Sponsored Thesis Project Competition on

"RE-IMAGINING URBAN RIVERS"

Season- 3

Project Title : Rejuvenation of Dal Lake and Enhancing the life of its Dwellers.

Creator : Bhumika Batra

Acknowledgment

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Summary

Dal Lake, situated in Srinagar, is not only renowned for its natural beauty but also serves as the main source of livelihood for over 50,000 individuals known as the Dal Dwellers. These dwellers reside in floating villages called 'Rah' or 'Raz, which have deep cultural and historical significance, being an integral part of the lake's ecosystem. The dal Dwellers engage in various activities such as fishing, agriculture, and ferrying tourists on shikaras to sustain their lives.

Beyond the Magnificent aesthetics, life within the lake is a mourning for lost glory, decaying heritage, excessive pollution, and iniquitous abuses hurled to denigrate and criticize the lake's inhabitants. There's grief as well as agony to the point that it's causing a community-wide existential crisis. Not only is the community vanishing, but it is also seen how in the last few years, due to the sudden growth in population it has led to deterioration of the lake. Along with that the Dal dwellers, who have been living on the banks of Dal Lake in Srinagar for generations, are now being forcefully evicted by the state in the name of conservation of the lake.

The focus of this study is on the architectural component of a floating community and its sustainability. The thesis not only demonstrates the importance of preserving and developing traditional architectural values, but it also demonstrates the flaws of this architecture that need to be addressed in the design of future floating communities. The goal of the thesis is to understand the current situation of villages on this lake and then further propose ideas that result to revitalize and promote floating communities as a unique cultural heritage and tourism attraction while also considering the lives of the people living there.

AIM

To study, revitalize, and promote floating communities as a unique cultural heritage and tourism attraction and propose solutions for the conservation of the lake.

OBJECTIVES

- Study of Dal Lake and floating hamlets in the lake
- Documentation of one floating hamlet, its built, social, physical and heritage mapping
- To analysis the current threats and impacts on the village
- To propose a solution for ecotourism and community enrichment.

ABOUT THE LAKE

LOCATION

Dal Lake is a scenic lake located near Tota Rani village in Srinagar, which is known as the summer capital of the Indian state of Jammu and Kashmir. Situated at a height of 1,775 meters above sea level, the lake has a length of 6.4 kilometers and a width of 4 kilometers, with a total area of approximately 10 square miles. The wetland is divided into four basins, namely Gagribal, Lokut Dal, Bod Dal, and Nagin, with Nagin also being considered an independent lake. There are two islands situated in the middle of Lokut-dal and Bod-dal, known as Rup Lank (or Char Chinari) and Sona Lank, respectively. The lake's beauty is enhanced by its surrounding snow-capped mountains, lush greenery, and floating gardens. Overall, Dal Lake is a popular tourist destination that attracts visitors from all around the world to its serene and picturesque surroundings.

PHYSICAL FEATURES

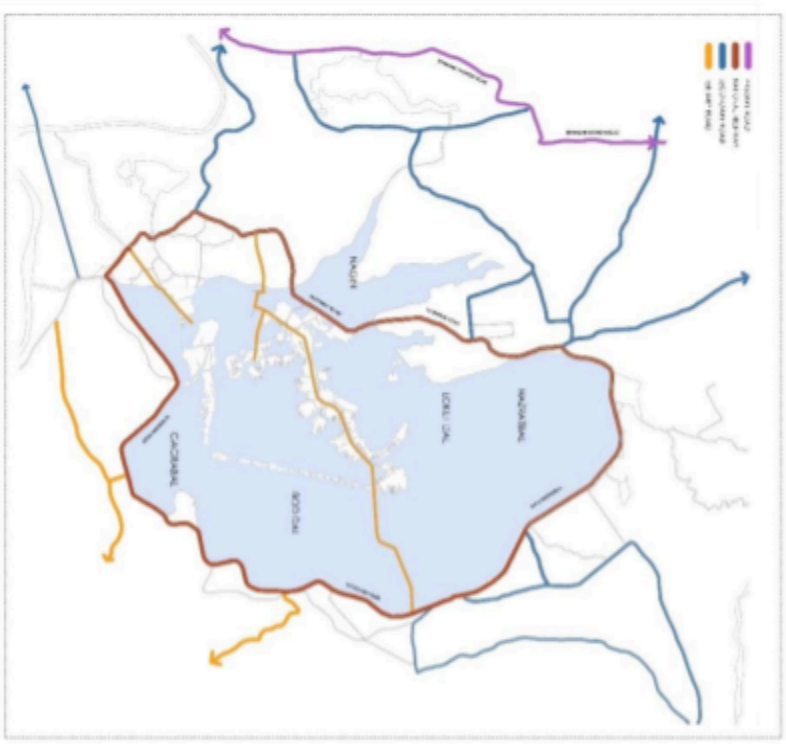
Dal Lake is a lake that experiences a wide range of temperatures throughout the year. The surface temperature can vary from 3°C (37°F) to 26°C (79°F), with the lowest temperature recorded in January and the highest in June. During the winter, the temperature can drop below 11°C (12°F), leading to the lake freezing over. Despite these variations, Dal Lake is considered a warm, monomictic (mixed type) lake, which means that it mixes completely at least once a year. The pH value on the surface ranges from 7.2 to 8.8 within a year, indicating that the lake is slightly alkaline.(Wani & Qadir, 2017) The dissolved oxygen value on the surface has a range of 1.4 to 12.3 within a year, suggesting that the lake supports a diverse range of aquatic life. (Bhat & Khan, 2019)Overall, Dal Lake's temperature and water quality make it a unique and fascinating ecosystem. The water quality of Dal Lake is an essential aspect of its ecosystem. The maximum nitrogen content at the surface was found to be 1315, while at the bottom, it was 22. This indicates that nitrogen levels are significantly higher at the surface, potentially due to the presence of floating gardens that use nitrogen-based fertilizers. Monitoring nitrogen levels is crucial as excessive levels can cause eutrophication, leading to the growth of harmful algae and aquatic plant species. Therefore, understanding the nitrogen cycle in Dal Lake is essential for maintaining the ecosystem's health. Additionally, monitoring pH and dissolved oxygen levels is important for identifying any changes that may occur in the lake's water quality. Regular water quality monitoring is necessary to ensure that Dal Lake remains a healthy and thriving ecosystem for years to come.

FAUNA AND FLORA

The Dal Lake is a thriving ecosystem that supports a diverse range of flora and fauna. Many Mughal gardens and orchards surround the lake, enhancing its beauty and attracting visitors from

all over the world. The lake is home to thousands of Lotus flowers, water lilies, and water chestnut trees, as well as willow, poplar, and chinar woods along its borders. Moreover, the catchment area of the lake is home to a variety of vegetation, including Rose, Pinus Gerardiana, Melia, Ephedra, Celtis, Daphne, Pinus roxburghii, Cupressus, and Ailanthus, contributing to the lake's ecosystem. In addition to the diverse flora, the Dal Lake is also home to a variety of zooplankton, benthos, and fish species. Zooplankton species found in the lake include Keratella cochlearis, K. serrulata, Polyactis vulgaris, Brachionus plicatilis, Monostyla bulla, and Alona cochlearis. (Bhat & Khan, 2019)The lake's fish population is dominated by Cyprinus, a species introduced in the early 1960s, while the native Schizothorax species is declining. The lake's fish population is an essential part of its ecosystem, providing a source of food for both humans and wildlife. Overall, the Dal Lake's diverse flora and fauna make it a unique and fascinating ecosystem that deserves protection and conservation efforts.

ROAD CONNECTIVITY



CONTEXT AND LANDMARKS

Figure 1 : Map of Context and Landmarks

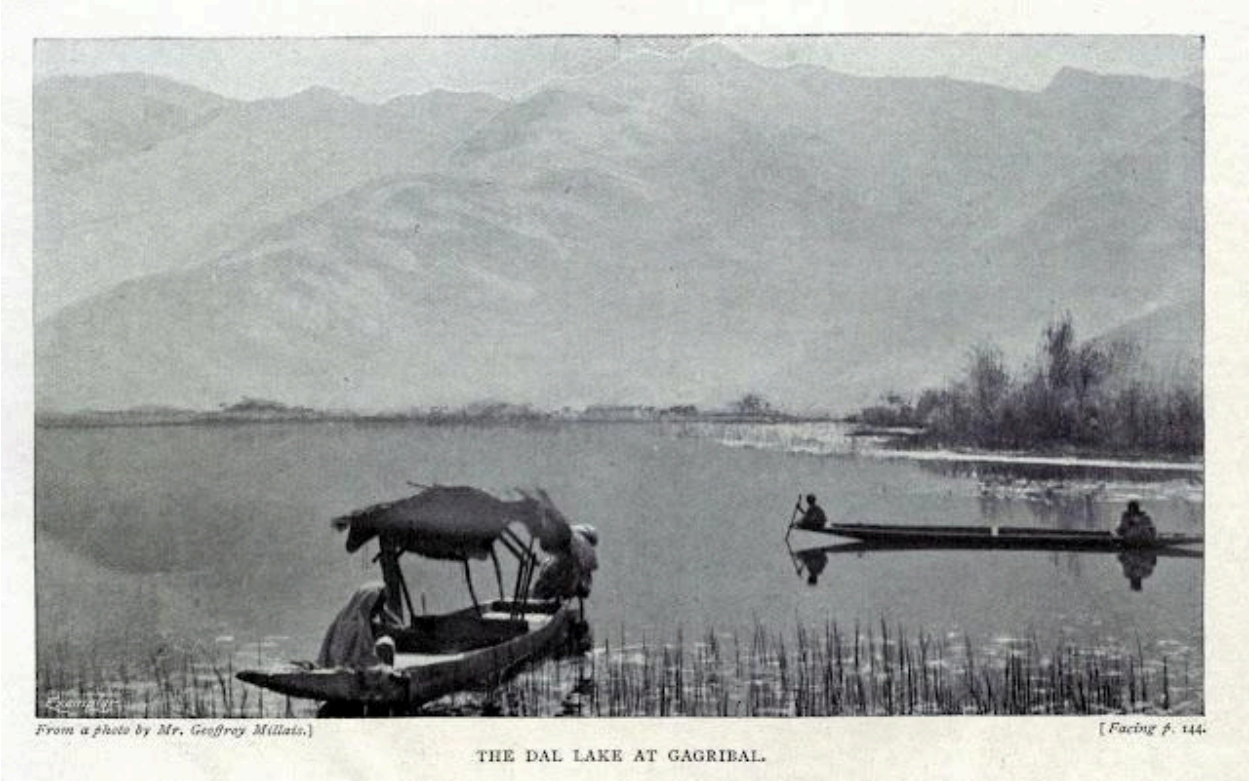
LITERATURE STUDY

ORIGIN OF DAL LAKE

The origin of Dal Lake and the area around it is closely tied to the geological and natural processes that shaped the Kashmir Valley. The formation of Dal Lake can be attributed to a combination of glacial and tectonic activities that occurred over millions of years.

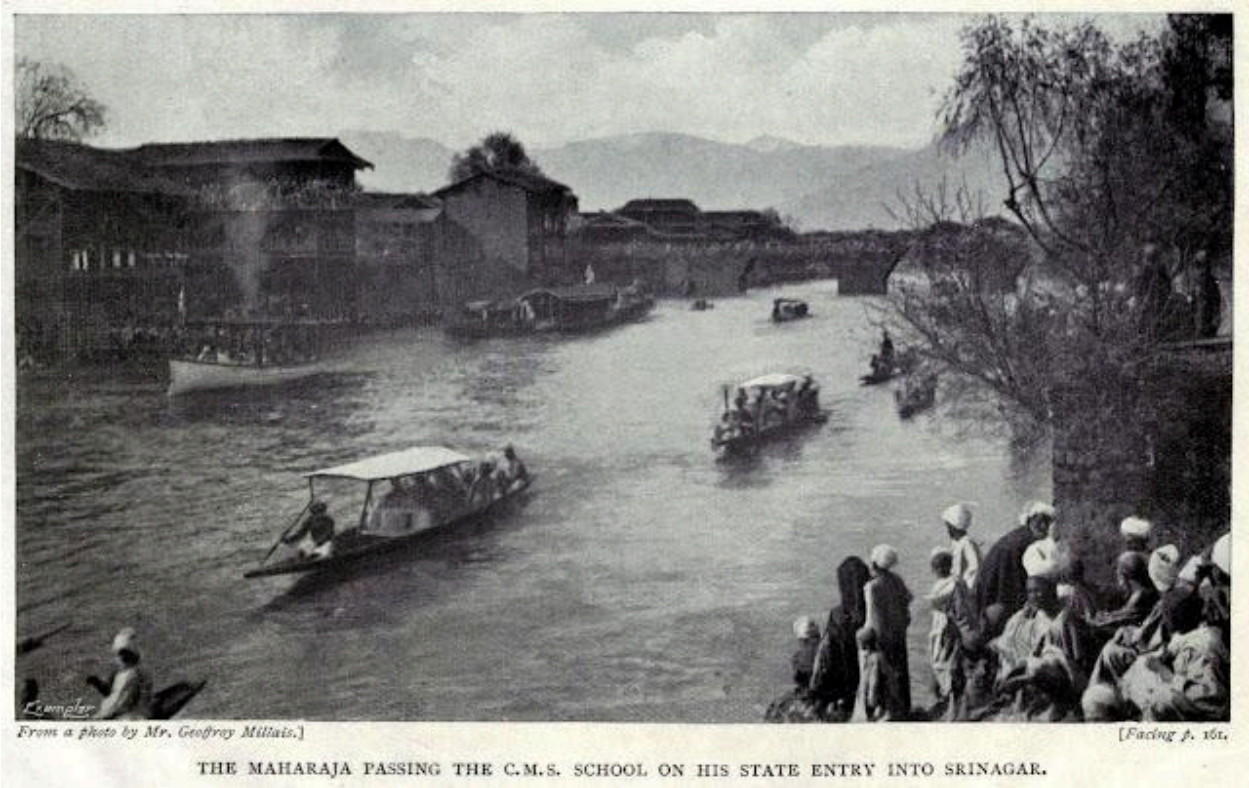
During the Pleistocene epoch, massive glaciers covered the region, shaping the landscape and carving out the valley. As the glaciers receded, they are left behind deep depressions that eventually filled with water, giving rise to the lakes in the Kashmir Valley, including Dal Lake. The lake is primarily fed by several small mountain streams and springs, which bring fresh water from the surrounding Himalayan Mountains.(Fazal & Amin, 2013) It is situated in a basin surrounded by the majestic Zabarwan Range, which adds to the scenic beauty of the area.

Over time, the area around Dal Lake has been shaped by human habitation and development. The lake has been a significant center of civilization and culture for centuries. Historical records suggest that the area around Dal Lake has been inhabited since ancient times, with evidence of human settlements dating back thousands of years. The region around Dal Lake has witnessed the rise and fall of several empires and dynasties, including the Mauryas, Kushans, Mughals, and later the Sikh and Dogra rulers. (Fazal & Amin, 2013)Each dynasty has left its mark on the architectural and cultural landscape of the area.



From a photo by Mr. Geoffrey Millais.] [*Facing p. 144.*

THE DAL LAKE AT GAGRIBAL.



From a photo by Mr. Geoffroy Millais.] *[Facing p. 161.*

THE MAHARAJA PASSING THE C.M.S. SCHOOL ON HIS STATE ENTRY INTO SRINAGAR.

Figure 3 : Picture of The Maharaja of Dogra Region entering Srinagar by Mr Geoffroy Millais

The Dal Lake in Kashmir has a rich history of development, beginning with King Sikander of the Shahmiri dynasty who constructed the first bundh across the lake in the 14th century. Later, Saif Khan, Governor of Kashmir during the Mughal era, constructed another bundh, giving rise to a third basin. Zain-ul-Abidin, another monarch of the Shahmiri dynasty, constructed an island, Sona Lank, as a tourist attraction. His grandson, Hasan Shah, constructed the famous Rupa Lank island. (*Mughal Architecture of Kashmir: An Overview Sajad Ahmad Darzi*, n.d.)

The Mughal emperors also contributed to the lake's development by constructing gardens along the eastern shores during the 16th and 17th centuries. A road was laid along the southeast shore of the lake in the 19th century, leading to the creation of a marshy area along the fringes of the Shankaracharya and Zabarwan mountains. During the Mughal era, the rulers recognized the natural beauty of Dal Lake and its surroundings and developed several gardens and palaces in the vicinity. They built enchanting Mughal gardens, such as the Shalimar Bagh, Nishat Bagh, and Chashme Shahi, which continue to attract visitors with their terraced lawns, fountains, and flowering plants. (Bhat & Khan, 2019)The British colonial period in the 19th century also had a significant impact on the area around Dal Lake. The British officers, captivated by the beauty of the region, constructed bungalows and cottages on the lake's banks as their summer retreats. This led to the further development of the tourism infrastructure and the establishment of the region as a popular tourist destination.

During the early 20th century, European tourists stayed in well-built and luxuriously furnished houseboats owned by Europeans, while locals began building houseboats as tourist resorts after independence. Currently, there are 775 registered houseboats in the Dal and Nagin lakes, with a total capacity of 5071 persons.

The surrounding areas of Dal Lake are dotted with neighborhoods, markets, and settlements. The city of Srinagar, the summer capital of Jammu and Kashmir, has grown around the lake and serves as the main hub for administrative, commercial, and cultural activities in the region.

Today, the area around Dal Lake is not only a popular tourist destination but also a vital part of the local economy. Tourism-related activities, such as houseboat stays, shikara rides, handicrafts, and hospitality services, contribute significantly to the livelihood of the local population.

Currently, Dal Lake can be described as having an expanse of open water, as well as marshy areas and floating gardens. This open water area is divided into three sub-basins: the northern Hazratbal basin, the central Bodal basin, and the southern Gagribal basin. Additionally, there is a detached arm of the lake, known as the Nagin basin, located to the west. The lake's catchment area covers 33717 hectares and is surrounded by mountain ranges on the north and northeast sides, while flat, arable land encloses the other sides. (By & Mohsin, n.d.)The terrain is rugged with high relief, and the highest part in the north reaches an elevation of around 5107 meters above mean sea level.

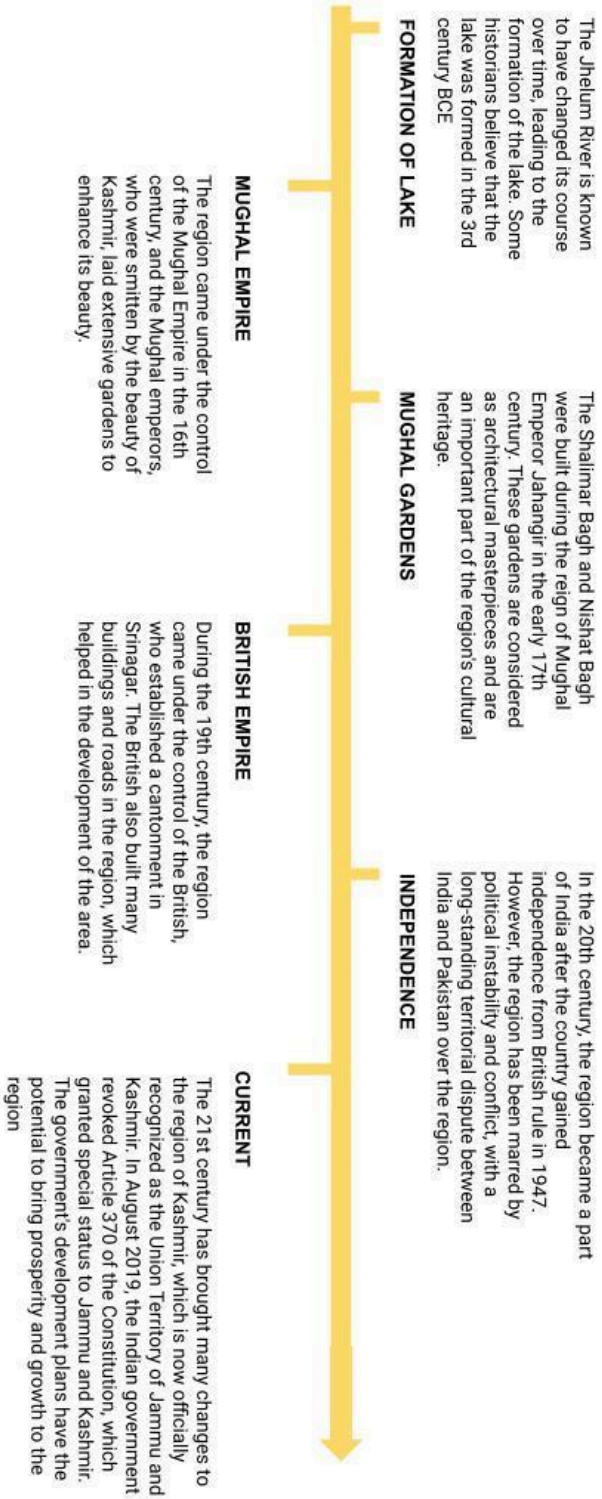
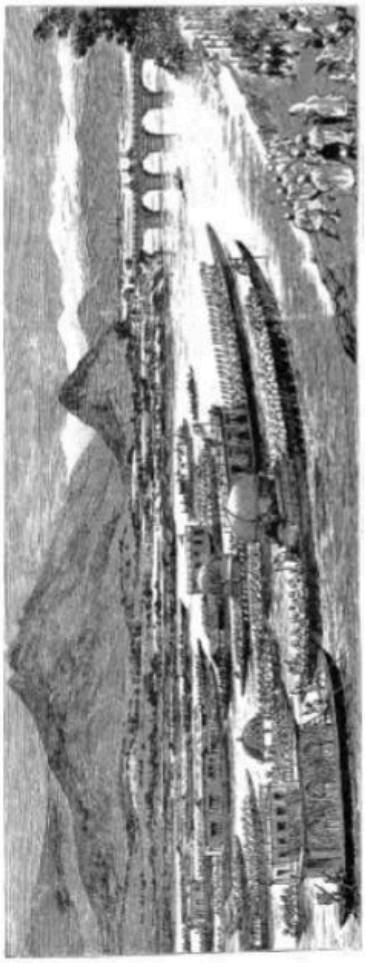

FORMATION OF LAKE
The Jhelum River is known to have changed its course over time, leading to the formation of the lake. Some historians believe that the lake was formed in the 3rd century BCE
MUGHAL GARDENS
The Shalimar Bagh and Nishat Bagh were built during the reign of Mughal Emperor Jahangir in the early 17th century. These gardens are considered as architectural masterpieces and are an important part of the region's cultural heritage.
INDEPENDENCE
In the 20th century, the region became a part of India after the country gained independence from British rule in 1947. However, the region has been marred by political instability and conflict, with a long-standing territorial dispute between India and Pakistan over the region.
CURRENT
The 21st century has brought many changes to the region of Kashmir, which is now officially recognized as the Union Territory of Jammu and Kashmir. In August 2019, the Indian government revoked Article 370 of the Constitution, which granted special status to Jammu and Kashmir. The government's development plans have the potential to bring prosperity and growth to the region
BRITISH EMPIRE
During the 19th century, the region came under the control of the British, who established a cantonment in Srinagar. The British also built many buildings and roads in the region, which helped in the development of the area.
MUGHAL EMPIRE
The region came under the control of the Mughal Empire in the 16th century, and the Mughal emperors, who were smitten by the beauty of Kashmir, laid extensive gardens to enhance its beauty.

