Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2

Impact Factor: 7.665, Peer Reviewed and UGC CARE I

WATER QUALITY ASSESSMENT AND PRESENT STATUS OF TRADITIONAL NATURAL SPRINGS IN THE HIMALAYAN TOWN PITHORAGARH, UTTARAKHAND

Prema Kaira, Assistant Professor, Shr. R. S. Dhoni Government Degree College, Jainti, Almora (Uttarakhand)
Tanuja Pokhariya, Assistant Professor, Soban Singh Jeena University, Almora, L.S.M. Campus, Pithoragarh

Abstract

Natural springs are the important source of drinking water in hilly region. These are founds in source of traditional from such as *Naula, Dhara and Chal Khal*. Presently more than 35 natural springs are located in Pithoragarh town. The water level of natural springs is decrease and polluted due to excessive urbanization in the last three decades. Erratic rainfall pattern, increases of built-up area, concretization, lack of proper drainage pattern and sewerage line the Mountain aquifer system badly affected.

This research paper focuses on assessment of natural springs in Pithoragarh town. In this research, a total eight municipal wards and more than twelve water quality parameters has selected for analysis. The entire data collected by field survey method and using stratified random sampling. The water quality results of the research were evaluated acceptable and permissible limits by B.I.S (Bureau of Indian Standard) and W.H.O (World Health Organization). Out of the total springs in the town, 27 springs are being used for springs samples surveyed showed that about 19% of the springs in the study area are potable and 16% of the springs are prohibited for drinking purposes with the concentration of coliform bacteria. Thus, the result of the study shows that due to anthropogenic activities and climate change the natural springs are depleting and polluting very steadily. This is a big challenge to the water springs of Pithoragarh town.

Keywords: Physico-chemical characteristics, Water Quality, Anthropogenic Activities, Natural Spring, Kumaun Himalaya.

Introduction:

Water is essential for life and a functioning environment. The availability and quality are important elements for human society and the environment. In the Himalayan region, natural springs provide the primary source of water for agricultural and domestic purposes (Valdiya and Bartarya 1989; Negi and Joshi 2004). Glaciers, springs, and seepage water are the primary sources of mountain streams and rivers. Mountain streams and rivers which are locally known as Gad, Gadheras and Nadi/Ganga. The spring is known as Naula, Dhara, panyar in the local

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

Kumauni language. Naula and Dhara have minor differences; in Naula, water is stored in a pond-like small structure, while in Dhara, water is falling from a certain height.

The Uttarakhand Himalayan lakes and springs are phenomenal and have attracted a lot of academic curiosity (Valdiya et al, 1996). Springs are essential for the survival and sustenance of an important part of the Himalayan population. Most of the population living in the high and low attitude part of the Himalayas depends predominantly on springs. Rivers pass deep valleys, limiting their use for water supply, while the extraction of groundwater aquifers in the Himalayan region is frequently challenging and expensive. In the inaccessible non-snow-fed, rain-shadow watershed region, springs serve as the only supply of water for drinking, domestic use, and livestock requirements. According to a preliminary assessment, springs are essential to 80%–90% of the population in Meghalaya, Sikkim, and Uttarakhand (ICIMOD 2015).

Several studies have examined the effects of anthropogenic modifications and climate change on the subsurface and spring hydrology in the Himalayas, including Grover (2015), Jeelani et al. (2018), Agarwal et al. (2012), Pant and Rawat (2015), Tiwari (2008), Rawat (2009). The groundwater degradation, characterized by declining water levels and contamination, has been documented in India and Nepal due to mismanagement and overexploitation (Immerzeel et al. 2010; Ashoka et al. 2017).

