

National food security vis-à-vis sustainability of agriculture in high crop productivity regions

B. S. Dhillon*, Poonam Kataria and P. K. Dhillon

India has made rapid progress in food grain production during second half of the 20th century in which Punjab has played a leading role. However, the growth rate in the state has slowed down over the years and now there is practically a plateauing of the productivity of wheat and rice, the two most important food grain crops. Further, intensive rice-wheat cultivation has created a stress on soil and water resources, and the very sustainability of crop production is under question. The agricultural problems being faced in Punjab, Haryana and other high crop productivity regions deserve immediate national attention because of their increasing relative importance to national food security and increasing food prices at the international level; and their utility to serve as laboratories of the nation for the development of technologies and strategies for agricultural progress in other states/regions on sustainable basis.

Keywords: National laboratory, national food security, rice-wheat cropping system, soil and water resources, sustainability of agriculture.

INDIA was a food-deficit nation and imported as much as 10.3 and 8.7 million tonnes of food grains in 1965–66 and 1966–67 respectively. This heavy dependence on the imports was many times described as a ‘ship-to-mouth’ situation. Some policy makers in the developed world even advocated that India be treated as a ‘lost nation’.

The introduction of high yielding varieties of wheat and rice in the second half of 1960s ushered in the era of ‘Green Revolution’. As compared to 50.8 million tonnes of food grain production during 1950–51, India produced as high as 217.3 and 230.7 million tonnes during 2006–07 and 2007–08 respectively (Table 1). A food-deficit nation became self-sufficient with exportable surplus. A net importer of food grains from 1950–51 to 1990–91, India became a net exporter from 1993–94 to 2005–06. Further, the national buffer stock of food grains had a record build-up of 58 million tonnes in 2002 (against the norm of 16.8 million tonnes). This rosy scenario led many policy makers to believe that Indian agriculture is doing very well. Consequently, the ‘feel-good’ factor led to less attention to the agriculture sector. Even the agricultural research institutions/agricultural universities, whose contributions are recognized at the international level got neglected. The financial support was frozen over the years in spite of inflation and more importantly, the need

for greater resources for undertaking more intensive research to enhance and sustain productivity at higher levels; the result being a serious setback to the technology generation. Apparently the trends in grain production vis-à-vis population growth were not appreciated. Further, food grain prices in the international markets remained low for about 30 years starting mid-1970s, which also led to complacency.

National food grain production did not register any consistent increase from 1996–97 to 2006–07 (Table 1); it fluctuated between 192 and 217 million tonnes (except that the production was extremely low during 2002–03 and high during 2007–08). On the other hand, the demand for food grains continued to rise because of burgeoning population and fast growth of economy resulting in increasing access to food. Consequently, India had to resort to large imports of 8.3 million tonnes of food grains during 2006–07.

Punjab played a leading role in the agricultural transformation of the nation. As compared to 1960–61, rice and wheat production in Punjab increased substantially (Table 2). Its contribution to the national food basket also registered a remarkable increase. With only 1.53% geographical area of the country, Punjab’s share in the national rice and wheat production was 10–12% and 20–22% during 2000s as compared to 0.7% and 15.8% during 1960–61 respectively. That the food security of the nation was significantly dependent on Punjab is evident from the contribution of the state to the national buffer stock of food grains, which has generally been 50–75% in wheat and 30–48% in rice (Table 3). Haryana and parts of some other states also witnessed similar progress.

B. S. Dhillon is in the Institute of Plant Breeding, Seed Science and Population Genetics, University of Hohenheim, 70593 Stuttgart, Germany; Poonam Kataria is and P. K. Dhillon was in the Department of Economics and Sociology, Punjab Agricultural University, Ludhiana 141 004, India. *For correspondence. (e-mail: dhillionbaldevsingh@gmail.com)

In Punjab, the area under rice and wheat cultivation expanded rapidly (Table 2) with the introduction of high yielding varieties and policy measures like subsidized inputs, assured market for the produce at remunerative prices, and consequently higher economic returns than competing crops. The area under maize, rapeseed and mustard, chickpea, pearl millet and groundnut, which were important crops, reduced so drastically that these crops, with the exception of maize, rapeseed and mustard, became marginalized, and are now being grown on an area less than 10,000 ha. The area also reduced in case of minor crops like lentil, linseed, mothbean and guar.

In case of wheat, the most important crop of the state, the highest yield of 4696 kg/ha was obtained during 1999–2000 (Table 2). Thereafter, it fluctuated between 4179 and 4563 kg/ha. In rice, the second most important crop in the state, the yield levels, as high as 3510 kg/ha during 1989–90 and 1993–94 were achieved. The yields from 1990–91 to 2002–03 varied between 3130 and 3545 kg/ha. Thereafter, it increased for two years (2003–04 and 2004–05) and then practically plateaued. However, the factors and inputs responsible for this increase in rice productivity could not be identified, and in the absence of any conclusive evidence, the increase may well be attributed to favourable weather conditions. The increase in yield during 2007–08 may partly be due to timely transplanting.

