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Physico-Chemical and Biological Analysis of Water and Effect of Contamination on Residents of Area Ner Chowk, District - Mandi (H.P.)

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Abstract: *The approximate population (2020) of the Nerchowk area is about 52944, an area of 80.26 km², and a population density of 659 people per km². Sample Collection Sites at Nerchowk Region. 31°36'24"N, 76°54'51"E longitude and latitude of Nerchowk.*

The present cross-sectional study is focused on measuring the quality of drinking water in areas of Nerchowk region, District – Mandi, Himachal Pradesh, India, and its effects on human health as told by the people living in these areas. Various analyses including physical, chemical, and microbiological assessments were carried out on the water samples collected from the villages. The present thesis aimed to assess and compare the water quality with WHO standards and its related health effects on residents of the Nerchowk Area. 30 sample sites are chosen nearby the Nerchowk area and water samples have been taken from each area. Data collection is based on the laboratory analysis of water samples. The study was carried out over 12 months that is, August 2021 to July 2022.

Keywords: *Physico-Chemical and Biological Analysis of Water, Effect of Contamination on Residents of Area Ner Chowk,*

I. INTRODUCTION

The summary of the literature indicates that much research work is done by experts in the area of Physico-Chemical and Biological Analysis of Water and the Effect of Contamination on Residents. Through it, we come to know that many testing and analysis results for studying the effect of water contamination have already existed. It is concluded from the literature that to take care of the health of human beings water analysis is very much important. Very less research work is done around north India and especially in Himachal Pradesh state. Very less research work on Physico-Chemical and Biological Analysis of Water is present in the Himachal Pradesh state. Proper investigation of the physical, chemical, and microbiological parameters of the water should be done in the Himachal region so that people can ensure water quality.

II. GAPS IN EXISTING LITERATURE

- 1) No proper research work is carried out on the chemical analysis of the water in the Nerchowk area.
- 2) Very less literature is available regarding the effect of water contamination on human health in the selected area.
- 3) Very less experimental data were found regarding the effect of impurities on human health.
- 4) The understanding of water contamination parameters and their relation to the residents is still limited and yet to be studied.
- 5) Many researchers have done a detailed study of chemical analysis of water and the effect of water impurities on the health individually but their combined or relative study has not been carried out yet.
- 6) Combined Physico-Chemical and Biological Analysis of Water and the Effect of Contamination on Residents yet to be carried out.

III. PROBLEM FORMULATION AND OBJECTIVES

Various analyses, parameters, testing techniques, and behavior of the water have been studied in the detail. There is a great requirement for water treatment or purification in some regions on a priority basis. Pure water for household purposes is essential for a healthy life. Separate study about the physical, chemical, and microbiological behavior of water is available up to a great extent. But the combined and cross-sectional study is limited and especially for developing countries like India. Keeping in view the gaps in existing research work a combined study for a specific area can be performed to test water quality and analyze the effect of contaminants on the health of the people.

The goal of this study is to look at the link between drinking water quality and human health and longevity. The aims and objectives of the present study are as follows: -

- 1) To analyze water physically, chemically, and biologically.
- 2) To study the causes of water contamination.
- 3) To study the physicochemical and biological analysis of water.
- 4) To examine how to improve the water quality.
- 5) Effect of various impurities on human health.
- 6) To identify the locations of bottlenecks for clean water and eliminate them.
- 7) To investigate techniques for minimizing the water impurities.
- 8) To find opportunities for water conservation.
- 9) To perform the various possible water tests and observe water quality.

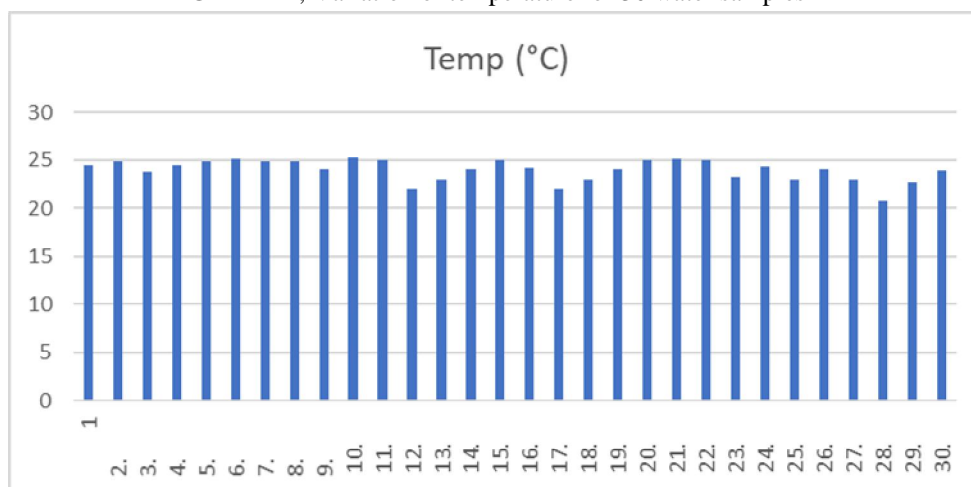
IV. VARIOUS PHYSICAL, CHEMICAL, AND MICROBIOLOGICAL TESTS

A. Various tests in the lab are performed on 30 water samples to determine their various values and compared with permissible limits.

