

## Status of Environmental Pollution in Rural Punjab and its Management

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### ABSTRACT

*Punjab agriculture is predominated by rice-wheat monoculture due to its superior yields and better prize structure than other crops. After green revolution, use of fertilizer, pesticides and insecticides has increased which is not only affecting the human health but also the soil health. With the advent of new technologies, the crop residue management has become a problem causing farmers to burn crop residue leading to air pollution. Faulty agronomic practices are affecting the rural environment which along with pollution due to industrial and transport sectors is affecting the environmental quality. Keeping in view the above consideration the study was planned with the objective of studying status and factors causing environmental pollution in rural Punjab. For this purpose, various researches and literature from last 20 years were reviewed. The review of literature revealed that air, water and soil pollution are the challenges of rural Punjab. Air pollution was observed higher than soil and water pollutions. It is estimated that in Punjab more than 17 million tones of rice stubble is burnt every year. The paddy straw burning causes nutrient losses like 3.85 million tones of organic carbon, 59,000 tones of nitrogen, 20,000 tones of phosphorus and 34,000 tones of potassium. This also adversely affects the nutrient budget in the soil. The polluted soil is also causing contamination in drinking water and food we eat. The air, water and soil are loaded with toxic chemicals. Proper management of the environment is the only way to ensure continuous and sustained development of the society. There is a need to create an awakening on the problems arising due to faulty agricultural practices, related consequences and to suggest means to reduce the stress on environment in the rural areas.*

**Key words:** Environment pollution; Rural Punjab; Management; Stubble burning; Soil nutrient; Crop residue.

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### INTRODUCTION

Environmental pollution simply means the contamination or undesirable changes of physical, chemical and biological quality of environment. It is the release of potentially harmful substance into environment due to human's activities and the negative impact of human's activities on our environment. This is because the exploration, innovation and modern technology which have to do with use of materials are now threatening the earth as planet and demand an urgent attention [10].

Punjab is primarily agriculture-based state due to the presence of abundant water sources and fertile soils. About 75.0 per cent of its population depends directly on agriculture. Punjab is one of the most fertile regions in India. The region is ideal for growing wheat crop. Rice, sugar cane, fruits and vegetables are also grown here. Indian Punjab is called the "Granary of India" or "India's bread-basket". It produces 10.26 per cent of India's cotton, 19.5 per cent of India's wheat, and 11.0 per cent of India's rice. In worldwide terms, Indian Punjab produces 2.0 per cent of the world's cotton, 2.0 per cent of its wheat and 1.0

per cent of its rice. Rice and wheat are doublecropped in Punjab with rice stalks being burned off over millions of acres prior to the planting of wheat. This widespread practice is polluting and wasteful [29].

Punjab has made a commendable progress in the production of food grains in the post-green revolution period. Food grain production underwent a big jump from 3.16 million tonnes in 1960–1961 to 28.35 million tonnes in 2011–2012 [17]. The green revolution was introduced as a new agricultural strategy in late 1960s which was marked with the arrival of new high yielding varieties of wheat, rice, maize and bajra (millet) and package of other inputs like chemical fertilizers, insecticides, pesticides and assured irrigation facilities. Punjab consumes highest amount of fertilizers in the country, amounting to almost 10.0 per cent of the national consumption with just 1.5 per cent of the geographical area of the country. The worst problem with the pesticides is that it has contaminated drinking water very severely. It may not be wrong to say that “PUNJAB IS BECOMING HOTSPOT FOR CANCER IN INDIA”. The excessive uses of fertilizers and pesticides have hugely contributed towards degradation of the quality of soil also [1].

Khan and Ghouri [15] in their research paper entitled “Environmental pollution: its effects on life and its remedies” gave an insight view about the effects of environmental pollution in the perspective of air pollution, water, land and soil waste pollution on human, animals and tree plants. It was suggested that world institutions, government and local organization should use advanced resources to balance the environment for living and encourage the individuals to live friendly with environment.

