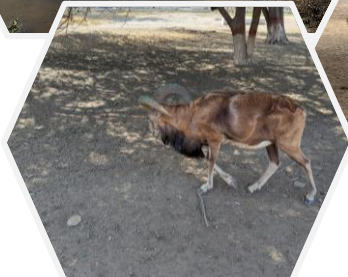




Bahawalpur

City Biodiversity

Action Plan



The Urban Unit
Urban Sector Planning & Management Services Unit (Pvt.) Ltd.



City Biodiversity Action Plan

Bahawalpur

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Executive Summary

Bahawalpur, the cultural and historic center of Southern Punjab, is experiencing rapid urban growth, placing mounting pressure on its natural ecosystems. Unplanned urbanization, expanding settlements, land-use change, pollution, and climate impacts are causing habitat degradation, biodiversity loss, and environmental instability.

A comprehensive biodiversity assessment using the City Biodiversity Index (CBI) revealed alarming declines in native and migratory bird species over the past decade, posing immediate risks to ecological stability and urban biodiversity resilience. Tree canopy cover in Bahawalpur remains critically low at just ~1% of the city area, severely undermining key ecosystem services such as carbon sequestration, urban cooling, and wildlife habitat provision.

In response to these challenges, the Bahawalpur City Biodiversity Action Plan (BCBAP) was formulated through extensive field surveys, stakeholder consultations, and GIS-based habitat mapping. Aligned with Pakistan's National Biodiversity Strategy and Action Plan (NBSAP), the BCBAP presents a strategic roadmap that includes a prioritized project list and an estimated implementation budget of PKR 283.9 million.

Key project interventions include:

- Riparian zone redevelopment along the Sutlej River to support native wetland and avifauna species.

- Desert and buffer zone afforestation in Cholistan to stabilize soils and enhance arid region biodiversity.

- Green linear trails and urban forest corridors (e.g., SLINC Red and SEINC Green Corridor) to restore ecological connectivity and expand urban green cover

- Nature-based wastewater treatment to improve water quality and establish biodiversity-rich urban nodes.

The BCBAP also emphasizes the importance of safeguarding critical habitats around Bahawalpur, including forests, deserts, wetlands, and agricultural zones, particularly along the Hakra River system. These ecosystems are increasingly threatened by urban encroachment and anthropogenic pressures.

To ensure long-term success, the plan establishes a governance framework built on public-private-academic partnerships, inclusive community participation, and strategic monitoring systems. The BCBAP promotes policy support, sustainable urban planning, environmental education, and nature-based tourism.



1. Setting The Stage

1.1 City History and Administration Profile

Bahawalpur is the 13th largest and 8th most populous city of Pakistan. The city has suffered rapid urbanization, with considerable expansion in its urban area. The city is divided into six tehsils, with 109 union councils, five municipal committees 714 villages.¹ The city's population is about 762,111 as of 2023, with a steady annual growth rate of 2.03%.² About 10% of the city's area is used for industrial purposes and 40% of the city's area is dedicated to residential use.³ About 5% of the city's area is dedicated to green spaces, 15% of the city's area is dedicated to commercial use and 30% of the city's area is used for agricultural purposes.⁴

The Parks and Horticulture Authority (PHA) actively manage 23 parks covering approximately 55.4 acres and maintains a 53 km green belt, expanding significantly from 20 parks and 18.5 acres of green belt in 2016⁵. Remote-sensing data from 2003 to 2018 show that forest cover declined by 89.3%, barren land dropped by 57.6%, agricultural area expanded by 34.5%, and urban land increased by 45.5%—indicating a sharp contraction of vegetative canopy amid urban growth.

Historically, the Nawabi rulers actively greened Bahawalpur through canal-based afforestation, formal gardens around landmarks like Noor, Darbar, and Gulzar Mahal, and the establishment of what became the 51,368 ha Lal Suhanra National Park⁶, incorporating floodplain forests and wetlands. In response to canopy collapse, the Bahawalpur City Biodiversity Action Plan now emphasizes proactive interventions: expanding tree canopy in PHA parks, restoring riparian forests along the Sutlej River, and greening urban corridors using native species, all designed to rebuild ecological functions while honoring the city's historical green heritage.

¹ <https://en.wikipedia.org/wiki/Bahawalpur>

² <https://worldpopulationreview.com/cities/pakistan/bahawalpur>

³ Dr. M. Ajmal Khan et al. (2018). Assessment of Urban Parks in Bahawalpur City, Pakistan. Journal of Environmental Science and Health, Part B, 53, 1-8.

⁴ <https://www.google.com/search?q=Bahawalpur+city+demographics&client=app-meta-whatsapp-sa-r>

⁵ <https://www.nation.com.pk/19-Oct-2024/dc-reviews-measure-taken-for-beautification-of-city>

⁶ https://en.wikipedia.org/wiki/Lal_Suhanra_National_Park

1.2 Geographical Profile

Bahawalpur is geographically located in the southeastern part of Punjab in Pakistan. The city lies at a longitude of 71.6752° E and a latitude 29.3978° N, .⁷ The city's height is about 118 meters (387 feet) above sea level.⁸ Bahawalpur is bordered by several cities, including Rahim Yar Khan, Multan, Muzaffargarh, and Lodhran.⁹ The city features a mix of desert, elevated areas, and fertile land, situated in the southern part of Punjab in Pakistan.¹⁰ The climate of Bahawalpur is characterized by three seasons: summer, winter, and the rainy season. Bahawalpur is found near a “Desert of Rajpatana,” so its climate has its natural impact. High-speed and very hot windstorms blow in summer.¹¹ The region is significantly affected by increasing aridity trends, with a declining trend in rainfall and fluctuations in mean annual temperature over the years.¹² The Lal Suhanra National Park, located close to the city, is a protected area that plays a significant role in maintaining the ecological balance of the area.¹³ The Sutlej River, which flows through the city, supports agriculture, industry, and the supply of drinking water in the area.¹⁴ The city's urban forests, including the Bahawalpur National Park, provide habitat for different plant and animal species.¹⁵

⁷ Hassan, M., et al. (2020). Geospatial Analysis of Urban Sprawl in Bahawalpur City, Pakistan. *Journal of Geographic Information System*, 12(2), 1-13.

