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Conservation Agriculture: Strategies in Agriculture

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INTRODUCTION

Ever-increasing global population, particularly in many developingcountries requires increased supply of food, fibre, oil, which poses a grave challenge before the agricultural scientists to produce more and 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. Total food grain production in the country is estimated to be a record 291.95 million tonnes, according to the second advance estimates for 2019-20. This is obviously a news to be happy about but as per the estimates of Indian Council for Agricultural Research (ICAR), demand for food grain would increase to 345 million tonnes by 2030. Increasing population, increasing average income and globalisation effects in India will increase demand for quantity, quality and nutritious food, and variety of food. Therefore, pressure on decreasing available cultivable land to produce more quantity, variety and quality of food will keep on increasing.

Why Conservation agriculture ??

Approximately one-third of the planet's soils are degraded. In manycountries, intensive crop production has depleted soils, to the extent that future production in these areas is jeopardized. Healthy soils are key to developing sustainable crop production systems that are resilient to the effects of climate change. They contain a diverse community of organisms that help to control plant diseases, insect and weed populations; recycle soil nutrients; and improve soil structure with positive effects on water holding capacity, nutrient retention and supply and levels of organic carbon.

Conservation Agriculture is 20 to 50 percent less labour intensive andthus contributes to reducing greenhouse gas emissions through lower energy inputs and improved nutrient use efficiency. At the same time, it stabilizes and protects soil frombreaking down and releasing carbon to the atmosphere.

History of Conservation Tillage/Agriculture

History repeats itself. The same is true for the tillage operation adopted in agriculture. In **8000 BC**, planting stick, helping planting of seeds without cultivation used to be used in agriculture. This was the earliest no-till planting. In 6000 BC, draft animals replaced humans for ploughing lands.

Mouldboard plough, cutting and inverting soil and burying weeds and residues was introduced in 1100 AD. Jethro Tull (1671-1741), regarded as "Father of Tillage" stressed huge importance on tillage towards pulverising soil for cultivation of crops. He conducted several experiments and based on that he wrote a Book "Horse HoeingHusbandry" or an Essay on the principles of Vegetation ad Tillage", where he emphasised tillage and row planting of crops.

Edward H.Faulkner (1886-1964) criticized the then universally-used mouldboard plough for disastrous tillage of soil and stood against the use of plough for cultivation of crops. He wrote a book "Plowman's Folly: A second Look", describes his thoughts on conservation tillage. He is regarded as the "Father of Conservation Tillage".

During 1940s, 2,4-D and its sister herbicides (MCPA, 2,4-DB, MCPP) and later atrazine and paraquat were synthesized and marketed, which enabled farmers to manage weeds with less tillage.

In 1970's, no-till drills, which open small groves for placing seeds and disturb soil to a least were developed. In 1990's newer version of no-till drill so-called new generation machines (happy seeder/turbo seeder) came into existence for no till seeding under conservation agriculture. All these gradually promoted the concept as well as adoption of conservation tillage as a principle of conservation agriculture.

Conservation agriculture was evolved in the USA because of land degradation and increase in oil prices. In the 1930's the "Dust Bowl" formed in the U.S Great Plains due to extensive tillage practices and exposure of soil to wind. It was estimated about 91 million ha of land was degraded by severe soil erosion. The tragic dust storms of that time and place served as a wake-up call about the interventions in soil management and ploughing can lead to unsustainable agricultural systems.

For the next 75 years, farmers have been adopting conservation agricultural practices that reduce tillage and maintain a residue cover on the soil. The modern concept of tillage aims at conserving resources and improving resource use efficiency through minimum tillage (started in the USA in mid 70's for providing fine tilth only in row zone); zero tillage (extreme form of minimum tillage) and conservation tillage (zero tillage + soil cover through residues).

Definition-

Conservation agriculture is a farming system that promotes minimum soil disturbance (i.e no tillage), maintenance of a permanent soil cover, and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, which contribute to increased water and nutrient use efficiency and to improved and sustained crop production (FAO).