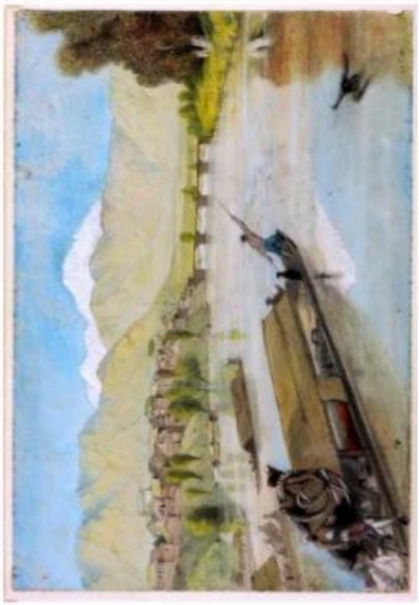
Figure 4 : Timeline of Dal Lake and the area around by Author

Ruler on a boat with attendants 17th century, reign of Jahangir British Museum Jahangir's trip to Wular Lake



'The Viceroy's tour in Kashmir – The procession of boats with his excellency nearing the Sumbul Bridge (Sumbal in Baramulla district) on the way to Srinagar' -The Graphic. 18th December, 1891.
Lord Lansdowne (1888 – 1894) was the viceroy at the time and setting up of Durand Commission for defining boundary of British India and Afghanistan was one of the high-points of his career.

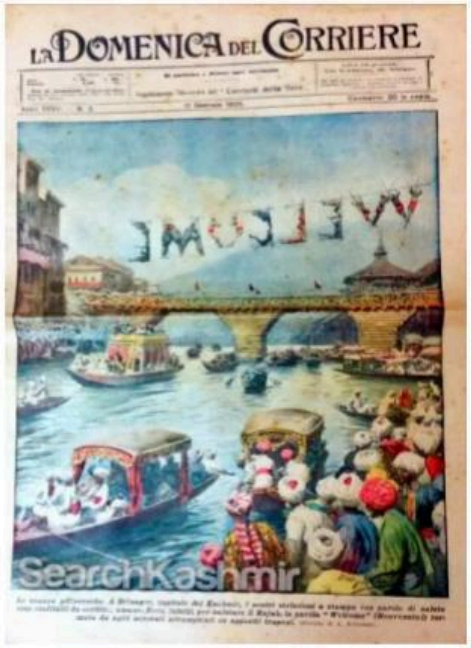
Maharaja's Boat From Francis Frith's album. Around 1850s to 1870s. via: Victoria and Albert Museum.



George Landseer painted in 1881 depicts scene from 1860 when he accompanied Lord Canning, Governor-General of India from 1856-62, to Kashmir.

Figure 5 : Old pictures and paintings showcasing the history of boatmen in Kashmir Pictures from Search Kashmir

The State Barge
From an album by Bourne & Shepherd. 1880.
via: bonhams.com



A famous image from Maharaja's Procession
cover of Italian weekly newspaper newspaper 'La Domenica Del Corriere', 11 January, 1925.
This is from time when Biscoe boys also took up boats besides the boatmen of Kashmir

"The picturesque river procession on the Jhelum (September 24, 1949) which was one of the festive items during the meeting of the Kashmir National conference. The boat carrying Pandit Jawaharlal Nehru and Sheikh Mohd. Abdullah appears at the centre of the picture."
via: Indian Photo Division

Boat procession caught by James Burke undated for Life Magazine
Based on the message "we convoke the constituent assembly"…it is probably 1951.

Figure 6 : Old pictures and paintings showcasing the history of boatmen in Kashmir Pictures from Search Kashmir

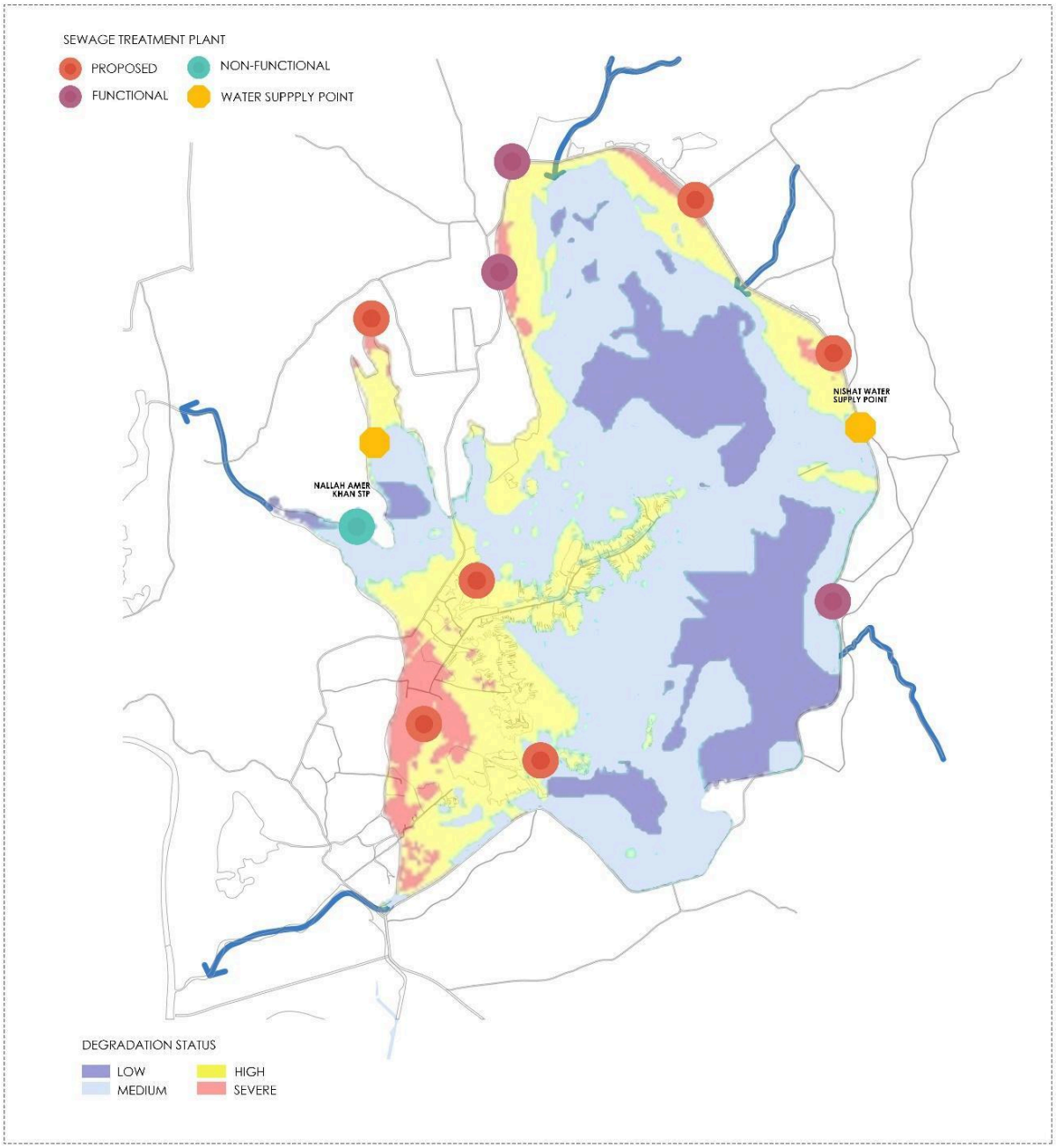
DAL LAKE

Main Source of Water

The Dal Lake is primarily fed by the Teilbal Nallah, which is a large perennial stream that flows from the Dachigam National Park and enters the lake at the northern end of the Hazratbal basin. There are also several small channels that contribute to the lake, including Botkol, which mainly drains water from the northern and northwestern catchment areas. In addition, there are several small streams like Meerakshah and Pishpav that enter the Hazratbal basin, and there are also springs inside the lake and along its periphery that contribute to its water level. During summer, the lake is flushed out through four outlet gates:

- Ram Munshi Bagh Gate,
- Gowkadal Gate,
- Fateh Kadal Gate,
- Nallah Amir Khan Gate

According to detailed studies, the area of Dal Lake has not reduced and remains the same as per the Survey of India mapping done in 2019-20. However, there is a significant infestation of weed/macrophytes, with 16.35 sq. km of the lake surface being affected, including 6.5 sq. km of water lily infestation. The lake has faced cultural eutrophic pressures due to urbanization, leading to siltation and pollutant ingress, which has deteriorated the water quality. To address these issues, multiple projects have been initiated, such as the Dal Development Project in 1977, the Dal-Nageen Lake Conservation and Management Programme under the National Lake Conservation Plan, and the formation of the J&K Lakes and Waterways Development Authority in 1997 for effective conservation of Dal Lake. A Project Feasibility Report (PFR) was prepared in 1997, followed by a Detailed Project Report (DPR) through the Alternate Hydro Energy Centre, Roorkee, which was submitted to the Government of India.(Centre et al., n.d.)



LAKE WATER CONDITION AND STP LOCATIONS

The lake is facing the threat of eutrophication due to the high levels of pollution caused by sewage, agricultural runoff, and other human activities. This has led to the growth of algae and other aquatic plants, which in turn has led to a decline in water quality. Majority of degradation of lake is seen along the floating settlements of the lake.

Figure 7 Showcasing Degradation Status

Open Water and Marshy Land

Open water and marshy lands are two distinct ecosystems that coexist within the Dal Lake, each playing an important role in the lake's ecological balance and biodiversity. Open water areas are the main body of the lake, covering around 70% of its total area. These areas are characterized by relatively deep waters and are home to a diverse range of aquatic flora and fauna, including fish, water birds, and water lilies. The open water areas of the lake also play a critical role in regulating the water quality and oxygen levels of the lake, helping to support a healthy and thriving ecosystem. On the other hand, marshy lands are shallow water areas that are characterized by wetland vegetation such as reeds, rushes, and cattails. These areas are important breeding grounds for many bird species and are also home to a variety of aquatic insects and small fish. The marshy lands play a critical role in the lake's water purification process, absorbing and filtering pollutants and excess nutrients from the water, which helps to maintain the lake's ecological balance and health. However, both open water and marshy lands in the Dal Lake are facing significant ecological threats, such as pollution, encroachment, and habitat loss. These threats have led to a decline in the lake's biodiversity, with many species of birds, fish, and aquatic plants disappearing from the lake. Additionally, the deterioration of the lake's water quality has resulted in significant public health concerns for the local community, who rely on the lake for their livelihoods and daily needs. To address these threats, various initiatives have been launched by the government and local stakeholders to protect and conserve the lake's open water and marshy land ecosystems. These initiatives include measures to reduce pollution, control encroachment, and restore damaged ecosystems through the planting of native vegetation and the creation of artificial wetlands. In conclusion, the open water and marshy lands in the Dal Lake are vital components of the lake's ecological balance and biodiversity. The threats faced by these ecosystems underscore the need for continued efforts to protect and conserve the lake's fragile ecosystem, ensuring that it remains a valuable natural resource for generations to come.

Table 1 : Area distribution in Dal lake (Town and Planning Report Srinagar)

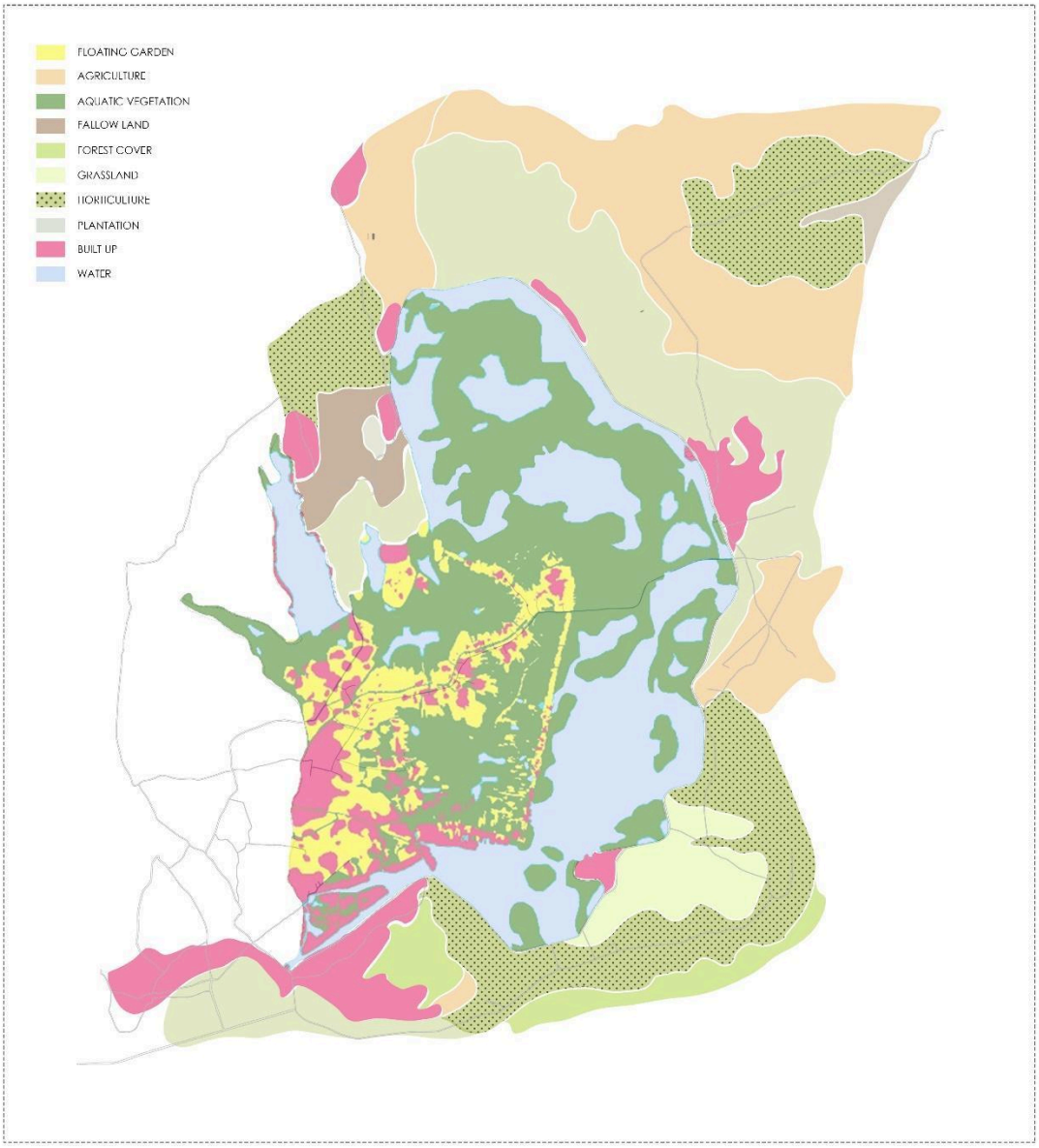
Description	Year 1895 (Settlement by Sir Walter Lawrence)	ETS survey carried out by Revenue Authorities in 2009	Satellite Imagery 2009
Total area	25.86 sq.km	25 sq.km	25.67 sq.km
Water Surface	18.21 sq.km	19.83 sq.km	20.21 sq.km
Landmass/fixed cultivation	7.65 sq.km	5.17 sq.km	5.55 sq.km

Significance of Dal Lake

Dal Lake is a vital landmark located in the heart of Srinagar, the summer capital of Jammu and Kashmir state in India. It is a significant tourist attraction that attracts millions of visitors every year. Tourists can enjoy a traditional Shikara ride on the lake, stay in houseboats, and bask in the natural beauty of the lake, surrounded by majestic mountains, lush greenery, and floating gardens. (Town Planning Centre et al., n.d.)

The tourism industry in Srinagar is heavily dependent on Dal Lake, as it generates a significant amount of revenue for the local economy. Many locals earn their livelihood through tourism-related activities, such as operating houseboats, selling handicrafts, and providing other services to tourists. Dal Lake is not only a popular tourist destination but also a vital habitat for various aquatic flora and fauna, including fish, lotus, water lilies, and other aquatic plants. It is also a critical site for various bird species, such as the kingfisher, heron, and egret. The lake's biodiversity plays an essential role in maintaining the ecological balance of the region.

Furthermore, Dal Lake is an integral part of the Kashmiri culture and heritage for centuries. It has been celebrated in Kashmiri poetry, literature, and art. The lake is often referred to as the "jewel in the crown of Kashmir." Additionally, it has spiritual significance, and there are several shrines and temples located on the lake's islands and banks, including the Hazratbal Shrine, which houses a holy relic of the Prophet Muhammad. Dal Lake is a valuable resource for the local economy, tourism industry, cultural heritage, biodiversity, and spiritual significance. It has become an iconic tourist spot and must-see location in Srinagar.



LAKE LANDSCAPE

The lake consists of multiple types of landscapes, majorly agriculture on lake, floating gardens, weeds and built up. Built up is seen on floating gardens and on the edges of the lake. Other landscape around the lake are also mapped which included plantation and horticulture along with forest cover

Figure 8 : Map Showcasing Lake Landscape

LIFE ON DAL LAKE

Dal Dwellers

The lake or Dal dwellers, also known as 'floating population,' with a current population of 60,000 people, these people have been living on the lake for generations. They are entirely dependent on the lake for their livelihoods and have developed a unique way of life that revolves around the water.

This floating population is unlike any other in the country, here people choose to live on water instead of land and have formed a deep connection with the lake and its environment. This started during the Dogra region. The origin of people staying on the lake can be attributed to historical and socio-economic factors.

From 1846 to 1952, Srinagar was designated as the capital of the Dogra region and served all throughout the 106 years that the Dogra's controlled the region. The Dogra Maharaja of Kashmir had put limitations on how many homes may be built in the valley. During that time the Britishers had just entered the country and were trying to make allies with various rulers all over the country. Due to the climatic condition of native British, the harsh heat of India was intolerable, to escape this many Britishers came to Kashmir. The British discovered a way around this restriction, nevertheless, and organized the construction of opulent houseboats on the Dal Lake. (Fazal & Amin, 2013)The phrase "each one a little piece of England afloat on Dal" arose to describe these houseboats. Initially, these houseboats were primarily used as temporary dwellings during the summer months when the Kashmiri elite and British officers sought relief from the heat by staying near the cool waters of Dal Lake. However, as the popularity of houseboats grew, some locals decided to make them their permanent homes.

Figure SEQ Figure * ARABIC 9 : Pictures depicting the life on Dal Lake

Figure 10 : Houseboat for the western tourists, Source: The Boats and Boatmen of Kashmir

During the colonial period, the British government imposed heavy taxes on landowners in Kashmir, which caused financial difficulties for many locals. In protest of these taxes, some Kashmir's decided to build their homes on boats, away from the land. This further increased the permanent living population of people on lakes. By living on the water, they were able to avoid taxation and maintain their way of life. Further they modeled their life around water by engaging in activities like fishing, and water agriculture.(*Mughal Architecture of Kashmir: An Overview Sajad Ahmad Darzi*, n.d.)

After India gained her independence, the Kashmiri Hanjis, a semi-nomadic community whose members labor in various trades according to the seasons, constructed and maintained the houseboats created by Britishers. They further created a whole community of their people also known as the 'boat dwellers'. Along with Dal Lake they also set up dongas or houseboats in lakes in other parts of Kashmir. In order to reduce dependency on land the Hanji people started making their own floating gardens also known as 'Rad', these gardens were used to grow vegetables and as time passed also used for building houses where people settled permanently. These vegetables we then sold out in the market, ninety percent of vegetables of Srinagar are grown on Dal Lake.

Figure 11 : Image of a houseboat and a cook boat on Dal Lake image from the book A lonely summer in Kashmir (1904) by Margaret Cotter

As time went by and with globalization, the houseboats quickly became a source of lodging for the tourists visiting Srinagar. The unique lifestyle and economic opportunities offered by living on the lake attracted more people over time. The growth of the tourism industry in the region further contributed to the increase in houseboat construction and the development of floating villages.(Amin, n.d.)

Today, there are numerous houseboats on Dal Lake, serving as residences, hotels, restaurants, and shops. The inhabitants of these floating villages are a mix of Kashmiri locals and people from other regions who have chosen to live on the lake. Many families have been living on houseboats for generations, passing down the tradition from one generation to the next.

The houseboat communities on Dal Lake have become an integral part of the local culture and identity. They contribute to the economy of the region by offering unique accommodation options for tourists, generating employment opportunities, and sustaining a vibrant local ecosystem of commerce and trade.

Social Culture of Dal Dwellers

The social culture of Dal dwellers is unique and closely tied to the lake and its surroundings. Most of the Dal dwellers are Muslims and have their own distinct cultural practices and

traditions. The community has a strong sense of community and belonging and often work together to solve common problems.

One of the most notable aspects of their social culture is their way of life. Living on a houseboat on the lake means that their homes are mobile, and they are constantly adapting to changing water levels and weather conditions. They have developed their own methods of navigation, fishing, and farming that are suited to the environment of the lake.

The Dal dwellers are also known for their handicrafts, particularly their expertise in embroidery, carpet weaving, and papier-mache. Many of these handicrafts are passed down through generations and are an important part of their cultural heritage.

Hospitality is an integral part of the social culture of the Dal dwellers. Visitors to the lake are often welcomed with open arms and are invited to share meals and stories with the locals. This hospitality extends to the shikara rides that the Dal dwellers provide for tourists, which are often accompanied by local music and food.

In terms of social hierarchy, the Dal dwellers have their own system of governance and leadership. The community is led by a group of elders who are responsible for making decisions and resolving disputes. They also play an important role in passing down traditions and cultural practices to younger generations.

One of the most popular festivals celebrated by the Dal Dwellers is the Urs of Hazrat Sheikh Hamza Makhdoom. This festival is celebrated on the 6th of October every year and attracts many people from all over the region. The festival is celebrated with great enthusiasm and includes a number of activities such as Qawwali performances, poetry recitations, and the distribution of food among the visitors.(Amin, n.d.)

Another important festival celebrated by the Dal Dwellers is the Urs of Hazrat Mir Syed Ali Hamdani. This festival is celebrated on the 13th of Zilhaj every year and is marked by a grand procession that starts from the shrine of Hazrat Mir Syed Ali Hamdani and ends at the Dal Lake. The procession includes people carrying the flags of the saint, and musicians playing traditional Kashmiri music. The festival also includes a number of cultural activities, such as Kashmiri dance performances and poetry recitations.