⁸ Rasheed, S., Akhtar, M., & Ashraf, M. (2022). Urban Green Spaces and Biodiversity Conservation in Bahawalpur City, Pakistan. *Journal of Environmental Science and Health, Part B*, 57, 1-8.

⁹ Ahmed, S., et al. (2022). Diversity of snakes in Bahawalpur district, Punjab, Pakistan. *Journal of Wildlife and Ecology*, 10(1), 1-8.

¹⁰ Khan, A., Arshad, S., & Mohsin, M. (2014). Population Growth and Its Impact on Urban Expansion: A Case Study of Bahawalpur, Pakistan. 2(8), 229–241.

¹¹ Azhar, M. M. (2024). Civilization and Culture of Bahawalpur State; A Research Review. Volume 2(1),30.

¹² Javid, K., Akram, M. A. N., Ranjha, M. M., & Pervaiz, S. (2020). GIS-based assessment of aridity over Punjab Province, Pakistan, by using climatic indices. *Arabian Journal of Geosciences*, 13(7), 1–12.

¹³ Khan, W. A., & Mian, A. (2013). Comparative Population Biology of Black (*Francolinus francolinus*) and Grey (*F. pondicerianus*) Francolins Under Lal Suhanra National Park (Pakistan) Conditions. *Pakistan Journal of Zoology*, 45(4), 949–958

¹⁴ Singh, D., Gupta, R. D., & Jain, S. K. (2015). Assessment of impact of climate change on water resources in a hilly river basin. *Arabian Journal of Geosciences*, 8(12), 10625–10646.

¹⁵ Khan, M. A., et al. (2022). Urban Forestry in Bahawalpur City, Pakistan: A Review. *Journal of Forestry Research*, 33(2), 1-12.

