



*The Rice-Wheat Consortium for the Indo-Gangetic Plains*

## Highlights 2003-2004

THE INDO-GANGETIC PLAINS OF SOUTH ASIA IS A MAJOR FOOD-GRAIN PRODUCING REGION. Over 300 million people there depend largely on the rice-wheat cropping rotation. Satisfying the demands of an increasing population, preserving the agricultural resource base, and improving livelihoods are all huge challenges. The Rice-Wheat Consortium for the Indo-Gangetic Plains (RWC)<sup>1</sup> works to increase the productivity of rice-wheat systems in South Asia, thereby



conserving natural resources, improving livelihoods, and reducing poverty.

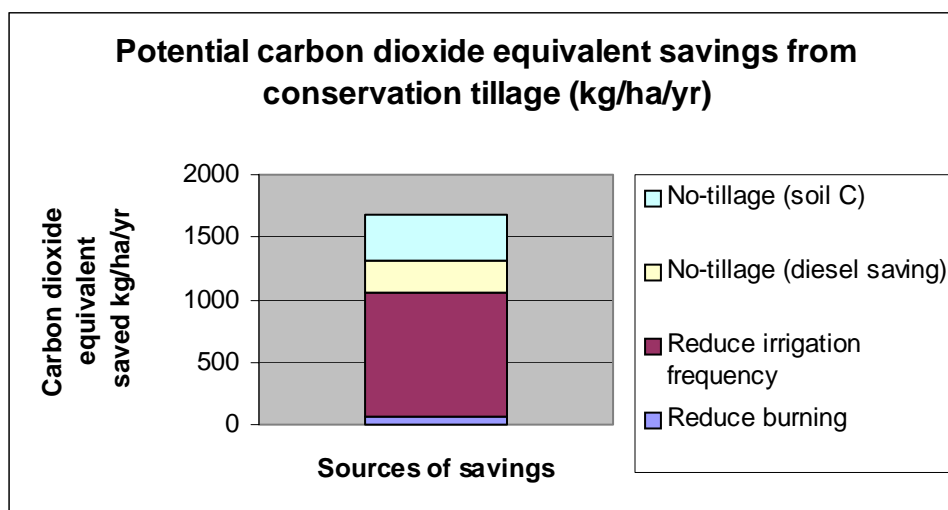
With RWC assistance, farmers on more than 1.5 million hectares (Table 1) have recently begun seeding their wheat crop directly into paddies after harvesting the rice, a practice known as zero-tillage. Sowing like this involves a single tractor pass, where previously 6-8 tillage operations were performed. Building on the success of zero-tillage, the Consortium is promoting a basket of practices improve productivity while saving water and other precious resources. Through the RWC, socioeconomists from national research programs are assessing the impacts of the practices discussed here on productivity, farmers' livelihoods and welfare, national food policy, and resource use efficiency regionwide. This document describes RWC efforts during 2003-04 and their impacts on farmers' lives.

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<sup>1</sup> The RWC is a partnership between the national agricultural research systems of Bangladesh, India, Nepal and Pakistan; several international centers of the CGIAR (CIMMYT, IRRI, ICRISAT, CIP and IWMI) and various advanced international institutions (Cornell University, Wis International and Info-Bridge Foundation in the Netherlands, Wageningen, IACR, Rothamsted, CABI-UK, and Melbourne University).

### Zero Tillage: Averting Dry Wells and Depleted Soils

Farmers are now in possession of more than 20,000 zero-tillage planters (up from only 4,000 in 2001) made by 68 manufacturers (compared to 32 in 2001). Adoption of zero-tillage could exceed several million hectares in a few years, as local manufacturers meet the demand for machinery, farmers share insights, and knowledge of the benefits spreads. Net benefits in India and Pakistan through higher yields and lower land preparation costs amounted to more than USD150 million in winter 2003 alone. Use of zero-tillage for wheat saves about 50 liters of diesel per hectare, representing a savings of 75 million liters, worth more than USD 37 million, regionwide. This and other features of zero-tillage help spare the release of huge amounts of CO<sub>2</sub>—more than 2 million tons per year, at current levels of adoption. Consortium studies on water balances at the farm and watercourse levels show that zero-tillage and sowing on raised soil beds—another beneficial practice described below—can save 10-18% irrigation water. This is equivalent to nearly 300-540 m<sup>3</sup>ha<sup>-1</sup>, water that could be available to increase productivity elsewhere. Animal drawn and light duty modular power tillers recently developed put zero-tillage within reach of the region's resource-poor farmers, even in the hilly terrains. Other resource conserving practices gaining favor include precision land leveling, paired row planting, partial residue retention, surface seeding, and planting high value crops in furrow irrigated-raised bed systems.



### Rewriting the Book on Rice Agriculture

Rice farmers traditionally "puddle" fields before planting, a costly tillage practice that obliterates soil structure and, over the long term, reduces productivity. "Zero-puddling" alternatives being promoted and tested by hundreds of farmers through the RWC include direct sowing of rice, either on unpuddled flats or raised beds using zero-tillage. The area of unpuddled rice has grown from nothing in 2001 to more than 500 hectares in 2003. Research backstopping for the new practice includes help in managing weeds and soil micronutrients, particularly iron and zinc.

