VOLUME 11 ISSUE 1 2025

ISSN 2454 – 3055

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 11, No. 1, 271-278 (2025)

International Journal of Zoological Investigations

Contents available at Journals Home Page: www.ijzi.net

Editor-in-Chief: Prof. Ajai Kumar Srivastav

Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Water Quality Analysis of the Himalayan River Lohawati: A Case Study from District Champawat, Uttarakhand, India

Kharkwal Lata[1] and Kumar Dharmendra[2]*

[1]Department of Zoology, S.V. Govt. P.G. College, Lohaghat 262524, Uttarakhand, India
[2]Government. P.G. College, Maldevata, Raipur, Dehradun 248008, Uttarakhand, India

**Corresponding Author*

Received: 28th September, 2024; **Accepted:** 22nd December, 2024; **Published online:** 21st February, 2025

https://doi.org/10.33745/ijzi.2025.v11i01.029

Abstract: This study investigates the physic-chemical properties of the Lohawati River to evaluate its water quality in comparison with the Bureau of Indian Standards (BIS) guidelines. The analysis encompassed various parameters including pH, temperature, total hardness (TH), magnesium (Mg), calcium (Ca), total dissolved solids (TDS), dissolved oxygen (DO), and heavy metals (chromium, lead, cadmium, mercury, arsenic and zinc). The results indicated that the pH of the river water ranged from 6.2 to 7.9, and the temperature varied between 6.8°C and 18.7°C. Total hardness was recorded between 109.9 mg/l and 246.8 mg/l, while magnesium and calcium concentrations ranged from 21.2 to 64.9 mg/l and 11.1 to 39.9 mg/l, respectively. TDS levels varied from 132 mg/l to 534.9 mg/l, and dissolved oxygen ranged from 4.2 mg/l to 7.9 mg/l. In terms of heavy metals, chromium (Cr) and lead (Pb) levels ranged from 0.11 to 0.19 mg/l and 0.01 to 0.19 mg/l, respectively, while zinc (Zn) content varied between 0.015 and 0.097 mg/l. This study provides a comprehensive assessment of the Lohawati River's water quality, revealing both acceptable and concerning trends in the physico-chemical characteristics, with implications for its suitability for human consumption and environmental sustainability.

Keywords: Physico-chemical, Water quality, Heavy metal, Total dissolved solids, Dissolved oxygen, Total hardness

Citation: Kharkwal Lata and Kumar Dharmendra: Water quality analysis of the Himalayan River Lohawati: A case study from district Champawat, Uttarakhand, India. Intern. J. Zool. Invest. 11(1): 271-278, 2025.

https://doi.org/10.33745/ijzi.2025.v11i01.029

Introduction

Water is essential for all forms of life, and it plays a critical role in maintaining human health. The human body is made up of around 70% water, and every organ system depends on it to function. However, over time, the quality of water worldwide has been declining due to both natural factors and human activities. Monitoring water quality is crucial for various purposes, such as drinking, agriculture, and industrial use. Regular assessment of water sources helps identify sources of contamination, such as pollutants from industrial, agricultural, or urban activities, and guides the development of sustainable water management strategies. By addressing these issues, it ensures the protection of public health, supports social well-being, and promotes economic growth by providing clean water for various sectors (Son *et al*., 2020).

In the Himalayas, water is collected in temporary "reservoirs." These reservoirs are natural storage systems, like snowpacks, glaciers, or small ponds, that hold the water for a while. Once the water is stored, it is slowly released into rivers and streams. This gradual release helps maintain a steady flow of water that replenishes groundwater (underground water supplies) and provides water to areas further downstream. Essentially, the process ensures that water is available over time, helping both the local environment and people living in the region. (Prakeshanjal, 2020)

The Himalayan region is often referred to as the "Water Tower of Asia" because it is the largest source of freshwater in the world. In addition to glacial rivers, the Himalayas are also the source of many groundwater-fed rivers. These smaller rivers, which are tributaries of the larger ones, help maintain stable water levels in the main rivers, even during winter when glacial melting slows down. These groundwater rivers not only sustain the Himalayan ecology but also provide a significant portion of the local population with access to fresh water. However, factors such as population growth, glacier melt, groundwater over-exploitation, snowmelt, pollution, and global warming are likely to affect the availability of water in the Himalayan rivers in the future (Chandel *et al*., 2021).