Both natural and anthropogenic processes can cause LULCC in the Himalayas, but human impact affects significant changes (Semwal et al. 2004). Aquifers are significantly impacted by changes in urban and agricultural settings, which can pose significant threats to the water quantity and quality. Over the past three decades, 159 natural springs have completely dried up, and 50 have become seasonal due to extensive deforestation, increased population, decreased percolation, and increased runoff in the Nainital District Tiwari (2008). The Almora region of the Kumaun Himalayas has also seen the adverse effects of land use dynamics, about 270 of 360 springs drying up (Rawat 2009).

The lithological structure, rock weathering, slope, terrain of spring catchment area, climatic changes, and human activities, in addition to precipitation, all affect the hydrochemistry of the springs. An assessment of spring water quality is essential from both an ecological and human health perspective. According to the WHO research, drinking water is the cause of around 80% of all diseases in humans (Sharma et al, 2014). Despite the fact that the spring water is freshwater, a number of contaminants from surrounding sewage and human waste, agricultural waste, and rock leaching are the main sources of declining water quality (Pathak B. et al, 2021). According to a recent measurement and analysis of the water quality in Nainital Lake by Pathak et al. (2021), the lake water is extremely contaminated and not suitable for human consumption without filtering. Based on the average value of physio-chemical characteristics, a study carried out in the Pithoragarh district indicated that no water sample was entirely suitable for drinking (Thakur et al, 2023). The rapid urbanization process, fast growth of urban population expansion, and ecological changes around the Pithoragarh town of Himalaya have all contributed to the

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

pollution and drying up of the springs. The government developed plans for a new gravity flow drinking water scheme and drinking water pumping schemes due to the above situations in order to provide the required water supply. As a result, springs were neglected as new drinking water facilities were put into place. Hence, due to the absence of effective management of the water sources springs, the water level of the springs has decreased. People and the state government are now paying more attention to these springs.

Material and Methods:

Objective:

The fundamental objectives of the presented research paper are based on the current situation, uses and quality of traditional natural springs in the study area, which are as follows:

1. To study the present status of natural water springs.
2. To assess the total number of drinkable natural springs.
3. To examine the quality of drinkable natural springs in the town.

Data Collection:

The present research paper is entirely based on primary data that are collected from different methods of field surveying, such as personal observation and spring data. They were collected in the post-monsoon period of 2024. Natural water sources have been selected by the purposive random sampling method. For the research, 8 municipal wards have been selected in which 08 natural water sources have been selected out of the total (Table.1). These water sources have been selected on the basis of the high dependency and drinkability of the town. The total population of these selected wards is 21,120 (Table.1).

Samples were taken from each of the water sources for the examination of water quality, and it was tested in the lab, and along with that, water discharge was also measured in the source area. A total of 12 parameters were studied to check the water quality (Table.3).

Table: 1. GPS Locations of Sampling Sites of Water Springs in Pithoragarh Town (2024)

S. N.	Ward Name	Sample Site Name	Coordination		Elevation (in m.)	Total Population	Present Usages
			Latitude (^{0}N)	Longitude (^{0}E)			
1	Bajeti	Mal Dhara	29.592505	80.198161	1636	4207	Drinking
2	Daula	Daula Naula	29.587383	80.227533	1536	NA	Drinking
3	Til Dhukari	Tildhukari Naula	29.582684	80.222124	1573	3895	Drinking
4	Linthuda	Rin Dhara	29·58784	80·213442	1575	4031	Drinking
5	Naya Bajar	Shivalaya	29.584495	80·211247	1607	2581	Drinking

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

		Dhara					
6	Khadkot	New Sera Naula	29·588811	80·203643	1602	4724	Drinking
7	Krishnapuri	Hanuman Dhara	29·57925	80·211266	1554	NA	Drinking
8	Sera Punedi	Sin Naula	29·590334	80·209184	1595	1772	Drinking
Total						**21,210**	

Study Area:

The study area, located in the town of district Pithoragarh in Uttarakhand, is situated within the higher to lesser Himalayan region of India. The study area extends between in 29°33.601' N to 29°36.001' N latitudes and 80°12.001' E to 80°14.401' E longitudes, covering an area of about 9.89 sq. km. and 1540 meter above sea level (Fig.1). The municipality council of Pithoragarh has 20 administrative wards.

