Agricultural Crisis of Punjab
Costly Mistakes

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The historical review of growth of agriculture in Punjab shows that ignoring basic research and hierarchical domination in research and policy formulation led to the crisis we see today. Two measures can help improve the situation in the long run. Basic and fundamental research will be intrinsic to ameliorate the current problems and for future agricultural growth. The existing agricultural research and policy formulation system should be relieved from the prevailing hierarchical domination and institutional barriers for progress.

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Punjab occupies an important place in the agricultural economy of India and was known as the "heartland of the green revolution." With just 1.57% of the area, it accounts for 12% of the national foodgrain production (Parveen et al 2012). About 84% of the geographical area of the state is cultivated, of which 95% is irrigated either by canals or tube wells (Government of Punjab 2015). Punjab is a major contributor towards the public distribution system supplying 50% to 60% foodgrains to the federal pool meant for distribution in deficit regions. In this way Punjab province had been a significant player in the food security of India for the last four decades.

The historical review of agricultural development provides a very interesting picture. India faced chronic food shortages after independence and it became alarming in the second-half of the 1960s. It was the period when the green revolution technology was developed at the international research institutions, especially at the International Maize and Wheat Improvement Centre (CIMMYT), Mexico. However, this technology required a symbiotic action of seeds, irrigation, chemicals, and fertilisers, and was most suitable for fertile areas having sufficient surface and/or groundwater for irrigation. Situated in the catchment areas of the Himalayan rivers, Punjab had sufficient surface as well as groundwater resources, and emerged as a suitable region for dissemination and adoption of the green revolution technology. Besides the land and water resources, the research and development (R&D) infrastructure for testing, modification, and dissemination of this technology had also taken a fairly good shape by this time. Therefore, to increase foodgrain production to feed the growing population, the seed–chemical–irrigation technology was instantly adopted in this region. Increasing area under foodgrains and enhancing their production were facilitated through policy, and R&D support. The Government of India (GOI) institutionalised the price fixation system for foodgrains by establishing the Agricultural Prices Commission in 1965 that assured the minimum support prices (MSP) for wheat and rice. The Food Corporation of India insured the marketing of wheat and rice at MSP in case the prices fell below it.

In fact, it was a one-way model of contract farming under which the federal government acted as the major contractor, and the farmers were asked to grow as much of wheat and rice as they could and the government was there to purchase the produce at predetermined prices. Since irrigation was the main requirement for adopting this technology, canal water was supplied at a nominal cost, and the canal network was strengthened and maintained by the government. The Rural Electrification Programme was launched to energise the tube wells. Electricity was supplied to the agricultural sector, to pump out water at highly subsidised rates, even free of cost for some years, which continues till today. Liberal institutional credit was made available to the farmers to install new tube wells. Consequently, the number of tube wells increased at a fast rate. In 1974–75, the tube well density, that is,

the number of tube wells per thousand hectares, was just 32, which increased to 67 in 1980–81 and further to 290 in 2012–13 (Government of Punjab 2015). Farmers received fertiliser subsidy. These policy interventions made the wheat–rice combination as the most profitable crop sequence with low production risk and absolutely no price risk. As a result, the substantial area shifts in favour of these two crops took place resulting in the monoculture of wheat in winter and rice in summer. The traditional diversity of cropping pattern was eroded in this process. In winter, the proportion of area under wheat—which declined from 45.30% of the net sown area in 1950–51 to 37.26% in 1960–61—started increasing at a very high rate reaching 67.10% in 1980–81 and 82.88% in 2004–05 (Bhullar and Sidhu 2006). The total number of crops in the cropping system and proportion of area under the crops other than wheat started declining. The total number of crops in the cropping system declined from 21 in 1960–61 to 10 in 1980–81, nine in 1990–91, and stagnated thereafter (Bhullar and Sidhu 2006).

