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Conventional Modes of Agricultural Modern Farming

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The ever-increasing global population, particularly in many developing countries, requires an increased supply of food, fiber, and oil. This poses a grave challenge for scientists to produce more from limited, shrinking, and degraded land and water resources. Tilling soils continuously without adding organic matter has adverse effects on soil health and quality of the produce. In recent years, concerns for soil erosion, soil quality deterioration, and chemical hazards have compelled researchers to look back to the past towards evolving conservation agriculture-based systems. These systems aim at higher productivity and profitability through rational and sustainable use of available resources on a long-term basis. Conservation Agriculture is a concept for resource-saving crop production that is based on enhancing natural and biological processes above and below the ground. It contributes to environmental conservation as well as to enhanced and sustained agricultural production. It can also be referred to as "resource-efficient agriculture." Conservation agriculture (zero tillage + soil cover through residues) was evolved in the USA because of land degradation and an increase in oil prices. E.H. Faulkner is regarded as the "father of conservation agriculture".

Conventional modes of agricultural practices with intensive tillage operations, clean cultivation (bear with no cover), monocropping or fixed crop rotation, imbalanced fertilizer use, and little use of organics have resulted in a host of problems in global agriculture.

1. Declining productivity factor (nutrient, labour, water and energy).
2. Deterioration of soil health (biological, chemical and physical).
3. Extreme surface runoff and water erosion.
4. Higher global warming potential.
5. Air and Groundwater pollution.

Conventional vs. Conservational agriculture

Conventional agricultural systems encourage clean cultivation through intensive tillage operations to prepare appropriate seed bed for sowing the seeds to ensure higher rate of germination and initial vigour, control of weeds and other pest, mixing of fertilizer and organic manures, resulting in bare soil with no plant cover.

Table 1: Difference between conservational and conventional agriculture

S.N.	Conservation agriculture	Conventional agriculture
1	Based on no tillage	Based on excessive tillage
2	Surface retention of residues	Residue burning
3	Use of in-situ FYM	Use of ex-situ FYM
4	Cropping system based	Crop based management
5	Intercropping used	Single or sole crop used
6	Brown manure used	Green manure used

Table 2: Area under conservation agriculture

Country	Area (Mha)	Percentage of global area
USA	35.61	22.7
Brazil	31.81	20.3
Argentina	29.18	18.6
Canada	18.31	11.7
Australia	17.7	11.3
India	3.5	2.3
Total (Worldwide)	156.99	100

Principles of conservational agriculture

Conservational agriculture has three basic principles:

1. Direct seeding involves growing crops without mechanical seedbed preparation and with **minimal soil disturbance** since the harvest of the previous crop.
2. A **permanent soil cover** is important to protect the soil against the deleterious effects of exposure to rain and sun; increase 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.
3. The **rotation of crops** is not only necessary to offer a diverse "diet" to the soil microorganisms, but as they root at different soil depths, they are capable of exploring different soil layers for nutrients.

➢ **Conservation agriculture practices**

A. Laser Land Levelling

It is a advance technology for adopting conservation agriculture practices like zero tillage, bed planting. Laser levelling provides an accurate, smooth and graded field on which irrigation water reaches to the tail-ends in less time, helping saving irrigation water by 20% and improves N-use efficiency under surface irrigation. Land levelling can reduce evaporation and percolation losses by enabling faster irrigation times by eliminating depressions. Other benefits like save water by 25-30% and increase yield by 5-15 % (Jat *et al*., 2009).

B. Conservation tillage (Zero/Minimum tillage)

Conservation tillage is a collective umbrella term, commonly given to zero tillage, direct drilling, minimum tillage and ridge tillage to denote that the specific practice fulfils some resources conservation objectives. Usually, the retention of residues for covering at least 30 % of the soil surface characterizes the lower limit of classification of Conservation tillage. Zero tillage was first started in 1980 in India promoted by Imperial Chemical Industries to promote Paraquat, a non-selective herbicide for controlling weeds in zero tillage wheat. Major benefits of ZT are reduced costs owing to saving in fuel and labour up to Rs. 2500-3000/ha, timely planting of crops, reduced weed density, saving of irrigation water up to 15-20% and improved input use efficiency.

C. Direct Seeded Rice (DSR)

DSR is an alternative to puddle transplanting for saving cost of labour and water usage. It is a labour, fuel, time, and water saving technology, which gives similar yield as compared to puddled transplanted rice if weeds were controlled with adequate and appropriate use of herbicidal chemicals. It avoids water required for land preparation and reduces overall water demand of the puddle transplanted rice. DSR does not affect rice quality and can be practiced in different ecologies, including upland, medium and lowland, deep water areas. Soil health is maintained and fertilizer and water use efficiencies are higher in DSR (saving of 35-40 % irrigation water). Thus, DSR is technically and economically a feasible alternative to puddle transplanted rice.

D. Brown Manuring with Sesbania

In brown manuring, both rice and Sesbania are sown together and allowed to grow for 25-30 days. Rice is sown in lines with a seed drill and Sesbania is broadcast on the moist soil. Sesbania plants are knocked down with 2,4-D ethylester @ 0.25-0.50 Kg/ha or Bispyribac-Na @ 25 g/ha. Sesbania while growing with rice prevents growth of weeds, reduces use of herbicides and irrigation water and supplies 15-20 Kg N/ha with fresh biomass of 10-12 t/ha. These practices can be followed in crops like maize, pearl millet, sorghum. In broad-leaved crops (soybean) 2,4-D cannot be used, but Sesbania can be cut manually and spread as mulch between crop rows for controlling weeds, and conservation of moisture and nutrients.

➢ Advantage of Conservation Agriculture

- Time saving and so, reduction in labour requirement can be seen.
- Reduction of cost of cultivations like reduction in cost of fuel, machinery operation and maintenance and labour cost.
- Higher efficiency of productivity
- Enhance soil organic matter.
- In-situ soil water conservation.
- Improvement of soil structure and soil quality.
- Reduce soil and water erosion
- Improvement quality of air and water.
- Increase soil biodiversity.
- Enhance carbon footprint.

Limitations of Conservation Agriculture

- CA is highly mechanised and management intensive practice.
- Its success depends largely on the availability of sufficient quantity of crop residues, required for surface retention.
- Continues zero tillage results in infestation of more perennial weeds such as Cyperus rotundus, Cyperus esculentus and Cynodon dactylon etc.
- Under residue laden conditions, pre-emergence herbicides are usually less effective when applied at the recommended doses, which needs some higher doses tried and optimized with higher volume rates of water.
- Band placement of nutrients is difficult without the help of suitable implements.
- Chemical from residues over a long period may result as allelopathy.

Economics of Conservation Agriculture

Under zero tillage, it is notable reduction in fuel consumption from 11.30 L/ha to 34.62 L/ha by conventional tillage, resulting in fuel saving of 24 L/ha (69%) (Patle, 2013). He also observed that conservation tillage increased B:C ratio and lowered operational energy (5.1-26.1%) compared to conventional practice. An estimated saving in CO_2 emission would be 62 kg/ha due to zero tillage.

Conclusion

Conservation agriculture has a potential to improve the natural resources use efficiency of soil, water, air and fossil fuel. They can also improve soil biodiversity, carbon status, soil health, input use efficiency as well as soil fertility status. However, their utilization needs to be optimized across locations, cropping seasons and crop based on sound benefit-cost economics.

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