Scope-

Conventional mode of agriculture practiced with intensive tillage operations, clean cultivation (bare soil with no cover), mono-cropping or fixed crop rotation, imbalanced fertilizer use, little use of organics, and indiscriminate use of irrigation water and resources have resulted in a host of problems in global agriculture, which are as follows:

- Declining factor productivity (Water, nutrient, energy, labour, pesticides)
- Deteriorating soil health (Physical, chemical and biological)
- Declining/Stagnating yield trends and farm income
- High surface water run-off and erosion
- Higher global warming potential
- Higher biotic interferences and declining biodiversity

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- Secondary salinization and sodicity problems
- Susceptibility to climatic variability
- Air and groundwater pollution

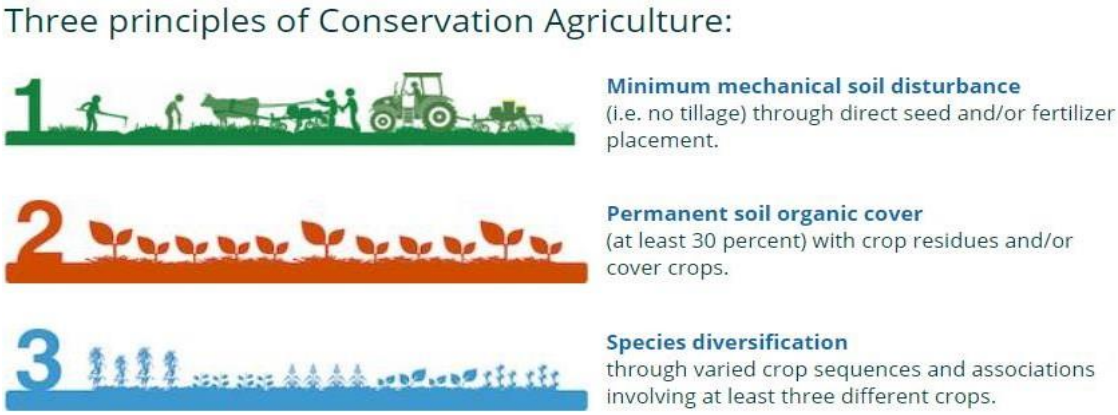
The earth resources, which have been shrinked, degraded and getting used alternatively to cater the needs of ever-burgeoning human population are inherent impediments to the increasing agricultural production and pose grave challenges for future agriculture. These challenges are:

- Land-use pattern changing, and urbanization and desertification continuing
- Increasing demands for food and water, but from receding groundwater table, and lessand low quality water; A rise in temperature by **1°C** will increase crop water demandsby **2%**
- Climate change leading to uncertainties and vulnerabilities
- Technology fatigues and access to inputs etc. in risk prone and poorly-endowedregions
- Extension systems are crumbling

Thus, considering present agricultural production scenarios and future projections, challenges for producing more at less cost and less resource-use to have food access to all country people loom large, which not only emphasize on the increase in crop production, but also underline that such production increases must be sustainable, by minimizing negative environmental effects in agriculture. Conservation agriculture is believed to have potential to achieve (i) acceptable profits, (ii) high and sustained production levels, and (iii) conservation of the environment..

Conservation agriculture, to a large extent, has the potential to regulate climate change as well as an adaptive mechanism (mitigation & adaptation) to reduce adverse effects of climate change due to emission of green house gases (GHG's), viz, CO_2, CH_4 and N_2O. Conservation agriculture based management practices are a viable option for sustainable agriculture and an effective tool to check land degradation. Considering the severe problems of land degradation due to runoff- induced soil erosion, rainfed areas, particularly in arid and semi-arid regions require the practice of conservation agriculture more than the irrigated areas to ensure a sustainable production.

Principles of Conservation Agriculture:



Recently, "controlled traffic" is loosely taken as the fourth principle of conservation agriculture to ensure less or no compaction of soil due to broad wheels/tyres of the tractors. A system, involving these 3 principles is a perfect and true conservation agriculture system, which would be a more sustainable cultivation system for the future.