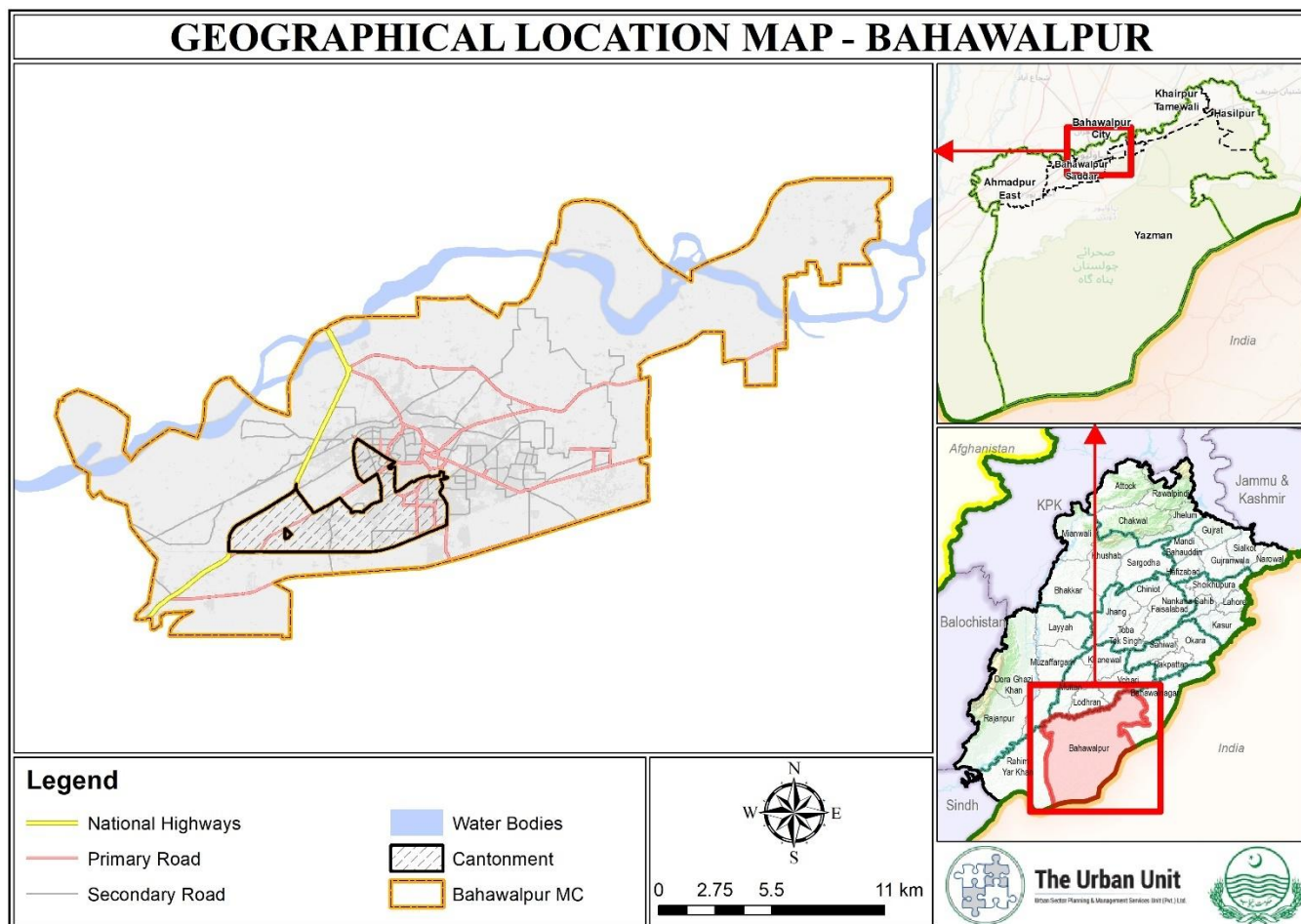


Figure 1. Geographical Location Map of Bahawalpur City

1.3 Purpose of the Biodiversity Action Plan

The purpose of the Biodiversity Action Plan is to protect and preserve the city's biodiversity. The plan aims to create protected areas and promote sustainable resource management.¹⁶ The plan also aims to raise awareness about the involvement of communities in conservation efforts and the importance of urban biodiversity.¹⁷ Urban planners are urged to prioritize the maintenance and the creation of parks to mitigate the environmental impacts of urban growth.¹⁸ Urban forestry initiatives to plant trees have been launched by the government in order to establish urban forests, which can be helpful for the reduction of the urban heat island effect and provide habitat for many plant and animal species as well.¹⁹

1.4. Regional Significance of the Biodiversity Action Plan

¹⁶ Singh, D., & Chaudhary, S. (2024). Biodiversity and Conservation.

¹⁷ Hussain, M., Iqbal, M., & Khan, M. A. (2018). Plant Diversity in Urban Areas of Bahawalpur City, Pakistan. *Journal of Botany*, 50(2), 137-144.

¹⁸ Khan, A., & Shafqat, A. (2014). Assessing the Spatial Distribution and Allocation Gaps of Urban Parks in Bahawalpur City of Punjab, Pakistan.

¹⁹ Iqbal, M., et al. (2020). Biodiversity Conservation in Bahawalpur National Park, Pakistan. *Journal of Biodiversity and Environmental Sciences*, 20(2), 1-8.

Bahawalpur's Biodiversity Action Plan (BAP) is important to influence the ecological health and well-being of the entire Punjab region. Its place near the Indus River Basin, a vital water source for Pakistan and a biodiversity hotspot, makes it a significant player in regional conservation efforts. The BAP will help to protect the Cholistan Desert, a fragile and unique ecosystem. The BAPs also focus on protecting wetlands that serve as vital stopover points for migratory birds traversing the Central Asian Flyway, a vital migratory pathway for millions of birds. The Biodiversity Action Plan (BAP) offers numerous benefits for regional sustainability and environmental conservation.

By protecting critical wetlands, the BAP plays a key role in conserving migratory bird populations and maintaining the ecological integrity of vital wildlife corridors. Its emphasis on community involvement and awareness-raising empowers residents, fostering a sense of ownership and responsibility toward natural resources. This grassroots engagement is essential for achieving long-term sustainable development goals. Moreover, the BAP serves as a valuable model for other cities in the region, demonstrating the effectiveness of sustainable land-use practices, the integration of green infrastructure, and the adoption of eco-friendly technologies. By inspiring other urban centers to adopt similar strategies, the BAP contributes to the creation of a network of environmentally responsible cities across Punjab, ultimately enhancing regional resilience to climate change and biodiversity loss.

2. Methodology

The Bahawalpur Biodiversity Action Plan has been developed with an emphasis on inclusive, sustainable, and adaptable practices to ensure conservation and protection of urban biodiversity. The plan takes a multi-tiered strategy to address habitat assessment, species profiling, health & well-being assessment, ecological significance, and biodiversity loss within Bahawalpur.

An extensive literature review and a field survey approach have been adopted for data collection and analysis. The key stakeholder involvement from local government entities, academic institutions, provincial departments, agencies, and community has been ensured to contextualize relevance and promote BAP ownership. GIS and remote sensing tools have also been used to map critical habitat, changes in land use, and evaluate ecological impacts in Bahawalpur. The methodology adopted for this plan is given below:

2.1 Desk Research

During the initial phase of the study, detailed desk research was conducted to understand the state of the environment and biodiversity of Bahawalpur city in the past decades. Identification of potential survey locations was conducted in Bahawalpur for a comprehensive analysis of its flora and fauna. Desk research and secondary data were based on available published and unpublished material, including reports, scientific journals, articles related to fauna, flora, green spaces, blue spaces, and threats to Bahawalpur city.

