Rice-wheat cropping system

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The rice-wheat belt is home to more than 600 million people in South Asia. It is estimated by FAO experts that approximately 240 million people consume rice and/or wheat produced in the rice-wheat cropping system, under which farmers grow rice in the monsoon (*kharif*) season followed by wheat in winter (*rabi*) season. Nearly 12 million hectares (ha) in South Asia, in large areas of Pakistan, northern India, Nepal and Bangladesh are cultivated in this manner. China has an additional 10 million ha.

In Pakistan the area under rice cultivation is 2.4 million ha, nearly 62 per cent of which is located in Punjab. On a major part of this rice hectarage, rice-wheat system is followed. Again, of the total rice area in the country, 50 per cent is under fine rice varieties. Likewise, 78 per cent of the total rice hectarage of Punjab — the largest rice growing province in the country — also is under fine rice varieties. Although the average yield of fine rice (Basmati) is about 89 per cent lower than the coarse variety (IRRI) the farmers, especially in Punjab, prefer to grow fine rice despite its lower yield and longer growing period due to its high market value. As a result, of the total fine rice grown in the country, nearly 96 per cent is cultivated in the Punjab province.

Due to late maturity of fine rice, the sowing of the subsequent wheat crops is often delayed, which continues in December against its optimum planting time of October 20 to November 20 in Punjab. Within this timespan, planting it during the first half of November is the best sowing time. Planting of wheat after the third week of November onwards results in the reduction of yield by 35 kg/ha for each successive delay of one day. Similarly, where an additional short duration crop is taken up after the early maturing rice before planting wheat, this results in delayed sowing and consequent reduction in the yield of wheat.

However, under rice-wheat farming system in Pakistan, rice is grown under anaerobic conditions, as soil is made impervious to water and air due to puddling and compaction in the standing water before planting of rice, as rice stem has holes through which air is conducted to its roots for respiration. On the other hand, the subsequent wheat crop requires well drained and aerobic soil conditions for deep penetration and respiration of its root system.

Consequently, farmers give 3-4 ploughings and 2-3 plankings for

age seed drills increased from five to 324 during the same period in the rice-wheat belt of Punjab alone. This drill also places fertilizer near the seed uniformly at the sowing time. Our farmers are very shrewd. If they are convinced that an agricultural innovation is beneficial to them they adopt it, and it travels from farmer to farmer. If they find that it is not in their interest, they automatically reject it. Therefore, the Department of Agriculture Extension should leave it to the farmers to adopt or reject it, as they are the best judge for themselves.

The major argument of Department of Agriculture Extension against zero tillage technology is that it will increase the incidence of rice stem borer attack on the ensuing rice crop, besides increasing weed growth in the wheat crop planted with zero tillage seed drill. However, field studies showed that there was no significant difference in the population of stem borer larvae in the residue of wheat sown by zero tillage and conventional tillage methods, but the weed infestation in the zero tillage method decreased by up to 40 per cent. Nevertheless, rice stem borers are easy to control through use of recommended insecticides at the right time. Again, the cut in cultivation cost due to zero tillage ranged from Rs 1358 to Rs 2343 per hectare, depending upon the farm size, saving in irrigation water was up to 20 per cent and reduction in the diesel use was 49 litres/ha. The yield of wheat increased by 15-20 per cent due to earlier planting by 5-15 days, and this increased plant cultivation by up to 22 per cent. Besides, zero tillage accelerated the decay process of stubbles, enhanced the microbial activity in the soil, thus increasing the fertilizer use efficiency. These observations are supported by the recent work on zero tillage in India, Bangladesh, Nepal and China in their rice-wheat belts. Even FAO has officially adopted this farming concept and is expanding this programme to other regions such as Africa, Mongolia, Kazakhstan etc.

Again, zero tillage drilling of wheat after rice has been found economical at Agri Research Institute and Farmers fields in DI Khan in NWFP. Direct seeding of wheat by zero tillage drill enabled its timely planting and saved the cost of land preparation by 100 per cent. This technology has also a good potential in the rice-wheat belt in Sindh, especially in Dobari farming system, where gram is sown in the residual moisture after rice harvesting, and no subsequent irrigation is given to the gram crop.

land preparation and sowing of wheat after the harvest of rice. Besides, one irrigation of 4-acre inch is given before land preparation, which takes 2-5 weeks under the conditions obtaining in the rice-wheat belt in Pakistan for rice fields to become workable for land preparation due to antecedent moisture. Occasionally, late rains in areas with standing rice crop and excessive moisture in the soil further delays harvesting of rice as well as timely sowing of wheat, resulting in a lower yield. Another factor, hindering achievement of optimum wheat yield in paddy areas is that wheat seed is generally broadcast into soil profile, leading to much reduced seedling emergence. It is, therefore, not surprising that wheat yield in the rice-wheat belt is significantly lower than in any irrigated areas outside this belt in the country.

Due to increasing population, the demand for food, water for agricultural, human and livestock consumption and industrial use is increasing. Again, the conventional agricultural practices are causing deterioration of soil, inefficient use of water and degradation of environment. To meet these challenges, zero tillage-based cropping systems, also called Conservation Agriculture, is becoming increasingly popular in different parts of the world — USA 19.4 million ha, Canada 6.7 million ha, Latin America 12 million ha, Australia one million ha and others 0.5 million ha with an overall total of 38.7 million ha. The policy-makers in Pakistan should take cognizance of this situation and develop conservation agriculture-based planning. Some of the major issues which need immediate attention are:

1. Water productivity should be increased through use of different crop establishment technologies for wheat such as zero tillage, reduced tillage, bed planting and laser-levelling. Mechanized rice transplanting, direct seeding of sprouted rice seed and its direct seeding without puddling should be tested in different agro-ecological conditions of the country.

2. Wheat seed, after soaking in 100-200 ppm solution of gibberalic acid for 6-8 hours and drying it in shade, be sown with zero tillage drill. It will significantly lower the seedling emergence period and partly meet the cold period requirement, which is reduced due to late planting of wheat after rice and cotton, the two major cropping systems in the country, thus increasing the yield of wheat in 70 per cent of its late sown area in the rice and cotton belts.

3. Instead of making bed planting of wheat a controversial issue due to inter-departmental rivalry in the Agriculture Department, it should be tried in farm in true perspective and let the farmers make their own decision. The bed planting of wheat, tried with the coordination of CIMMYT, has resulted in 40 per cent saving of water in China. Similar studies with the assistance of CIMMYT could be initiated in Pakistan on cotton, maize and other crops.

4. Zero tillage and mulching culture system comprising no soil preparation after rice, planting of wheat with zero tillage drill or broadcasting and mulching of rice stubbles on wheat seed be tested, as this popular system in China has resulted in 30 per cent saving of the cost of production and increased output by 12.4 per cent.

5. As the cost of tractor cultivation is higher, the two-wheel Chinese hand-tractor seeder be tried under our conditions, as it has also produced very encouraging results for seeding wheat in the rice-wheat system in Nepal and Bangladesh.