Journal of Advances and Scholarly Researches in Allied Education

Vol. XI, Issue No. XXI, Apr-2016, ISSN 2230-7540

AGRICULTURAL RESOURCE DEPLETION AND ARISING CONCERNS OF ENVIRONMENTAL ETHICS IN PUNJAB: A DIRE NEED OF RESCUE, REVIVAL AND SUSTAINABLE DEVELOPMENT

AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

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Agricultural Resource Depletion and Arising Concerns of Environmental Ethics in Punjab: A Dire Need of Rescue, Revival and Sustainable Development

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Abstract – Today, it is a well-established fact that growing environmental complexities and concerns are an integral part of the overall process of sustainable development. Degradation of the environment, as a matter of fact, has been associated with almost every human action. At the threshold of 21st century, when we are at the verge of facing a global environmental crisis, with situations like global warming, climate change, draughts and frequent environmental calamities on the rise, man has finally begun to realise the ill consequences of his conscious and unconscious activities, most of which had been to satisfy and satiate his never ending greed and desires. The once harmonious relationship between man and environment today stands at crossroads, marred due to increased human greed, prominence of materialism, consumerism, individualism and egoism, ruthless misuse and waste of nature and natural resources, irresponsible and uncontrolled use of technology and indifference towards environment. Therefore, study and practice of environmental ethics have become very relevant today.

Agriculture has been the most important human enterprise since the arrival of mankind on earth. It has been that productive unit of human survival where man has been getting the bountiful free gifts of nature, in abundance, such as land, light, water, air, weather, temperature, humidity and rainfall. It is the primary unit indispensable for human existence that produces food, feed, fuel, fibre and other valuable products through the cultivation of plants and domestication of animals. But alas! What has happened to this little, yet, the most developed creature called humans? Why have there been so much of ignorance, insensitivity, insanity and indifference? How could men think of their existence in seclusion…apart, aloof and away from nature?

This paper seeks to look into some of these pressing questions giving special reference to the agricultural practices of Punjab and multiple problems arising henceforth, like- soil erosion, siltation and saltification; water contamination and depletion; and prominence of cancer and other life-taking diseases in the great land of green revolution. It also seeks to study the newer environmental and ethical concerns that have arrived before both, the peasant as well as the normal people of Punjab due to intensive agriculture, excessive use of chemical fertilizers, unscientific and over use of deadly chemical pesticides and many more bad practices prevalent in Punjab.

Key words: Environmental ethics, Resource depletion, Sustainable development, Climate change…

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Agriculture has been the back bone of the Indian economy since time immemorial. Western Indian states have been the pioneers in supplying food grains to the entire nation. It was after the introduction of high yielding varieties of wheat and rice during late 1960s, coupled with a progressive and a productive policy of progressive farming that put the agricultural economy of the State on the path of constant growth, popularly known as the Green revolution. Consolidation of holdings, development of irrigation, high capital investment, improved infrastructure and strong institutional reforms provided a very conducive environment for the success of green revolution and its immediate implications within the state. Green revolution not only enabled the state to remain on a high growth trajectory but also led to increase in the real income of the farmers. This technology intensive strategy resulted into the transformation of agriculture and rural economy in the state and converted Punjab

into the food bowl of the country, making the nation self-sufficient in food grains to a great extent.

Punjab's share in Agricultural Production in India:

Wheat	18% (over 16 Million Tonnes)
Rice	11% (over 10.8 Million Tonnes)
Milk	7.5% (over 9.5 Million Tonnes)
Cotton	10% (over 1.7 Million Bales)
Kinnows and Oranges	75% (over 0.95 Million Tonnes)
Mushroom	45% (over 70,000 Tonnes)
Honey	26% (over 14,000 Tonnes)

Source: Department of Agriculture, Punjab, 2013-14

Agriculture still continues to be an important sector of the state's economy in terms of employment and contributes about 22% of the Gross State Domestic Product (2010-11). As per the agricultural statistics, the State has about 4.2 million hectares of cultivable area, which is 3% of the net area within the country. It produces about 19% of India's wheat and 11% of rice from 12.4% and 6.7% of the total area under which wheat and rice are grown respectively in the country. Punjab has been a major contributor of food grains over the last four decades contributing 25-50% of rice and 38-75% of wheat to the central pool of food grains (Kumar and Vipin, 2015). Cotton is another important crop of the state which is grown over 5.2 lakh hectares (2011-12) and constitutes about 5% of the total cotton area, and 9% of the total cotton production in the country.