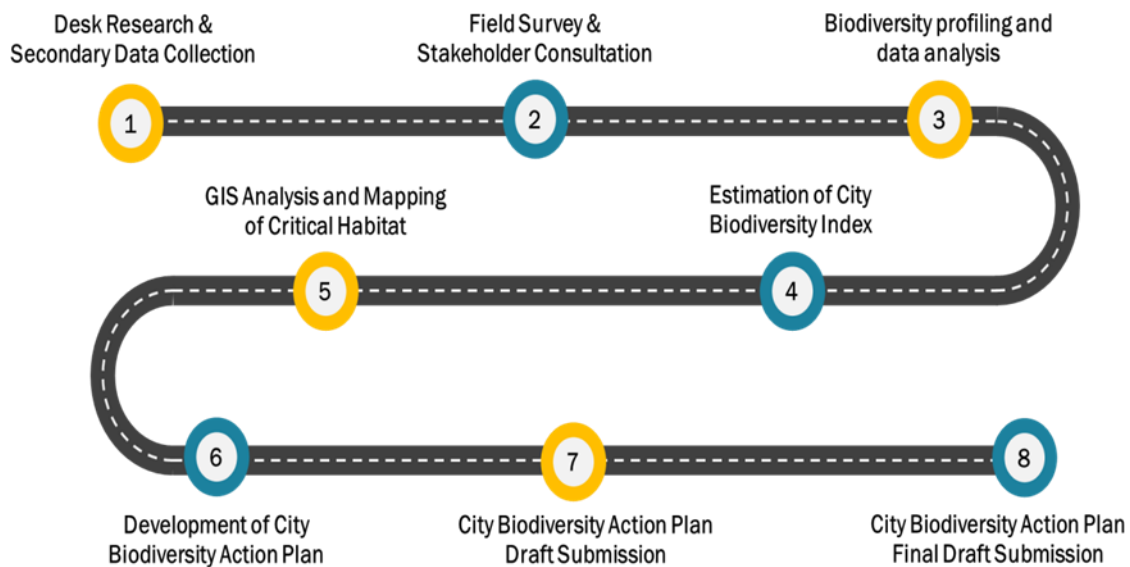


Figure 2. Road Map of Methodology

2.2 Field Visits and Biodiversity Indicators

During the study, key biodiversity indicators such as species richness, pollution level, human impact, habitat quality and associated threats and opportunities were identified. The specific methodologies were followed

to conduct a field survey and evaluate the biodiversity indicators for the fauna and flora of the city.

The Faunal Diversity

The diversity of vertebrates' fauna, i.e., Mammals, Birds, Reptiles, and Amphibians in different habitats, was recorded through different methods, including point count, transect method, and direct count method. Furthermore, during each field visit, different evidence such as footprints, signs of paths, and bird sounds was recorded to list the animal presence in the area.

- **Point count Method:** The point count method is a common bird monitoring technique where observers record bird species and their numbers at specific locations, or "points," during a set period. During this method, randomly selected points in different habitats were observed for a fixed time (30 minutes) while staying there to make observations and count all the birds detected by sight or sound within a predetermined radius. The process was replicated at multiple sites to allow the collection of holistic data concerning the population sizes and species richness.
- **Transect Method:** The transect method is a widely used technique to assess the distribution and abundance of various animal species across a specific area. A straight line known as a transect (ranging from 2 to 3 km in length) was laid out, and organisms were recorded at regular intervals. Animal sightings along these transects were made to record the distribution of animals, including insects, birds, reptiles, amphibians, and mammals across the sites. This was a method for us to keep track of how species were distributed along the transect in response to environmental factors like vegetation, temperature, or moisture.
- **Direct Count Method:** This method was also applied to build an inventory of animals in the study area. The Direct Count Method is considered one of the most applied techniques for estimating species abundance and diversity. This involved counting the animals directly in a defined area. This method was ideal for species that were visible and not too abundant or dispersed. While it ensured high accuracy by counting every individual, it could be time-consuming and resource-intensive, especially for large populations. The method proved most effective in areas where animals were easily observable, making it suitable for smaller-scale studies or species that were easier to track.

The Floral Diversity

A systematic and scientific approach was used to evaluate the plant diversity in Bahawalpur to ensure the detailed documentation of floral diversity. A variety of habitats were surveyed in the city, including forests, parks, wetlands, roadside plantings, green spaces, and agricultural areas. Floral diversity of the visited site was extensively documented using the quadrats and transect method, through which systematic, randomized species sampling and photographic documentation were conducted for further analysis and identification. Plant species were identified based on phyllotaxy and floral morphology with the help of available literature and e-source flora of Pakistan.²⁰ To ensure correct classification and develop a detailed species inventory.

- **Line Transect Method:** A 100-meter-long linear strip was covered to record every species of plant visible along each transect.
- **Quadrat Method:** A randomized quadrat plot of 10m² was laid at a regular interval of 100m in the forest

²⁰ <http://legacy.tropicos.org/Project/Pakistan>

plantation to record the shrubs and trees of each dense plantation area. All the plant species, their richness, frequency, and abundance were recorded for further analysis and documentation.

2.3 Carbon Sequestration Assessment

Carbon sequestration in plants refers to the process of capturing and storing carbon dioxide (CO₂) from the atmosphere through photosynthesis, where plants convert CO₂ into organic compounds such as carbohydrates. Estimating the amount of carbon sequestered by plants involves calculating the carbon stored in various plant components (e.g., leaves, stems, roots).

The general formula to estimate carbon sequestration from plants is:

$$\text{Carbon Sequestered (kg)} = \text{Biomass (kg)} \times \text{Carbon Fraction}$$

Where Biomass (kg) is the total mass of the plant or plant component (e.g., tree, shrub, etc.).

Carbon Fraction is the proportion of the plant biomass that is carbon. Typically, the carbon content of plant biomass is about 50% (or 0.5), though this can vary depending on plant species.

Allometric equation for Plant Biomass estimation:

$$\text{Biomass} = a \times (\text{DBH})^b$$

Where a and b are constants derived from empirical data as given:

$$\text{Biomass} = 0.1 \times (\text{DBH})^{2.5}$$

This would give the above-ground biomass in kilograms through DBH in centimeters.²¹ While below-ground biomass was calculated by multiplying above-ground biomass with root to root-to-shoot factor of 0.26.