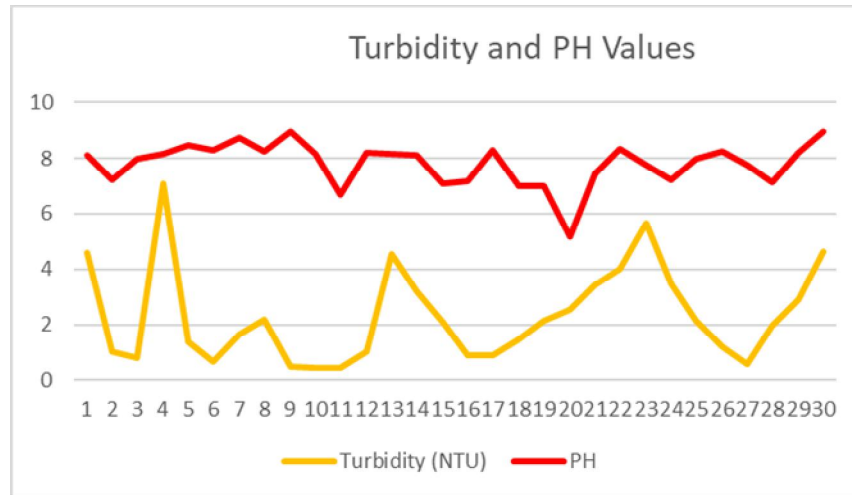
TABLE 1, Various Physical Tests

Sr. No.	Physical Quantity	Measuring Instrument / Chemical Used	Units	Remarks / Permissible Range
1.	Temperature	Digital thermometer	°C	Normal Temperature
2.	Colour	Solution of specific concentration of [Cl ₆ K ₂ Pt + C ₁₂ CoH ₁₂ O ₆ + HCL] used	Hazen Units or C.U. (color Unit or chloplatinat unit)	5-15 C.U.
3.	Odor	Concentrated HCL used	No Units	Agreeable (odorless) or Not Agreeable (having any odor)
4.	Taste	NaCl of Specific Concentration	No Units	Agreeable/Normal or Not Agreeable/Abnormal
5.	Turbidity	Digital Turbidity Meter	NTU	1-5 NTU
6.	PH	Digital PH Meter	No Units	6.5-8.5
7.	Conductivity	Digital Conductivity Meter	µS	200 to 800 µS/cm

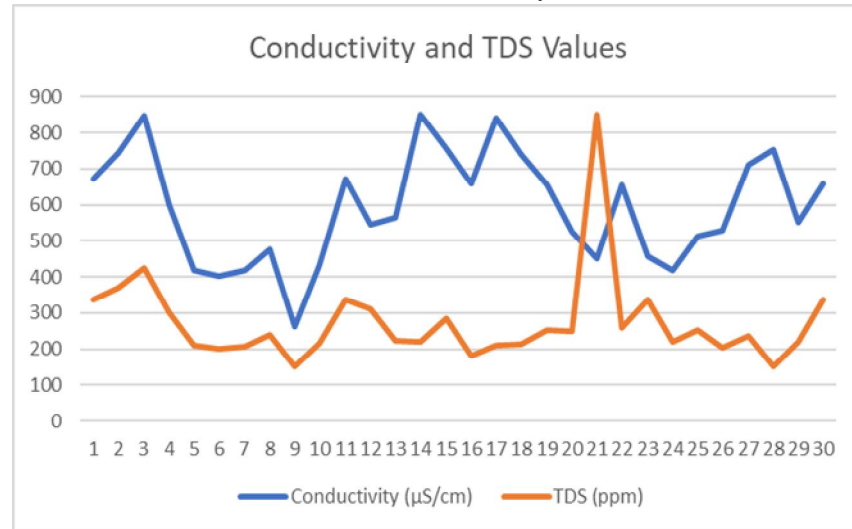
GRAPH 1, Variation of temperature for 30 water samples



