

## Permanent beds and rice-residue management for rice–wheat systems in the North West India

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### ABSTRACT

Rice–wheat (RW) cropping systems are critical for food security and livelihoods in South Asia. This is particularly so in India where 10 million hectares of rice and wheat are grown in sequence, providing 85% of the total cereal production and 60% of the total calorie intake. Over 150 million people are economically dependent on RW systems in South Asia. The area and productivity of RW systems across South Asia increased dramatically between the 1960s and the 1990s, with the rate of increase in production surpassing the rate of population increase. This Green Revolution was enabled by the introduction of nutrient-responsive improved varieties, rapid expansion of irrigation and favourable government policies. However, the sustainability of RW systems is now in question, as evidenced by many factors including yield stagnation or decline of rice or wheat across the RW systems of South Asia, soil degradation, declining groundwater levels, severe air pollution from rice stubble burning, and declining terms of trade. Around 2000 it was suggested by members of the Rice-Wheat Consortium of the Indo-Gangetic Plains, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, U.P., India and others that permanent raised beds could lead to increased productivity and resource use efficiency of RW systems. A system for retaining rice residues (instead of burning) was also dearly sought. RWC commissioned a large project. Permanent beds for irrigated rice–wheat and alternative cropping systems in north-west India and Indo-Gangetic Plain-to address these questions. The project involved collaboration between Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, RWC, CIMMYT, Mexico, IRRI, Philippines and Uttar Pradesh Diversified Agriculture Support Project (UPDASP), Lucknow. In the month of February 2004, the project team organised an international workshop at Islamabad, Pakistan, to bring together the experience and learnings of researchers working on permanent raised beds and rice-residue management for RW systems across the Indo-Gangetic Plain. The papers contained the work that was presented at the Pakistan workshop and the experience in permanent raised beds and direct drilling into rice residues for RW systems in the North West India. The papers also present important breakthroughs in the challenge of direct drilling wheat into rice stubbles, avoiding the need for burning and the associated air pollution and loss of organic matter and nutrients.

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### INTRODUCTION

The environmental sustainability of RW systems, let alone the ability to increase production in pace with population growth, are major concerns. Symptoms of environmental degradation, which vary depending on location, include declining soil organic matter content and nutrient availability and the emergence of multiple nutrient deficiencies; increasing soil salinisation; increasing weed, pest and pathogen populations; rapidly declining groundwater levels; and particulate and greenhouse gas air pollution from stubble burning (Gulati, 1999; Pingali and Shah, 1999; Byerlee *et al.*, 2003). One of the biggest

threats to sustaining and increasing the productivity of the RW systems of South Asia, especially in the north-western IGP, is water shortage. Groundwater levels are declining rapidly in north-western India (Pingali and Shah, 1999; Hira and Khera, 2000; Hira *et al.*, 2004) and water shortage during winter in Pakistan has been predicted to increase more than fourfold by 2017 (Qutab and Nasiruddin, 1994; Kahlown *et al.*, 2002). Lack of irrigation and drainage infrastructure is a major constraint to increasing production in the eastern IGP, where the ability to develop water resources for irrigation is economically limited. On top of this, the cost price squeeze of agricultural commodities has a serious impact on the

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