Innovations

Smart and Sustainable Rural Frontiers- A Literature Review of Border Villages of Punjab

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Abstract

Introduction: *Borders serve as geographical boundaries that define the political or legal limits of a region. Villages situated near these boundaries are referred to as border villages. Punjab, in particular, shares a long stretch of international border with Pakistan. Despite their strategic and developmental significance, these areas have received limited attention.* ***Problem:*** *A survey of the available literature indicates that considerable research has been conducted on issues such as environmental conditions, socio-economic development, rural infrastructure, and soil and water quality across Punjab. However, these studies often overlook the specific challenges and conditions faced by villages located in the border districts.* ***Methodology:*** *To bridge this research gap, an in-depth review of literature was conducted, examining a number of research and review papers on the Smart Village Concept, rural development, border-specific issues, and socio-economic challenges. The objective was to evaluate the applicability and potential of adopting the Smart Village framework in the border villages of Punjab.* ***Findings:*** *The findings highlight that many villages have significant limitations in basic infrastructure, healthcare, education, employment opportunities, and environmental consciousness and ineffective implementation of rural development schemes. Most existing studies lack a comprehensive and integrated perspective, and there is a noticeable paucity of reliable, research data focused specifically on border villages. This survey aims to focus on a holistic approach that changes these villages into smart and self-reliant communities.*

Key Words: *Border Villages, Punjab, sustainability, smart, rural development, environment*

1. Introduction

The Indian state of Punjab shares a stretch of 553km length of international border with Pakistan. There are six districts of Indian Punjab i.e. Gurdaspur, Ferozepur, Amritsar, Pathankot, Tarn Taran and Fazilka that share the international border. All these districts lag in growth and progress due to several reasons. Firstly, restricted visiting and working hours in the fields near the fence and restriction on growing tall crops does not allow the farmers to progress, diversify crops and enhance their income. Secondly, the rivers and their distributaries which flow across the state especially in these border districts often wash away the crops during rainy season and floods. Thirdly, the long spell of terrorism has left this belt at the mercy of nature with no industrial development and hence no other avenues for better earning and lifestyle. This total border area of 6369.82 sq. km (approx.) is inhabited by a population of 7936818, as per 2011 census. There has been an increase in trans-border activities like smuggling, border crossers, illicit trade, drug trafficking and Pakistani spies (Singh, A., 2013). Due to such inaccessible and insecure conditions the people living in border areas are under psychological stress and face socio-economic problems. Thus for an integrated & sustainable development, the process of planning and development holds special importance in these distinct habitations to make them smart entities (Fig. 1).

2. Methodology

The present study is based on data collected through an extensive review of existing literature. As mentioned earlier Punjab shares the international border with Pakistan, spanning across six border districts. The villages located in these districts are relatively remote and isolated from the rest of the state due to their geographical positioning. Several key issues of rural studies analysed have been discussed below:

2.1 Smart Village Concept and Rural Development

Sustainable development is essential for the social, economic, and governance aspects. For meaningful progress, responsible use of natural resources and environmental conservation are important (Ranade et al., 2015; Shukla, 2016). With nearly 69% of Indians living in villages, and agriculture being the primary livelihood, rural areas form the backbone of the country's economy (Ramachandra et al., 2015). Developing villages into self-reliant, well-equipped, and educated communities—smart villages—is vital. These villages focus on clean energy, health, education, and better infrastructure (Kochare et al., 2019).

Technology intervention enables smarter agriculture, efficient distribution systems, and improved connectivity (Shukla, 2016). The Sansad Adarsh Gram Yojana (SAGY), launched in 2014, encourages MPs to adopt and transform one village into a model of sustainable rural development, focusing on better use of existing programs.

