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Methodologies for Application of Resource Conservation Technologies (RCTs)

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SUMMARY

This study has evaluated the advantage of resource conservation technologies (RCTs) over established methods of cultivation and has identified the factors impelling adoption of these technologies. The study has emphasised superiority of RCTs over the conventional practices in terms of cost saving and efficient inputs-use. However, there is a need to internalize the RCTs in their totality by applying plans and strategies based on local dynamics.

INTRODUCTION

This article discusses some of the RCTs on surface level. The RCTs primarily focus on resource savings through minimal tillage, ensuring soil nutrients and moisture conservation through crop residues and growth of cover crops, and adoption of spatial and temporal crop sequencing. These pro-sustainable technologies and the practices therein have long been practised by the farmers in the Indo-Gangetic Plains but got eroded in recent times. With squeezing net returns and increasing threats of sustainability, the viability of rice-wheat farming is looming large. These issues are being discussed and concerns are being raised by the planners and policy makers. Considerable efforts are being made to popularize and increase the adoption of RCTs in the region. In the absence of specific information, however, the policies and efforts are inadequate and ineffective to achieve the desired results in this direction.

Factor Affecting in Adoption of RCT

- Knowledge gap-The farmer does not know how to use the instruments due to their complexity.
- Value-based farming- An organic farmer is an organic farmer based on ideology. There are opportunistic organic farmers who are there to make use of the great margins. But, ideology of the "planet-saving" aspects of organic farming are being emphasised.
- Tradition and inertia- I lumped these two together because they are fairly related. Changing the farming practice involves learning new skills, acquiring new equipment, loss of use of expensive equipment and a significant risk to the business.
- The innovation is not addressing shared problem- Some innovations are innovations looking for application in their potential targets. The farmer does not share the vision. Most of the innovations are emphasising non-target problems.

Why RCT is Important

At present, the challenge for agricultural scientists is to increase food production to meet food security needs of ever-growing population of world. However, such production increases must be accomplished sustainably, by minimizing negative environmental effects and, equally important, providing increased income to help improve the livelihoods of those employed in agricultural production. There are several key issues in this equation on which there is not unanimous consensus. The demand for food is still increasing, not only to meet food security for a growing population, but to provide nutritional security as well. Most of the sources of productivity growth such as improved varieties, fertilizer, and water used in the last 54 Green Revolution years are already being exploited. Future sources of productivity growth will be more complex and harder to find. To maintain ecological balance for supporting life and to make the resources available for present and future generation Competition for surface and groundwater resources will be more severe as domestic and industrial needs will compete for it. Fossil fuels will be more costly, adding to production costs directly as well as indirectly. GHGs will increase with subsequent effects on climate, especially an increase in severe climatic events such as drought, floods, etc. This will make the challenge more difficult and complex. One obvious way to accomplish

this sustainable food production objective is to make more efficient use of the natural resources that are needed to produce food; this includes soils, water, air, inputs and people.

Various Kinds of Methodologies for Application of RCT

Laser Land Levelling

It is a precursor technology for adopting conservation agricultural practices. It was introduced for first time in India at farm level in western Uttar Pradesh during 2001. It alters fields having a constant slope of 0 to 0.2% using laser equipped drags buckets, which allows the land surface smoothening within 2 mm from its average elevation. Helping in saving of irrigation water upto 20% and improves N-use efficiency under surface irrigation. There is 3-4 % increase in the net area owing to fewer requirements of bunds and channels. All these factors lead to increase in yield. The laser land levelling saves water by 25-30%, improves yields by 5-15% with other associated benefits. It increases yields of direct-seeded and transplanted rice by 6% and 12%, respectively, and results in average water saving in these two rice cultures by 9.5 and 6.6%, respectively compared to traditional land levelling.

