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ECOLOGICAL ASPECTS OF AGRICULTURE MODEL FOLLOWED BY PUNJAB: AN ANALYSIS

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Abstract
Indian economy has undergone a significant structural change since Independence. Therefore, the pattern of growth of each sub-national unit is unique. Punjab is predominantly an agricultural economy. Keeping in view the national food requirement, in the late sixties, Punjab followed a specific development model characterized by agriculture. It provided the much needed food security but derailed the economy that had to culminate in to a tertiary sector driven economy. So adopting agricultural model, Punjab is facing so many ecological problem like overdependence of groundwater resources, floods and water logging, over use of fertilizer, chemicals and pesticides etc. , so with this health problems are also existing in Punjab. So this is high time to analyze the ecological fallouts in detail.

Key Words: Ground Water, Fertilizers, Chemicals, Pollution, Health-Hazards.

Introduction

Indian economy has undergone a significant structural change since Independence. This is highlighted by the change in the sector-wise composition of income and workforce over the years. The decade of 1990s witnessed major policy changes in the Indian economy and its State/Union territory economies. Each state of the Indian union is different in terms of its natural, social, political and economic features. Therefore, the pattern of growth of each sub-national unit is unique. Punjab is predominantly an agricultural economy. Keeping in view the national food requirement, in the late sixties, Punjab followed a specific development model characterized by agriculture. It provided the much needed food security but derailed the economy that had to culminate in to a tertiary sector driven economy. The problem has further been compounded by the social turmoil of 1980s and 1990s which affected all the sub-systems of Punjab economy.

Punjab, the granary state of India has been the leader of the Green Revolution. Growth of agriculture output in Punjab has lead to higher per-capita income and better standards of living. Falling water table and groundwater overdraft has become a serious problem in the state. Punjab is the topper state in consumption of chemical fertilizers and pesticides per hectare. The health ailments are alarmingly rising and are being getting closely identified with indiscriminate chemical use in agriculture. Following section, analyzes the ecological aspects of agriculture model followed by the state.

Over Dependence on Groundwater Resources

Punjab is predominantly an agrarian State having 85 percent of its geographical area under cultivation with an average cropping intensity of 189 percent. *Water is the only natural resource available and the state is devoid of any other mineral or natural resources.* Punjab's agriculture being highly intensive is dependent on heavy requirement of water. The present cropping pattern and the efforts to increase the productivity of food grains has led to immense strain on irrigation system due to limited surface water resources, which are grossly inadequate to meet requirements and this is causing stress on ground water resources. In the State, the surface water resources are being fully utilized through well-organized canal irrigation system. The available surface water is unable to meet the demand of agriculture; as such there is an increasing pressure on the ground water resource. The ground water is being over exploited to meet the ever increasing demand for diverse uses, i.e., for irrigation, industry, power generation and household use. *In respect of ground water, the state is facing a dual phenomenon of rising and falling water table.* The water table, mostly in South-Western parts, is rising because water extraction is limited due to blackish/saline quality. The water table is falling in North-Western, Central, Southern and South-Eastern parts of the State, where ground water is generally fresh and fit for irrigation. This has far reaching implication for the ecology of the region.

Agriculture in Punjab is primarily an artificial irrigation based, i.e., using surface as well as ground water resources. Intensive agriculture, based on wheat-rice rotation, has led to a serious imbalance in use and availability of ground resources. An analysis of net area irrigated in Punjab by source of irrigation (table 1) is indicative of the fact that only 27 percent of the total area is irrigated by surface water or canals and rest 72 percent area is irrigated by tube-wells and wells. The historical dependence on canals and other sources of surface water has gradually been reduced in favour of groundwater. In Punjab, there are only two major sources of irrigation; the govt. canals and tube-wells and wells. Presently, more than 72.68 percent of the net area irrigated in Punjab is dependent on tube-wells and wells, i.e., the groundwater. *The availability of surface water resources is unable to meet the demand for agriculture and as such there is an increasing pressure on underground water resources. The ground water is being over exploited to meet increasing demand for diverse purposes i.e., intensive irrigation, drinking, industry and power generation.*

