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Water Scarcity Water Access: Punjab's Dilemma of Water Resources Management and Future Trends

An empirical study of Garhshankar and Balachaur tehsils of Hoshiarpur district in Punjab]

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Abstract: Celebrated since decades as the success *sutra* or exponent of the Green Revolution, Punjab is currently facing several challenges contributing to a severe hydrological crisis. The malefices assailing the health of Punjab or the land of 'five rivers' include rapid groundwater depletion, on the one hand and extreme conditions of widespread flooding on the other. The State's intensive paddy-wheat monoculture has pushed groundwater extraction to an unsustainable average of 156.36 percent. In the critical "dark zone" districts like Sangrur and Patiala, extraction rates exceed 200%, dropping water tables by over a meter annually. This severe over-extraction alters aquifer geochemistry, causing naturally occurring uranium, arsenic, and fluoride to leach into regional drinking water supplies. This toxicity adds to the already compounded industrial pollution. This is evident in the heavy metal dumping within Ludhiana's Buddha Nullah, as well as the extensive nitrate runoff from agricultural fertilizers.

Paradoxically, despite dropping water tables, Punjab increasingly suffers from severe monsoon floods. Linear infrastructure developments and encroached floodplains block natural drainage, while dense subsoil clay layers (paddy plough pans) prevent floodwaters from filtering down to recharge deep aquifers. Groundwater depletion in Punjab exceeds 145 percent, with 80 percent of the State's area showing declining water tables. Recent severe floods and escalating contamination present urgent causes for concern, threatening both agricultural sustainability and public health.

This paper synthesizes the viewpoints of the local people in addressing approaches to provide structural solutions to the crisis. The objective is that climate-resilient water governance is essential to protecting public health and preserving Punjab's agricultural economy.

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Introduction

Once celebrated as the cradle of India's Green Revolution, Punjab is now facing an unprecedented ecological crisis driven by the collapse of its water systems. For decades, intensive agriculture transformed the State into the nation's breadbasket. This productivity came at the expense of endangering its natural hydrology. Today, Punjab faces a severe triple threat: catastrophic groundwater depletion, widespread heavy metal contamination, and frequent climate-induced flooding. This crisis is primarily rooted in an entrenched paddy-wheat monoculture that relies heavily on unmetered electricity to pump water from deep underground.

Punjab is increasingly suffering from extreme monsoon floods. Urbanization, concrete infrastructure, and soil compaction prevent these floodwaters from naturally recharging the deep aquifers, leaving contaminated surface water to pool in low-lying zones instead.

This research paper examines how people perceive the historic agricultural policies, regulatory failures, and changing climate patterns intersect to drive this crisis. Ultimately, it argues that a fundamental shift from aggressive resource extraction to climate-resilient water resources that support crop diversification and modernized water infrastructure.

"Dark Zone" District Data Breakdown

The Central Ground Water Board (CGWB) classifies areas where groundwater extraction surpasses 100 percent of the natural annual recharge as "Over-Exploited," commonly known as 'Dark Zones'. Punjab currently leads India with an average groundwater extraction stage of 156.36 percent, with 19 out of its 23 districts trapped in this critical dark zone category.

The Table-1 below outlines the extraction metrics, rapid water table declines, and specific contaminant risks for the State's worst-affected districts, including Sangrur and Patiala:

Table-1: State of the water crises in 'Dark Zones' of Punjab

District	Groundwater Extraction Stage (%)	Average Annual Water Table Drop	Primary Water Quality Risks / Contaminants
Sangrur	**309.99%**(2nd highest in India)	~106.5 cm per year	Uranium (exceeding 30 ppb safe limits), Nitrates from heavy fertilizer runoff
Patiala	**217%**(100% over-exploited blocks)	~100.2 cm per year	Arsenic (>10 ppb), Fluoride (>1.5 mg/L), and Uranium
Barnala	**210% to 223.59%**	~103.3 cm per year	Heavy Uranium clusters, High Total Dissolved Solids (TDS)
Fatehgarh Sahib	**209%**	~70.4 cm per year	High Fluoride salinity, Uranium contamination
Jalandhar	**239%**	~68.4 cm per year	High Nitrate concentration, Uranium, industrial chemical leaks

Key Data Trends & Insights

The Malwa Crisis Zone: Sangrur (now including parts of Malerkotla) stands as an extreme hotspot, extracting more than three times its naturally extractable water resources each year. This extreme over-extraction is driven almost entirely by late-season paddy transplantation.

Approaching the Absolute Limit: According to the National Green Tribunal (NGT) monitoring committee, if current extraction velocities continue unmitigated, groundwater

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levels in these specific districts are projected to drop below 300 meters by 2039, effectively exhausting the State's usable upper water reserves.

extraction rates (Sangrur, Patiala, Barnala) consistently show the highest post-monsoon uranium spikes. Over-pumping alters the geochemical oxidation state of the deep soil, causing naturally bound uranium to dissolve into the remaining water table.

Water Quality and Toxicity: A Public Health Crisis

The depletion of Punjab's aquifers is directly linked to severe groundwater degradation. As water tables recede, deep drilling introduces oxygen into previously stable underground formations. This geochemical shift triggers the dissolution of naturally occurring geogenic toxinsinto the remaining water supply. Compounding this geogenic crisis is widespread anthropogenic pollution from agricultural runoff. The heavy application of chemical fertilizers introduces massive volumes of nitrates into the shallow unconfined aquifers, leading to widespread groundwater toxicity.

Deep Underground Pumping ➔ Oxygen Influx into Soil ➔ Geochemical Oxidation ➔ Uranium & Arsenic Leach into Drinking Water

The Paradox of Recent Floods

Punjab faces catastrophic seasonal flooding even as its underground water reserves dry up. During intense, climate-induced monsoon spikes, billions of cubic meters of water submerge millions of acres of farmland.

However, this massive surface volume fails to replenish the state's depleted dark zones due to a combination of artificial structural blocks and degraded soil conditions.

Monsoon Torrent ➔ Surface Flooding ➔ Hardened Subsoil/Concrete ➔ Blocked Aquifer Recharge ➔ Evaporation & Contaminated Runoff

Policy Solutions and Structural Interventions

To reverse Punjab's ecological decline, policy design must transition from supply-side exploitation to demand-side conservation. Breaking the water-intensive paddy-wheat monoculture loop requires systemic financial incentives, localized engineering, and smarter surface water allocation.

[Deficit Pricing Framework] ➔ [State-Backed MSP Procurement] ➔ [Acreage Shift to Maize/Pulses] ➔ [Reduced Deep Aquifer Pumping]

Defining the geographic locale

An empirical study has been conducted on 24 villages after the Punjab floods of 2025 to determine the thoughts of the inhabitants regarding the vagaries of water availability and awareness of water resources along with their utilization in Punjab. The following are the villages and their details have been given successively.

Table-2: List of Villages Visited

Sr. No.	Village	Tehsil	District
1	Karimpur Chahwala	Balachaur	Shahid Bhagat Singh Nagar
2	Pojewal	Balachaur	Shaheed Bhagat Singh Nagar
3	Saroya	Balachaur	Shahid Bhagat Singh Nagar
4	Balachaur	Balachaur	Shahid Bhagat Singh Nagar
5	Rurkimuglan	Balachaur	Shahid Bhagat Singh Nagar
6	Takarla	Balachaur	Shahid Bhagat Singh Nagar
7	Binewal Tibbian	Garhshankar	Hoshiarpur
8	Sarhala Khurd	Garhshankar	Hoshiarpur
9	Pandori Beet	Garhshankar	Hoshiarpur

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10	Shahpur	Garhshankar	Hoshiarpur
11	Sewan Shiwan	Garhshankar	Hoshiarpur
12	Pahlewal	Garhshankar	Hoshiarpur
13	Dhamai	Garhshankar	Hoshiarpur
14	Sekhowal	Garhshankar	Hoshiarpur
15	Khanpur	Garhshankar	Hoshiarpur
16	Samundra	Garhshankar	Hoshiarpur
17	Ghagon Guru	Garhshankar	Hoshiarpur
18	Chak Hajipur	Garhshankar	Hoshiarpur
19	Kalewal Beet	Garhshankar	Hoshiarpur
20	Rampur Bilron	Garhshankar	Hoshiarpur
21	Saila Khurd	Garhshankar	Hoshiarpur
22	Kukran	Garhshankar	Hoshiarpur
23	PakhowalBihran	Garhshankar	Hoshiarpur
24	Rasulpur	Nawanshahr	Shahid Bhagat Singh Nagar

Garhshankar is an administrative tehsil in the Hoshiarpur district of Punjab, India. It includes various villages governed through Gram Panchayats and is a key part of the district's rural administration. Garhshankar is the main town for most villages within the tehsil. The nearest railway station is situated at MahngarwalDoaba, while the nearest airport is Adampur Airport, located at an approximate aerial distance of 30.0 km.

Garshankarwas founded by Doad Rajput king, Shankar Sahai in 1000 AD. His quitar or fort was later was destroyed by western conquerors. Garhshankar became a Tehsil in 1844 during the British administration. Before the Partition in 1947, Garhshankar had a significant population of Muslim GhorewahaRajputs as per the 1904 Hoshiarpur gazette report. The total area of the tehsil is 796 km, including 782.11 sq km rural area and 13.56 sq km urban area. The sex ratio is approximately 965 females per 1,000 males.