Several groundwater rivers in the Himalayas originate from the Kumaon region of Uttarakhand, including the Gandaki (Champawat), Ladhiya (Champawat), and Lohawati (Lohaghat) rivers. These rivers contribute to the Kali River system, the longest river in Uttarakhand, which forms the boundary between India and Nepal. This study focuses on the Lohawati River, a significant tributary of the Kali River (Fig. 1). The river originates in the forests of Katreshwer and flows through an area rich in temples and religious sites. The ancient city Lohaghat is situated on its bank. The aim of this study is to address the existing knowledge gap regarding the physicochemical characteristics of the Lohawati River in order to assess its water quality. Given that the river serves as a source of potable water for numerous nearby villages, this research will also contribute to evaluating the safety of the water for human consumption.

Materials and Methods

Study Area: The study was carried out in the Kumaon region of Uttarakhand, specifically in Lohaghat, which is located on the bank of the Lohawati River in the Champawat district at an elevation of 1754 meters. Five distinct sampling sites along the river were selected for this study. Samples were collected monthly from January to December 2023. The exact GPS coordinates for each sampling site are provided in Table 1.

Sample Collection: Samples were collected in accordance with the standard protocol established by the Bureau of Indian Standards (BIS), IS 3025 Part 1 (1987). 250 ml polypropylene bottles were used for sampling. On-site testing was conducted to measure parameters such as pH and temperature. The collected samples were then promptly sent to the S.V.G.P.G. Lohaghat laboratory for further analysis.

Physico-Chemical Analysis: A total of 15 parameters were analyzed for this study, following the BIS standard testing procedures. The parameters included: pH (IS 3025, Part 11, 1983), Temperature (IS 3025, Part 9, 1984), Odour (IS 3025, Part 5, 1983), Taste (IS 3025, Part 8, 1984), Dissolved Oxygen (DO) (IS 3025, Part 38, 1989), Total Hardness (TH) (IS 3025, Part 21, 2009), Calcium (Ca) (IS 3025, Part 40, 1991), Magnesium (Mg) (IS 3025, Part 46, 1994), Total Dissolved Solids (TDS) (IS 3025, Part 16, 1984), Cadmium (Cd) (IS 3025, Part 41, 1992), Chromium (Cr) (IS 3025, Part 52, 2003), Lead (Pb) (IS 3025, Part 47, 1994), Arsenic (As) (IS 3025, Part 37, 1988),

Fig. 1: Lohawati River (Near Shiv mandir).

Table 1: GPS location of sampling sites

S. No.	Site name	Longitude	Latitude
1	Katreshwer	80.064582	29.413188
2	Dhobi ghat	80.085719	29.401871
3	Main market (Lohaghat)	80.085402	29.399561
4	Shiv mandir (Lohaghat)	80.088232	29.394528
5	Chauri	80.098378	29.389999

Mercury (Hg) (IS 3025, Part 48, 1994), and Zinc (Zn) (IS 3025, Part 49, 1994).

Statistical Analysis: Data analysis was conducted using MS Excel and Past 4.0 software. Annual data from all five sampling sites were evaluated using statistical methods, including mean, median, standard deviation, and correlation analysis.

Results and Discussion

The physico-chemical properties of all the water samples tested in this study are presented in Table 2, while the results for heavy metal analysis are provided in Table 3.

pH is a measure of the concentration of hydrogen ions in a solution. According to BIS guidelines, drinking water should have a pH between 6.5 and 8.5. In this study, the pH of the Lohawati River ranged from 6.2 to 7.9. The pH values reported by Singh *et al.* (2014) for water sources in the Garhwal Himalayas ranged from 6.2 to 7.2, which is consistent with the findings of this study.

