Available online at
www.currentagriculturetrends.com

ISSN (E): 2583 – 1933

Curr. Agri.Tren.:e-Newsletter, (2022) *1*(2), 11-13

Current Agriculture Trends: e-Newsletter

Article ID: 109

Conservation Agriculture: A Solution to the Problems of Conventional Agriculture

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Article History
Received: 24.01.2022
Revised: 7.02.2022
Accepted: 13.02.2022

INTRODUCTION

Green revolution has increased the Indian food grain production by four folds since 1950-51 with adoption of HYVs, intensive input use, extensive tillage, irrigation *etc*. The intensive cultivation has led to degradation of natural resources such as soil, water, vegetation *etc*. In this context, globally conservation agriculture (CA) has opened a new paradigm as it has potential for higher resource use efficiency, water productivity and climate change mitigation through its key principles.

Out of 142.2 m ha of total cultivable area in India, rainfed area constitutes 87 m ha contributing 44 per cent of total food production and irrigated area constitutes 55.2 m ha with 56 per cent of total food production. The cultivable area is affected by various land degradation problems. Total degraded area accounts to be 120.7 m ha, out of which 73.3 m ha is affected by water erosion, 12.4 m ha by wind erosion, 6.64 m ha by salinity and alkalinity and 5.7 m ha by soil acidity. These land degradation problems are resultant of improper land management practices.

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

1. Erosion of topsoil and organic matter as a result of intensive and deep tillage.
2. Mono-cropping and low fertilizer application resulting in nutrient imbalance and poor nutrient use efficiency attributing to various losses.
3. Poor use of organic manures such as FYM, compost and no recycling of crop residues due to their use as fodder and fuel.
4. No or low green manuring as it competes with the regular crop for resources.
5. Water logging, salinity and alkalinity and acid soils etc.

What is Conservation Agriculture?

Conservation agriculture (CA) can be defined as "a concept for resource-saving agricultural crop production that strives to achieve acceptable profits together with high and sustained production levels while concurrently conserving the environment" (FAO, 2007).

The four principles of conservation agriculture are:-

1. Minimum mechanical soil disturbance: This principle focuses on least disturbance to the soil as possible. Based on this, the term **"Conservation tillage**" has came into existence which refers to a number of strategies and techniques for establishing crops in a previous crop's residues which are purposely left on the soil surface. The principal benefits of conservation tillage are improved rain water conservation and the reduction of soil erosion.

2. Permanent organic soil cover: This envisages the maintenance of sufficient crop residue cover on the soil by cover crops and crop rotation practices which help in reducing surface runoff and avoids contamination of surface water sources apart from controlling weeds. It enhances soil organic matter content which improves soil aggregation, structure, density, porosity resulting in improved soil fertility and productivity. It also reduces soil crusting, increases hydraulic conductivity and water holding capacity.

3. Diversified crop rotations in the case of annual crops or plant associations in case of perennial crops: The crop rotation practices and inclusion of various diversified crops in cropping systems will helps in pest, disease and weed control. Crop rotation will improve soil health by improving the soil structure due to greater distribution of bio pores by diverse roots resulting in better distribution and exploration of water and nutrients in soil profile.

4. Controlling in-field traffic reducing compaction: This principle focuses on reduction of heavy implements usage in field to avoid soil compaction. The FAO now includes "controlling in-field traffic" as a component of conservation agriculture; this is accomplished by having field-traffic follow permanent tracks. This can also be accomplished by using a ridge-till or permanent bed planting system rather than planting on the flat (Sayre and Hobbs, 2004).

The types of conservation tillage are:-

a) Ridge tillage:- Ridge tillage uses specialized planters and cultivators to maintain permanent ridges on which row crops are grown. After harvest, the crop residue is left until planting time. The planter places the seed in the top of the ridge after pushing residue out of the way and slicing off the surface of the ridge-top.

b) Minimum tillage: Aims at reducing tillage operations to the minimum necessity for a reasonably good seed bed to establish adequate crop stand and favourable soil conditions for growth and development of crops. Here use of herbicide is essential for control of weeds. The different types of minimum tillage are,

i) Row zone tillage
ii) Plough pan tillage
iii) Wheel zone tillage

c) Zero/No tillage: No-till systems do not use tillage for establishing a seedbed. Crops are simply planted into the previous year's crop residue. No-till planters are equipped with coulters that slice the soil, allowing a double disc opener to place the seed at a proper depth. The slot is closed with a spring press wheel. Herbicides are typically used as the sole means for weed control in no-till systems.

Role of Conservation Agriculture in present scenario:-

- CA has tremendous potential for achieving sustainable yield increase by improving the growth conditions for crops and the efficiency of input.
- CA reduces soil degradation and builds up soil fertility by reducing soil erosion, water pollution *etc*.
- CA conserves and enhances biodiversity in the field.

- CA eliminates power-intensive soil tillage, thus reducing the drudgery and labour required for crop production by more than 50 per cent for small scale farmers.
- For mechanized farms, it reduces fuel requirements by 70 per cent and the need for machinery by 50 per cent.
- Climate change effects can be minimized by carbon sequestration and moisture conservation and thus protects livelihoods security under changing climate scenarios.

Challenges and Limitations of CA:-

- Retention of residues for mulch cover and different spacings for rotation crops
- Change of mindset of farmers and unemployment to labour in initial years
- Growing of cover crops, crop rotation in rainfed areas is affected by constraint of moisture availability
- Benefits of CA come about over a period of time and in some cases, might appear less profitable in the initial years
- Crop residue cover management in Alfisols is difficult due to termite problem and faster decomposition in tropical and subtropical regions due to high temperature.

CONCLUSION

CA offers a powerful option for meeting future food demands while also contributing to sustainable agriculture. These methods improve the efficiency of input and increase farm income, sustain crop yields, protect & revitalize soil, biodiversity and the natural resource base. These CA practices enhance natural biological processes above and below the ground by reducing interventions such as mechanical soil tillage to an absolute minimum. Hence, CA gives a hope in current agriculture practices to overcome the natural resource degradation and climate change situations. But the adoption of these practices at farmer level needs wide publicity and extension work.

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