Enhancing Water Productivity Through Use of Resource Conservation Technology

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Introduction

Water is a key component of agricultural production. Water scarcities can decrease production and adversely affect food security. Only 19% of agricultural land cultivated through irrigation supplies 40% of the world's food. Water for agriculture is critical for future food security. Increasing demand of water by non-agricultural uses and concerns for environmental quality have put irrigation water demand under greater scrutiny and threatened food security.Climate change could contribute to higher temperatures and evapotranspiration and lower precipitation. This will put additional pressure to draw irrigation water from already overexploited aquifers, where the rate of water recharge is lower than the withdrawal rates. These and other water issues exacerbated by climate change present a serious concern because, on average, irrigated system yields are frequently double those of non-irrigated systems. The yields of non-irrigated systems could also reduce due to these stresses.

Improving the productivity of irrigation water is increasing importance in many developing countries, especially in Asia, where irrigated crop production accounts for a major portion of strategic food supplies for ensuring food security. The water resources available for irrigation are becoming more fragile, especially with respect to increase in soil salinity from poor irrigation management. The use of a conservation agriculture (CA)-based resource conserving technologies RCTs)-zero tillage, furrow irrigated raised bed and direct seeded rice has tremendous potential in significant saving in irrigation for a wide spectrum of crops, over traditional seeding on the flat with flood irrigation.

CA involves integration of minimal soil disturbance, residue retention and sensible/profitable cropping /farming system. CA based RCTs options optimize the natural resources and inputs for the sustainability of the system, enhances water productivity and crop diversification. It includes direct seeded rice, surface seeding, unpuddled planted rice, zero tillage, bed planting which saves costly inputs (labour, water, seeds, fertilizer, pesticides and fuel uses) and improves water productivity, profitability and system sustainability. Direct-seeded rice needs only 34% of the total labour requirement and saves 15% water and 29% of total cost of the transplanted crop. Farmer's participatory on –farm evaluation have shown positive response towards direct seeded rice on account of cost saving i.e. Rs. 2400-3000 ha-1, water and seed saving and early maturity of the crop. Important factors that are forcing a shift from the traditional puddled-transplanting system to unpuddled direct seeded zero till rice are shortages of labour & water and escalating fuel prices. In wheat, Zero tillage (ZT) reduces irrigation requirements compared with conventional-tillage by using residual water more effectively. In furrow-irrigated raised bed planting systems (FIRB), crops are grown on the raised beds and furrows are used for irrigation. This technology provides farmers with an opportunity for crop intensification and diversification with substantial saving in irrigation water. In FIRB system, there is water saving of 30-40% compared to conventional practice. Permanent bed planting system increased the rice yield by 33 % and 60% in wheat along with reduction in the cultivation cost by 26 % for rice and 24 % for wheat compared with conventional farmer's practice. It also improved water and fertilizer use efficiency by 20-25 percent and reduced the total production cost by nearly 30 percent in RW system.

Why Conservation Agriculture (CA) ?

- To stabilize/ reverse widespread soil and water degradation.
- To enhance water productivity for agro-ecosystem.
- To minimize environmental pollution through reducing machinery used in various tillage operations which results in less GHG's emission.
- Reducing production cost by minimizing labour requirement, machinery used, less input needed and saves time, fuel and water.
- Improve farm family livelihood by increasing net farm profit and thus raising their living standard, nutritional and socio-economic status.

Zero Tillage (ZT) in India

In India, research on zero tillage (ZT) for wheat started almost three decades ago. Several state agricultural universities tried ZT in the 1970s but their efforts failed due to technical difficulties such as the lack of adequate planting equipment and the difficulty in controlling the weeds chemically. ZT technology is now turning into a great success story and looks set to become as one of the best technologies after green revolution. ZT in cereal systems have helped in saving fuel, water, reduce cost of production; improve system productivity and soil health (Saharawat *et al*. 2010). In zero till system, residues when retained on the soil surface, serve as physical barrier for emergence of weeds, moderate the soil temperature, conserve soil moisture, add organic matter and improve the nutrient-water interactions. The innovation of ZT devices advances the wheat sowing 15 to 20 days and also cuts the production cost of wheat in rice-wheat cropping system. Farmers adopting zero-tillage can saves Rs 2000 to 2500 per hectare compared to conventional tillage, which can make savings and stabilize profits for farming community (Singh *et al.* 2007). Crop residue and cover crops if integrated along with ZT reduces weed germination and emergence by altering the soil temperature, release of the phytoto-toxins, soil pH and sun light (intensity and quality).