The research area is situated in a mountain valley and features a distinctive geomorphic setting. Pithoragarh town is situated on a gentle slope of 5 degree to 15 degree. The town, lying in a valley, is moderately warm during summer and cool during winter. The temperate mountain ridges and high elevations receive snowfall and have an average temperature of 5.5 to 8.0°C during the coldest months of December and January. Due to the wide variations in elevation Pithoragarh town has extremely high and low temperatures. The minimum average temperature is 3.23°C in January, while the maximum average temperature is 33°C in June. The average annual precipitation of Pithoragarh is about 166 mm, approximately 141 rainy days during the year. According to the census 2011, the total population of the town Pithoragarh is 56044 and out of the total population 29127 are male and 26917 are female.

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

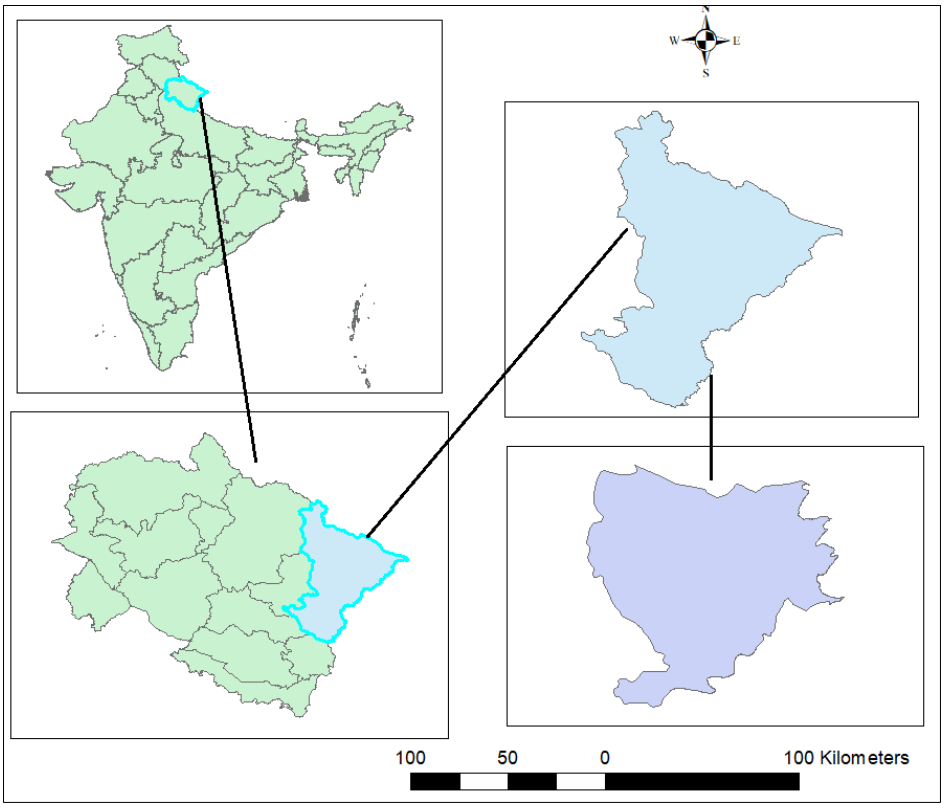

Fig. 1: Location Map of the Study Area

Result:

The fundamental objective of the study is focused on the present status and quality of natural springs in the administrative ward of Pithoragarh town. Rainfall and underground water capacity are the main components for the natural water resource management. According to the water quality assessment, only eight traditional natural springs are in drinkable condition in the town area. Whose water quality results are also acceptable by BIS and WHO.

The results of the study analyze three key findings: first, the current status of natural springs in the town (Table.2); second, selection and assessment of total drinkable water sources (Table.1); and third, evaluation of the water quality of selected drinking water sources (Table.3).