Conservation Tillage (Zero/Minimal Tillage)

Conservation tillage is a collective umbrella term, commonly given to zero-tillage, direct-drilling, minimum-tillage and ridge-tillage to denote that specific practice fulfils some resources conservation objective. Usually, the retention of residues for covering at least 30% of the soil surface characterizes the lower limit of classification for conservation tillage, but other conservation objective of these practices includes conservation of time, fuel, soil biota (earthworms, micro-organisms), soil water, structure and nutrients, labour, energy and farm chemicals. Zero tillage was first started in 1980s in India. It was promoted by Imperial Chemical Industries (ICI, U.K.) to promote paraquat a non-selective contact herbicide, for controlling weeds including Phalaris minor in zero-till (ZT) wheat.

In zero-tillage, soil is not ploughed, but sowing of crop is done by using a specially designed seed drill. Soil gets less disturbed, when sowing is done. At the time of seeding, fertilizers can be simultaneously placed beneath the seeds. This technology proved better for direct-seeded rice (DSR). maize, cluster bean, mungbean, pearl millet, wheat, chickpea, rapeseed-mustard soybean, and lentil.

The major benefits of zero-till technology include

- Reduced costs owing to savings in fuel and labour.
- Timely planting of crops, resulting in higher yields,
- Reduced weed density.
- Saving of irrigation water up to 15-20%,
- Improved input-use efficiency and
- Build-up in soil organic carbon owing to reduced burning of crop residue.

Sowing of wheat with traditional method requires 7-8 days in field preparation after late harvesting of paddy, especially long-duration basmati rice that delays sowing of wheat resulting in decrease in yield. Wheat sowing after rice can be advanced by 7-10 days by adopting this technique, and wheat yield losses caused by late sowing can be avoided. Zero tillage in cereal systems has helped to save fuel and water, reduce cost of production, improve system productivity and soil health.

Bed Planting (Narrow/Broad)

In bed planting, crops are grown on the raised beds alternated by furrows. Beds are usually made at 0.6-1.0 m wide, and 2-3 rows of crops are sown on the beds and irrigation water is applied in the furrows. The beds

could be narrow (0.6-0.7 m width) or broad (1.2-1.4 m width). First time these beds are made after tilling the soil, and the same beds may be used for subsequent years, but little reshaping of the beds are required once in a year, preferably before rainy season (kharif) crops grown. Bed planting provides opportunity for crop diversification through intensification and more efficient use of water under rainfed as well as irrigated conditions because of optimum water storage and safe disposal of excess water. It saves seed, nutrients, energy and water.

Happy Seeder Technology

Happy Seeder (HS) or Turbo Happy Seeder (THS) is a tractor-operated machine developed by the Punjab Agri University (PAU) in collaboration with Australian Centre for International Agri Research (ACIAR), It is used for in-situ management of paddy stubble (straw), While it was developed in 2002, the PAU officially recommended it to farmers in 2005-06 and it made to the markets in 2006. Currently, it costs around Rs 1.50 to 1,60 lakh and is manufactured by different companies. The agriculture department gives 80 per cent subsidy to farmer groups and 50 per cent subsidy to individual farmers. After harvesting the paddy field using a combined harvester fitted with Super-SMS (Straw Management System) equipment. These chops and evenly spreads the stubble in the field farmers can directly sow wheat seeds using Happy Seeder with the stubble's organic value adding to the soil.

Brown Manuring with Sesbania

In brown manuring, both rice and Sesbania are sown together and allowed days Rice is sown in lines with a seed drill and Sesbania is broadcast on the moist soil. Sesbania grow for 25-30 plants are knocked down with 2,4-D ethyl ester @0.25-0.50 kg/ha or Bispyribac Na @20-25 g/ha (Fig. 11). Bispyribac-Na is a broad-spectrum herbicide and a better option, which can reduce cost of weed control. Sesbania while growing with rice smothers weeds, reduces herbicide use and irrigation water, and supplies 15-20 kg N/ ha with fresh facilitates better biomass of 10-12 t/ha. Its emergence of rice where soil usually forms crust, conserves moisture with brown mulch, improves soil C content and increases farmers' income. Studies at the IARI. New Delhi have shown that direct-seeded rice with brown manuring zero-till wheat + residue system gives higher system p rice productivity rice-conventional wheat system. This practice can be followed in crops like maize, pearl millet, sorghum. In broad-leaved Props like soybean, 2,4-D cannot be used, but Sesbania can be cut manually and spread as mulch between crop rows for controlling weeds, and conservation of moisture and nutrients.