Village –wise key points of information

Table 2: List of Villages surveyed

S. No.	Village	Total Population			Child Population (0–6 yrs)			Scheduled Castes (SC)			Literate Population			Illiterate Population		
		Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Balachaur															
2	BinewalTibbian	4,532	2,307	2,225	493	243	250	1,131	595	536	3,320	1,878	1,442	1,212	429	783
3	Bilron	2,	1,	1,1	26	1	12	83	4	42	1,	90	78	63	26	37

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		325	161	64	0	34	6	7	12	5	689	1	8	6	0	6
4	Chak hajipur	1,241	634	607	108	46	62	626	330	296	847	484	363	394	150	244
5	Dhamai	1,424	687	737	115	51	64	468	221	247	1,065	558	507	359	129	230
6	Ghagon guru	501	255	246	65	35	30	129	64	65	377	200	177	124	55	69
7	Karimpur chahwala	1,186	611	575	121	69	52	219	116	103	906	518	388	280	93	187
8	Khanpur	1,479	760	719	183	92	91	839	423	416	1,018	553	465	461	207	254
9	Kalewal	884	469	415	83	50	33	472	251	221	646	367	279	238	102	136
10	Kukran	197	105	92	17	11	6	4	2	2	152	83	69	45	22	23
11	Pojewal	1,732	908	824	194	101	93	460	242	218	1,221	727	494	511	181	330
12	Pahlewal	1,841	901	940	198	99	99	516	265	251	1,381	726	655	460	175	285
13	Pakhowal Bihran	1,105	569	536	109	54	55	458	231	227	810	458	352	295	111	184
14	Rurkimuglan	905	445	460	114	63	51	545	263	282	620	325	295	285	120	165
15	Rasulpur	1,283	626	657	136	76	60	666	332	334	964	494	470	319	132	187
16	Saroya	3,712	1,917	1,795	409	217	192	1,904	996	908	2,744	1,507	1,237	968	410	558
17	Sarhala Khurd	944	460	484	94	43	51	466	219	247	745	390	355	199	70	129
18	Samundra	2,681	1,359	1,322	295	162	133	911	471	440	1,957	1,060	897	724	299	425
19	Saila Khurd	4,688	2,440	2,248	531	266	265	1,404	690	714	3,337	1,824	1,513	1,351	616	735
20	Sekhowal	1,33	650	682	167	88	79	371	17	200	938	502	436	394	148	246

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		2							1							
21	Sewan	852	417	435	104	53	51	336	161	175	0	0	0	78.21	88.46	68.49
22	Shahpur	447	244	203	56	32	24	361	198	163	338	194	144	109	50	59
23	Takarla	2,430	1,234	1,196	265	129	136	308	165	143	1,463	871	592	967	363	604

[i] Dhamai is in Garhshankar tehsil of Hoshiarpur district in Punjab. Located approximately 12 km from the tehsil headquarters it is around 38 km from the district headquarters in Hoshiarpur. Dhamai is a designated Gram Panchayat with Pin Code - 144527. As per Census 2011, the village code of Dhamai is 032056. It covers a total geographical area of 188 hectares. Garhshankar is the nearest town. Dhamai village is governed under the Panchayati Raj system, with a Sarpanch as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Dhamai has a total population of 1,424 people, consisting of 687 males and 737 females. The village has 320 households and a sex ratio of 1,072 females per 1,000 males. There are 115 children in the 0–6 years age group. The village has 1,065 literate and 359 illiterate residents. There and 468 people belonging to the Scheduled Castes (SC).

[ii] Pahlewal is located approximately 3 km from the tehsil headquarters in Garhshankar and around 33 km from the district headquarters in Hoshiarpur. Pahlewal village is a designated Gram Panchayat. As per Census 2011, the village code of Pahlewal is 031995. The village covers a total geographical area of 84 hectares and falls under Pincode - 144527. Garhshankar is the nearest town. The village is governed under the Panchayati Raj system, with a Sarpanch serving as the elected head. The village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. Pahlewal village has a total population of 1,841 (Census 2011) people comprising 901 males and 940 females. The village has 373 households and a sex ratio of 1,043 females per 1,000 males. There are 198 children in the 0–6 years age group. The village has 1,381 literate and 460 illiterate residents. Additionally, 516 people belong to Scheduled Caste (SC) communities.

[iii] Sewan Shiwan is a medium size village in Garhshankar Tehsil of Hoshiarpur district, Punjab with 176 families and a population of 852 of which 417 are males and 435 are females as per Census 2011. Population of children in the age group 0-6 is 104 which makes up 12.21 percent of the total village population. Average sex ratio of Sewan village is 1043 which is higher than the Punjab State average of 895. Child sex ratio for Sewan as per Census 2011 is 962, higher than the Punjab average of 846. Sewan village has a higher literacy rate (78.21) as compared to Punjab (75.84 percent). Male literacy stands at 88.46 percent while female literacy rate was 68.49 percent. Sewan village is administrated by the Sarpanch. The village has an active website, but it lacks information on available schools and hospitals etc. Most of the villagers belong to the Schedule Castes (SC) constituting 39.44 percent of the population. There were 267 workers of which 86.89 percent were Main Work (having employment for earning for more than 6 months in a year) while 13.11 percent were involved in Marginal activity that

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provides livelihood for less than 6 months in a year. Of 267 workers engaged in Main Work, 57 were cultivators (owner or co-owner) and 95 were agricultural labourer.

[iv] Shahpur is in Garhshankar tehsil of Hoshiarpur district, Punjab. It is located approximately 4 km from the tehsil headquarters in Garhshankar and is around 32 km from the district headquarters. It is a designated Gram Panchayat. As per Census 2011, the village code of Shahpur is 032008. The village covers a geographical area of 213 hectares and has the pincode 144527. Shahpur village is governed under the Panchayati Raj system, with a Sarpanch as the elected head. The village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. Shahpur has a total population of 447 people, comprising 244 males and 203 females. The village has 97 households and a sex ratio of 831 females per 1,000 males. There are 56 children in the 0–6 years old age group. The village has 338 literate and 109 illiterate residents. Additionally, 361 people belong to Scheduled Caste (SC) communities.

[v] Khanpur is a village situated in the Garhshankar tehsil of Hoshiarpur district in Punjab. It is located approximately 29 km from the tehsil headquarters in Garhshankar and around 23 km from the district headquarters in Hoshiarpur. Khanpur village is a designated Gram Panchayat. According to Census 2011, the village code of Khanpur is 031860. It has a geographical area of 94 hectares and has Pincode 144526. Mahilpur is the nearest town. Khanpur has a Sarpanch serving as the elected head. The village falls under the Chabbewal Vidhan Sabha (Assembly) constituency of the Hoshiarpur Lok Sabha (Parliamentary) constituency. Khanpur village has a population of 1,479 people, consisting of 760 males and 719 females. It has 332 households and a sex ratio of 946 females per 1,000 males. There are 183 children in the 0–6 years age group. The village has 1,018 literate and 461 illiterate residents, 839 people belong to the Scheduled Castes (SC) category.

[vi[Sarhala Khurd is situated in Garhshankar tehsil of Hoshiarpur district, Punjab. It is approximately 30 km from the tehsil headquarters in Garhshankar and around 31 km from the district headquarters in Hoshiarpur. It is a designated Gram Panchayat. As per Census 2011, the village code of Sarhala Khurd is 031810. The village has a geographical area of 140 hectares with 144525 as its Pincode. Mahilpur is the nearest town. Sarhala Khurd has a Sarpanch and falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. It has a total population of 944 people, comprising 460 males and 484 females. The village has 198 households and a sex ratio of 1,052 females per 1,000 males. There are 94 children in the 0–6 years age group. The village has 745 literate and 199 illiterate residents while 466 people belong to the Scheduled Castes (SC).

[vii] Binewal is in the Garhshankar tehsil of Hoshiarpur district, Punjab. It is located 10 km from the tehsil headquarters in Garhshankar and around 35 km from the district headquarters in Hoshiarpur. Jaitpur is the Gram Panchayat for Binewal village. As per Census 2011, the village code of Binewal is 032012, it covers a geographical area of 841 hectares and has 146111 as the Pincode. Garhshankar is the nearest town. The village comes under the Panchayati Raj system, with a Sarpanch serving as the elected head. The village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. It has a total population of 4,532 people, comprising 2,307 males and 2,225 females. The village has 979 households and a sex ratio of 964 females per 1,000 males. There are 493 children in the 0–6 years age group. The village has 3,320 literate and 1,212 illiterate residents. Additionally, 1,131 people belong to Scheduled Caste (SC) communities.

[viii] Karimpur Chahwalavillage is in

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Balachaur tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is approximately 22 km from Balachaur also Shahid Bhagat Singh Nagar district headquarter. The village code of Karimpur Chahwala is 032519. It has a total area of 182 hectares with 144521 as the Pincode. Garhshankar is the nearest town. Karimpur Chahwala village is under the Panchayati Raj system, with a Sarpanch as the elected head. As per Census 2011, Karimpur Chahwala village has a total population of 1,186 people, consisting of 611 males and 575 females. The village has 236 households and a sex ratio of 941 females per 1,000 males. There are 121 children in the 0–6 years age group. The village has 906 literate and 280 illiterate residents as well 219 people belong to the Scheduled Castes (SC).