Lately, some disturbing trends have emerged in the agriculture sector of the state. The over dependence on wheat and rice and intensive use of farm land with more than 200% cropping intensity have led to a crisis in terms of over exploitation of natural resources viz. Soil and ground water. But people have been highly ignorant, insensitive, and indifferent towards these problems.

Whenever a new system is introduced in a society, the people of that society, along with the responsibility of utilising it, have the additional and latent responsibility of adapting to it, leaving old customs and practices. This responsibility increases when that new system, to be adopted, is technology oriented. In such circumstances, people to whom the system is being introduced to need to be given proper guidance and education and training, as to how should they utilise, how not to misuse and how should they control the repercussions that come along, that leads to a holistic development. This was not taken into account while implementing the technical Green Revolution that required awareness, information, skill and education. Farmers needed to be extensively educated and guided, as to how should they utilise the technology of HYV seeds, how should they control the use of pesticides and fertilizers so as not to harm the soil, water, environment and their health, how to judiciously use resources etc. Thus, resultantly, the advantages of Green Revolution were immediate and short lived and for each economic advantage that came, a parallel socio-economic and environmental problem was created.

While productivity increased, the quality of soil depleted due to excessive use of fertilizers and heterogeneity in crop production. Farmers only grew wheat and rice, for they were commercial. Other crops were ignored, and soil depleted further. Requirement of water increased twofold immediately, then to manifold subsequently, which lead to severe exploitation of natural water resources, large scale borings and big pump sets found their places in every farmer's field rather than utilizing the canal water. While the quantity of production increased, so did the cost of inputs, leading to low profits. Basically, an added short term advantage brought along many long term problems associated with it. While the advantages died quickly, the problems stayed and got multiplied into more complexities. This has been further explained in the article, later.

The State of Punjab

Punjab is situated in the northwest India. The Indian state borders the Pakistani province of Punjab to the west, Jammu and Kashmir to the north, Himachal Pradesh to the northeast, Chandigarh to the east, Haryana to the south and southeast and Rajasthan to the southwest. The total area of the state is 50,362 square kilometres. The population is 2, 7704,236 (Census, 2011). Punjab's capital is Chandigarh, which is administered separately as a Union Territory since it is also the capital of neighbouring Haryana. Other major cities of Punjab include Mohali, Ludhiana, Amritsar, Patiala and Jalandhar.

Broad Objectives

The major objectives of this paper are as follows:

- To analyse the present agricultural practices in Punjab and its associated major problems
- To outline the effects of green revolution in Punjab and do the in-depth study of their severity.
- To provide suggestive measures and adaptive strategies for sustainable agriculture
- To suggest a way out from the existing approach of farming to ecological and economic farm practices which is sustainable and durable.

Agriculture Profile: Punjab

Net sown area:	4158 Thousand Hectare (83% of TGA)
Gross Cropped area:	7882 Thousand Hectare
Average farm size:	3.76 Hectare
	Major Crops: Paddy, Wheat, Maize, Cotton & Sugarcane
Area under Paddy-wheat	77% of cropped area

rotation:	
Cropping Intensity:	190% (Highest in India)
Contribution to Gross SDP of state:	21.83% (at factor cost)
Contribution to Central Pool • **Wheat** • **Paddy**	38.7 % (10.96 MT) 22.1% (7.73 MT)
Average yield : • **Wheat** • **Paddy** • **Cotton**	3998 kg/ha 4716 kg./ha (Highest in India) 575 kg/ha
Irrigated Area : • **Surface water:** • **Ground water:**	98% (Highest in India) 27% 73%
Ground water development :	170% (as on March, 2009)
Fertilizer Consumption :	239 kg/hectare (Highest in India)
Pesticide Consumption :	923g/ha (Highest in India)
Farm power availability :	2.6 kw/ha (Highest in India)
Farm mechanization • **11% (4,76,835) tractors of the country** • **One tractor for every 9 ha of net cultivated land of as compare to National Average of 62 ha**	

