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Conservation Agriculture: A tool for Sustainable Crop Production

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Conservation agriculture is a management system that maintains a soil cover through surface retention of crop residues with no till/zero and reduced tillage. CA is described by FAO (http://www.fao.org.ag/ca) as a concept for resource saving agricultural crop production which is based on enhancing the natural and biological processes above and below the ground. As per Dumanski *et al.* (2006) conservation agriculture (CA) is not "business as usual", based on maximizing yields while exploiting the soil and agro-ecosystem resources. Rather, CA is based on optimizing yields and profits, to achieve a balance of agricultural, economic and environmental benefits. It advocates that the combined social and economic benefits gained from combining production and protecting the environment, including reduced input and labor costs, are greater than those from production alone. As per FAO definition CA is to) achieve acceptable profits) high and sustained production levels, and conserves the environment. It aims at reversing the process of degradation inherent to the conventional agricultural practices like intensive agriculture, burning/removal of crop residues. Hence, it aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It can also be referred to as resource efficient or resource effective agriculture.

Why Conservation Agriculture Need?

These challenges draw attention to the need and urgency to address options by which threats to Indian/Asian agriculture due to natural resource degradation, escalating production costs and climate change can be met successfully. A shift to no-till conservation agriculture is perceived to be of much fundamental value in meeting these challenges. Therefore, business as usual with conventional agriculture practices does not seem a sustainable option for sustainable gains in food-grain production, and hence CA-based crop management solutions adapted to local needs will have to play a critical role in most ecological and socio-economic settings of Asian Agriculture. The promotion of CA under Indian/Asian context has the following prospects:

- Reduction in cost of production

- Reduced incidence of weeds
- Saving in water and nutrients
- Increased yields
- Environmental benefits
- Crop diversification opportunities
- Resource improvement

Goal of Conservation Agriculture

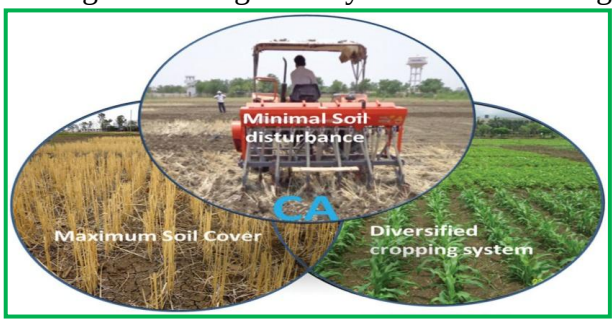
1. Conserve and improve efficiency of natural resources
2. Sustain agriculture production
3. Social and economic equity
4. Environmental health

Benefits of Conservation Agriculture (CA)

1. CA also uses or promotes various management practices, those are listed below:
2. Maintaining permanent or semi-permanent soil cover
3. Minimum soil disturbance
4. Integrated disease and pest management
5. Higher efficiency in the sense of more output for a lower input
6. Regular crop rotation Improvement of air quality.
7. Utilization of green manures/ cover crops
8. Time saving and reduction in labour requirement

Conservation agriculture and its principles

Conservation agriculture is a pathway towards management of agro-ecosystems for achieving enhanced and sustained productivity, increased profits and food security while conserving and improving the natural resource base along with environment. It relies on the practical application of three linked principles, along with other relevant good agricultural practices (GAPs) of crop production (FAO, 2014) and must be taken care. These three principles are



- **Minimum mechanical soil disturbance:** Soil biological activities are generally supposed to produce very stable soil aggregates as well as variant sizes of pores which allows proper aeration and infiltration of water. With mechanical soil disturbance by tillage or other cultivation practices, the biological soil structuring processes fade away. Minimum soil disturbance is responsible for maintaining optimum composition of respiration gases in the root zone, moderate oxidation of soil organic matter, appropriate porosity for soil water movement, retention and release, and hinders the re-exposure and germination of weed seeds (Kassam and Friedrich, 2009).

- **Permanent organic soil cover :** A permanent soil cover is imperative in conservation agriculture to protect the soil from the harmful effects resulting from the exposure to rain and sun; to provide constant food supply to the soil micro and macro organisms; and to change the

soil microclimate for optimum growth of soil organisms, together with plant roots. This, in turn, improves soil aggregation, carbon sequestration, soil biological activity and biodiversity (Ghosh *et al*., 2010). Soil cover is attained with biomass obtained from crop residues, stubbles and cover crops. FAO (2014) prescribes that at least 30% of the total cultivated area should be covered by crop residues.

- **Diversified crop rotations:** Diversified crop rotation is required for providing food to the soil microorganisms along with utilization of nutrients by the crops in rotation which are present in different soil layers due to leaching. It can be achieved by rotating deep rooted crops with shallow rooted crops. Further, a diversity of crops in rotation leads to adverse soil flora and fauna. The crop rotations which involve legumes are beneficial for biological nitrogen fixation, reducing pest infestation by disruption of the pests' life cycle and improving biodiversity (Kassam and Friedrich, 2009; Dumanski *et al*., 2006).

Conservation Agriculture Practices

- Conservation Tillage
- Mulching
- Crop Residues Management
- Land Configuration
- Crop Rotation
- Direct Seeded Rice and SRI Method

Constraints for Adoption of Conservation Agriculture

A mental change of farmers, technicians, extensionists and researchers away from soil degrading tillage operations towards sustainable production systems like no tillage is necessary to obtain changes in attitudes of farmers (Derpsch, 2001). In many cases, it may be difficult to convince the farmers of potential benefits of CA beyond its potential to reduce production costs, mainly by tillage reductions. CA is now, considered a route to sustainable agriculture. Spread of conservation agriculture, therefore, will call for scientific research linked with development efforts. The following few important constraints which impede broad scale adoption of CA.

- Lack of appropriate seeders especially for small and medium scale farmers:
- The wide spread use of crop residues for livestock feed and fuel:
- Burning of crop residues:
- Lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers:
- Skilled and scientific manpower:

Conclusion

Conservation Agriculture, which is rooted in the fundamental principles of providing permanent soil cover (through crop residues, cover crops, agro-forestry), minimal soil disturbance and crop rotation is now considered to be the primary route to sustainable agriculture: it is thus a way of achieving higher production goals thus protecting natural resources and the environment. Conservation Agriculture has numerous benefits such as improvement of soil physical, chemical and biological health, sustaining crop production by conserving natural resources and maintaining soil quality, saving of cost, energy and labour, improvement in water and nutrient use efficiency, reduction in emission of GHGs by carbon

sequestration, reduction in soil erosion and environmental pollution by eliminating the need of burning crop residues, and climate change mitigation as well as adaptation.

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