[ix] Pojewal Gram Panchyat is situated in Balachaur tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is located about 20 kms from the tehsil headquarters in Balachaur and 24 km from the district headquarters in Shahid Bhagat Singh Nagar. The village code of Pojewal is 032524. It covers a geographical area of 665 hectares and has 144521 as the Pincode. A Sarpanch heads the village. As per Census 2011, Pojewal has a total population of 1,732 comprising 908 males and 824 females. The village has 376 households and a sex ratio of 907 females per 1,000 males. There are 194 children in the 0–6 years age group. The village has 1,221 literate and 511 illiterate residents with 460 Scheduled Caste (SC) members.

[x] Saroya is situated in Balachaur tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is approximately 20 km from the tehsil headquarters in Balachaur and around 18 km from the district headquarters in Shahid Bhagat Singh Nagar. Saroya village is a Gram Panchayat with the village code 032515 and pin code 144521. The village covers a total geographical area of 529 hectares. As per Census 2011, Saroya has a population of 3,712 people, comprising 1,917 males and 1,795 females. The village has 752 households and a sex ratio of 936 females per 1,000 males. There are 409 children in the 0–6 years age group. The village has 2,744 literate and 968 illiterate residents. Additionally, 1,904 people belong to the Scheduled Castes (SC).

[xi] Rasulpuris in Nawanshahr tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is located approximately 13 kms from the tehsil headquarters, Nawanshahr and a similar distance from district headquarters, Shahid Bhagat Singh Nagar. The village code of Rasulpur is 032243 and 144513 is the Pincode. Banga is the nearest town. The total geographical area is 185 hectares. Rasulpur village is governed by the Panchayati Raj system, with the Sarpanch as the elected head. Rasulpur has a population of 1,283 (2011 Census) comprising 626 males and 657 females. The village has 285 households and a sex ratio of 1,049 females per 1,000 males. There are 136 children in the 0–6 years age group. The village has 964 literate and 319 illiterate residents along with 666 people Scheduled Castes (SC).

[xii] Sekhowalis situated in Garhshankar tehsil of Hoshiarpur district, Punjab. It is located 22 km from the tehsil headquarters, Garhshankar and 64 km from the district headquarters in Hoshiarpur. Kambala is the Gram Panchayat for Sekhowal village. The village code of Sekhowal is 032019. The village covers a total geographical area of 916 hectares and falls under the 144525 Pincode. Garhshankar is the nearest town. Sekhowal village is governed under the Panchayati Raj system, with a Sarpanch serving as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. According to Census 2011, Sekhowal village has a population of 1,332 comprising 650 males and 682 females. There are 258 households with a sex ratio of 1,049 females per 1,000 males. There are 167 children in the 0–6 years age group. The village has 938 literate and 394 illiterate residents with 371 Scheduled Castes (SC).

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[xiii] RurkiMughlan village is in Balachaur tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is about 10 kms from Balachaur and around 20 km from the district headquarters in Shahid Bhagat Singh Nagar. RurkiMuglan is a Gram Panchayat with the village code 032480 and the Pincode 144521. The village covers 247 hectares. Balachaur is the nearest town. RurkiMughlan is under the Panchayati Raj with a Sarpanch serving as the elected head. The total population of 905 comprises 445 males and 460 females. The village has 178 households and a sex ratio of 1,033 females per 1,000 males. There are 114 children in the 0–6 years age group. The village has 620 literate and 285 il

[xiv] Takarla is situated in Balachaur tehsil of Shahid Bhagat Singh Nagar district, Punjab. It is 10 km from the tehsil headquarters in Balachaur and 30 km from the district headquarters in Shahid Bhagat Singh Nagar. Nawan Pind Takarla serves as the Gram Panchayat for Takarla village. As per Census 2011, the village code of Takarla is 032440 and the Pincode is 144521. The village covers an area of 775 hectares. Takarla village is under the Panchayati Raj system, with a Sarpanch as the elected head. As per Census 2011, Takarla has a population of 2,430 people, comprising 1,234 males and 1,196 females. The village has 522 households and a sex ratio of 969 females per 1,000 males. There are 265 children in the 0–6 years age group. The village has 1,463 literate and 967 illiterate residents with 308 Scheduled Castes (SC).

[xv] Samundra is situated in Garhshankar tehsil of Hoshiarpur district, Punjab. It is approximately 9 km from tehsil headquarters Garhshankar and about 42 km from district headquarters Hoshiarpur. It is a Gram Panchayat with the village code of 032053 and Pincode 146021. The village covers a an area of 296 hectares. Garhshankar is the nearest town. Samundra village is under the Panchayati Raj system, with a Sarpanch as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Samundra village has a population of 2,681 with 1,359 males a is situated in Garhshankar tehsil of Hoshirapur district, Punjab. It is located 8 km from Garhshankar tehsil headquarters and around 41 km from district headquarters, Hoshiarpur. Ghagon Guru village is a designated Gram Panchayat. As per Census 2011, the village code of Ghagon Guru is 032046 and the Pincode is 144521. The village covers total geographical area of 126 hectares. Ghagon Guru village is under the Panchayati Raj system, with the Sarpanch as the elected head. The village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Ghagon Guru village has a population of 501 people, comprising 255 males and 246 females. The village has 101 households and a sex ratio of 964 females per 1,000 males. There are 65 children in the 0–6 years age group. The village has 377 literate and 124 illiterate residents with 129 belonging to Scheduled Castes (SC).

[xvi] Chak Hajipur is situated in Garhshankar tehsil of Hoshiarpur district, Punjab. It is approximately 7 km from Garhshankar tehsil headquarters and around 47 km from the district headquarters, Hoshiarpur. Chak Hajipur village is a Gram Panchayat with the village code 032049 and Pincode 144527. The village covers a geographical area of 151 hectares. It is governed under the Panchayati Raj system, with a Sarpanch as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Chak Hajipur village has a total population of 1,241 people, comprising 634 males and 607 females. The village has 250 households and a sex ratio of 957 females per 1,000 males. There are 108 children in the 0–6 years age group. The village has 847 literate and 394 illiterate residents and 626 Scheduled Castes (SC).

[xvii] Kalewal Beetis situated in Garhshankar

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tehsil of Hoshiarpur district, Punjab. It is located 2 km from Garhshankar and around 40 kms from district headquarters, Hoshiarpur. Kalewal Beet serves is the Gram Panchayat for Kalewal village. As per Census 2011, the village code of Kalewal is 031967 and Pincode is 144527. The village covers a total geographical area of 168 hectares. Kalewal is governed under the Panchayati Raj system, with a Sarpanch serving as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Kalewal village has a population of 884 people, with 469 males and 415 females. The village has 178 households and a sex ratio of 884 females per 1,000 males. There are 83 children in the 0–6 years age group. The village has 646 literate and 238 illiterate residents with 472 Scheduled Castes (SC).

[xviii] Rampur Bilron is in the Garhshankar tehsil of Hoshiarpur district, Punjab. It is located approximately 11 km from the tehsil headquarters in Garhshankar and around 42 km from the district headquarters in Hoshiarpur. Bilron village is a designated Gram Panchayat. As per Census 2011, the village code of Bilron is 032001 and the Pincode is 146110. The village covers 883 hectares. Bilron village is governed under the Panchayati Raj system, with a Sarpanch as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Bilron village has a population of 2,325 people, comprising 1,161 males and 1,164 females. The village has 482 households and a sex ratio of 1,002 females per 1,000 males. There are 260 children in the 0–6 years age group. The village has 1,689 literate and 636 illiterate residents with 837 people belonging to the Scheduled Castes (SC).

[xix] Saila Khurd is in Garhshankar tehsil of Hoshiarpur district, Punjab. It is located 10 km from the tehsil headquarters in Garhshankar and around 30 km from the district headquarters in Hoshiarpur. Saila Khurd village is a designated Gram Panchayat. As per Census 2011, the village code of Saila Khurd is 031931 and the Pincode is 144528. The village covers a total geographical area of 159 hectares. Saila Khurd village is under the Panchayati Raj system, with a Sarpanch as the elected head. It has under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Saila Khurd village has a total population of 4,688 people, consisting of 2,440 males and 2,248 females. The village has 967 households and a sex ratio of 921 females per 1,000 males. There are 531 children in the 0–6 years age group. The village has 3,337 literate and 1,351 illiterate residents as also 1,404 people belong to the Scheduled Castes (SC).

[xx] Kukran is situated in Garhshankar tehsil of Hoshiarpur district, Punjab. It is 30 km from tehsil headquarters, in Garhshankar and 26 km from district headquarters, Hoshiarpur. Kukran is a Gram Panchayat with the village code 031770 and Pincode 146112. The village covers a geographical area of 67 hectares. Kukran village is under the Panchayati Raj system, with a Sarpanch as the elected head. The village falls under Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Kukran has a population of 197 comprising of 105 males and 92 females. The village has 39 households and a sex ratio of 876 females per 1,000 males. There are 17 children in the 0–6 years age group. The village has 152 literate and 45 illiterate residents as well as 4 people belonging to the Scheduled Castes (SC).

