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Growing More with Less: Conservation Agriculture for Making Farming Sustainable?

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Conservation Agriculture offers a practical pathway to sustainable intensification by producing food efficiently while protecting natural resources. Through reduced tillage, residue retention and crop diversification, it can improve soil health, conserve water, reduce input costs and stabilize yields under climate stress. However, adoption faces challenges such as initial yield uncertainty, residue competition, limited machinery, finance and technical knowledge. Its success ultimately depends on local adaptation, farmer support and enabling policies.

Introduction

South Asian agriculture is a climate-vulnerability hotspot because rising inputs no longer guarantee proportional yield gains. In India, The Indian Express reports that fertilizer-use efficiency has declined sharply: 1 kg NPK produced 12.1 kg cereal grain in the 1960s but only 5 kg in the 2010s. Climate stress further worsens this declining productivity. Sustainable intensification (SI) is an approach to agriculture that aims to produce more food from the same area of land while minimizing environmental damage and conserving natural resources. It seeks to increase productivity without continuously expanding cultivated land or excessively increasing external inputs. Conservation agriculture (CA), based on minimum soil disturbance, permanent soil cover and crop diversification, is considered a promising pathway to SI.

What Is Sustainable Intensification?

SI is a strategy for increasing production with more efficient resource use and reduced environmental damage. It is better understood as a broader transformation of agriculture. It involves different strategies that work together depending on the local situation:

- Produce more with efficient use of inputs
- Maintain production while reducing environmental damage
- Restore underused or degraded farmland
- Shift away from environmentally harmful production
- Protect natural ecosystems

It is about finding the right balance between productivity, efficient use of resources, environmental protection and long-term sustainability, while considering the specific needs of each farming system. One way to achieve this is through Conservation Agriculture (CA). In this context, sustainable intensification is the broader goal, while CA provides practical farming practices that can help achieve it.

What Is Conservation Agriculture?

For generations, farming has often involved ploughing the soil, clearing crop residues and growing the same crop repeatedly. But does producing food always require disturbing the soil again and again? Conservation Agriculture offers a different approach.

Instead of constantly working the soil, CA focuses on working with natural soil processes. It aims to protect soil structure, keep the soil covered and encourage greater diversity in the field. According to FAO, Conservation Agriculture is built around **three closely connected principles: minimum soil disturbance, permanent soil cover and crop diversification**.

Disturb the soil less

The first principle is straightforward: plough less, or avoid ploughing whenever possible. Rather than repeatedly turning the soil, farmers can use reduced-tillage or no-tillage methods and sow seeds directly into the field.

FAO specifies that mechanical soil disturbance should be less than 15 cm wide or cover less than 25% of the cropped area, with no periodic tillage exceeding these limits. Reducing soil disturbance helps protect soil structure, reduce erosion and save fuel, labour and time. Instead of repeatedly disturbing the soil to prepare it for every crop, farmers allow the soil to retain more of its natural structure and biological activity.

Never Leave the soil bare

The second principle is keeping the soil covered. Instead of leaving the field exposed, farmers can use crop residues, mulch or cover crops to protect the soil surface.

According to FAO criteria, at least 30% of the soil surface should remain covered immediately after seeding for the system to qualify as Conservation Agriculture. Although this may seem simple, maintaining soil cover provides several benefits. It reduces water loss and soil erosion, keeps the soil cooler and helps suppress weeds. As they gradually decompose, they add organic matter to the soil, improving soil health and supporting productivity over the long term.

Give the field more than one crop

The third principle is species diversification. Instead of growing the same crop repeatedly, CA encourages crop rotations and crop associations involving at least three different crop species.

Different crops interact with the soil and other organisms in different ways. This can help break pest and disease cycles, improve nutrient cycling and strengthen biological control. It also spreads risk i.e, if one crop performs poorly because of drought, pests or changing weather, others may still perform well.

The real strength of Conservation Agriculture comes from **using all three principles together**, rather than relying on any one practice alone. When the soil is disturbed less, its structure and biological life are better protected. When it is covered, moisture is conserved and erosion is reduced. When different crops are grown together or in rotation, nutrients are cycled more effectively and the farming system becomes more biologically diverse.Together, these practices can create healthier soils, better water infiltration and crops that are more resilient to environmental stress. Over time, this can mean more stable production, lower input costs and a smaller environmental footprint.

How CA Supports Sustainable Intensification

Conservation agriculture is not about simply growing more crops. Its real strength lies in helping farmers get more from the resources they already have—while making their fields more resilient for the future. This is what makes CA a practical pathway to sustainable intensification.

- **More stable yields**

CA does not always produce an immediate jump in yield, and that is important to acknowledge. Its bigger advantage is stability. Studies from South Asia show that CA-based systems can match conventional farming and, over time, improve profitability by reducing fuel, labour and other input costs.

During heat waves or droughts, this advantage becomes even clearer. Crop residues protect the soil from drying out, while reduced tillage helps conserve moisture around the roots. Instead of chasing record yields in good years, CA helps farmers avoid severe losses in difficult years—something that matters greatly to smallholders.

- **Healthier soils**

Think of healthy soil as the foundation of a farm. CA protects this foundation by disturbing the soil less, keeping it covered and growing different crops. Over time, these practices can increase organic matter, improve soil structure and encourage earthworms and beneficial microorganisms. Better-structured soil allows rainwater to soak in rather than simply running off, while holding nutrients and moisture for longer. The result is soil that is less vulnerable to erosion, compaction and degradation, and better able to support crops season after season.