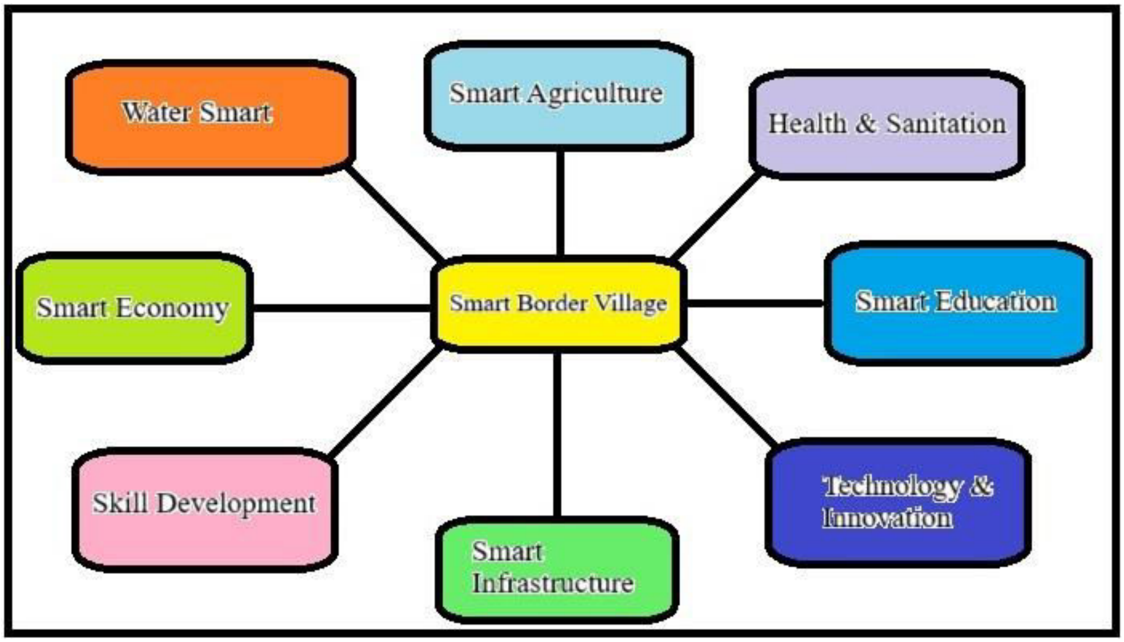
Migration from villages to cities in search of better opportunities is common, highlighting the need for rural development that is inclusive and eco-friendly. Strengthening rural areas is vital for national progress (Rao, 2019). Various government initiatives in India have focused on infrastructure, agriculture, and education, but greater emphasis is needed on technology use and behavioral change to achieve the vision of smart villages (Singhal & Singh, 2016). Studies on global and national smart village efforts show that due to the diversity in rural settings and rapid digital changes, a tailored, location-specific approach is essential for effective development (Zavratnik et al., 2018).

2.1.1. Socio-economic and environmental issues

Assessing the socio-economic conditions of rural communities is the key to understanding their needs. Despite various development programs, disparities remain due to differing economic stratas within villages (Islam & Mustaquim, 2014). In village like Kotni in Raipur, Chhattisgarh, surveys revealed inadequacy in basic amenities like clean water and sanitation, which could be addressed through stronger government action (Kumari, 2022). Underdeveloped local economies highlight the urgent need for policies that boost livelihoods and restructure rural economies (Chothani et al., 2021). A study comparing villages in Maharashtra found that most residents had average land holdings, income, and socio-economic status, typically belonging to middle-aged family members (Masudkar et al., 2017).

Several studies highlight the link between environmental awareness and socioeconomic factors in rural communities. In Turkey (Afyonkarahisar and Eskisehir), low income, poor regulation enforcement, and reliance on salespeople or personal experience influenced agrochemical use (Akca et al., 2007). A similar study in Hebei, China, revealed low farmer awareness of pesticide safety, influenced by education, gender, and crop purpose (Hou & Wu, 2010). Only 7.56% of residents showed environmental awareness, underscoring the need for stronger government involvement and centralized waste systems (Nan et al., 2011).

In Barisal, Bangladesh, an awareness program improved environmental understanding, especially among primary school children (Uddin, 2019). In rural Romania, open waste burning was common due to poor municipal waste systems, contributing to pollution and low awareness (Mihai et al., 2019). In Ghana's Ejura-Sekyedumase Municipality, education, media access, and farm size influenced knowledge of agrochemical risks. Field training and curriculum integration were recommended (Mabe et al., 2017).