Minimal Soil Disturbance:

The practice of ploughing the field to prepare for sowing or seed bed preparation has been in vogue since time immemorial. Farmers

have perceived that tillage or soil loosening would improve soil fertility, increase its ability to absorb rainwater, and help in controlling unwanted weed flora. This practice over time causes a decline in soil fertility and productivity resulting from deterioration of soil physical, chemical and biological properties. Organic matter is critical to have a stable soil structure and repeated tillage operations cause deterioration of soil properties, making it vulnerable to soil runoff and erosion. The practice of conservation agriculture advocates minimal soil disturbance and hence much less or no tilling carried out.

Permanent Organic Soil Cover:

In conventional agriculture, crop residues are incorporated or used either as fodder for livestock or burnt with a view to control insect-pests, diseases and weed flora, and to permit timely tillage operations. Contrary to this practice, if residues are allowed to remain on the soil surface, they act as a layer of mulch. This layer protects the soil against the harmful effects resulting from exposure to sun and rain; provides micro-organisms in the soil with a constant supply of 'food', altering the micro-climate in the soilfor optimal growth and development of organisms. The mulch layer plays an important role in improving biological activity, soil organic matter content, and in turn helps improve physical, chemical and biological soil properties. At least 30% area of the soil surface should be covered by crop/plant residue in conservation agriculture. However, though conservation agriculture advocates this approach, many socio-economic factors will govern its adoption, given the opportunity cost attached to crop residue.

Diversified Crop rotation with a Legume:

Plant residue when not burnt and soils are not ploughed; control of insect pests, diseases, and weeds has to be achieved through crop rotation and an integrated pest management approach. Such crop rotation practice interrupts the infection chain between subsequent crops and offers a 'diet' to soil micro- organisms. Crop rotation also promotes exploration of nutrients by crops from different soil layers and helps in reducing pressure created by mono-cropping. Thus, crop rotation functions as a biological pump to recycle the nutrients. The resultant higher microbial activity stimulates nitrogen fixation and humus formation with an aobjective to complement natural soil biodiversity and create a healthy soil micro- environment. Pursued scientifically as part of conservation agriculture practice, this option has much to offer to the cause of soil health.

Limitations of Conservation Agriculture

Disadvantages in the short term might be the high initial costs of specialized planting equipment and the completely new dynamics of a conservation farming system, requiring high management skills and a learning process by the farmer. Long term experience with conservation farming all over the world has shown that conservation farming does not present more or less but different problems to a farmer, all of them capable of being resolved.

- The most important limitation in all areas where conservation agriculture is practiced is the initial lack of knowledge. There is no blueprint available for conservation agriculture, as all agro-ecosystems are different. A particularly important gap is the frequent dearth of information on locally adapted cover crops that produce high amounts of biomass under the prevailing conditions. The success or failure of conservation agriculture depends greatly on the flexibility and creativity of the extension and research services of a region.
- As conservation agriculture partly relies on the use of herbicides, at least during the initial stage of adoption, some people worry that adoption of conservation agriculture will increase

herbicide use and that in turn will lead to increased contamination of water by herbicides.

- Reductions in leaching of pesticides under conservation agriculture might be affected by greater microbial activity in the soil.
- Released chemicals/allele-chemicals from residues over a long period may result in allele-pathy and other associated effects on soil, resulting in poor cropgrowth and yields.

REFERENCES

Das, T.K.2012.Conservation agriculture for enhancing productivity and resouces-use efficiency.(In) Annual Report 2011-12 (IARI-CIMMYT Challenge Programme),Division of Agronomy, Indian Agricultural Research Institute, New Delhi, 45 pp.

Das, T.K.2012.Conservation agriculture for enhancing productivity and resouces-use efficiency.(In) Annual Report 2011-12 (IARI-CIMMYT Challenge Programme),Division of Agronomy, Indian Agricultural Research Institute, New Delhi, 20 pp.

Gupta, R.K. and Sayre, K.2007.Conservation Agriculture in South Asia. Journal of Agricultural Sciences 145: 207-14