- **Making every input count**

Water and fertilizers are becoming increasingly valuable, particularly where farmers face irregular rainfall and rising production costs. Crop residues act like a protective blanket, slowing evaporation and keeping moisture in the root zone for longer.

At the same time, healthier roots and active soil biology can improve access to nutrients and water. Better nutrient cycling can also reduce dependence on excessive fertilizer and pesticide use. In this way, CA helps farmers get more crop from every drop of water and every unit of input.

- **Benefits beyond the farm**

The benefits of CA extend beyond the field. Less tillage means fewer tractor passes and lower fuel consumption, while keeping residues on the soil reduces erosion and nutrient loss. Healthy soils can store more carbon, and reduced runoff helps protect nearby rivers and water bodies from sediment and nutrient pollution. Together, these benefits make farming more productive while placing less pressure on the environment.

Ultimately, CA supports sustainable intensification by shifting the focus from "use more to produce more" to "use resources better to produce sustainably."

CA In The Field

In Ramba village, Haryana, farmer **Sahab Singh** saw neighbouring farmers benefiting from zero-tillage and decided to try it himself in 1999. At first, the results disappointed him, but guidance from wheat scientists helped him refine the practice. Earlier, preparing his fields required **8–10 ploughings and 75–88 litres of diesel per hectare**. With zero tillage, he could sow wheat directly, saving labour, fuel and ₹2,500–2,900 per hectare in ploughing costs. By 2007–08, his zero-till wheat yielded 6 tonnes per hectare—similar to conventional farming. For Sahab Singh, conservation agriculture meant a simple change: less ploughing, lower costs and no sacrifice in yield.

The Trade Offs In CA

Conservation Agriculture is **not an overnight solution**. Like learning any new farming method, it can take time before the benefits become clear.

- Initial yield dips

During the transition, yields may remain stable or decline temporarily, particularly when farmers are still adapting to new sowing, residue and weed-management practices. This can be difficult for smallholders who cannot easily absorb a short-term income loss.

- Residue competition

Crop residues have several important uses in smallholder farming systems, which can make it difficult for farmers to leave enough residues on the field:

- Fodder: Livestock often depend on crop residues for feed, particularly during dry seasons.
- Fuel: In some rural households, crop residues are also used as a source of cooking fuel.
- Soil cover: Under CA, residues need to remain on the field as mulch to protect the soil from erosion and moisture loss.

Farmers can address this challenge by retaining some residues in the field while using the remaining material for other purposes. However, limited financial incentives and the cost of residue-management machinery can make this difficult. Therefore, treating crop residues as a useful farm resource rather than waste is important for making CA practical and affordable for smallholder farmers.

- Knowledge, training and equipment barriers

Adoption of CA is constrained by:

- Limited extension services: Weak agricultural extension systems can make it difficult for farmers to learn and adopt new practices.
- Insufficient technical knowledge: Farmers may lack practical knowledge about zero tillage, residue management, crop rotation and weed control.
- Equipment gaps: Direct-seeding equipment can be expensive or difficult to access, particularly for small farmers.
- Training deficits: Farmers who receive practical training and guidance are more likely to adopt conservation-oriented practices.

Financial constraints further increase these difficulties, as many smallholders lack the capital needed to purchase machinery or manage the initial costs of changing their farming system.

Adapting CA To Local Conditions

Conservation agriculture must be adapted to local soils, crops, climate and socio-economic conditions—there is no universal blueprint. The challenges faced by farmers can vary widely: labour availability may be the main concern in one region, while machinery, land ownership or access to finance may be more important elsewhere. Successful CA therefore requires on-farm demonstrations, farmer-to-farmer learning, practical training and financial or institutional support suited to local conditions. The goal is not to impose one fixed package, but to help farmers develop a CA system that works for their own fields and livelihoods.

Conclusion

Conservation agriculture shows that farming does not always have to depend on using more inputs to produce more. By disturbing the soil less, keeping it covered and growing diverse crops, farmers can protect soil, save water, reduce costs and make their farms more resilient to climate stress. However, CA is not a one-size-fits-all solution. Farmers need access to suitable machinery, quality seeds, technical guidance, finance and supportive policies. The practices must also be adapted to local soils, crops and farming conditions. Ultimately, the future of sustainable farming may depend on a simple shift in thinking: instead of working against nature, learn to work with it.

References

1. FAO (2024). Conservation agriculture in the Indo-Gangetic Plains. *FAO Conservation Agriculture Case Studies*.
2. FAO (2024). Conservation Agriculture. *Food and Agriculture Organization of the United Nations*.
3. Struik, P.C. and Kuyper, T.W. (2017). Sustainable intensification in agriculture: the richer shade of green. A review. *Agronomy for Sustainable Development*, 37(5): 39.
4. FAO (2011). *Conservation Agriculture and Sustainable Crop Intensification*. Rome: Food and Agriculture Organization of the United Nations.
5. Pretty, J. and Bharucha, Z.P. (2014). Sustainable intensification in agricultural systems. *Annals of Botany*, 114(8): 1571–1596.
6. Jat, M.L., Singh, R., Chakraborty, D., Sapkota, R.K., Stirling, C.M. and Jat, H.S. (2020). Conservation agriculture for sustainable intensification in South Asia. *Nature Sustainability*, 3(5): 333–340.
7. ICAR (2024). Zero tillage in wheat saved resources and enhanced income. *Indian Council of Agricultural Research*.