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More crop and income with less water under sustainable agriculture

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Water productivity through adoption of proven water management technologies varies from crop to crop and from technology to technology. But, the amount of data available from research on water use, yield and water productivity impacts of those technologies is heavily skewed depending upon systems, wherein more than 90 per cent of arable lands under irrigated agriculture covered with surface irrigation with little or no information on drip, sprinklers and sub-surface methods. The adoption of water saving technologies for sustainable crop production appears to be under threats of several constraints, induced by physical settings, socio-economic conditions and institutional and policy environments, on large-scale implementation of water-saving irrigation devices; and these constraints operate in different ways under different situations. The pre-impact on adoption of proven water management technologies in the farmers' plots were profound that reflected higher crop production compared to their traditional methods. The technologies generated increased the water use efficiency and prevented application losses due to conveyance wherein selection of crop(s) and crop sequence(s) also played a pertinent role for enhancement of water use efficiency through crop cultivation and related agronomic practices. Optimum scheduling of irrigation, suitable method of application, conjunctive use of rain, surface and ground water for crop cultivation using improved agro-technology and provision of drainage. Application of proper amount of water at proper time increased the water use efficiency and crop yield maximization with given amount of water reducing evaporation and deep percolation losses. Scheduling of irrigation with limited water availability was found a bigger challenge to the irrigation experts for proper utilization of water resources.

- **Zero/Minimal tillage :** Delayed monsoon caused *kharif* rice transplantation is usually severely affected the *rabi* cropping where the time didn't allow land preparation to keep pace with available residual soil moisture. Growing wheat/mustard/lentil/linseed like crops under such rice based crop sequences in lowland eco-system is thus, might be good proposition under zero/minimal tillage operation which not required any further time for land preparation while was fully recharged with moisture and optimal for seed germination. So sowing crops under minimal tillage/zero-tilled condition is better option for growing crops like wheat and mustard. Growing of these crops was made possible by zero-tilled seed drill machine in low land situation where sufficient residual soil moisture persists for seed germination.

  Results : Zero-tilled (ZT) wheat with three irrigations recorded the highest grain yield of 1900 kg/ha as compared to lowest grain yield of 1200 kg/ha. The mean of 18 farmers' yield was 1536 kg/ha. The conventional tillage (CT) recorded the highest grain yield of 2800 kg/ha and the lowest grain yield 2500 kg/ha with three irrigations. Conventional tillage in clay soil was not permitting crop growing due to drainage congestion made by irrigation. Irrigation applied particularly at CRI stage of wheat which resulted yellowing of leaf at early stage. Water use efficiency of ZT wheat was 8.30 to 11.60 kg/ha/mm with three irrigations CT with three irrigations that recorded the highest WUE of 12.20 kg/ha/mm. Farmers' acceptance for growing wheat under zero-tilled conditions was mainly attributed due to higher benefit cost ratio obtained than that of conventional tillage.

- **Use of Drum Seeder :** Drum seeding of wet rice was done during *kharif* season. Land situation was medium upland having good drainage after seeding. Shallow puddling was done for drum seeding in clay soil. One pass of power tiller followed by a bullock drawn country plough was used for puddling. Seeds were soaked for 24 hours and incubated for sprouting (0.5 cm). Philippines 12-row plastic drum seeder was used. Calibration of seed dropping was done through closing the excess whole by polythene tape. Performances of wet direct seeding (DR) was compared against transplanted rice (TR) and found remunerative and cost effective.

  Results : Performance of wet seeded rice in medium land situation of the command was good as compared to transplanted one. Rice yield increased to the tune of 22.8 and 14.7% in case of variety Ratna and IET 4094. Plant growth and yield parameters also supported the fact. Wet seeded rice matures one week earlier than transplanted one. Farmers are motivated to use the drum seeding in less rainfall areas for effective utilization of soil moisture wherein in high rainfall during July and August might cause a problem of plant emergence due to stagnation of water in the field after wet seeding of sprouted seeds. Hence, the drum seeding may be advocated as appropriate technology at less rainfall area as well as in upland conditions for judicious moisture utilization.

Prof. (Dr) A. ZAMAN specializes in Agricultural Water Management for enhancing crop and water productivity worked as Agronomist and presently acting as Dean, Faculty of Agriculture, in Bidhan Chandra Krishi Viswavidyalaya [SAU], West Bengal, India. He was former Director of Research and former Chief Scientist (Water Management) as well as Head, Department of Agronomy. He was former Head, Irrigation Expatriate Team led to Uganda (East Africa) from the Government of India (1994-1996). He has coordinated, associated and involved with under and post-graduate teaching programme and has significant research experiences in field of water management and in academia and well as having considerable administrative experiences in different capacity at various time frame. He is also designated as IFFCO-Chair Professor. He has more than 200 research papers published in the journal of national and international reputes in his credit and guided 7 Ph.D. students and more than 50 M. Sc. (Ag) in Agronomy students towards completion of their thesis work.