



An Assessment of Terrestrial Plant Diversity Surrounding the Chimnabai Lake in Kheralu Taluka, Mehsana District, Gujarat

Shivani G. Patel¹ and P. K. Patel²

¹Research Scholar, Department of Botany, S.P.T. Arts & Science College, Godhra, Gujarat, India

²Department of Botany, S.P.T. Arts & Science College, Godhra, Gujarat, India

Abstract

Chimnabai Lake is situated near Kadarapur village in Kheralu Taluka of Mehsana district. The purpose of this study was to determine the diversity and status of terrestrial floral species in the surrounding area of the lake. 70 species of terrestrial plants belonging to 33 families were identified. The Asteraceae family dominated the 33 families, with Poaceae, Mimosaceae, Moraceae, Amaranthaceae, and so forth following. Among 26 tree species, Mimosaceae was the most dominant family followed by Fabaceae, Moraceae and Myrtaceae and so on. *Senegalia senegal* of the Fabaceae family has the highest IVI (42.08) and least of *Ficus racemosa* of Moraceae family (2.42). The outcome displays the species richness and floristic diversity around the lake area. Therefore, in order to successfully preserve this lake's biological and social diversity, more conservation initiatives must be implemented in the future.

Keywords: Chimnabai Lake, Gujarat, Kheralu, Mehsana, Terrestrial Plants.

Introduction

Freshwater resources are an integral aspect of the ecosystem. In addition to regulating ecological features like soil protection, rainfall patterns, and climate, they also play a crucial part in supporting an ecosystem that supports all kinds of life and the daily activities of both humans and animals (Cheng, *et al.*, 2014; Pant, *et al.*, 2018; Qaisar, *et al.*, 2018). Additionally, freshwater resources sustain biodiversity preservation, carbon sequestration, nitrogen cycling, groundwater recharge, fishing, irrigation, hydropower, recreation, medicinal species, and non-timber forest products (NTFPs) (Naiman and Turner, 2000; Atkinson, *et al.*, 2017). According to Maitland (2013), lakes are bodies of standing water that are located in basins that are not connected to the sea. Lakes are an essential component of the natural environment because of their potential to define the landscape and its biological functioning (Pant, *et al.*, 2017). Lakes have frequently been referred to as the hotspot of biodiversity since they are the

ecotones where a greater number of species overturn within a short area (England, *et al.*, 2008). The structural and functional value of lakes play a significant role in subsistence, culture, commerce, recreation, water storage, drought mitigation, and water purification. As such, lakes are an essential component of human existence, supporting enormous species of flora and fauna (Schallenberg, *et al.*, 2013). Rivers, lakes, ponds, marshes, reservoirs, streams, swamps, and agricultural fields are among the various types of water bodies found in Gujarat. Gujarat has the largest wetland area in India, according to SAC, with an estimated total of 3474950 ha, of which 92.3% and 7.7% are covered by interior and coastal wetlands make up about 17.56% of the state's total land area (Barot, 2015). Nearly every kind of inland and coastal wetland may be found in Gujarat, including mangroves, coral reefs, freshwater lakes, village ponds, and mud flats.

*Corresponding Author:

Shivani Patel;

DOI: <http://dx.doi.org/10.21746/aps.2024.13.8.2>

Page | 6472

Materials and Method

Study Area

The study was conducted between the periods of June-2023 to March-2024. Chimnabai Lake is located between 23.93°N and 72.64°E near Kadarapur village in Kheralu Taluka, Mehsana district in Gujarat. The lake was created by Baroda state ruler Sayajirao Gaekwad III in memory of his deceased wife Chimnabai I. The construction was started in 1898 and completed in 1905. The lake is spread over an area of 1600 acres. It has a water storage capacity of 632 million cubic feet. The lake provides irrigation to 900 hectares (2200 acres) land of ten surrounding villages.

Chimnabai Lake have the adaptive habitat for wader birds as well as terrestrial birds. Senma and Acharya reported Sarus crane in Chimnabai Lake. Chimnabai Lake has supported one vulnerable bird species (Sarus crane) and because of very few anthropogenic activities, this site plays a very important role in the breeding ground for many bird species (Parihar, *et al.*, 2020).