The proportion of area under the crops other than wheat also declined from 62.74% in 1960–61 to 22.4% in 1990–91, and the decline continued reaching 17.12% in 2004–05 (Bhullar and Sidhu 2006). In the summer season, rice emerged as the single main crop. The proportion of area under rice cultivation was just 6.05% in 1960–61 and went up to 47.77% in 1990–91, and further to 63.02% in 2004–05. As in the winter crop season, the proportion of area under crops other than rice and the total number of crops in the system also declined in summer season. The area under crops other than rice was 82.06% in 1960–61, declined to 35.61% in 1990–91, and further to 24.86% in 2004–05. The number of crops grown declined from 20 to nine during this period (Bhullar and Sidhu 2006). The situation, by and large, is the same even today. Monoculture replaced the diversity of the cropping pattern. Since these crops required large amounts of water and were soil nutrient exhaustive crops, the water and soil resources were overstressed.

The total surface water availability at different head works is about 1.80 million-hectare metre (mham) per annum. Out of this, 0.28 mham is lost during conveyance and only 1.52 mham is available at the outlet that irrigates about 1 million hectares of land. The remaining 3.15 million hectares of land gets irrigated with the use of groundwater. The total sustainable availability of groundwater is 2.14 mham per annum. Therefore, the total water availability, including surface as well as groundwater, is 3.66 mham per annum. The current crop production pattern dominated by wheat–rice crop rotation requires 6.15 mham of irrigation water per annum. So, there is a gap of 2.49 mham between demand and supply of water which is being met through over-pumping of groundwater (Kumar and Sandhu 2017). The over-exploitation of groundwater in the last three and half decades has wreaked havoc on the groundwater resources of the state. There are about 14,05,000 electric pumpsets in the state for pumping out groundwater. A recent study conducted jointly by Water Recourses and Environment Directorate, Government of Punjab and Central Ground Water Board (GoI 2013) reports that out of total 145 blocks of Punjab, only 22 are in the safe category.

In the overexploited, critical, and semi-critical categories there are 110, 5, and 2 blocks respectively. The blocks of almost entire central Punjab, that is, the rice belt of the state fell in the overexploited category except for a few areas located closer to the rivers. This indicates that the groundwater level is receding at a very fast rate and the cost of pumping is increasing continuously. The frequency of deepening the wells depict a disturbing trend. Between 1995 and 2005, 23% farmers deepened their wells thrice or more, 32% twice and 35% once (Parveen et al 2012). Even the pumping technology requires changes. It is increasingly becoming difficult to lift the groundwater with centrifugal pumpsets and these are being replaced with submersible technology. The cost of submersible technology is beyond the reach of small farmers, putting further strain on their limited financial resources.

Intensive agriculture is considered to have seriously eroded the fertility levels of the soil in Punjab. Wheat and rice are the most nutrient exhaustive crops of the state removing 80% of nitrogen, phosphorus, and potassium, 80% of sulphur, and 77% of zinc, of the total removal of nutrients per year. Based on nutrient requirements for each crop, it was estimated that the addition of nitrogen through chemical fertilisers was higher than removal since 1980–81, and this positive difference between addition and removal has been increasing over the years resulting into positive nitrogen balance. In many areas of the state, the application of nitrogen is higher than the recommended doses. The status of nitrogen nutrient in Punjab soils thus improved in the 1990s. The proportion of samples is low in the available nitrogen and which decreased from 78% of total samples tested during 1981–90 to 66% during 1991–92. The deficiency of phosphorus in Punjab soils has increased over time. In the 1990s, 62% of soil samples were found to be low in phosphorus compared with 48% in the 1980s. Intensive agriculture also drains the micronutrients from the soil. Micronutrient deficiencies especially of iron, sulphur, manganese, etc, are appearing in Punjab soils (Bhullar and Sidhu 2006). A recent study shows that more than 25% of the total ground area of Punjab suffers from one and/or the other kind of land degradation (Bhattacharyya et al 2015).

