SAARC Agriculture Centre (SAC)
South Asian Association for Regional Coperation

Policy Brief

Promotion of Resource Conserving Technologies in South Asia

Sikander Khan Tanveer and Md. Harunur Rashid

SAC Policy Brief: 18/Crops-01, August 2026

Executive Summary

Resource Conserving Technology (RCT) in agriculture sector, refers to any practice or technology that involves the efficient use of natural resources and minimizes damage to the environment. RCTs improve input efficiency, enrich timely crop planting, reduce the requirement of labor and boost farm income. Successful Resource Conservation Technologies (RCTs) across SAARC Member States include, Zero tillage, Planting of crops on Beds, Direct Seeded Rice (DSR), Mechanically Transplanted Rice (MTR), Alternative Wetting and Drying (AWD), Legumes based cropping systems, Efficient water use systems, Sustainable Land Management (SLM) practices, Green manuring, Vermi Composting, use of Biochar, Crops diversification, Intercropping, Crops residue management, Integrated Nutrient Management (INM), Integrated Pest Management (IPM), Use of mulches, Relay cropping, Agroforestry, Use of Happy Seeder and Super Seeder for planting of crops, Laser land levelling and development and disseminating of different crops varieties suited for diverse agro-ecological conditions, and problem soils. Although a significant number of RCTs, have been developed and are being promoted in SAARC Member States, however their large-scale adoption remains low. Continuous policy support by the SAARC Member States, training and investment from Member States are vital to improve these practices, and boost skills. Furthermore, strong partnerships among global, regional and local organizations will help to drive the widespread promotion of RCTs in South Asia.

1. Introduction

South Asia is the world's most populous region, holding 25 percent of the global population on just 3.4 percent of its land. With over 70 percent of its people living in rural areas, the region relies heavily on land ecosystems for survival. More than 85% of the farm households in South Asia are smallholder farmers, who supply 75% of the total food in the region (Bhandari & Meah, 2021). Approximately 42% of the 4.13 million square kilometre area within SAARC Member States is impacted by multiple degradation. The area confronts the twin challenges of environmental degradation and food insecurity. It is estimated that the region could lose between 10% to 50% of crop production by the end of the century due to global warming. Small landholdings and heavy dependency on rainwater are few of the main restraining factors in agriculture in the region. The irrigated area as a percentage of the arable land is around 56% in Bangladesh, 31% in Bhutan, 33% in India, 47% in Nepal, 90% in Pakistan and 39% in Sri Lanka. Cereals and pulses are the staple food of the population while cropping systems in South Asia are predominantly under irrigated management and are very intensive, with two or more crops in a year. Groundwater depletion in the north western Indo-Gangetic plains (IGP) is a major concern for the sustainability of South Asian agriculture. Agricultural land in this region is shrinking rapidly, which is limiting the food production. Excessive food demand is increasing pressure on agriculture for food security and livelihoods due to high population growth. Soils of this region have already been affected by intensive agriculture, a heavy reliance on agro-chemical inputs, traditional farming practices and crop rotations and less organic matter.

Different RCTs, being practiced in SAARC Member States include include Zero tillage, Planting of crops on Beds, Direct Seeded Rice (DSR), Mechanically Transplanted Rice (MTR), Alternative Wetting and Drying (AWD), Efficient water use systems, Sustainable Land Management (SLM) practices, Legumes based cropping systems, Green manuring, Vermi Composting, use of Biochar, Intercropping, Crops diversification, Crops residue management, Integrated Nutrient Management (INM), Integrated Pest Management (IPM), Agroforestry, Use of mulches, Relay cropping, Use of Happy Seeder and Super Seeder for planting of crops, Laser land leveling, and development and disseminating of different crops varieties suited for diverse agro-ecological conditions, and problem soils.