Apart from these festivals, the Dal Dwellers also celebrate the traditional Kashmiri festivals, such as Eid-ul-Fitr, Eid-ul-Adha, and Muharram. During these festivals, the dwellers dress up in their traditional attire, prepare special delicacies, and invite their friends and relatives to celebrate together.

The Dal Dwellers are known for their hospitality and warmth towards visitors. They often invite tourists to their homes to share a cup of Kashmiri tea or to enjoy a traditional meal with them. This hospitality is reflected in their culture, which values community and sharing.

Various Occupations followed by Dal Dwellers

The dal lake dwellers have created a unique way of life that revolves around the lake. Their livelihood purely depends on the lake some of the jobs are:

1. Fishing: The Dal Lake dwellers rely on fishing as a major source of income. They use traditional fishing methods such as hand nets, traps, and fishing lines to catch fish. The resources required for fishing include boats, fishing nets, and other fishing equipment. The yearly salary of a fisherman can range from INR 50,000 to INR 1,50,000.(Amin, n.d.)

2. Agriculture: The floating gardens or 'Rad' are a unique form of agriculture practiced on the lake. The resources required for Rad farming include mud, weeds, and vegetable waste. The crops grown in these gardens include tomatoes, cucumbers, and other vegetables. The yearly salary of a Rad farmer can range from INR 30,000 to INR 1,00,000.

3. Tourism: Tourism has become an important source of income for the Dal Lake dwellers in recent years. Many of them operate houseboats or shikaras that are rented out to tourists as a means of accommodation or transportation. The resources required for this include houseboats, shikaras, and maintenance equipment. The yearly salary of a houseboat owner or shikara operator can range from INR 2,00,000 to INR 10,00,000.

Figure 14 : Picture of agriculture activities Source: Author

4. Handicrafts: The Dal Lake dwellers are also known for their skills in wood carving, papier-Mache, and embroidery. They produce a variety of handicrafts that are sold to tourists. The resources required for this include raw materials such as wood, paper, and fabric, as well as tools such as chisels, hammers, and needles. The yearly salary of a handicraft artisan can range from INR 50,000 to INR 2,00,000.

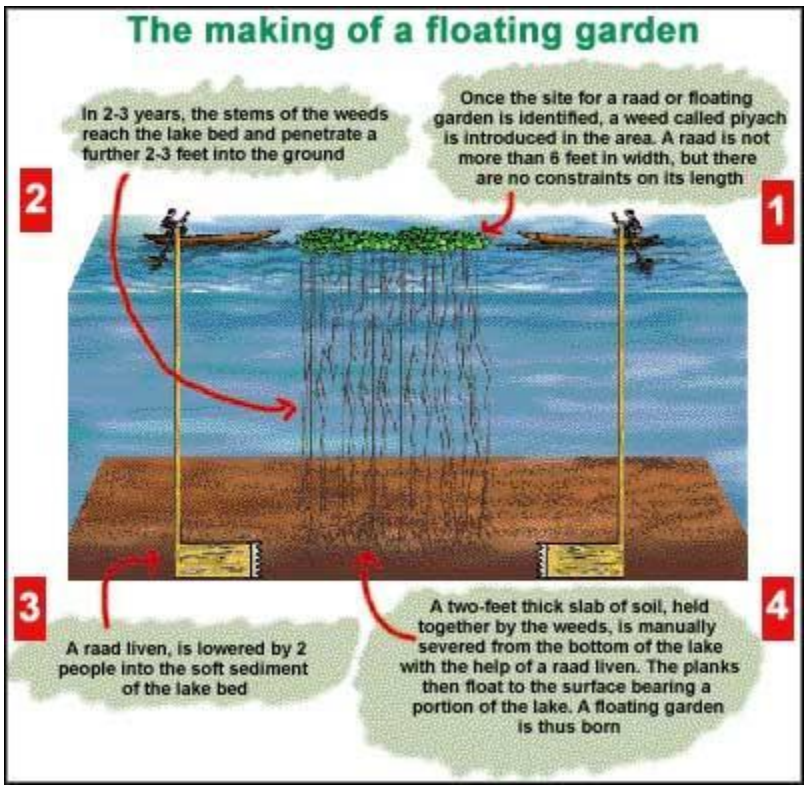
5. Transport: The Dal Lake dwellers also provide transportation services to tourists and locals using their shikaras. They ferry people to and from various locations around the

lake. The resources required for this include shikaras and maintenance equipment. The yearly salary of a shikara operator can range from INR 50,000 to INR 2,00,000.

Floating Villages

Floating gardens and hamlets in Dal Lake are formed using an indigenous method of cultivation and construction that has been passed down for generations among the lake dwellers. The process for creating floating gardens starts with identifying a suitable site on the lake. Once a site has been identified, the local people introduce a weed called "piyach" into the area. The piyach weed helps to hold the soil together and provides a natural fertilizer for the plants. Over a period of 2-3 years, the stems of the piyach weed reach the lake bed, which is around 5-6 feet deep, and penetrate a further 2-3 feet into the lake bed. Then the process of raising the floating garden begins.

A "raad liven," which looks like a gigantic pincer consisting of two planks each three feet in width, is lowered by two people in two boats into the soft sediment of the lake bed. A two-foot-thick slab of soil, held together by the piyach weed, is manually severed from the bottom of the lake with the help of the planks, which are fitted with steel edges. The planks then float to the surface bearing a portion of the lake bed with them. More soil is added to the surface of the raad, and the weed decomposes to become a natural fertilizer for the vegetables grown on the floating garden.



As for the floating hamlets, they are constructed using a similar process. First, a platform is created using long wooden logs tied together with ropes. This platform is then anchored to the lake bed using wooden poles that are hammered into the lake bed. The platform is then covered with a layer of soil, and the lake dwellers plant their crops and build their homes on top of it. Overall, the process of creating floating gardens and hamlets in Dal Lake is labor-intensive and requires a lot of hard work and expertise. However, it has become an integral part of the culture and livelihoods of the lake dwellers, who rely on these floating gardens and hamlets for their sustenance. The annual lotus harvest, for instance, is a significant event in their social calendar, as the lotus stems, called nardoo, are an important part of their diet. Visitors, especially foreigners, are attracted to the lotus plantations and often spend long hours there, enjoying the picturesque scenery.

Deterioration of Dal Lake

The Dal Lake, once known for its beauty and pristine waters, has deteriorated significantly over the years due to human activities and natural factors. The increasing pollution, encroachment, and climate change have had a severe impact on the lake and the people living around it. One of the major consequences of the deterioration of the Dal Lake is the negative impact on its marine life. The pollution levels in the lake have increased to alarming levels, which has resulted in a decline in the number of fish species and other aquatic animals. The excessive growth of weeds and algae has also affected the dissolved oxygen levels in the lake, making it difficult for marine life to survive. (Amin et al., 2014)The local fisherman who depend on fishing for their livelihoods have been severely affected by the decline in the fish population.

The pollution levels in the lake have also affected the health of the people living in the nearby areas. The toxic chemicals and pollutants in the lake water have resulted in an increase in waterborne diseases and other health problems among the local population. The water quality has deteriorated to such an extent that it is no longer safe for drinking or other domestic purposes. The encroachment of the lake has also resulted in a loss of biodiversity, affecting the flora and fauna of the lake. The excessive growth of weeds and algae has affected the water quality and has also resulted in the loss of aquatic vegetation, which is an important part of the lake's ecosystem.

The deterioration of the Dal Lake has had a severe impact on the marine life and the people living in the nearby areas. It is important for the authorities to take immediate action to address the issue and prevent further damage to the lake's ecosystem. Measures such as better waste management, stricter regulations on encroachment and pollution, and awareness campaigns can go a long way in ensuring the preservation of this valuable natural resource. The decline in the health of Dal Lake has also had economic consequences for the people living in the nearby areas. Tourism, which is a major source of income for the people living around the lake, has been adversely affected. The once popular houseboats and shikara rides are no longer as attractive to tourists due to the pollution and encroachment of the lake.

Solid Waste and its Rising Problem

Solid waste pollution is one of the most significant environmental problems facing the Dal Lake. The lake receives a large amount of solid waste from both residential areas and commercial activities, which poses a serious threat to the lake's ecosystem and public health.

The solid waste in the Dal Lake is made up of a variety of materials, including plastic bags, food waste, sewage, and industrial waste. Much of this waste is not properly disposed of, and it accumulates in the lake, polluting the water and degrading the lake's ecosystem. The accumulation of solid waste in the lake can also lead to the formation of stagnant pools of water, which can become breeding grounds for disease-carrying mosquitoes and other insects, posing a significant public health risk.

Solid waste pollution in the Dal Lake also has significant economic impacts on the local community. The tourism industry, which is a major source of income for many people in the area, has been severely impacted by the pollution. The unsightly and unpleasant conditions caused by the solid waste pollution have deterred many tourists from visiting the lake, leading to a decline in tourism revenues and livelihoods for local residents who depend on the industry.

To address the problem of solid waste pollution in the Dal Lake, various initiatives have been launched by the government and local stakeholders. These initiatives include measures to improve waste collection and disposal, increase public awareness about the importance of proper waste management, and promote the use of eco-friendly products.

In conclusion, the solid waste pollution in the Dal Lake poses a serious threat to the lake's ecosystem, public health, and local economy. The continued efforts to address this problem are essential to ensure the long-term sustainability and well-being of the lake and the communities that depend on it.

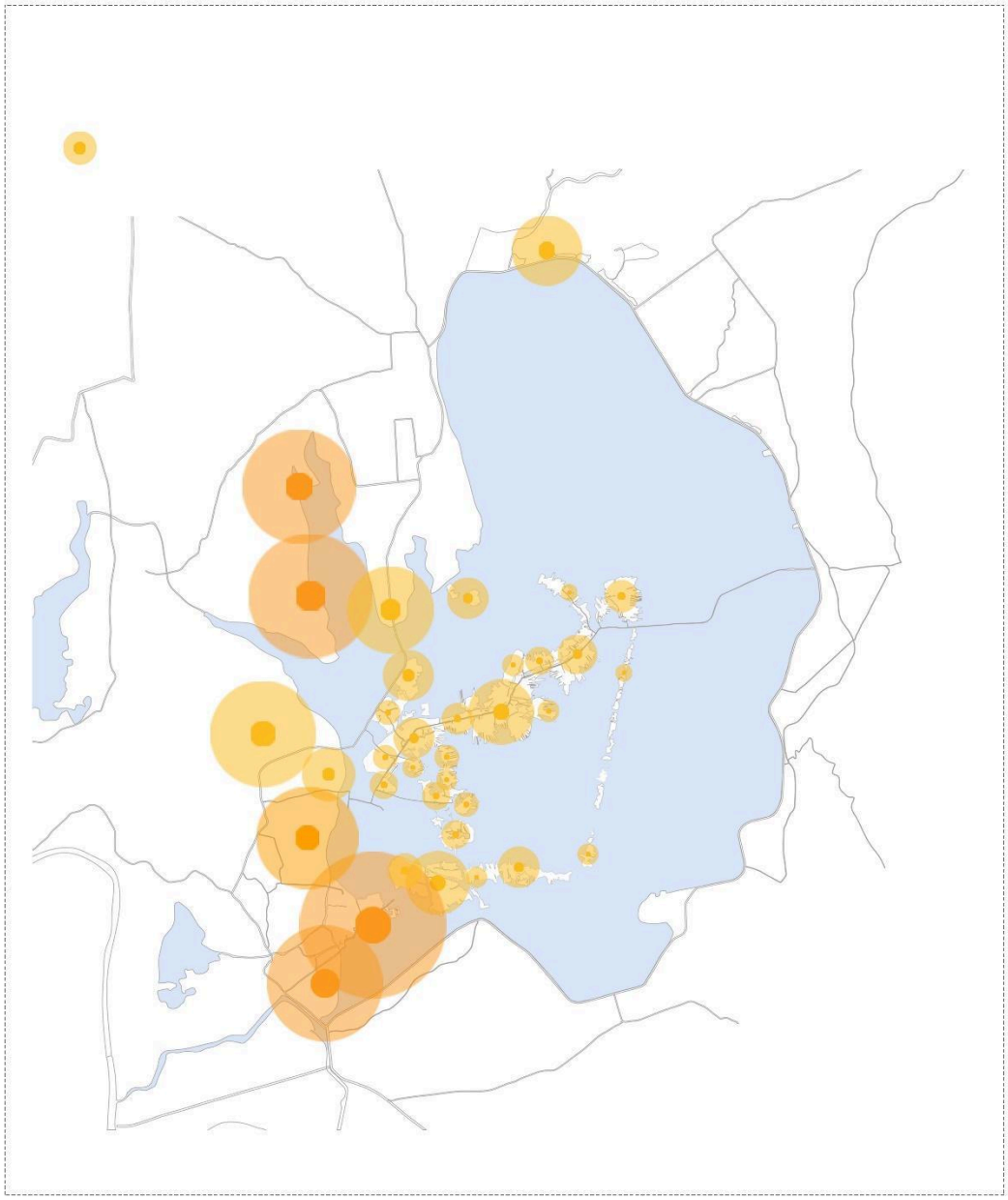
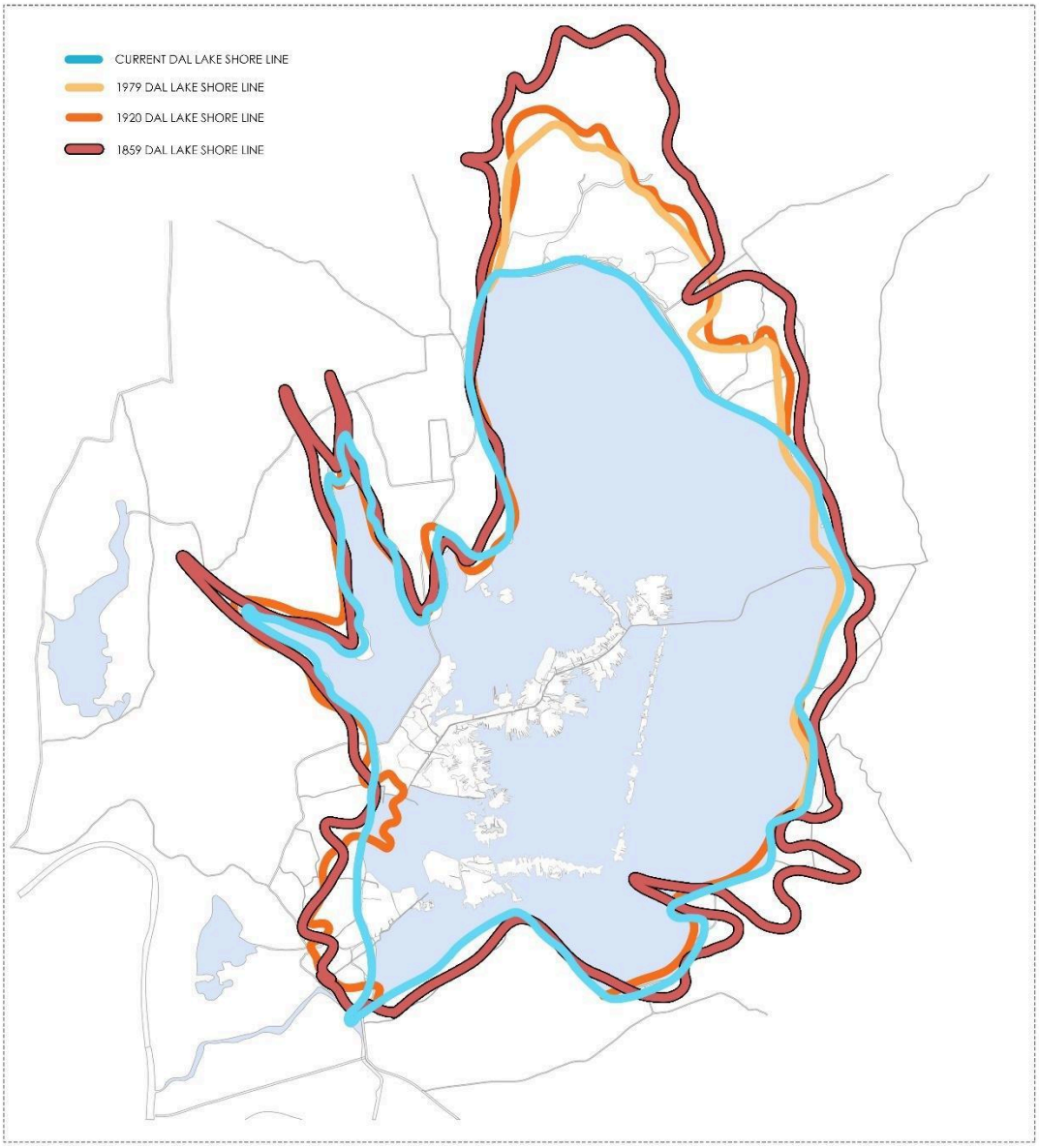


Figure 18 : Map for Lake Population



LAKE SHORELINE

Population growth and urbanization have contributed to the decline of the shoreline of Dal Lake. The increase in population has led to an increase in demand for land, resulting in the encroachment of the lake's shoreline. This has further led to the construction of houses, hotels, and other structures on the lake's banks reducing the lake's size.

Figure 19 : Map Showcasing Lake Shoreline

Initiatives for Dal Lake Conservation

1. Nodal Consulting Firm

- The Dredging Corporation has been appointed as the nodal consulting firm to develop a dredging strategy and explore options for sewage management.
- A bathymetric survey of Dal-Nageen water body was requested to determine the required level of dredging.

2. Save Dal Project

- In 1997, the "Save Dal Project" worth Rs 500 crore was launched to restore the lake's condition.
- The State Disaster Response Force and the Lakes and Waterways Development Authority collaborated to clean the lake and remove harmful weeds.
- Approximately 100 SDRF troops and ten boats were deployed for the purpose.

3. National Lake Conservation Plan

- The Ministry of Environment and Forests sanctioned funds for Dal Lake's conservation under the National Lake Conservation Plan.
- Restoration and rehabilitation processes, such as the construction of siltation tanks, mechanical de-weeding, and deepening of outflow channels, are being implemented with government funding.

4. Constructional Remedies

- Various measures were taken to rehabilitate the lake, including deepening of outflow channels, removal of bunds and barricades, and the construction of siltation tanks.
- A ban on new construction along the lakeside, including new houseboats, has been imposed.

5. Relocation of Population

- As Dal Lake supports a large population, relocation plans have been proposed by the government to mitigate threats such as encroachment and mixing of human waste in the lake.
- Long-term plans include reforestation of watershed areas to prevent erosion and silt flow and regulation of livestock grazing.

The above are some of the ways that the LCMA (Lake Conservation and Management Authority) earlier LAWDA (Lake and Water Development Authority), out of these the Relocation of Population and Rehabilitation the Dal people has caused unrest in the entire area. This scheme is forcing people to uproot from their home and rehabilitate in areas with flood prone land and poor administration.

REHABILITATION AND RESETTLEMENT

The inhabitants of Dal Lake, who have lived there for generations, have faced many difficulties in recent years. The government's efforts to clean up and rehabilitate the lake have disrupted their lives, and the process of relocating them has been difficult.

The government has taken several steps to relocate people living in the lake's catchment area to reduce pollution levels. However, the rehabilitation process has been slow, and many people are still living in the area. The government has been trying to provide them with alternative accommodations, but many people have refused to leave the lake.

One of the main reasons for this reluctance is the people's emotional attachment to the lake. Many of them have lived there for generations and are reluctant to leave the place where they were born and raised. Furthermore, many of them rely on fishing, tourism, and other activities related to the lake for their livelihoods. They fear that relocation will result in a loss of income and job opportunities.

Another issue that has arisen is the lack of proper compensation for those who have been relocated. While the government has promised to provide alternative housing and other forms of assistance, many people claim that they have not received adequate compensation. The government is also facing a shortage of resources to complete the rehabilitation process. The cost of relocating thousands of people, constructing new housing and other facilities, and managing the lake's pollution is enormous. As a result, the process has been slow, and many people are still living in the lake's catchment area.

The authorities responsible for the rehabilitation of Dal Lake dwellers in Jammu and Kashmir have faced significant delays and challenges in executing the relocation process. Out of a total of 3,163 structures, only 1,101 structures have been acquired so far. This number includes additional structures that were added to the list in 2010 under the Prime Minister's reconstruction plan.(Centre et al., n.d.)

The population residing within the lake has been identified as a major obstacle to its conservation. The lake spans over 25.76 square kilometers, with 20.21 square kilometers of water and 5.55 square kilometers of land. In 2007, a plan was initiated to shift an estimated population of 55,000 individuals living in the lake to the Rakhi Arth colony at Bemina within three years, aiming to clear the inner areas of the lake for conservation purposes by 2010.

However, the rehabilitation project has faced significant delays, with only 34% of the work completed thus far. The increasing population within the structures has also posed challenges and escalated the cost of rehabilitation. Each family, on average, requires a five marla plot with a constructed house, and the slow pace of the process suggests it may take around three decades to rehabilitate all families.

The government has allocated 7,000 kanals of land for the construction of flats at Rakh-e-Arth in Bemina for the rehabilitation of Dal dwellers. The conservation management plan for Dal Lake

is fully funded by the Central government, while the cost of rehabilitation is to be borne by the state government.

Regrettably, the allocated funds for the conservation of Dal Lake have largely remained unspent. The state government failed to utilize the Rs 380 crore allocated under different central financial packages, including the Rs 80 crore from the Prime Minister's Reconstruction Program in 2004 and the Rs 300 crore under the Prime Minister's Developmental Package (PMDP) in 2015. These funds were meant for lake conservation, cleaning, and rehabilitation of the people residing inside Dal Lake to other locations.

In summary, the rehabilitation process for Dal Lake dwellers has faced significant delays, inadequate utilization of allocated funds, and challenges associated with the increasing population. The slow progress suggests that it may take several decades to fully rehabilitate all families, while the conservation of the lake remains a critical priority.

Over the years, the human population living in the vicinity of the lake has engaged in various activities that have resulted in the degradation of the lake. This includes converting water areas into landmass for agriculture and settlements. Besides solid wastes, economic activities such as growing vegetables and flowers, houseboats and shikaras used for tourism, have also brought sediment, organic and non-organic matter, and nutrients into the lake. This has led to multi-dimensional degradation of the lake, causing shrinkage of the water body, increase in its bed level, excessive growth of weeds, obstruction of its natural inflow and creating stagnant zones with poor quality of water.

1. As part of efforts to improve the ecological condition of the lake, the Authority has implemented a range of measures, including relocating human settlements either completely or partially outside the lake. So far, 3250 families have been relocated to various colonies developed for the purpose of resettling those who live near the Dal lake. The DPR, which was prepared by AHEC and IIT Roorkee, had also recommended that families should be encouraged to voluntarily move out of the lake area and settle elsewhere.