Temperature is an important parameter that influences the rate of chemical reactions and the solubility of substances in water. The temperature of the water samples in this study ranged from 6.8°C to 18.7°C, with the highest temperature recorded at Site 4 and the lowest at Site 1. Similar temperature ranges have been observed in previous studies. For example, Joshi *et al.* (2009) reported water temperatures ranging from 15.5°C

Table: 2 Annual data for physicochemical parameters

Physico-chemical Parameters					
	Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**
pH	6.25-7.6 7.1±0.3	7.1-7.9 7.6±0.23	7.1-7.9 7.6±0.28	7.3-7.9 7.5±0.17	7.2-7.9 7.5±0.22
Temp	6.8-12.9 9.2±2.0	9.1-13.7 11.4±1.61	11.5-17.3 14.3±1.7	10.7-18.7 14.3±2.8	7.6-16.5 12.7±3.2
DO	5.3-7.9 6.7±0.89	4.2-6.9 5.9±0.88	4.2-6.7 6±0.8	4.2-6.9 5.8±0.8	4.3-7.6 6.2±1.10
TH	109.9-135.6 123.02±9.01	148.9-264.7 192.7±6.7	147-263.4 184.6±37.8	153.6-264 191.2±30.3	149.7-246.8 178.6±33.7
Ca	21.2-26.5 23.83±1.91	32.2-67.3 44.5±11.50	31.9-64.9 42.8±11.03	33.7-61.7 44.3±8.25	30.9-61.4 40.9±9.91
Mg	11.1-18.2 15.45±1.91	15.1-39.9 19.8±6.7	17.9-25.3 18.8±2.7	16.5-26.7 19.7±2.88	14.3-23.4 18.5±2.65
TDS	132-218.3 179.26±22.10	307.1-599.3 415.79±82.65	361.7-534.9 419.9±58.5	376.7-512.3 422.3±43.2	345.7-462.7 398.12-39.8
Odour	Acceptable	Disagreeable	Disagreeable	Disagreeable	Disagreeable
Taste	Acceptable	Disagreeable	Disagreeable	Disagreeable	Disagreeable

Table 3: Annual data for heavy metals

Heavy metal analysis					
	Site 1	**Site 2**	**Site 3**	**Site 4**	**Site 5**
Cr	0.011-0.019 0.014±0.0028	0.012-0.019 0.014±0.0021	0.011-0.019 0.015±0.0022	0.011-0.018 0.015±0.0022	0.011-0.019 0.014±0.0025
Pb	0.011-0.018 0.014±0.009	0.012-0.019 0.014±0.0021	0.011-0.019 0.015±0.0025	0.012-0.018 0.015±0.0018	0.011-0.019 0.015±0.0023
Zn	0.025-0.097 0.062±0.022	0.049-0.098 0.071±0.0159	0.054-0.095 0.078±0.012	0.062-0.097 0.082±0.011	0.015-0.097 0.060±0.0235
Cd	<0.001	<0.001	<0.001	<0.001	<0.001
As	<0.005	<0.005	<0.005	<0.005	<0.005
Hg	<0.001	<0.001	<0.001	<0.001	<0.001

to 16.7°C in the River Ganga at Haridwar, while Patni *et al*. (2018) observed temperatures between 18.1°C and 25.7°C in water sources of the Pithoragarh district.

Total Dissolved Solids (TDS) is a measure of all dissolved substances, both organic and inorganic, in water. The acceptable limit for TDS in drinking water is 500 mg/l. In the tested samples, TDS ranged from 132 to 534.9 mg/l. Sharma *et al*. (2014) conducted a study on the River Sharda (Kali River) in the Champawat district, where they observed TDS values between 100 mg/l and 280 mg/l. TDS is an important indicator of water taste and salinity (Sinha *et al*., 2021).

