8: CROPPING SYSTEM

8.1: Prevalent wheat cropping systems:

Wheat is grown mainly in cropping sequences like Rice-Wheat, Jowar-Wheat, Bajra-Wheat, Maize-Wheat, Pulse-Wheat, Cotton-Wheat, Soybean-Wheat etc. in different parts of the country under irrigated condition although Rice-Wheat system is the most common. Under rainfed condition, fallow-Wheat is most common, but sometimes short duration pulse crops are also grown. Growing water guzzling crop of rice creates depletion of ground water thereby reducing the availability for irrigation. Besides, non judicious and imbalanced application of fertilisers makes the system less sustainable. The prevalent cropping systems in major wheat growing states are as under:

Table-8.1: Prevalent cropping system involving wheat in major Wheat growing states

Sl. no.	State	Prevalent wheat based Cropping systems	Total area under wheat (lakh ha)	Percentage of irrigation under wheat crop (%)
1	Bihar	Rice-Wheat, Maize-Wheat, Sesame –Wheat	22.6	93.2
2	Chhattisgarh	Soybean-Wheat, Rice-Wheat, Sorghum-Wheat, Cotton-Wheat	1.0	73.6
3	Gujarat	Groundnut-Wheat, Maize-Wheat, Rice-Wheat, Cotton-Wheat, Pigeon Pea-Wheat	13.5	90.8
4	Haryana	Rice-Wheat, Sorghum-Wheat, Cotton-Wheat, Bajra-Wheat, Maize-Wheat	25.0	99.4
5	Himachal Pradesh	Maize-Wheat	3.7	20.6
6	Jammu & Kashmir	Rice-Wheat, Maize-Wheat	2.9	28.7
7	Jharkhand	Rice-Wheat	1.7	89.1
8	Karnataka	Groundnut-Wheat	2.1	56.7
9	Madhya Pradesh	Rice-Wheat, Sorghum-Wheat, Soybean-Wheat, Cotton-Wheat,	57.9	87.1
10	Maharashtra	Soybean-Wheat, Bajra-Wheat, Rice-Wheat, Cotton-Wheat	11.0	73.9
11	Punjab	Rice-Wheat, Cotton-Wheat, Maize-Wheat,	35.1	98.8
12	Rajasthan	Sorghum-Wheat, Maize-Wheat, Bajra-Wheat	28.1	98.1
13	Uttar Pradesh	Rice-Wheat, Bajra-Wheat, Sorghum-Wheat, Sugarcane-Wheat	99.6	98.1
14	West Bengal	Rice-Wheat	3.4	95.9
		All India Average	312.0	92.1

Ref. DES, DAC, MoA, Govt of India, 2013

8.2: Preference of farmers for rice-wheat cropping system:

The western part (Punjab, Haryana and Western Uttar Pradesh) of Rice-Wheat belt of Indo-Gangetic Plains, where wheat is the predominant crop, provides a favourable environment through assured irrigation for both rice and wheat crops. The overall rice and wheat yields here are almost twice the yields obtained in the eastern states of Indo-Gangetic Plains. Wheat requires about 400 mm of water for irrigation to cater the need of the irrigation at all 6 critical growth stages. Availability of water for irrigation in these areas, mechanized farming including mechanized harvesting & threshing, longer shelf life, assured procurement & minimum support price and higher economic returns of the system are the main reasons for the farmers of NWPZ to stick to the rice-wheat system. The eastern Indo gangetic plains of NEPZ have abundance of water for irrigation. .The popularity of the Rice – wheat system in the NEPZ states can also be attributed to most of the similar reasons as in NWPZ. However, the increasing trend of mechanization resulting in comparatively lesser cost of cultivation, extending boundaries of assured procurement and higher MSP add to the reasons for the preference of the farmers. Madhya Pradesh in the Central Zone is emerging as one of the main wheat growers of the country. Availability of provisions of more irrigations under restricted irrigation conditions and assured procurement and higher Minimum Support Price with enhanced bonuses leading to higher economic returns of Rice-Wheat system lured the farmers to incline towards the system.