### **KINDS OF POLLUTION IN RURAL PUNJAB**

Classification of environmental pollution is difficult task because the pollutants and the media through which the pollutants are transported are all inter-connected and inter-related. In the current scenario, Punjab is dealing with different kinds of pollution, such as

1. Air Pollution
2. Soil pollution
3. Water pollution

#### **Air Pollution**

Air pollution is the presence of pollutants in the atmosphere, in the form of solid, liquid or gas, in such a concentration, that is injurious to human, plants and animals. Air pollution is one of the major health problems confronting humans today (Gawande & Kaware, 2015). It is revealed from the researches that air pollution was observed higher than soil pollution and water pollution due to presence of pollutants in air such as CO, CH<sub>4</sub>, NO<sub>2</sub>, SO<sub>2</sub> that are emitted from burning crop, industries and vehicles [22].

#### **Factors affecting the air quality of Punjab**

- Agricultural pollution
- Industrial pollution
- Vehicular pollution

#### **Agricultural pollution**

Pollution from agricultural activities adversely affects the state’s environment. In Punjab air pollution is highly due to burning of crop residue. Punjab produces around 23 million tonnes of paddy straw and 17 million tonnes of wheat straw annually. More than 80.0 per cent of paddy straw (18.4 million tonnes) and almost 50 per cent wheat straw (8.5 million tonnes) produced in the state is being burnt in fields. Almost whole of paddy straw, except Basmati rice is burnt in the field to enable early sowing of next crop. Lately, the farmers have extended this practice to wheat crop also. Though part of the wheat straw is used as dry fodder for the milch cattle, the remaining straw is usually burnt for quick disposal. Biomass burning is supposed to be the largest source of air pollution in many areas of the developed and developing world. [3]. Out of total biomass generation in Patiala (Punjab) crop residue contributes 90.4 percent [20].

**Table 1 End use of stubble by the farmers**

End use	Rice (percentage of total stubble production)	Wheat (percentage of total stubble production)
Fodder	7	45
Soil incorporation	1	<1
Burnt	81	48
Rope making	4	0
Miscellaneous	7	7

Source: Government of Punjab (2007)

This produces high level of pollutants like (NO<sub>2</sub>, SO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>) etc. and affects health of the human and also decrease quality of soil. Various researches have revealed that northeastern region of India is characterized as the region of biomass burning (Habib *et al*, 2006). Generation of cereal crop residue burning was highest in the states of Uttar Pradesh (72 Mt) followed by Punjab (45.6 Mt), West Bengal (37.3 Mt), Andhra Pradesh (33.0 Mt) and Haryana (24.7 Mt) (Jain *et al*, 2014). The open field burning of straw after combine harvesting is a common practice in the state in order to ensure early preparation of fields for the next crop. Apart from affecting the soil fertility burning of agricultural residue is now recognized as an important source of air pollution in rural areas.

Air pollution has adverse impacts on human health, plants, animal, materials and as well as, in its global implications like depletion of the ozone layer, green house effects, etc. Air Pollutants usually enter the body through the respiratory system or skin and may affect specific organs as shown in the table below:

Name of the Pollutant	Effect on Human Health
CO	Central nervous system affected at 15 mg/m <sup>3</sup>
SO <sub>2</sub>	Increased mortality at 0.25 mg/m <sup>3</sup> with 750mg/m <sup>3</sup> smoke. Induced respiratory illness in children at 0.046 mg/m <sup>3</sup> with smoke at 100 mg/m <sup>3</sup> for long term exposure. Throat irritation at 8-12 mg/m <sup>3</sup> . Eye irritation at 10mg/m <sup>3</sup> . Immediate coughing at 20 mg/m <sup>3</sup>
Particulates	Irritation of nose & throat, respiratory problems especially bronchial asthma, skin diseases, eye irritation
NO <sub>2</sub>	Increased respiratory illness over 6 months test period at 0.06-0.109 mg/m <sup>3</sup>
Ozone	Irritate nose & throat at 0.05 mg/m <sup>3</sup> Headache( in 30 m) at 1 mg/m <sup>3</sup>

Source:ENVIS Centre: Punjab [7]