Source: Ray and Ali; 2021 (Modified)
Fig. 1: A Smart Border Village

2.1.2. Heavy metals in Soil and Water

(Bhatti et al., 2016 b) conducted research on the heavy metal content in soil and fodder (berseem) near Beas and Sutlej River banks in the state of Punjab. The contents of Cu, Pb, Co, Cd were well within the limits in soil but for fodder crops, Cr content in Berseem plant was found above the permissible limit.

For heavy metal estimation in the agricultural soils of District Sangrur in Punjab, soil samples were collected from 50 distinct villages and results showed concentrations of all tested heavy metals, including Fe, Cr, Cu, Ni, Zn, Pb, Co and Cd were within the permissible limits established by Indian standards (Sharma and Chahal, 2018).

A number of studies pertaining to the presence of heavy metal in the soil & water samples are shown in Table 1 given below:

Table 1: Various studies done on Heavy Metal Analysis in water and soil samples

Study area	Sample Type	Parameter studied	Results	References
Patiala, Punjab, India	Water	Al, Ni, Cd, Pb, As, Se, Cr	Ni & Al (0.01 & 0.05 mg/l), above permissible limits, at one site Cd 0.006mg/l, above the limits	Sekhon and Singh, 2013
Ludhiana &	Water	Cr, Mn, Cu, Zn,	The Metal Pollution Load Index (MPLI) of these heavy metals higher in	Kaur, T., et al., 2014

Study area	Sample Type	Parameter studied	Results	References
Patiala		As, Cd, Hg, U, Sb	Ludhiana MPLI of Nickle and Lead high in Patiala	
Andhra Pradesh	Water	Cr, Cd, Cu, Fe, Zn, Pb	Pb, Cr, Cd higher than the permissible limits in 2 samples	Ramachander, 2015
Malwa region	Water	Pb, As, Fe, Cd, Hg, Zn	Out of 240 samples 98,240,152, 128, 223, 11of the samples had these heavy metals above the permissible limits, respectively	Sharma & Dutta, 2017
Pakistan	Water	As, Cr, Cu, Fe, Pb, Ni	All within limits	Jamil, 2018
Amritsar District	Water	As, Se	0.059 As, 0.0039 Se	Virk, 2018
Pakistan	Water	As, Cr, Cu, Fe, Pb, Ni	All within limits	Jamil, 2018
Amritsar District	Water	As, Se	0.059 As, 0.0039 Se	Virk, 2018
Budhha Nullah, Ludhiana	Water	Ni, Cd, Co, Zn, Cu, Cr, Pb	Co, Pb more than the permissible limits, HPI 271.75-10.306.36 exceeding the limits	Kaur, J., et al., 2021
Amritsar District	Water	As, Cd, Co, Cr, Ni, Pb, Se, Zn	6 out of 11 sites HPI> 100, the critical value index	Rajput, 2020
World over	Soil	Cr, Cd, Pb, Zn, Ni, Cd, As, Hg	66.08,49.60,1733.94,289.78,29.14,1.52 mg/kg respectively	Su et al., 2014
Near Beas Sutlej Banks	Soil & Fodder	Cu, Cd, Co, Pb	All within limits	Bhatti et al., 2015
Punjab	Soil&	Cu, Cr,	Cr, Cd, Pb higher in crops than soil	Bhatti et al.,

Study area	Sample Type	Parameter studied	Results	References
	Crops	Cd, Pb, Co	samples	2015
Karnataka	Soil	Cr, Cd, Pb, Ni	Cr 45%, Ni 28%, Cd 40%, Pb 38%, Fe 28% respectively of the samples exceeded the permissible limit	Ramakrishniah & Manasa, 2016
Fazilka	Soil	Pb, Ni, As, Zn, Cd	All within permissible limits	Narang, 2017
Sangrur	Soil	Fe, Cu, Zn, Ni, Pb, Co, Cd, Cr	Cu, Pb, Cd and Cr above the limits while Fe, Co, Ni, Zn were above the limits	Chahal and Sharma, 2018
Jalandhar District	Soil	Cr, Cu, Co, Pb	All within the permissible limits	Dogra, N., et al., 2019
Iran	Soil	Fe, Zn, Mn, and Cu	Majority of the heavy metals were below the permissible limits; Cu and Mn more in south and north eastern parts, Zn more in central part of the studied area.	Keshavarzi and Kumar, 2020
Karnataka	Soil	Pb, Cu, Fe, Cr, Cd, Zn, Ni, As in pre and post monsoon samples	Fe, Ni, Pb, Zn, Cr content more in post monsoon samples	Gupta, M, N., et al., 2019

Source: Literature survey

2.1.3. Physcio-chemical parameters of soil

The composition of soil particles i.e. sand, silt and clay vary geographically and influence certain physical and chemical properties like pH, Electrical conductivity (EC), porosity, moisture content (MC), Bulk density (BD), soil organic matter (SOM), organic carbon (OC), etc. which define the soil characteristics of an area.

