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Conservation Agriculture: Need of Future

(Divya Pipalde[1], *Dr. Nisha Sahu[2], Dr. R.C. Jain[1] and Dr. S.C. Gupta[1])
[1]R.A.K. College of Agriculture, Sehore
[2]ICAR-Indian Institute of Soil Science, Bhopal
*Corresponding Author's email: nishasahu5@gmail.com

Conservation agriculture (CA) is an agricultural practice that prevents agricultural losses while rehabilitating degraded land. This promotes permanent land cover, minimal soil degradation and preservation of plant diversity. It improves biodiversity and natural biological processes above and below the surface, facilitates more efficient water use, and enhances and supports agriculture.

CA promotes good agricultural practices such as holistic agriculture with timely remediation and improved rainfall and water use. This includes the use of good seeds and other good practices, including the integrated management of pests, diseases, food, plants and water.

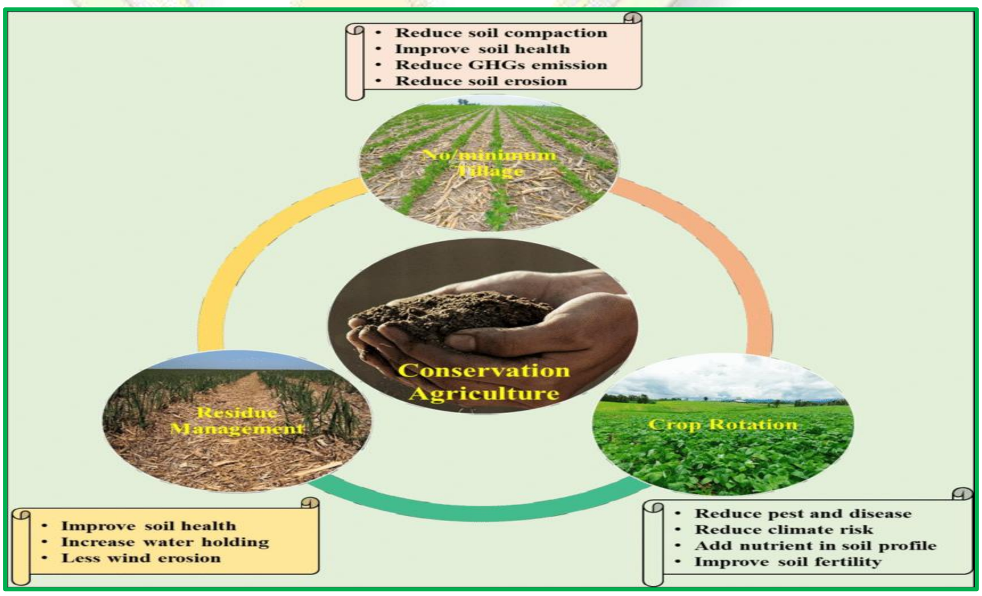
CA is at the center of sustainable agricultural efforts. This opens up many options for the integration of crops, such as the integration of crops with livestock and the integration of trees and pastures with agriculture. (FAO, United Nations).

Conservation Agriculture Principles

CA is a land management system that minimizes damage to soil structure, composition and natural biodiversity. Although there many differences between the types of crop planted and the specific management, all forms of conservation agriculture have three fundamental principles.

- maintain permanent or semi-permanent soil cover (using either a previous crop residue or specifically growing a cover crop for this purpose)
- minimum soil disturbance through tillage (just enough to get the seed into the ground)
- regular crop rotations to help combat the various biotic constraints;

Conservation Agriculture is based on three main principles adapted to reflect local conditions and needs:



1. Permanent soil organic cover: It is divided into three groups: 30-60%, >60-90% and >90% land cover, measured directly after operation. Regions with less than 30% are not considered CA. "Permanent organic land cover" means residual crops and/or cover crops (e.g. beans, grains or other large crops for soil yield rather than crop yields) by reducing erosion and soil degradation to adapt to climate change and being affected by extreme weather conditions (e.g. precipitation) impacts of climate change, periods of drought and soil saturation, air temperature, strong winds) and increased stability in the protection of agricultural systems. In fact, cover crops can improve soil compaction, control pests and diseases, and increase diversity in agro-ecosystems.

2. Minimum mechanical soil disturbance: Minimal Soil Disturbance means minimal disturbance that does not directly reach the seeds. The affected area should be less than 15 cm or less than 25% of the planted area, whichever is smaller. Temporary tillage that affects the area more than the above limits should not be done. Strip processing is allowed if the affected area is smaller than the border. "Minimum soil disturbance" characterized by direct cultivation and/or direct fertilization. Helps to improve the soil surface, control and increase soil organic matter, thereby reducing soil erosion. In addition, no-tillage and reduced tillage reduces the power of agricultural machinery, improves soil drainage and improves food availability for insects, birds and small animals due to the abundance of crops and plant seeds in the soil. In fact, it provides many ecosystem services, including minimal soil disturbance, water management, carbon monoxide, soil stability, soil protection from erosion, water remediation seepage, improving soil fertility by improving nitrogen storage (long-term), soil and water remediation and good weather reduces soil erosion and fuel consumption. All of this is important for reducing the vulnerability of agricultural systems and improving their ability to adapt to climate change, which in turn contributes to mitigation goals.