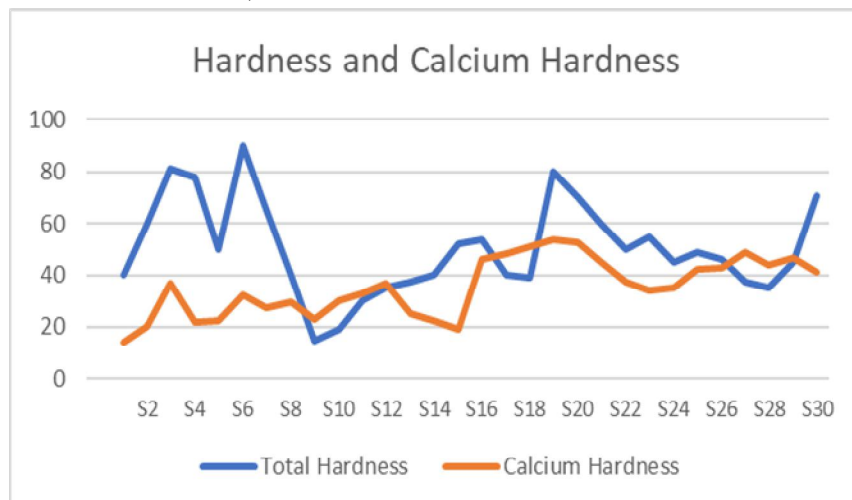
GRAPH 2, Values of turbidity and PH



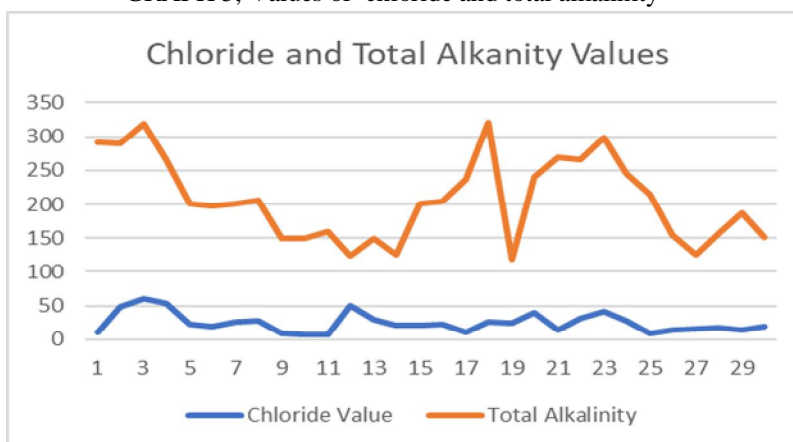
GRAPH 3, Values of conductivity and TDS



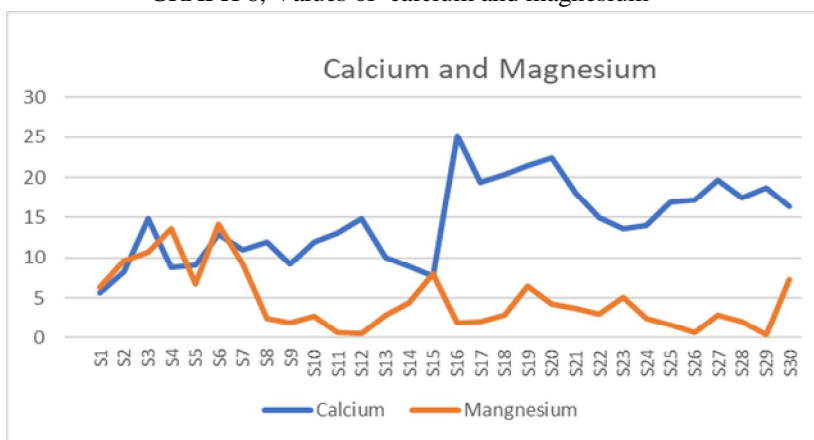
GRAPH 4, Values of hardness and calcium hardness



GRAPH 5, Values of chloride and total alkalinity



GRAPH 6, Values of calcium and magnesium



B. Various tests in the lab are performed on 30 water samples to determine their various values and compared with permissible limits.

TABLE 3, Various Chemical Tests

Sr. No.	Physical Quantity	Measuring Instrument / Chemical Used	Solution in Burette	Indicators
1.	Calcium	Titrate with respect to NDTA , $(A-B) \times 4$	NDTA solution	NaCl and NaOH
2.	Magnesium	$(\text{total harness} - \text{calcium harness}) \times 0.244$		
3.	Chloride	Titrate with respect to, silver nitrate $(A-B) \times 10$	N/50 Silver nitrate used.	Potassium chromate
4.	Alkalinity	Titrate with respect to H_2SO_4 , $(A-B) \times 20$	H_2SO_4 has a concentration of 0.02N	Phenolphathline
5.	Hardness	titrate concerning the EDTA, $(A-B) \times 20$	EDTA solution,	Erichrome Black – T, ammonia buffer
6.	Calcium Hardness	multiply the calcium value by 2.497		
7.	Arsenic	Arsenic testing kit		

C. Bacteriological Tests

Fig.1 Bacteriological tests

Coliform Test (Primary Test)	Confirmatory test → BGLBB Brilliant Green Lactose Bile Broth)	Faecal Coliform → E Coli (Escherichia Coli)
<u>Technique</u> → Multiple tube Fermentation technique	<u>Technique</u> → Multiple tube tube Fermentation technique	<u>Technique</u> → Multiple tube Fermentation technique
<u>Medium Used</u> → McConkey's Broth	<u>Medium Used</u> → BGLBB	<u>Medium Used</u> → E.Coli Broth
<u>Preparation of tube</u> → 10 ml McConkey's & 10ml 20ml (Direct Sample)	<u>Preparation of tube</u> → 10 ml BGLBB (with inoculation loop)	<u>Preparation of tube</u> → 10 ml E.Coli medium & (with inoculation loop)
<u>Incubation Time</u> → Place with in 30 min. in an an incubator 35-37°C temp for 48 hrs.	<u>Incubation Time</u> → Place tubes at 35-37°C temp for 48 ± 2 hrs in incubator	<u>Incubation Time</u> → Incubate the tubes at 44.5°C in water bath (with in 30 min after inoculation) at 24±2h
<u>Method of Counting</u> → MPN (Most Probable Number)	<u>Method of Counting</u> → MPN (Most Probable Number)	<u>Method of Counting</u> → MPN (Most Probable Number)

TABLE 18. MPN (100 ml) values when the the count of only 10 ml are used.
No. of tubes giving positive results out of five. MPN (100 ml)

- 1) *Total Coll Forms*: Use the standard procedure for tests. Take 10mL media and Durham's tube in auto clove 15lb/in2. Media prepared in auto clove and the put-in laminar airflow. Put a 10 mL sample in the test tube and insert media into it and observe for bubble formation. Then put all samples in an incubator for at least 48 hours.
- 2) *E-Coll*: Only performed if the only previous test is positive. In our case, all water samples are passed so need not perform this test.