Hardness refers to the mineral content of water, primarily the carbonates of calcium and magnesium, which are responsible for water hardness. Mountain waters are generally harder

Table 4: Correlation analysis between various parameters

Correlation analysis										
	pH	***Temp***	***DO***	***TH***	***Ca***	***Mg***	***TDS***	***Cr***	***Pb***	***Zn***
pH	1									
Temp	0.7647	1								
DO	-0.8998	-0.7975	1							
TH	0.96774	0.7935	-0.9677	1						
Ca	0.9716	0.8085	-0.9628	0.9993	1					
Mg	0.9339	0.7421	-0.9817	0.9905	0.9853	1				
TDS	0.9752	0.8447	-0.9394	0.9905	0.9946	0.9631	1			
Cr	0.4842	0.8817	-0.4610	0.5077	0.5323	0.4258	0.6025	1		
Pb	0.4842	0.8817	-0.4610	0.5077	0.5323	0.4258	0.6025	1	1	
Zn	0.5059	0.7194	-0.7599	0.5927	0.5886	0.6228	0.5639	0.4008	0.4008	1

than plains. In this study, water hardness in the Lohawati River ranged from 109.9 mg/l to 246.8 mg/l, with the highest hardness recorded at Site 5.

Calcium and Magnesium are essential nutrients for the human body, and their concentration in water is generally dependent on the water source. For example, water from mountainous regions, which are natural sources of minerals, tends to have higher levels of calcium and magnesium. In this study, calcium concentrations ranged from 21.2 mg/l to 64.9 mg/l, while magnesium concentrations ranged from 11.1 mg/l to 39.9 mg/l. The acceptable values for calcium and magnesium are 75 mg/l and 30 mg/l, respectively. Kiran *et al*. (2022) found that the water hardness in the Champawat district ranged from 104 to 208 mg/l, with calcium and magnesium concentrations ranging from 16.67 mg/l to 37.19 mg/l and 14.3 mg/l to 34.98 mg/l, respectively. Similarly, Seth *et al*. (2016) observed water hardness in the Gola River (Nainital) between 135 mg/l and 570 mg/l, with calcium and magnesium concentrations ranging from 12 mg/l to 36 mg/l and 37 mg/l to 119 mg/l, respectively.

Dissolved Oxygen (DO) is a crucial parameter for assessing the health of an aquatic ecosystem. Decreases in DO can harm biological activity and water organisms (Zhong *et al*., 2021). In this study, DO levels in the Lohawati River ranged from 4.2 mg/l to 7.9 mg/l, with the acceptable range for DO being 6.5 mg/l to 8 mg/l.

Odour and Taste are basic physical parameters that determine water quality. In this study, most of the sampling sites exhibited unacceptable taste and odour, with the exception of Site 1.

Heavy metal pollution is a significant concern for river ecosystems, as elevated levels of heavy metals can adversely affect human health and aquatic life. These metals are toxic, non-degradable, and bioaccumulative, making water contaminated and unsafe for consumption (Myvizh *et al*., 2020). In this study, six heavy

