

Effect of Human Activities on Groundwater: A Survey of Perceptions and Attitudes about Groundwater Issues in Rural Area, Sindh, Pakistan

Engr. Mirza Mohib¹, Engr. Wajid Ali Panhwar¹, Engr. Muhammad Abdullah¹, Ing. Siddique, Muhammad Abubakar¹, Engr. Wajeelha Qamar²

¹M Eng. Student, University of Applied Sciences Magdeburg, Saxony Anhalt, Germany

²Assistant Professor of Civil Engineering Department NFC-Institute of Engineering and Fertilizers Research (IEFR), Jaranwala Road, Faisalabad, Pakistan.

ABSTRACT: Groundwater contamination has been recognized as a major problem in the rural and urban areas of Pakistan. So, it is important to know the perception of humans about groundwater. It has affected severely not only the efficiency of the production rate of crops but also the overall economy of the country. Groundwater contamination harms the environment, economy, and society. Hence, it is imperative to control the contamination of groundwater. Thus, this study aims to study the factors causing contamination of the groundwater in Pakistan. Also, several types of pesticides and fertilizers are used in the rural areas of Pakistan. The research was carried out using a quantitative method where data collection was done using a questionnaire survey. Assessment of the gathered data was done based on results obtained from statistical analysis of gathered data. Analysis of data involved calculation average index for determining the level of occurrence and severity level of the factors and types of pesticides and fertilizers used in the rural areas of Pakistan. Analysis results of 150 completed questionnaire forms received from farmers and property owners indicated that the top three factors from sixteen investigated factors of groundwater contamination from the perspective of occurrence and effect on overall. While the top three factors with the highest Significance level are Fertilizers, Pesticides, and chemicals. This study will be immensely helpful for the practitioners involved in the use of chemicals that result in the contamination of groundwater. So that they can take the necessary action by using a proper percentage of herbicides, pesticides, and other severe types of fertilizers which contaminate the groundwater. It will also help the research for further research to develop tools and mechanics to control the underlying problems.

Key Word: Groundwater Governance, Irrigated Areas, Surveys, Farmer's opinion, Pakistan

1 Introduction:

Human exercises usually influence the dispersion, amount, and compound nature of water assets. The reach-in human exercises that influence the association of groundwater and surface water is expansive. The accompanying conversation doesn't give a comprehensive study of every human impact, however, stresses those that are somewhat broad. To give a sign of the degree to which people influence the water assets of essentially all scenes, probably the most significant constructions and elements identified with human exercises are superimposed on different pieces of the applied science.

The impacts of human exercises on the amount and nature of water assets are felt over a wide scope of reality scales. In the accompanying conversation, "present moment" suggests time scales from hours to half a month or months, and "long haul" may go from years to many years. "Neighborhood scale" suggests good ways from a couple of feet to two or three thousand feet and regions as extensive as a couple of square miles, and "sub territorial and provincial scales" range from tens to thousands of square miles. The terms point source and nonpoint source

concerning conversations of pollution are utilized regularly.

Besides that, other legitimate activities within the ground-water reservoir tend to adversely affect the utilization and quality of groundwater: agricultural practices (including irrigation), recreation or urban development, drainage, mining, and waste disposal (Zaporozec, Ground-water pollution and its sources., 1981).

1.1 Aim and objectives:

The scarcity and unreliability of surface water supplies left farmers with no other option than to abstract groundwater to fulfill irrigation water demands, regardless of its quality and the pumping cost (Suhag, 2016.).

The point of this examination is to save the groundwater from the contamination made by humans since groundwater is the principle hotspot for farming fields. To accomplish these points, the following targets have been set up, which are:

- Awareness of chemical contamination.
- Awareness of the use of pesticides.

1.2 Scope study:

Pakistan is the third-largest user of groundwater, consuming about 9% of the global groundwater abstraction and occupying 4.6% of the total groundwater-irrigated area of the world (Bhutta & Smedema, 2007) Groundwater is polluted by various sources, however fundamental and more viable is humans. Formers use pesticides and manures to acquire the most extreme yield, however, their pesticides are exceptionally unsafe for groundwater. Cylinder wells and hand siphons are the primary hotspots for bringing down the groundwater table. The extent of this exploration is restricted to the groundwater the board-related associations in Sindh. The review was brought out through the post and the hard way. The designated respondents are the human and groundwater board authority.

2 Research method

For wider acceptance and usability of ground-water zoning, it is necessary to establish a comparative classification system of hydrogeologic units such as proposed by (Zaporozec, Groundwater zoning in water resources management, 1972)

This examination is done depends on the quantitative method of exploration. It includes a far-reaching writing audit to recognize the danger of the tainting of groundwater by people, to distinguish how their issues are settled and their effect on the groundwater. Considering writing, a poll is created to decide the variables event and seriousness, the kinds of groundwater issues delivered by humans and their effect level on the treatment of groundwater cost and appraisal of the degree of execution of different groundwater network the executives. Regarding different periods of farming activities, The Questionnaire review was helped post and manually. The examination strategy utilized for this investigation is the Weighted Opinion Average.