[xxi] Pakhowal is in Garhshankar tehsil of Hoshiarpur district, Punjab. It is 16 km from the tehsil headquarters in Garhshankar and around 36 km from the district headquarters in Hoshiarpur. Pakhowal is a designated Gram Panchayat with the village code of and pincode is 146021 031957. The village covers an area of 246 hectares. Pakhowal village is a

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Panchayati Raj system, with a Sarpanch as the elected head. For political representation, the village falls under the Chabbewal Vidhan Sabha (Assembly) constituency and the Hoshiarpur Lok Sabha (Parliamentary) constituency. As per Census 2011, Pakhowal village has a total population of 1,105 people, consisting of 569 males and 536 females. The village has 236 households and a sex ratio of 942 females per 1,000 males. There are 109 children in the 0–6 years age group. The village has 810 literate and 295 illiterate residents with 458 belonging to Scheduled Castes (SC).

[xxii] Balachaur is a Municipal Council city in district Shaheed Bhagat Singh Nagar, Punjab. The city is divided into 13 wards, with elections held every five years. According to the 2011 Census of India, the population of Balachaur Municipal Council is 21,631, comprising 11,180 males and 10,451 females.

Methods and materials

The survey method was used for gathering data and the tools of investigation ere the questionnaire having structured and unstructured questions. The mixed method approach was utilized whereby the partcipants in the survey were asked questions in detail about certain aspects of their responses. Thus, the qualitative and quantitative form of data was amassed on the basis of the interview method as also the Focus Group Discussion and observation methods. A total of 220 individuals participated in the survey including the geographical areas of Garhshankar and Balachaur tehsils.

Quantitative and qualitative analysis of results and discussion of interpretation

The data collection was conducted across two time zones. The first was during the immediately after the floods of last year and once during the sowing post the floods. The families belonging to agriculture as the main occupation were given a wide berth to air their views and concerns pertaining to their immediate environment. The details of the research findigs are given in the following paras:

Table 1: Age Distribution of Sample

Sr. No.	Age Distribution	Frequency	Percentage
1	<20	36	16
2	20 – 30	49	22
3	30-40	63	29
4	40-50	40	18
5	Above 50	32	15
	Total	220	100

The Table- 1 presents the age distribution of 220 respondents included in the study. The largest proportion of respondents belong to the 30–40 years age group, comprising 63 participants (29 percent), indicating that middle-aged adults form the dominant segment of the sample. The 20–30 years age group is the second largest, with 49 respondents (22 percent), followed by the 40–50 years old age group with 40 respondents (18 percent).

The younger age group of below 20 years includes 36 respondents (16 percent), while those belong to the above 50 years category has the smallest representation, accounting for 32 respondents (15 percent).

The age distribution demonstrates a fairly balanced representation across different age categories, although respondents aged 30–40 years are more prominently represented. Together, the age groups 20–40 years account for 112 respondents (51 percent), suggesting that over half the sample falls within the economically active and productive age range. Meanwhile, respondents aged 40 years and above

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constitute 72 participants (33 percent), and those below 20 years represent 16 percent of the sample.

The relatively even spread across age groups enhances the diversity and allows for meaningful comparisons across different stages of adulthood. However, the slight concentration in the 30–40 years category may have a greater influence on the overall findings, particularly as age is associated with the variables under investigation.

Table 2: Education level of the respondents

Sr. No.	Level of Education	Frequency	Percentage
1	Illiterate	1	0.50
2	Primary School	6	3
3	High School	7	3
4	Secondary	15	7
5	Undergraduate	48	22
6	Graduate	40	18
7	Post Graduate	97	43.50
8	Other	6	3
	Total	220	100

The Table-2 presents the educational background of the respondents. A total of 220 respondents were included in the study. The distribution of respondents according to their level of education indicates that the respondents are largely well-educated. The highest proportion of respondents belongs to the Post Graduate category, accounting for 97 respondents (43.50 percent). This is followed by Undergraduate respondents, with 48 respondents (22 percent), and Graduates, with 40 respondents (18 percent). Together, undergraduate, graduate, and postgraduate respondents constitute 83.5 percent of the total sample, showing that the majority of participants have higher education qualifications.A smaller proportion of respondents have lower educational qualifications. Secondary-level educated respondents represent 7 percent (15 respondents), while Primary School and High School educated respondents each account for 3 percent (6 and 7 respondents respectively). Only 1 respondent (0.50 percent) was found to be illiterate, indicating that illiteracy is almost negligible among the sample population. The "Other" category includes 6 respondents (3 percent), representing the educational backgrounds not covered in the listed categories.

The educational profile of the respondents suggests that the study population is predominantly composed of individuals with advanced educational qualifications. The dominance of postgraduate respondents (43.50 percent) indicates a highly educated sample, which may contribute to better awareness, understanding, and informed responses regarding the subject under investigation. The considerable representation of undergraduate (22 percent) and graduate (18 percent) respondents strengthens the academic profile of the sample. Since more than four-fifths of respondents had higher education, the findings of the study are likely to be influenced by respondents who have greater exposure to academic knowledge, information sources, and analytical skills. The very low percentage of illiterate respondents (0.50 percent) and limited representation of respondents with only primary or secondary education suggest fewer individuals from less-educated groups. Therefore, the data provides insights from a largely educated population.

Overall, the Table shows that the respondents have a strong educational background, with postgraduate, undergraduate, and graduate categories dominating the sample. This indicates that the study primarily reflects the perspectives of highly educated individuals.

Table 3: Gender Distribution of sample population

Sr. No.	Gender	Frequency	Percentage

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1	Male	92	42
2	Female	128	58
	Total	220	100

T
able 3 presents the gender-wise distribution of the sample population. The total sample consists of 220 respondents, including both male and female participants.The Table-3 indicates that out of the total 220 respondents,92 participants (42 percent) were male, while128 participants (58 percent) were female. The data shows that female respondents constituted a higher proportion of the sample compared to male respondents.

The females exceeded the males by 16 percentage suggesting that the sample was comprised greater representation of females. The gender distribution reflects a moderately balanced but female-dominant sample, with females accounting for more than half the respondents

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Table 4: Occupation Categories of population

Sr. No.	Occupation	Frequency	Percentage
1	Farmer	5	2
2	Services	12	6
3	Govt. Job	65	30
4	Business	9	4
5	Private Job	53	24
6	Unemployed	14	6
7	Students	62	28
	Total	220	100

Table 4 presents the occupational distribution of the surveyed population across different categories. The data shows variations in employment patterns, with government jobs, student population, and private employment forming the major occupational groups.The largest proportion of respondents belongs to the Government Job category, accounting for 65 individuals (30 percent) of the total population. This indicates a strong presence of public-sector employment among the respondents and suggests that government services are a significant source of livelihood in the study area. The second-largest group consists of students, with 62 respondents (28 percent). The high proportion of students reflects a considerable young population. This may also suggest future potential for workforce participation as these individuals enter employment. The Private Job category includes 53 respondents (24 percent), making it the third-largest occupational group. This shows that private-sector employment plays a crucial role in providing opportunities and contributes significantly to the economic structure of the population.A smaller proportion of respondents are engaged in services, comprising 12 individuals (6 percent), while 14 respondents (6 percent) are reported as unemployed. The unemployment rate indicates that a section of the population is currently without employment opportunities, which may highlight the need for skill development and job creation initiatives.The Business category accounts for 9 respondents (4 percent), suggesting that entrepreneurship and self-employment activities are relatively limited among the surveyed population. Similarly, only 5 respondents (2 percent) are identified as farmers, indicating a very low dependence on agriculture as an occupation.

Overall, the data indicate a population structure characterized by higher

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dependence on salaried employment and education rather than agriculture or self-employment. This reflects a shift towards modern occupational patterns and formal economic activities.

Table 5: Levels of Income earned (monthly)

Sr. no.	Income	Frequency	Percentage
1	<10,000/- INR	89	41
2	10,000 – 50,000/- INR	63	29
3	50,000 – 1,00,000/- INR	42	19
4	Above 1,00,000/- INR	26	11
	Total	220	100

Table 5 presents the income (monthly) distribution of the respondents. The data indicates considerable variation in income levels, with a larger proportion of respondents belonging to the lower-income category. The findings show that the largest group of respondents, 89 individuals (41 percent), earn a monthly income of less than Rs. 10,000, indicating that a significant proportion of the sample belongs to the lower-income group. This suggests limited earning capacity and may reflect economic constraints among a considerable section of the respondents. The second-largest category consists of respondents earning Rs. 10,000 to Rs. 50,000 per month, accounting for 63 respondents (29 percent). This group represents individuals with moderate income levels and indicates that nearly one-third of the respondents have a relatively stable but limited income source. A smaller proportion of respondents, 42 individuals (19 percent), fall within the Rs. 50,000 to Rs. 1,00,000 monthly income category. This indicates the presence of a middle-to-upper income segment within the sample, though it represents less than one-fifth of the total respondents. Only 26 respondents (11 percent) reported earningabove Rs. 1,00,000 per month, making it the smallest group. This suggests that high-income earners constitute a minority among the respondents.