²² During the visit, the diameter at breast height (DBH) was measured from the trunk of trees at 1.3 meters above the ground by using a measuring tape. The obstacles, like branches, shoots, loose bark, and vines, were excluded to ensure accuracy.



Figure 3. A Glimpse of Measuring the Trees DBH

2.4 Vegetation Dynamics

Based on the GEE cloud platform, Landsat images of 2014 and 2024 were used to calculate the NDVI to

²¹ Chave, J., Andalo, C., Brown, S., Cairns, M. A., Chambers, J. Q., Eamus, D., Fölster, H., Fromard, F., Higuchi, N., Kira, T., Lescure, J.P., & Yamakura, T. (2005). Tree allometry and improved estimation of carbon stocks and balance in tropical forests. *Oecologia*, 145, 87-99.

²² Ajani, A., & Shams, Z. I. (2016). Comparative status of sequestered carbon stock of *Azadirachta indica* and *Conocarpus erectus* at the University of Karachi Campus, Pakistan. *International Journal of Environment*, 5(2), 89-97.

analyze the characteristics of the spatiotemporal patterns of vegetation and detect the factors that affect vegetation changes. This includes the following steps:

- The Landsat images of both years were obtained for preprocessing, including QA band cloud removal processing, and clear images that can fully display the study area.
- The NDVI was calculated by using the band math, and the spatial and temporal distributions of the NDVI were determined.
- Using ArcMap, both the years compared and the factors influencing the vegetation change in Bahawalpur were detected from the perspectives of climate, terrain, and anthropogenic factors.

2.5 City Biodiversity Index (CBI)

City Biodiversity Index was calculated using the guidelines given in “Handbook on the Singapore Index on Cities’ Biodiversity”. Twenty-eight (28) indicators given in this handbook were used for calculating the City Biodiversity Index (CBI). A city scoring higher has better ecological services, biodiversity health, and efficient government. The maximum score is 112 points. A score of 90-112 (Excellent) is considered a good score, which reveals that its ecosystems are healthy, its biodiversity is in good health, and that the government is efficient.²³ A score between 68-89 (Good) reflects cities with well-maintained biodiversity and effective ecological management, and a score between 44-67 (Moderate) indicates moderate biodiversity with room for improvement in conservation and governance efforts. If the City Biodiversity Index score is 1-43, then it means that biodiversity loss is very severe, ecosystem services are poor, and urban planning is also inadequate.

City Biodiversity Index Scoring Slab	
Point Scoring	Status
90-112	Excellent
68-89	Good
44-67	Moderate
1-43	Poor

2.6 Swot Analysis

This analysis was used to identify strengths, weaknesses, opportunities, and threats related to biodiversity and conservation efforts in Bahawalpur. SWOT analysis is very useful in strategic planning for conservation, sustainable development, and addressing biodiversity challenges.

²³ Arun, S., & Sreeja, V. (2021). City biodiversity index for sustainable urban planning. *Journal of Environmental Sustainability*, 12(1), 12–25.



Stakeholder Consultation

A stakeholder consultation session with local stakeholders at the site-specific level was conducted to obtain maximum information related to fauna and flora, threats to the local biodiversity, conservation efforts being made, infrastructure deficiencies and requirements, and possible measures to promote eco-tourism at the specific site. The meetings with the representatives of the Wildlife and Forest Department, Academia, Zoo, and Community were held. Discussions were made on the key factors responsible for biodiversity decline, habitat degradation, and threats associated with the local biodiversity.

3.1 Consultation with Academia

A meeting session with different experts from the Botany and Zoology Departments was conducted at Islamia University, Bahawalpur, to discuss the current condition of urban biodiversity and challenges in Bahawalpur. Dr. Ghulam Sarwar from the Department of Botany at Islamia University, Bahawalpur, suggested that shrubs should be planted along roads instead of trees. He pointed out the lack of a pre-planned study on the planting of Paper Mulberry in Bahawalpur and emphasized the need for a survey on all trees around roads and parks. He shared that both Conocarpus and Paper Mulberry cause allergies and impose a negative impact on health. He also mentioned that Neem trees in Bahawalpur are prone to burning due to the intense heat and recommended planting olive trees for their medicinal properties and suitability for arid regions. He highlighted the absence of research on climate change but mentioned ongoing studies on plant diversity. Dr. Sarwar advocated for incorporating Miyawaki forests into a smaller scale and recommended planting fruit trees like mango and jamun in urban areas.



Figure 4. Consultation with the Botanical Experts of Academia

Dr. Mushtaq Lashari from the Department of Zoology at Islamia University Bahawalpur, discussed several challenges facing biodiversity research at the university. He highlighted the lack of fieldwork and said that students are not interested in it due to a shortage of grants for such projects. There is no active project on biodiversity or invertebrates, and World Fisheries Day is not observed. Dr. Lashari mentioned that while there are 20 BS Honors students, 70 M.Phil. students, and 20 PhD students but there is no official collaboration with the Wildlife Department and Fisheries Department. He shared that research centers in the Cholistan Desert focus on ungulate diversity assessments. He has been working at the university since 2012 and identified crows and kites as the top birds in the area. He observed that students deliberately avoid fieldwork and that most research is done at the molecular level. According to Dr. Lashari, zoologists should focus more on exploring wildlife biodiversity, but funding constraints have limited the Zoology Department's involvement in this area.