V. DISCUSSION

The objective of this thesis was to perform the analysis of the water in the Nerchowk region on the physical, chemical, and biological aspects and to check the effect of the contamination on the health of the residents. In the light of the collection of data, findings, and analysis, the following inferences can be made-

- 1) Improvement should be done in waste disposals and sewage methods.
- 2) Time to time audit of water at various locations is necessary.
- 3) For getting more accurate and precise results month-wise analysis should be done for at least two years and then the results should be summarized.
- 4) Authorities should regulate and monitor the water supply as well as personal resources from time to time.
- 5) All personal or public water sources should be kept neat and clean.
- 6) Tanks, containers, etc. which are used for storing water should be cleaned by proper methods weekly.
- 7) The study area is very small, analysis should be done on a large area and for a longer time for better results.
- 8) Due to the limited lab and technical support heavy metal analysis is not performed in this presented work, heavy metal analysis should be done.
- 9) At least 5-year-old data from hospitals etc. can be collected for analyzing the history of any water disease.

VI. CONCLUSIONS

From the analysis of data gathered from literature, the internet, and various journals on physical, chemical, and biological analysis of the water, as well as various analyses performed in this study in the Nerchowk area we concluded all samples collected from various sites are safe for drinking. All samples collected are tested chemically, physically, and bacteriologically for the various possible aspects and they are found all quantities are under permissible limits and water is safe for household tasks.

- 1) The taste and color of water samples are agreeable.
- 2) The odor of all samples is marked as odorless.
- 3) No residual chlorine is found.

- 4) No arsenic traces are found.
- 5) Calcium and magnesium values are within permissible limits.
- 6) Hardness and calcium hardness are in an acceptable range.
- 7) Alkalinity, Chloride values, TDS, conductivity, turbidity, and PH values are in permissible ranges.

VII. SCOPE OF FUTURE WORK

For a detailed analysis of water quality in the Nerchowk Area, the monitoring and analysis should be carried out for a longer period. The minimum time for such monitoring should be one year to have a series of data or trends to confirm the study's reliability. Standardization of the sampling locations would also help in making the obtained data more comparable with scientific findings. The analysis of water parameters should be analyzed in advanced analytical techniques such as Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) in comparison to FAAS in the future. Besides the chemical and heavy metal analysis, the microorganisms (protozoa parasite, algae, bacteria, and viruses), radionuclides (radioactive materials such as uranium), and disinfectants should be analyzed using advanced techniques such as ICP-MS.

This study seeks to determine how well Ner-Chowk potable water supply conforms with state and national drinking water standards. Questions were posed to residents who are receiving their primary drinking water supply from the IPH Department or any other sources. To analyze any problem in the water chemical analysis should be done. Effect of water contamination in agriculture field should be carried out. Toxicological studies should be carried out to determine the associated potential risks. Domestic waste and agricultural activities affect groundwater quality so the monitoring of fertilizers and pesticides is needed. Programs should be implemented to monitor the bore wells and hand pumps exceeding the limitation of guidelines All public supplies should be checked for microbial safety. Toxic material must be treated chemically and converted into harmless materials. People awareness campaigning should be organized/implemented by the government and non-government organizations. For better health measures bottled water should be checked from time to time. For a detailed analysis of water quality in the Nerchowk Area, the monitoring and analysis should be carried out for a longer period. The minimum time for such monitoring should be one year to have a series of data or trends to confirm the study's reliability. Standardization of the sampling locations would also help in making the obtained data more comparable with scientific findings.

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VIII. LIMITATIONS

This thesis is limited primarily to data collected in the Nerchowk region only. However, results of water quality analyses conducted in some other locations are also included. The limitations of the study can be improved by analyzing more samples throughout all districts of Himachal Pradesh instead of the small region like Nerchowk.