2. It is a very distressing experience for an individual and their family to be forced to leave a place where they have lived for generations and settle in a new place where they may feel like strangers. It can be even more difficult when they are asked to change their occupation to something they are not familiar with. However, in order to protect the lake and ensure progress and prosperity for the people of Jammu & Kashmir, those who have been uprooted must face hardship and an uncertain future. It is the responsibility of the community, the State, and the nation to show gratitude to these families and ensure they are properly resettled and rehabilitated.

3. Given the immense scale of the issue, it is crucial to develop a resettlement plan and approach with utmost caution. The citizens of Kashmir and the country must acknowledge that their fellow citizens residing in the lake region are relinquishing

their water privileges, land, homes, livelihoods, and well-being to preserve the beauty, ecological harmony, and surroundings of the semi-arid areas of Kashmir.

4. The process of resettling human populations is a constantly evolving process that requires adaptable planning and implementation to respond to both anticipated and unanticipated situations. There cannot be rigid rules or fixed plans for this process, as it needs to remain flexible. Even with meticulous planning, errors may occur, and it is crucial to rectify them as soon as they are identified. The key to success is to be able to learn from mistakes and adjust the approach accordingly.

5. In the past, the objective was to provide land in exchange for the land being occupied by displaced families. However, due to the increasing population and urbanization, there is a scarcity of land in cities like Srinagar. The State Government is the only agency that can acquire land for resettlement, but it can only be done through compulsory land acquisition. Recently, the remaining residents of Dal Lake have been hesitant to move out, and the acquisition and rehabilitation process has come to a standstill. The cost of the process has also increased significantly, and important aspects such as complete sewerage and drainage facilities have been neglected in the development of the Rakh-i-Arth Housing Colony.

6. The residents of Dal Lake have a significant contribution towards preserving the beauty of the lake. They utilize the weeds and other materials removed from the lake in their vegetable gardens, and are also hired by the Authority to manually remove weeds and extract lilies from the lake.

7. Considering the current circumstances, it is no longer feasible to rely solely on the principle of providing land in exchange for land for the resettlement of the lake dwellers. Many of them have shifted to an urban lifestyle despite practicing agriculture on the landmass created within the water body. Therefore, it is necessary to encourage them to pursue alternative vocations instead of agriculture. To determine suitable options, a study titled 'Recent Trends in the Economy of Jammu & Kashmir' was conducted, and its findings suggest that a significant number of families affected by the project might prefer to be resettled in non-agricultural fields, particularly in arts and handicrafts. A copy of the study is attached for reference.

8. Interference to a minimum for the benefit of the ecological health of natural resources. However, since Dal Lake is a living system closely related to human beings, the recommendation may be challenging to implement. Additionally, aside from the floating population of tourists and those who work on the lake for a part of the day or year to make a living, there are also those who reside in the catchment and within the lake.

9. To address the waste generated by those living in the catchment area, proposals for sewage treatment and disposal are being made. However, there is a question

about how to reduce the adverse effects of Lake Dwellers living in the lake and carrying out economic activities. Several approaches can be taken to solve this problem:

- Option (a) is to shift the entire population and stop their economic activities such as cultivation on floating gardens and watery land.
- Option (b) is to shift the entire population but allow them to continue their cultivation.
- Option (c) is to shift a part of the population, particularly those who cause pollution in parts of the lake that are in bad condition or not aesthetically acceptable.
- Option (d) is to shift only those who are not mainly dependent on the lake for their livelihood.
- Option (e) is to not shift any significant population and instead find ways to make the waste from the lake dwellers and their activities less harmful for the lake.

The current population residing in the 58 hamlets within the Dal Lake area is estimated to be around 50,000 to 60,000 individuals. The displacement of such a large population would have a detrimental impact on the lake's ecological system. It is also recognized that resettlement would result in significant social and economic consequences, causing distress and hardship for many poor families. In addition, the cost of relocation would be very high. Therefore, it is advisable to avoid displacement as much as possible, and if unavoidable, to minimize it to the greatest extent possible.

Progress Made so Far

1. In 1986, the government established a High-Level Committee, led by the Divisional Commissioner of Kashmir, to determine the number of plots to be allotted for the acquisition of structures and land under them, as well as their rehabilitation outside the Dal Lake. The Committee bases the allotment of plots on the number of families in a given structure and compensation of structure on the evaluation done by the engineering wing of LAWDA. The rehabilitation plan only includes structures that have been assigned specific Plate Numbers based on the Socio-Economic Survey conducted in 1986.
2. To acquire land within Dal Lake, a special Court Committee was formed in 2010 consisting of two retired Judges and a sitting Deputy Commissioner, Srinagar. The concerned Revenue authorities prepare the necessary revenue documents and submit them to the Collectorate Wing of the Authority, who then present the agenda to the Court Committee for a decision. Unlike other land acquisition cases, the process of acquiring structures and land within Dal Lake is voluntary. Those interested in selling their land at the fixed rate set by the High-Level Committee can apply to the authority with the necessary revenue documents, and the HLC decides the number of plots to be allotted to a particular structure based on the number of families currently residing in the structure and the amount of compensation to be paid.

3. To speed up the rehabilitation and resettlement of Dal-Nageen Lake dwellers, a committee has been formed by the Government under the guidance of the Divisional Commissioner, Kashmir, as directed by the Hon'ble High Court. This committee will monitor the land acquisition and rehabilitation work in the Dal Lake area. Additionally, the Principal Secretary to the Government, Revenue Department, will be the Chief Nodal Officer and the Revenue Department will be the Nodal Department for rehabilitation work. This was mandated by the Government through Order No. 904-JK(GAD) of 2020, issued on 29.09.2020.

Progress of Land/Structures Acquisition

Total area of the Dal-Nageen Lake is 49432 Kanals out of which 27310 Kanals is state Land and 22122 Kanals is proprietary Land. The progress of land/Structure acquisition is tabulated as under;

Land

Table 2 : Land Report (Town and Planning Report Srinagar)

	Description of Land		Area	
			Kanal	Marlas
1	Land Mass		10206	18
	Watery Land		39226	00
	Total Land		49432	18
	a.	State Land	27310	00
	b.	Proprietary Land	22122	18
2	Land Acquired under NLCP & PMRP/PMDP			
	a.	Land Mass	2400	11
	b.	Water Land	7029	09
		Total	9430	00
3	Balance Land to be Acquired			
	a.	Land Mass	4950	18
	b.	Water Land	7742	00
		Total	12692	18

Structure

Table 3:Rehabitation Scheme Report (Town and Planning Report Srinagar)

Sno	Description	No of structures	No of structures acquired	No. of structured to be acquired
1	No of structures as per SES,1986	2532	1125	1407
2	Structures for Ashai Bagh to Saida Kadal As per Court Directions	631	01	630
3	Structures by virtue of construction of WFR as per Govt approved alignment	888	0	888
	Total	4051	1126	2925

A revised DPR was prepared by the Authority to acquire 12692 kanals of land and rehabilitate the remaining families residing in 2925 structures. The cost of the rehabilitation program was estimated to be Rs. 4500 Crores based on the LAAR Act and submitted to the Government. After

several meetings, it has been decided to consider the possibility of providing eco-development facilities and civic amenities to the Dal dwellers in the 58 hamlets where they presently reside. This approach will limit the high cost of relocation and take into account the social and economic attachments the Dal dwellers have with the lake. The Lake is unique as it is one of the few lakes in the world where people reside inside the lake. In order to provide basic facilities and beautify the hamlets, various eco-developmental works like slope stabilization, walkways, community toilet blocks, shikara ghats, street lights, and eco-parks have been proposed in these hamlets.(Centre et al., n.d.)

LIST OF HAMLETS/VILLAGES INSIDE DAL LAKE

S.NO	Name of Hamlet	S.NO	Name of Hamlet
1	Abi Nowpora	30	Latti Mohalla Kalan
2	Abi Karapora	31	Kachru Mohalla
3	Mir Mohalla	32	Roni mohalla Kalan
4	Abi Karpora A	33	Chinga Mohalla
5	Bujjal & Jafri Mohalla	34	Shiekh Mohalla (Tanga Khan)
6	Abi Karapora (B)	35	Aram Mohalla
7	Batapora Kalan	36	Hang Mohalla
8	Abi Karapora (C)	37	Ashraf Mohalla
9	Razaki Dar/Shabir Mohalla	38	Sofi Mohalla(Khurd)
10	Asithal	39	Ahkoon Mohalla
11	Khan Mohalla/Kabutar Mohalla	40	Sofi Mohalla (Kalan)
12	Kalu Mohalla	41	Bhat Mohalla
13	Pati Badhar & Joo Mohalla	42	Lato Mohalla Chinar (Khurd)
14	Sultani Mohalla	43	Gada Mohalla
15	Mir Mohalla	44	Roni Mohalla (khurd)
16	Khar & Pectoo Mohalla	45	Kath Mohalla
17	Tibo Mohalla	46	Bata Mohalla
18	Kand Mohalla A	47	Moti Mohalla (Kallan)
19	Kand Mohalla B	48	Moti Mohalla (Khurd)
20	Bala Mohalla	49	Taki Lal Shah
21	Shiekh Mohalla & Balla Mohalla	50	Akhoon Mohalla
22	Goocho Mohalla	51	Sofi Mohalla (C)
23	Tenda Mohalla	52	Sultan Mohalla
24	Ashraf Mohalla	53	Tilla Mohalla
25	Bali Mohalla	54	Tibu & Chutto Mohalla
26	Wani Mohalla	55	Mir Mohalla
27	Kalu Mohalla	56	Nehru Park
28	Kani Mohalla	57	Dr. Karan Singh
29	Akhoon Mohalla	58	Habak Gada Mohalla (Fisherman)

Table 5: List of Hamlets

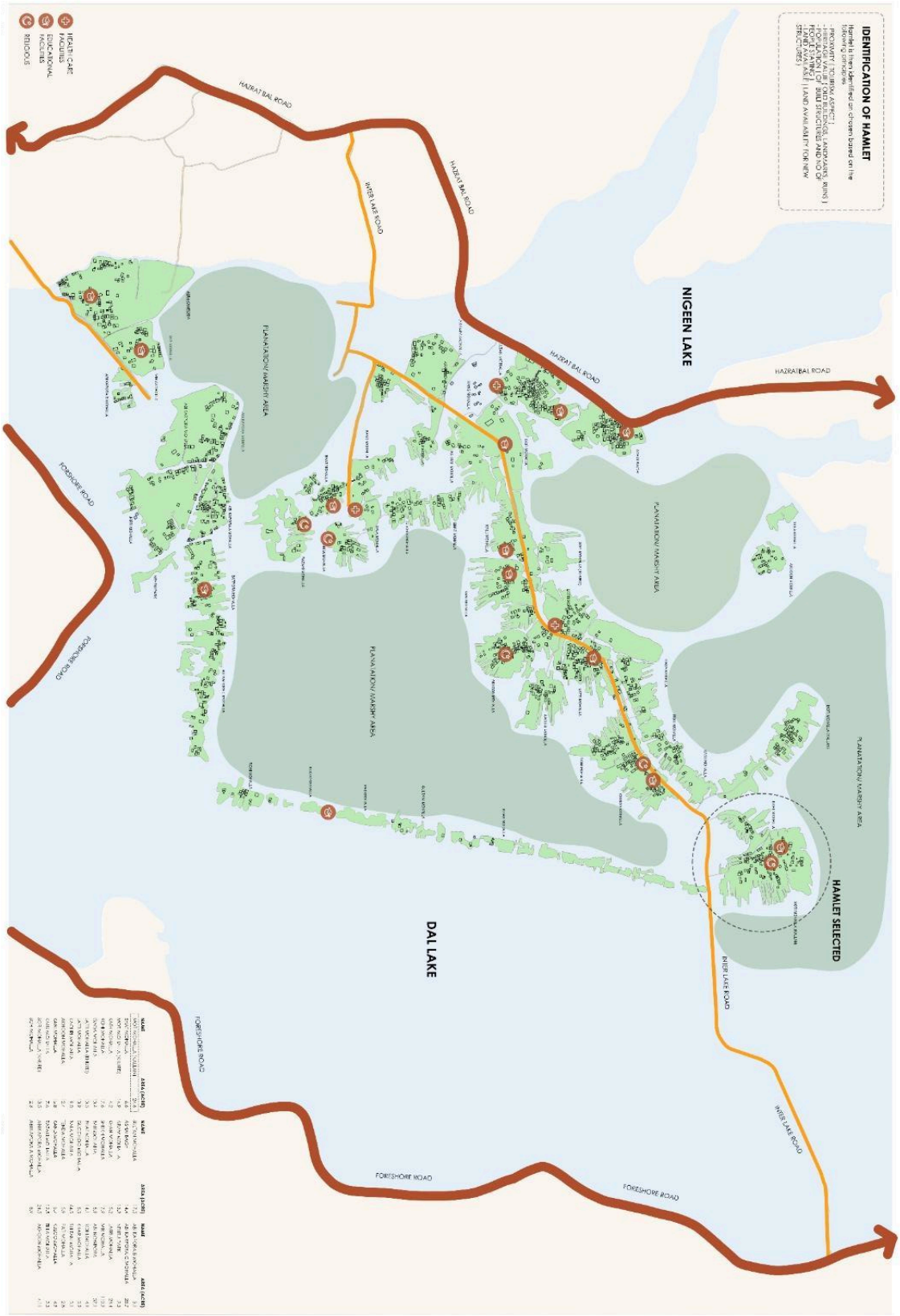


Figure 20 Map showcasing Hamlets in the region.

Status of acquired structures in various Hamlets/Villages inside Dal –Nigeen Lake

S.No.	Name of the Hamlet	Series	Total No. of structure in the Hamlet	Structure acquired by		Total acquired	Balance un-acquired
				UEED	LCMA		
1.	Abi Nowpora	01 to 110	110	17	07	24	86
2.	Abi Karpora	111 to 198	90	0	01	01	89
3.	Mir Mohalla	199 to 219 A	23	0	0	0	23
4.	Abi Karpora A	220 to 356	137	01	03	04	133
5.	Bujjal and Jafri Mohalla	357 to 379	23	01	0	01	22
6.	Abi Karpora B	380 to 387	08	0	0	0	08
7.	Batapora Kalan	338 to 387	18	01	05	06	12
8.	Abi Karpora C	388 to 405	22	0	0	0	22
9.	Razaki Dar/Shabir Mohalla	428 to 613	189	0	42	42	147
10.	Asithal	614 to 680	67	02	29	31	36
11.	Khan Mohalla Kabutar Khana	681 to 717	37	0	25	25	12
12.	Koolu Mohalla	718 to 769	52	0	50	50	02
13.	Pati Mohalla	770 to 813	44	0	41	41	03
14.	Sultani Mohalla	814 to 844	31	0	29	29	02
15.	Mir Mohalla	845 to 851	07	0	06	06	01
16.	Khar & Pectoo Mohalla	852 to 900 A, 900 A to 900 B & 901 to 919	51	0	37	37	14
17.	Tibu Mohalla	901 to 919	19	05	06	11	08
18.	Khanda Mohalla A	920 to 994	75	02	19	21	54
19.	Khanda Mohalla B	995 to 1034	40	02	05	07	33
20.	Bala Mohalla	1035 to 1043	09	0	05	05	04
21.	Sheikh Mohalla Bala Mohalla	1044 to 1124	81	0	51	51	30
22.	Goocho Mohalla	1125 to 1154	30	0	07	07	23
23.	Tenda Mohalla	1155 to 1173	19	0	03	03	16
24.	Ashraf Mohalla	1174 to 1200	27	06	04	10	17
25.	Bali Mohalla	1201 to 1220	20	0	01	01	19
26.	Wani Mohalla	1221 to 1242	22	0	02	02	20
27.	Kalu Mohalla	1243 to 1260	18	0	02	02	16
28.	Kani Mohalla	1261 to 1313	54	0	04	04	50
29.	Ahkoon Mohalla	1314 to 1359	46	01	07	08	38
30.	Latti Mohalla Kallan	1360 to 1512	152	20	52	72	80

31.	Karchri Mohalla	1513 to 1566	54	04	25	29	25
32.	Roni Mohalla (Kallan)	1567 to 1621	55	04	10	14	41
33.	Chinga Mohalla	1622 to 1653	31	0	03	03	28
34.	Sheikh Mohalla (Tanga Khan)	1654 to 1671	18	01	09	10	08
35.	Aram Mohalla	1672 to 1681	10	0	03	03	07
36.	Hang Mohalla	1682 to 1696	15	0	05	05	10
37.	Ashraf Mohalla	1697 to 1720	24	06	15	21	03
38.	Sofi Mohalla (Khurd)	1721 to 1729	09	07	02	09	0
39.	Akhoon Mohalla	1730 to 1746	17	15	02	17	0
40.	Sofi Mohalla (Kallan)	1747 to 1838	95	52	30	82	13
41.	Bhat Mohalla	1839 to 1865	27	0	06	06	21
42.	Latti Mohalla Chinar (Khurd)	1866 to 1911	46	08	10	18	28
43.	Gada Mohalla	1912 to 1924	13	06	05	11	02
44.	Roni Mohalla (Khurd)	1925 to 1968	44	04	06	10	34
45.	Kath Mohalla	1969 to 2040	72	54	11	65	07
46.	Bata Mohalla	2041 to 2064	24	06	07	13	11
47.	Moti Mohalla (Kallan)	2065 to 2229	165	04	84	91	80
48.	Moti Mohalla (Khurd)	2230 to 2312	83	14	27	41	42
49.	Takiya Lalshah	2313 to 2365	53	0	31	31	22
50.	Akhoon Mohalla	2366 to 2373	08	0	01	01	07
51.	Sofi Mohalla C	2374 to 2378	05	0	05	05	0
52.	Sutan Mohalla	2379 to 2385	07	04	02	06	01
53.	Tilla Mohalla	2386 to 2455	70	0	67	67	03
54.	Tibu & Chutto Mohalla	2456 to 2475	20	0	20	20	0
55.	Mir Mohalla	2476 to 2484	10	0	06	06	04
56.	Nehra Park	2485	01	0	0	0	01
57.	Dr. Karan Singh	2486 & 2486 A	02	0	0	0	02
58.	Habak Gada Mohalla (Fisherman)	2487 to 2525	39	0	39	39	0
		Total (A)	**2538**	**247**	**873**	**1124**	**1414**
59.	Left & right side of Ashai Bagh to Saidakadal to Ashai Bagh under PMRP	01 to 631	631	-	01	02	629
		Total B	**631**	**-**	**01**	**02**	**630**
		Total A+B	**3169**	**247**	**874**	**1126**	**2043**

Table 6 : Showcasing status of Structures in the region

MOTI MOHALLA

Out of the Hamlets listed before Moti Mohalla was chosen as the hamlet for study and designing. This hamlet was chosen on the following basis.

1. Proximity to Ghats- The Mohalla is one of the first mohallas that is visible on a clear day from the ghats of Nishant Bagh and the highest point of Shalimar Bagh. Moti Mohalla, due to its closeness to the Foreshore Road, makes it easy for movement by shikaras and easy approachability by vehicles to Ghats.
2. Connectivity by Road: An internal road was constructed for the hamlets in the Lake. Moti Mohalla is one of the first hamlets that one crosses when they travel through this road, this makes it the approachability easy for tourists.
3. Population of the Mohalla – Moti Mohalla consists of a population of 1800 people making it a good strength for study and documentation.
4. Structures of the Mohalla – Presence of a few heritage buildings as well as the quantity of structures in comparison to the other hamlets in the lake makes it a good hamlet for study.


PROCESS
LITERATURE STUDY OF DAL LAKE AND ITS CULTURE
MAPPING OF DAL LAKE'S LANDSCAPE HERITAGE
IDENTIFICATION OF PROBLEMS
MAPPING OF HAMLETS IN DAL LAKE
IDENTIFICATION OF HAMLET
DAL LAKE
FLOATING HAMLETS
moti mohalla
OCCUPATION
CULTURE
CURRENT SCENARIOS
STATISTICAL DATA
DOCUMENTATION - MAPPING
HERITAGE MAPPING
BUILT MAPPING
SOCIAL MAPPING
OWNERSHIP MAPPING
IMPACT ASSEMENT
STRATEGIES

Figure 21 : Showcasing Methodology for Strategy identification.

Documentation and mapping

Documentation and mapping are important steps in any effort to understand and improve the condition of Dal Lake. Here are some key aspects of documentation and mapping:

- Physical mapping: Physical mapping involves creating a detailed map of the physical landscape of Dal Lake, including its shorelines, islands, water channels, and other features. This mapping can be done using a combination of ground surveys, aerial photography, and satellite imagery.

- Land use mapping: Land use mapping involves documenting how different areas of the lake are used by local residents, including for fishing, farming, and housing. This can be done through field surveys and interviews with local residents.

- Water quality mapping: Water quality mapping involves collecting data on the chemical and biological composition of the lake's water, including its pH level, dissolved oxygen content, and nutrient levels. This mapping can be done through regular water quality testing and analysis.

- Socio-economic mapping: Socio-economic mapping involves documenting the social and economic characteristics of the lake's inhabitants, including their occupations, income levels, and access to basic services like healthcare and education. This can be done through surveys and interviews with local residents.

- Documentation of traditional knowledge: Finally, documentation of traditional knowledge is an important aspect of any effort to improve the condition of Dal Lake. This involves documenting the traditional knowledge and practices of local residents related to fishing, farming, and other aspects of lake management. This knowledge can be used to develop more sustainable and effective management strategies for the lake.

Survey Questionnaire

Name of Hamlet:
Local Name of Hamlet (If any):
Location of Hamlet:
Area of Hamlet:
Classification of Land:

Agriculture Land	
Agriculture on water	
Built up	
Empty area	

No of houses in the Hamlet:
Population of the Hamlet:

- Male Population:
- Female Population:

Population of Children in the Hamlet:

	MALE	FEMALE
Population below 06 yrs		
Population below 14-40 yrs		
Population below 41-60 yrs		
Population below >60 yrs		
Population below children going to school		

Facilities available in the village:

	YES	NO	Distance from the village
Post / Telegraph office			
Pharmacy /Medical Shop			
Bank			
School (Pre primary/ Middle/Senior, as per population)			
Religious place			
Klraana/ General store			
Skillcenter/ Adult Training center			

Accessibility of Road:

- Seasonal Variation on its accessibility:

Distance from hospital (Kms.):
Distance from market / mandi:

Distance from Bus / train point (Kms.):
Distance from Court /administrative area (Kms.)
Distance from police station (Kms.):
Minimum distance between your place of working and residence (Kms)

Major Occupation of the Village:

Lighting Facilities (Street Lights):
Waste disposal system:
Community Gathering area:
Parking Facilities:

- Shikara
- Vehicles

Tourism Facilities available currently
Main Festivals celebrated:

Availability of open spaces?
Spaces for children to play?

WINTERS:
What is done for sewage during the winter?
For drinking water ?
For heating purposes ?