Soil samples from some villages in Punjab revealed that they are acidic, have sandy texture, and low organic matter content. The pH, EC, bulk density, water holding capacity were well within the range. Soil texture was sandy with Ca, Mg, Na, K, CO_3 well within in the range (Bhatti et al., 2016). Some studies done on the physico-chemical analysis of soils have been mentioned in Table 2 given below:

Table 2: Various studies done on Physico-chemical parameters in soil samples

Study Area	Parameter studied	Results	References
Karnataka	pH, Acidity, EC, Cl^-, Fe, Cu, Ni, Pb, Zn, Cd, As, Cr, SQI	All except Acidity, Cl^-, Cd, Cr are high in post monsoon samples	Gupta, M, N., et al., 2019
Sangrur, Punjab, India	pH, EC, Na, K, CEC, Ca, TOC	Na, K, CEC, were above the permissible limits	Sharma and Chahal., 2018
Punjab	pH, EC, Soil composition, SOM, Ca, Mg, Na, K, N, P, CaCO3,	EC 0.307-0.0.723mS/cm, sandy texture 3.15-5.33%, SOM 1.83-2.91%, CaCO3 high so calcareous soils, Ca, Mg abundant, Na, N, K in limits	Bhatti et al., 2016b
Punjab	pH, EC, soil texture, SOM, OC, N, P, K	pH 6.421-6.65, EC-0.220-0.602 mS/cm, Soil texture 78-93.67%, SOM 2.73-4.17%, OC 0.10-0.35g/kg, N-0.033-0.084g/kg, K-1.118-1.436g/kg respectively.	Bhatti et al., 2016a
Jalandhar District, Punjab	pH, OC, P, Ca, Mg	pH acidic to alkaline, OC 6.9%	Dogra et al., 2019
Himachal Pradesh, India	Bulk density, Moisture content, pH, EC, OC, SOM,	Sand 75%, silt 23.33%, clay 15.66% B.D. 1.54gm/cm3, OC 1.42%	Sharma and Bhattacharya., 2017

Gonian Bathinda, Punjab	pH, EC, BD, TOC, SOM, TP	pH (7.92 – 9.61), EC (0.08 – 0.78 dS/cm), BD (0.986 – 1.296 g/cm3), TOC (0.12 – 1.08%), SOM (0.21 – 1.86%), TP (382.16 – 1609.19 mg/kg) and Avl. P (2.00 – 51.73 mg/kg).	Kumar, R., et al 2016
Talwandi Saboo, Bathinda, Punjab		pH (8.24 – 9.42), EC (0.18 - 0.99 dS/cm), BD (1.042 – 1.379 g/cm3), TOC (0.26 – 1.1%), SOM (0.45 – 1.89%), TP (230.81 – 922.70 mg/kg) and Avl. P (4.03 – 31.89 mg/kg)	

Source: Literature survey

2.1.4. Physicochemical parameters of water

Various studies have been carried out on the physico- chemical parameters of water which have been tabulated in Table 3 as shown below:

Table 3: Various studies on physico-chemical parameters of Water

Study area	**Parameters**	**Results**	**Reference**
Eight districts of Punjab	$Na^{+,}$ K^+ Mg^{2+} Ca^{2+} F^- Cl^-, NO_3, SO_4, Hardness	The groundwater quality 6% of the study area is fit, 18% marginal and 76% is unfit for irrigation purpose.	Chopra and Krishna, 2014
Sukena village, Maharashtra, India	pH, TDS, alkalinity, BOD, DO, Hardness, F-, Cl- NO3-, Fe, Temp., Turbidity	TDS, DO, Alkalinity, BOD and hardness, above the limits.	Savale et al., 2015
SW Punjab, India	Na+, Ca^+, Mg^{2+}, K^+ and HCO_3^- , SO_4^-, Cl^-. F^- and As.	$Na^+ > Ca^{2+} > Mg^{2+} > K^+$ and HCO $^{3-}$ > SO_4^- > Cl^-. Fluoride content in 75 % of the samples above permissible limit. Mean value 9.37 (summer)	Kaur, T., et al., 2017