Table 1: Net Area Irrigated in Punjab by Source ('000 Hectare)

Year	Govt. Canals	Private Canals	Tube-wells	Others	Total
1970-71	1286	6	1591	5	2888
	(44.53)	(0.21)	(55.09)	(0.17)	(100)
1980-81	1430	-	1939	13	3382
	(42.28)	-	(57.33)	(0.38)	(100)
2006-07	1148	-	2878	46	4072
	(28.19)	-	(70.68)	(1.13)	(100)
2011-12	1113	3	2969	-	4085
	(27.24)	(0.07)	(72.68)	-	(100)

Note: Figures in parentheses denote the percentages.
Source: *Statistical Abstract*, Govt. of Punjab, various issues.

Another important fact underscored by growth of number of tube-wells (table 1.1) is that in Punjab there are two types of tube-wells: diesel operated and electric operated. The break-up of number of tube-wells into diesel and electric operated is indicative of the fact that with minor variations, the number of diesel operated tube-wells has remained fairly stable but the number of electric operated tube-wells has increased nearly by 10 times in the 30 years and much of this increase can be attributed to the current decade. The share of electric operated tube-wells has crossed the mark of 85 percent. The end of decade of 1990 has been characterized by concession to the farmers in the form of free electricity. The free electricity along with convenience of use has led to ever before pressure on groundwater. Widespread rural electrification coupled with a flat-fee electricity subsidy that has led to a dramatic increase in the number of wells, groundwater-based irrigation now far surpasses surface water use.

Table 1.1: Number of Tube-wells in Punjab (Lakhs)

Year	Diesel Operated		Electricity Operated		Total
	No.	Percent	No.	Percent	No.
1970-71	1.01	52.60	0.91	47.40	1.92
1980-81	3.20	53.33	2.80	46.67	6.00
1990-91	2.00	25.00	6.00	75.00	8.00
2000-01	1.70	18.18	7.65	81.82	9.35
2010-11	2.40	17.36	11.42	82.63	13.82
2013-14	1.79	12.74	12.36	87.97	1405

Source: *Statistical Abstract*, Govt. of Punjab, 2014

On the whole, the area underlain by groundwater of unfit quality is around 7957 square kms which comes out to be 16 percent of Punjab State. In addition, the state has gone from growing a previously healthy mix of crops such as wheat, maize, pulses and vegetables to devoting nearly 80 percent of its crop area to rice and wheat, two of the most water-intensive crops. Overall, central and state level agriculture policy–consisting of minimum support prices, effective procurement of selected crops, input subsidies benefiting farmers in electricity, fertilizer, and irrigation and the increased availability of credit facilities over the years–has played a key role in pushing farmers to grow primarily wheat and rice–at enormous detriment to water resource sustainability in the country. Agriculture in Punjab is primarily an artificial irrigation based, i.e., using surface as well as ground water resources. Intensive agriculture, based on wheat-rice rotation, has led to a serious imbalance in use and availability of ground resources. The total water supply of 3.13 m ham falls short by 1.27 m ham of the total water demand of 4.40 m ham. The deficit is met by over-exploitation of groundwater reserves through tube-wells and wells. Punjab has been overusing water because it is expected to feed the entire nation. The State should be suitably compensated in much the same manner as states with mineral reserves are given royalty on coal and bauxite. There is a point in this argument; *Punjab's virtual water exports amount to 20.9 billion cubic meters every year. "Virtual water" refers to the water embedded in commodities.* For instance, a kg of basmati rice takes up to 7,500 liters of water to produce. An equivalent amount of water is deemed to be "exported" along with the rice. Food-surplus states are usually water exporters and the food-deficient ones, like Bihar, the importers. Keeping in view the alarming situation of over exploitation of Ground water as described above, there is an urgent need to formulate guidelines for release of electricity connection for agriculture pump sets.