Source: Deptt. of Agriculture, Punjab, 2013-14& Statistical Abstract of Punjab, 2013

MATERIALS AND METHOD

The study is based on a secondary data analysis of agricultural data of the last four decades. Various government reports have been referred for the analysis of agricultural status in Punjab and its associated issues. Data pertaining to production trends was obtained from the department of agriculture, Punjab. The status of land and its degradation, quality issues data were obtained from the soil survey division of the Department of agriculture.

RESULTS AND DISCUSSION:

As discussed above, it is a very well-known fact that Punjab is an agriculturally intensive economy. So in this regard, it is important to know the various agricultural zones and their specific issues and problems in the present times. Presently, Punjab has 20 districts. On the basis of agro-climatic conditions, we divide the state into three regions: Zone A, the sub-mountainous region; Zone B, the central belt; and Zone C, the south-western cotton belt.

Zone A (Sub-mountainous region), known as the *Kandi* region, has an undulating topography comprising about 17 percent of the total area of the state. This zone has particularly abundant rainfall that averages approximately up to more than 1,100 mm per annum. The cropping pattern of the area is more diverse than other zones and comprises crops like wheat, rice, basmati rice, maize, oilseeds, fruits, and vegetables.

Zone B, the central region also known as the "Sweetwater" region, comprises about 47 percent of the area of the state. Average annual rainfall in this region is about 760 mm. It is highly productive and has a tight-knit system of irrigation; mainly through the use of tube-wells. The main cropping system in Zone II is the rice-wheat rotation. The water table in this region has been falling at an alarming average rate of 0.94 meters per year since 2004-07. The steep falling ground water is due to the massive increase in the number of tube wells from 192,000 in 1970-71 to 1,276,200 in 2008-09, that has in exorable been fuelled by power subsidies. The falling water table and declining soil fertility threat en the sustainability of the production capacity of this region.

Zone C, the south-western region popularly known as the cotton belt, comprises almost 36 percent of the cultivated area of the state. This region is endowed with deep and brackish ground water and sandy soil. It is much drier than the other two zones. The average annual rainfall of this region is 360mm. Over the last decade, there has been a fall in the area under cotton that is due to a steady decline in its productivity. At the same time, the increase in area under rice has increased salt accumulation on the soil surface due to the continuous use of underground water which is brackish and has led to water logging of the soil.

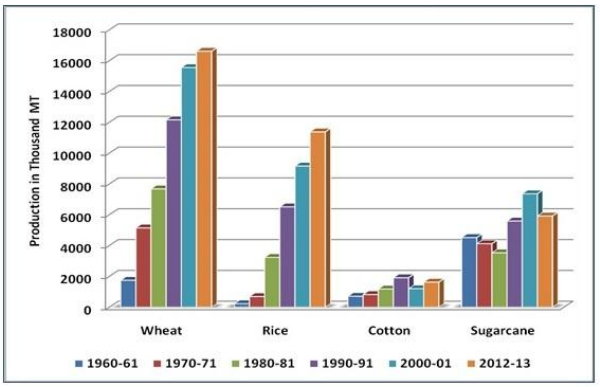


Figure 1: Production of wheat, rice, cotton and sugarcane in Punjab

(Source: Department of Agriculture, Government of Punjab)

The various provinces of all the three zone scan be seen in the following table:

Table 1. Agro-Climatic provinces under different regions:

Zone	Province
Zonel (sub-mountainous region)	Guradaspur, Hoshiarpur, Nawar Shahar, Rupnagar, Mohali

ZoneII(central region)	Amristar, TaranTaran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Patiala, Moga, Sangrur, Barnala
ZoneIII(south-western region)	Firozpur, Faridkot, Muktsar, Bathinda,Mansa

Source: Sidhu and Vatta, 2014

Decreasing Productivity

Over the years, there has been considerable decline in the overall marginal production of different crops in the region. Due to the over use of chemical fertilizers and pesticides, which is required by HYV seeds, the productivity of the land has been declining. This has resulted in the declining trend in the per unit production of various crops like different varieties of rice and wheat. This has been observed that the once so called successful green revolution is now no more a success full revolution, but a bane.