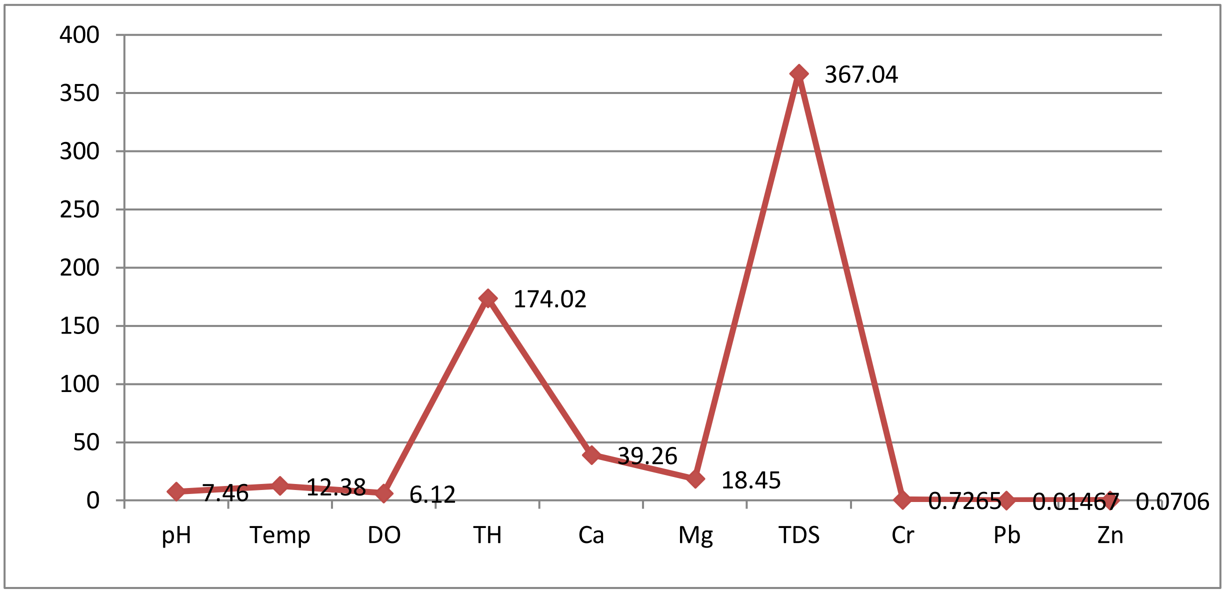

Fig. 2: Annual values of physicochemical parameters.

metals were analyzed. Chromium levels ranged from 0.11 to 0.19 mg/l, which exceeds the acceptable limit of 0.05 mg/l. Similarly, lead concentrations ranged from 0.01 to 0.19 mg/l, surpassing the recommended limit of 0.05 mg/l. Zinc concentrations ranged from 0.025 to 0.097 mg/l, which remains within the acceptable limit of 5.0 mg/l, as set by the Bureau of Indian Standards (BIS). Cadmium and mercury concentrations were found to be below 0.001 mg/l, with permissible limits of 0.005 mg/l for cadmium and 0.002 mg/l for mercury. Arsenic concentrations were also below 0.005 mg/l, with the permissible limit for arsenic being 0.05 mg/l. Therefore, while zinc, cadmium, mercury, and arsenic concentrations are within the acceptable standards, chromium and lead levels exceed the permissible limits in certain samples.

Correlation Analysis:

The correlation analysis indicates that water hardness is strongly correlated with both calcium (Ca) and magnesium (Mg). Dissolved oxygen (DO) shows a negative correlation with temperature, total dissolved solids (TDS), and total hardness (TH). TDS is positively correlated with pH, temperature, and hardness, while calcium is strongly correlated with magnesium and total hardness, as well as positively correlated with TDS. Chromium (Cr) is positively correlated with zinc (Zn) and lead (Pb), while negatively correlated with dissolved oxygen (DO), as shown in Table 4. The average values for all examined parameters across the five sampling locations are presented in Figure 2.

Conclusion

This study reveals that the Lohawati River is not suitable for potable use due to several factors. Many of the sampling points showed dissolved oxygen (DO) levels that are too low to support healthy aquatic ecosystems, and water hardness was found to be excessively high at some locations. The concentration of total dissolved solids (TDS) also exceeded acceptable levels for drinking water, and several other physic-chemical parameters did not meet the required standards for safe water use. Although the Lohawati River's heavy metal levels are not significantly high, its location in the remote Himalayan region, far from industrial activity, makes even small traces of heavy metals a cause for concern. In such an untouched environment, the presence of these metals suggests pollution, pointing to potential contamination sources that should be investigated further.

The primary sources of pollution in the river include human activities such as household waste disposal and sewage discharge. Despite these concerns, the river still holds potential to provide water for a large population. With the implementation of effective, sustainable management practices and increased awareness regarding river conservation, there is a strong possibility for restoring the river's physic-chemical quality.

Conflict of Interest

The authors declare no conflicts of interest.

References

Chandel VS and Ghosh S. (2021) Components of Himalayan river flows in a changing climate. Water Resources Res. 57: e2020WR027589.

IS 3025(1987) Methods of sampling and test (Physical and Chemical) for water and wastewater Part 1. Sampling CHD 32: Environmental Protection and Waste Management.

IS 3025-05 (1983) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 5: Odour (CHD 32: Environment Protection and Waste Management).

IS 3025-08 (1984) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 8: Taste (CHD 32: Environment Protection and Waste Management).