Study area	Parameters	Results	Reference
		11.01µg/L (winter) respectively.	
Malwa region, Punjab	pH, TA, TH, TDS, Na, K, Ca, Mg, $SO^{4-}NO^{3-}$, Cl^-, Fe, Cd, As, Cr, Zn, Hg etc.	All parameters above permissible limits. Groundwater highly contaminated and not fit for human consumption and domestic applications	Sharma, R. 2018
Pakistan	pH, EC, Ca, Mg, TDS, taste, colour, odour	10/100 samples slightly yellow coloured and slight smell, 14 are brackish, TDS up to 5600mg/l, EC >800Ms/cm, Mg 2.6-162mg/l, Ca 36-324mg/l, hardness >1300mg/l	Arshad et al., 2019
Ludhiana, Punjab	pH, TDS, TS, TSS, DO, BOD, EC, COD, Temp., Hardness, Ca, Mg, Cl-, PO^{4-}, NO^{3-}, Na, K	EC high, DO low, COD, BOD high upstream, TS 3720mg/l, TA 733.3-2100mg/l, NO_3^- 67.63-114.91mg/l, PO_4^- 7.68mg/l	Kaur et al., 2020
Karnataka	pH, TDS, EC, Hardness, Ca, Mg, NO^{3-}, Cl-, Alkalinity	pH 6.1-8.3, TDS 640-3298mg/l, EC 1005-5497us/cm, Ca 38-277.5, Mg 13.2-143.2, Cl^- 35-661 mg/l, NO_3^- 2.90-368 mg/l, Alkalinity 86-506mg/l	Rama Krishnaiah., 2016
Karnataka	pH, TDS, EC, Cl, F, SO^{4-}, Alkalinity, Turbidity,	pH 7.01-7.50, EC 1-3.9Ms/cm, TDS 460-2070mg/L, TH 127.1-571mg/L, Cl^- 111.7-603 mg/L, F^- 0.5-1.6 mg/L	Hiremath et al., 2012
Nagaland	pH, TDS, Alkalinity, Total hardness, Cl, DO, Mg and Ca hardness	pH 7.05- 7.34, Total alkalinity 55.6- 65 mg/L, Chloride 14.1-16.3mg/L, DO 8.68- 9.56 mg/L, 4.89-7.18mg/L, TH 55 - 62.3mg/L, Ca hardness	W, Temjen and Singh, M.R., 2017

Study area	Parameters	Results	Reference
		18.6-19.6 mg/L, Mg hardness 8.5-10.4 mg/L and TDS 111.7-137.1mg/L	

Source: Literature survey

A report on water logging in (Planning commission, Government of India, 2013), southern and south-west regions of the Punjab revealed high levels of nitrate and fluoride. Districts like Bhatinda, Mansa, Muktsar, Faridkot, Ferozepur, Ludhiana, Hoshiarpur, Tarn Taran, Moga, Gurdaspur, and Amritsar have nitrate concentrations exceeding the critical level. Some parts of Amritsar, Bhatinda, Gurdaspur, Sangrur, Barnala, and Muktsar districts have fluoride content above 10 mg/l. The alkaline groundwater of Bathinda is moderately to severely saline, and has high fluoride concentration (Kaur, T. et al., 2016; CGWB, 2007)

3. Major issues in water samples of Punjab

While reviewing the literature a number of issues were highlights that have been reported in the water samples of Punjab State (Table 4).