Table: 2. Status and water discharge of natural springs of the town area during the post-monsoon period (September to November 2024)

S.N.	Ward Name	Spring		Spring Name	Water Discharge
		Total Number	Drinkable Condition		L.P.M
1	Bajeti	04	01	Malla Dhara	4.76

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

2	Daula	03	01	Daula Naula	2.6
3	Til Dhukari	02	01	Til Dhukari Naula	2.85
4	Linthuda	02	01	Rin Dhara	16.8
5	Naya Bajar	02	01	Shivalaya Dhara	17.4
6	Khadkot	03	01	Sera Naula	2.4
7	Krishnapuri	01	01	Hanuman Dhara	4.8
8	Sera Punedi	03	01	Sin Naula	3.12
Total		20	08		

Table. 2 depicts the status of natural springs and water discharge in the city. Out of the total 20 words of the town, potable water sources are located only in eight wards. Their status is currently approved on the basis of the evaluation of the municipality and water quality standards. There are a total of 20 water sources in these 8 wards of the town, out of which only 8 are drinkable (Fig.2). Their condition is potable only one-on-one in each ward. The water discharge capacity of these selected water sources is also good per liter minute (L.P.M.) (Table. 2). The highest water discharge in the town was found in Shivalaya Dhara (Naya Bazar Ward), which was 17.4 L.P.M, and the lowest water discharge was found in Shera Naula (Khadkot Ward), which was 2.4 LPM.

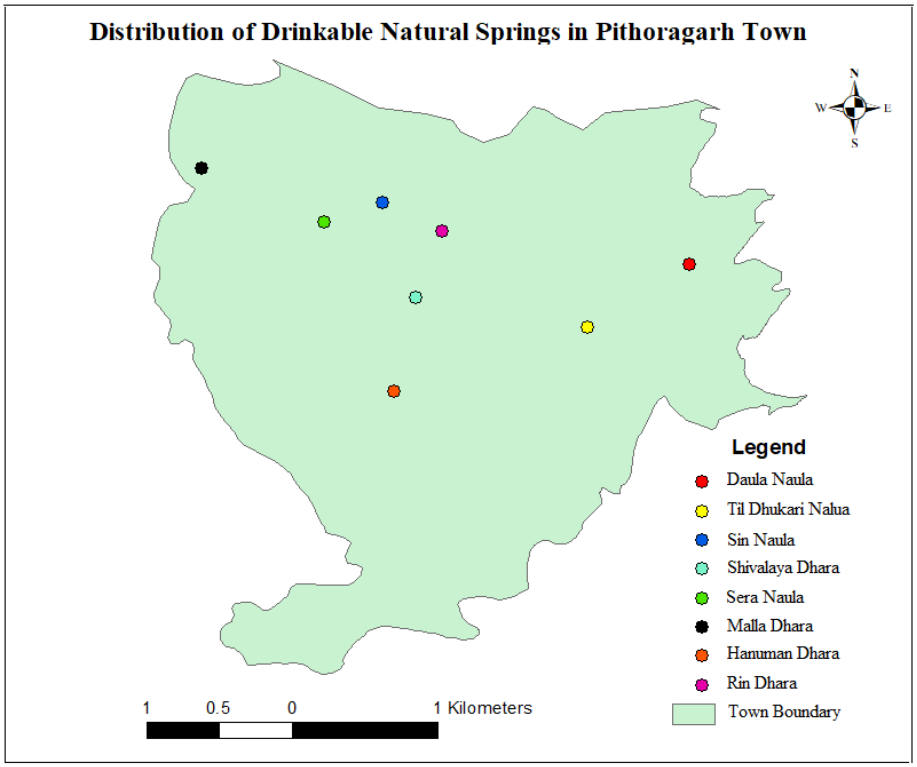

Figure: 2. Spatial distribution of surveyed traditional natural springs in the Pithoragarh town

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

As per findings (Table.3), the mean value of the pH was 7.54 at 25°C, TDS 283 mg/L, total alkalinity 185.42 mg/L, total hardness 270.25 mg/L, calcium 51.63 mg/L, magnesium 29.84 mg/L, and coliform (588.69/100 ml of water). The least coliform was found in Hanuman Dhara (13.02/100 ml of water), while the highest coliform was in Shivalaya Dhara (2419.6/100 ml of water).