3 Questionnaire development:

The performance of irrigation systems in Pakistan was considered weak due to the reduced involvement of farmers in the operational and management affairs (Latif & Tariq, 2009). Questionnaire overview is the most widely recognized instrument utilized by numerous analysts in the social event the pertinent strong data to confirm and legitimize the proposed research region. For this exploration, the poll study was led to recognize the cooperation of the human with groundwater just as the rancher discernment over the groundwater pollution like

synthetic defilement, inordinate utilization of pesticides, and the ill-advised utilization of composts. The poll utilized in this examination was planned to utilize close structure or limited sort. Shut polls regularly require short reactions such as Yes or No, Agree or Disagree, Important or Not Important, and so on. Shut finished inquiries are not difficult to pose and speedy to reply, they require no composition by one or the other respondent or questioner, and their examination is direct.

The survey utilized in this investigation comprises of two sections which are Part 1 and Part 2. Section 1 zeroed in on respondent demography which is looking for respondent's data like job, region, area of horticulture ranch, and the size of homestead. Section 2 of the poll is to distinguish recurrence of event seriousness level of Factors regarding the tainting of groundwater according to the human discernment. It comprises 16 normal elements of defilement of groundwater by different sorts of human exercises like utilization of synthetic substances, pesticides, and manures distinguished from writing surveys. Section 2 of the poll is partitioned into three sections like compound defilement, utilization of pesticides, and composts. The respondents were mentioned to express the likelihood of event of each factor to the taking part human with groundwater. The six Likert point scale is defined below in Table 1.

Table 1. Decimal separators are commas, a thousand separators are spaces

Probability	of	Scale
Not agree		0
Mildly agree		1
Fairly agree		2
Agree		3
Strongly agree		4
Extremely agree		5

4 Data collection and analysis:

The Questionnaire overview was done by hand among two gatherings of respondents (for example ranchers and landowners.). A sum of 170 surveys was circulated during the semester break. As a reaction, 80 finished survey sets were gotten back which were utilized for examination reasons. The analysis method employed for this study is Weighted Analysis for calculating frequency in percentage, valid percentage, and cumulative percentage.

• **Weighted Opinion Average:**

Weighted opinion averages of each not set in stone to evaluate their apparent significance. The average weighted perceived significance was then computed using the formula adapted from (Chabota Kaliba, 2009):

$$WA = \frac{1}{6} \times \frac{\sum_1^6 F_i R_i}{\sum_1^6 F_i} \times 100$$

Where WA is the average weighted perceived significance; is the response type on the Likert scale, i ranging from 1 to 6 on the Likert scale; is the frequency or a total number of respondents choosing response type i on the Likert scale.

• **Weighted Perceived Significance (R_i):**

For instance, in WA, the normal weighted perceived significance was processed as follows:

$$WA = \frac{1}{6} \left\{ \frac{(F_1 \times R_1 + F_2 \times R_2 + F_3 \times R_3 + F_4 \times R_4 + F_5 \times R_5 + F_6 \times R_6)}{(F_1 + F_2 + F_3 + F_4 + F_5 + F_6)} \right\} \times 100$$

It is essential that the potential upsides of normal weighted apparent significance, WA, gone from 25% to 100% because each factor identified through writing or meetings had some degree of significance that would add up to nothing. The factors whose WA score was 50% and above were categorized as major tools which are mostly implemented in Pakistan.

5. Demographic analysis:

5.1 Respondent’s Area:

A total of 170 questionnaire sets were distributed to the respondents involved in farming and 150 completed questionnaires were received back. Questionnaires were distributed in several different areas where farmers owned their agricultural form. Questionnaires were distributed into three districts i.e., Khairpur, Nawab Shah, and Hyderabad. Each respondent’s area consisted of different sizes of farms and farmers had their perception over the factors that influence their performance in the association according to their area. **Table 2** below shows the frequencies of each area in which the questionnaires were distributed. Areas were selected to conduct a study to meet the conditions farmers were facing. Data were collected from a field survey including interviews with farmers and a review of the literature. Field studies were conducted quite a time between semester breaks. From the questionnaire survey, we figured out the layout of the irrigation facilities, their physical conditions and the mechanism of their farming, and their thinking towards

better management. The level of agreement of farmers with various statements was figured out through a questionnaire.

Table 2. Respondent’s area

Area	Frequency
Khairpur	47
Hyderabad	54
Nawab shah	49

5.2 Respondents’ location of agriculture farm:

This section identifies the location at which the respondent’s farms were located i.e., Start, Middle, or End. **Table 3** shows the details about the location of agriculture farms.