## Cropping Diversification

Policy and productivity studies of the last decade suggest that South Asian farmers could enhance incomes and better manage soil and water by diversifying their cropping systems. The RWC is promoting this in various ways—including the addition of crops such as quality protein maize (QPM), sugarcane, pigeon pea and mung beans, chickpea, lentil, faba beans, potatoes, and vegetables. Improved varieties from CIMMYT, ICRISAT and AVRDC are finding favor with farmers, who have produced more than 150 tons of QPM, pigeon pea, mungbean and potato seed for local use and farmer-to-farmer exchanges. In Bihar, eastern Uttar Pradesh, and eastern Bangladesh, resource-poor, small-scale farmers are using zero-tillage to grow maize during the dry, winter season, sowing it with dibble sticks in the ridges of potato fields. Cropping on raised beds of soil greatly improves productivity and the efficiency of irrigation and weeding, as well as making it easier to grow a range of crops in monsoonal climates. When the same soil beds are used for several years under zero-tillage, the above-mentioned benefits and the time saved allow more diverse and intensive farming. It is possible, for example, to add a crop of mungbean to the rice-wheat rotation, or to intercrop peas, faba beans, or okra with maize, or wheat and Indian mustard with sugarcane, to name a few possibilities. Boro<sup>2</sup> rice, a traditional crop of the eastern IGP, is being promoted as an intercrop with maize, a system that can provide net annual incomes of as much as USD 1,700 per hectare. Participants have helped to relocate boro rice cultivation from flood-prone, low-lying areas to irrigated midlands and upland rice ecologies.

## Benefits of Better Land Use

Bring into full production large tracts of underused land could substantially improve local food supplies and enhance livelihoods. This is particularly true in the eastern Indo-Gangetic Plains following the main rice season. An RWC study employed satellite data and geographic information systems to measure the extent and distribution of underutilized land (fallows, areas of excessive moisture or salinity, and riverside areas) in eastern Uttar Pradesh. Such underutilized areas comprised over 70,000 hectares—more than a quarter of the district's cultivable land. In addition, under-productive, late-planted wheat and barley were found to cover at least 60% of the total wheat/ barley area. Earlier planting dates alone, achieved through zero-tillage, could easily increase district wheat production by as much as 75,000 tons per year. Other options for other parts of the district include zero-tillage, bed planting, surface seeding, and Boro rice. The RWC plans to conduct similar studies in other zones. The outcomes could benefit some of the region's poorest farmers.

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<sup>2</sup> The seedlings are started in November and the main fields planted in February with harvest in May. It is the highest yielding rice crop in rice systems of South Asia because of the cooler temperatures and high radiation receipts

<sup>5</sup> Tal lands low-lying depressions, usually connected with river systems, that remain flooded for greater part of the year. *Chaur lands* are not part of river systems; hence, stored water evaporates, deep percolates, or is used by farmers for surface irrigation in nearby fields. *Chaur lands* become available for planting in winter season. *Diara lands* are formed through deposition of alluvial sediments and are flooded for short times.

## **Fertility and Residue Management**

With help from IRRI staff, the RWC is promoting use of leaf color charts to help farmers apply nitrogen fertilizer at the right time and in the amounts really needed. The Consortium is also researching and promoting residue management and proper fertilizer placement practices, with the direct participation of farmers. Because of the difficulties of sowing directly into crop residues, many farmers burn their residues, heavily polluting local air for weeks on end and releasing large amounts of CO<sub>2</sub> in bursts. New double disk planters and punch planters can seed respectively into 4 or 7 tons of residue per hectare, and are being made available to farmers. Besides slowing CO<sub>2</sub> emissions and cutting pollution, the retention of residues helps control weeds, preserves soil moisture, improves soil structure, and enhances productivity by cooling soil and the air surrounding the crop and by helping the plant make better use of nutrients like nitrogen, phosphorus and potash. Inter-cropping of green manure crops with rice is also being tested, to promote green manuring without need for additional supplies of irrigation water during peak summers.

## **Improving Poor Farmers' Livelihoods**

Many resource-poor and flood-prone farmers, having plots in low-lying areas, have traditionally practiced rice-fallow or fallow-boro rice/legume rotations. In zero-till mixed cropping systems, several crops such as (mungbean+ rice+ sesame+ maize+ sesbania) are seeded in fixed rows or are surface broadcasted. Notwithstanding the timings, intensity, or duration of floods, the system ensures farmers' incomes on the order of USD 350/ha/season. Use of zero-tillage and high-yielding varieties of lentils and chickpea has reduced seeding rates by 70-80 kg/ha, improving yields and net returns by US\$ 100/ha.

## **Analysis of Impacts**

RWC supported socioeconomists are conducting cross-border comparisons on benefits and impacts for the practices described above. Key aims are to (1) document the diffusion of resource-conserving technologies in South Asia; (2) analyze the technical, economic, social, and institutional factors that affect the farm-level decision to adopt these practices; and (3) assess impacts on national policies, the quality of the resource base, farm-level profitability, and the distribution of benefits.