- Burning/ buqhari - where is wood collected from ?
- Coal - Where is coal collected from ?
- Other :

Condition of houses in the village respond to the cold weather?
Accessibility during heavy snowfall?
Problems faced by the village due to snow ?

SUMMERS:
What is done for cooling purpose ?
Effect on agriculture?
Effect on lake ?
Problems faced during summers ?

MONSOONS
Does the village flood?
Is there any effect on the house ?
Effect on houses and land spaces?
Effect on occupation?

TOURISM
Effect of Tourism on occupation:
Would you want you village to be a tourism destination:
What would be the impact of having home stays in your village?

Hno	Building Use	Name of Head of the House	No of people living in the house	House on water or land (W/L)	Pucca/Kutcha (P/K)	Age of the house	Area of the House	Floors		Room		Size of Kitchen	Washroom			Store Room/ Attic
								No.	M-Floor	No.	Avr Size		Inside/ outside	No	Size	

Building Use | R1- Residential C1- Commercial M- Mixed Use R2- Religious S- Storage C2- Community

Sewage Facility		Water Facility		Electricity Facility	Construction Material & Technique										Heating and cooling techniques
					Foundation		Floor		Walls		Roof		Windows - Orientation		
Domestic	Storm	Drinking	Daily use		Material	Condition	Material	Condition	Material	Condition	Material	Condition	Material	Condition	

Condition | 1 - Good, 2 - Moderate 3- Bad

Unique features	Open space	Need for extra space?						Problems faced in the house	Suggestion for improvement	Structural Condition
		Room(E/N)	Size	Room(E/N)	Size	Room(E/N)	Size			

Structural Condition | 1- Demolition Required 2- Renovation required 3- No action required

House no.	Name of Head of the House	No of people		Primary Occupation	Secondary Occupation	Third Occupation (If any)	Seasonal Variation	Occupation of Females	Monthly Income	Literacy Status	Major Possessions	Any Skill performed	Area of agriculture land owned if any
		M	F										

Occupation | F- Fisherman, F1- Farming, S- Shikara Drivers, A - Artisan, C - Chestnut collectors, S1 - Shop owners

Occupation: AGRICULTURE

Percentage of crop grown on water:
Percentage of crop grown on land/soil:
Average hours required on the crop bed:
What is done to plow the land:
How is the crop harvested:
Do crops grow all year?
When nothing is being cultivated, what is done on the land:
What fertilzers are used:
Where are crops sold:
Where are seeds brought and bought from:
What can be done to better the agriculture produce:
Involvement in husbandry?

- Food for cattle ?
- Vet ?

Highest selling crops:

What all crops are grown:

Name of Crop	Grown on		Percentage of crop produced in an year	Seasons		Storage of seeds	Storage of crop	Cost of Crop in market	Special Equipment required?	Problems faced
	Land	Water		Sowing	Harvesting					

Occupation: FISHING

Sno	Name of Fisherman	Name of Fishes caught	Hours spent fishing	Daily Income	Storage of fish	Storage of Equipment	Parking for Fishing canoe	Problems faced

Name of Fish	Places to catch fish	Season Variation		Price at which it is sold	Problems faced
		Best	Worst		

What equipment are required for fishing:
Where is the catch sold:
What can be done to better fishing experience.

Occupation: Shikara Drivers
Best and worst season for shikara drivers:
Shikara Driver routes:

Sno	Name of Shikara Driver	Time spent in a day	Avr money earned in a day	Parking of Shikara Safety	Places to get clients	Maintance of shikara	Cost of shikara	Do you sell anything on your shikara	Route taken by the shikara driver	Problems Faced

HAMLET BUILDING NUMBERING

Figure 22 : Map for Building Identification

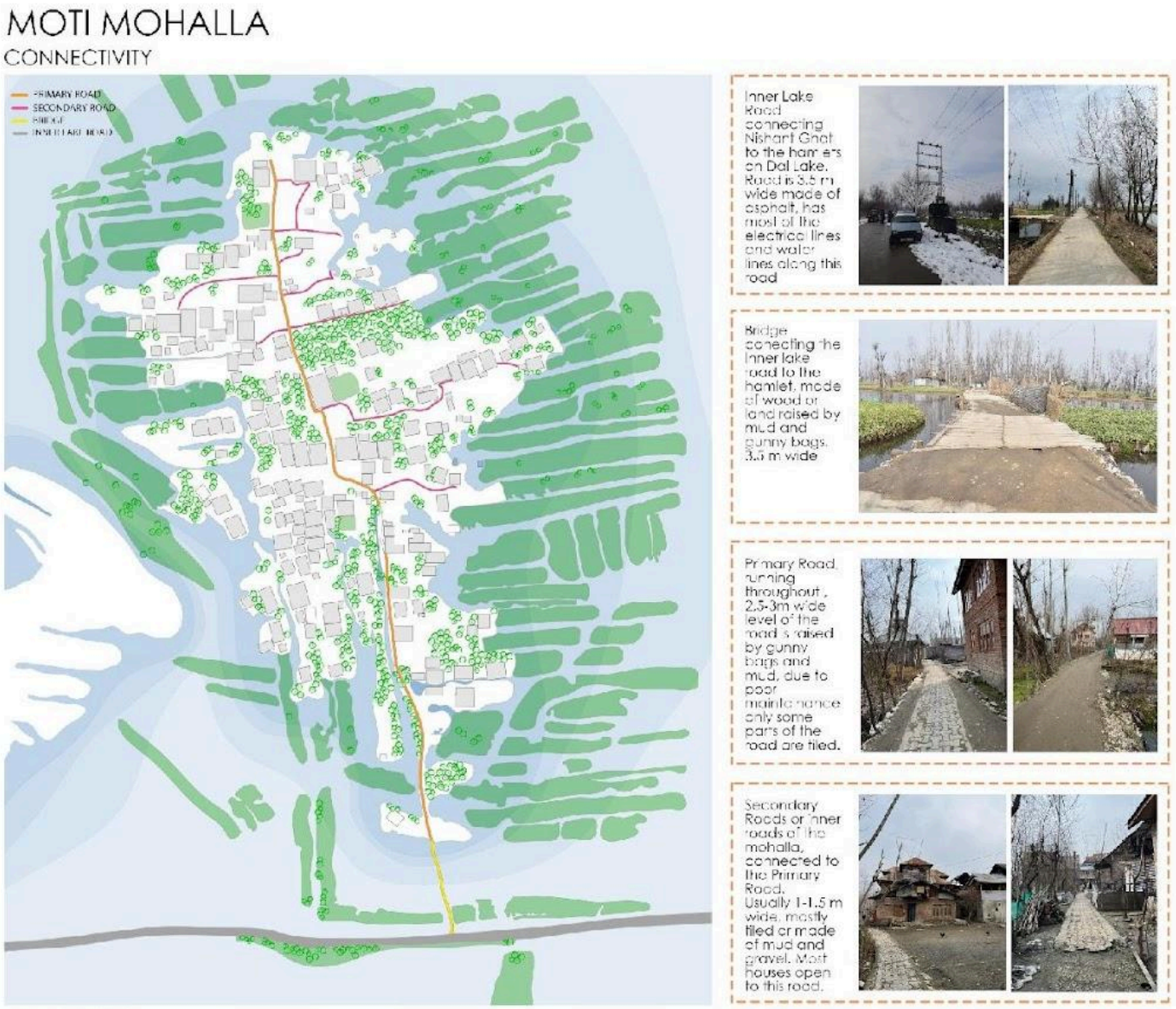


Figure 23 : Connectivity throughout the Hamlet

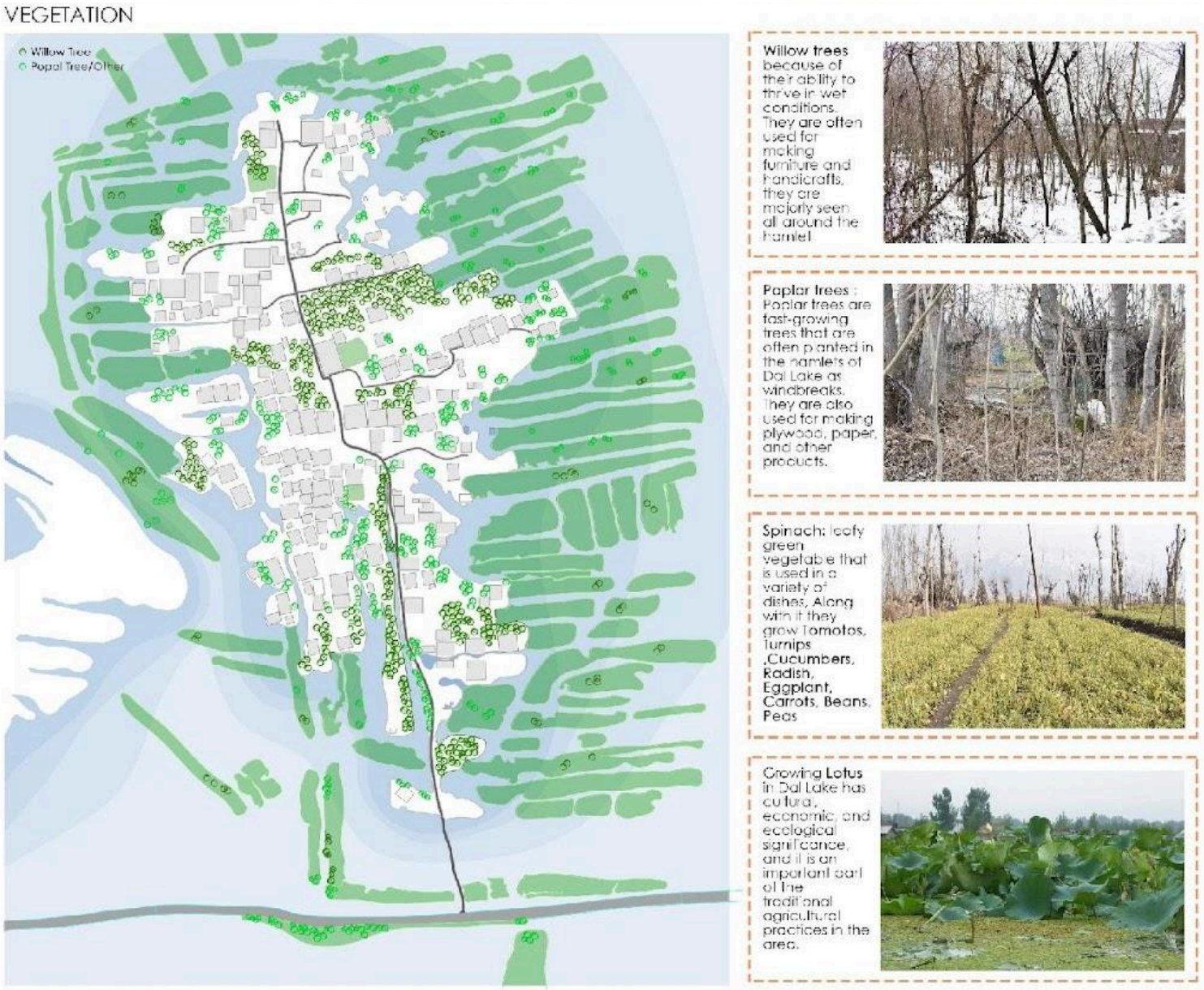


Figure 24 : Map of Vegetation in the Hamlet

Figure 25 : Landmark Map

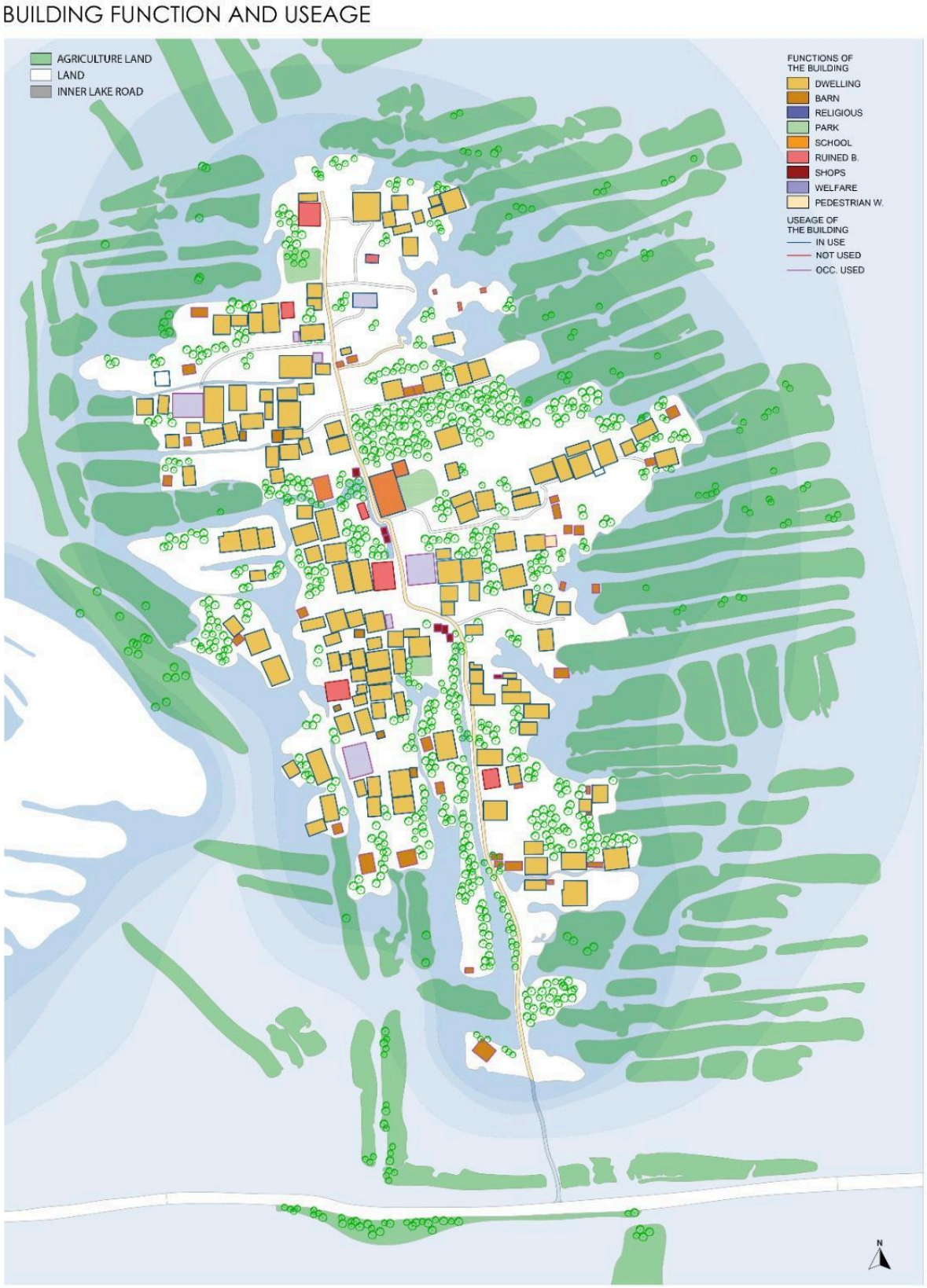


Figure 26 : Map showcasing Building function.

SOCIAL HOUSE MAPPING

People in Moti Mohalla are usually occupied in occupation activities like Fishing , Agriculture and Mazdoori. These activities are majorly performed by the men of the house, the females are involved in activities like Tailoring, Weaving or House wifes. Women are also seen to be actively of huge importance for agriculture activities. Most of the houses in the mohalla consists of houses that are occupied by both farmers and fishermen, thus mixed use occupation is maximum. After that Farmers are seen to occupy most of the houses. The fisher man are seen to have houses along the water edge, where the fishing canoes are also parked. The inner houses of the mohalla consists of mixed or farming practicing families.

Figure 27 : Social House Mapping

HEIGHT AND ROOF ANALYSIS

Figure 28 : Map Showcasing Height and Roof Analysis

Figure 29 : Map showcasing structural systems.

Construction Details

TYPE 1 : FIRST FLOOR WALLS - BRICK
SECOND FLOOR WALLS - BRICK
FLOORING : WOOD
ROOF : WOOD AND CGI SHEETS

With wood framing and filling of brick, these are one of the newest forms of construction observed in the mohalla.

TYPE 2 : FOUNDATION : STONE
FIRST FLOOR WALLS : BRICK
SECOND FLOOR WALLS : TIN
SLAB : WOOD
ROOF : WOOF AND CGI SHEETS

Most of the houses in the village use a combination of tin and brick for their houses, with brick on the lower level to provide strength and tin on the higher floor.

TYPE 3 : FOUNDATION: STONE
FIRST FLOOR WALL : BRICK
SECOND FLOOR WALL : WOOD
ROOF : WOOD AND CGI SHEETS
SLAB : WOOD

A number of houses use their second floor as attic /store, these are covered by wood walls. Keeping the lighter weight on top of the building this helps in load division.

TYPE 4: WALLS : ALUMINIUM SHEETS
ROOF WOOD AND CGI SHEETS

Smaller houses in Moti mohalla with ls income have built houses out of tin walls, these have poor structural strength and poor insulating capabilities. Usually have slighting slanting roof

TYPE 5 : FOUNDATION : STONE
WALLS : WOOD
ROOF : WOOD AND CGI SHEETS

Only a small amount of houses in Moti Mohalla are built completly out of wood due to its low strenght and low insulating capacity. Mostly usee for Barns, keeping cattle or to provide temporary shelter.

Figure 30: Construction material for Dwellings

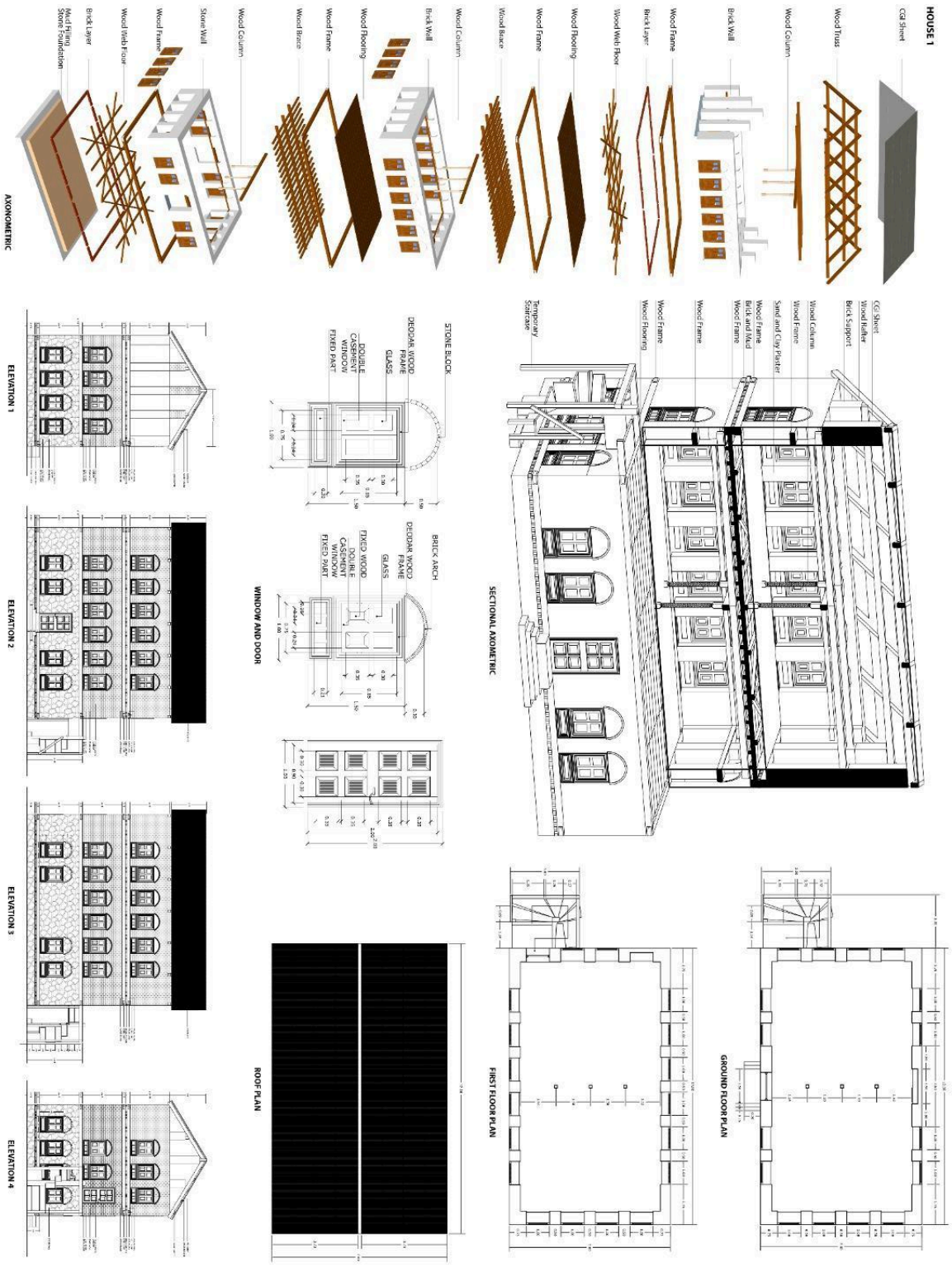


Figure 31: Dwelling Unit Type 1

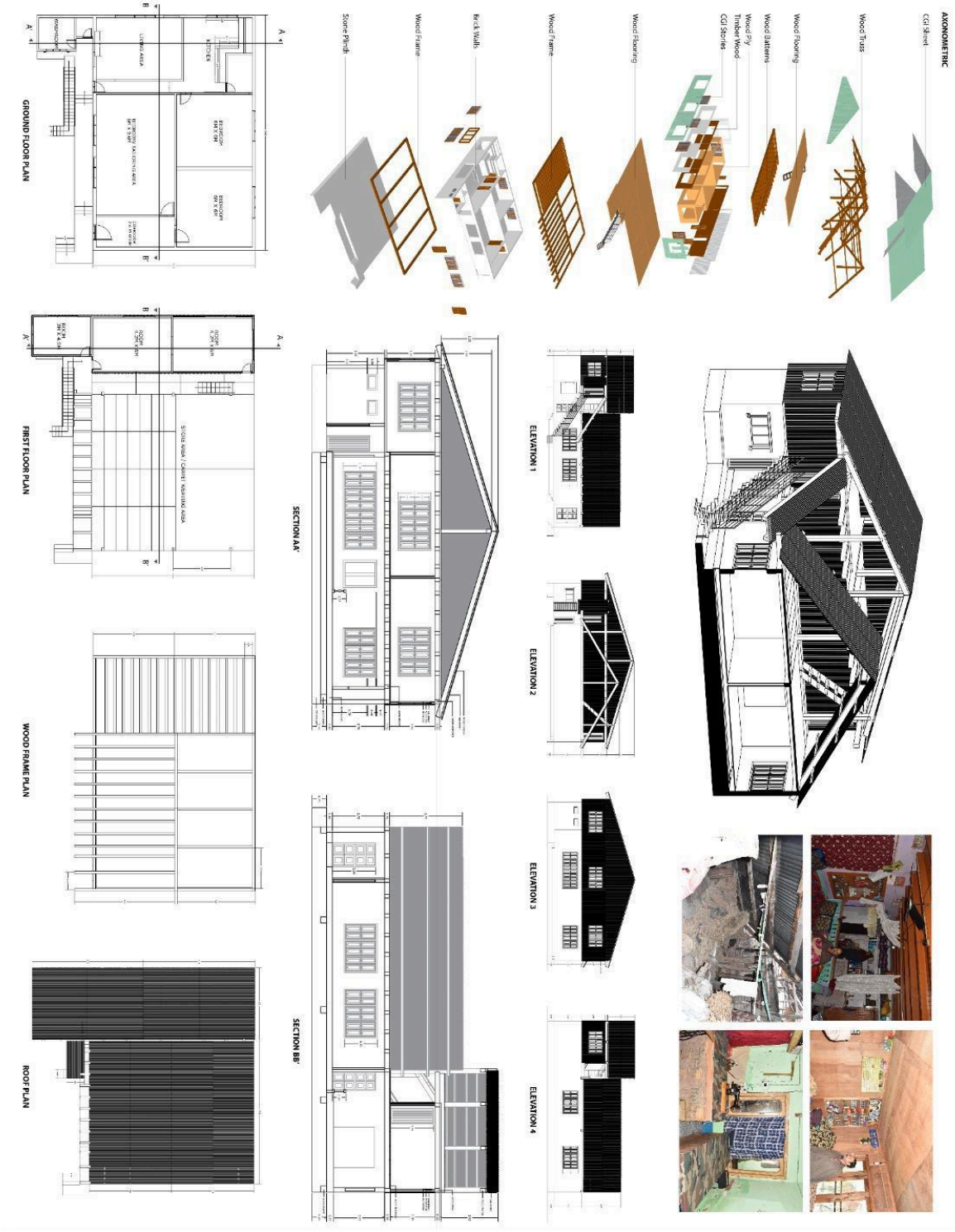


Figure 32 : Dwelling Unit Type 2

Impact Assessment

Impact assessment is an important step in understanding the effects of any proposed interventions or management strategies on Dal Lake and its inhabitants. Here are some key aspects of impact assessment:

- Environmental impact assessment: Environmental impact assessment involves evaluating the potential environmental impacts of any proposed interventions or management strategies, including changes to land use, water quality, and other factors. This assessment can be done using a variety of tools, including computer models, field surveys, and stakeholder consultations.

