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Climate Resilient Rice based Agroforestry: A High Yielding, Water Efficient and Remunerative Option for South Asian Farmers

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Abstract—*Monsoon (Kharif) rice in South Asia is normally grown under rain-fed conditions and suffers from the vagaries of monsoonal rains. There is a huge uncertainty in the onset of monsoon as many times it is either preponed or postponed by up to two weeks. Such erratic behaviour in the onset of monsoon severely affects yields of rice and of the succeeding winter crops making farming an uneconomic enterprise. To adapt to such monsoonal patterns and grow rain fed rice without reducing yield, an on-station experiment was conducted with robust rice seedlings of various ages raised by integrating all factors of nursery management, termed as Climate Resilient Rice Production Technology (CRRPT), at the Red and Lateritic Zone of West Bengal, India, a region located in South Asia during 2015 and 2016. The CRRPT (with 25, 35, 45 and 55 day old seedlings), was compared with three existing rice production practices (direct-seeded rice using drum seeder (DSR Drum seeders), system of rice intensification (SRI), and conventional transplanting method)in terms of grain productivity and water use. Rice yield was not reduced when transplanted using CRRPT seedlings of 45 or 55 days old, and rather increased by 22% and 11 % respectively with CRRPT seedlings of 25 or35 day sold in comparison to conventional transplanting method with 35 days old seedlings. Water use was highest in DSR (2383 liters water Kg^{-1} of grain) followed by SRI (2087 liters) and conventional (2011 liters). The CRRPT with 35 to 55 days old seedlings was most water efficient using only 1601-1729 liters water to produce one Kg rice. The on-station experiment was then followed bythe on the on-farm evaluation of CRRPT in 120 farmers' fields in five districts of West Bengal during 2017 and 2018, in which CRRPT showed a net advantage of US$ 227 ha^{-1}, comprised of a ''yield effect'' of US$223 ha^{-1} and a ''cost-saving effect'' of US$3 ha^{-1}. Among the components of cost effects, saving on plant protection chemicals was the highest (US$28 ha^{-1}) followed by labour for seedling uprooting and transplanting (US$20 ha^{-1}) and seed (US$20 ha^{-1}). However, CRRPT required US$65 ha^{-1} more for labour used for harvesting and processing compared to conventional method. We conclude that the CRRPT with robust seedlings has potential to increase productivity, profitability and water use efficiency. The technology can help improve farmers' resilience to climatic change and variability, and hence could be recommended to rain fed rice farmers of South Asia.*

Keywords*: System for rice intensification, DSR Drum seeder, Water use, Nursery management, Robust seedlings, Economics.*