## **New Participants and Products**

The RWC continued to expand its membership under the coordination of CIMMYT and the Consortium's Facilitation Unit. The RWC has also developed a web page [<http://www.rwc-prism.cgiar.org/rwc/index.asp>] that lists major news items, contains many RWC or related publications, and has links to other sites of relevance. National partners are also working with CIMMYT in the development and distribution of CD-based country "Almanacs" that put GIS data

and power at the fingertips of all RWC partners and stakeholders. New research information and RWC events are shared through Rice Wheat Information Sheet (RWIS).

Newly developed tillage and planting equipment has been exchanged among RWC participants in Nepal, Pakistan, Uzbekistan and Philippines. With assistance from IRRI and CIMMYT, national partners of the RWC have developed (1) a precision laser land leveling system, and (2) prototypes of zero-tillage planting implements that can be drawn by the two-wheel and four wheel tractors used by smallholder farmers. Wheat farmers region-wide have experimented with the prototypes.

### **RWC Support**

Over the years a consortium of generous partners has supported the RWC, including the following:

- The Asian Development Bank (ADB).
- The Directorate General, International Cooperation of the Government of the Netherlands (DGIS).
- The CGIAR Finance Committee (support obtained with help from the World Bank).
- The Australian Centre for International Agricultural Research (ACIAR).
- The Department for International Development, UK (DFID).
- The International Fund for Agricultural Development (IFAD).
- The United States Agency for International Development (USAID).
- The New Zealand project is funded by NZODA and is in collaboration with Massey University.

National research systems of the participating countries have also provided funding and significant in-kind support for RWC activities, and international centers like CIMMYT and IRRI have drawn on their own unrestricted funds to ensure that work goes forward.

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### The adoption of resource-conserving practices in South Asia, 2001-04.

	Districts			Area (ha) coverage			Number of farmers@		
	2001	2002	2003	2001	2002	2003	2001	2002	2003
<b>Zero-tillage</b>									
Uttar Pradesh (W)	11	22	22	11,800	40,900	175,000	7,300	16,500	50,000
UP, Uttra.& HP	16	18	22	820	4,270	60,000	700	3,200	36,000
Bihar	8	10	18	380	1,000	18,000	1,000	1,700	6,000
Haryana	10	10	12	97,166	275,000	350,000	15,000	52,000	70,000
Punjab India	8	13	14	20,000	50,000	2,150,000	3,000	8,000	46,700
Pakistan Punjab	16	16	16	78,408	189,980	335,000	10,281	26,574	47,900
Pakistan Sind/	2	3	3	132	397	1,100	11	32	100
Nepal	6	6	6	32	76	2,100	35	70	1,500
Bangladesh	3	3	-	4	10	10	5	10	10
<b>Total</b>	<b>80</b>	<b>101</b>	<b>113</b>	<b>208,742</b>	<b>561,033</b>	<b>1,156,210</b>	<b>37,332</b>	<b>107,686</b>	<b>258,210</b>
<b>2-wheel HT</b>									
Nepal Tarai	6	-	NR	120	-	NR	NR	100	NR
Bangladesh	10	NR	NR	363	NR	500	NR	150	NR
<b>Total</b>	<b>16</b>			<b>483</b>				<b>250</b>	
<b>Bed Planting</b>									
Uttar Pradesh (W)	11	16		1,330	2,840*	20,000	200	780	8,000
Uttar Pradesh (E)	16	16		50	126	100+	10	34	50
Bihar	1	2	3	4	125*	50+ 200P	10	125	150
Haryana	11	11		1,000	400	1,000	50	35	100
Punjab India	12	12		1,000	1,700	10,800	50	73	250+
Pakistan Punjab	9	9	9	1,312	1,750	2,800	64	80	160
Nepal	3	3		5	27	-	8	21	-
Bangladesh	3	3	3	5	25	50	5	23	50
<b>Total</b>	<b>73</b>	<b>78</b>		<b>4,706</b>	<b>6,993</b>	<b>35,000</b>	<b>397</b>	<b>1,171</b>	
<b>Surface seeding</b>									
Bangladesh	5	5		10,000 <sup>3</sup>	10,000 <sup>4</sup>	NR	30,000	30,000	NR
Nepal	4	2		223	457	NR	132	262	NR
Eastern India	3	4		500	560	20,000	1,000	1,050	-
<b>Total</b>	<b>12</b>	<b>11</b>		<b>10,723</b>	<b>11,117</b>	<b>20,000</b>	<b>31,132</b>	<b>31,312</b>	

<sup>3</sup> Frequency depends on seeding conditions; estimates of last WRC survey indicated up to 10,000 ha when conditions were favorable. \* Area under intercropped and vegetable crops. @ - estimated area.

<sup>4</sup> Frequency depends on seeding conditions; estimates of last WRC survey indicated up to 10,000 ha when conditions were favorable.