Data Collection

In order to gather data, the lake was surveyed and sampled using a foot trail. The number of

sampling quadrants was decided using the species area curve method (Palmer, 2007). A total of 22 sample quadrates, each measuring 20×20 meters for trees, were collected. In each quadrant, nested plots measuring 5×5 meters were planted for shrubs and 1×1 meters for herbs (Dangol, 2002). The quadrates were arranged so that, the plant species in each quadrat should show variation in vegetation, density, dominance and abundance (Bhadra and Pattanayak, 2016). Due to inaccessibility of the water body, the aquatic flower species were not investigated. Experts and the local population assisted in the on-site observation and identification of the terrestrial plant species. The species that could not be identified on the spot were gathered, tagged, dried, and brought to the lab for additional identification.

Data Analysis

The collected data were tabulated and subjected to quantitative analysis using MS Excel. In this study area, the IVI of each plant species was determined by computing its frequency, relative frequency, dominance, relative dominance, density, and relative density. Then, using the given formula, the IVI of only tree species was determined.

$$\text{Frequency (\%)} = \frac{\text{Number of quadrates of species occurrence} \times 100\%}{\text{Total number of quadrates studied}}$$

$$\text{Relative Frequency} = \frac{\text{Frequency of a species} \times 100}{\text{Sum of frequency of all species}}$$

$$\text{Density} = \frac{\text{Total number of individuals of a species present in all quadrates}}{\text{Total number of quadrates studied}}$$

$$\text{Relative density} = \frac{\text{Density of a species} \times 100}{\text{Sum of the density of all species}}$$

Dominance = Sum of the basal area occupied by stems of all individuals of a species in all studied quadrates

$$\text{Where, basal area} = \frac{(\text{GBH})^2}{4\pi}$$

$$\text{Relative dominance} = \frac{\text{Total basal area of a species} \times 100}{\text{Sum of total basal areas of all species}}$$

Importance value Index (IVI) = Relative Density + Relative Frequency + Relative Dominance

Results and Discussion

Composition of Plant Species

In the surrounding area of Chimnabai Lake, 70 terrestrial plant species belonging to 33 distinct families were identified. There are 12

shrub species, 6 climber species, 26 tree species and 29 herb species. With 8 species, Asteraceae is the most dominant family among the 33 plant families. Poaceae with 7 species, Lamiaceae with 4 species, Moraceae,

Malvaceae, Amaranthaceae, Apocynaceae, and the Fabaceae family with 3 species each, and 28 families with a single plant species were identified in the study.

The 26 tree species were observed during the study from 16 different families. Mimosaceae with 5 species was the most common family among tree species which was followed by Fabaceae, Moraceae and Myrtaceae with 4, 3, and 2 species respectively and 12 families with only one tree species. During the study, a total of 29 species of herbs from 12 families were discovered, with Poaceae and Asteraceae being the most dominant families. Similarly, a total of 9 species of shrub belonging to 8 distinct families were discovered. In addition to these, records of 6

climber species from 5 different families were made.

The 4 major tree species that were found near the Chimnabai Lake are *Senegalia Senegal*, *Acacia niotica*, *Vachellia tortilis* and *Azadirachta indica*. The predominant shrub species found around the lake are *Cassia auriculata*, *Abutilon indicum* and *Parthenium hysterophorus*, but the main herb species found there are *Cynodon dactylon*, *Cenchrus biflorus*.

The Chimnabai Lake contained a total of 29 species of herbs, with 9 shrubs and 6 climbers following as the other prominent plant species. The checklist of terrestrial plant species found in Chimnabai Lake is shown in Table 1.