Conservation Agriculture (CA)-based management practices such as Zero tillage, is being advocated for increasing crops yields, and input use efficiency, in rice-wheat cropping systems of South Asia (Hobbs and Gupta, 2003). Crop residue burning can be suitably addressed by CA based system because it significantly reduces emissions of GHGs like Nitrous oxide and Methane as burning of one ton of crop residue emits 40 g of Nitrous oxide and 2.3 kg of Methane (Grace et al., 2003). DSR has potential for minimizing the cost of production, soil health hazards, GHG mitigation and the negative impacts on the succeeding crops (Chakraborty et al., 2017). High –

Efficiency Irrigation Systems (HEIS), like Drip irrigation, Sprinkler irrigation, and Moisture Sensors, are being used for different crops like rice, wheat, cotton, and vegetables.

Promotion of different Resource Conservation Technologies (RCTs) in SAARC Member States, will boost crops yields, while preserving water, and cutting production costs for a sustainable environment.

2. Methodology

This policy brief presents the outcomes of a virtual regional consultation meeting on the "Promotion of Resource Conservation Technologies in SAARC Members States" held from November 25-27, 2024 by the SAARC Agriculture Centre (SAC) Dhaka Bangladesh. The meeting featured country papers from nominated SAARC Member States focal points. In addition to the Member States focal points, scientists of different research organizations and academia of SAARC Member States, scientists of different international research organizations including CIMMYT, IRRI and CIP also participated in this meeting and presented their papers on various resource conservation technologies (RCTs). Participants shared practical recommendations for scaling up RCTs across the region.

3. Evidences of benefits of RCTs in South Asia

Resource Conserving technologies (RCTs) have shown a number of benefits in South Asia, by saving water, moisture conservation, timely planting of crops, curbing soil erosion, boosting of soil health, better use of fertilizers, efficient use of chemicals, reductions in GHGs emissions, decreasing the cost of production and ultimately rising of farmers income. For example, planting of wheat with Zero till contributes to more timely planting of wheat. It reduces cost of production, improves the efficiency of natural resource use and have also other important environmental benefits. Similar results have been reported by Hobbs et al., (2008). According to them, Zero tillage technology, which is primarily used for wheat cultivation, conserves moisture, reduces soil erosion and lowers fuel and labor costs. It can increase wheat yield by 10-15% compared to Conventional tillage. Jat et al., (2009), reported that Zero-till drilling in crop residues keeps canopy temperatures lower by 1 - 1.5 ^{o}C during grain filling stage and sustains soil moisture availability to the plants. Singh et al., (2021), also reported 9.6% higher system productivity under No tillage, than the Conventional tillage under maize-vegetable pea system in the Eastern Himalayas.

Laser land leveling improves water productivity and helps in efficient use of nutrients (especially N). In irrigated rice-wheat systems of India, Laser land leveling has become a popular method for enhancing water-use efficiency (Jat et al., 2015; Aryal et al., 2015). According to Aryal et al., (2015a), Laser land leveling in rice fields reduced irrigation time by 47-69 h ha^{-1} $season^{-1}$ and in wheat fields by 10-12 h ha^{-1} $season^{-1}$. Techniques such as Leaf Color Chart helps in better management of fertilizers. Use of Happy Seeder/Supper seeder in the rice-wheat cropping system instead of burning, helps in the better management/incorporation of rice crop residues. It supports timely wheat sowing while enhancing soil fertility and reducing GHGs emissions.

Green manuring and promotion of legume crops, improve soil fertility and use of crops residues as a mulch result in water savings, moderate's crops canopy temperatures and improves soil health. Crops diversification have the potential to improve soil quality and productivity. Raised-bed planting systems and High-Efficiency Irrigation Systems (HEIS, significantly improve water productivity as compared to conventional planting. Studies show that these systems, improve yields up to 30-40% in case of different crops like cotton, wheat and fruits and also reduce irrigation costs up to 20-30%. These systems also minimize water logging and salinity problems. Kumar (2016), reported that application of a micro-irrigation system (Sprinkler and Drip) can help to save water from 12 to 84%, depending on location and crops. In India, HD CSW 18, first wheat variety, specifically bred for Conservation Agriculture (CA), and suited for early sowing (mid-October) has been released for NCR, which matures in 150 days and has average yield of 6.0 $Mgha^{-1}$.