A comparison of the compound growth rates of food-grain production and productivity in the state and the

country at large reveals some startling facts. In case of Punjab, the growth rates were very high during 1960s, stabilized during 1970s and 1980s, and declined thereafter (Table 4). During 2000s, growth rates were as low as 0.25% for productivity and 0.52% for production.

Intensive cultivation of rice and wheat is being practised in Punjab with high input use (Table 5). There has been over- and injudicious use of natural resources as well as applied inputs. The quantity and quality of underground water are declining. In fact, underground water has depleted at an alarming rate. In the absence of adequate availability of organic manures and imbalanced use of inorganic fertilizers, soil health has been adversely affected. The deficiency of many micronutrients, like zinc, iron and manganese has appeared. Because of intensive agriculture and rising labour costs, there has been greater or rather many times misplaced emphasis on the use of chemical plant protection measures (applications of pesticides including fungicides and weedicides) and farm machinery and power. All these factors led to decline in total factor productivity, rise in cost of cultivation and reduced economic returns to the farmers. Above all an apprehension is developing that the stress on natural resources, if not arrested timely, may lead to highly adverse consequences like salinization/alkalinization, barrenness and desertification of soil. Similar situation is emerging in Haryana and the high productivity regions of other states.

As a first and quick response, it is thought that the corrective policy and development measures should have been initiated in Punjab in mid-1980s when indications of fatigue in rice–wheat cropping system and stress on natural resources started appearing. While this is true, but equally true is the fact that national food security concerns rightly continued to be of prime importance to the policy makers, and the support to intensive rice and wheat cultivation has to be continued.

There is an urgent need to develop policies and strategies to sustain agriculture in the states with high crop productivity, and at the same time emphasize on increasing productivity in other states/regions. The present scenario and problems encountered in the high productivity states/regions need due attention of critical analyses; and the remedial action plans need to be developed, implemented, and their effectiveness evaluated. Otherwise, the other states/regions particularly in the Indo-Gangetic plains will meet the same fate as that of Punjab, as the crop productivity gets enhanced in those states/regions as evident from the growth rates in Punjab and India (Table 4). National growth rates followed the same trend as recorded in Punjab with a gap of about two decades. Thus, the experience of Punjab and Haryana can be advantageously exploited by treating these states as laboratories of the nation to develop strategies for agricultural development enabling others to follow a sustainable path.

Table 1. National production, and imports and exports of food grains

Year	Production (million tonnes)	Imports (million tonnes)	Exports (million tonnes)
1950–51	50.8	4.8	–
1960–61	82.0	3.5	–
1970–71	108.4	3.6	–
1980–81	129.6	0.7	–
1990–91	176.4	0.9	0.7
1991–92	168.4	0.3	1.3
1992–93	179.5	1.8	0.7
1993–94	184.3	0.9	1.3
1994–95	191.5	0.6	1.1
1995–96	180.4	0.5	5.6
1996–97	199.4	1.3	3.8
1997–98	192.3	2.5	2.6
1998–99	203.6	2.4	5.1
1999–2000	209.8	1.9	2.1
2000–01	196.8	0.4	2.6
2001–02	212.9	2.2	5.2
2002–03	174.8	2.0	8.9
2003–04	213.2	1.7	8.3
2004–05	198.4	1.3	8.2
2005–06	208.6	1.7	5.8
2006–07	217.3	8.3	5.8
2007–08	230.7*		

*Advance estimate as on 9 July 2008.

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, Government of India.

Table 2. Area, average productivity and production of rice and wheat in Punjab and the state's contribution to national production

Year	Rice				Wheat			
	Area (000 ha)	Productivity (kg/ha)	Production (000 tonnes)	Contribution (%) ^a	Area (000 ha)	Productivity (kg/ha)	Production (000 tonnes)	Contribution (%) ^a
1960–61	227	1009	229	0.7	1400	1244	1742	15.8
1965–66	292	1000	292	1.0	1550	1236	1916	18.4
1970–71	390	1760	688	1.6	2299	2240	5145	21.6
1975–76	567	2550	1447	3.0	2439	2370	5788	20.1
1980–81	1183	2740	3223	6.0	2812	2730	7677	21.1
1985–86	1714	3180	5449	8.5	3112	3530	10988	23.4
1989–90	1908	3510	6697	9.1	3251	3590	11681	23.4
1990–91	2015	3230	6506	8.8	3272	3710	12155	22.9
1991–92	2074	3260	6755	9.0	3233	3800	12295	22.1
1992–93	2065	3390	7002	9.6	3281	3770	12369	21.6
1993–94	2179	3510	7642	9.5	3335	4010	13377	22.4
1994–95	2277	3380	7703	9.4	3311	4090	13542	20.6
1995–96	2161	3130	6768	8.8	3223	3880	12518	20.2
1996–97	2159	3397	7334	9.0	3229	4234	13672	19.7
1997–98	2279	3465	7897	9.6	3301	3853	12719	19.2
1998–99	2519	3152	7940	9.2	3338	4332	14460	20.4
1999–2000	2604	3347	8716	9.7	3388	4696 ^d	15910 ^d	20.8
2000–01	2612	3507	9157	10.8	3408	4563	15551	22.3
2001–02	2489	3545	8824	9.4	3420	4532	15499	21.3
2002–03	2530	3510	8880	12.4	3375	4200	14175	21.6
2003–04	2614	3694	9655	10.9	3444	4207	14489	20.1
2004–05	2647 ^b	3943	10437	12.6	3482	4221	14695	21.4
2005–06	2642	3858	10193	11.1	3468	4179	14493	20.9
2006–07	2621	3868	10138	10.9	3467	4210	14596	19.3
2007–08	2610	4019 ^c	10489 ^c	10.9	3494 ^e	4516	15780	20.1
Maximum increase (%) ^f	1066	298	4480		149	277	813	