IS 3025-09 (1984) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 9: Temperature (CHD 32: Environment Protection and Waste Management).

IS 3025-11 (1983) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 11: pH value (CHD 32: Environment Protection and Waste Management).

IS 3025-16 (1984) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 16: Filterable residue (Total Dissolved Solids) (CHD 32: Environment Protection and Waste Management).

IS 3025-21 (2009) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 21: Total Hardness (CHD 32: Environment Protection and Waste Management).

IS 3025-37 (1988) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 37: Arsenic (CHD 32: Environment Protection and Waste Management).

IS 3025-38 (1989) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 38: Dissolved Oxygen (CHD 32: Environment Protection and Waste Management).

IS 3025-40 (1991) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 40: Calcium (CHD 32: Environment Protection and Waste Management).

IS 3025-41 (1992) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 41: Cadmium (CHD 32: Environment Protection and Waste Management).

IS 3025-46 (1994) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 46: Magnesium (CHD 32: Environment Protection and Waste Management).

IS 3025-47 (1994) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 47: Lead (CHD 32: Environment Protection and Waste Management).

IS 3025-48 (1994) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 48: Mercury (CHD 32: Environment Protection and Waste Management).

IS 3025-49 (1994) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 49: Zinc (CHD 32: Environment Protection and Waste Management).

IS 3025-52 (2003) Methods of sampling and test (Physical and Chemical) for water and wastewater, Part 52: Chromium (CHD 32: Environment Protection and Waste Management).

Joshi MD, Kumar A and Agarwal N. (2009) Studies on physicochemical parameters to assess the water quality of River Ganga for drinking purpose in Haridwar district. RASAYAN J Chem. 2(1): 195-203.

Kiran P, Pande AP and Pande C. (2022) Physicochemical investigation of some primitive water sources in district Champawat for potability and preservation of historical aesthetics, Uttarakhand India. Holistic Approach Environ Sci. 12: 1-8.

Myvizh P and Aruna Devi P. (2020) Heavy metal contamination in water of the river cauvery – A case study of Erode, Salem, and Namakkal districts, Tamil Nadu. J Himalayan Ecol Sustainable Develop. 15: 190: 202.

Patni K, Punetha G and Pande AP. (2018) Physicochemical analysis of selected springs water samples used for drinking purpose at Pithoragarh City, Uttarakhand, India. Int J Res. 7(7): 653-669.

Prakash A. (2020) Retreating glaciers and water flows in the Himalayas: Implications for governance. ORF Issue Brief No. 400, September 2020, Observer Research Foundation. https://www.orfonline.org/research/retreating-glaciers-and-water-flows-in-the-himalayas-implications-for-governance.

Seth R, Mohan M, Singh P, Singh R, Dobhal R, Singh KP and Gupta S. (2016) Water quality evaluation of Himalayan Rivers of Kumaun region, Uttarakhand, India. Appl Water Sci. 6: 137-147.

Sharma S, Rao SN and Bhadula S. (2014) Seasonal variation in physico-chemical characteristics of Sharda river water within Tanakpur City, Uttarakhand. Int J Plant Anim Environ Sci. 4(4): 301-305.

Singh S, Negi RS and Dhanai R. (2014) A study of physico-chemical parameters of springs around Srinagar Garhwal valley, Uttarakhand. Int J Engineer Develop Res. 2(4): 3885-3887.

Sinha PR, Kumar K and Unial VP. (2021) Groundwater hydrochemistry of Naulas and Dharas (Springs) of Almora Kumaun Himalayas in Uttarakhand their evaluation using graphical tools. Ecol Environ Conserv. 27(2): 325-333.

Son CT, Giang NTH, Thao TP, Nui NH, Lam NT and Cong VH. (2020) Assessment of Cau River Water quality using a combination of water quality and pollution indices. J Water Supply Res Technol Aqua 69(2): 160-172.

Zhong M, Liu S, Li K, Jiang H, Jiang T and Tang G. (2021) Modeling spatial patterns of dissolved oxygen and the impact mechanisms in a Cascade River. Front Environ Sci. 9: 781646.