Figure 5. Consultation with the Zoological Experts of Academia

3.2 CONSULTATION WITH ZOO STAFF & WILDLIFE

DVM doctor at Bahawalpur Zoo informed the team that the Zoo is facing numerous challenges in the care and management of its captive animals. One of the primary concerns is space constraints, particularly in the Lion House. Currently, lions are kept separately with a total of 17 lions housed in the facility. Only one tiger cage is appropriate and other cages, including those for chimpanzees, have been modified to accommodate tigers. The zoo houses 6 to 7 bears, but the breeding stock is already fully occupied, exacerbating the space issues. There is also no dedicated quarantine room, and only a simple hatchery is available for breeding purposes.

Staffing issues are another significant challenge. There is insufficient regular staff, and most workers are employed on a daily wage basis. With only 35 to 36 staff members, many of whom are sweepers or involved in non-animal care roles, the zoo struggles to maintain proper care. Animal keepers are limited, and there is a lack of proper staff training.

Animal care is another area of concern, with basic treatment methods being used for many species and no advanced technologies are employed. Especially treatment of diseased animals is difficult during their breeding season when aggressive behavior among males is common. Research at the zoo has been minimal, with university students conducting limited research that is often restricted to paper studies. Many students from nearby Universities visit the Zoo for an internship. However, there have been no Ph.D. research projects conducted at the zoo.

Mr. Qasim Raza, Assistant Director Wildlife, highlighted several significant conservation challenges in the region. One major issue is the lack of water availability, which negatively impacts wildlife in the area. Additionally, there are transport issues at checkpoints, making it difficult to monitor and protect wildlife effectively. Another concern is the involvement of local political elites, exacerbating the threat to wildlife. The absence of a proper conservation management plan further complicates the situation, and the Deputy Director's involvement in setting up camps suggests a lack of delegation or an organized structure. Moreover, there is a general lack of organization within the system, along with inadequate facilities for staff and a shortage of personnel dedicated to wildlife conservation. The need for focused research on local animals also remains unmet, which hinders the development of effective conservation strategies. To address these challenges, Raza suggests the establishment of proper facilities for staff, the creation of a comprehensive conservation management plan for the Cholistan Desert, and dedicated research efforts to protect the local wildlife.

Despite these challenges, efforts to improve the zoo's facilities have been made. A rehabilitation project from 2017 to 2021 included the development of a main gate, lab, and hatchery, but the lab remains non-functional due to a lack of equipment. Although there is a surplus of animals, there is a shortage of staff, and each section would benefit from having a dedicated veterinarian, especially for birds. Mr. Muhammad Yaqoob, Assistant Director, Wildlife, informed that no animals are released from the zoo for breeding purposes in the wild. However, a few years back, blackbucks from Lal Suhanra were successfully released in a project aimed at reintroducing the species to the desert. Staff suggested that there should be dedicated,

trained, regular staff for animal care.



Figure 6. Consultation with the Wildlife Officials

Biophysical Environment Profile

4.1 Habitat & Conservation Areas of the city

Bahawalpur encompasses significant habitat and conservation zones both within and around its urban periphery. At its eastern boundary lies the Lal Suhanra National Park, one of South Asia's largest protected areas, spanning approximately 127,480 acres (51,368 ha) of which 8,491 ha are irrigated plantations (green land), 40,942 ha desert, and 1,935 ha wetland (ponds and lakes)²⁴. A UNESCO-designated Biosphere Reserve since 1977, the park supports over 160 bird species, 50 mammal species, and 25 reptile species, including key reintroduced wildlife such as blackbuck, chinkara, nilgai, hog deer, and Indian rhino. To the west, the Bahawalpur Plantation Reserved Forest serves as a crucial ecological buffer and green anchor in the face of increasing aridity and land degradation. The Bahawalpur Zoo, covering 25 acres (over 10 ha), supports roughly 870 animals, including native species like blackbuck, nilgai, chinkara, spotted deer, and reintroduced predators such as Asiatic lions and Bengal tigers. It actively facilitates ex-situ breeding programs and public education initiatives²⁵. The city also has 23 actively managed parks and approximately 53 km of green belts, spanning nearly 55 acres, indicating a steady increase in managed green infrastructure since 2016's 18.5 acres and 20 parks (PHA)²⁶. These urban green zones enhance local biodiversity, recreation, and urban shading. Adjacent to the northern edge of the city, the Sutlej River riparian corridor sustains aquatic habitats, supports agricultural livelihoods, and forms a natural ecological link between urban and wetland ecosystems. Collectively, these protected and managed areas—spanning forest reserves, wetlands, zoo collections, and urban parks constitute the ecological backbone of Bahawalpur. Continued reinvestment in their restoration, connectivity, and community engagement will be essential to sustaining ecological resilience, climate adaptation, and urban biodiversity in the coming decades.