The existing buffer stock norm of Govt of India indicates the requirement of 11.2 million tonnes of wheat as on 1st January every year. Wheat constituted little more than 50% of the stock of foodgarins (34.38 million tonnes) in the central pool as on 1st January of the current year (Ref. Agri statistics at a glance, 2013, Govt of India). As such surplus wheat is available in the national food basket signifying the contribution of the farmers growing wheat.

8.3: Problem in prevalent cropping system:

While considering the sustainability of Rice-Wheat Cropping System (RWCS) of the country, it has been observed that the rice and wheat yields are either stagnant or yet to reach their potential. Swaminanthan (2002) indicated that Punjab, Haryana Western Uttar Pradesh regions (a major part of RWCS belt of India), which today serve as India's food basket, may become very food insecure in another 20 years . As such there is wide concern about the sustainability of this system. Some of the important issues are :

i. **Depletion of Ground Water Resources:** Though ground water is a natural bounty with highest possible irrigation efficiency, whereas the development of surface water irrigation potential is a very costly affair entailing even the loss of productive land in networking of canals along with the associated problem of water logging, salinity, etc. North Western part of India (Haryana and Punjab) with Rice-Wheat cropping system is a typical example of such declining Ground water which is due to its overexploitation and brackish nature in some areas.

ii. **Decline in Soil Fertility:** Simultaneous increase in nutrient mining and imbalanced fertilizers application are damaging the soil fertility status so far as the quality of soil resources, environmental pollution and cost of production are concerned. Out of 16 plant nutrients, C, H and O being contributed by air and water, rest 13 are taken up from soil. Presently, farmers apply nitrogen, phosphorus and zinc (in some cases) only i.e. for other 10 nutrients there is no replenishment towards soil bank. The status of potash and various micronutrients is declining and may not be sufficient to meet the requirement of the crop in near future due to their lack of replenishment.

In the major rice-wheat system areas of North-West India, soil carbon has decreased from 0.05 in 1960's to 0.02% in the late 1990's. Such a decline is prevalent throughout the RWCS in India. There is perceptible decrease in the efficiency of chemical fertilizers as such.

iii. **Decline in Factor Productivity:** While yields are stagnating and even declining or unable to reach the potential status in certain cases, input use pattern reflects progressive increase in nutrient demand, more application of pesticides and also strain on water front. This implies that input use efficiency is decreasing with simultaneous increase in cost of production. The higher cost of production in any crop increases the risk probabilities. The net income from Rice-Wheat Cropping System is declining and farmers are finding hard to maintain their per unit economic returns . Reduction in cost of production through various means viz., operational costs involving land preparation, mechanization in sowing, intercultural and harvesting/threshing including Resource conservation Technologies in Conservation Agriculture practices may augment the farmers income out of their crop fields.

iv. **Rising Problem of Insect-pest and Disease Complex:** The lush green crops of rice and wheat with liberal use of nitrogenous fertilizers and constant favourable condition becomes a paradise for building up an insect-pest and disease complex. Under the circumstances farmers tend to act on the advice of dealers, are adding complexity to the situation. This situation is further deteriorated by monoculture. Some of important issues are

- **Incidence of Rusts (Stripe rust)** has been growing a major concern & occurs only in the peak growing season of the crop. Massive awareness and spray operations of Propiconazole including growing resistant varieties of wheat answers the threat. Spraying of Propiconazole and Tebuconazole in alternate seasons are also recommended to escape any build up of resistance.
- **Karnal Bunt** is another problem that comes on the way of achieving higher productivity and marketing. Resistant varieties have been developed but the wheat fields where the disease occurred have been suggested to be kept out of wheat cultivation at least for three years and simultaneously soil and seed treatment need to be carried out even in other nearby areas.

v. **Problem of weeds and their management:** Weed is one of the major biotic constraints in wheat production as they compete for nutrients ,moisture, light and space. Weeds are associated with specific crops and the most critical stage of crop-weed competition remains within 30-35 days after sowing. Improved cultural practices led to build up of the difficult weed *Phalaris minor*.