REFERENCES

- [1] E. of Japan, "Standard Guidelines for the Environmental Monitoring of Chemicals," Water, pp. 41-130, 2002, [Online]. Available: <https://www.env.go.jp/en/chemi/pops/Appendix/04-GuideLine/04Chapter3.pdf>
- [2] S. Panday and J. K. Malik, "Urban Waste Management in Himachal Pradesh," p. 15, 2015.
- [3] F. Edition, "Guidelines for Drinking-water Quality," World Health, vol. 1, no. 3, pp. 104-8, 2011, doi: 10.1016/S1462-0758(00)00006-6.
- [4] M. Concannon and P. Nash, "Designing a Water Filtration Device to Remove Chemical and Biological Contamination in Mandi District," May, 2018.
- [5] L. Deshpande, "Water Quality Analysis Laboratory Methods," Council. Sci. Ind. Res. New Delhi, Govt. India, p. 68, 2012, [Online]. Available: <http://mpcb.gov.in/envtdata/LSD-NEERI- Water Quality Analysis.pdf>
- [6] K. Fong, E. Grainger, R. Melanson, and D. Salisbury, "Improving Water Quality Treatment and Monitoring Techniques in Rural Himachal Pradesh Villages," pp. 8-19.
- [7] M. Achparaki et al., "We are IntechOpen , the world ' s leading publisher of Open Access books Built by scientists , for scientists TOP 1 %," Intech, p. 13, 2012, [Online]. Available: <http://dx.doi.org/10.1039/C7RA00172J%0Ahttps://www.intechopen.com/books/advanced-biometric-technologies/liveness-detection-in-biometrics%0Ahttp://dx.doi.org/10.1016/j.colsurfa.2011.12.014>
- [8] A. K. Yadav, "Physicochemical Studies on Assessment of Ground Water Quality of Kota District," Thesis, p. 208, 2016.
- [9] N. H. Region, "Government of India Ministry Of Water Resources Our Vision Water security through sound groundwater management GROUND WATER INFORMATION BOOKLET Mandi District, Himachal Pradesh CONTENTS," 2013.