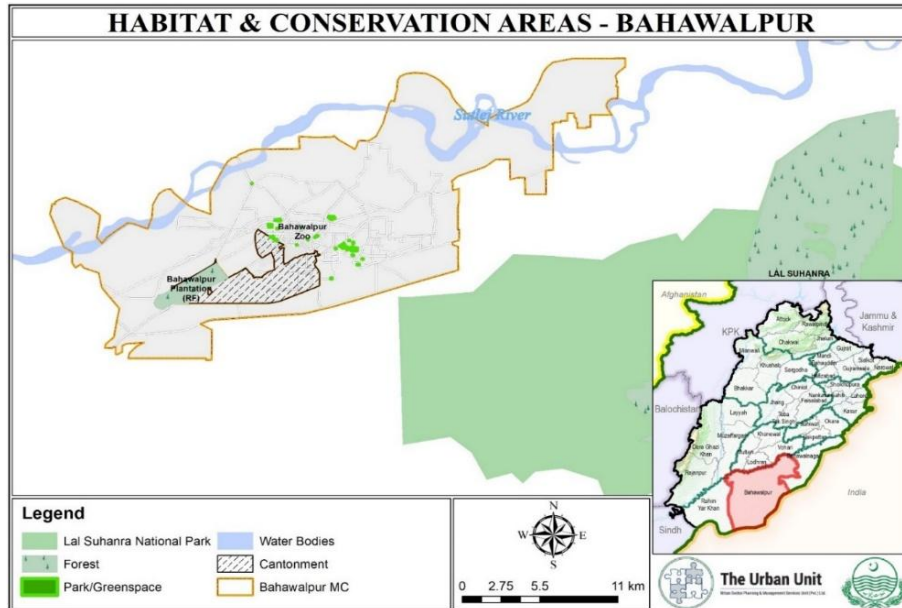


Figure 7. Spatial Distribution of Habitat & Conservation Areas of Bahawalpur

²⁴ <https://tribune.com.pk/story/1299691/wild-natures-gifts-bahawalpur>

²⁵ <https://bahawalpur.punjab.gov.pk/bwp-zoo>

²⁶ <https://punjablaws.gov.pk/laws/2511>

Lal Suhanra National Park

It is a stunning oasis located in the heart of the Cholistan Desert in Bahawalpur, Punjab. Covering an expansive 162,568 acres, it is one of the largest parks in South Asia and is recognized as a UNESCO Biosphere Reserve. Established in 1972, Lal Suhanra serves as a symbol of Pakistan's dedication to preserving endangered plant and animal species within its desert ecosystem. This park is home to around 300 bird species, 50 mammal species and 25 reptile species.²⁷

The Blackbuck area covers a total of 28 acres and is home to 315 Blackbucks, consisting of 98 males, 148 females, and the remainder being subadults. There are 12 dominant males, known as Alpha males, who play a key role in mating. The area experiences maximum male production. Veterinary support is limited, as there is no dedicated veterinary officer. In case of any health issues, the staff seek assistance from doctors at Cholistan University of Veterinary and Animal Sciences, specifically Dr. Mubashir and Dr. Qudratullah.

Although Blackbucks typically do not pose a threat to visitors, they may become aggressive during the mating season. To maintain their health, the Blackbucks are treated with Nilzan and Albamax for deworming every three months. The area is equipped with two water points, which are refilled every 24 hours. The Blackbucks are fed three times daily: Berseem or Javi in the morning, Black Chany around 4 PM, and Gurd at night.

The area is home to several common bird species, including red-vented bulbuls, peacocks, crows, and mynas. The common plants found in the region include Berry, Jand, Farash, Kikar, Safaida, Simbal, and Salvadora. The staff consists of 17 workers employed on daily wages, with only one permanent employee.



Figure 8. A glimpse of the blackbuck enclosure at Lal Suhanra National Park

Patisar Lake is a prominent water body located in Lal Suhanra National Park, situated in the Cholistan Desert near Bahawalpur, Punjab, Pakistan. This lake is an important ecological feature of the park, providing water to the region's wildlife, particularly during dry periods. Patisar Lake is also known for its role in supporting diverse bird species, including migratory birds, which makes it a popular spot for bird watching. The lake's presence helps sustain the desert ecosystem, contributing to the overall biodiversity of the park. It also adds to the beauty and charm of Lal Suhanra National Park, making it a key attraction for nature enthusiasts and conservationists. During our visit to Patisar Lake and its surrounding areas in Lal Suhanra National Park, we observed a wide variety of bird species. Among the common birds, we spotted the Indian Roller, Red-vented Bulbul, Jungle

²⁷ <https://pwl.gop.pk/tours/lal-suhanra-national-park/>

Babbler, Crows, and Kites. The lake's waters also attracted several waterfowl, including Egrets, Ducks, and Pond Herons. We also encountered Sparrows, Common Coots, and the Gritter Coucal in the vicinity. These birds, along with others, contribute to the rich biodiversity of the area, making it a fascinating spot for bird watching and an essential part of the park's ecosystem.



Figure 9. A glimpse of Patisar lake at Lal Suhanra National Park

At the Children's Park in Lal Suhanra National Park, we observed a variety of birds within the enclosures. These included pigeons (both black and white), doves, guinea fowl, and several species of peafowl such as the Blue Peafowl, Pied Peafowl, Black-shouldered Peafowl, and White Peafowl. Additionally, we saw Rhesus monkeys, Lohpras, and Ring-necked pheasants in the park. There was also an enclosure housing Nilgai, Spotted deer, and Chinkara. The Chinkara population in the park consisted of 31 individuals, while there were 20 spotted deer in total, including 4 males, 10 females, and 6 whose gender was not identified. It was noted that chinkaras tend to fight with each other, and if separated, they may become aggressive. Rabbits were also present in the park, adding to the variety of species in the area.





Figure 10. Variety of captive birds at Children Park in Lal Suhanra National Park- (a). Blue peafowl (b). Black-shouldered Peafowl (c). White Peafowl (d). Guinea fowl (e). Pied Peafowl (f). Dove

4.2 City Faunal Profile

A total of 36 bird species were recorded from the built-up areas, gardens, and parks of Bahawalpur during our survey. Out of the total birds, 83.9% were local birds, and the remaining 16.1% were migratory. The most abundant birds were the house crow, followed by black kites, common myna, little brown dove, and house sparrow.