Fertilizer consumption in Punjab (1960-2013)

Year	Nitrogen N	Phosphorus P	Potash K	Total	Consumption (kg/ha)
1960-61	5	…	…	5	…
1970-71	175	31	7	213	37.50
1980-81	526	207	29	762	112.50
1990-91	877	328	15	1220	162.60
1995-96	1020	227	16	1263	166.31
2000-01	1008	282	23	1313	168.33
2005-06	1255	369	63	1687	214
2006-07	1299	354	38	1691	215
2007-08	1317	341	37	1695	213
2008-09	1332	379	55	1766	223
2009-10	1348	383	56	1787	226
2010-11	1403	435	73	1911	243
2011-12	1416	449	53	1918	243
2012-13*	1436	416	33	1885	239
2013-14**	1425	469	83	1977	251

Nutrient (000' Tonnes)

(Source: Department of Agriculture, Government of Punjab)

Heterogeneity in Crop production

During and even after the green revolution died, for that matter, it has been noted that there is still, an unevenness of sorts, in the distribution and production of different High Yielding varieties of Seeds that were introduced. Out of them, five crops namely wheat, rice, maize, Jowar and Bajra have been selected under the study and only they have shown positive results, not any other crops. The production of pulses, oily seeds, cotton and jute suffered because poor farmers having limited land, confined to wheat and rice only, often branding the revolution as wheat-rice revolution.

Wide Disparity in the Distribution of income

It is a well-known fact that every positive thing brings about some negativity along with itself. There is no doubt in the fact that green revolution brought about a great transformation with North Indian states along with Punjab, but it also brought about interregional disparities because of variations in the availability of irrigation facilities, difference in the suitability of different regions for production of wheat and paddy, further stimulated by the structural and physical differences of various regions. In general, big farmers benefitted the most as they could afford and implement the new technology. Farmers with large land holdings benefitted more as they had the capacity to invest. So this resulted in a huge gap in the productivity of large and small farmer's income.

As pointed out in Kumar and Vipin, in 2015, another factor responsible for the widening of such disparities was the practice of reverse leasing (i.e. larger farmers leasing inland, from small farmers) as well as the fall in the area lease doubt by the large farmers to small farmers, after the advent of green revolution. The rising number of suicides in Punjab directly exposes the extremity of rural insecurity, environmentally and economically, bringing out the un- sustainability in Punjab's agriculture. The number off armours who committed suicide in just two districts 2990-1256 in Bathinda and 1634 in Sangrur District- between 2000 and 2008.