The distribution shows that income levels among respondents are skewed toward lower and middle-income categories. Around 70 percent of respondents earn below Rs. 50,000 per month, highlighting that most participants have comparatively modest financial resources. The limited representation of high-income groups (only 11 percent) suggests that the population is predominantly composed of individuals from economically weaker or moderate-income backgrounds.This income pattern may influence respondents' purchasing behaviour, access to resources, financial decision-making, and ability to participate in economic activities, depending on the context of the study. The findings indicate that income is an important demographic factor that should be considered while analyzing other related variables.

Table 6: Residence Location of population

Sr. no	Location	Frequency	Percentage
1	Urban	67	30
2	Semi-urban	15	7
3	Rural	138	63
	Total	220	100

Table 6 presents the distribution of the population according to location of their residence. The data indicates that the respondents belong to three different residential categories: urban, semi-urban, and rural areas.The Table shows that the majority of the population resides in rural areas, with 138 respondents (63 percent)

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belonging to this category.

This indicates that the study population is predominantly rural, suggesting that the findings may largely reflect the experiences, conditions, and characteristics of people living in rural settings. The urban population accounts for 67 respondents (30 percent), indicating a significant representation of individuals from urban areas.

The semi-urban category represents the smallest proportion, with only 15 respondents (7 percent). The lower representation of semi-urban residents suggests that this transitional residential group is less prevalent among the respondents as compared to rural and urban populations.The distribution shows a clear dominance of the rural population (63 percent), followed by urban residents (30 percent), while semi-urban residents constitute a small minority (7 percent).
The findings suggest that this residential pattern may indicates that the study area has a higher proportion of rural inhabitants.

II. **Level of concern for water Resources**

Table 7: Concerns about available water sources

Sr. No.	Concerns about available water sources	Frequency	Percentage
1	Not at all	10	4
2	Never thought about it	4	2
3	Little concern	58	26
4	Frequently concerned about scarcity	24	11
5	High concern at water table going down	70	32
6	Very concerned about quality of water	54	25
	Total	220	100

Table 7 presents the respondents' level of concern regarding the availability and condition of water sources. The responses reflect varying degrees of awareness and anxiety about water scarcity, declining groundwater levels, and water quality issues.The data indicates that a large majority of respondents are aware of issues related to water availability and quality. The highest proportion of respondents (32 percent) expressed high concern about the declining water table, suggesting that groundwater depletion is perceived as a major environmental and livelihood challenge. This concern may be linked to increasing dependence on groundwater sources, irregular rainfall patterns, excessive extraction, and reduced recharge of underground water resources.The second most significant concern reported by respondents was water quality, with 25 percent of participants being very concerned about the quality of available water. This indicates growing awareness regarding possible contamination, health risks, and the suitability of water for domestic and agricultural purposes. Concerns about quality may arise due to changes in taste, color, pollution, chemical contamination, or declining reliability of existing water sources.

Around 26 percent of respondents little concern regarding available water sources. This group acknowledged the existence of water-related issues but did not perceive them as an immediate threat. Their lower level of concern could be due to better access to water resources, availability of alternative sources, or limited awareness of long-term water challenges.

A smaller proportion (11 percent) stated that they are frequently concerned about water scarcity, indicating that some respondents experience direct difficulties related to water shortages. These individuals may face seasonal shortages, reduced availability of irrigation water, or competition among users for limited water resources.Only 4 percent of respondents reported being not at all

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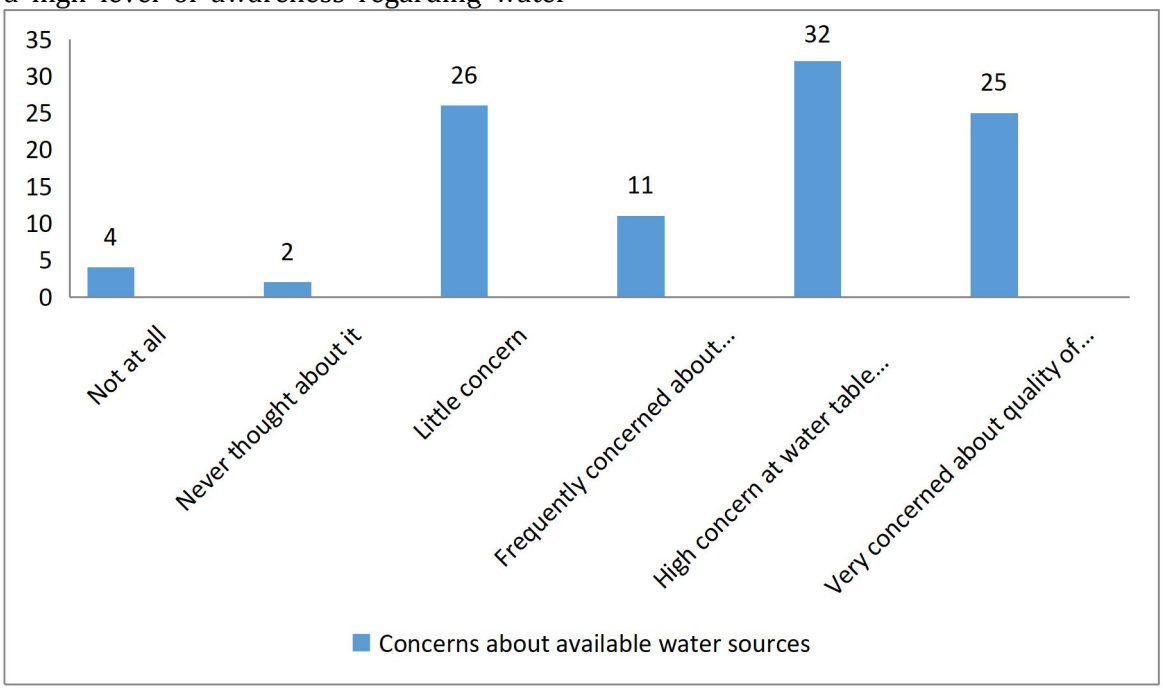
concerned, while 2 percent had never thought about the issue. Together, these groups represent a very small segment (6 percent) with limited awareness or immediate experience of water-related problems.The findings reveal that 94 percent of respondents have some level of concern about available water sources, demonstrating a high level of awareness regarding water-related challenges. The dominant concerns are declining groundwater levels (32 percent) and water quality issues (25 percent), together accounting for more than half of the responses (57 percent). This suggests that water resource management, groundwater conservation, and water quality improvement should be prioritized.



Thus, the results highlight the need for sustainable groundwater management practices; awareness programs on water conservation; regular monitoring of water quality; promotion of rainwater harvesting and groundwater recharge measures; community participation in protecting and managing local water resources. Overall, the table reflects that respondents are increasingly recognizing water insecurity as an important environmental and social issue requiring immediate attention.

Table 8: Sources of water supply

Sr. No.	Water Supply	Frequency	Percentage
1	Tap water	110	50
2	Motor (Tubewell)	77	35
3	Well	14	6
4	Pond	0	0
5	Water tank	9	4
6	RO Bottles	8	3
7	River / National Source	2	1
	Total	220	100

Table 8 presents the sources of water supply used by the respondents. The data indicates that households rely on a combination of public and private water sources, with tap water being the most common source.The findings show that tap water is the dominant

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source of water supply, used by 50 percent of households, reflecting improved access to organized water distribution systems. However, 35 percent of households continue to depend on motor-operated tubewells, highlighting the importance of groundwater resources in meeting local water requirements.Traditional sources such as wells (6 percent) and river/natural sources (1 percent) have limited usage, suggesting a shift away from older and potentially less reliable water sources. The complete absence of pond water usage indicates that ponds are not considered a suitable source for household consumption.The use of water tanks (4 percent) and RO filters (3 percent) indicates that a small section of the population relies on alternative arrangements, either due to concerns about water availability or quality.

The findings highlight that tap water (50 percent) is the leading source of water supply, showing relatively better access to piped water facilities. Groundwater sources (motor tubewell and wells combined) account for 41 percent of households, indicating continued dependence on underground water. Modern purification sources (RO bottles) are used by only 3 percent of households, suggesting limited adoption of packaged purified water. Natural surface water sources are almost absent, with only 1percent relying on river/national sources and none using ponds. The overall pattern suggests a transition toward improved water supply systems, but groundwater remains an important supplementary source.

Thus, the water supply patterns reflect a mixed system where tap water provides the primary source of household water, while groundwater through tubewells remains a major alternative. The low dependence on unsafe traditional sources indicates improvement in water accessibility. However, continued monitoring of groundwater quality and expansion of reliable piped water infrastructure may be necessary to ensure sustainable and safe water availability.