- [10] V. K. Choubey, O. Singh, D. G. Durbude, and R. Singh, "Impact of Sewage Effluent on Drinking Water Sources of Shimla City and Suggesting Ameliorative Measures," no. April, p. 184, 2013.
- [11] "Physical and Chemical Analysis of Drinking Water of Balh Tehsil Distt . Mandi Himachal," no. January 2018.
- [12] A. Jafari, H. Mirhossain, B. Kamareii, and S. Dehestani, "Physicochemical Analysis of Drinking Water in Kohdasht City Lorestan, Iran," *Asian J. Appl. Sci.*, vol. 1, no. 1, pp. 87–92, 2007, doi: 10.3923/ajaps.2008.87.92.
- [13] U. G. A. Extension, W. Testing, F. O. R. Public, and W. Supplies, "Testing for water quality," 2009.
- [14] J. W. Clune and I. I. I. Charles A. Cravotta, "Drinking water health standards comparison and chemical analysis of groundwater for 72 domestic wells in Bradford County, Pennsylvania, 2016," no. May, 2019, doi: 10.3133/sir20185170.
- [15] W. A. M. Hassanien, "Physico-Chemical pre-treatment for drinking water," *Dep. Chem.*, vol. PhD thesis, no. August, p. 162, 2004.
- [16] M. B. Addisie, "Evaluating Drinking Water Quality Using Water Quality Parameters and Esthetic Attributes," *Air, Soil Water Res.*, vol. 15, 2022, doi: 10.1177/117862212211075005.
- [17] O. Akoto and J. Adiyiah, "Chemical analysis of drinking water from some communities in the Brong Ahafo region," *Int. J. Environ. Sci. Technol.*, vol. 4, no. 2, pp. 211–214, 2007, doi: 10.1007/BF03326276.
- [18] O. D. James and A. Analysis, "An Analysis of the Potability of Water in Logan County Recommended Citation," 1994, [Online]. Available: http://dclu.langston.edu/mccabe_theses
- [19] A. Khayum, N. Nandini, J. S. Chandrashekar, and R. Durgesh, "Assessment of Drinking Water Quality of Bangalore West Zone , India - a case Study," *Environ. We An Int. J. Sci. Technol.*, vol. 6, no. January 2011, pp. 113–122, 2011.
- [20] J. Fawell and M. J. Nieuwenhuijsen, "Contaminants in drinking water," *Br. Med. Bull.*, vol. 68, pp. 199–208, 2003, doi: 10.1093/bmb/ldg027.
- [21] H. C. Kataria, S. Ambore, and M. Namdeo, "Physico-chemical analysis of drinking water of Gandhi Nagar area of Bhopal speical reference to pollution," *Biomed. Pharmacol. J.*, vol. 3, no. 1, pp. 257–258, 2010.
- [22] M. Mohsin, S. Safdar, F. Asghar, and F. Jamal, "Assessment of drinking water quality and its impact on residents health in Bahawalpur City,," *Int. J. Humanit. Soc. Sci.*, vol. 3, no. 15, pp. 114–128, 2013, [Online]. Available: http://www.ijhssnet.com/journals/Vol_3_No_15_August_2013/14.pdf
- [23] S. Sorlini, D. Palazzini, J. M. Sieliechi, and M. B. Ngassoum, "Assessment of physical-chemical drinking water quality in the logone valley (Chad-Cameroon)," *Sustain.*, vol. 5, no. 7, pp. 3060–3076, 2013, doi: 10.3390/su5073060.
- [24] N. L. Gupta, "Analysis of drinking water quality of the rural community of district Sirmaur, H.P,," no. July, 2014, doi: 10.13140/RG.2.2.11401.60003.
- [25] E. T. Gyamfi et al., "Chemical analysis of potable water samples from selected suburbs of Accra , Ghana," *Proc. Int. Acad. Ecol. Environ. Sci.*, vol. 2, no. 2, pp. 118–127, 2012.
- [26] T. Juneja and A. Chaudhary, "Assessment of water quality and its effects on the health of residents of Jhunjhunu district , Rajasthan : A cross sectional study," vol. 5, no. April, pp. 186–191, 2013.
- [27] A. J. Whelton et al., "Residential tap water contamination following the freedom industries chemical spill: Perceptions, water quality, and health impacts," *Environ. Sci. Technol.*, vol. 49, no. 2, pp. 813–823, 2015, doi: 10.1021/es5040969.
- [28] P. Ziemkiewicz, J. Hause, B. Gutta, J. Fillhart, and B. M. M. S., "Final Report: Water Quality Literature Review and Field Monitoring of Active Shale Gas Wells Phase I," *West Virginia Dep. Environ. Prot. Div. Air Qual.*, p. 141, 2013, [Online]. Available: <http://publichealth.hsc.wvu.edu/media/1299/water-report-phase-i-submitted-feb-20-2013.pdf>
- [29] Arslan Mumtaz, Muhammad Saffar Mirjat, Hafeez ur Rehman Mangio, and Aashifa Soomro, "Assessment of Drinking Water Quality Status and its Impact on Health in Tandojam City," *J. Basic Appl. Sci.*, vol. 13, no. September, pp. 363–369, 2017, doi: 10.6000/1927-5129.2017.13.60.
- [30] N. Soni and A. Bhatia, "Analysis of Quality of Drinking Water of Private Bore-well and Piped water Supply in Jaipur city, Rajasthan, India," *Res. J. Recent Sci.*, vol. 4, p. 313, 2015, [Online]. Available: www.isca.me
- [31] N. Rahmanian et al., "Analysis of physiochemical parameters to evaluate the drinking water quality in the state of perak, Malaysia," *J. Chem.*, vol. 2015, no. Cd, 2015, doi: 10.1155/2015/716125.
- [32] N. Rahmanian et al., "Analysis of physiochemical parameters to evaluate the drinking water quality in the State of Perak, Malaysia," *J. Chem.*, vol. 2015, no. Cd, p. 10, 2015.
- [33] M. Saleem, A. Hussain, and G. Mahmood, "Analysis of groundwater quality using water quality index: A case study of greater Noida (Region), Uttar Pradesh (U.P), India," *Cogent Eng.*, vol. 3, no. 1, 2016, doi: 10.1080/23311916.2016.1237927.
- [34] A. Ayaliew Werkneh, "Physico-Chemical Analysis of Drinking Water Quality at Jigjiga City, Ethiopia," *Am. J. Environ. Prot.*, vol. 4, no. 1, p. 29, 2015, doi: 10.11648/j.ajep.20150401.14.
- [35] J. G. Lafta, "Analysis of Water Quality using -Chemical – Physical- Biological Parameters of the Kinds of Water used for Drinking in the Baghdad Province- Al Adhamiya City," *Chem. Mater. Res.*, vol. 7, no. 12, pp. 1–4, 2015.
- [36] Y. Meride and B. Ayenew, "Drinking water quality assessment and its effects on residents health in Wondo genet campus, Ethiopia," *Environ. Syst. Res.*, vol. 5, no. 1, pp. 1–7, 2016, doi: 10.1186/s40068-016-0053-6.
- [37] M. Sahoo, M. R. Mahananda, and P. Seth, "Physico-Chemical Analysis of Surface and Groundwater around Talcher Coal Field, District Angul, Odisha, India," *J. Geosci. Environ. Prot.*, vol. 04, no. 02, pp. 26–37, 2016, doi: 10.4236/gep.2016.42004.
- [38] S. Singh, A. Ali, K. Kant Upadhyay, and K. A. Wani, "An Investigation on Physical, Chemical and Bacteriological Quality of Drinking Waters and Health Issues of the Rural Areas in Uttar Pradesh, India," vol. 8, no. 2, pp. 350–355, 2016, [Online]. Available: www.researchtrend.net
- [39] R. Bhatia and D. Jain, "Water quality assessment of lake water: a review," *Sustain. Water Resour. Manag.*, vol. 2, no. 2, pp. 161–173, 2016, doi: 10.1007/s40899-015-0014-7.
- [40] A. Appavu, S. Thangavelu, J. S. Jesudoss, and B. Pandi, "Research Paper STUDY OF WATER QUALITY PARAMETERS OF CAUVERY RIVER WATER," *J. Glob. Biosci.*, vol. 5, no. 9, pp. 4556–4567, 2016.
- [41] M. F. Alam, N. C. Dafader, S. Sultana, N. Rahman, and T. Taheri, "Physico-chemical analysis of the bottled drinking water available in the Dhaka city of Bangladesh," *J. Mater. Environ. Sci.*, vol. 8, no. 6, pp. 2076–2083, 2017.
- [42] T. Akter et al., "Water Quality Index for measuring drinking water quality in rural Bangladesh: A crosssectional study," *J. Heal. Popul. Nutr.*, vol. 35, no. 1, pp. 1–12, 2016, doi: 10.1186/s41043-016-0041-5.

