keep enough crop residue on the soil, decreasing surface runoff and preventing pollution of surface water sources while also suppressing weeds. It increases the amount of organic matter in the soil, which improves aggregation, structure, density, and porosity,

leading in increased soil fertility and production. It also improves hydraulic conductivity and water retention capacity while reducing soil crusting.

3. Varied crop rotations for annual crops and plant associations for perennial crops: Crop rotation strategies and the use of a variety of diversified crops in cropping systems will aid in pest, disease, and weed management. Crop rotation will promote soil health by increasing the dispersion of bio pores caused by varied roots, resulting in improved water and nutrient distribution and exploration in the soil profile.

4. Keeping track of in-field traffic minimizing compaction: To minimize soil compaction, this concept focuses on decreasing the use of heavy tools in the field. The FAO now recognizes "managing in-field traffic" as a component of conservation agriculture, which is performed by directing field traffic along fixed rails. Instead of planting on the flat, this can also be performed by employing a ridgetill or permanent bed planting scheme (Sayre and Hobbs, 2004).

Ridge tillage is a kind of conservation tillage that employs specialized planters and cultivators to preserve permanent ridges on which row crops are cultivated. The agricultural leftover is left until planting season after harvest. After moving residue out of the way and slicing off the surface of the ridgetop, the planter deposits the seed in the top of the ridge.

5) Minimal tillage: Aims to reduce tillage operations to the bare minimum required to create a reasonably decent seed bed and favourable soil conditions for crop growth and development. Herbicides are required to manage weeds in this situation. The following are the several methods of minimal tillage:

I) Row zone tillage
ii) Tillage with a plough pan
iii) Tillage in the wheel zone

6) No/zero tillage: Tillage is not used in no-till systems to establish a seedbed. Crops are simply sown onto the agricultural leftover from the previous year. Coulters in no-till planters slice the soil, allowing a double disc opener to distribute the seed at the correct depth. A spring press wheel is used to seal the slot. In no-till systems, herbicides are usually the only way to keep weeds at bay.

Conservation agriculture's role in the current situation:

- By enhancing crop growing conditions and input efficiency, CA offers enormous potential for delivering long-term production increases.
- CA improves soil fertility and lowers soil degradation by minimizing soil erosion, water pollution, and other factors. CA also conserves and enriches biodiversity in the field.
- CA eliminates power-intensive soil tillage, reducing drudgery and labor required for crop production by more than 50% for small-scale farmers; for mechanized farms, it reduces fuel requirements by 70% and the need for machinery by 50%; and it protects livelihoods security under changing climate scenarios through carbon sequestration and moisture conservation.

CA's Challenges and Limitations:

Retention of residues for mulch cover and different spacings for rotation crops in the early years - Change of mindset of farmers and unemployment to labor in the early years - Growing of cover crops and crop rotation in rainfed areas is hampered by moisture availability constraints

CA benefits develop over time and may look less beneficial in the early years. Crop residue cover maintenance in Alfisols is tough because to termite problems and quicker decomposition in tropical and subtropical locations due to high temperatures.

Conclusion

CA is a viable solution for fulfilling future food demands while also contributing to long-term agricultural sustainability. These strategies maximize input efficiency and agricultural revenue while also protecting and revitalizing soil, biodiversity, and the natural resource base. By eliminating interventions like mechanical soil tillage to a bare minimum, these CA techniques improve natural biological processes above and below ground. As a result, CA provides present agricultural techniques hope for overcoming natural resource deterioration and climate change. However, widespread public awareness and extension activity are required to encourage farmers to adopt these approaches.

References

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