Table 9: Water quality

Sr. No.	Water Quality	Frequency	Percentage
1	Good	103	47
2	Have to filter through cloth	2	1
3	Use of RO	109	49
4	Salty to taste	0	0
5	Better to taste	5	2.50
6	Cloudy	0	0
7	Muddy	1	0.50
8	Not drinkable	0	0
	Total	220	100

Table 9 presents the respondents' perceptions regarding the quality of drinking water. The data indicate that the majority of households use treated water or consider their water quality satisfactory, while only a very small proportion reported visible quality issues.Out of the total respondents, 109 (49 percent) reported using Reverse Osmosis (RO) systems for drinking water, making it the most common practice. This suggests that a significant proportion of households rely on additional purification methods to ensure safe drinking water, possibly due to concerns about groundwater quality or contamination. A nearly equal proportion, 103 respondents (47 percent), considered their water quality good. This indicates that many households perceive their available water sources as acceptable for consumption without major treatment requirements.Only 5 respondents (2.5 percent) reported that their water was better in taste, however, taste-based satisfaction was limited. A very small number of

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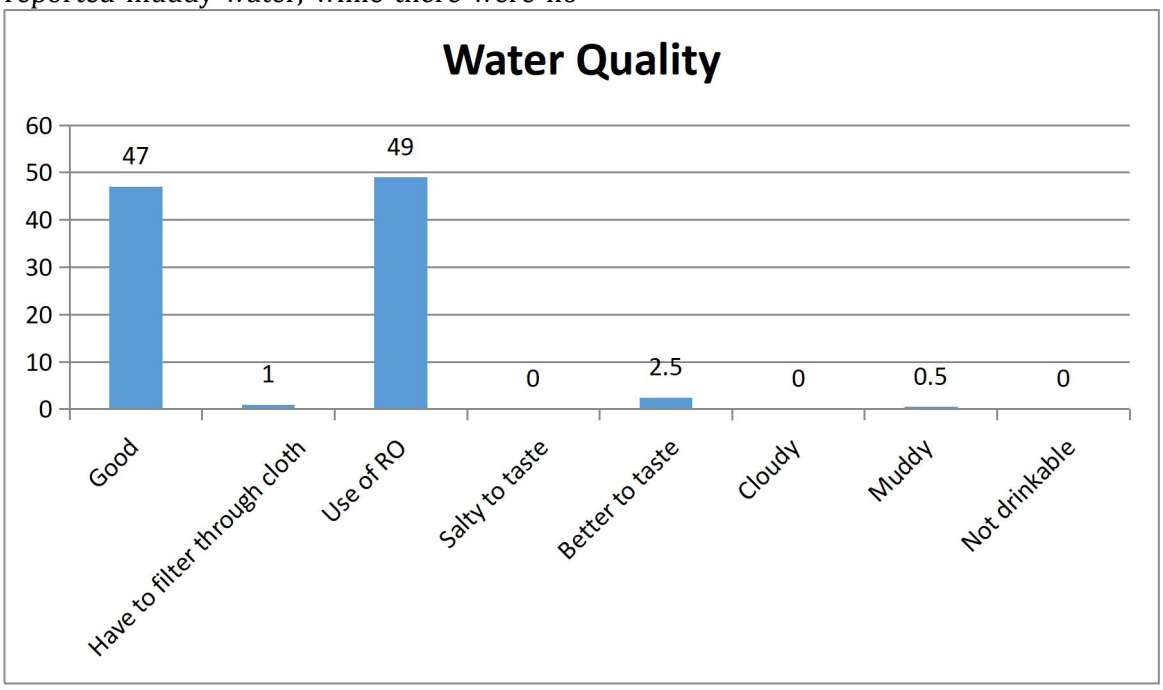
respondents (2 respondents, 1 percent) mentioned that they filter water through cloth, showing the use of traditional and low-cost filtration practices among a few households. Issues related to poor water quality were reported by very few respondents. Only 1 respondent (0.5 percent) reported muddy water, while there were no reports of the water being salty, cloudy, or not drinkable. The absence of complaints regarding salinity, cloudiness, and undrinkable water suggests that severe water quality problems are not widespread in the study area.



The findings show that drinking water quality is generally perceived as satisfactory among the respondents. However, the high dependence on RO systems (49 percent) indicates that many households prefer additional purification despite considering the water quality good. This may reflect concerns regarding invisible contaminants, mineral content, or safety standards rather than only visible water problems. Traditional filtration methods are rarely used, and very few households experience physical issues such as muddy water.Overall, the water quality situation appears relatively favorable, but the widespread use of RO technology highlights the community's preference for improved water safety and quality assurance. Further testing of chemical and microbial parameters would be useful to confirm the actual quality of the water sources.

Table 10: Quality of water is used in home regularly

Sr. No.	Quality of water	Frequency	Percentage
1	Unlimited	10	4.50
2	Never assessed	53	24
3	Big overhead storage Tank is full	54	25
4	Many buckets	14	6
5	Few buckets	70	32
6	Have speed storage tanks	10	4.50
7	Use running fresh water supply only for cooking	9	4

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	Total	220	100

Table 10 presents the pattern of regular water usage among households based on the quantity and method of water storage/use. The data shows variation in household water consumption practices and indicates differences in water availability, storage capacity, and awareness of water use.The findings show that the majority of households use a limited quantity of stored water regularly. The highest proportion of respondents (32 percent) reported using a few buckets of water, suggesting moderate water consumption and possibly limited storage facilities.A significant number of households (25 percent) reported that their large overhead storage tanks remain full, indicating better access to water supply and greater storage capacity. This suggests that some households have reliable water availability and are able to maintain adequate reserves for daily needs.About 24 percent of respondents had never assessed their regular water usage, reflecting a lack of awareness or monitoring of household water consumption patterns. This group may not have clear knowledge about the amount of water used daily or may not consider water measurement important. Only 6 percent of households reported using many buckets of water, showing that a relatively small section of the population consumes larger quantities of stored water. Similarly, 4.5 percent of households reported unlimited water availability, indicating that very few households experience unrestricted access to water. A small proportion of respondents (4.5 percent) use separate storage tanks, while 4 percent depend only on running fresh water supply for cooking purposes. These figures suggest that alternative water management practices are less common among households.

The findings show that household water use is mainly dependent on small-scale storage practices, with most families relying on a few buckets of stored water supplies. While some households have adequate storage facilities such as overhead tanks, a considerable proportion of respondents lack awareness about their water consumption levels. The findings highlight the need for promoting water conservation practices, regular monitoring of household water use, and improved awareness regarding efficient water management.

Table 11: Responsibility for maintaining adequate water at home lies with

Sr. No.	Maintaining water at home	Frequency	Percentage
1	Father	10	4.50
2	Mother	24	11
3	Both	90	41
4	Myself	61	27
5	My siblings (sister)	3	1.50
6	Supply comes by itself	32	15
7	If required we ask for tanker	0	0
	Total	220	100

Table 11 presents the distribution of respondents according to who is responsible for maintaining an adequate water supply at home. The responses indicate the role of family members and external sources in managing household water availability. The findings show that household water management is primarily a shared responsibility, with the largest proportion of respondents (41 percent) reporting that both family members are responsible for maintaining adequate water at home. This suggests that water-related tasks are generally handled collectively rather than being assigned to a single individual.A considerable number of respondents (27 percent) reported that they themselves take

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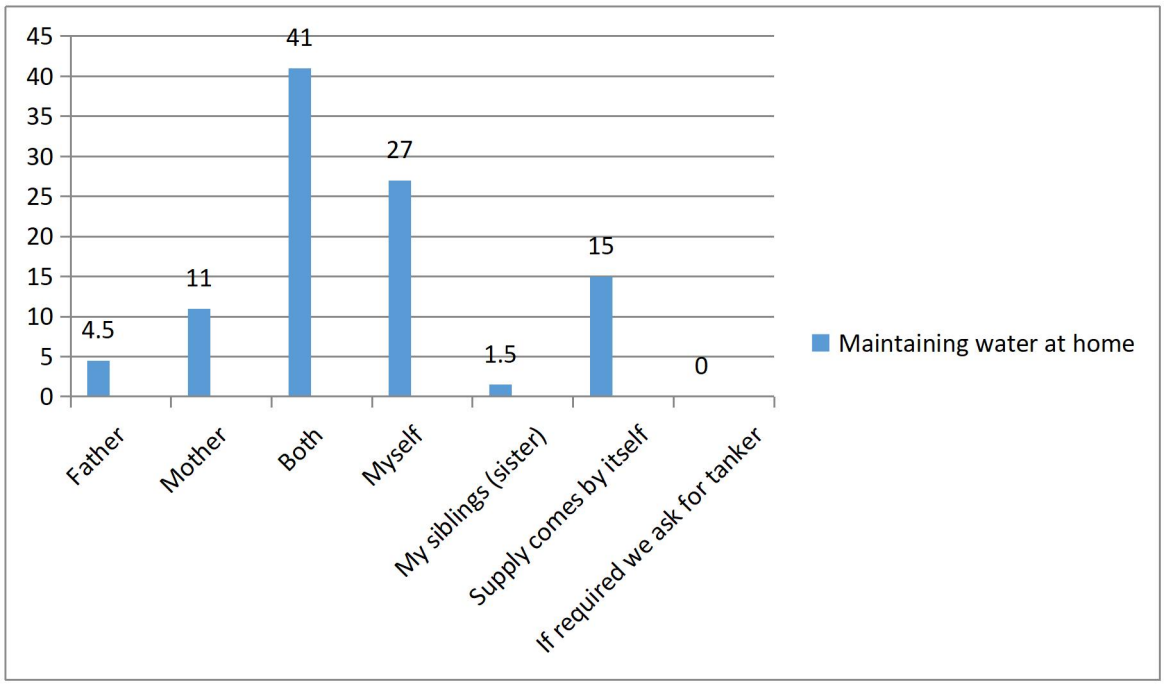
responsibility for ensuring sufficient water availability at home. This indicates a level of individual involvement and awareness regarding household water management, particularly among members who may directly handle water collection, storage, or monitoring.The role of mothers in maintaining water supply is reported by 11 percent of the respondents, while only 4.5 percent identified fathers as being primarily responsible. The relatively lower involvement of fathers may indicate that routine household water-related activities are less frequently assigned to male members in the studied households. Only 1.5 percent stated that their sisters are responsible for maintaining water at home, showing that this responsibility is rarely delegated to younger family members. Around 15 percent of respondents indicated that the water supply comes automatically, meaning they do not need to take specific responsibility for arranging or maintaining water availability. This may reflect upon households with regular and reliable water supply systems.

