Conservation agricultural practices in semi arid zone of Rajasthan

Richa Sachan, Anirudh Choudhary and Shani Kumar Singh

Abstract
Rajasthan Stands at fifth position after Uttar Pradesh, Punjab, Madhya Pradesh and Andhra Pradesh in food grain production, and stands at third position in area. Conservation agriculture (CA) technologies involve minimum soil disturbance, permanent soil cover through crop residues or cover crops, crop rotations for achieving higher productivity and helps to improve biodiversity in the natural and agroecosystems. CA improves soil water use efficiency, enhances water infiltration, and increases insurance against drought. CA provides a base for sustainable intensification of the agricultural production system. Thus, CA is based on the integrated management of soil, water and agricultural resources in order to reach the objective of economically, ecologically and socially sustainable agricultural production.

However, there are still constraints for promotion of CA technologies, such as lack of appropriate seeders for small and medium farmers, burning of crop residues etc. The need to develop the policy frame and strategies is urgent to promote CA in the region. In Rajasthan, high intensity and erratic rains associated with poor soil permeability creates excessive runoff and severe erosion hazards. In this region farmrainwater harvesting can be done. Low and highly unstable crop production and rapidly falling groundwater levels are the major challenges to be tackled in semi-arid rainfed areas.

This paper reviews the emerging concerns of conventional agriculture systems, and analyses the constraints, policy issues and research needs for conservation agriculture in Rajasthan.

Keywords: Conservation agriculture, Constraints, policy of CA adoption, CA technologies

Introduction
Conservation Agriculture (CA) is defined as a sustainable agriculture production system comprising a set of farming practices adapted to the requirements of crops and local conditions of each region, whose farming and soil management techniques protect the soil from erosion and degradation, improve its quality and biodiversity, and contribute to the preservation of the natural resources, water and air, while optimizing yields. No-tillage is defined as a system of planting crops into un-tilled soil by opening a narrow slot, trench or band only of sufficient width and depth to obtain proper seed coverage. No other soil tillage is done”. Permanent or continuous No-tillage should be aimed at, rather than not tilling in one season and tilling in the other, or occasionally not tilling the soil. The soil should remain permanently covered by crop residues from previous cash crops or green manure cover crops, and most of these residues will remain undisturbed on the soil surface after seeding.

In the State of Rajasthan 70 per cent of the population is living in rural areas and depends on agriculture as source of livelihood. The geographical features of Rajasthan are dominated by the Aravalli range which divides the State into two distinct zones. The region to the west and north-west, comprising of eleven districts and nearly 61 per cent of the total area of the State, is known as the Great Indian Thar Desert. The type of soil is sandy in this region which is poor in nitrogen and has low water holding capacity. The south-east and eastern parts of the Aravalli Hills are productive for agriculture purposes, having clay loam type soil. The rainfall fluctuates from 200-550 mm in the western and semi-arid parts to 550-1000 mm per annum in south-eastern and eastern parts of the Aravalli Ranges. Low and highly unstable crop production and rapidly falling groundwater levels are the major challenges to be tackled in semi-arid rainfed areas. In south-eastern Rajasthan, high intensity and erratic rains associated with poor soil permeability creates excessive runoff and severe erosion hazards.

Status of conservation agriculture in abroad, India and Rajasthan
In India, CA adoption is still in the initial phases. Over the past few years, adoption of zero tillage and CA has expanded to cover about 1.5 million hectares (Jat et al., 2012[8];
Global adoption of conservation agriculture systems

<table>
<thead>
<tr>
<th>Country</th>
<th>Area (M ha)</th>
<th>% of Global Area</th>
</tr>
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<tbody>
<tr>
<td>USA</td>
<td>26.5</td>
<td>21.2</td>
</tr>
<tr>
<td>Brazil</td>
<td>25.5</td>
<td>20.4</td>
</tr>
<tr>
<td>Argentina</td>
<td>25.5</td>
<td>20.4</td>
</tr>
<tr>
<td>Australia</td>
<td>17.0</td>
<td>13.6</td>
</tr>
<tr>
<td>Canada</td>
<td>13.5</td>
<td>10.8</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>4.5</td>
<td>3.6</td>
</tr>
<tr>
<td>China</td>
<td>3.1</td>
<td>2.5</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>1.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Others</td>
<td>5.3</td>
<td>4.2</td>
</tr>
<tr>
<td>Total</td>
<td>124.8</td>
<td>100.0</td>
</tr>
</tbody>
</table>


The potential of CA to reverse the process of soil degradation and make agricultural production more secure is so significant a factor that farmers need to be encouraged and supported proactively in practical ways to start and complete the transition to CA for the benefit of themselves, their local and national communities, and the future generation (FAO, 2001; Lal, 2010) [5].