4. Constraints in the promotion of RCTs in South Asia

4.1. Technical constraints

Technical limits for resource conservation technologies (RCTs) for promotion in South Asia include a shortage of skilled labor and low farmer awareness about Resource Conservation Agriculture (RCA) related machinery. Key barriers include low machinery quality, equipment shortage, high costs, poor maintenance, access, and a lack of local research for resource conservation technologies across diverse cropping systems of a country.

4.2. Machinery related issues

The key challenges facing RCTs related machinery include, equipment unreliability, market scarcity, high acquisition costs, components and spare parts deficits, and deficits after sales maintenance.

4.3. Limited location specific research

Gaps in regional trials across diverse cropping systems and agro-ecologies limit the large-scale promotion of RCTs in SAARC Member States, which is a hurdle in the promotion of different types of RCTs on large scale in this region.

4.4. Lack of Knowledge

Inadequate stakeholder coordination, limited farmers awareness of Conservation Agriculture and misplaced promotion of unsuitable Resource Conservation Technologies severely hinder large-scale adoption across South Asia.

4.5. Socio-economic issues

Adopting Resource Conservation Technologies (RCTs) faces major socio-economic hurdles. These include small land sizes, absentee landlords, poor farmer awareness, high machinery costs, and financial limits for smallholders. Farmers are also reluctant to change due to traditional habits, while a lack of technical training for workers slows progress.

4.6. Inadequate financing

Financial barriers to promote Resource Conservation Technologies (RCTs) in South Asian countries stem from weak institutional backing. Chief constraints include inadequate public subsidies for adaption, insufficient financial incentives to purchase specialized conservation machinery, and an overall lack of fiscal support to ease the transition toward sustainable farming practices.

4.7. Inappropriate policy support

A major barrier of scaling up resource conservation technologies (RCTs), in South Asia is the lack of robust government policy support.

5. Recommendations for the promotion of Resource Conservation Technologies (RCTs) in South Asia

5.1. Research and Development on Resource Conserving technologies

Encouragement of SAARC Member States, and their research institutions to conduct continuous, region-wide studies on resource conservation technologies across diverse cropping systems and ecologies.

5.2. Human Resource Development

Strengthening of Resource Conservation Technologies (RCTs) need farmers training, researchers and extension workers capacity building and collaboration of national-international partnerships.

5.3. Awareness about Resource Conserving technologies

- Private sector, NGOs and INGOs drive large-scale RCT promotion through stratagic advocacy and vital financial support.
- Raising public awareness through large -scale demonstrations about the benefits of Resource Conservation Technologies (RCTs).

5.4. Policy Support

- Mainstreaming and promotion of RCTs in the different agriculture development programmes and plans by the governments of SAARC Member States.
- Development of carbon credit policies to promote conservation agriculture, approve regulations for sustainable soil and water use, and ban crop residue burning.
- Government needs to support local manufacturers financially, reduce custom duties on imported RCT machinery, setup customer hiring centres, and service providers and promotion of public-private partnerships.
- Provision of subsidy and soft loans to the farmers for the purchase of RCTs related machinery.
- Trainings of the farmers, agriculture extension personnel, and agriculture related dealers on Conservation Agriculture and Resource Conservation Technologies.

5.5. Regional Cooperation on promotion of Resource Conserving technologies

- Development/Declaration of a centre, as a Regional Centre of Excellence on Conservation Agriculture (CA) for promotion of RCTs on large scale in the South Asia.
- Development of a regional project for research and promotion of RCTs and development of a regional unified policy on soil health improvement, crop management under changing climate conditions.
- Capacity building of stakeholders including scientists, extension personnel, and farmers on Conservation Agriculture (CA), and Resource Conservation Technologies alongside policy-makers exposure visits to ongoing research and development initiatives across SAARC Member States.

Conclusion

Resource Conservation Technologies boost crops yields, enrich soil health, save water and inputs for sustainable farming. RCTs cut GHGs emission, save time and lower cost of production. Limited policy support, financial constraints, small land holdings, and a shortage of machinery and skilled labor-compounded by low awareness restrict the adoption of Resource Conservation Technologies across South Asia. Promotion of Resource Conservation Technologies across South Asia requires robust governments policies, farmers financial support, availability of proper machinery, skilled labor, financial support to the local manufacturers, capacity building of extension personnel, service providers and farmers, awareness among the farming community about the benefits of RCTs, and strong public private partnerships.