Table 1: checklist of other Plant species found in the study area (Herbs, Shrubs, and Climbers)

No.	Scientific Name	Local Name	Family	Habit
1	<i>Abutilon indicum</i> (L.) Sw.	Khapat (Kanski)	Malvaceae	Shrub
2	<i>Acalypha indica</i> L.	Vichikato, Dadari	Euphorbiaceae	Herb
3	<i>Acanthospermum hispidum</i> DC.	Gadariyu	Asteraceae	Herb
4	<i>Achyranthes aspera</i> L.	Aghedi	Amaranthaceae	Shrub
5	<i>Amaranthus spinosus</i> L.	Kantalo-dabho	Amaranthaceae	Herb
6	<i>Amaranthus viridis</i> L.		Amaranthaceae	Herb
7	<i>Argemone mexicana</i> L.	Darudi	Papaveraceae	Herb
8	<i>Boerhavia diffusa</i> L.	Satodi	Nyctaginaceae	Herb
9	<i>Boerhavia erecta</i> L.	Satodi	Nyctaginaceae	Herb
10	<i>Bothriochloa pertusa</i> (L.) A. Camus	Zizvo	Poaceae	Herb
11	<i>Cadaba fruticosa</i> (L.) Druce	Telio hemkand	Capparaceae	Herb
12	<i>Calotropis procera</i> (ait.) R. Br.	Nano-ankado	Asclepiadaceae	Shrub
13	<i>Capparis decidua</i> (Forssk.) Edgew.	Kerado	Capparaceae	Shrub
14	<i>Capparis sepiaria</i> L.	Kanther	Capparaceae	Shrub
15	<i>Cassia auriculata</i> L.	Aval	Caesalpiniaceae	Shrub
16	<i>Cenchrus biflorus</i> Auct.	Dhaman	Poaceae	Herb
17	<i>Cenchrus setigarus</i> Vahl,	Dhaman	Poaceae	Herb
18	<i>Chloris barbata</i> Sw.	Mindadiyu	Poaceae	Herb
19	<i>Cocculus hirsutus</i> (L.) W.Theob.	Vevdi	Menispermaceae	Climber
20	<i>Convolvulus arvensis</i> L.	Khetrau fudardi	Convolvulaceae	Herb
21	<i>Cuscuta reflexa</i> Roxb.	Amarvel	Convolvulaceae	Climber
22	<i>Cyanthillium cinereum</i> (L.) H.Rob.	Sahdevi	Asteraceae	Herb
23	<i>Cynodon dactylon</i> (L.) Pers.	Dharo	poaceae	Herb
24	<i>Dactyloctenium aegyptium</i> (L.) Willd.	Tarakiyu	Poaceae	Herb
25	<i>Datura innoxia</i> Mill.	Kalo dhaturo	Solanaceae	Shrub
26	<i>Euphorbia hirta</i> L.	Dudheli	Euphorbiaceae	Herb
27	<i>Evolvulus alsinoides</i> L.	Zini Fudardi	Convolvulaceae	Herb
28	<i>Launaea procumbens</i> (Roxb.)	Moti Bhonpatri	Asteraceae	Herb
29	<i>Mucuna pruriens</i> (L.) DC.	Kaucha, Kuvech	Fabaceae	Climber

30	<i>Ocimum gratissimum</i> L.	Kaji	Lamiaceae	Herb
31	<i>Opuntia elatior</i> Mill.	Fafdo thor	Cactaceae	Shrub
32	<i>Parthenium hysterophorus</i> L.	Congress grass	Asteraceae	Shrub
33	<i>Pedaliium murex</i> L.	Motu Gokhru	Pedaliaceae	Herb
34	<i>Pergularia daemia</i> (Forsk.) Chiov.	Chamar Dudheli	Asclepiadaceae	Climber
35	<i>Phyllanthus niruri</i> L.	Bhoyamli	Euphorbiaceae	Herb
36	<i>Saccharum spontaneum</i> L.	Dabh, Kans	Poaceae	Herb
37	<i>Sida cordifolia</i> L.	Mahabala	Malvaceae	Herb
38	<i>Sonchus asper</i> (L.) Hill.	Sonaki	Asteraceae	Herb
39	<i>Spargula arvensis</i> L.		Caryophyllaceae	Herb
40	<i>Tinospora cordifolia</i> (Willd.) Miers.	Galo	Menispermaceae	Climber
41	<i>Trichosanthes cucumerina</i> L.	Jangli Padvel	Cucurbitaceae	Climber
42	<i>Tridax procumbens</i> L.	Pardeshi Bhangro	Asteraceae	Herb
43	<i>Vernonia cinerea</i> (L.) Less.	Sahdevi	Asteraceae	Herb
44	<i>Xanthium strumarium</i> L.	Gadariyu	Asteraceae	Herb

Importance Value Index (IVI)

The largest percentage composition is made up of trees (37%), which are followed in order of importance by herbs (41%), shrubs (13%) and climbers (9%) species.