Kumar *et al* [17] conducted a survey on value of health damage caused by smoke pollution. Data was collected from 625 respondents from three villages of Patiala district of Punjab. Tobit and Poission model was used to estimate mitigation expenditure and workdays lost equation. Findings revealed that air pollution caused Rs. 76 million total annual welfare loss of health damage in rural Punjab. Results also indicated other effects of stubble burning in Punjab such as loss of soil nutrient; vegetation, bio-diversity and accidents due to low visibility. Rice residue burning results in extensive impacts both on and off farm, e.g., losses in soil nutrients, soil organic matter, production and productivity, air quality, biodiversity, and water and energy efficiency and on human and animal health. In India, air pollution from residue burning can be severe, with impacts on human health by directly causing or exacerbating a range of health hazards and contributing to the incidence of traumatic road accidents through significantly reduced visibility.

### Industrial pollution

In Punjab, all industries are categorized into Red (highly polluting) and Green (Moderately, mildly or non-polluting) categories. The Red category industries require environmental clearance from Competent State Authority of the Department of Environment. As per latest data provided by the Punjab Pollution Control Board, a total of 15,021 units in the year 2015-2016 fall under red category industries (highly polluted) due to use of coal or rice husk

as fuel and contributing high level of suspended particulate, oxide nitrogen and sulphur, organic compounds and other pollutants in the air. It has serious and severe effects on human health and environment degradation [16].

#### **Air polluting industries and pollutants in Punjab**

<b>Air polluting industries</b>	<b>Pollutants</b>
Rice, Sugar, Food Products	Particulates, CO <sub>2</sub> , SO <sub>2</sub> , NO <sub>x</sub>
Beverages	Particulates, Odour
Cotton/Woolen/Synthetic/Textile/Dying etc	Particulates
Paper Products & Printing	Particulates, mercaptans
Leather & Leather Products	Particulates, Odour
Rubber & Plastic Products	Particulates, Odour, VOCs
Chemical Products	Cl <sub>2</sub> , HCl, Acid mist, Acid fumes, Hydrocarbons
Non-Metallic Mineral Products	Particulates
Metal Products	Metallic Particulates, CO, SO <sub>2</sub> , AcidMist
Transport Equipment & Parts	Particulates
Brick Kilns	Particulates, SO <sub>2</sub> , CO
Pharmaceuticals	Odour, Particulates
Rolling, forging & galvanizing units	Particulates
Fertilizer, Vanaspati, Thermal, Cement, etc.	Odour, Particulates

Source: Status of Environment Report Punjab [6]

#### **Vehicular pollution**

In Punjab there are massive growths in vehicles from 3, 60,154 in 1981 to 90 and 64,476 in 2015-016 and this is contributing to increase level of pollutants in the atmosphere such as carbon monoxide, particulate matter, nitrogen oxide etc. This affects the health of the human, plants and animals. The major pollutants released as vehicle/fuel emissions are carbon monoxide, nitrogen oxides, photochemical oxidants, air toxics namely benzene, aldehydes, 1-3 butadiene, lead, particulate matter, hydrocarbon, oxides of sulphur and polycyclic aromatic hydrocarbons ; While the predominant pollutants in petrol/gasoline driven vehicles are hydrocarbons and carbon monoxide, the predominant pollutants from the diesel-based vehicles are oxides of nitrogen and particulates. As per studies Central Pollution Control Board , vehicular emissions are responsible for most of hydrocarbons (90-95%) and carbon monoxide (70-80%) emissions [9].

#### **Soil pollution**

Soil is the thin layer of organic and inorganic materials that covers the earth's rocky surface. Due to excess use of pesticides, insecticides, herbicides, fertilizer like ammonium nitrate (NH<sub>4</sub>NO<sub>3</sub>), phosphorus (P<sub>2</sub>O<sub>5</sub>) etc. and over use of NPK fertilizer reduce quantity of crop and as well as soil which affect the human health like pollution in drinking water, contamination in vegetable due to presence of chemical, polluted environment with harmful gases to breath and foul smells etc.