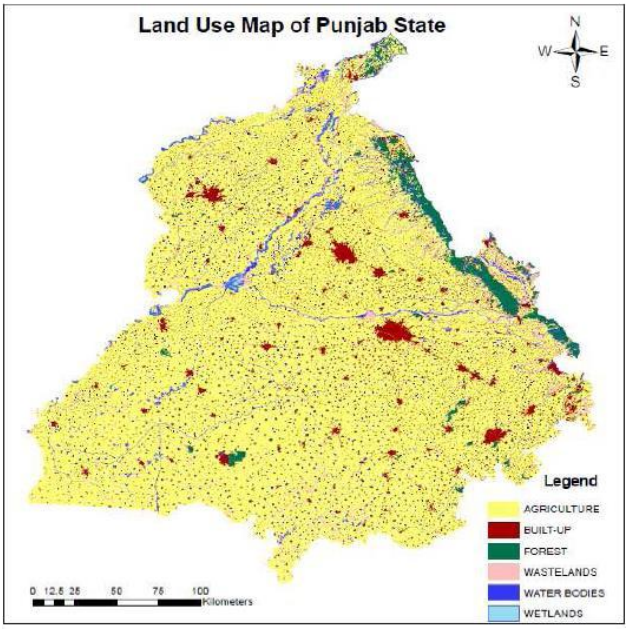
Increasing Social Tension

Apart from creating economic divide, green revolution also brought social tensions as these new technologies have created a class of farmers who have resources and opportunities to prosper and who have prospered. While on the other hand, poor and small farmers could not live up to the pace and have lagged, becoming stagnant. There is now a very conspicuous difference in the economic status of the two groups of farmers. This has led to a social polarisation in the rural areas and thus, growing tensions.

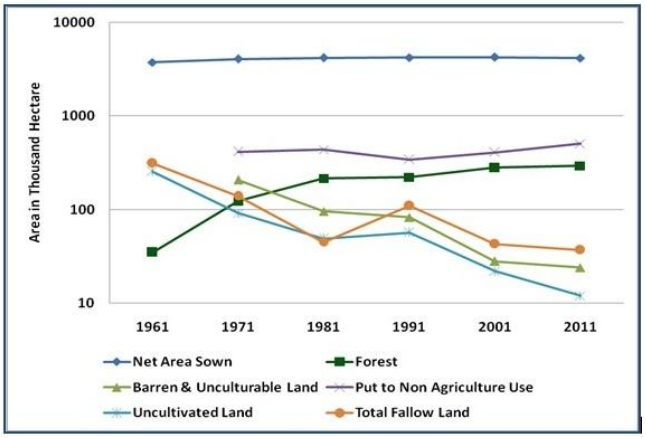
Land Issues: Quality a major concern

As popularly known to all new agricultural techniques, technology could be applied only in big farms and big land holdings and is responsible for low profitability of agriculture. But the experiences from the world show a different trend. In order to succeed with farmers with small land holdings, government should assist them to buy land through the **provision of institutional credit**, on a long term basis, at a low rate of interest and by reducing stamp duty. Also they should be facilitated to

enlarge their operational holdings by **liberalizing the land lease market.** These could be attained by providing tenants with their rights and least interference by the owner. There are some emerging land issues such as increase in demand for land for non-agricultural purposes, including the setting up of special economic zones, displacement of farmers, tribes and others due to development projects. Apart from these, there is a quality issue which Punjab has been battling for long, now. Post implementation of Green revolution, Punjab saw an indiscriminate use of chemical fertilizers and pesticides which have deteriorated the soil quality. The pH value has altered to such an extent that CRI crops grown in those soils are turning out to be dangerous as chemicals are entering the food chains, contaminating food. So there is a very serious issue which should be taken care at the earliest, before it is too late. Effective policy and planning changes need to be brought about to bring in the desired changes. Also, there is a need for careful acquisition during the conversion of land to non-agricultural land.



Land use pattern in Punjab from 1961 to 2011



Source: Statistical Abstract of Punjab, 2012 as cited in Jerath, Neelima; Ladhar, Satnam Singh; Singh, Gurharminder; 2014. State of Environment, Punjab-2014