- Social impact assessment: Social impact assessment involves evaluating the potential social impacts of any proposed interventions or management strategies, including changes to livelihoods, community structures, and social norms. This assessment can be done using a combination of field surveys, stakeholder consultations, and other social science research methods.

- Economic impact assessment: Economic impact assessment involves evaluating the potential economic impacts of any proposed interventions or management strategies, including changes to income levels, employment, and other economic factors. This assessment can be done using a combination of economic models, surveys, and stakeholder consultations.

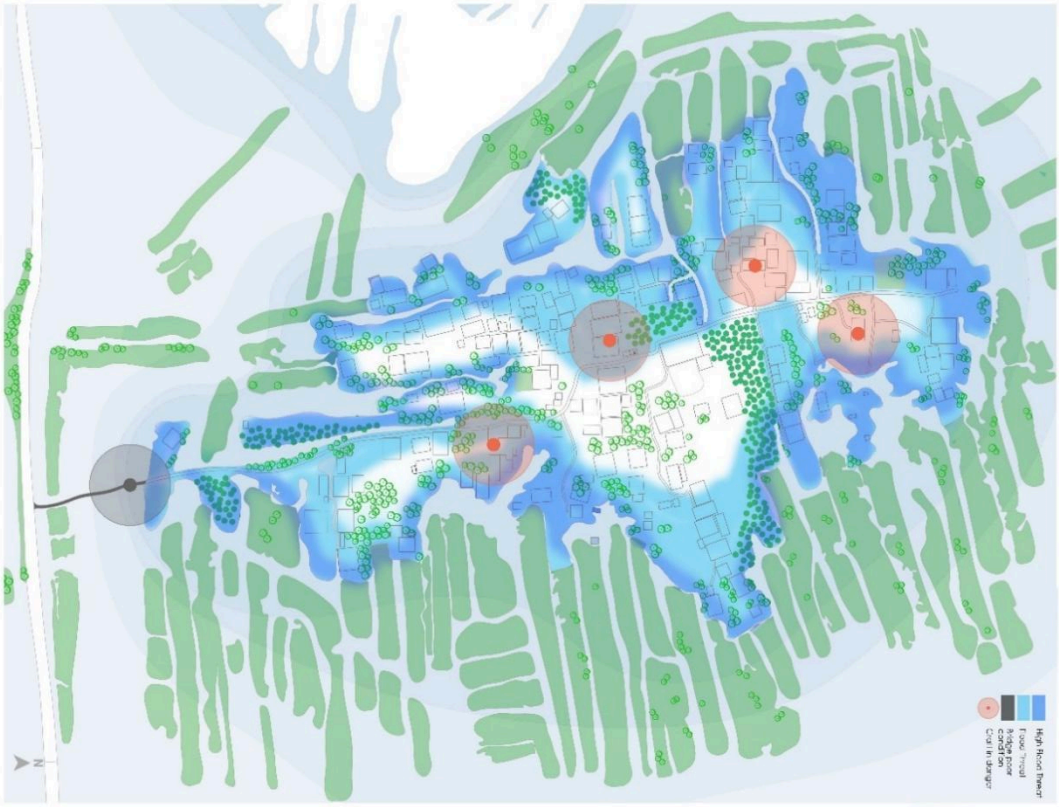
- Technological impact assessment: Technological impact assessment involves evaluating the potential technological impacts of any proposed interventions or management strategies, including changes to infrastructure, equipment, and other technologies. This assessment can be done using a combination of technical studies, stakeholder consultations, and other research methods.

- Stakeholder engagement: Finally, stakeholder engagement is a critical aspect of impact assessment, as it allows local residents, policymakers, and other stakeholders to provide input and feedback on any proposed interventions.

IMPACT ASSEMENT MAPS

MINIMISE

Flood control by better infrastucture - tool kit for houses in the mohalla
Better control of pollution through Bioremediation
Better control by project implementation
Weed control by involving dwellers into lake conservation activities
Preservation of Plantation in the Mohalla



REVIVE

Heritage buildings by conserving and utilizing them in a functional manner
Revive the cultural crafts of the mohalla and further encourage it

Figure 33 : Map of Impact Assessment

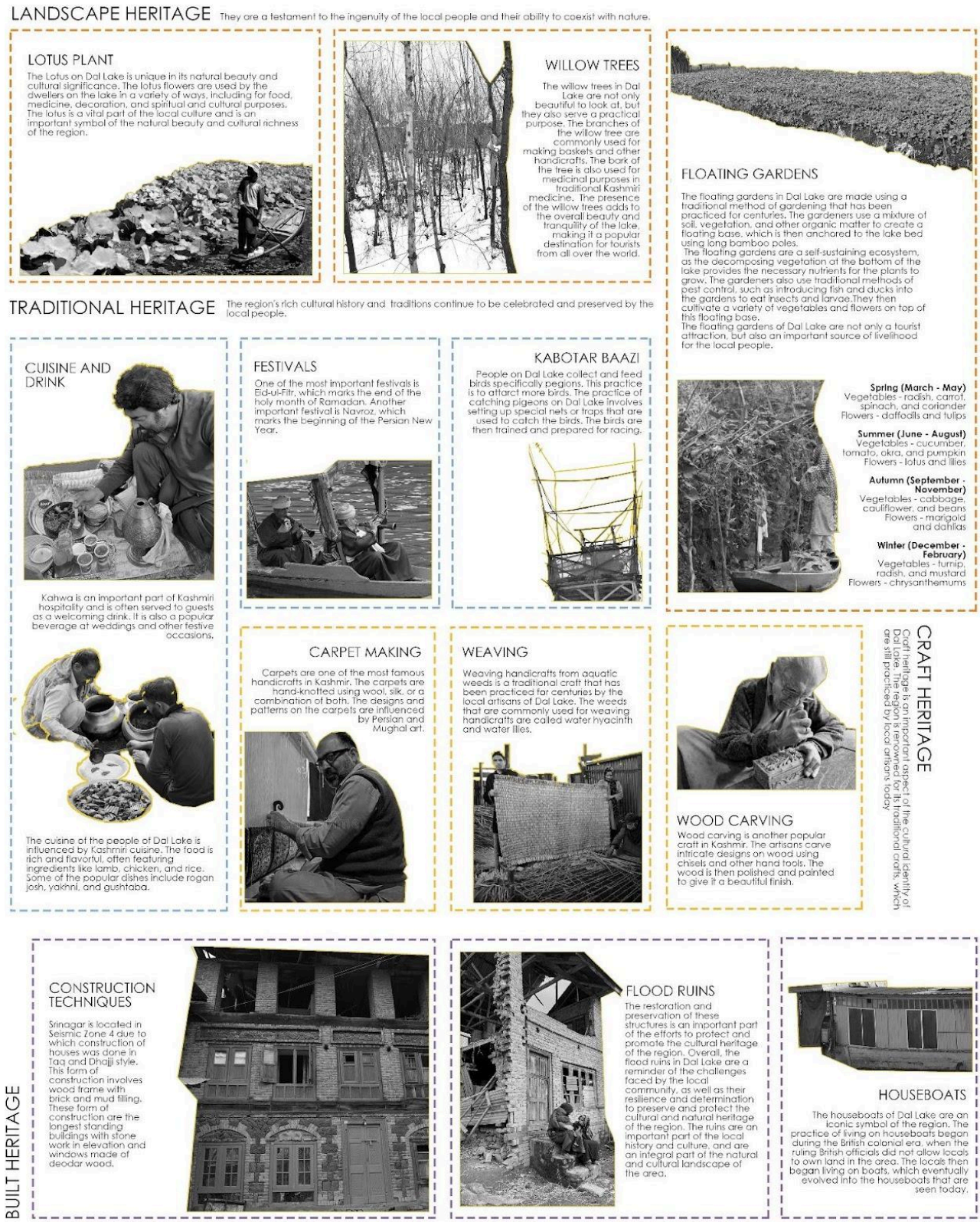


Figure 34 : Dal Lake Heritage

Figure 35 : Heritage Mapping

Proposal of the Hamlet:

1. Sewerage System

a. Implement a Small-Scale Sewage Treatment Plant (STO) with a capacity of 18 kiloliters per day (0.18 megaliters per day) in each hamlet.
b. Install a sewer line along with a communal collection sump in each hamlet.
c. Go back to Indigenous practices and introduce the Phythorid or Dewart Technology

Sewage System

Addressing the sewage management in these hamlets and villages is undeniably one of the most critical and pressing issues in their overall development. The problem of sewage management poses a significant challenge, and as a result, a pragmatic and tailored solution that suits the specific local conditions is proposed. The sewage generated from these settlements is a major ecological and environmental concern for pristine Dal Lake, as it significantly contributes to the lake's nutrient load, polluting its waters on a daily basis. The environmental degradation of the lake can be directly attributed to human settlements established within and in close proximity to its shores.

The primary objective of this project is to establish a comprehensive public wastewater collection and disposal system that ensures the proper handling and treatment of sewage and sullage discharged from the hamlets and villages. The aim is to carry out these operations without causing any adverse health impacts or environmental hazards. However, the challenge lies in the fact that the ultimate disposal site for the treated sewage is none other than Dal Lake itself, making the task even more intricate and critical.

In devising a viable approach, the initial hurdle was to plan and execute different essential amenities while considering the constraint of water channels. A thorough geotechnical investigation revealed that the landmass of these hamlets and villages is highly saturated. Consequently, any excavation beyond a depth of 1.00 meter would necessitate relentless dewatering and could lead to unnecessary sloughing, rendering the execution process cumbersome. To overcome this challenge, the focus was on keeping excavation depths to the minimum.

In this context, numerous alternatives were diligently analyzed, exploring different permutations and combinations to find an optimal solution. After careful evaluation, a final and most feasible approach was arrived at, which involved adopting an integrated method of sewage treatment and disposal through the introduction of a sewerage system.

According to the proposed plan, each hamlet will be equipped with a collection tank, along with a standby tank for continuous operations. Once a tank becomes filled, there will be an efficient system in place to replace it with an empty one, while ensuring the collected sewage is disposed

of responsibly at an appropriate location. This integrated approach of treatment and disposal was chosen over the existing system, which has shown limited effectiveness in other locations.

By embracing the sewerage system, this project aims to effectively manage the sewage in these hamlets and villages, contributing significantly to the enhancement of Dal Lake's environmental conditions. It serves as a pivotal step towards curbing pollution and preserving the natural beauty and ecological balance of this remarkable lake. With careful planning, execution, and monitoring, the hope is that the initiative will foster sustainable development while ensuring a harmonious coexistence between the communities and the delicate ecosystem of Dal Lake.

Methodology and Process:
The current population in each hamlet ranges is 900 individuals. To address sewage management, a systematic approach will be implemented. Each house in the hamlet will be linked to either a 110mm HDPE sewage pipe or a 150mm RCC spun pipe, equipped with intermediate manholes for collection. The collected sewage will be directed to a common sump. From there, a sewage submersible pump will lift the sewage through a 110mm diameter HDPE rising main and transfer it to the Compact Sewage Treatment Plant (STP) for processing.

Design Parameters:
The sewage generation per capita will be considered at 80% of the water supply, amounting to 108 liters per capita per day (lpcd).

Design Population

Year	**2023 (Base Year)**	**2023 (Mid-Year)**
Total Population	900	1400

1. **Sewage Generation:**

Design Population: 1400 souls
Add Floating Population @10%: 1540 souls

Total designed population: 1540 souls
• Sewage generation per capita adopted is 80% of water supply = 108 lpcd.

• Sewage Generation for 1113 population: 1540 x 108
= 1,66,320 lpcd
= 166.23 cum/day
= 0.166 MLD
Say 0.18 MLD

2. **Technology proposed: Compact STP (MBR / SBR)**

The project involves the Supply, Installation, Testing, and Commissioning of Electrical Motor-driven submersible pumping units, designed with the following specifications:

a. Pump Type: Submersible non-clog sewage pump
b. Number of pumping units for each sump: 2 (1 operational + 1 standby)
c. Motor Capacity: 1.0 HP, featuring:
- Stainless steel motor housing & pump casing for durability in challenging conditions.
- Watertight, dust-tight, and completely submersible seal for protection.
- Double seal design (Mechanical + oil seal) to enhance bearing lubrication and prevent leakage.
- High-efficiency dry type motor for eco-friendliness.
- Cutter impeller to prevent clogging issues.
- Robust construction for improved reliability.
- Hand-carry design for easy transport.
- Auto reset thermal overload protection for extended motor lifespan.

d. Total Dynamic Head: 15.0 Meters
e. Phase: Single phase
f. Discharge of each pumping unit: 350-450 Liters per minute
g. Safety: In-built thermal overload protection
h. Installation: Vertical
i. Suction delivery: 110 mm

The pumping units will be equipped with stainless steel bodies, along with level controllers and sensors. Each unit will have its own solar panel, inverter, and double batteries to provide power backup in case of electricity failure. The scope of work includes fitting the required capacity solar panels, wiring, and fixers, ensuring a complete and efficient setup.

Manholes:

Manholes are essential R.C.C. chambers constructed in accordance with IS: 4111(Part 1) along the sewer alignment. Their primary function is to grant access to the sewers for inspection, testing, cleaning, and the removal of obstructions. These structures facilitate the connection of sewer lines and allow for alterations in direction, alignment, and gradient. The proposed manholes are rectangular in shape, adhering to the minimum internal size of 1.00 m x 0.9 m as specified by IS: 4111(Part 1). Additionally, they are designed to receive sewage from various directions.

Spacing of Manholes:

Manholes are strategically placed at every change in sewer alignment, gradient, and at the junction of two or more sewers. They are also installed at the head of all sewers or branches and wherever the size of the sewer undergoes a change. On straight stretches of sewers, manholes are spaced at regular intervals, the frequency of which is dependent on the sewer's size. Larger diameter sewers may have greater spacing between manholes. Moreover, the spacing is influenced by the type of equipment used for sewer cleaning purposes.
The proposed Sewage Treatment Plants (STPs) are designed using the latest technology, specifically Compact STP with MBR or SBR technology. The salient features of these proposed STPs are as follows:

I. Compact Membrane Bioreactor (MBR) is an innovative modular product that efficiently treats sewage.
II. Contributes to the circular economy model by reducing, reusing, and recycling resources.
III. Utilizes a process that involves biological degradation of organic load and nutrients, integrated with membrane filtration.
IV. Effectively eliminates nitrogen and phosphorus from the treated sewage.
V. Consistently achieves high-quality treated sewage, compliant with the latest NGT (National Green Tribunal) standards.
VI. This technology generates minimal sludge compared to conventional treatment processes. Almost all sludge is digested within the system, resulting in a sludge-free process and reducing hassles related to sludge treatment and disposal.
VII. The STPs can handle an additional 20% hydraulic and organic load.
VIII. MBR combines the activated sludge process with a membrane filtration system, encompassing various stages like screening, oil and grease removal, equalization, fine screening, anoxic zone, aeration, and membrane filtration.
IX. The system is completely modularized, making it the most compact sewage recycle plant.
X. Operations are fully automated, and the plant operates silently.

Water Treatment System Qualities:

- High Treatment Capacity: The system can treat wastewater with 2 to 3 times greater efficiency than conventional BOD treatment methods, making it suitable for high-concentration and high-pollutant load wastewater. Its tolerance to fluctuations in pollutant load and resistance to bulking simplify operation and maintenance.
- Sludge Reduction: Compared to conventional activated sludge systems, this system produces significantly less excess sludge, eliminating the need for sludge circulation and reducing operational efforts and costs.
- Compact Facility: The treatment pool's surface area required is 2 to 3 times smaller than conventional facilities, enabling better utilization of limited space.
- Utilization of Existing Facilities: The system can be easily installed by modifying existing facilities, and with some adjustments, existing nitrification and denitrification units can also be used.

Advantages of Compact SBR STP:

- ETP/STP Upgradation: The existing plant's capacity can be upgraded 3 to 5 times that of conventional systems.
- Sludge Reduction: The system excels in reducing sludge (total oxidation) due to lower biomass yield and higher endogenous decay rate of sludge.
- Maintenance: The system requires no cleaning even after ten years of operation.
- N&P Removal: It is highly effective in removing Nitrogen and Phosphorus from wastewater.
- Ease of Modification: Upgrading the old ETP does not require additional civil work; minor arrangements are sufficient to triple the plant's capacity.

STP Type:

The proposed STP is a fully portable container-type system, eliminating the need for heavy civil foundations. However, considering the impact of the September 2014 floods, it is recommended that the STP be elevated at least 2 meters above the existing ground level. Each STP in every hamlet is designed to have a capacity of 0.18 MLD.

Pythorid and Dewart Solutions

The Phytorid system, also known as the Floating Treatment Wetland (FTW), is a nature-based wastewater treatment technology that harnesses the purifying capabilities of plants and microorganisms to clean sewage and improve water quality. This system offers a sustainable and eco-friendly approach to treat sewage, making it particularly beneficial for sensitive ecosystems like Dal Lake, where preserving water quality is of utmost importance.

The Phytorid system functions as an artificial wetland, utilizing a combination of floating aquatic plants and microorganisms to break down and remove pollutants from the sewage water. The process involves a series of stages that allow natural processes to efficiently treat the wastewater. The contaminated water is passed through a bed of floating plants, such as reed beds or water hyacinths, which absorb nutrients like nitrogen and phosphorus. The plant roots provide an ideal habitat for beneficial bacteria, which further break down organic matter, harmful pathogens, and pollutants in the water.

In the context of Dal Lake, which faces considerable pollution from sewage discharge, implementing the Phytorid system offers multiple benefits. Firstly, it helps in reducing the nutrient load in the lake, specifically nitrogen and phosphorus, which are major contributors to the lake's eutrophication and the growth of harmful algae. By removing these nutrients, the system helps restore the natural balance of the lake's ecosystem.

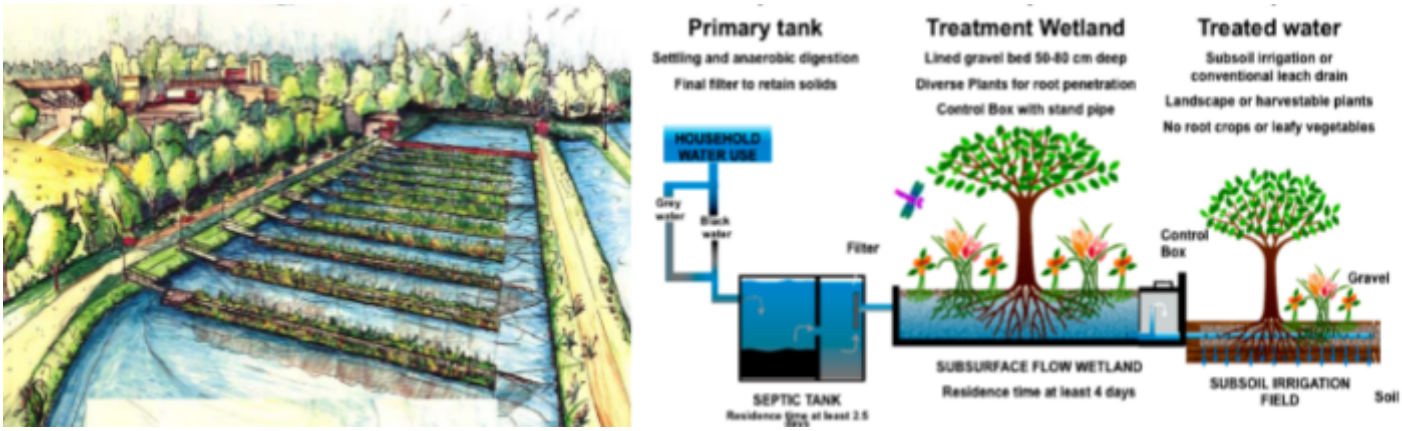
Secondly, the Phytorid system offers a low-cost and sustainable sewage treatment solution. Traditional sewage treatment plants can be expensive to construct and operate, especially in remote areas like Dal Lake. The Phytorid system, on the other hand, has relatively lower maintenance costs and can be easily adapted to the local conditions.

Moreover, the system has a small footprint and can be implemented in areas where space is limited. In the case of Dal Lake, where the available land for conventional treatment plants might be scarce, the floating wetlands can be deployed without the need for large-scale civil works.