The burning of wheat and paddy stubbles & leftover straw in fields is also contributing to loss of soil fertility. The burning of straw leads to loss of precious nutrients as nearly 25 per cent nitrogen & phosphorus, 50per cent Sulfur and 75.0 per cent of potassium uptake from soil is retained in the crop residues. It has been estimated that burning of 1 tonne of paddy straw accounts for loss of 5.5 kg nitrogen, 2.3 kg phosphorus and 1.2 kg sulfur, besides organic carbon. Further, heat generated by paddy straw burning penetrates into the soil, leading to loss of moisture and useful microbes, thus, adversely affecting soil properties. High cost of collection and lack of economically viable options to utilize the straw, are identified as major factors, compelling the farmers to burn it. One of the recognized threats to the rice-wheat cropping system sustainability is the loss of soil organic matter as a result of burning.

In Punjab total consumption of NPK fertilizers in Punjab has increased from 19.11 lakh nutrient tones in 2010-11 to 19.43 lakh nutrient tons in 2015-16 and consumption of

chemical fertilizers (NPK) per hectare of gross cropped area has also increased from 242 Kgs in 2010-11 to 247 Kgs per hectare in 2015-16. In Punjab the consumption of fertiliser per hectare is 223.46 kg as compared to 90 kg nationally. In recent years a drop in productivity has been observed, mainly due to falling fertility of the soil. This is believed to be due to excessive use of fertilisers and pesticides over the years.

High usage of nitrogenous fertilizers with relative under-utilization of other fertilizers and micronutrients has led to imbalance in micro nutrient in soils of the Punjab. In Punjab, during 2014-15, the total area under Bio-pesticides during the Kharif season is 0.87 Lakh hectares, whereas, the total area under Chemical & Bio pesticides is about 35.77 lakh hectare. The various studies undertaken in the state since 1970 has indicated the presence of residues of chemical pesticides like organ chlorines, organophosphates, synthetic pyrethroids and carbamates in human beings, milk, water, vegetables and other food products at levels, which are dangerous for human health [9].

#### **Water pollution**

Hazardous pollutants from agricultural and industrial sources commonly pollute water like sewage and discharge from sewage treatment work, oil spoilage and industrial wastes. Bisphenol a (BPA) is one of the common toxic chemicals released frequently into the water bodies from municipal waste water treatments plants [7, 24]. However in recent time excess use of chemicals fertilizers, insecticides pesticides etc. in agricultural crops affects the quality of soil and also damage the quality of water. Red category industries also contribute as point source of pollution.

Singh and Singh [26] conducted a study on "Impact and degree of ground water contamination: a contextual analysis of rustic region in Punjab state" on 300 respondents from Punjab. It was found that premature yellowish teeth, constipation, diarrhea, graying of hair, hair fall, typhoid, joint pain, were major diseases existing in the region. It assessed the drinking water quality and impacts on human health.

#### **Management of agricultural waste**

A policy for utilization and management of paddy straw is being formulated by State Govt to permanently address the pollution hazard issue associated with open field straw burning and to ensure handsome returns to the farmers on their huge stock of paddy straw by ensuring its optimum utilization for power generation as a renewable source of non-conventional energy. Various organizations are working to improve the status of environment in Punjab which are as follows.

#### **Punjab Agricultural University, Ludhiana, Punjab**

Punjab Agricultural University (PAU), Ludhiana, Punjab is working towards developing efficient agro-technologies for crop residue recycling in machine harvested areas as an alternative to burning. The major equipments developed by PAU are: (i) Happy Seeder Machine for planting in standing paddy stubbles; (ii) Tractor Operated Paddy Straw Chopper; (iii) Straw Collector and Baler; (iv) Residue Incorporation in Soil; (v) Compositing Techniques using Paddy Straw.

**(i) Happy Seeder Machine for planting in standing paddy stubbles:** This technology, developed by PAU, has already been adopted by the government of Punjab and is being popularized by Department of Agriculture. Wheat was successfully sown in 200 acres area using Happy Seeder during 2007-2008 producing 5-10 per cent more yield (with 50-60 % less operational costs) compared to conventionally sown wheat. Financial analysis by PAU indicated that this machine is more profitable than other conventional alternatives like full stubble incorporation through direct drilling or rotary seeding.

