OPEN ACCESS Freely available online

ISSN: 2168-9881
Agrotechnology

Perspective

# Conservation Agriculture for Sustainable Developments in Farming

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## DESCRIPTION

Conservation Agriculture (CA) is an agricultural strategy that helps to preserve arable land while also restoring damaged areas. It encourages the preservation of a permanent soil cover, little soil disturbance, and plant diversity. It improves biodiversity and natural biological processes above and below ground, resulting in more efficient water and fertilizer usage, as well as enhanced and long-term crop production. With regionally modified approaches, CA concepts are generally applicable to all agricultural landscapes and land uses. External inputs such as agrochemicals and plant nutrients of mineral or organic origin are delivered optimally and in methods and quantities that do not interfere with or disrupt biological processes, while soil interventions such as mechanical soil disturbance are kept to a bare minimum or avoided.

Rice and wheat production in the Indo-Genetic Plains (IGP) intensive, irrigated agricultural methods is associated with considerable negative environmental and health externalities. CA has the ability to reduce some of these externalities while increasing agricultural revenue. In the Indian IGP, however, farmer adoption of CA is still low. The current research focuses on the barriers to zero tillage adoption, which is a crucial CA component (ZT). We investigate whether zero tillage wheat is possible for smallholders, as well as the possibility for technology targeting to achieve quicker and wider dissemination. Remote sensing data and farm household data were obtained from the Indian states of Punjab and Bihar, two different agricultural economies in the IGP, and analyzed using econometric models and machine learning techniques. While smallholder adoption was modest (holding less than 2 ha of land), the on-farm impacts of ZT on variable cost reduction, yield and profit improvement are comparable to big farmers. Using an equilibrium displacement model, we assess the economic potential of technology targeting. Technology targeting based on landholding size does not appear to provide significant economic gains in Punjab, a reasonably developed state. Technology targeting might significantly increase economic surplus and alleviate rural poverty in Bihar, a less prosperous state with a large population of smallholders.

Zero-tillage farming with residue cover conserves water, progressively enhances soil organic matter, and controls weeds while lowering machinery, fuel, and time expenses associated with tilling. Allowing the soil to breathe enhances water infiltration, retains soil moisture, and reduces topsoil erosion. In the face of weather extremes induced by climate change, conservation agriculture increases water intake, allowing for more steady yields. Farmers may encounter barriers to adopting conservation agricultural techniques, despite the fact that it has numerous benefits for both farmers and the environment. Adoption might be difficult in wetlands or soils with inadequate drainage. When crop leftovers are few, farmers often use them first for feed, resulting in a lack of residues for soil cover. Appropriate seeders are required to begin conservation agriculture, and these may not be available or inexpensive to all farms. Conservation agriculture is also a knowledge-intensive technique, and not all farmers may have access to the knowledge and training needed to conduct it. Finally, while conservation agriculture improves yields over time, producers may not experience immediate advantages. Innovations, tailored research, and new technology, on the other hand, are assisting farmers in overcoming these obstacles and facilitating the implementation of conservation agriculture.

Both conservation agriculture and organic farming employ crop rotation and conserve the soil's organic matter to maintain a balance between agriculture and resources. The fundamental difference between organic and conservation agriculture farming is that organic farmers utilize a plow or soil tillage, whereas conservation agriculture farmers follow natural principles and do not till the soil. Tillage is used by organic farmers to eradicate weeds without using inorganic fertilizers. Farmers who practice conservation agriculture, on the other hand, utilize a permanent soil cover and plant seeds through it. They may utilize inorganic fertilizers to control weeds at first, especially in low-fertility soils. The usage of agrichemicals may be reduced or phased out over time.

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**Received:** 03-May-2022, Manuscript No. AGT-22-16964; **Editor assigned:** 06-May-2022, PreQC No. AGT-22-16964 (PQ); **Reviewed:** 20-May-2022, QC No. AGT-22-16964; **Revised:** 27-May-2022, Manuscript No. AGT-22- 16964 (R); **Published:** 03-June-2022, DOI:10.35248/2168-9881.22.11.261

**Citation:** Martin G (2022) Conservation Agriculture for Sustainable Developments in Farming. Agrotechnology. 11:261

The transition to conservation agriculture necessitates a conceptual shift. Farmers, for example, must abandon their customary method of hoeing or ploughing the field in favor of "biological tillage" by plant roots and earthworms. Farmers are also encouraged to view their farms as a business rather than just a method to feed their family as a result of the change. Conservation agriculture necessitates significant modifications in extension services. Farmer field schools and other techniques that put farmers and their needs first, rather than treating them as simple consumers of instruction, are a successful way to promote conservation agriculture. Such radical changes necessitate education, not just on the farm but also in schools and universities. Extension personnel will require extensive training in order to master the essential technology. Field demonstrations and public awareness efforts will be required. The media must be used to help the campaign succeed.