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Impact of Green Revolution on Long-Term Sustainability of Land and Water Resources in Haryana

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Indian agriculture has made spectacular progress since the introduction and widespread use of high-yielding variety (HYV) seeds particularly in areas endowded with assured irrigation. Production of foodgrains increased from 72.35 million tonnes in 1965-66 to 173 million tonnes in 1989-90. Wheat and rice are the main contributors to this increase. Production of wheat increased from 10.39 million tonnes to 49.65 million tonnes and that of rice from 30.59 million tonnes to 74.06 million tonnes during this period (Government of India, 1990). This incremental foodgrains production is more concentrated in the north-western region including Punjab, Haryana and Western Uttar Pradesh.

With the development of irrigation resources which helped to increase the irrigated area from 1.293 million hectares in 1966-67 to 2.532 million hectares in 1988-89, with about 40 fold increase in fertiliser consumption and significant improvement in plant types (83.4 and 95.5 per cent of the area under HYV of rice and wheat respectively), Haryana has increased its foodgrains production from a mere 2.592 million tonnes to 8.656 million tonnes during the last two and a half decades (Table I).

Land and water are basic natural resources which have a direct impact on agricultural production. Land resource is non-renewable and is subject to erosion and degradation through various means. Similarly, water resources are limited and highly variable. To meet the regularly growing demand for foodgrains and other agricultural commodities, judicious use of these resources is essential. But during the last two decades over-exploitation of these resources has adversely affected the soil productivity. There is a growing concern about the sustainability of much of today's agricultural breakthrough. The decreasing compound growth rate of rice from 11.4 per cent during 1967-68 to 1977-78 to 5.12 per cent during 1978-79 to 1988-89 in Haryana confirms the fears. An attempt has been made in this paper to find out the extent of utilisation of land and water resources in Haryana and examine their impact on long-term sustainability of agricultural production in the state.

UTILISATION OF LAND AND WATER RESOURCES

During the last two and a half decades the net area sown in Haryana increased by only 4 per cent while the total cropped area increased by 30.7 per cent, showing a significant increase in the cropping intensity (Table I). With the release of high-yielding, photo-insensitive and highly fertiliser responsive varieties of rice and wheat in the sixties and with the extension of irrigation facilities, there have been perceptible shifts in area from coarse cereals, pulses and oilseeds to rice and wheat. The area under rice in Haryana increased over three fold. So is the case with the area under wheat (an increase of 150 per cent). Cultivation of similar type of crops continuously has led to the emergence of problem weeds as *Phalaris minor* wheat and *Echinochloa sps.* in rice and a number of insect-pests. The infestation of these weeds and pests has become so serious that without the adoption of chemical control

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measures it is difficult to harvest any yield. During the year 1989-90 Haryana farmers used 566.8 thousand litres of herbicide for rice and 745 tonnes for wheat. Pesticides consumption has also gone up to 4,691 metric tonnes (technical material) in 1988-89 from 373 metric tonnes in 1966-67.

TABLE I. IMPORTANT INDICATORS OF AGRICULTURAL DEVELOPMENT RELATED TO LAND AND WATER USE IN HARYANA

(area in 000 ha)

Particulars	1966-67	1988-89	Increase/ Decrease (per cent)
(1)	(2)	(3)	(4)
1. Total geographical area	4,399	4,392	-
2. Net area sown	3,423	3,564	4.1
(As percentage of total area)	(77.80)	(81.10)	
3. Total cropped area	4,599	6,012	30.7
4. Cropping intensity (per cent)	134.4	168.69	34.3
5. Net irrigated area as percentage of net area sown	37.8	71.0	33.2
(a) Canal irrigated area	991	1,238	24.9
(b) Tubewell irrigated area	302	1,294	328.4
6. Gross irrigated area	1,736	4,074	136.6
7. Area under rice	192	621	223.4
8. Area under wheat	743	1,859	150.2
9. Area under coarse cereals	1,432	819	(-) 42.8
10. Area covered under HYV			
(a) Rice (as percentage of total rice area)	1.8*	83.4	
(b) Wheat (as percentage of total wheat area)	11.9*	95.5	
11. Fertiliser consumption (nutrient kg./ha)	2.90	89.01	-
12. Pesticide consumption (technical material) (metric tonnes)	373	4,691	257.6
13. Production of foodgrains (000 tons)	2,592	8,656	234.0
(a) Wheat	1,059	5,913	458.0
(b) Rice	223	698	213.0
(c) Coarse cereals	747	612	(-) 18.07

Source: Statistical Abstract of Haryana, 1989-90 and Department of Agriculture, Government of Haryana, Hisar.
* Based on area for the year 1967-68.