**(ii) Tractor Operated Paddy Straw Chopper:** For incorporation of paddy straw into soil, the University has also developed a Tractor Operated straw Chopping-cumspreading machine. The Machine, in a single operation, harvests the left over paddy stubble after combining, chops it into pieces and spreads it on to the field. The chopped and spread stubble then can easily be incorporated in the soil after light irrigation by using a rotavator or disc harrow and is allowed to decay.

**(iii) Straw Collector and Baler:** Baler is also another promising technology developed by PAU for collecting paddy straw. Balers make rectangular or round bales by collecting the loose straw from the ground. One operation of stubble shaver in a combine harvested paddy field, created favorable conditions for operating a baler, which in turn, results in smooth sowing of the next crop.

**(iv) Residue incorporation in Soil:** *In situ* incorporation of paddy straw before sowing wheat, did not adversely affect the wheat crop. Rather the incorporation of the residues had a favorable effect on soil physical, chemical and biological properties.[1, 19]

#### **Punjab Pollution Control Board (PPCB)**

India is a legislation rich country with reference to pollution. Eleven major laws exist to control pollution in India and many forums for their implementation in various ways. The Punjab Pollution Control Board (PPCB) is the main governing body in Punjab for ensuring that the national ambient air quality standards are met. It is entrusted with the functions of planning a comprehensive program for the prevention, control and abatement of pollution in Punjab. PPCB has to support and encourage developments in the field of pollution control. PPCB has taken various measures to limit the amount of industrial pollution in the state but not much has been done to address agricultural pollution.

The PPCB is The Punjab Pollution Control Board has been monitoring the pollution levels at 20 locations out of which nine are in the residential cum commercial areas and 11 are in the industrial areas. As per the statistics of the period from 1995–2005, both the 24-hour and annual averages of SPM/RSPM at residential cum commercial monitoring locations exceeded the permissible limits for residential areas (24 hourly permissible limits for SPM and RSPM are 200 and 100  $\mu\text{g}/\text{m}^3$  respectively and for Annual average permissible limits are 140 and 60  $\mu\text{g}/\text{m}^3$ ) throughout the year, with the maximum values being observed in Ludhiana followed by Mandi Gobindgarh, Jalandhar and Amritsar.

#### **Punjab State Council for Science and Technology**

The Punjab State Council for Science and Technology was established on 21 July 1983, with the objective of infusing scientific knowledge in the minds of people. The institute has been trying to achieve this through various means of display and publications, about the nature of life while signifying the useable aspects of available technologies.

#### **Punjab Energy Development Agency (PEDA)**

The Punjab Energy Development Agency was established in the year 1991, for the promotion and development of non-conventional and renewable energy programs or projects in the state of Punjab.

#### **Punjab Biodiversity Board**

The Punjab Biodiversity Board was notified in the state in December 2004 under section 22 of the Biological Diversity Act, 2002, to protect Punjab's natural ecosystems and its flora and fauna. The Board has been set up in the Department of Environment to ensure that biodiversity in both wild and cultivated areas are properly protected. Under the Act, no corporate body or association can commercially utilize the state's biodiversity without approval of State Biodiversity Board.

The Punjab Biodiversity Board also maintains a database on the State's Biodiversity Strategy and Action Plan, Punjab's Environment status which includes both wild and agriculture biodiversity in the state of Punjab.

### **CONCLUSION**

It has been seen from various review of literatures that air pollution is higher than other pollution like soil and water pollution in rural Punjab. It has serious effects on human health, soil and water such as respiratory, cardiovascular problem like asthma and other life threatening ailment like cancer and also affects the nutrient of soil and reduce the quality of water due to excesses use of chemical fertilizers. In view of these problems, government legislation, management and enforcement of the use of subsidies and devices by government to reduce the level of burning are required.

For a happy, progressive and purposive living, the earth and its environment must not only be kept pollution-free but also be protected from the hazards of pollution. It is the need of the hour to make people aware of the causes and effects of environmental pollution on health and provide them solution to combat the ill effects of the same. Scientists are working on different adaptation strategies but its reach to the end users and its adoption by them needs immediate action.

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