Table 4: Major Issues reported in water samples in Punjab State

S. No.	Problem/Issue	District/Block
1	Overuse of pesticides	All districts
2	Brackish water	Gurdaspur, Tarn Taran, Faridkot, Patti, Bathinda, Nadala, Jhunir
3	Selenium in ground water	Nawanshahr, Sangrur, Hoshiarpur, Tarn Taran, Ludhiana, Ferozepur, Fatehgarh Sahib, Kapurthala, Jalandhar
4	Flooding	Ferozepur, Amritsar, Ludhiana, Patiala, Sangrur
5	Water Logging	Ferozepur, Fazilka, Muktsar
6	Salinization of ground water	Fazilka, Ferozepur, Bathinda, Mansa, Moga, Faridkot, Abohar, Muktsar
7	Industrial pollution in ground water	Ludhiana, Sangrur, Ropar, Jalandhar

Source: Modified (Kaur, G., 2022; Sharma, 2014)

The commonly occurring major contaminants like fluoride, chloride, nitrates, and salinity reported in water samples across Punjab are summarized in Table 5.

Table 5: District-Wise contaminants of water and the possible source

S. No.	Contaminant	District/Block	Possible source
1	Chloride (>1000mg/l)	Muktsar, Ferozepur	Chlorination of water
2	Fluoride (>1.5mg/l)	Amritsar, Fazilka, Ferozepur, Gurdaspur, Moga, Muktsar, Bathinda, Patiala, Faridkot, Sangrur, Mansa, Mohali, Fatehgarh sahib, Kapurthala	Weathering of rocks
3	Iron (>1.0mg/l)	Ferozepur, Gurdaspur, Bathinda, Faridkot, Hoshiarpur, Mansa, Sangrur, Ropar, Fatehgarh sahib	Weathering of iron containing rocks, corrosion of metallic pipes etc.
4	Nitrate (<45 mg/l)	Bathinda, Ferozepur, Faridkot, Fatehgarh Sahib, Gurdaspur, Hoshiarpur, Kapurthala, Jalandhar, Ludhiana, Muktsar, Moga, Mansa, Nawan Shaher, Patiala, Rupnagar, Sangrur	Agriculture runoff, waste water, animal feedlots, septic tanks or urban drainage etc.
5	Salinity (as EC in µS/cm)	Ferozepur, Faridkot, Bathinda, Mansa, Muktsar, Sangrur	Geological formations and long residence time

Source: Modified, (Kaur, G., 2022; CGWB, 2020-12., Sharma, 2014)

Similarly various studies carried out on heavy metals such as Arsenic, Uranium, Selenium, Chromium, Lead, Cadmium, Nickel, Manganese, Mercury detected in groundwater of Punjab have been enlisted below in Table 6.

Table 6: Summary of various studies on Heavy Metal reported in Ground water of Punjab State.

S. No.	Heavy Metal	District/Block	Range in ground water	References
1	Arsenic	Gurdaspur	4-42µg/l	Virk, H.S., 2020, Hundal et al., 2007
2	Arsenic	Amritsar, Tarn Taran	10-43µg/l	Hundal et al., 2007
3	Arsenic	Amritsar	3.80-19.1µg/l	Hundal et al., 2007
4	Arsenic	Ferozepur	11-688µg/l	Hundal et al., 2007

S. No.	Heavy Metal	District/Block	Range in ground water	References
5	Arsenic	Ferozepur, Fazilka	1.0-59.6μg/l 5.015-10.990 mg/l	Bajwa et al., 2015 Narang, et al., 2018
6	Uranium	Bathinda, Mansa, Faridkot	2-644μg/l	Kumar et al., 2015
7	Uranium	Ferozepur	2.8 – 579 μg/l 30-331.4 μg/l	Kumar et al., 2015., Virk, H.S. 2020
8	Uranium	Fazilka, Tarn Taran	30-366μg/l	Virk, H.S. 2017, 2020,
9	Uranium	Ferozepur, Faridkot, Mansa, Bathinda	0.5 – 579 μg/l	Bajwa et al., 2015
10	Chromium		< 0.5 – 228 μg/l	
11	Cobalt		<0.2- 481 μg/l	
12	Copper		<0.05- 15 μg/l	
13	Iron		10 – 3424 μg/l	
14	Lead		< 0.01 – 444 μg/l	
15	Manganese		< 0.5 – 508 μg/l	
16	Nickel		< 0.2 – 308 μg/l	
17	Zinc		< 0.05 – 2365 μg/l	
18	Iron	Amritsar, Tarn Taran	8.90-14.58 ppm	Virk, H.S., 2017, 2019a
19	Selenium	Amritsar, Tarn Taran, Gurdaspur, Bathinda		Virk, H.S., 2017, 2019 (a), 2020, Singh, A., et al., 2021
20	Chromium	Bathinda	>0.003μg/l	Singh, K., et al., 2021