3. Species diversification: Through varied crop sequences and associations involving at least three different crops. "Crop diversification" means the practice of growing more than one species in a given agricultural area in rotation and/or in combination. Diversification of different types of crops improves soil fertility and structure, soil holding capacity, and the distribution of water and nutrients across soil profiles, improving the performance of agriculture against climate change, helping to prevent pests and diseases, and increasing yield stability. In fact, multiple products are more stable and more powerful than a single product. Crop diversification provides many ecosystem services, helps increase crop yields and agricultural productivity, and reduces carbon emissions from agriculture. "CA principles can be widely applied to all agriculture and land use using local practices. CA increases biodiversity, minimizes or avoids natural biological processes above and below the surface of the soil boundary, and other agrochemical inputs such as agricultural products and crops of mineral or organic origin. Nutrients are approved for use in amounts and methods that do not affect or interfere with biological processes (Jug, D., et al. 2018).

Some concepts related to CA are

- **No tillage:** No-till (NT) is the CA agronomic application of annual crops, defined as a soil-disturbing tillage method. The NT must leave at least 30% of the area with plant debris immediately after the crop is established and the crop is planted using a machine capable of seeding from the plant residues of previous crops. The agronomic practice that best characterizes annual crop CA is NT, which has the highest soil retention of the annual crop as any tillage of the soil is completely prevented.
- **Groundcovers:** Ground cover (GC) is the most common agronomic application of CA for perennial crops to protect the soil between tree rows from erosion. Using this method, at least 30 percent of the land not covered by the canopy is protected by planted cover crops, native vegetation or inert cover such as pruning or leaves. For the production of

cultivated crops and the spreading of inert mulches, farmers should use methods based on CA principles of minimal soil degradation.

- **Direct seeding or planting:** Direct seeding involves growing a crop without mechanical bed preparation and with minimal soil disturbance since harvesting the previous crop. Sowing refers to the precise sowing of large seeds such as corn and beans; while sowing generally refers to the continuous flow of seeds such as small grains such as wheat and barley. The device penetrates the ground cover, opens the seed tray and places the seed in the tray. Seed hopper size and associated earth movement should be kept to the absolute minimum possible. Ideally, the seed tray is completely mulched again after planting and there should be no loose soil on the surface. Land preparation for seeding or planting without tillage includes cutting or rolling weeds, residue from previous crops or cover crops; or spraying herbicides to control weeds and sowing seeds directly through the mulch. Crop residues are left completely or just enough to provide complete soil coverage, and fertilizers and amendments are either dusted onto the soil surface or applied at planting time.
- **Soil organic cover:** Conservation of soil cover is a core principle of CA. Crop residues are left on the soil surface, but cover crops may be required if there is too much time between harvest and planting elsewhere. Cover crops increase the sustainability of CA systems by improving not only the soil but also their ability to contribute to increased biodiversity in agro-ecosystems. cover crops are beneficial as they:
  - Protect the soil during fallow periods.
  - Mobilize and recycle nutrients.
  - Improve the soil structure and break compacted layers and hard pans.
  - Permit a rotation in a monoculture.
  - Can be used to control weeds and pests.
- **Crop rotation:** Crop rotation is not only necessary to provide a diverse "diet" for soil microbes, but because they take root at different depths in the soil, they are able to explore different soil layers at different times to search for nutrients. Nutrients that have leached to deeper layers and are no longer available to commercial crops can be "recycled" by the crops in the crop rotation. Thus, crop rotation acts as a biological pump. In addition, the diversity of crop rotations leads to a diversity of soil flora and fauna, as the roots secrete different organic matter, attracting different types of bacteria and fungi, which in turn are important in converting these substances into matter usable by plants important role. Crop rotation also has an important phytosanitary function, as it prevents the transfer of crop specific pests and diseases from one crop to another.

Benefits of conservation agriculture in India

✓ CA saves time and reduces the need for work.
✓ Reduce costs such as fuel, operating and maintenance costs, and energy costs.
✓ Higher performance, i.e., more output with less input.
✓ Increase organic matter.
✓ In soil water conservation.
✓ Improve the soil structure and therefore the rooting zone.
✓ Reduce soil erosion, thus reducing the maintenance costs of roads, dams and water utilities.
✓ Improve water quality.
✓ Improve air quality.
✓ Biodiversity increases.
✓ Carbon sequestration.

Drawback of conservation agriculture in India

- ✓ **Understanding the system** – Conservation agriculture systems are much more complex than conventional systems. Site specific knowledge has been the main limitation to the spread of CA system. Effective management of these systems is demanding in terms of understanding the underlying processes and component interactions that determine overall system performance. For example, crop residues retained on the surface act as mulch, reducing soil water loss through evaporation and maintaining moderate soil temperature regimes (Gupta and Jat, 2010).
- ✓ **Building a system and farming system perspective** – Systems perspectives are built in collaboration with farmers. Therefore, a core group of scientists, farmers, extension workers and other stakeholders working in a partnership model will play a key role in the development and dissemination of new technologies.
- ✓ **Technological challenges** – While the basic principles which form the foundation of conservation agriculture practices, that is, no tillage and surface managed crop residues are wellunderstood, the adoption of these practices in different agricultural situations is a major challenge. These challenges relate to the development, standardization and adoption of agricultural machinery to minimize soil disturbance, and the development of harvesting and crop management systems.
- ✓ **Site specificity** – Adapting strategies for conservation agriculture systems will be highly site specific, yet learning across the sites will be a powerful way in understanding why certain technologies or practices are effective in a set of situations and not effective in another set. This learning process will accelerate building a knowledge base for sustainable resource management.

Long-term research perspective

Conservation agriculture practices, e.g. no-tillage and surface-maintained crop residues result in resource improvement only gradually, and benefits come about only with time. In fact, in many cases, the benefits in terms of increased yields may not appear during the first years of assessing the impact of conservation agriculture practices. Understanding the dynamics of changes and interactions between physical, chemical and biological processes is essential for the development of better soil-water and nutrient management strategies (Abrol and Sangar, 2006). Therefore, research on conservation agriculture needs to take a longer-term perspective.

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