Leaf Color Chart

It is an easy-to-use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant N status The LCC had been jointly developed by International Rice Research Institute (IRRI) and Philippines Rice Research Institute (PhilRice) from a Japanese prototype, for the purpose of measuring the required quantity of nitrogen to be applied in Rice field and thereby to get a maximum productivity. The LCC is also suitable for maize & wheat providing farmers with a good diagnostic tool for detecting N deficiency The LCCs relevant to use for Sugarcane, Potato, Cotton, Cassava, Vegetables, Mustard, Oilpalm etc. are under Research and Development in order to maximize the yield of these crops.

It is an innovative cost-effective tool for real-time or crop-need-based N management in Rice, Maize and Wheat. LCC is a visual and subjective indicator of plant nitrogen deficiency and is an inexpensive, easy to use and simple alternative to chlorophyll meter /SPAD meter (soil plant analysis development). It measures leaf color intensity that is related to leaf N status. LCC is an ideal tool to optimize N use in Rice/Maize/Wheat at high yield levels, irrespective of the source of N applied, viz., organic manure, biologically foxed N. or chemical fertilizers. Thus, it is an eco-friendly tool in the hands of farmers.

Green Seeker

The Green Seeker crop sensing system is a variable rate application and crop vigour mapping system that offers a more efficient and precise way to manage crop inputs such as nitrogen. The system verifies in real-time the amount of nitrogen the soil has made available using complex agronomic calculations called NDVI. The Green Seeker system then determines a fertilizer prescription for instant application so that you are applying the right amount of nutrients needed by the plant at the right time.

System of Rice Intensification

The System of Rice Intensification, known as SRI -- le Système de Riziculture Intensive in French and la Sistema Intensivo de Cultivo Arrocero (SICA) in Spanish -- is a climate-smart, agroecological methodology for increasing the productivity of rice and more recently other crops by changing the management of plants, soil, water and nutrients.

SRI methodology is based on four main principles that interact with each other:

- Early, quick and healthy plant establishment
- Reduced plant density
- Improved soil conditions through enrichment with organic matter
- Reduced and controlled water application

Based on these principles, farmers can adapt recommended SRI practices to respond to their agroecological and socioeconomic conditions. Adaptations are often undertaken to accommodate changing weather patterns, soil conditions, labour availability, water control, access to organic inputs, and the decision whether to practice fully organic agriculture or not.

Furrow Irrigated Raised Bed System

In bed planting systems, wheat or other crops are planted on the raised beds in ridge - furrow system. This system is often considered more appropriate for growing high value crops that are more sensitive to temporary water logging stress. Farmers often raise crops such as cotton, maize-soybean and wheat on the raised beds. However, the practice of growing rice, the major water-using crop in rice-wheat systems, on narrow raised beds was introduced only very recently in the Indo-Gangetic Plains (IGP) to reduce water use. Conserve rainwater and improve system productivity**.**

CONCLUSION

Thus, in conclusion said 'Resource Conservation Technologies' has clearly indicated the superiority of RCT over conventional practices in terms of cost saving and more efficient use of inputs. In order to enhance the productivity, profitability and sustainability of produce, the tillage technologies developed at the research farms need to be transferred and fine-tuned at farmer's field through on-farm participatory research. The study has suggested policy implications for equitable and sustainable growth in adoption of these technologies.

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