Table 3. Respondents Location of agriculture farms

Location	Frequency	Percent	Cumulative %
Start	47	31.3	31.3
Middle	61	40.7	72
End	42	28	100

The table identifies out of 150 farmers, 47 farmer’s lands were located at the start, 61 at the middle, and 42 at the end with a percentage of 31.3, 40.7, and 28.0, respectively.

5.3 Respondent’s total farms:

Under this heading, the size of respondent’s homesteads or complete ranches claimed by them is examined.

Table 4: Size of farm/ total farms

Size (Acres)	Frequency	Percent	Cumulative %
1 to 20	87	58.0	58.0
20 to 40	39	26.0	84.0
40 to 60	13	8.6	92.6
60 to 80	6	4.0	96.6
80 to 100	2	1.3	97.9
100 to 120	1	0.7	98.6
120 to 180	1	0.7	99.3
180 to 200	1	0.7	100.0

6. Results:

calculated as weighted average according to their frequency level.

6.1 Awareness over chemical contamination:

In **table 5** given below, factors that influence awareness over chemical contamination are discussed and are

Table 5: Factors and their ranking regarding awareness over chemical contamination

Factors	Not agree	Mildly Agree	Fairly Agree	Agree	Strongly Agree	Extremely Agree	total	WA
	0	1	2	3	4	5		
Agri Chemicals can contaminate groundwater.	4	14	13	44	48	27	150	72.11
Do you use herbicides?	1	9	28	49	41	22	150	70.67
Herbicides are contaminating the groundwater.	2	10	32	32	44	30	150	71.78
Chemical application rates are higher when low or no-tillage is performed.	3	12	25	36	46	28	150	71.56
Proper and precise education is needed for Agri-chemical management system.	2	10	26	35	34	43	150	74.22
Better communication utilizing modern equipment (such as mobile phone) help spread knowledge?	1	12	27	34	39	37	150	73.22
Farmers should take part in fertilizer management clinics to gain accurate knowledge.	2	9	20	42	50	27	150	73.33

Table 5 gives insight concerning rancher's reactions in various positions. It shows that ranchers with a recurrence of 48 have firmly concurred, recurrence with 4 does not concur, recurrence with 27 very concurs that Agri synthetic substances can pollute groundwater alongside their weighted normal. Recurrence level with 49 concur, recurrence 41 emphatically concur that they use herbicides. Also, the rest are displayed in the table.

6.2 Awareness over the use of pesticides:

The impact of different factors according to the use of pesticides are ranked in Table 6.

Table 6: Factors and their ranking regarding awareness over the use of pesticide

Factors	Not agree	Mildly Agree	Fairly Agree	Agree	Strongly Agree	Extremely Agree	total	WA
	0	1	2	3	4	5		
During cultivation and tillage using a high quantity of pesticides is useful.	7	20	28	42	28	25	150	65.44
Inaccurate or high proportions of pesticides can contaminate groundwater.	1	13	27	56	36	17	150	68.22
Knowledge about pesticide use can reduce the risk of groundwater contamination.	3	10	22	31	48	36	150	74.33
Pesticide manufactures are providing information about accurate proportions for the safe application so as not to contaminate the groundwater.	2	19	36	28	43	22	150	67.44

In **table 6** it is examined that what and how ranchers think concerning how much effect of any components can cause over the utilization of pesticides. The table shows the recurrence level of 48 ranchers concur that during development and culturing utilizing the high number of pesticides is valuable. Ranchers with a recurrence level of 58 concur that inexact or high extents of pesticides can taint groundwater. Information about the utilization of pesticides, 48 degrees of recurrence concur that it can decrease groundwater defilement. The table additionally shows the weighted normal of each factor.

6.3 Awareness about fertilizers:

The following are the factors that were studied through the questionnaire regarding awareness about fertilizers. The objective was to make sure the thinking of farmers using excessive use of fertilizers or unbranded fertilizers or vice versa.

Table 7: Factors regarding awareness about fertilizers being used

Factors	Not agree	Mildly Agree	Fairly Agree	Agree	Strongly Agree	Extremely Agree	total	WA
	0	1	2	3	4	5		
Excessive use of fertilizers is contaminating the groundwater.	3	10	35	45	35	22	150	68.33
Unbranded/ low standard fertilizers are harmful for soil and groundwater contamination.	4	18	29	37	42	20	150	67.22
A high quantity of fertilizers is useful for crop yields.	14	17	28	47	27	17	150	61.89

Fertilizers rates need to be higher when using reduced or no-tillage is performed.	12	31	36	25	30	16	150	58.67
Commercial soil test labs recommend correct amounts of fertilizers	12	12	32	36	44	14	150	64.44

The table shows the outcomes that around ranchers with recurrence level of 45 to 50 that they think inordinate utilization of composts is tainting the groundwater. The table gives the outcomes regarding the effect of amount and nature of manures being utilized in groundwater just as the paces of composts that should be higher when decreased or no culturing is performed.