Constraints for adoption of conservation agriculture

A mental change of farmers, technicians, extensionists and researchers away from soil degrading tillage operations towards sustainable production systems like no tillage is necessary to obtain changes in attitudes of farmers (Derpsch, 2001) [2]. Major challenges are:

- Lack of appropriate seeders especially for small and medium scale farmers
- The wide spread use of crop residues for livestock feed and fuel
- Burning of crop residues
- Lack of knowledge about the potential of CA to agriculture leaders, extension agents and farmers
- Skilled and scientific manpower

Challenges in conservation agriculture in Rajasthan

Understanding the system is a major problem as Conservation agriculture systems are much more complex than conventional systems. Site specific knowledge has been the main limitation to the spread of CA system.

Building a system and farming system perspective – A system perspective is built working in partnership with farmers. A core group of scientists, farmers, extension workers and other stakeholders working in partnership mode will therefore be critical in developing and promoting new technologies.

While the basic principles which form the foundation of conservation agriculture practices, that is, no tillage and surface managed crop residues are well understood, adoption of these practices under varying farming situations is the key challenge. These challenges relate to development, standardization and adoption of farm machinery for seeding with minimum soil disturbance, developing crop harvesting and management systems. Adapting strategies for conservation agriculture systems will be highly site specific, yet learning across the sites will be a powerful way in understanding why certain technologies or practices are effective in a set of situations and not effective in another set and research in conservation agriculture must have longer term perspectives.

Policy issues

Conservation agriculture implies a radical change from traditional agriculture. There is need for policy analysis to understand how CA technologies integrate with other technologies, and how policy instruments and institutional arrangements promote or deter CA (Raina et al., 2005).

Greater support from stakeholders including policy and decision makers at the local, national and regional levels will facilitate expansion of CA and help farmers to reap more benefits from the technology. Shift in focus from food security to livelihood security and there is a need for generating a good resource database with agencies involved complementing each others’ work. Besides resources, systematic monitoring of the socio-economic, environmental and institutional changes should become an integral part of the major projects on CA. Policy support for capacity building by organizing training on CA is needed. Availability of trained human resources at ground level is one of the major limiting factors in adoption of CA. Training on CA should be supported at all levels. CA has to be mainstreamed in relevant ministries, departments or institutions and supported by adequate provision of material, human and financial resources to ensure that farmers receive effective and timely support from well trained and motivated extension staff.

Support for the adaptation and validation of CA technologies in local environments. Support the development of CA equipment and ensure its availability. In the medium to long run, local manufacture of these will increase availability, ensure that equipment is adapted to local conditions, increase employment opportunities and reduce costs. The larger and more complex equipment is expensive and users may have to hire it. There is an opportunity to develop a local hire service industry by providing equipment, and training on machine maintenance and business skills. Where governments support land preparation schemes using ploughs, there is scope to change the equipment to rippers or direct seeders to reduce the cost and align the schemes to CA approaches.

Promote payments for environmental services (PES) and fines for faulty practices. A system perspective is the best to build working in partnership with farmers, who are at the core of...
Adoption and spread of ZT wheat has been a success story in Rajasthan, India. Due to (1) reduction in cost of production by Rs 2,000 to 3,000 ha−1 (Malik et al., 2005, RWC-CIMMYT, 2005) [2]; enhancement of soil quality, i.e. soil physical, chemical and biological conditions (Jat et al., 2009a, Gathala et al., 2011b) [3]; enhancement, in the long term C sequestration and build-up in soil organic matter constitute a practical strategy to mitigate Green House Gas emissions and impart greater resilience to production systems to climate change related aberrations (Saharawat et al., 2012) [4]; reduction of the incidence of weeds, such as Phalaris minor in wheat (Malik et al., 2005) [5]; enhancement of water and nutrient use efficiency (Jat et al., 2012, Saharawat et al., 2012) [6]; enhancement of production and productivity (4% – 10%) (Gathala et al., 2011a) [7]; advanced sowing date (Malik et al., 2005) [8]; reduction in greenhouse gas emission and improved environmental sustainability (Pathak et al., 2011) [9]; avoiding crop residue burning reduces loss of nutrients, and environmental pollution, which reduces a serious health hazard (Sidhu et al., 2007) [10]; providing opportunities for crop diversification and intensification—for example in sugarcane based systems, mustard, chickpea, pigeonpea etc. (Jat et al., 2005) [11]; improvement of resource use efficiency through residue decomposition, soil structural improvement, increased recycling and availability of plant nutrients (Jat et al., 2009a) [12]; and use surface residues as mulch to control weeds, moderate soil temperature, reduce evaporation, and improve biological activity (Jat et al., 2009b, Gathala et al., 2011b) [4]. Because of the ZT wheat benefits, the CA based crop management technologies have been tried in other cropping systems in India (Jat et al., 2011) [10], but there are large knowledge gaps in CA based technologies which indicates there is a need to develop, refine, popularize and disseminate these technologies on a large scale.

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 Rajasthan 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 CA 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.

References


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