IMPACT OF USE OF MODERN TECHNOLOGY ON SOIL FERTILITY AND PRODUCTIVITY OF CROPS

Adoption of cereal-based crop rotations particularly rice-wheat and low (89 kg./ha) and imbalanced (105 N: 34 P: 1 K) use of fertilisers have had an adverse impact on soil health resulting in stagnation in the productivity of crops. The major effects of this rotation during the last two decades are manifested in erosion of soil fertility in terms of depletion of soil nutrients and organic matter. Analysis of soil test reports for the past 15 years reveals a significant decrease in the nutrient status of soils, particularly P, K and organic carbon (Mehla, 1990). Soil fertility is also affected by cropping intensity and nutrients added from outside. Removal of nutrients by crop plants has increased with the start of the green revolution. For an average productivity of 10 tonnes of cereals (6 tonnes of rice and 4 tonnes of wheat) per hectare, the estimated nutrient absorption will be 634 kg. including 220 kg. nitrogen, 102 kg. phosphorous and 312 kg. potash (based on estimates worked out by Tandon and Rego, 1989). But the present level of nutrient (NPK) consumption in rice-wheat crops in Haryana is 350 kg. per hectare (based on data presented in Agricultural Officers'

TABLE II. DISTRICTWISE IRRIGATED AREA, GROUNDWATER QUALITY, NUMBER OF TUBEWELLS, AVERAGE ANNUAL WATER TABLE CHANGE AND EXTENT OF SALINITY/ALKALINITY

District	Total geographical area (000 ha)	Net irrigated area (000 ha)			Groundwater quality (per cent)			Number of tubewells	Average annual water table change (cm/year)	Saline/ alkaline area (000 ha)
		Canals	Tubewells	Total	Good	Normal	Saline/ sodic			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Ambala	374	7	105	112	100	-	-	37,135	-18	
Kurukshetra	373	83	225	308	76	4	20	84,455	-33	70
Karnal	372	61	248	309	59	5	36	82,799	-26	
Sonepat	219	84	82	166	32	11	57	26,828	-16	155
Rohtak	384	127	104	231	5	14	81	22,612	+8	
Jind	331	173	54	227	14	7	79	25,853	+18	57
Hisar	633	344	72	416	21	10	69	31,740	+26	
Sirsa	427	188	43	231				17,210	+32	175
Bhiwani	509	103	67	170	11	16	73	14,983	+19	
Mahendragarh	298	6	152	158	20	9	71	41,168	-1	
Gurgaon and									-24	69
Faridabad	488	44	204	248	28	12	60	60,956	-12	
Haryana	4,408	1,220	1,356	2,576	37			4,45,739	-	526

Workshops at Haryana Agricultural University, Hisar, 1990-91) which is much below the quantity required for the maintenance of soil productivity at sustainable level. The present nutrient status of our soils is already low to medium in nitrogen and phosphorous and medium to high in potash. Zink deficiency has become quite common in the rice belt during the last 15 years and the deficiency of more micro-nutrients as iron and sulphur may occur in the near future due to increase in cropping intensity and exploitation of production potential of crops.

Large scale adoption of rice-based cropping system in north-eastern Haryana has resulted in the deterioration of soil texture and structure. Regular puddling in rice fields affects the physical condition of soil and leads to compactness. Puddling increases bulk density of surface soil with consequent decrease in infiltration rate and also water absorption in deeper soil layers which restricts prolification of wheat roots.

Continuous exploitative agriculture by adopting cereal-based (rice-wheat) crop rotations and application of heavy irrigations have had an adverse impact on soil health. In Haryana an area of about 6.35 million hectares has been affected by soil degradation (Haryana Agricultural University, 1990). Increase in irrigated area from 37.8 per cent of the net area sown in 1966-67 to 71 per cent in 1988-89 has facilitated the large scale adoption of rice-wheat rotation. In areas having good quality underground water, tubewells are the major source of irrigation. The number of tubewells in this region has increased 18 fold during the last 25 years. Consequently, the area irrigated by tubewells increased by 328 per cent. Due to over-exploitation of underground water in north-eastern region, lowering of water table at the rate of 12 to 33 cm. per year has become a key problem (Table II). In 1987-88, a comparatively dry year, farmers had to lower down their tubewell motors 3-6 metres and this has also caused a number of deaths due to presence of poisonous gas (carbon mono-oxide) in these borewells. On the other hand, in the central-southern districts of Jind, Rohtak, Bhiwani, Hisar and Sirsa where most of the area is irrigated by canals, there is a very fast rise in the water table (8-32 cm/year) leading to waterlogging (624 thousand hectares) and salanisation (526 thousand hectares). Unfortunately, most of the underground water in these districts is sodic/saline which makes the reclamation of these soils more difficult (Table II). Already 73 per cent of the salt affected soils of the state fall in these districts (Bhargava, 1988). Large tracts of land go out of cultivation due to the twin problems of waterlogging and salinity which go side by side.

CONCLUSION

The green revolution successes have led to a breakthrough in foodgrains production in Haryana. But the unscientific use of modern technology has resulted in a number of problems. Over-exploitation of land and water resources during the last two decades has led to deterioration of soil health, created nutritional imbalance and disturbed the natural hydrology, particularly in intensively irrigated areas. The new development strategy should, therefore, be aimed at maintaining growth in productivity while reducing its harmful side-effects. This can only be achieved through scientific management of land and water resources and better crop planning.

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