7. Conclusion:

Unfortunately, in Pakistan, the culture of measurement is non-existing because certain people benefit enormously from a lack of data and information. As a result, basins are over-drafted, creating problems of groundwater accessibility for smallholder farmers. It is, therefore, important that the rights of small users are protected because it can have severe economic impacts on their farms, including devaluing their lands. This situation also strengthens the perception that the problems of groundwater management in Pakistan are not due to the lack of regulations but are of more of a political nature (Badiani & Jessoe, 2013).

This examination is comprised of three destinations in assessing the issues of view of humans with regards to groundwater tainting in numerous spaces of Pakistan. These targets are accomplished and clarified in the prior sections. Pakistan’s existing drainage network is inadequate, and most of it is in a state of disrepair. For the salt equilibrium in the fresh groundwater areas, it is crucial to know how much salt needs to be evacuated and where it should be stored or discharged (PPSGDP, 2000). The outline of the multitude of discoveries is clarified in after segments.

• **Identifying Common Factors causing chemical contamination of groundwater:**

The first objective was to identify common factors of the chemical contamination of groundwater. This Objective was achieved through literature review. In this objective, a total number of 7 common factors were identified with the help of study and research. The factors are discussed in chapter 2 of the thesis.

• **Assessing the level of occurrence and severity of the proper use of pesticides:**

This objective was achieved through a questionnaire survey and statistical analysis. The findings of this

objective highlighted that topmost four commonly occurring factors that affect the groundwater by using pesticides, and the factors are cultivation and tillage, the high proportion of pesticides, knowledge about pesticides, and information provided by manufacturers using the accurate proportion of pesticides. While topmost four severe factors causing improper cultivation and tillage in rural areas of Pakistan, and the use of excess pesticides by farmers in the fields cause severe contamination in the groundwater.

• **Identifying the excess use of fertilizers:**

The third objective of this study was to identify common types of fertilizers used in rural areas of Pakistan. From this survey, it is found that types of excessive use of fertilizers in the different areas of Pakistan causing, contamination of groundwater and impact the production of crops. The farmers should avoid excess use of fertilizer that is harmful to both crops and especially to groundwater.

8. Recommendation

There are a few proposals recommended for partners who are engaged with the pollution of groundwater, and utilization of overabundance synthetics and manures, which defile groundwater quality and production issues in any event, for surface water. For the ranchers, there are a few ideas places as manageable farming strategy is applied as opposed to utilizes the inordinate utilization of synthetic substances like pesticides and unequal utilization of manures. Therefore, ranchers need to utilize a proper proportion of synthetics (composts and pesticides) and control all exercises engaged with the creation of harvests. Therefore, collaboration among ranchers and the water system in the executive’s division is considered essential to diminish the more tainting of groundwater and surface water. Agrarian and water system specialists show their advantage in advancing more oversaw agribusiness exercises the customary method of horticulture.

The alternate approaches to forestall extreme pollution are portrayed beneath. The execution of supplement the board strategies before applying supplements in the harvests.

- Control domesticated animals' admittance to streams
- Limit the culturing
- Have excrement the board plan

References

- 1) Badiani, R., & Jessoe, K. (2013). The Impact of Electricity Subsidies on Groundwater Ex- traction and Agricultural Production. Working paper, University of California at Davis.
- 2) Bhutta, M. M., & Smedema, L. (2007). One hundred years of waterlogging and salinity control in the Indus valley, Pakistan. A historical review. *Irrig. Drain.*, 56, 581–590.
- 3) Chabota Kaliba, M. M. (2009). Cost escalation and schedule delays in road construction projects in Zambia. *International Journal of Project Management*, 27, 522-531.
- 4) Latif, M., & Tariq, J. (2009). Performance assessment of irrigation management transfer from Government to farmer-managed irrigation system. A case study. *Irrig. Drain.*, 58, 275–286.
- 5) PPSGDP. (2000). Legal and Regulatory Framework for Punjab Province; Technical Report No. 45 Groundwater Development Project. Lahore, Pakistan: Punjab Private Sector Groundwater Development Project.
- 6) Suhag, R. (2016). Overview of Groundwater in India. PRS Legislative Research.
- 7) Zaporozec, A. (1972). Groundwater zoning in water resources management. *Water Resources Bulletin*, 1137— 1143.
- 8) Zaporozec, A. (1981). Ground-water pollution and its sources. *GeoJournal*, 5.5, 457-471.