Floods and Water Logging

Attempt to increase the production has resulted in blocking the natural water flows. Despite the infrastructure of dams and large head works on all major rivers and low dams on excessive discharging rivulets of the State, occasional excessive

flood waters, which cannot be impounded upstream of the dams, have to be passed downstream keeping in view the regulation norms based on the safety of dams. Sometimes even water has to be released in the interest of power generation when there are no irrigation requirements. Table 4.13 is an indicative of the damage caused by such floods in the immediate past. Almost every year several towns and villages are affected by floods and a significant loss is caused to land, human life and cattle in the region.

The net impact of water logging is that about 1.04 lac hectare area out of 2.16 lac hectare area of Muktsar has become critically water logged, making the land unfit for any worthwhile purpose. In low lying areas, the land stands submerged and totally unfit for cultivation, as a result not only agriculture production of this area has declined over the last few years, soil quality has deteriorated quite substantially.

Table 2: Effect of Floods during Rainy Season in Punjab in India

Year	Villages/ Towns Effected (No.)	Area Affected (in sq. km.)	Population Affected (No.)	Human Lives Lost (No.)	Cattle Heads Lost (No.)
1980	1191	489	85724	44	117
1990	755	471	90465	13	275
2000	81	127	319	5	88
2008	2001	5004	389116	34	104
2011	1196	6954	171773	36	133
2013	1408	37892	137858	1334	2540

Source: *Statistical Abstract*, Govt. of Punjab, various issues

Water Pollution

Another important aspect is water quality, which is impacted by untreated or inadequately treated industrial effluents and sewage flowing into nallahs and rivers. The problem is further compounded by the mixing of storm water and sewage in various municipal towns as these carry solid waste, bio-medical waste and hazardous waste from city roads into the water bodies. The pollution and contamination of water resources due to industrial waste, sewage and excessive use of chemical/pesticides in agriculture has led to high pH, BoD, DO, feacal coliform and concentrations of Arsenic etc. At some places, it has become toxic due to high concentration of heavy metals, such as, mercury, copper, chromium, lead, iron, nickel, cyanides and pesticides like DDT, BHC, endosulfan and aldrin. This can adversely affect the health of the populace and may cause diseases like cancer, skin diseases and miscarriage cases etc. Toxic water may even enter the food chain and alter geno-toxicity or damage DNA, causing irreparable loss to both human beings and wildlife. The chemical quality of groundwater is also getting deteriorated due to natural release of selenium and fluorides at some places. As such, special attention would have to be given to these aspects to provide safe water. Improvements in existing strategies, innovation of new cost effective techniques resting on a strong science and technology base are needed to eliminate the pollution of surface and ground water resources. Technology and training have to play important roles in the development of water resources and their management.

Region, the Chemical Dumping Ground

Chemical fertilizer consumption in Punjab is relatively on the higher side (table 3). In just a 1.5 of the geographical area, consistently around 7 to 8 percent of the country's total fertilizer consumption is done in Punjab only.

Table 3: Chemical Fertilizer in Punjab in Relation to India

Year	NPK Consumption In Punjab (MT)	NPK Consumption In India (MT)	Punjab as a % of India
1980-81	07.62	60.25	12.65
1990-91	12.20	125.00	9.76
1999-00	14.47	181.00	7.99
2000-01	13.13	167.00	7.86
2001-02	14.07	174.00	8.09
2010-11	19.11	281.00	6.80

Source: *Statistical Abstract*, Punjab, 2014-15

Pesticide consumption (table 3.1) is continuously on the rise. In terms of quantity, total consumption of pesticide that was 3300 MT (technical grade) in the year 1974-75, became 4300 MT in 1981-82, 6500 MT in 1991-92 and finally touched the

level of 7086 MT in the year 2001-02. That is, the pesticide consumption has almost tripled in the last thirty years. As compared to it, at all India level, the total pesticide consumption that was 44783 MT in the year 1974-75 rose to 60868 MT in the same period. Share of Punjab in total pesticide consumption that was 7.38 percent in the year 1974-75, rose to 9.01 percent in 1991 and has touched the level of 14.89 percent in 2002-02. Presently this share is more the 15 percent mark. These are the statistics which have emerged from the recorded sales figures. Actual ground reality is worst. In Punjab, the pesticide retailing is a free for all trade. In this region, low literacy level coupled with low income has facilitated the pesticide traders to make the area a dumping ground of chemicals. The pesticides (especially the POPs) that were banned a decade ago are freely available and being actively used.