None of the respondents spoke about their dependence on water tankers when required, suggesting that tanker-based water supply is not commonly used in the study area.



The findings show that water management within households is largely a collective activity, with shared family responsibility being a dominant pattern. Individual responsibility is also significant, indicating active participation of household members in ensuring water availability. The minimal reliance on external sources such as tankers suggests that households largely depend on existing water supply systems rather than emergency arrangements. The findings highlight the importance of family cooperation and reliable water infrastructure in meeting daily household water needs.

Table 12: Action taken in case of emergency or water shortage

Sr. No.	Action source	Frequency	Percentage
1	Report to Sarpanch	123	56
2	Report to MC	70	32
3	Buy R.O Bottles	27	12
	Total	220	100

Table 12 presents the actions taken by

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respondents during emergencies or situations of water shortage. The data shows that the majority of respondents prefer to report the issue to local village authorities, while some rely on alternative arrangements such as purchasing R.O. water bottles.

Out of the total respondents, 123 individuals (56 percent) reported that they approach the Sarpanch in case of a water emergency or shortage. This indicates that the Sarpanch remains the primary point of contact for addressing community-level water-related problems, reflecting the importance of local governance institutions in managing basic services. A significant proportion or 70 individuals (32 percent), stated that they report water-related issues to the Municipal Committee (MC). This suggests that a considerable number of people depend on formal administrative bodies for resolving water supply problems, particularly where municipal authorities are responsible for water management. Only 27 respondents (12 percent) reported that they purchase RO water bottles during emergencies. This is the least preferred option, possibly due to the higher cost of bottled water, limited affordability among households, or a preference for seeking long-term solutions through local authorities rather than temporary alternatives.

The research findings show that community members are largely dependant on institutional mechanisms rather than individual coping strategies during water shortages. The combined share of respondents approaching the Sarpanch and Municipal Committee is 88 percent, indicating strong reliance on local governance systems for emergency water management. However, the 12 percent who purchase RO bottles highlight that some households resort to immediate private solutions when public water sources fail.

There is a need for strengthening local water management systems, improving emergency response mechanisms, and ensuring timely intervention by local authorities to reduce dependence on costly short-term solutions like bottled water.

Table 13: Natural water sources nearby

Sr. No.	Source of natural water	Frequency	Percentage
1	Yes	52	24
2	No	105	47
3	Don't Know	52	12
4	Maybe earlier there may have been but now there are none	11	05
5	Total	220	100

Table 13 presents the respondents' awareness and perception regarding the availability of natural water sources in their nearby areas. The responses indicate varying levels of knowledge and recognition of local natural water resources.

The analysis shows that 47 percent of the respondents reported that there are no natural water sources available nearby, making it the largest response category. This suggests that a significant proportion of the population perceives a decline or absence of natural water resources in their surroundings. The lack of nearby natural water sources may indicate changes in land use, environmental degradation, groundwater depletion, or reduced accessibility of traditional water bodies.

Around 24 percent of the respondents confirmed the presence of natural water sources nearby. This indicates that some areas still retain access to natural water resources such as ponds, rivers, streams, wells, or other traditional sources. However, the comparatively lower percentage suggests that these resources may not be widespread

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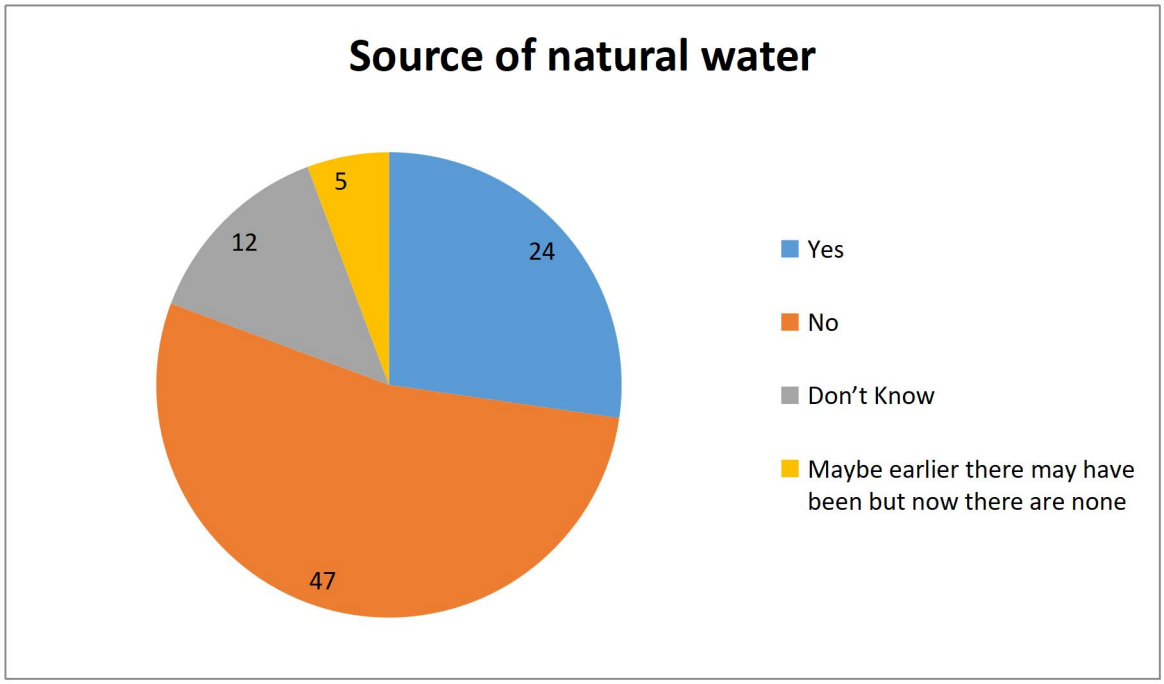
or equally accessible to all communities. Approximately 12 percent of the respondents were unaware of whether natural water sources exist nearby. This lack of awareness may reflect limited community engagement with local environmental resources, reduced dependence on traditional water sources due to modern water supply systems, or a decline in the visibility of such resources.

A smaller group (5 percent) stated that natural water sources may have existed earlier but are no longer present. This response highlights possible historical changes in the local environment, including drying of water bodies, encroachment, pollution, or other factors leading to the disappearance of natural sources.



The findings show that most of the population perceives a scarcity or absence of natural water sources in their local areas. While some communities continue to have access to natural water resources, a considerable proportion believes that these sources have declined or disappeared over time. The results suggest the need for conservation and restoration of local water bodies, awareness programs on water resource management, and sustainable practices to protect remaining natural water sources. The responses also indicate the importance of documenting traditional water resources before they are permanently lost.

Table 14: Man-made sources of water in the area

Sr. No.	Source of water in area	Frequency	Percentage
1	Yes	104	47
2	No	59	27
3	Don't Know	57	26
	Total	220	100

Table 14 presents the respondents' awareness regarding the availability of man-made sources of water in the area. The responses were categorized into three groups: "Yes", "No", and "Don't Know". A total of 220 respondents were considered for the study. The data shows that 47 percent (104 individuals) reported that man-made sources

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of water are available in their area. This represents the largest proportion of responses, indicating that nearly half of the surveyed population recognizes the presence of artificial water sources such as wells, tube wells, canals, reservoirs, water tanks, or other constructed water facilities. However, 27 percent (59 individuals) stated that there are no man-made sources of water in their area. This suggests that a considerable section of the population either depends on natural sources of water or has limited access to constructed water facilities. Furthermore, 26 percent (57 individuals) selected Don't Know, indicating a lack of awareness or insufficient information about the availability of man-made water sources. This relatively high percentage suggests that some community members may not be familiar with local water infrastructure or may have limited involvement in water resource management.

The findings indicate that man-made water sources exist in the area, as nearly half of the respondents confirmed their presence. However, the combined percentage of respondents who either do not have access to such sources (27 percent) or are unaware of them (26 percent) totals 53 percent, which is higher than those who reported their availability. This highlights possible issues related to unequal distribution, accessibility, or awareness of water facilities within the community.

The results suggest the strong need for improving access to artificial water sources in areas where they are unavailable. Increasing community awareness about existing water facilities and strengthening local water management and information-sharing systems to ensure that residents are aware of available resources. Overall, the data reflects that while man-made water sources are present in the area, their availability and awareness among residents remains uneven.