Multifaceted Distress

The stagnated productivity, increasing costs, declining profits, receding water availability, declining soil productivity, etc, coupled with future uncertainties have brought about an economic, environmental and social distress. A large proportion of the farmers are under debt trap resulting in very high rate of farmers' suicides (Sidhu et al 2011). The green revolution has completed a full cycle comprising high growth period, stagnation and now a period of crises. Why did the green revolution fade away in just three decades? What was lacking at the planning level? Why did it fail to move on the sustainable path? Which policies made it unsustainable? There

are numerous reasons, but the focus of this article is only on the research and policy formulation issues.

The crisis is not a spontaneous one but rooted in the history of agricultural research and policy planning in Punjab. The origin of the crisis goes back to the early years of the green revolution. The fast rise in productivity and production created such an atmosphere of optimism that everyone failed not only to predict but to ponder over the long-run consequences of the policies that were followed. The managers of the agricultural research and economy believed in the wonders of new technology and the prospect of any problem in future was assumed to be unlikely. Those who tried to put a different viewpoint were denounced as opponents of progress. On 29 July 1971, Norman Borlaug, the man behind the green revolution, wrote a letter to M S Randhawa, the then Vice Chancellor of Punjab Agricultural University (PAU) stating,

> I have been trying to battle their vicious campaigns as best as I could, but not always effectively, for they can devote their entire time to writing such nonsense while my colleagues and I must spend our energies and time on conducting research and extending green revolution to other countries. (Saha 2013)

It may be an honest expression, but it not only gridlocked the voices that might have made us aware of the consequences we are facing today, but also institutionalised the system of command approach in agricultural and policy research silencing academic dissent.

Lack of Perspective

No one can deny that the new technology provided much-needed relief to India's food supply, but it was destined to be short-lived and unsustainable in the absence of a long-term perspective plan and well-thought-out institutional and policy responses from time to time. These responses must have emerged from free academic discourses. But there always existed a hierarchical thinking that dominated the academic discourses. The political directorate believed in this pattern as both political and agricultural academic hierarchies of Punjab are the product of the late 1960s and early 1970s, and have moved along since then. This approach failed to understand the process of ushering in the green revolution and its drivers, and consequently to formulate appropriate research and policy responses to the changing situations. There is no long-run policy perspective even today. Many committees were formed to respond to emerging problems. But most of the expert committees and panels were dominated by those who have in one way or another been part of the very hierarchy. To quote from a newspaper article, "The tragedy is that those who are responsible for the crisis are being asked to provide solutions" (Sharma 2013). This is exactly opposite of what Albert Einstein's famous quote says, "We cannot solve our problems with the same thinking we used when we created them."

It should have been recognised that the ushering in of the green revolution was not the result of an induced or spontaneous local technological change. Rather, it was the result of ongoing international and national impulses, and largely based on the support from the United States (US) and the technology flow from international agricultural research organisations, acceptance of the US support and the technology flow by the GOI, a conducive resource base in Punjab for the implementation of the technological package and enthusiastic participation of the youth of Punjab of that time. It was the result of the symbiotic action of all the four drivers. Any disorder in the symbiotic action had the potential to unsettle the ongoing process and this is what happened.

In the decade of the 1960s, global and domestic circumstances paved the way for the green revolution. The US was finding it difficult to continue the food supplies under the Public Law 480 (PL 480). The conditions of food supply were made more stringent. A correspondent of the *Economic Weekly* wrote on 11 July 1964, "the reported move in the US to make a fundamental change in the basis of PL 480 assistance has understandably disturbed New Delhi … There is no doubt that, in terms of our present difficulties, a harder version of PL 480 would have alarming repercussions …" He further wrote, "any difficulties, so far unforeseen, in securing adequate supplies of wheat and rice would eliminate what little hopes there are of stabilising food prices in the near future" (*Economic Weekly* 1964). Although the US was making the changes in PL 480, it was disinclined to alienate India and its people in the prevailing global geopolitical situation. The US was keen to do something on the ground in India that would have appeared to be benevolent while also serving its larger interests. But there was some resistance to the new technology both in the government and the farming community. The worsening food situation in 1965 provided the much-needed opportunity and washed away any resistance that was there. India decided in favour of accepting the green revolution package. As said earlier, the resource base of Punjab, including productive soils, canal network, sweet groundwater, and above all the receptive farming community helped the central government to cherry-pick Punjab as the first choice to try the new technology.