Table 3.1: Pesticide Consumption in Punjab in Relation to India (in MT Tech. Grade)

Year	Pesticide Consumption in Punjab (MT)	Pesticide Consumption in India (MT)	Punjab as a % of India
1974-75	3300	44733	7.38
1981-82	4300	60868	7.06
1991-92	6500	72133	9.01
2001-02	7086	48350	14.89
2005-06	7050	44324	14.89
2006-07	6450	43718	14.75
2007-08	6600	42827	15.41
2008-09	6500	45180	14.38
2009-10	6500	42264	15.37

Source: Directorate of Plant Protection and Quarantine, Faridabad, and Zonal Conferences on Inputs (2010).

Effect on Human Health

The health ailments are alarmingly on the rise and are being getting closely identified with indiscriminate chemical use in agriculture. In Punjab, the home of India's Green Revolution, news reports about cancer deaths first emerged in late 1990s when the media reported high cancer mortality in a few select villages. Village Gyana and Jajjal in Bathinda district hogged the limelight for being "cancer stricken" villages (Pandher 1999). The government was initially in a denial mode and even stated that "there have been no cancer deaths in Punjab" in response to a parliamentary question (Punjab 2003). The denial mode did not last long, and a spate of reports and publications increased the focus on cancer mortality in Punjab. The state's own agency, the Punjab Pollution Control Board commissioned the Post Graduate Institute of Medical Education and Research, Chandigarh to study the issue. The study report (PPCB 2005) revealed that the prevalence of confirmed cancer cases was 103 per lakh (100,000) Talwandi Sabo and 71 per lakh at Chamkaur Sahib Blocks of Punjab.

The report, titled "An epidemiological study of cancer cases reported from villages of Talwandi Sabo Block, District Bathinda, Punjab" concluded that cancer deaths in Talwandi Sabo block were greater than those in Chamkaur Sahib "probably due to more use of pesticides, tobacco and alcohol". It further stated that "Limited studies show that in drinking water the levels of heavy metals such as As, Cd, Cr, Se, Hg were generally higher, and pesticides such as heptachlor, ethion and chloropyrifos were also higher in samples of drinking water, vegetables and blood in Talwandi Saho as compared to Chamkaur Sahib"

Present '*Status Report from Government'* is as follows. The government survey report (released by Health Minister Madan Mohan Mittal on 28.1.2013) of a statewide cancer awareness and symptom-based early detection campaign showed that 33,318 cancer deaths have occurred during last five years, out of which 14,682 were in the Malwa region alone. The survey data reveals that there are 84,453 persons in the state who have cancer-like symptoms. It covered almost 98 per cent of the state's population, has found that the incidence of cancer is higher than national and international average. When compared to World Health Organization's point of reference - 80 affected among a population of one lakh - Punjab's survey discovered that 90 in a population of one lakh were suffering from cancer. While 215 people per lakh have died of cancer, another 318 per lakh are suspected of suffering from the disease. Region wise, Malwa (107.1 per lakh) tops the list followed by Doaba (88.1 per lakh) and Majha (64.7 per lakh). In Malwa, district-wise, incidence of cancer was highest in Muktsar (136.3 per lakh). Among Doaba districts, the incidence of cancer was highest in Kapurthala (99.1 per lakh).

Punjab is facing much deteriorated position on all sides of ecological aspects. So government should adopt some policies and some ways which helpful to escape from this problems, like change the cropping pattern and chose the multi cropping pattern, government should banned on over dumping or over use of fertilizers, chemicals and pesticides etc. , use and proper disposal of the empty pesticides containers. So with the help of these efforts can change the ecology violability of Punjab.

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