- [43] S. Sharma and Y. K. Walia, "Physicochemical and biological assessment of river beas water during monsoon season in Himachal Pradesh, India," *Pollut. Res.*, vol. 35, no. 4, pp. 713–721, 2016.
- [44] A. K. Choudhary et al., "Improving Water Quality in the Villages of Himachal Pradesh Revising Monitoring and Treatment Techniques," pp. 1–50, 2017, [Online]. Available: <http://www.wpi.edu/Academics/Projects>.
- [45] J. Lu and F. Yuan, "The effect of drinking water quality on the health and longevity of people-A case study in Mayang, Hunan Province, China," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 82, no. 1, pp. 0–10, 2017, doi: 10.1088/1755-1315/82/1/012005.
- [46] S. RK, S. MR, and C. SC, "Physico-Chemical Analysis of Drinking Water Quality Parameters of Galore Area in Lower Himalayan Region, India," *J. Environ. Anal. Toxicol.*, vol. 08, no. 02, 2018, doi: 10.4172/2161-0525.1000562.
- [47] T. BA, B. TW, and B. TS, "Analysis of Physical and Chemical Parameters in Ground Water Used for Drinking around Konso Area, Southwestern Ethiopia," *J. Anal. Bioanal. Tech.*, vol. 08, no. 05, 2017, doi: 10.4172/2155-9872.1000379.
- [48] B. Sharma, P. Singh, and R. Dobhal, "Education on Drinking Water Quality and Its Health Impacts among Students and Community People," *Am. J. Educ. Res.* Vol. 5, 2017, Pages 400-408, vol. 5, no. 4, pp. 400–408, 2017, doi: 10.12691/education-5-4-8.
- [49] A. P. Dwivedi and I. P. Tripathi, "Physico-chemical Analysis and Mapping of Ground Water Quality in Residential Area of Two Different Zone of Central India," *Int. J. Adv. Res. Chem. Sci.*, vol. 4, no. 10, pp. 15–25, 2017, doi: 10.20431/2349-0403.0410002.
- [50] N. Thakur, M. Rishi, D. A. Sharma, and T. Keesari, "Quality of water resources in Kullu Valley in Himachal Himalayas, India: perspective and prognosis," *Appl. Water Sci.*, vol. 8, no. 1, pp. 1–13, 2018, doi: 10.1007/s13201-018-0668-z.
- [51] A. K. Singh et al., "Physicochemical parameters and alarming coliform count of the potable water of Eastern Himalayan state Sikkim: An indication of severe fecal contamination and immediate health risk," *Front. Cell Dev. Biol.*, vol. 7, no. AUG, 2019, doi: 10.3389/fpubh.2019.00174.
- [52] L. T. Popoola, A. S. Yusuff, and T. A. Aderibigbe, "Assessment of natural groundwater physico-chemical properties in major industrial and residential locations of Lagos metropolis," *Appl. Water Sci.*, vol. 9, no. 8, pp. 1–10, 2019, doi: 10.1007/s13201-019-1073-y.
- [53] N. Aydın et al., "Microbiological and physico-chemical properties of packaged, residential treatment device and tap water drinking water and their possible effects on human health," *J. Water Sanit. Hyg. Dev.*, vol. 8, no. 4, pp. 767–776, 2018, doi: 10.2166/washdev.2018.056.
- [54] A. Batool, S. Aziz, S. Imad, S. S. Kazmi, M. Shafiq, and M. A. Ghufraan, "Physico-chemical quality of drinking water and human health : a study of salt range Pakistan," *Int. J. Hydrol.*, vol. 2, no. 6, pp. 668–677, 2018, doi: 10.15406/ijh.2018.02.00141.
- [55] S. Mahajan and A. S. Gupta, "Assessment Of Drinking Water Quality Based On Water Quality Index of Balh Tehsil District Mandi (H.P.), India," vol. 8, no. 10, pp. 1195–1202, 2020, [Online]. Available: <http://aegaeum.com/>
- [56] P. T. Dung et al., "Soil Texture, Organic Matter and Nutrients Affect Production of Acacia in Northeast Vietnam," *Asian J. Adv. Res. Reports*, vol. 12, no. 2, pp. 33–41, 2020, doi: 10.9734/ajarr/2020/v12i230285.
- [57] A. Daghara, I. A. Al-Khatib, and M. Al-Jabari, "Quality of Drinking Water from Springs in Palestine: West Bank as a Case Study," *J. Environ. Public Health*, vol. 2019, 2019, doi: 10.1155/2019/8631732.
- [58] S. Mahajan and A. Gupta, "Seasonal Assessment of Drinking Water Quality for Anions, Biological Oxygen Demand, Chemical Oxygen Demand and Dissolved Oxygen of Tehsil Balh, Distt Mandi ,Himachal Pradesh, India," vol. 11, no. 8, pp. 125–137, 2020, [Online]. Available: www.jespublication.com
- [59] H. Pathak, "Chemometric analysis of drinking water quality parameters of Sagar city, Madhya Pradesh, India," *Ovidius Univ. Ann. Chem.*, vol. 31, no. 2, pp. 99–105, 2020, doi: 10.2478/auoc-2020-0018.