Additionally, the Phytorid system is eco-friendly and compatible with the natural environment. As it utilizes living plants and natural processes, it has a minimal ecological impact and complements the cultural and environmental heritage of Dal Lake. This system can also create valuable habitats for aquatic and avian fauna, enhancing biodiversity in the area.

Furthermore, the Phytorid system can be integrated with modern technology and monitoring systems to optimize its performance. Advances in remote sensing and data analytics can be used to monitor water quality parameters and the health of the wetland plants. This combination of age-old techniques with contemporary technology can significantly improve the efficiency and reliability of the Phytorid system in treating sewage and maintaining the water quality of Dal Lake.

In conclusion, the implementation of the Phytorid system in Dal Lake can offer a sustainable and nature-based solution to tackle sewage pollution. By utilizing floating wetlands with aquatic plants and microorganisms, this system can efficiently remove nutrients and pollutants from the sewage, benefiting the lake's water quality and ecosystem. As an eco-friendly and low-cost option, the Phytorid system holds immense promise for safeguarding the natural beauty and cultural heritage of Dal Lake while contributing to the conservation and sustainable development of this precious resource.



2. Expansion of Lake Water Surface by way of Dredging of acquired Land.

3. Eco - Development Works in Hamlets:

a. Slope stabilization

b. Pathway

- Community Pathways
- Tourism Trail

c. Viewing Decks /jetties /ghats and fishing points.

d. Eco-parks

e. Tourism areas-

- Light and Sound show,
- Restaurants to show case Kashmiri cuisine.
- Shops selling goods made by the community of the hamlet.
- Toilets
- Guest Houses

f. Community Area

- Community Center
- Urban open spaces for the people of the Hamlet
- Dispensary
- Schools and Anganwadi
- Workshop areas

f. Street lighting

Pathways – Tourism Trail

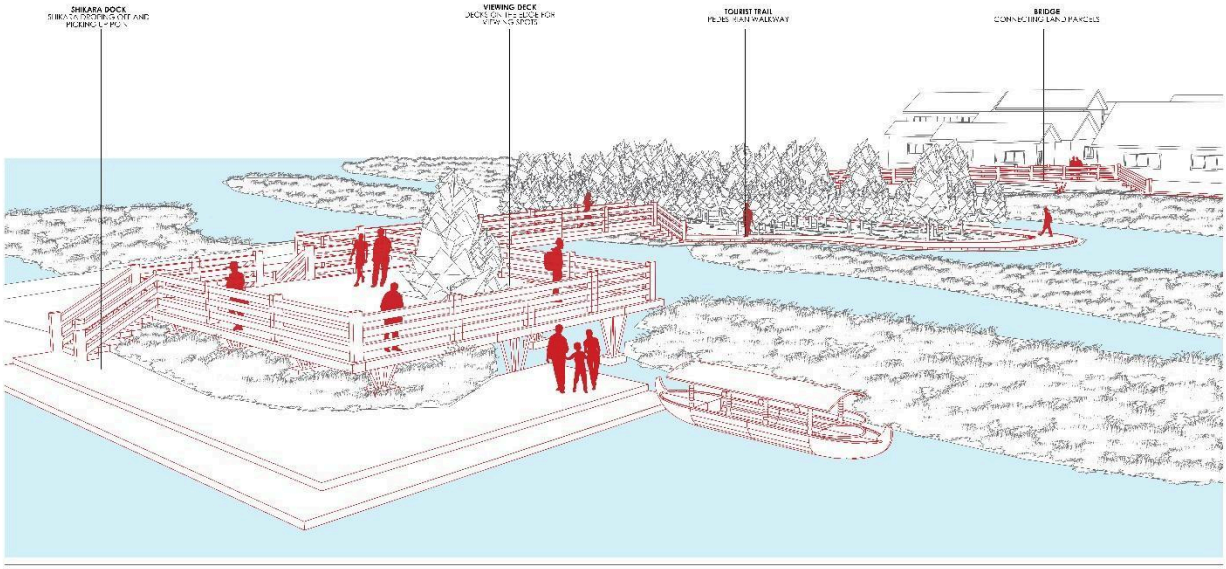


Figure 37 : Tourism trail render Source: Author

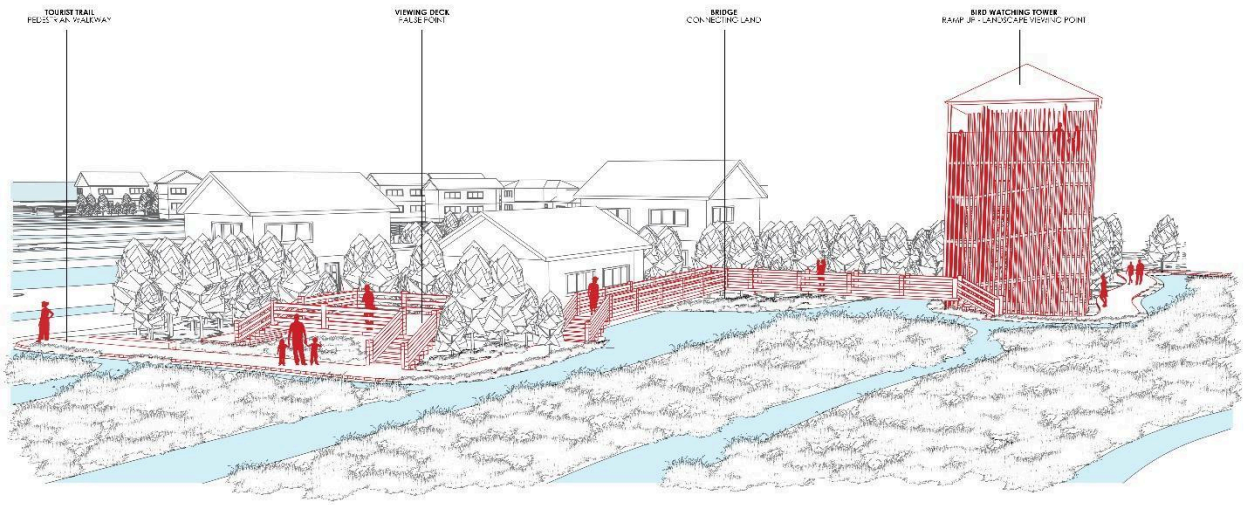


Figure 38 : Tourism trail render Source: Author

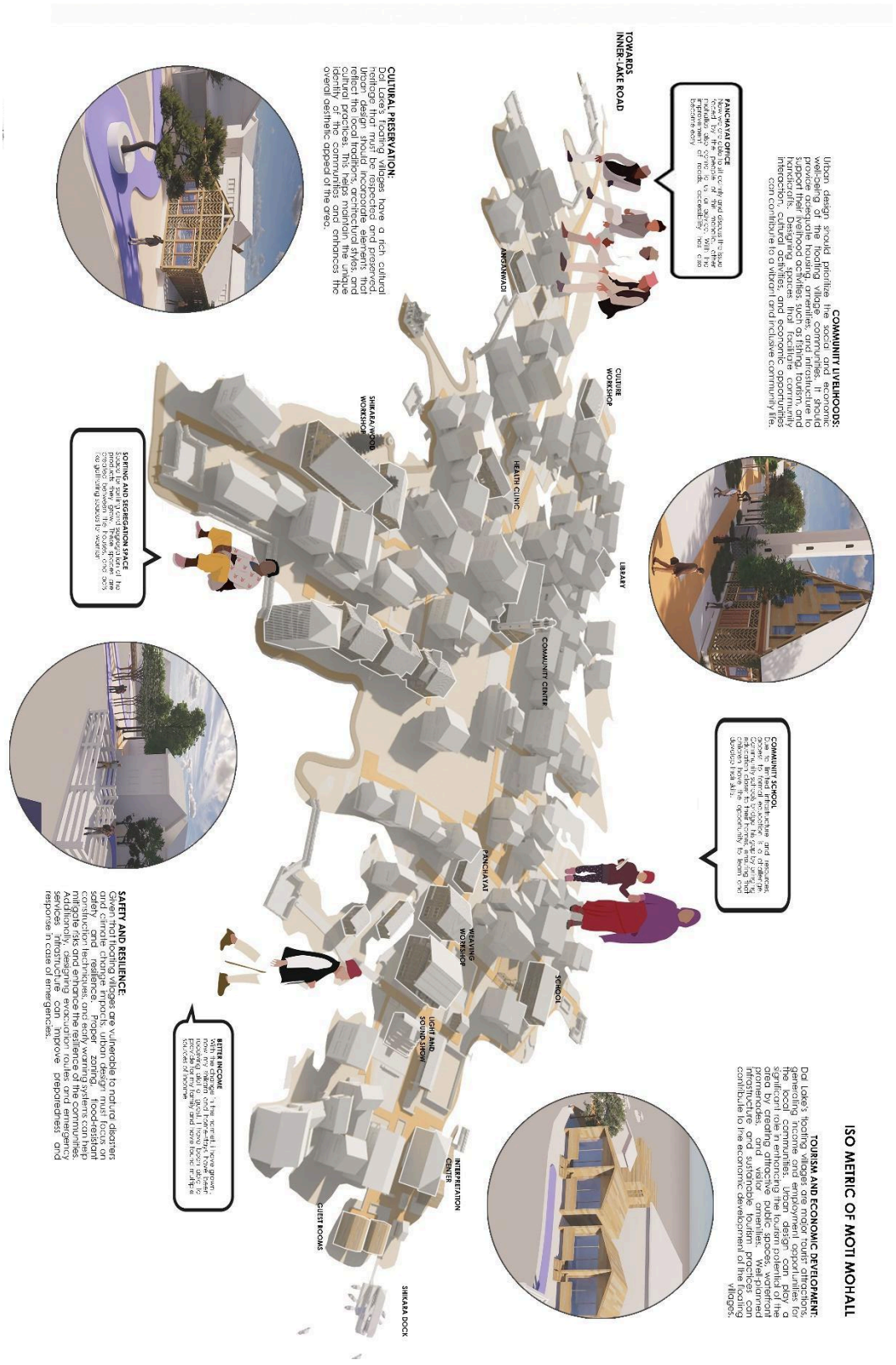


Figure 39; Isometric diagram of Village Source: Author

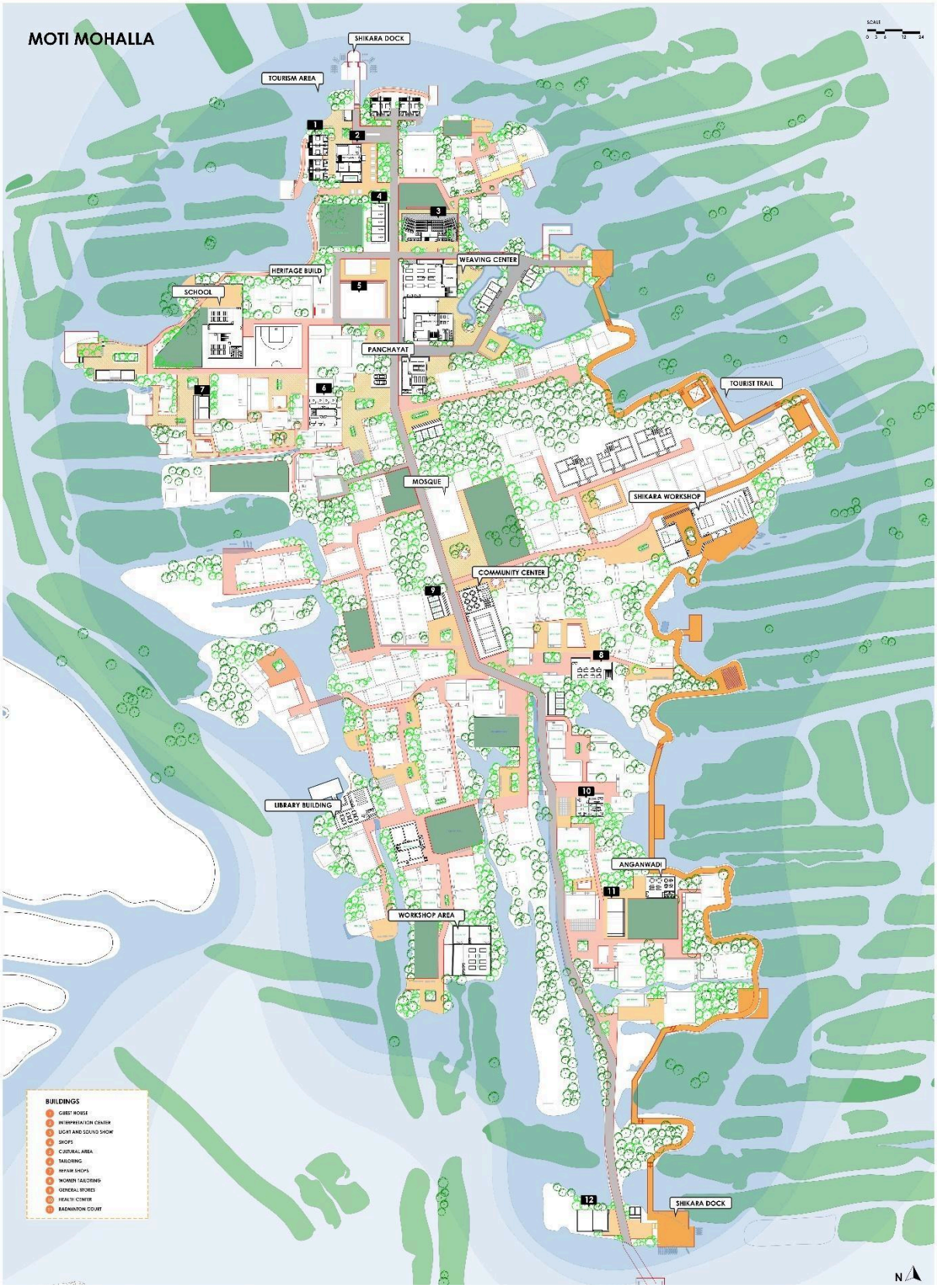

MOTI MOHALLA
SHIKARA DOCK
TOURISM AREA
HERITAGE BUILD
SCHOOL
WEAVING CENTER
PANCHAYAT
TOURIST TRAIL
MOSQUE
SHIKARA WORKSHOP
COMMUNITY CENTER
LIBRARY BUILDING
ANGANWADI
WORKSHOP AREA
SHIKARA DOCK
BUILDINGS
N

Figure 40 : Proposed Site Plan of Moti Mohalla

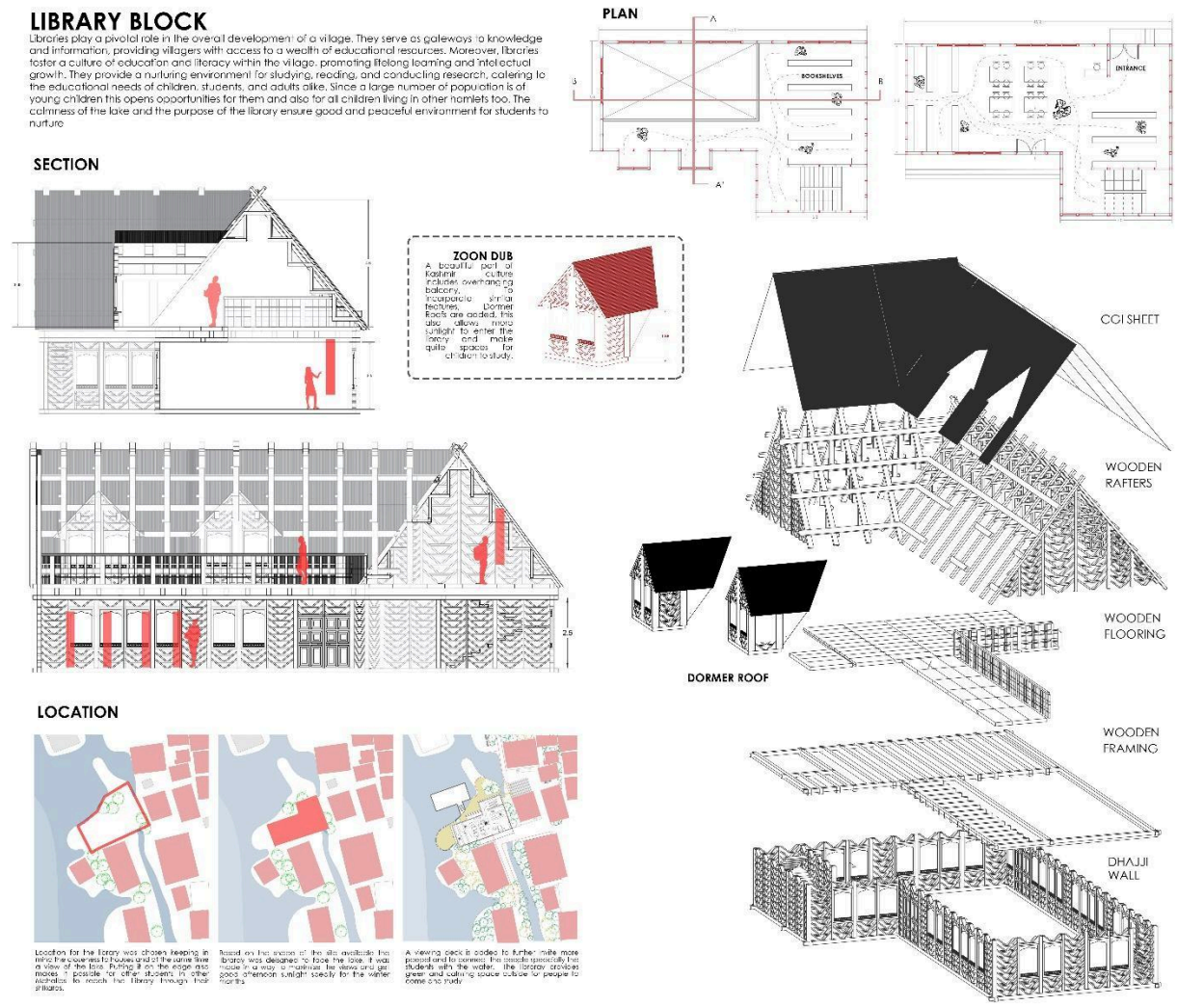


Figure 41: Proposed Library Source: Author

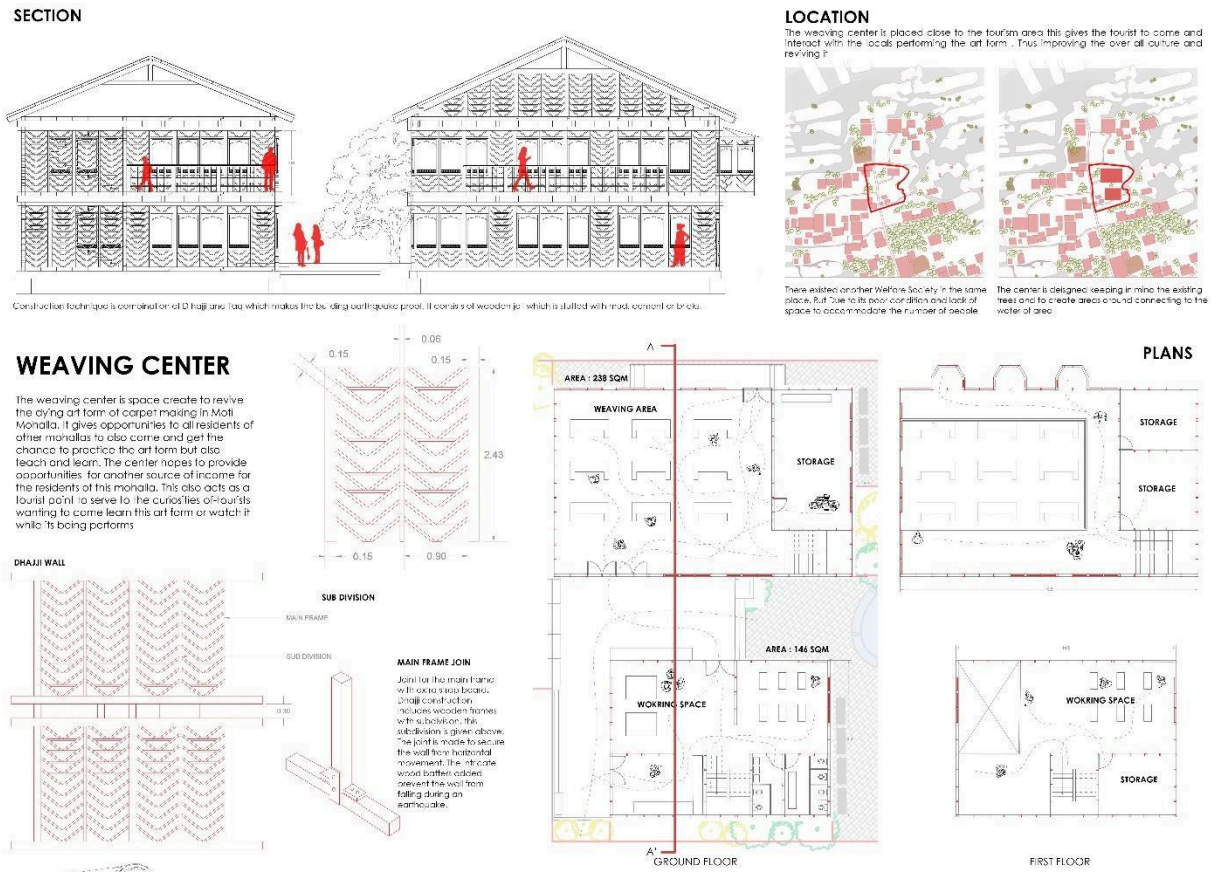


Figure 42 : Proposed Weaving Center Source: Author

Dhajji and Taq Construction

Dhajji and Taq construction techniques are traditional building methods that have been used for centuries in the Kashmir region, particularly in sensitive areas like Dal Lake. These techniques offer a range of benefits that make them well-suited for construction in such delicate environments.

Dhajji construction is a timber-framed system where wooden columns and beams form the primary framework of the building. The spaces between the wooden frame are filled with a mixture of clay, straw, and other natural materials, creating a lightweight yet sturdy wall. This construction method allows for flexibility and resilience, which is crucial in an area like Dal Lake, where the ground may be subject to changes due to water levels and sedimentation.

Taq construction, on the other hand, involves using wooden latticework, which is then filled with bricks or other materials to create the walls. This technique also offers flexibility and allows for the absorption of structural movements, making it earthquake-resistant.

In sensitive zones like Dal Lake, where the ecosystem and landscape need to be preserved, the slow impact of Dhajji and Taq construction on the ground is a significant advantage. Unlike conventional construction methods that involve heavy concrete foundations, Dhajji and Taq structures are less intrusive on the land. Their lightweight and flexible nature allow them to adapt to the natural movements of the ground, reducing the risk of land settlement and subsidence.