Table 2: Presence of terrestrial plant species

Plant Species	Percentage composition
Trees	37%
Herbs	41%
Shrubs	13%
Climbers	9%

Among the species found around the lake, *Senegalia senegal* of the Fabaceae family has the highest IVI (42.08). *Acacia nilotica* (36.10) has the second highest IVI followed by *Vachellia tortilis* (25.80) and *Azadirachta indica* (21.77). While *Ficus racemosa* of the family Moraceae has the lowest IVI (2.42) among tree species. Among the 16 families of tree species, Mimosaceae has the highest IVI followed by Fabaceae and Meliaceae respectively. The IVI of tree species found in Chimnabai Lake is shown in Table 3.

Mimosaceae family has the highest number of tree species followed by Fabaceae, Moraceae and Myrtaceae and rest of the families have one tree species.

Table 4: Family-wise diversity in tree species

Family	Number of Tree species
Mimosaceae	5
Fabaceae	4
Moraceae	3
Myrtaceae	2
Anacardiaceae	1
Annonaceae	1
Boraginaceae	1
Caesalpinaceae	1
Meliaceae	1
Moringaceae	1
Rhamnaceae	1
Rutaceae	1
Salvadoraceae	1
Salicaceae	1
Simaroubaceae	1
Ulmaceae	1

Table 3: Ecological attributes of the tree species from the study area

No.	Scientific Name	Local Name	Family	F	RF	D	RD	BA	RDo	IVI
1	<i>Azadirachta indica</i> A. Juss.	Limdo	Meliaceae	50	6.83	0.59	5.70	32363.09	9.23	21.77
2	<i>Acacia auriculiformis</i> Benth.		Mimosaceae	31.82	4.35	0.36	3.51	8462.76	2.41	10.27
3	<i>Acacia catechu</i> (L.) Willd.	Khair	Mimosaceae	22.73	3.11	0.50	4.83	20154.72	5.75	13.68
4	<i>Acacia nilotica</i> L.	Baval	Mimosaceae	86.36	11.80	1.32	12.72	40561.39	11.57	36.10
5	<i>Aegle marmelos</i> L.	Bili	Rutaceae	9.09	1.24	0.09	0.88	1837.27	0.52	2.64
6	<i>Ailanthus excelsa</i> L.	Arduso	Simaroubaceae	13.64	1.86	0.23	2.19	7294.82	2.08	6.14
7	<i>Cordia sinensis</i> Lam.	Nani Gundi	Boraginaceae	22.73	3.11	0.36	3.51	9410.26	2.68	9.30
8	<i>Eucalyptus globulus</i> Labill.	Nilgiri	Myrtaceae	18.18	2.48	0.32	3.07	7608.06	2.17	7.73
9	<i>Ficus benghalensis</i> L.	Vad	Moraceae	18.18	2.48	0.27	2.63	12889.75	3.68	8.79
10	<i>Ficus racemosa</i> L.	Umaro	Moraceae	4.55	0.62	0.09	0.88	3237.66	0.92	2.42
11	<i>Ficus religiosa</i> L.	Pilpo	Moraceae	13.64	1.86	0.18	1.76	7604.66	2.17	5.79
12	<i>Flacourtia indica</i> (Burm.f) Merr.	Garigular Lodri	Salicaceae	9.09	1.24	0.14	1.32	2660.05	0.76	3.32
13	<i>Holoptelea integrifolia</i> (Roxb.) Planch.	Kanjo	Ulmaceae	18.18	2.48	0.18	1.76	8429.65	2.40	6.64
14	<i>Leucaena leucocephala</i> (Lam.) de Wit	Pardeshi Baval	Mimosaceae	45.45	6.21	0.55	5.27	14929.23	4.26	15.74

