Economic and Environmental Potentials of Conservation Agriculture in the Traditional Maize Farming Systems of India

Singh, Vivek and TR, Prabhakaran and Krishna, Vijesh

CIMMYT, CIMMYT, CIMMYT

2011

Economic and Environmental Potentials of Conservation Agriculture in the Traditional Maize Farming Systems of India*

Vivek Kumar Singh[1], Prabhakaran T.R., & Vijesh Krishna
International Maize and Wheat Improvement Center (CIMMYT), New Delhi, India

Introduction

Maize ranks among the most prominent crops of rainfed farming systems in India, grown under traditional farming practices. However, the characterisation studies of maize growing tracts in India reveals that, despite its increasing popularity, a number of pervasive challenges - both in the environmental and sustainability frontiers - are associated with these production systems (Joshi et al., 2005). The major issues include soil degradation, active erosion in sloping areas, poor-quality seeds, expensive and unreliable fertilizer supplies, labour shortages, competing uses for crop residues and animal manures, poor quality feeds and lack of efficient value chains. Conservation agriculture (CA) based crop management, along with an innovation system approach, providing a pathway for coping with many of these stresses in the rainfed conditions, is increasingly gaining agriculture R&D focus against this backdrop. The overall goal of the paper is, hence, set to review the trends in rainfed maize production and report the potentials of CA in sustaining the economy and ecology of maize farming system of rainfed areas of India.

Traditional maize-based rainfed farming systems of India: relevance

In India, during the last decade, maize has witnessed rapid production and productivity growth. This is mainly attributed to the emergence of commercial irrigated farming systems in certain regions of the country, especially South India. Rainfed agriculture in India occupies 67% of the net sown area, contributing 44% of food grains and supporting 40% of the population. In total, some 450m Indians earn their livelihoods under rainfed conditions. In case of maize, about 3/4th of cultivation is still rainfed and with the exception of the last decade (1997/98-2007/08), area increase remains greater in the rainfed systems (Table 1). However, the productivity of rainfed maize remains low: less than 20 quintals/ha of grain. The rainfed system is also a low-cost one as can be observed in Table 2, where the cost of cultivation of maize in Bihar (where the crop is cultivated largely with irrigation) is found significantly higher than that of mostly-rainfed Jharkhand or Rajasthan. The adoption of modern inputs is also lower in rainfed systems, as the farmers spend 56% lower for seeds (indicating relatively marginal adoption of hybrids) and 38% lower for fertilizer, compared to mostly-irrigated maize systems. However, low-input farming is not economically viable as observed by the associated low per-unit cost of maize production. Hence, improving maize-based cropping systems is imperative for rural development and food security. Crop productivity among smallholder farmers in many rainfed areas could be profitably enhanced with proper management and the introduction of resource conserving technologies and varieties with superior yield potential and stress tolerance.

---

*The article was awarded with Best Poster Award

[1] Author for correspondence: v.singh@cgiar.org

Table 1: Spread of maize ('000 ha) in rainfed and irrigated systems

	1957-58	1967-68	1977-78	1987-88	1997-98	2007-08
Rainfed maize	3533.28	4915.98 (5.28)	4754.16 (2.56)	4381.28 (1.03)	5018.08 (1.18)	6211.80 (2.19)
Irrigated maize	546.72	664.02 (1.49)	925.84 (0.38)	1178.72 (0.08)	1301.92 (0.77)	1908.20 (2.89)

Figures in parenthesis show compound growth rate (%).
Source: Directorate of Economics and Statistics, Government of India.

Table 2: Change in economics of maize cultivation with irrigation (2007-08)

	Bihar	Jharkhand	Rajasthan
% maize area under irrigation	60.3	1.8	2.7
Cost of Cultivation (Rs/ha)	9627.4	7411.7	6845.7
Yield (quintal/ha)	34.9	20.7	11.3
Per unit cost (Rs/quintal)	276.2	357.9	606.9

Source: Ministry of Agriculture, Government of India

Conservation Agriculture in Maize: the way forward

The concept of CA encompasses three management objectives, viz. minimizing soil disturbance, retaining crop residues on the soil surface, and encouraging economically viable crop rotations that best complement reduced tillage and crop residue retention, thereby striving to achieve acceptable profits, high and sustained production levels and ensure environmental conservation (Wall, 2007; FAO, 2009). Various studies have indicated that the CA practices effectively reduce production costs and labor requirements (Erenstein and Laxmi, 2008) thereby ensuring timely field operations in the irrigated conditions. Since these practices moderate soil temperature, improve soil quality and reduce erosion, enhance rainfall infiltration and reduce evaporative losses, its potential to effectively enhance the rainfed production systems could be highly significant.

Despite the abovementioned potentials, the environmental merits of CA are hardly examined, especially in the rainfed context. According to Paroda (2009), poor land management attributes to significant degradation of soil, and enormous quantity of soil carbon is lost due to inefficient production methods. The CA approach could have a significant impact in this regard, which is seldom studied in the South Asian context. The present study develops a framework for assessing the environmental and economic implications of CA in maize farming systems, especially with regard to the soil carbon saved by better land management practices. This is of special importance, as the approach of conservation tillage has to be tailored to farmer needs, resource-base and cropping systems associated with a particular production system (Wall, 2007). The current management practices of traditional maize of eastern India are assessed through case-study method, and the associated environmental consequences are reported. Based on the case-study observations, a generic model for assessment of impacts of CA will be formulated. The findings would be helpful for the researchers, extension agents as well as governmental agencies to focus more on potential constraints of rainfed maize-based farming systems, to sustainably enhance the rural livelihoods.

References

Erenstein, O., Thorpe, W., Singh, J, Varma, A. 2007. Crop-livestock interactions and livelihoods in the Indo-Gangetic Plains, India: a regional synthesis. Mexico, D.F.: CIMMYT.

FAO, 2009, Conservation Agriculture. Food and Agriculture Organization, Rome.

Jat, S.L., Parihar, C.M., Singh, A.K., Jat, M.L., Jat, R.K., Singh, D.K., and Kumar, R.S, Conservation agriculture in maize production systems. DMR Technical Bulletin 2011/4. Directorate of Maize Research, Pusa Campus, New Delhi.

Joshi, P.K., Singh, N.P., Singh, N.N. et al. 2005. Maize in India: production systems, constraints, and research priorities. Mexico, D.F.: CIMMYT.

Paroda, R.S., 2009, Global conventions and partnerships and their relevance to conservation agriculture. 4th World Congress on Conservation Agriculture. 4-7 February 2009, New Delhi.

Paudyal, K.R., Ransom, J.K, Rajbhandari, N.P., et al. 2001. Maize in Nepal: production systems, constraints, and priorities for research. Kathmandu: NARC and CIMMYT.

Wall, P., 2007. Tailoring conservation agriculture to the needs of small farmers in developing countries: an analysis of issues. *Journal of Crop Improvement* 19: 137–155.