Table 15: Presence of dried up wells in the area

Sr. No.	Dried up wells in the area	**Frequency**	**Percentage**
1	Yes	81	37
2	No	110	50
3	Don't Know	29	13
	Total	220	100

Table 15 presents the respondents' views regarding the presence of dried-up wells in their area. Out of the total respondents, 220 individuals were surveyed. The findings show varying levels of awareness and experience regarding the drying of wells.

The findings show that 50 percent of the respondents (110 people) said that there were no dried-up wells in their area, making it the largest response category. This indicates that half of the surveyed population either has not experienced the phenomena of wells drying up or are living in areas where groundwater sources remain relatively stable.

However, 37 percent of the respondents (81 people) confirmed the presence of dried-up wells in their locality. This is a substantial proportion, suggesting that groundwater depletion is a noticeable issue for many residents. The occurrence of dried wells may be associated with factors such as declining groundwater levels, excessive extraction of groundwater for domestic or agricultural purposes, reduced rainfall, and changing climatic conditions.

A smaller group, 13 percent (29 people), stated that they did not know whether dried-up wells existed in their area. This indicates a lack of awareness among some residents regarding local water resource conditions or limited interaction with well-based water sources.

Overall, the findings suggest that while a majority of respondents do not observe

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dried-up wells, a significant proportion of the population is affected by or is aware of groundwater scarcity issues. The awareness of the presence of dried wells among more than one-third of the respondents highlights the need for effective groundwater management, water conservation practices, and awareness programmes to prevent further depletion of water resources. The percentage of respondents who are unaware also indicates the importance of improving community-level knowledge about groundwater conditions and sustainable water use.

Table 16: Awareness of rain water harvesting

Sr. No.	Rain water harvesting	Frequency	Percentage
1	Yes	198	90
2	No	11	5
3	Don't Know	11	5
	Total	220	100

Table 16 presents the level of awareness among respondents regarding rainwater harvesting. The data shows that out of the total 220 respondents, a large majority (198 respondents, 90 percent) reported that they were aware of rainwater harvesting. Only 11 respondents (5 percent) stated that they were not aware of it, while another 11 respondents (5 percent) reported that they did not know about the concept.

The findings indicate that awareness of rainwater harvesting is very high among the respondents, with nine out of every ten individuals having knowledge about this water conservation practice. This high level of awareness may be attributed to increasing environmental education, government campaigns, community awareness programmes, and growing concerns about water scarcity and sustainable water management.

However, the presence of 10 percent respondents who either lacked awareness or were uncertain suggests that there is still a need for further awareness initiatives. Special attention should be given to educating these groups about the importance of rainwater harvesting, its benefits in groundwater recharge, reducing water shortages, and promoting sustainable use of water resources.Overall, the data reflects a positive awareness level towards rainwater harvesting, indicating that most respondents understand its significance and may be more likely to support or adopt rainwater conservation measures. Nevertheless, continued awareness programmes are necessary to achieve complete community participation in rainwater harvesting practices.

Table 17: Need for initially any rain water harvesting feature

Sr. No.		Frequency	Percentage
1	Yes	193	88
2	No	13	6
3	Don't Know	14	6
	Total	220	100

Table 17 presents the respondents' views regarding whether there was initially any rainwater harvesting feature available. The responses were categorized into three groups: 'Yes', 'No', and 'Don't Know'.The Table-17 indicates that a large majority (193 respondents, 88 percent) reported that a rainwater harvesting feature was initially

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available. This high percentage suggests that rainwater harvesting was already recognized and implemented as an important water conservation practice in the study area. It reflects a strong presence of rainwater management infrastructure or awareness among the respondents.Only 13 respondents (6 percent) stated that there was no rainwater harvesting feature initially, indicating that the absence of such facilities was limited to a small proportion of the surveyed population. This may suggest that most locations had adopted some form of rainwater harvesting, while only a few areas lacked these facilities.Furthermore, 14 respondents (6 percent) selected 'Don't Know', showing that a small segment of participants were uncertain about the existence of rainwater harvesting features. This uncertainty may be attributed to limited awareness, lack of involvement in water management activities, or inadequate visibility of the installed systems. Overall, the findings reveal that rainwater harvesting features were widely available initially, as confirmed by 88 percent of respondents. The very low percentage of negative responses (6 percent) indicates that the practice had already gained acceptance and implementation. However, the presence of respondents who were unaware (6percent) highlights the need for improved information dissemination and community awareness regarding rainwater harvesting systems and their benefits.

The results suggest that rainwater harvesting was a well-established practice among the surveyed population, but continued awareness programs may help ensure that all community members understand and utilize these water conservation measures effectively.

Table 18: Always carry drinking water when travelling

Sr. No.	Responses	Frequency	Percentage
1	Yes	134	61
2	Often	22	10
3	Always	55	25
4	Never	9	4
	Total	220	100

Table 18 gives the responses regarding the habit of carrying drinking water while travelling. The data shows the extent to which individuals follow the practice of carrying their own drinking water, which reflects awareness of hydration needs and preparedness during travel.

The findings indicate that a majority of respondents follow the practice of carrying drinking water when travelling. Of the total respondents, 134 participants (61 percent) reported that they carry drinking water, showing a positive level of awareness regarding the importance of staying hydrated during travel. Furthermore, 55 respondents (25 percent) stated that they always carry drinking water, suggesting that a considerable proportion of individuals have developed this habit as a regular practice. Another 22 respondents (10 percent) reported carrying water often, indicating that they follow the practice frequently but not consistently. Only 9 respondents (4 percent) reported that they never carry drinking water while travelling, representing a small minority who do not follow this precautionary habit.

The overall response pattern shows that 96 percent of respondents either carry drinking water, often carry it, or always carry it while travelling, indicating a high level of awareness about the benefits of having safe drinking water available during journeys.

The low percentage of respondents who never carry water suggests that most

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individuals recognize the importance of hydration and personal preparedness.The fact that only 25 percent of respondents always carry drinking water highlights that there is still scope for encouraging this habit among travelers. Awareness campaigns and health education initiatives can further promote the practice of carrying safe drinking water, particularly for long-distance travel and outdoor activities.The findings indicate a generally positive attitude towards carrying drinking water while travelling, with the majority practicing this habit either regularly or occasionally.

Table 19: Affected by the recent floods

Sr. No.	Responses	Frequency	Percentage
1	Yes totally	19	9
2	Not at all	128	58
3	Very much	19	9
4	To some extent	54	24
	Total	220	100

Table 19 presents the respondents' perceptions regarding the extent to which they were affected by the recent floods. The responses were categorized into four levels: "Yes totally," "Not at all," "Very much," and "To some extent."

The data indicates that a majority of respondents (58percent) reported that they were not affected at all by the recent floods. This suggests that more than half of the surveyed population either lived in areas less impacted by flooding or had adequate protection and resources to avoid major consequences. A considerable proportion (24 percent) stated that they were affected to some extent, indicating that they experienced 'some' difficulties during the floods but the impact was not severe. They faced temporary disruptions such as waterlogging, transportation problems, damage to property, or difficulties in daily activities.

Only 9 percent respondents reported being very much affected, and another 9 percent indicated that they were totally affected by the floods. Together, these groups represent 18 percent of the total respondents, showing that a smaller but significant section of the population experienced severe flood-related impact. This group faced serious consequences such as loss of property, displacement, livelihood disruption, or extensive damage.

The results show that the impact of the recent floods was unevenly distributed. While the majority remained unaffected, nearly 42 percent experienced some level of impact, ranging from moderate to severe. The results highlight that although widespread devastation was not reported by most respondents, the flood created substantial challenges for a notable section of the community.The results also highlight a need for improved flood preparedness, early warning systems, and targeted support mechanisms for vulnerable groups who are more likely to experience severe consequences during such natural disasters.

Table 20: Need for water management in Punjab

Sr. No.	Responses	Frequency	Percentage
1	Yes	172	78
2	No	51	22
	Total	220	100

Table 20 presents the respondents' opinions regarding the need for and importance of water management in Punjab. The responses were categorized into two groups: "Yes" and

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"No." Out of the total 223 respondents, 172 respondents (78 percent) expressed agreement that water management is important, while 51 respondents (22 percent) did not support the idea.

The findings indicate that a large majority of respondents (78 percent) recognize the importance of water management in Punjab. This suggests that most people are aware of the growing concern related to water availability, groundwater depletion, inefficient irrigation practices, and the need for sustainable water-use strategies in the State. The high proportion of positive responses reflects public understanding that effective water management is essential for maintaining agricultural productivity, environmental sustainability, and future water security.

There were 22 percent who disagreed or did not consider water management a significant concern. This comparatively smaller group indicates limited awareness, differences in local experiences with water availability, or perceptions that existing water resources are sufficient for their needs.

Conclusion and Policy Implications

The results demonstrate a strong public perception in favour of improving water management practices in Punjab. Since Punjab's economy is highly dependent on agriculture, the majority support for water management highlights awareness among respondents about the need for conservation measures, efficient irrigation methods, groundwater recharge, and responsible water usage. However, the presence of nearly one-fourth of respondents who do not support the idea suggests a need for greater awareness campaigns and community participation. Educating people about the long-term consequences of excessive groundwater extraction and promoting sustainable water practices could help build wider acceptance of water management initiatives. Thus, water management is viewed as an important issue by most respondents, indicating a favourable social environment for implementing policies and programs aimed at sustainable water resource management in Punjab.

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