15	<i>Mangifera indica</i> L.	Aambo	Anacardiaceae	9.09	1.24	0.09	0.88	4329.51	1.24	3.35
16	<i>Miliusa tomentosa</i> (Roxb.)J.Sinclair	Umph	Annonaceae	18.18	2.48	0.23	2.19	9199.21	2.62	7.30
17	<i>Moringa oleifera</i> Lam.	Saragvo	Moringaceae	27.27	3.73	0.36	3.51	6194.97	1.77	9.00
18	<i>Pithecellobium dulce</i> (Roxb.) Bth.	Goras Aml	Fabaceae	9.09	1.24	0.09	0.88	3054.90	0.87	2.99
19	<i>Prosopis cineraria</i> (L.) Druce	Khijado, Shami	Fabaceae	45.45	6.21	0.55	5.27	20996.90	5.99	17.47
20	<i>Salvadora persica</i> L.	Piludi	Salvadoraceae	22.73	3.11	0.32	3.07	18177.06	5.19	11.36
21	<i>Senegalia senegal</i> (L.) Britton	Goradiyo Baval	Fabaceae	81.82	11.18	1.55	14.92	56014.41	15.98	42.08
22	<i>Senna siamea</i> (Lam.) H.S.Irwin & Barneby	Kasheed	Caesalpiniaaceae	27.27	3.73	0.32	3.07	4784.45	1.37	8.16
23	<i>Syzygium cumini</i> (L.) Skeels	Jambu	Myrtaceae	13.64	1.86	0.14	1.32	5985.11	1.71	4.89
24	<i>Tamarindus indica</i> L.	Aamli	Fabaceae	13.64	1.86	0.18	1.76	13029.32	3.72	7.34
25	<i>Vachellia tortilis</i> (Forssk.) Galasso & Banfi	Israeli Baval	Mimosaceae	68.18	9.32	0.95	9.21	25473.83	7.27	25.80
26	<i>Ziziphus mauritiana</i> Lam.	Khati bor	Rhamnaceae	31.82	4.35	0.41	3.95	5822.32	1.66	9.96

F=Frequency, RF= Relative Frequency, D=Density, RD=Relative Density, BA= Basal Area, RDo= Relative Dominance, IVI=Importance Value Index

Conclusion

The rich species diversity is a sign of the distinctiveness and conservation potential of the study area. The most significant ecological characteristics of any ecosystems are their phytosociological parameters and diversity indices, which exhibit fluctuations in response to both anthropogenic environmental factors. The present study provides a wealth of diversity-related information that will be an invaluable resource for evaluating the diversity. The current study provides a checklist and information on the variety of plant species trees, shrubs, herbs and climbers that have been identified in the area of the Chimnabai Lake. There are 70 terrestrial plant species altogether, belonging to 33 families; of these, 26 are trees (37%), 29 are herbs (41%), 9 are shrubs (13%), and 6 are climber (9%) species. The Asteraceae family, which has 8 species, is the most dominant family near the lake. According to the IVI calculation, *Senegalia senegal* of the Fabaceae family and *Acacia nilotica* of the Mimosaceae family have the highest IVIs 42.08 and 36.10 respectively, among tree species. According to this study, Chimnabai Lake is home to a wide variety of plant species and has a high level of plant diversity. The results of this study on various herb, shrub, and tree species can undoubtedly be incorporated into the management, assessment and conservation plan for biodiversity.