The growth process was a tremendous success in the first one-and-half decades but after that there was a persistent weakening of its drivers. The US emerged as the sole superpower with the decline of the Union of Soviet Socialist Republics and turned its back on such benevolences like food aid. The neo-liberal policies started promoting private agricultural research and the international research

organisations lost their relevance to multinational research companies. The intellectual property clause in international trade regulations was attached to agriculture to commercialise agricultural research. The Indian food situation was much better than the pre-green revolution period and the government reduced public investments in agriculture. The deterioration of land and water started in the early 1980s and has continued. The youth of Punjab, who participated in the green revolution, lost interest in agriculture as problems cropped up, and started looking for other employment avenues.

The second part of the whole story is the administrative-research-cum-policy responses to the challenges that emerged in the due course of time. Since the issues were, by and large, related to research and technology, so the PAU was at the centre of all the activities and responses. The PAU scientists customised the technologies they got through collaborations with international organisations to suit the local conditions and disseminated it. But the basic and fundamental research was largely done outside, and the PAU scientists applied it in real situations. So applied research and extension structure was set in the PAU. When research and technology flow from international organisations dried up, there was a void. Ignoring basic agricultural research was a costly mistake and there is no significant effort in this direction yet. Had the emphasis been placed on basic research earlier along with applied research, it might have helped to develop the sustainable technologies and agricultural system.

The growth model adopted from the US had inbuilt tendencies to move towards specialisation. Thus, the cropping pattern prompted by technological change and supporting policies moved towards wheat and rice. But, there emerged the issue of water table decline. The response was to limit specialisation and move towards diversification. It was exactly the opposite of what was practised in the previous two decades. Since 1985, the stated policy and research agenda is for diversification of cropping pattern with almost no success. But any alternative viewpoint was passionately rejected. On 18 February 2005, an article was published in the *Tribune* by a scholar from Punjab University suggesting that the state should continue to grow wheat and rice in the given circumstances (Shergill 2005). It was just a viewpoint, but a prompt reply appeared in the *Tribune* under the name of the PAU vice chancellor, emphatically disproving it (Aulakh 2005). In 2015, the basmati rice acreage increased too much under the hyped diversification policy and the basmati rice price decreased to half in comparison to the previous year (*Tribune* 2015). This was done even though many experts advised against doing so. In fact, the present policies are not working but there is little space for alternative viewpoints. This policy vacuum is responsible for the widespread distress and alienation of the farming community.

Two Measures for Improvement

There are two measures that can partly help to improve the situation in the long run. First, the basic and fundamental research will be crucial to ameliorate the current problems and for the future growth of agriculture. Hence, efforts should be made in this direction. There is a strong need for the establishment of a centre for basic and fundamental research in the PAU with adequate funding to address the issues that the state agriculture faces. Second, the existing agricultural research and policy formulation system needs to be relieved from the hierarchical domination and institutional barriers. Academic freedom is a universally accepted right of the scientists. Scientists are the most qualified to tackle this crisis, so relieve them from all limitations and fund them liberally. A few lines from a Canadian university's agreement with the faculty association, which describes the rights and responsibilities of the university teachers (UNBC-FA 2014), are worth quoting here:

> The Parties agree that they will not infringe or abridge the academic freedom of any Member. Members are entitled, regardless of prescribed doctrine, to freedom to practice their professions; freedom in carrying out research and in publishing the results thereof; freedom of teaching and discussion; freedom of creative activity; freedom to select, acquire, disseminate, or use documents in the exercise of their professional responsibilities; freedom to criticise the University, the Employer, and the Association; freedom from institutional censorship; and freedom to choose their directions of research.

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