Discussion:

In this work, we have attempted to characterize and analyze the spring properties that are available in and around the major town and its environs in Pithoragarh. Table.3 displays the mean result of the physico-chemical examination of spring water.

Total Dissolved Solids (TDS) and pH: According to BIS guidelines, the permitted maximum of TDS is less than 500 mg/L, however WHO guidelines indicate that it should be between 500 and 1000 mg/L. The concentration of TDS in the sample springs varied between 248-408 mg/l (table 3), showing that no sampling spring crosses the permissible limit of BIS and WHO. The average TDS of the sample springs in the study area is 300 mg/l. The average pH of the spring water sample in the study area is 7.54. All water samples were declared acceptable for human consumption since none of them had pH levels higher than what is considered suitable for human consumption.

Turbidity: The maximum value of turbidity is found in Tildhukari naula (3.32) and minimum in Rin dhara and Hanuman dhara (less than 0.50) (Table.3 and Plate.1,2). Turbidity levels in every water sample were well within the BIS maximum permissible limits.

Alkalinity: The capacity of the water to neutralize the acid is known as alkalinity. The alkalinity of the 8 spring water samples varies from 94.4-304 mg/l. The average alkalinity of the spring water sample in the study area is 185.42 mg/l. All spring water sources were considered potable because no sample of spring water had an alkalinity level higher than the permitted level.

Total Hardness (TH): The main source of hardness is the mineral compound that dissolves in water. Spring water samples of the study area show hardness ranging from 228-380 mg/l. The average hardness of this spring samples is 270.25.

Calcium and Magnesium Content: The calcium in the surveyed water samples varies from 30.08-80 mg/l. The maximum amount of calcium is observed in Tildhukari naula (80 mg/l) (Plate.2 (A)). Magnesium in the spring water samples varies from 12.79 to 44 mg/l.

Coliform: Coliform bacteria were detected in all the surveyed springs in the study area. The maximum coliform is detected in Shivalaya dhara of Naya Bazar ward which is 2419.6 MPN/100ml and minimum in Malla dhara of Bajeti dhara which is 3.6 MPN/100 ml. The concentration of coliform was highest this spring in the Naya Bazar ward, which is located in the city center where human occupancy has increased significantly (Plate.1 A, D). Whereas in the Bajeti ward, no habitation has been constructed around the surveyed spring area.

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2

Impact Factor: 7.665, Peer Reviewed and UGC CARE I

Plate: 1. Present Status of Natural Springs (Dhara) in Traditional Form (A. Shiwalaya Dhara (Naya Bajar ward) B. Rin Dhara (Linthuda Ward) C. Hanuman Dhara (Krishnapuri Ward) D. Malla Dhara (Bajeti Ward))

A B C D

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

Plate: 2. Present Status of Natural Springs (Naula) in Traditional Form (A. Tildhukari Naula (Tildhukari Ward)
Shin Naula (Sera Punedi Ward) C. Shin Naula (Sera Punedi Ward D. New Sera Naula (Khadkot Ward

Table: 3. Water Quality Analyses (W.Q.A) of Drinkable Natural Springs in Pithoragarh town (During Post-Monsoon Period, 2024)

S. N.	Sample Site	Spring Name	pH at 25^0C	TDS, mg/L	Turbidity, NTU	Total Alkalinity ($CaCO_3$) mg/L	Total Hardness ($CaCO_3$) mg/L	Colour, Hazen	Odour	Calcium (Ca), mg/L	Magnesium (Mg) Mg/L	Choloride, mg/L	Total Coliform,MPN /100ML	Chlorin)
1	**Bajeti**	**Malla Naula**	7.85	110	less than 0.50	94.4	232	Less than 1	Agree	30.08	12.79	7.76	3.7	ND