References

- Atkinson, C. L., Krista, A. C., Amanda, T. R. and Michael, J. V. "Consumer-driven nutrient dynamics in freshwater ecosystems: From individuals to ecosystems." *Biological Reviews*, 92.4 (2017): 2003-2023.
- Barot, C. J. "Floristic and ecological studies of selected wetlands in Mehsana district, North Gujarat." *Ph. D. Thesis, Hemchandracharya North Gujarat University, Patan* (2015).
- Bhadra, A. K., & Pattanayak, S. K. "Abundance or Dominance: Which is more justified to calculate Importance Value Index (IVI) of plant species." *Asian Journal of Science and Technology*, 7.9 (2016): 3577-3601.
- Cheng, G., Xin, L., Wenzhi, Z., Zhongmin, X., Qi, F., Shengchun, X. and Honglang, X. "Integrated study of the water-ecosystem-economy in the Heihe River Basin." *National Science Review*, 1.3 (2014): 413-428.
- Cooke, T. "Flora of the Presidency of Bombay." *I, II & III. London: BSI, Calcutta, reprinted 1958, I-II (1901-1908).*
- Dabgar, P. J. "A contribution to the wetland flora of Satlasana talukas, North Gujarat." *Advances in Biological Sciences*, 5.1 (2006): 79-82.
- Dangol, D. R. "Economic uses of forest plant resources in western Chitwan, Nepal." *Banko Janakari*, 12.2 (2002): 56-64.
- England, J., Kevin, S. S. and Matthew, G. C. "Monitoring, river restoration and the Water Framework Directive." *Water and Environment Journal*, 22.4 (2008): 227-234.
- Maitland, P. S. "Biology of fresh waters." *Springer Science and Business Media* (2013).
- Naiman, R. J., & Turner, M. G. "A future perspective on North America's freshwater ecosystems." *Ecological Applications*, 10.4 (2000): 958-970.
- Neupane, A., Sachin, T. and Pooja, D. "Terrestrial Plants around Historical Kawasoti Lake, Nawalpur District, Nepal." *Indonesian Journal of Social and Environment Issues*, 3.2 (2022): 101-111.
- Pant, R. R., Fan, Z., Faizan, U.R., Guanxing, W., Ming, Y., Chen, Z. and Handuo, T. "Spatiotemporal variations of hydro geochemistry and its controlling factors in the Gandaki River Basin, Central Himalaya Nepal." *Science of the Total Environment*, 622 (2018): 770-782.
- Palmer, M. W. "Species-area curves and the geometry of nature." *In Scaling biodiversity*, (2007):15-31.
- Pandey, N., & Ghimire, S. K. "Floristic Diversity in a Community Managed Forest of Kanchanpur District, Western Nepal." *Journal of Plant Resource*, 18.1 (2020): 124-134.
- Parihar, A., Parin, D., Yogesh, K., Dolatsang, V., Dharmik, P., Vishal, P. And Hiteshkumar, P. "Comparative Study on Three Different Avifaunal Community of Mehsana, North Gujarat." *Asian Journal of Advances in Research*, 3.1 (2020): 21-31.

16. Senma, R. C., & Acharya, C. A. "Sarus Crane in Chimnabai Sarovar, North Gujarat." *Zoo's Print*, 25.6 (2010): 33.
17. Qaisar, F. U. R., Faizan, U., Fan, Z., Ramesh, R.P., Guanxing, W., Sardar, K. and Chen, Z. "Spatial variation, source identification, and quality assessment of surface water geochemical composition in the Indus River Basin, Pakistan." *Environmental Science and Pollution Research*, 25.13 (2018): 12749-12763.
18. Saxton, W. T., & Sedgwick, L. G. "Plants of Northern Gujarat." *Rec. Bot. Surv. India*, 6 (1918): 207-323.
19. Schallenberg, M., Winton, M.D., Verburg, P., Kelly, D.J., Hamill, K.D., & Hamilton, D.P. "Ecosystem services of lakes." *Ecosystem Services in New Zealand: Conditions and Trends. Manaaki Whenua Press, Lincoln*, 2013: 203-225.
20. Shah, G.L. "Flora of Gujarat State." Volume I & II. *Sardar Patel University Vallabh Vidhyanagar, Gujarat, India*, (1978): 1074.
21. Yogi, D.V. "A contribution to the Flora of North Gujarat." *PhD thesis submitted to Sardar Patel University, Vallabh Vidyanagar, Gujarat*, (1970).

Source of support: Nil;

Conflict of interest: The authors declare no conflict of interests.

Cite this article as:

Patel, S. G. and Patel, P. K. "An Assessment of Terrestrial Plant Diversity Surrounding the Chimnabai Lake in Kheralu Taluka, Mehsana District, Gujarat." *Annals of Plant Sciences*.13.08 (2024): pp. 6472-6480.