- Phalaris minor is one of the threats in wheat production. The obnoxious weed was found to have built up resistance to the most effective weedicide- isoproturon. Application of other herbicides viz., Sulfosulfuron or Leader, Clodinafop, Pinoxaden and fenoxaprop have been the most effective measure to contain the grassy weed to grow.
- Integrated Weed Management combines nos of effective weed control measures which involves maintaining the optimum plant density, maintaining optimum time of sowing, proper spacing, adequate recommended fertilizer and irrigation water management in combination with chemical methods i.e. application of herbicides leads to effective management of weed species thus prevents any weed shift flora.

8.4: Suggested alternate cropping system:

In Rice-Wheat Cropping System (RWCS) much of the problem relates to rice and it is the most remunerative crop in the kharif season with probably no alternative at present. Apart from the core districts are

tempting to grow rice under sub-optimal conditions which is more damaging to the quality of natural resources. Delay in harvest of rice further delays sowing of wheat that results in yield reduction. While retaining rice in Kharif season, early varieties maturing in 95-105 days after transplanting will facilitate diversification within the RWCS as replacement of wheat with crops including short duration ones (mustard-summer moong, pea-potato, toria-sunflower, potato-sunflower, toria-potato, potato-onion, pea-cucurbits, raya-cucurbits, etc.). The alternative crop sequences with pulses and oilseeds will save the resources and may be equally profitable as well as soil fertility improvement. In case where rice is yet to be kept in the cropping system as inevitable introduction of direct seeded rice(DSR) may be the ultimate option to arrest the resource depletion.

Intercropping wheat in sugarcane is another viable option. Sugarcane alone is a remunerative crop and also there is enough scope of addition of wheat through intercropping. Growing wheat after sugarcane also existed in areas like Western UP and is also a profitable cropping system. The system is therefore found to create yield enhancement of wheat and ultimately enhance the total income of the farmers.

8.5: Means to stabilize and sustain the rice-wheat cropping system:

There has been depletion of natural resources in RWCS and also in reversible limits thus sustainability of the system is in question. The necessary measures are therefore need to be taken to stabilize the system. Some of the measures are as under:

a. **Zero Tillage:** Zero tillage as breakthrough in wheat cultivation. The long duration rice cultivation before wheat usually overlaps the following wheat season thereby induces delayed sowing of wheat. Zero tillage reduces the time taken for land preparation besides economizing the cost of production resulting in increasing the margin of profit for the wheat growers. Additionally, wed infestation is also reduced in zero tillage areas.

b. **Green Manuring:** There is a fallow period of 45-50 days between harvest of wheat and transplanting of rice which is sufficient to raise a very good green manure crop. Though any leguminous crop can be used for green manuring but Sesbania aculeata is best fit. It grows well even on marginal soils, could accumulate about 250 q ha^{-1} biomass in seven weeks. Its incorporation in the soil can contribute 60-80 kg N ha^{-1}. The carbon and nitrogen ratio is ideal for rapid decomposition and nitrogen availability is as fast as from urea. Green manuring alone is sufficient to meet all the nitrogen need of Basmati rice, whereas in other varieties it is possible to skip the basal dose.

c. **Crop Residue Management:** Due to short turn-around period between two crops in RWCS, crop residue management is a serious problem. Wheat residue management becomes a problem if a third crop (rice/ moonbeam/cowpea/fodder) is taken during summer. Since it is very crucial to sustain the RWCS and in conservation tillage it is worth to retain 30% of the crop residues.

d. **Integrated Pest and disease Management (IPM):** I Wheat is comparatively a safe crop as far as pest incidence is concerned

e. **Judicious Water Management:** Water-Use-Efficiency in Rice-Wheat Cropping System (RWCS) is generally low. Water management in RWCS can be optimized by appropriate soil management to reduce percolation, proper scheduling of irrigation, use of ground water and utilization of rain water. Thus, proper use of water resource may enhance the water productivity.

f. **Direct Seeded Rice (DSR)** in rice - wheat growing system may reduce the water use 30% & increase the Water Use Efficiency (WUE) of the system as a whole without sacrificing the yield at the end.