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

2	**Daula**	**Daula Naula**	7.36	340	1.87	198	264	Less than 1	Agree	66	24	Less than 5.00	189.2	ND
3	**Tildhukari**	**Tildhukari Dhara**	7.32	408	3.32	304	380	Less than 1	Agree	80	44	Less than 5.00	920	ND
4	**Linthuda**	**Rin Naula**	7.47	248	less than 0.50	182	228	Less then 1	Agree	44	29	8.0	101.4	ND
5	**New Bajar**	**Shivalaya Dhara**	7.61	288	1.62	168	270	less than 1	Agree.	52.00	34	Less than 5.00	2419.6	ND
6	**Khadkot**	**New sera Naula**	7.41	354	1.98	185	310	-	-	53	32	Less then 5.00	967	ND
7	**Krishnapuri**	**Hanuman Dahara**	7.87	268	less than 0.50	188	250	less then 1	Agree	44	34	Less than 5.00	13.02	ND
8	**Sera Pu**	**Sin Naula**	7.49	248	0.87	164	228	Less then 1	Agree	44	29	7.0	95.7	ND

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

	ned i											
Minimum		**7.32**	**248**	**less than 0.50**	**94.4**	**228**	**-**	**-**	**30.08**	**24**	**Less than 5.00**	**3.6**	**-**
Maximum		**7.87**	**408**	**3.32**	**304**	**380**	**-**	**-**	**80**	**44**	**8.0**	**2419.6**	**-**
Mean		**7.54**	**283**	**-**	**185.42**	**270.25**	**-**	**-**	**51.63**	**29.84**	**-**	**588.69**	**-**
Desirable limit (BIS)		**6.5 to 8.5**	**500**	**1**	**200**	**200**	**5**	**Agree**	**Agree**	**75**	**30**	**250**	**-**
Permissible limit (BIS)		**No Relaxation**	**2000**	**5**	**600**	**600**	**15**	**Agree**	**Agree**	**200**	**100**	**1000**	**-**

ND- not detected

Conclusion:

The chemical composition of water sources is hardly affected by the geology of the area, underground water processes such as infiltration, weathering leaching and human activities such as the use of fertilizers. The above study is an observation of the quality and water discharge of water samples collected from drinking water sources in different wards of Pithoragarh town. The results show that the quality of the spring water in a few chosen drinkable springs meets WHO and BIS drinking water standards. There are eight springs spread throughout eight distinct town wards. The water appears to be suitable for human consumption based on its physical and chemical characteristics.

The water quality and water level of natural water sources located in the city are deteriorating due to erratic rainfall patterns. increases of built-up area, concretization, lack of proper drainage pattern, and sewerage line. Increasing urbanization and unplanned management of the quality and quantity of water is deteriorating, which has the greatest impact on human health. Among all the drinking water sources in Pithoragarh town, the water quality of Hanuman dhara is the best, which is located in the periphery of the town. Apart from this, the water sources located in the central part of the city were found to have poor quality and high levels of coliform

were found in them. Most of the water sources in the city are not potable due to the presence of high levels of coliform in them, out of which 8 water sources are potable.

The result of the study shows that due to urbanization, anthropogenic activities and climate change the natural springs are depleting and polluting very steadily. Poor quality of water has the greatest impact on health such as typhoid, hepatitis A, cholera and polio.

