Conservation Agriculture - Preserving Farmland for Future Generations

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Conservation agriculture (CA), is a farming system that aims to degraded areas can be restored and arable land loss can be avoided. It encourages the diversity of plant species, little disturbance of the soil, and preservation of a permanent soil cover. It contributes to better and sustained agricultural production by enhancing biodiversity and naturally occurring biological processes both above and below the ground. It also increases the efficiency of water and fertilizer utilization.

CA enhances beneficial farming in agricultural land and livestock husbandry for rainfed and irrigated production thereby making more easily and timely operations. CA serves as a foundation for sustainable agricultural production intensification when combined with other well-known best practices, such as the use of high-quality seeds and integrated pest, nutrient, weed, and water management, among others. It creates more opportunities for the integration of production sectors, including the integration of crops and livestock as well as the landscapes of agriculture with pastures and trees (Gupta and Jat (2010).

The Food and Agriculture Organization of the United Nations (FAO) has determined that conservation agriculture (CA) has three key principles that producers (farmers) can proceed through in the process of CA. These three principles outline what conservationists and producers believe can be done to conserve what we use for a longer period. (http://www.fao.org.ag/ca)

Principles of Conservation Agriculture

Conservation agriculture practices perused in many parts of the world are built on ecological principles making land use more. Adoption of CA for enhancing Resource use efficiency (RUE) and crop productivity is the need of the hour as a powerful tool for the management of natural resources and to achieve sustainability in agriculture. Conservation agriculture basically relies on 3 principles, which are linked and must be considered together for appropriate design, planning and implementation processes. These are:

Minimal soil mechanical disturbance

Very solid soil aggregates and various sizes of pores that permit the infiltration of water and air are produced by the biological activity of the soil. This method is not associated with mechanical tillage and can be referred to as "biological tillage." The biological soil structuring activities will vanish with mechanical soil disturbance. The rooting zone's ideal ratio of respiration gases is provided or maintained by little soil disturbance, which also moderates the oxidation of organic matter, increases porosity for water transport, retention, and release, and reduces the re-exposure and germination of weed seeds.

Permanent soil organic 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 to 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.

Diversified crop rotations

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 diverse soil flora and fauna. Cropping sequence and rotations involving legumes help 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.

Advantages of Conservation Agriculture

(i) **Cost of production** – cost of production will be decreased due to the rapid adoption of zero-till technology. Cost reduction is attributed to savings on account of diesel, labour and input costs, particularly herbicides.

(ii) **Reduced incidence of weeds** –When zero-tillage is adopted resulting in reduced in use of herbicides.

(iii) **Saving in water and nutrients** –considerable saving in water (up to 20% – 30%) and nutrients are achieved with zero-till planting and particularly in laser levelled and bed-planted crops.

(iv) **Increased yields** – 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.

(v) **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_2, CH_4 and N_2O. 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.

(vi) **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, pigeon pea, sugarcane, etc., could be well adapted to the new systems.

(vii) **Resource improvement** – No tillage when combined with surface management of crop residues begins the processes whereby 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.

Constraints for adoption of conservation agriculture

- **Lack of appropriate seeders especially for small and medium scale farmers:** Although significant efforts have been made in developing and promoting machinery for seeding wheat in no till systems, successful adoption will call for accelerated effort in developing, standardizing, and promoting quality machinery aimed at a range of crop and cropping sequences.
- **The wide spread use of crop residues for livestock feed and fuel**: Specially under rainfed situations, farmers face a scarcity of crop residues due to less biomass production of different crops. There is competition between CA practice and livestock feeding for crop residue. This is a major constraint for promotion of CA under rainfed situations.
- **Burning of crop residues**: For timely sowing of the next crop and without machinery for sowing under CA systems, farmers prefer to sow the crop in time by burning the residue. This has become a common feature in the rice-wheat system in north India. This creates environmental problems for the region.
- **Lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers**: This implies that the whole range of practices in conservation agriculture, including planting and harvesting, water and nutrient management, diseases and pest control etc. need to be evolved, evaluated and matched in the context of new systems.
- **Skilled and scientific manpower:** Managing conservation agriculture systems, will call for enhanced capacity of scientists to address problems from a systems perspective and to be able to work in close partnerships with farmers and other stakeholders. Strengthened knowledge and information sharing mechanisms are needed.

Conclusion

Compared to the conventional paradigm of agricultural research and development, which was primarily focused on meeting specific food grain production targets in India, conservation agriculture offers a fresh approach. Given the pervasive issues with resource degradation that have accompanied previous production-boosting tactics that showed little regard for resource integrity, a paradigm change is now required. Sustainable productivity increase currently requires integrating considerations about the environment, soil quality, resource conservation, and productivity. In terms of knowledge base, developing and promoting CA systems will be extremely challenging. This will require scientists to have significantly greater ability to approach issues from a systems viewpoint, to collaborate closely with farmers and other stakeholders, and to increase the exchange of knowledge and information.

References

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