- [60] H. Kamal and I. Hashmi, "Water quality assessment of Raw and Chlorinated drinking water of a Residential University," vol. 14, no. 1, 2021, [Online]. Available: <https://doi.org/10.24949/njes.v14i1.633>
- [61] S. Mahajan, A. Shree Gupta, and S. C. Chauhan, "a Study of Physico-Chemical Characteristics of Drinking Water of Balh Tehsil, District Mandi, Himachal Pradesh, India," vol. 33, no. 12, 2020.
- [62] S. Hayet, K. M. Sujana, A. Mustari, and M. A. Miah, "Hemato-biochemical profile of turkey birds selected from Sherpur district of Bangladesh," *Int. J. Adv. Res. Biol. Sci.* vol. 8, no. 6, pp. 1–5, 2021, doi: 10.22192/ijarbs.
- [63] J. Elizabeth Philip, K. Prakash, K. Jims, L. Joseph, and A. Professor, "Analysis of Pollution Trends in Subsurface Water At Poovanthuruth, Kottayam," vol. 9, no. 9, pp. 1–4, 2021, [Online]. Available: www.ijert.org
- [64] A. Pathak and A. Patel, "Assessment of Water Quality of Gomti River Using Water Quality Index and Gis, in Lucknow City, Uttar Pradesh," vol. 7, no. 5, p. 2021, 2021, [Online]. Available: www.ijariie.com
- [65] M. Lewoyehu, "Evaluation of Drinking Water Quality in Rural Area of Amhara Region, Ethiopia: The Case of Mecha District," *J. Chem.*, vol. 2021, 2021, doi: 10.1155/2021/9911838.
- [66] D. Ganpurev et al., "Microbiological and Hydrochemical Parameters of Deep Wells Used for Drinking Water in Ulaanbaatar, Mongolia," *Proc. 5th Int. Conf. Chem. Investig. Util. Nat. Resour.*, vol. 2, pp. 89–97, 2021, doi: 10.2991/ahcps.k.211004.014.
- [67] J. K. Ondieki, D. N. Akunga, P. N. Warutere, and O. Kenyana, "Bacteriological and physico-chemical quality of household drinking water in Kisii Town, Kisii County, Kenya," *Heliyon*, vol. 7, no. 5, p. e06937, 2021, doi: 10.1016/j.heliyon.2021.e06937.
- [68] R. Babich et al., "Defining drinking water metal contaminant mixture risk by coupling zebrafish behavioral analysis with citizen science," *Sci. Rep.*, vol. 11, no. 1, pp. 1–11, 2021, doi: 10.1038/s41598-021-96244-4.
- [69] M. Hussain, L. Jamir, and M. R. Singh, "Assessment of physico-chemical parameters and trace heavy metal elements from different sources of water in and around institutional campus of Lumami, Nagaland University, India," *Appl. Water Sci.*, vol. 11, no. 4, pp. 1–21, 2021, doi: 10.1007/s13201-021-01405-5.
- [70] G. Ali, M. K. Bashir, S. Abbas, and M. Murtaza, "Drinking-water efficiency, cost of illness, and peri-urban society: An economic household analysis," *PLoS One*, vol. 16, no. 9 September, pp. 1–13, 2021, doi: 10.1371/journal.pone.0257509.
- [71] O. K. Jean-Eudes, R. F. Avahounlin, C. N. Kéloromé, O. Pierre, A. M. H. Adéké, and E. W. Vissin, "Evaluation of the Physico-Chemical Quality and Potability of Groundwater Consumption in Department of Collines at Benin," *J. Geosci. Environ. Prot.*, vol. 10, no. 01, pp. 29–48, 2022, doi: 10.4236/gep.2022.101003.
- [72] J. N. CUMINGS, *Biochemical aspects.*, vol. 55. 1962. doi: 10.5005/jp/books/11431_8.
- [73] Wisconsin Department of Natural Resources, "Wisconsin Public Water Systems 2018 Annual Drinking Water Report," no. June, 2019, [Online]. Available: <https://dnr.wi.gov/topic/DrinkingWater/>
- [74] A. Nasabimana, P. Li, S. He, X. He, S. M. Khorshed Alam, and M. Fida, "Health risk of the shallow groundwater and its suitability for drinking purpose in



- tongchuan, China,” *Water (Switzerland)*, vol. 13, no. 22, 2021, doi: 10.3390/w13223256.
- [75] CAWST, “Introduction to Drinking Water Quality Testing: Manual,” no. October, 2013, [Online]. Available: www.cawst.org
- [76] M. Shiferaw, J. Nugusa, and M. Tegegne, “Water Quality Analysis of Nekemte Town Water Supply,” *Appl. Eng.*, vol. 5, no. 2, pp. 35–43, 2021, doi: 10.11648/j.ae.20210502.11.
- [77] Y. Sayato, “WHO Guidelines for Drinking-Water Quality,” *Eisei kagaku*, vol. 35, no. 5, pp. 307–312, 1989, doi: 10.1248/jhs1956.35.307.
- [78] A. Alsulaili, M. Al-Harbi, and K. Al-Tawari, “Physical and chemical characteristics of drinking water quality in Kuwait: Tap vs. bottled water,” *J. Eng. Res.*, vol. 3, no. 1, pp. 25–50, 2015, doi: 10.7603/s40632-015-0002-y.



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