References

1. Agarwal, A., Bhatnagar, N.K., Nema, R.K., et al. (2012) Rainfall dependence of springs in the Midwestern Himalayan hills of Uttarakhand. Mountain Research and Development 32(4): 446-455.
2. Asoka, A., Gleeson, TWada Y., Mishra, V. (2017) Relative contribution of monsoon precipitation and pumping to changes in groundwater storage in India. Nature Geoscience 10(2): 109. https://doi.org/10.1038/ngeo2869
3. Grover, V.I. (2015) Impact of Climate Change on the Water Cycle. In Managing Water Resources under Climate Uncertainty. Springer International Publishing. 3-30
4. ICIMOD (2015) An Integrated Springshed Management Approach Linking Science, Policy and Practice
5. Immerzeel, W.W., Van Beek L.P., Bierkens MF (2010) Climate change will affect the Asian Water towers. Science 328(5984) https://doi.org/10.1126/science.1183188
6. Jeelani, G., Shah R.A., Fryar AE et al. (2018) Hydrological processes in glacierized high-altitude basins of the western Himalayas. Hydrogeology Journal, 26(2): 615-628. https://doi.org/10.1007/s10040-017-1666-1
7. Negi, G. C. S., & Joshi, V. (2004) Rainfall and spring discharge patterns in two small drainage catchments in the Western Himalayan Mountains, India. Environmentalist, 24(1): 19–28.
8. Pant, C.C., Rawat, P.K. (2015) Declining changes in spring hydrology of non-glacial river basins in Himalaya: a case study of Dabka catchment. In Dynamics of Climate Change and Water Resources of Northwestern Himalaya. Springer, Cham. 151-179
9. Pathak, B., Upadhyay, R., Bakshi, S., Bisth, S. and Kotlia, B. S., (2021) Assessment of water quality of Nainital lake and surrounding springs using water quality index (WQI) and heavy metal pollution index (HPI). Earth Science India, 14 (1): 28 - 40.
10. Rawat, J.S. (2009) Saving Himalayan Rivers: developing spring sanctuaries in headwater regions. In: Shah BL (ed) Natural resource conservation in Uttarakhand, Ankit Prakashan, Haldwani, India. 41-69
11. Semwal, R, Nautiyal S, Sen KK, et al. (2004) Patterns and ecological implications of agricultural land-use changes: a case study from central Himalaya, India. Agriculture,

Journal of East-West Thought
ISSN: *2168-2259 (online)*
(https://jetjournal.us/)
Volume 15, Issue 1, Jan-March – 2025 Special Issue 2
Impact Factor: 7.665, Peer Reviewed and UGC CARE I

Ecosystems and Environment 102(1): 81-92. https://doi.org/10.1016/s0167-8809(03)00228-7

12. Sharma, P., Mehar P. K., Kumar, A., Gautam, Y. P., and Mishra, K. P., (2014) Changes in water quality index of Ganga River at different location of Allahabad, Sustainability of water quality and ecology. 3: 67 - 76.
13. Thakur, P.K., Kumar V., Deoli V. (2023) Assessment of Spring Water Quality Using Water Quality Indices and Multivariate Statistical Techniques in Pithoragarh, Uttarakhand, Journal of The Institution of Engineers (India) Series A
14. Tiwari, P (2008) Land use changes in Himalaya and their impacts on environment, society and economy: A study of the Lake Region in Kumaon Himalaya, India. Advances in Atmospheric Sciences 25(6): 1029-1042.
15. Valdiya, K. S., & Bartarya, S. K. (1989). Diminishing discharges of mountain springs in a part of Kumaun Himalaya. Current Science, 58(8): 417–426.
16. Valdiya, K. S., Kotalia, B. S., Pant P. D., Shah, M., Tewari, S. sah, N. and Upreti, M.1996. Quaternary palaeolakes in Kumaun Lesser Himalaya: finds of neo - tectonic and palaeo - climatic significances. Current Science, Vol.70 (2). PP 157 - 16. Anuradha, Raina G., Rawat S. S. and Malviya P., 2021. Spring Water Quality Assessment using water quality index of Lansi village of Udhampur, Jammu Kashmir. International Journal of Environmental Science, 10(1): 19 - 23.