Another crucial benefit of these construction techniques is their earthquake-resistant properties. The traditional timber framing used in both Dhajji and Taq construction absorbs and dissipates seismic energy, making the buildings more resilient to earthquakes. In an area like Dal Lake, which is situated in a region with seismic activity, earthquake-resistant structures are of paramount importance for the safety of residents and visitors.

Moreover, the use of natural and locally-sourced materials in Dhajji and Taq construction aligns well with the principles of sustainable and eco-friendly building practices. By utilizing materials that are readily available in the region, these techniques contribute to the conservation of natural resources and reduce the carbon footprint of construction activities.

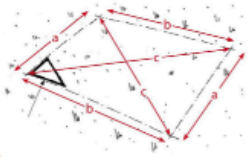
Furthermore, Dhajji and Taq construction techniques are an integral part of the cultural heritage of the Kashmiri people. Preserving and promoting these traditional building methods not only supports the local craftsmanship but also helps in maintaining the unique architectural identity of the region. In sensitive areas like Dal Lake, where cultural preservation is essential, using these traditional techniques in construction can be seen as a tribute to the rich history and heritage of the local communities.

In conclusion, Dhajji and Taq construction techniques offer numerous advantages that make them well-suited for use in sensitive zones like Dal Lake. Their slow impact on the ground and earthquake-resistant properties provide a safer and more sustainable option for building in areas prone to natural movements and seismic activity. Additionally, their cultural significance and eco-friendly attributes further highlight their relevance in preserving the natural and cultural heritage of the region. Embracing these traditional construction methods not only ensures the long-term safety and stability of buildings but also celebrates the timeless craftsmanship of the Kashmiri people.

EXACAVATION

Trace the area to be excavated 9 house outline plus 3-4 feet on either side

Dig out the hard soil to create a level surface for house.



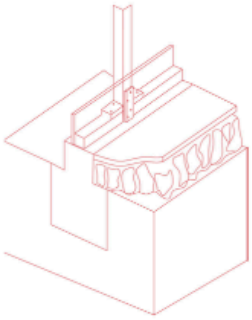
Opposite sides a/a and b/b are paralle and have the same lenght. Then verify the diagonals c/c they must be exactly same

PLINTH

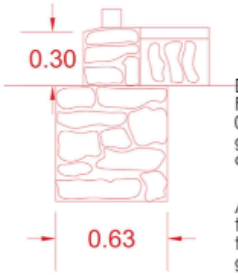
For plinth, in order to avoid humidity coming from the ground , placement of a bed of vertical stones on the natural soil

Then add a layer of stabalized earth which is a micture of earth and cement or earth and bitumen.

The finished floor must not touch the timber base plate as water will get trapped between the floor and the base plate and the timber will not



FOUNDATION

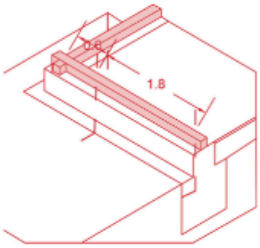


Depth and Width:
Foundation must be atleast 0.6 m/ 2 ft deep in solid ground(excpet on the rock) and at least 2ft wide.

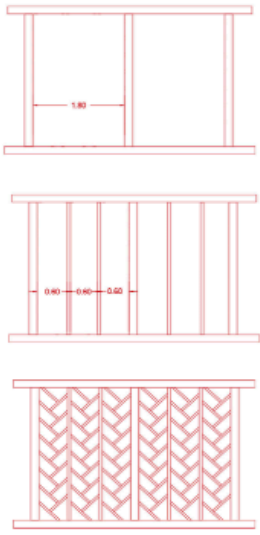
Add a Plinth of 0.3 m/1ft on top of the foundation to keep the base plate away from the ground

Place Ancor rods while making the foundation and make sure that the rods area embedded in 1" of mortar all around

Keep the first anchor rods 2ft from the corner and place the following less than 6ft apart



WALL



The posts of the main frame arae made of timber with a minimal cross section of 4" by 4" placed at 6ft spacing center to center

For two storey building the posts on the ground should be stronger and have a minimum cross section of 4" x 5". Place the larger side in the direction of the wall

For secondary subdivision use timber half as thick as the posts (2"x 4") and place it at 2ft, 3ft or 18" depending on the chosen final subdivision pattern

For the chosen pattern:
Timber an number of nail needed for 1 wall element of 6 x 8 ft

Timber in cft : 3.29
Number of nails : 88

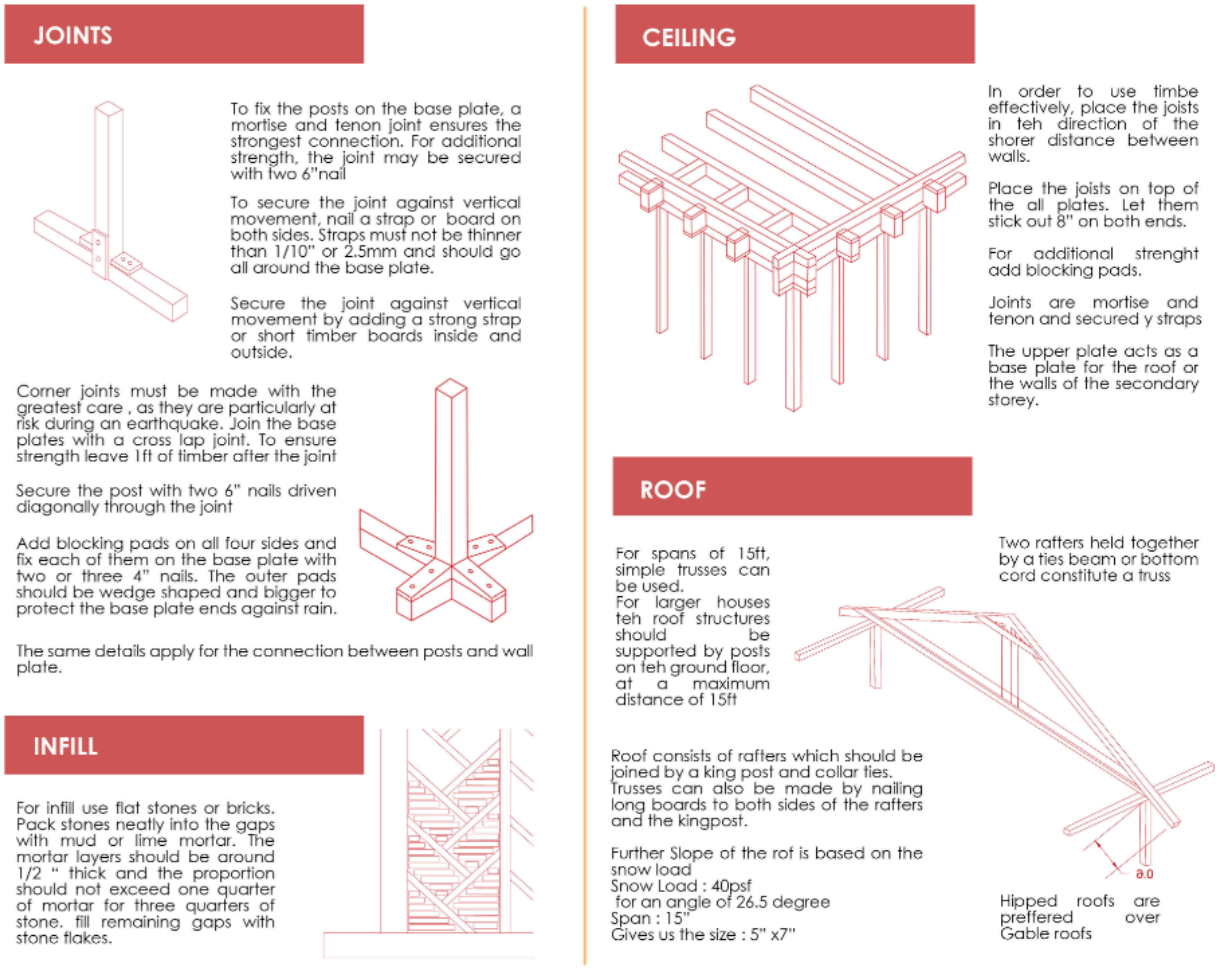


Figure 43 : Tool kit for Dhajji Construction

Lake Restoration

1. Increase and regular check on Buffer Zones

Dal Lake, located in the beautiful Kashmir Valley of India, is renowned for its natural beauty, floating gardens, and houseboats. It has been designated as a UNESCO World Heritage Site due to its cultural significance and unique ecological characteristics. As a precious freshwater lake, it faces numerous challenges, such as pollution, encroachment, and sedimentation, which threaten its ecological health and cultural heritage.

In contrast to other UNESCO heritage lakes around the world, where buffer zones can extend up to hundreds of meters, Dal Lake's 50-meter buffer is relatively small. This inadequate buffer zone leaves the lake vulnerable to human activities that can degrade water quality and impact the surrounding environment.

Sl. No.	Zone/ Area	Green Belt /Buffer (mtr.)
1	Dalgate and Nehru Park	50 meter from edge of the lake or building line whichever is more
2	Nehru Park to Nishat junction (NFR)	100 meter from edge of the lake
3	Nishat Garden to Naseem Bagh	
4	Naseem Bagh to Ashai Bagh Bridge, Nigeen	
5	Around Nigeen Lake from Nigeen Club up to Saidakadal	As shown in the Proposed Landuse Plan
6	Western periphery of Dal Lake from Saidakadal to Dalgate	50 meter from centre of the proposed Dalgate – Saidakadal Western Foreshore Road or the required green belt whichever is more
7	Telbal Nallah (from edge of Nallah)	50
8	Nallah Amir Khan	20
9	Other Tributary Nallahs that feed into the Lake	20
10	Circulation/ Navigation Channels /Irrigation Channels	20

Figure 44 : Buffer Zone Data Source: Master Plan 2023 Srinagar

Expanding the buffer zone to at least 75 meters is a prudent step to safeguard the lake's ecological and cultural values. A wider buffer zone will help restrict potential sources of pollution and encroachments, providing more space for natural processes to function effectively. It will act as a green buffer, allowing vegetation to act as a natural filter, absorbing nutrients and pollutants from the surrounding land and reducing their impact on the lake.

Moreover, a larger buffer zone can serve as a protective corridor for wildlife, allowing for better connectivity between the lake and surrounding natural habitats. This is essential for the survival of various species and maintaining the biodiversity of the area.

To ensure the effectiveness of the buffer zone, it is essential to implement strict regulations and conduct regular monitoring. Any permanent construction within the buffer zone should be strictly prohibited, and any existing encroachments must be addressed through proper enforcement measures.

Community involvement and awareness are also vital in maintaining the buffer zone. Local residents and stakeholders need to be educated about the importance of the buffer zone and their role in preserving the lake's health and cultural heritage. Involving local communities in restoration efforts can also create a sense of ownership and pride, leading to more responsible and sustainable practices.

In conclusion, increasing the buffer zone around Dal Lake to a minimum of 75 meters is crucial for the lake's restoration process and long-term sustainability. By acting as a green buffer and protective corridor, the extended buffer zone will help safeguard the lake's ecological integrity, cultural heritage, and biodiversity. Regular monitoring and strict enforcement of regulations are essential to ensure that no permanent construction is allowed within the buffer zone. The collaborative efforts of all stakeholders, including local communities, are vital in preserving the natural and cultural treasure that is Dal Lake. Through such measures, the restoration process can be facilitated, and the unique beauty and significance of Dal Lake can be preserved for

generations to come.

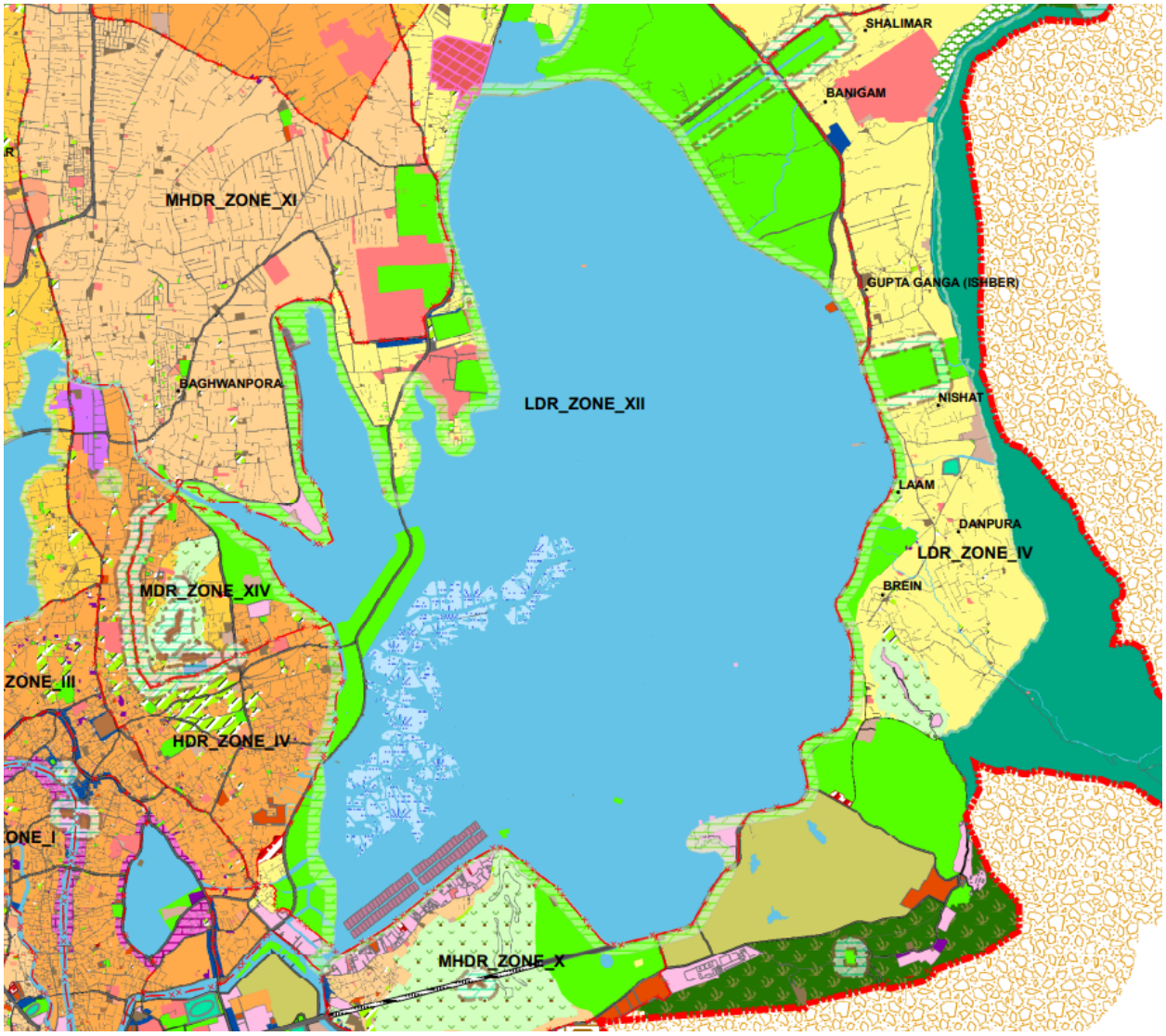


Figure 45 : Master plan 2023 Srinagar

2. Create a distinct boundary along the lake's edge, particularly on the western side, using a physical delineation as indicated in the Master Plan. Designate the Western Foreshore Road from Dalgate to Saidakadal as a greenway to clearly demarcate the lake margin. This measure will effectively prevent any encroachment and block the entry of pollutants into the lake, ensuring complete restriction of undesirable activities.

3. Restoring the Inflow and Outflow Channel
    - Ensure Un-interrupted flow of water towards Nallah Amir Khan.

By restoring and maintaining the water flow towards Nallah Amir Khan, several benefits can be achieved. Firstly, it will enhance the connectivity between Nigeen and Dal Lake, allowing water to move freely between the two lakes. This improved connectivity will facilitate the exchange of nutrients, dissolved oxygen, and aquatic organisms, creating a more balanced and dynamic ecosystem.

A continuous water flow will also prevent the formation of stagnant zones, which can lead to the accumulation of pollutants and deteriorate water quality. Stagnant areas often become breeding grounds for algae blooms and other harmful pathogens, posing a threat to aquatic life and human health. Uninterrupted water circulation will help disperse these pollutants and maintain a healthier and cleaner environment.

Furthermore, a steady flow of water between Nigeen and Dal Lake will aid in sediment transport. Sediments that accumulate in one lake may be naturally transported to the other through the flowing water, preventing excessive sedimentation and preserving the lake's natural depth and contours.

Maintaining good water circulation between the lakes is especially essential during the changing seasons. In the summer months, when water levels may decrease due to evaporation and reduced inflow, a consistent flow towards Nallah Amir Khan can help regulate water levels and mitigate the impacts of water scarcity.

In addition to ecological benefits, restoring the water flow can have positive social and economic implications. Both Nigeen and Dal Lake are popular tourist destinations, and a healthy and vibrant ecosystem will enhance their appeal and attract more visitors. This, in turn, can boost local economies and support livelihoods that rely on tourism and related industries.

To achieve the goal of uninterrupted water flow, comprehensive planning, and cooperation between government agencies, local communities, and environmental organizations are crucial. Restoration efforts may involve dredging, desilting, and improving the infrastructure around Nallah Amir Khan to allow a smooth passage of water between the lakes.

4.The urban runoff from the Catchment needs to be controlled and treated by the setting up of bio-filter around the lake and other measures.

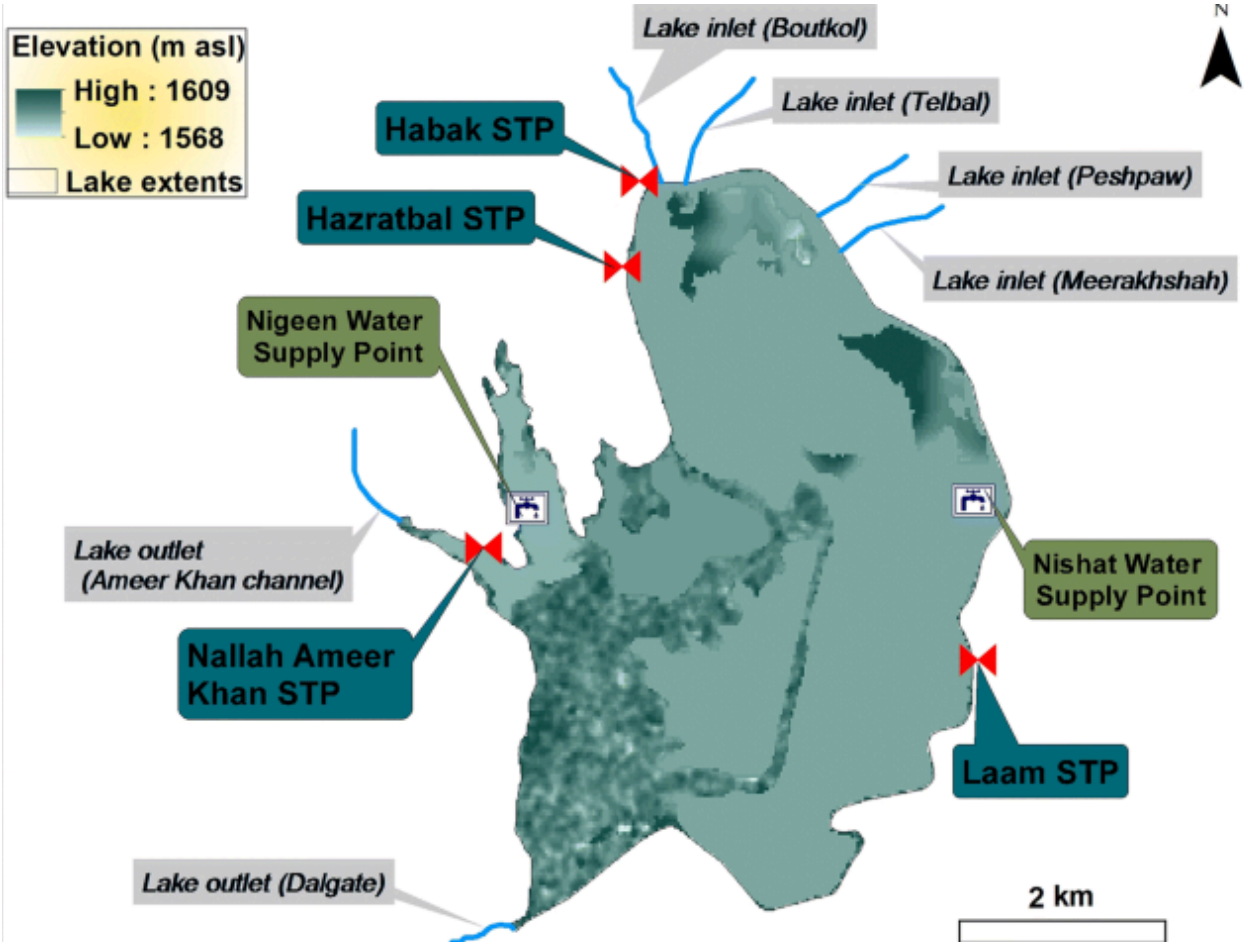


Figure 46 : Dal lake maps with all inflow outflow channels and stp locations

5. The sewage treatment infrastructure in the Lake area comprises five plants with a combined capacity of approximately 37 MLD, currently treating around 32 MLD of sewage. However, three of these plants, which utilize FAB technology, are aging and struggling to maintain the required effluent quality standards and meet the demands of a growing population and expanding service areas. Therefore, it is essential to conduct a comprehensive review of the existing sewerage system and develop a plan for complete sewage treatment. The forthcoming vision document will include specific recommendations for suitable technologies to be implemented.

The remaining two plants use SBR technology, while certain areas like Telbal and parts of Zakura lack sewage treatment plants altogether. Addressing this issue becomes a top priority to ensure that these areas are equipped with sewage treatment facilities to mitigate environmental impacts effectively.

Site Survey



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CERTIFICATE OF COMPLETION

This is to certify that this thesis project titled "**Rejuvenation of Dal Lake and Enhancing the Life of its Dwellers**" was carried out by Smt. **Bhumika Batra,** a student of **Bachelor of Architecture (B.Arch.)**, at the **Amity School of Architecture and Planning**. The research for this project was undertaken under the guidance of the afore-mentioned institute and completed during the period **of 2nd Jan 2023 to 25th May 2023.**

This project was shortlisted under the *Sponsored Thesis Project Competition on "RE-IMAGINING URBAN RIVERS" (Season- 3)* hosted by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG).

This report has been submitted by the student as a final deliverable under the competition. All parts of this research can used by any of the undersigning parties.

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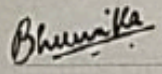
   Signature -



   Institute
   Name - Amity University
   Department - Amity School of Architecture and Planning
   Authorized Representative - Prof. (Dr.) Amit Hajela
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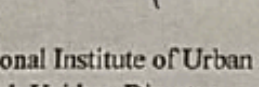

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