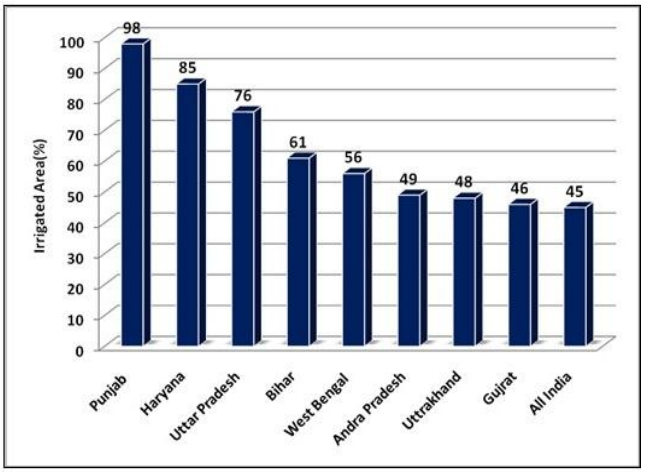
Irrigation and Water Management

Water is the leading input in agriculture. Development of irrigation and water management systems, is crucial for raising living standards in rural areas. Major areas of concern in irrigation are: **decline in real investment**, **constricted spread of investment**, **low recovery of costs**, **decline in water table, wastages and in efficiencies in water use** and **non-involvement of users**. Both investment and efficiency in irrigation systems are needed. Major areas of reforms needed in irrigation are: **stepping up and prioritizing public investment**, **raising profitability of groundwater exploitation and augmenting ground water resources, rational pricing of irrigation water and electricity**, **involvement of user farmers in the management of irrigation systems** and, **making ground water markets equitable.** In a recent study, new watershed guidelines based on Parthasarathy Committees recommendations were accepted by the Central Cabinet in March 2009. The implementation has to be developed, in order to obtain benefits in rain fed areas. National Rain fed Area Authority has a big responsibility in matters relating to water conservation and watershed development. Assets created under NREGS can help in improving land and water management.

Net Irrigated Area by different sources in Punjab (1970-71) to (2010-11)

	Canals	Tubwells	Other Source	Total Irrigated Area
70-71	1291	1592	5	2888
1980-81	1430	1939	13	3382
1990-91	1669	2233	7	3909
2000-01	962	3074	2	4038
2010-11	1116	2915	-	4074

Source: Statistical Abstract of Punjab, 2012



CONCLUSION AND SUGGESTIONS

The role of Punjab has been vital since the inception of green revolution in India and making India self–sufficient in Food and its security. But, having said that, the state where green revolution took place in 1960's also witnessed the adverse conditions of the farmers and their suicides evidentializing the extent to which the revolution brought misery for them rather than happiness.

The recent trend in agriculture in the state highlights the need to bring about some conventional as well as non-conventional changes in the pattern. Reports suggest large scale degradation in soil quality and ground water resources have been witnessed. These existing problems coupled with changing climatic patterns could adversely affect the production system of the state and food security issue in the long term. Although majority of the state is irrigated but deteriorating the quantity and quality of soil and water, could further aggravate the problems.

Agriculture in Punjab is in threat due to couple of problems like rapid fall in groundwater due to decline in rainfall, unfavourable changes in temperature during critical periods of growth of wheat, and increasing incidences of insect-pest attacks on the cotton crop due to rise in humidity caused by continuous flooding of paddy fields. Also the production and marketing risk for vegetable crops as well as fruits tend to be high due to lack of institutional support. This would discourage the farmers for large scale adoption of crops resulting into a decline in the extent of crop diversification.

Thus, there is a need for a much deeper investigation of crop yields and such man made conventional problems of degrading soil and water conditions and other climatic factors. The locals and the policy makers should look to take some serious action in order to protect agriculture in Punjab and make it sustainable. Initiatives like crop insurance mechanism for crops like cotton, fruits and vegetables, would help in crop diversification without any risk from the farmers end. There should be efforts to promote initiatives like soil health check, check in the use of fertilizers and other chemicals. Farmers should be made aware about the ill effect of the present pattern and future implications. They should be made aware about land and fertilizer ratios, promote dry farming. Loans should be available to the farmers at very low interest rates so as they come forward for investment in agricultural sector.

Having said all that, as been stated earlier, abolition of old practices for the adoption of new systems is a complex process. The uneducated and hardly aware farmers require institutionalised support from NGOs working in this direction, as well as the government. That is to say, that a transformation from technological and commercially oriented ways of farming to more organic, natural and economic ways of farming, has to be essentially a gradual and understood change, so that results can be realised as well, not just enjoyed. This calls for a need to promote rural development studies in the Youth specialising in agriculture, who can help uneducated and unaware farmers. This will ensure that the development that happens is not biased and centred, but reaches everyone equally.

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