References

Aryal, J.P., Mehrotra, M.B., Jat, M.L., and Sidhu, H.S. (2015). Impacts of laser land levelling in rice-wheat systems of the north-wetern Indo-gangetic plains of India. Food Security, 7:725-738.

Bhandari, H, Meah, N. (2021). Strengthen the multi-dimensionality of family farming to promote social innovations contributing to territorial development and food systems that safeguard biodiversity, environment and culture in South Asia (Pillar 7). In: Shrestha RB, et al. (eds). UN decade of family farming 2019-2028: Regional action plan to implement the UNDFF for achieving the SDGs in South Asia. Dhaka (Bangladesh): SAARC Agriculture Centre. Chapter 14:195-209.

Chakraborty, D., Ladha, J.K., Rana, D.S., Jat, M.L., Gathala, M.K., Yadav, S., Rao, A.N., Ramesha, M.S. and Raman, A. (2017). A global analysis of alternative tillage and crop establishment practices for economically and environmentally efficient rice production. Nature Scientific Reports 7: 9342.

Grace, P.R., Harrington, L., Jain, M. and Robertson, G.P. (2003). Long-term sustainability of the tropical and subtropical rice-wheat system: An environmental perspective Issues and Impacts (improvingthepro): Improving the productivity and sustainability of rice - wheat systems. pp. 27 - 43.

Hobbs, P. R., Gupta, R. (2003). Rice - Wheat Cropping Systems in the Indo - Gangetic plains: Issues of water productivity in relation to new resource conservation technologies. In Kijne JW, Barker, R., Molden, D (eds), Water productivity in Agriculture: Limits and Opportunity for improvement. CABI Publishing in association with International Water Management Institute, pp.239-253.

Hobbs, P. R., Sayre, K., & Gupta, R. (2008). The role of conservation agriculture in sustainable agriculture. Philosophical Transactions of the Royal Society B: Biological Sciences.

Jat, M.L., Gathala. M.K., Ladha. J.K., Saharawat, Y.S., Jat, A.S., Kumar, V., Sharma, S.K., Kumar, V. and Gupta, Raj K. (2009). Evaluation of precision land leveling and double zero-till systems in the rice–wheat rotation: Water use, productivity, profitability and soil physical properties. Soil Till. Res., 105: 112-121.

Jat, Ml., Singh, Yadvinder-Singh., Gill, G., Sidhu, H.S., Aryal, J.P., Stirling, C.M., Gerard, B. (2015). Laser assisted precision land leveling: Impacts in irrigated intensive in irrigated intensive production systems of South Asia. In book: Soil - Specific Farming. Precision Agriculture (pp.323-352). Chapter 13. Publisher.CRC Press Taylor and Francis Group. DOI: 10.1201/b 18759-14.

Kumar, M.D. (2016). Water saving and yield enhancing micro irrigation technologies in India: Theory and practice. In Micro Irrigation Systems in India (pp.13-36. Berlin: Springer.

Singh Yadav Gulab, Subhash Babu, Anup Das, M. Datta, K.P. Mohapatra, Raghavendra Singh, Vinod K. Singh, S.S. Rathore, Mandakranta Chakraborty. (2021). Productivity, soil health, and carbon management index of Indian Himalayan intensified maize - based cropping systems under live mulch - based conservation tillage practices. Field Crops Research 264 (2021) 108080.

Authors

Sikander Khan Tanveer
Senior Program Specialist (Crops), SAARC Agriculture Centre, BARC Complex, Dhaka, Bangladesh

Md. Harunur Rashid
Director, SAARC Agriculture Centre, BARC Complex, Dhaka, Bangladesh

SAARC Agriculture Centre (SAC)
BARC Complex, Farmgate, Dhaka-1215, Bangladesh
Email: director@sac.org.bd | Website: www.sac.org.bd | Phone: 880-2-41024776, +880-2-4102779