^aContribution to national production; ^bRice area was highest during 2004–05; ^cRice productivity and production were highest during 2007–08; ^dWheat productivity and production were highest during 1999–2000; ^eWheat area was highest during 2007–08; ^fIncrease over 1960–61.

Source: Statistical Abstract of Punjab, Government of Punjab; and Agricultural Statistics at a Glance, Ministry of Agriculture, Government of India.

Table 3. Contribution of wheat and rice by Punjab to the national pool of food grains

Year	Contribution (%)	
	Wheat	Rice
1970–71	74	16
1980–81	73	45
1990–91	61	41
2000–01	58	33
2001–02	51	33
2002–03	52	48
2003–04	57	38
2004–05	55	37
2005–06	61	32
2006–07	75	31
2007–08	61	30

Source: Agricultural Statistics at a Glance, Ministry of Agriculture, Government of India.

Under this scenario of stagnating food grain production, the matter of most serious concern is that recently the maintenance of the national buffer stock has become more dependent on the contributions by the states of

Punjab and Haryana. For example, during 2006–07, Punjab contributed 75% of wheat. This happened as the quantity of surplus food grains at the national level reduced and, thereby, the relative contribution of Punjab increased; though, in terms of absolute quantity, the total procurement at the national level and in Punjab decreased. The relative importance of Punjab and Haryana for the national food security may increase further unless agriculture in other states/regions registers an even faster growth rate. In the process, if other states/regions choose the same path that has been followed by Punjab and Haryana, which they may do in the absence of alternatives, their agricultural progress is bound to encounter similar challenges of conservation of natural resources, sustainability of agriculture and remunerative returns to the farmers. Unless the problems are looked into and their solutions developed on an urgent basis, national food security may be at risk.

At the international level, the prices of food grains have risen sharply during recent years and this trend is bound to continue due to enhanced demand for food as well as increasing use of biofuels; the most important

Table 4. Compound growth rate of food grain production and productivity in India and Punjab

Decade	Compound growth rate (%)			
	Production		Productivity	
	India	Punjab	India	Punjab
1960s	1.85	9.45	1.35	6.98
1970s	2.07	5.76	1.62	3.24
1980s	2.73	4.48	2.98	3.04
1990s	2.09	2.26	2.17	1.34
2000s ^a	2.01	0.52	1.52	0.25

^a2000–01 to 2007–08.

Based on data culled from various issues of Statistical Abstract of Punjab and agricoop.nic.in

Table 5. Comparative input-use in India and Punjab

Parameter	India	Punjab
Cropping intensity 2005–06 (%)	136	191
NPK 2006–07 (kg/ha)	113	209
Electric consumption for agricultural purposes 2006–07 (GWh)*	99023 (21.7%)	8229 (31.2%)

*Provisional estimates, and values in brackets are the percentage share of that of total consumption, which was used for agricultural purposes.

Source: Agricultural Statistics at a Glance 2008, Ministry of Agriculture, Government of India.

examples being ethanol production from sugarcane in Brazil and from maize in the USA. Thus, due to economical and other reasons as well as national prestige (we should keep in mind the humiliations, which the nation had to face during the period of extreme food scarcity in 1960s), it will not be in national interest to pivot our food security on imports.

The challenges being faced by agriculture in the regions having higher productivity, which geographically form only a small part, are different than those being focused in the rest of the country. For example, the challenges in Punjab are sustainability and diversification whereas in other states, the emphasis has to be on enhancement of productivity and sustainability. Further, rainfed farming is rightly getting great attention at the national level but in Punjab almost all cropped area is irrigated. Thus, the resources for agricultural research and

development (for example, the resources for research at present are being provided mainly under All-India Coordinated Research Projects), should be urgently augmented on the basis of agro-ecological regional needs. India is a large country with very diverse agro-ecologies, and it needs to be viewed accordingly.

In conclusion, the problems being faced by agriculture in the states of Punjab and Haryana and other regions with high crop productivity deserve immediate national attention because of the increasing relative importance of these states/regions to national food security and their utility to serve as laboratories of the nation which can be used to develop appropriate strategies for agricultural progress in other states/regions on sustainable basis so as to avoid the pitfalls encountered in these areas.

Received 19 August 2009; accepted 4 December 2009