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Conservation Agricultutre: Scope and Challenges

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Introduction

Conservation agriculture identified by the practice of minimum soil disturbance, crop rotations, and maintenance of organic soil cover reinforces ecosystems services through a number of interrelated pathways. The regulatory services such as carbon sequestration, climate regulation, and control of soil erosion are reinforced through minimum tillage and inclusion of trees in conservation agriculture. Support services through nutrient recycling, soil formation habitat provision derived from crop rotation, minimum soil disturbance, and plant residue retention. Despite some challenges associated with conservation agriculture, when done correctly, Conservation agriculture could ensure current food security and nutrition for all without compromising the economic, social, and environmental bases for future generations.

Conservation agriculture is one of the many ways of managing resources on the farm to reduce erosion, build resilient soil system and improve productivity. It has components that directly contribute to both mitigation and adaptation to climate change; however, targeting has been poor in the past. The emphasis of taking it to small farmers without reasonable resource to invest on their farms seems to be misplaced. Consideration of the within-farm factors and the environments outside the farm is an important step that will determine the result of popularization and scaling out efforts. Fig. 1 summarizes some of the issues that need further analysis to describe carefully which farmer typology to target for conservation agriculture adoption.

Conservation agriculture is a crop management system based on **three principles**: (1) minimum soil disturbance, (2) permanent soil organic cover with crop residues and cover crops, and (3) crop rotations that include diverse species.

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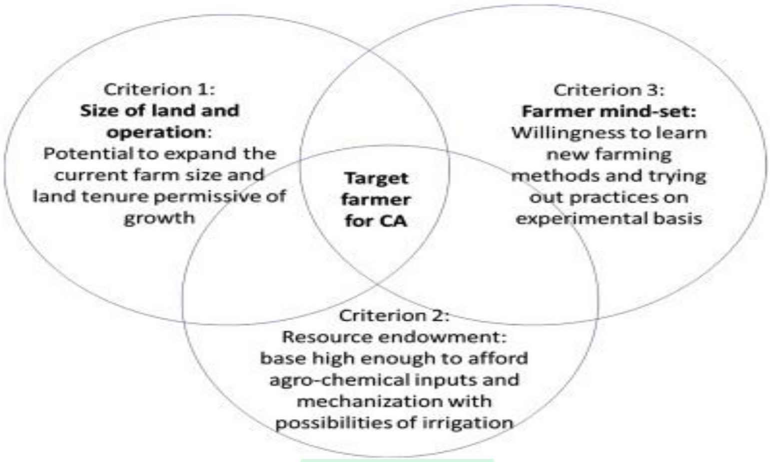

Figure 1. An illustration of some of the factors that describe a farmer who can potentially rip benefits by applying conservation agriculture practices.

Continuous minimum mechanical soil disturbance with direct seeding (i.e. no-tillage). The disturbed area must be less than 15 cm wide or less than 25% of the cropped area (whichever is lower). Mechanical disturbance should be limited to the purpose of placing seed or fertilizer. This fights against soil erosion and preserves soil organisms.

Permanent soil organic cover with crop residues and/or cover crops to the extent allowed by water availability. Ground cover is measured immediately after the direct seeding operation, and the area should have over 30% cover. This allows the retention of a protective layer of vegetation on the soil surface to suppress weeds, protect the soil from the impact of weather and avoid soil compaction.

Species diversification through varied crop sequences and associations involving at least three different crops. A well-designed crop rotation promotes good soil structure, fosters a diverse range of soil flora and fauna that contribute to nutrient cycling and plant nutrition, and prevents phyto sanitary diseases.

Approximately 47, 39, 9 and 3.5 percent of the land is under conservation agriculture in South America, US and Canada, Australia and rest of the countries respectively. It can save the product on cost significantly and it was found that production cost per acre of soybeans under no-tillage is reduced by US$ 27.00 in Argentina, by US$ 14.18 in the USA and by US$ 11.50 in Brazil. After 19 days, total losses of carbon from ploughed wheat fields were up to five times higher than for un-ploughed fields. Experiences of Chitwan farmers

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also revealed that it saves the land preparation cost by approx. 30 and intercultural operation cost (weeding) by 25% respectively under direct seeded rice and zero-tillage wheat. No-till wheat significantly reduced the costs of production; farmers estimate this at about 2500 rupees ha^{-1} (US$ $60ha^{-1}$), mostly due to using less diesel fuel, less labor, and less pumping of water. Since planting can be accomplished in one pass of the seed drill, time for planting was also reduced, thus freeing farmers to do other productive work.

Water-use efficiency is also increased and save water by 15-50% through the adoption of conservation agriculture technologies. It reduces water runoff, better water infiltration and more water in the soil profile throughout the crop growing period. It has potential to increase water application efficiency by over 50%. Similarly, it increases in nutrient use efficiency of the crop by 15-25%.

While fossil fuels are the main producer of carbon dioxide, estimates are that the widespread adoption of conservation tillage could offset as much as 16% of world-wide fossil fuel emissions. Conservation agriculture also reduces crop vulnerability to extreme climatic events. More importantly, smallholder farmers relegated by the conventional agriculture can also be benefitting from it.

Yield gains of 200-500 $kgha^{-1}$ are found under rice-wheat system with no-till wheat against conventional-till system. It is reported that, it increases in yield of crops by 15 to 25%. Sufficient evidence has accumulated to conclude that conservation agriculture contributes to sequester significant quantities of atmospheric CO_2 in the form of soil organic matter. Similarly, conservation agriculture can reduce the significant amount of green house gas emission through improved input use efficiency.

Challenges in conservation agriculture

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The challenges are those of the small and the fragmented land holdings and availability of the seeds and manure and fertilizers and the biocides and irrigation and the lack of maximums and soil erosion and the lack of the agricultural marketing along with a inadequate storage facility and a transport inadequate.

Conclusion:

Conservation agriculture offers a new paradigm for agricultural research and development different from the conventional one, which mainly aimed at achieving specific food grains production targets in India. A shift in paradigm has become a necessity in view of widespread problems of resource degradation, which accompanied the past strategies to enhance production with little concern for resource integrity. Integrating concerns of productivity, resource conservation and soil quality and the environment is now fundamental to sustained productivity growth. Developing and promoting conservation agriculture systems will be highly demanding in terms of the knowledge base. This will call for greatly enhanced capacity of scientists to address problems from a systems perspective; be able to work in close partnerships with farmers and other stakeholders and strengthened knowledge and information-sharing mechanisms. Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource use-efficient, competitive and sustainable. Conserving resources enhancing productivity has to be the new mission.