

## Conservation Agriculture: Principles and Impact

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### INTRODUCTION

Global agriculture is facing numerous challenges and adversely affecting food and nutritional security. Among others, intensive agriculture and excessive use of external inputs are leading to degradation of soil, water and genetic resources and negatively affecting agricultural production. Conservation agriculture (CA) practices involve minimum soil disturbance, permanent soil cover through crop residues or cover crops and crop rotations for achieving higher productivity. Globally, CA is being practiced on about 125 M ha (FAO, 2012).

### Conservation Agriculture:

The term Conservation Agriculture refers to the system of raising crops without tilling the soil while retaining crop residues on the soil surface.

### Basic Principle of Conservation Agriculture:

Surface crop residue retention/ permanent organic soil cover - A permanent soil cover is important to protect the soil against the deleterious effects of exposure to rain and sun; to provide the micro and macro organisms in the soil with a constant supply of “food”; and alter the microclimate in the soil for optimal growth and development of soil organisms, including plant roots. In turn it improves soil aggregation, soil biological activity and soil biodiversity and carbon sequestration (Ghosh, *et al.*, 2010).

Minimal soil movement - The soil biological activity produces very stable soil aggregates as well as various sizes of pores, allowing air and water infiltration. This process can be called “biological tillage” and it is not compatible with mechanical tillage. With mechanical soil disturbance, the biological soil structuring processes will disappear.

Conservation tillage is tillage and planting combination that retain a 30 % or greater cover of crop residue on the soil surface. In addition to erosion protection conservation tillage increases soil organic matter and improve physical properties. They also break disease, insect and wild life cycle, improve nutrient and water use efficiency. Minimum soil disturbance provides/maintains optimum proportions of respiration gases in the rooting-zone, moderate organic matter oxidation, porosity for water movement, retention and release and limits the re-exposure of weed seeds and their germination (Kassam and Friedrich, 2009).

Crop rotation -The rotation of crops is not only necessary to offer a diverse “diet” to the soil microorganisms, but also for exploring different soil layers for nutrients that have been leached to deeper layers that can be “recycled” by the crops in rotation. Furthermore, a diversity of crops in rotation leads to a diverse soil flora and fauna. Cropping sequence and rotations involving legumes helps in minimal rates of build-up of population of pest species, through life cycle disruption, biological nitrogen fixation, control of off-site pollution and enhancing biodiversity (Kassam and Friedrich, 2009).

### Impact of Conservation Agriculture Practices:

Reduced Incidence of Weeds- Most studies tend to indicate reduced incidence of *Phalaris minor*, major weed in wheat, when zero-tillage is adopted resulting in reduced use of herbicides.

Saving Water and Nutrients – Limited experimental results and farmers experience indicate that considerable saving in water (up to 20% – 30%) and nutrients are achieved with zero-till planting and particularly in laser leveled and bed planted crops.

Increased Yields - In properly managed zero-till planted wheat, yields were invariably higher compared to traditionally prepared fields for comparable planting dates. CA has been reported to enhance the yield level of crops due to associated effects like prevention of soil degradation, improved soil fertility, improved soil moisture regime (due to increased rain water infiltration, water holding capacity and reduced evaporation loss) and crop rotational benefits. Yield increases as high as 200 – 500 kg ha<sup>-1</sup> are found with no-till wheat compared to conventional wheat under a rice-wheat system in the Indo-Gangetic plains.

Environmental Benefits - Conservation agriculture involving zero-till and surface managed crop residue systems are an excellent opportunity to eliminate burning of crop residue which contribute to large amounts of greenhouse gases like CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O. Burning of crop residues, also contribute to considerable loss of plant nutrients, which could be recycled when properly managed. Large scale burning of crop residues is also a serious health hazard.

Crop Diversification Opportunities - Adopting Conservation Agriculture systems offers opportunities for crop diversification. Cropping sequences/rotations and agroforestry systems when adopted in appropriate spatial and temporal patterns can further enhance natural ecological processes. Limited studies indicate that a variety of crops like mustard, chickpea, pigeonpea, sugarcane etc., could be well adapted to the new systems

Resource improvement – No tillage when combined with surface management of crop residues begins the processes where by slow decomposition of residues results in soil structural improvement and increased recycling and availability of plant nutrients. Surface residues acting as mulch, moderate soil temperatures, reduce evaporation, and improve biological activity.

### Advantages of Conservation Agriculture

- Reduces labour, time and fuel cost.
- Reduces overall cost of operation.
- Reduce use of fossil fuel leads to less environmental pollution.
- Reduces soil compaction due to less traffic ability.
- More yields in dry year.
- Less soil erosion, less flooding.
- Recharge of aquifers due to better infiltration.
- Increased crop intensity.
- Less pollution of water.
- Less leaching of chemicals and solid nutrients into ground water.
- Less environmental pollution, Carbon sequestration (greenhouse effect).
- Saving water.

### Disadvantages of Conservation Agriculture

- Formation of hard pan below soil surface due to zero tillage and requires use of sub-soiler to break hard pan after 5-7 years.
- Need to control weeds by using herbicides thus increasing cost.
- Not suitable to all crop rotations.
- May result in soil borne pests and pathogens in transition stage.

- High cost of machinery such as, laser land leveler, zero-till drill, strip till drill, raised bed planter, straw cutter cum incorporator, straw combine, straw baler, biomass digesters.

### CONCLUSION

Conservation agriculture involves minimum soil disturbance, surface crop residue retention, crop diversification enhances natural ecological processes. It also improve the soil structure, increased recycling and availability of nutrients and also improve biological activity in soil in turns reflects on less environmental pollution and carbon sequestration.

### REFERENCES

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