Table 1. Zero-Till Coverage Area Under Different States In India (2009-10)

State	Area Under Zero-Till (ha)	Coverage (%)
Punjab	3,54,324	46.6
Haryana	2,60,020	34.2
Eastern Uttar Pradesh	662	0.08
Bihar	45,800	6.01
Andhra Pradesh	1,00,000	13.1
Tamil Nadu/Karnataka	40	0.005
Total	760846	100

Major constraints in adoption of CA

Some reasons for limited CA adoption that were preliminarily indentified are :

- **Mindset** – Changing mind set of farmers is one of the constraints in adoption of CA, they lack knowledge and experience about this new production system.
- **Technological challenges** – Due to unavailability of appropriate machinery and equipments and its easy accessibility farmers are unable to transform their farm from conventional to conservation agriculture.
- **Mixed farming**- It is widely practiced by most of the farmers in India which involves widespread integration of crop and livestock as a result of which crop residue/ straw is utilized as fodder to feed

animals or as a fuel for cooking purpose.

- **Lack of research and government policies**- No blueprints or scientific database are available on CA due to lack of extensive research and no effective govt. policies has been formulated so far for encouraging its adoption.
- **Long term benefits**- CA practices gives higher yield by minimizing production cost meanwhile conserving the natural resources in after certain years only but farmers need immediate bene fits in short period of time.
- **Financial constraints to farmers**- Most of farmers are small and marginal, they lack financial support and credit facilities for purchasing machinery and equipments needed in CA.

The difficulties impede, slow down or even reverse the process of CA adoption. Hence, more enabling policy and institutional environments are needed to promote and sustain development and adoption of CA.

Steps to Address These Constraints/ Challenges

Successful adoption of conservation technologies call for greatly accelerated effort in development of suitable machinery along with water, nutrient and weed management techniques for a wide range of crops and cropping system. Government should make a firm and sustained commitment to encourage and support CA, expressed in terms of effective and favorable policies which are mutually reinforcing across the spectrum of government responsibilities, including the main-streaming of CA in public advisory, research and educational services and sufficiently flexible to accommodate variability in local ecological and socio-economic characteristics. Financial and structural assistance to farmers can be justified by recognition of the public good value of environmental and socio-economic benefits generated by CA. Major responsibility to overcome these challenges rely on extension department to conduct wide scale field demonstrations and trail in order to create awareness and knowledge among farmers about CA. Technology should be provided in a comprehensive mode i.e. complete package of practices should be provided to farmers from seed sowing till harvesting of crop.

Conclusion

CA practices have been found to improve crop productivity, soil health *vis a vis* conserving natural resources. However, a great challenge lies for its expansion in large areas. Therefore, focused research, favorable policies and change in mindset of practitioners is required to harness the benefits of conservation agriculture. The adoption of CA is need of the hour to enhance system productivity and profitability while conserving natural resources. CA therefore offers high potential economic, environmental, and social gains in the Indo-Gangetic Plains (IGP). This implies moving beyond mere production cost savings to natural resource savings and using CA as a stepping-stone in Indian agriculture.

References

Saharawat Y. S., Singh B., Malik R. K. and Kumar V. 2010. Evaluation of alternative tillage and crop establishment methods in a rice-wheat rotation in north westerns IGP. Field Crop Research 116 : 262-267.

Singh M., Chandurkar P. S. and Kumar A. 2007. Weed management in rice based zero tilled sown wheat. *Pakistan Journal of Weed Science Research* 13 (3&4):183-189