S. No.	Heavy Metal	District/Block	Range in ground water	References
	Mercury	Bathinda	>1ppb	Singh, K., et al., 2021

Source: Literature survey

The Press Information Bureau, Government of India, Ministry of Jal Shakti has brought some alarming results in a published report (pib., 2021) As part of quality monitoring of ground water, the Central Ground Water Board (CGWB, 2021) has reported that arsenic, lead, cadmium, chromium and uranium in many of the districts of Punjab have been found to be above the permissible limits of BIS. These reports have been mainly from the Malwa and Doaba regions of Punjab (Table 7).

Table 7: Number of Districts of Punjab with Heavy metals beyond permissible limits

S. No.	Heavy metal	Districts	No. of Habitations	Permissible limit
1	Arsenic	Mansa, Faridkot, Sangrur	10	0.01mg/l
2	Lead	Bathinda, Ferozepur, Muktsar	06	0.01mg/l
3	Cadmium	Fatehgarh Sahib, Ludhiana, Patiala, Sangrur	08	0.003mg/l
4	Chromium	Bathinda, Mansa, Sangrur	10	0.05mg/l
5	Uranium	Bathinda, Faridkot, Ludhiana, Ferozepur, Muktsar, Patiala, Sangrur, Fatehgarh Sahib	-	30µg/l
6	Iron	-	10	1.0mg/l
7	Fluoride	-	176	0.5–1.5mg/l

Source: pib, GOI, Ministry of Jal Shakti (2021)

(Singh, K. et al., 2021) carried survey on the water samples of Bathinda district for the presence of carcinogenic heavy metal like Mercury (Hg), Chromium (Cr), Arsenic (As), Cobalt (Co), Cadmium (Cd) and Selenium (Se).The results showed that Cr and Hg were beyond the permissible limit in all the samples while 16% of the samples had Se beyond the permissible limit. All other heavy metals were present within the limits. A survey of 1971 villages of the state was conducted by Punjab

Water and Sanitation Department sponsored by World Bank and randomly the samples were taken and details are shown in Table 8 given below:

Table 8: Number of Habitations with heavy metals in potable water of Punjab

S.No.	District	No. of Villages	Heavy metals	Beyond permissible limit
1	Amritsar	82	-	Arsenic
2	Bathinda	22	Cr, As, Pb, Se,	Uranium, Mercury
3	Ferozepur	89	U, Pb, Al, Se	
4	Ludhiana	95	Al, Se, Hg	Lead
5	Gurdaspur	206	Cd, Ni, Al, As.	Lead
6	Tarn taran	48	U, As, Ni, Pb, Se	
7	Jalandhar	165		Lead, Selenium
8	Fazilka	22	U, F^- , Al	
9	Fategarh Sahab	51	U, F^- , Se, Ni	
10	Kapurthala	67	Se, Pb, Al	
11	Hoshiarpur	150	Cr, Pb, Se, Ni, Al, As.	
12	Moga	26	Al, Pb, U	
13	Pathankot	113	Al	
14	Patiala	41	-	Lead
15	Sangrur	62	U, Pb, Se, F^-	
16	Nawan Shahar	32	Hg, Se, Al, Pb	
17	Mohali	46	Al, Pb, F^-	
18	Ropar	290	Pb	Al

Source: Times of India, 2018

3. Conclusion

It is evident from the literaturereview that most village communities remain unaware of issues like health, hygiene, soil and water quality, waste disposal, and the harmful effects of excessive fertilizer and pesticide use. Deteriorating quality of soil and water, increasing levels of heavy metals, industrialization, urban growth, migration etc. Little attention has been given to the basic facilities & environmental challenges in villages near international borders—especially in Punjab. This survey aims to bring forth this gap and an integrated study be conducted to make Smart Border Villages.

Funding: The authors declare that there is no funding.
Conflict of interest: The authors declare that there is no conflict of Interest

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