The resident birds of Bahawalpur, Pakistan include the Alexandrine Parakeet, Barn Owl, Black Drongo, Common Hoopoe, Common Myna, Common Tailorbird, Eurasian Collared Dove, House Crow, House Sparrow, Indian Pond Heron, Indian Robin, Indian Roller, Jungle Babbler, Oriental Magpie-Robin, Pied Bush Chat, Purple Sunbird, Red-vented Bulbul, Rock Pigeon, Rose-ringed Parakeet, and Red wattled Lapwing.



Figure 11. Some of Recorded Birds of Bahawalpur-(a). Red wattled lapwing (b). Crow (c). Indian roller

The mammals evidenced in Bahawalpur include the Asiatic Jackal, Asiatic Lesser Yellow House Bat, House Mouse, House Rat, Indian Crested Porcupine, Indian Grey Mongoose, Indian Hare, Indian Pipistrelle, Jungle Cat, and Small Indian Civet.

The reptiles found in Bahawalpur include the Oriental Garden Lizard, Yellow-bellied House Gecko, Indian Cobra,

Saw-scaled Viper, Checkered Keelback, Indian Flapshell Turtle, Crocodile, and Bengal Monitor Lizard. A detailed faunal diversity inventory has been constructed for Bahawalpur city and is attached as Annexure A.

Bahawalpur Zoo

Bahawalpur Zoo is home to a variety of animals in captivity, including a Grey White Pelican, Yellow Pheasant, Wolf, Monkey, Royal Bengal Tiger, Parrot, Red-necked Pheasant, Tiger, Common Crane, White Peacock, Chakor Peafowl, Common Moorhen, Hog Deer, Blue Bull, Black Buck, Silver Pheasant, Marsh Crocodile, and a Cat. Notably, one of the wolves requires proper care and attention as it is not well. Additionally, wild animals such as Crows, Kites, Mynas, Bulbuls, Sparrows, and Doves are also present, contributing to the zoo's dynamic environment. Some mislabeling on the cages of animals has been recorded in the zoo and will likely be addressed for accuracy. The zoo plays an important role in education and conservation efforts, providing a safe and educational space for both captive and wild animals.

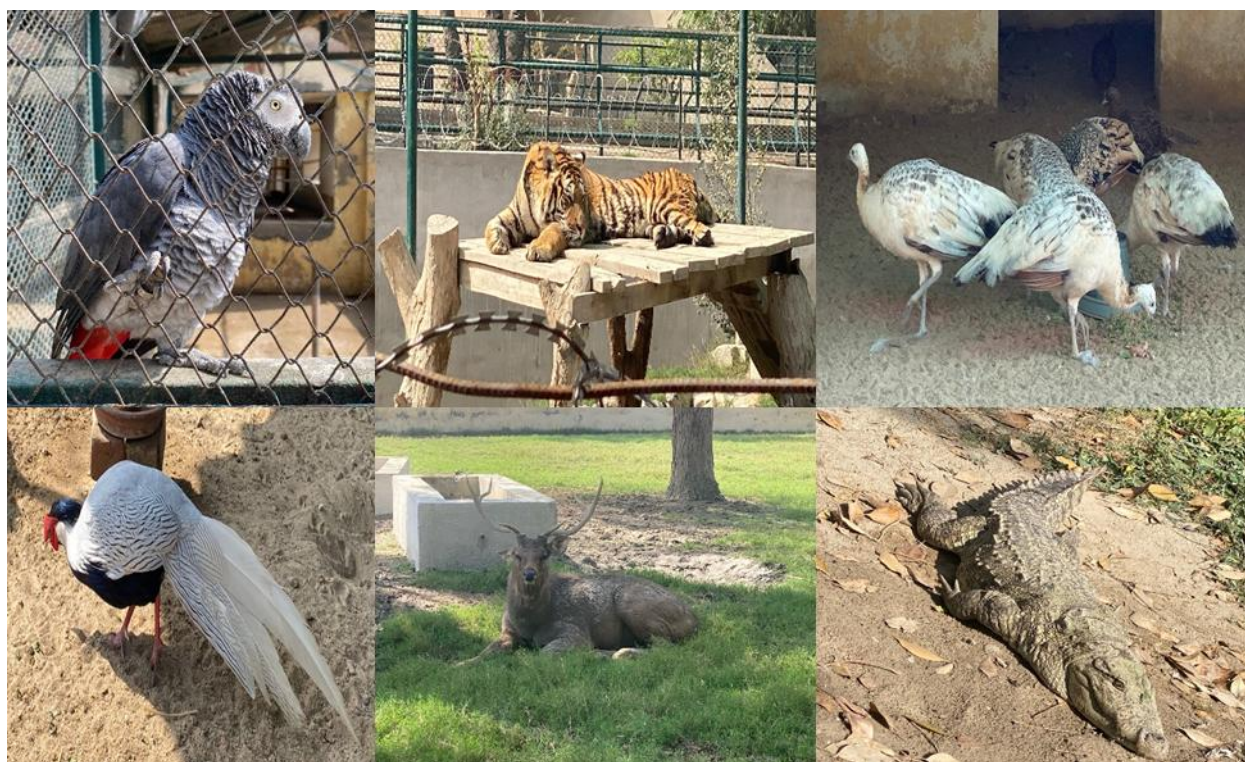


Figure 12. Captive Wildlife of Bahawalpur Zoo (a). African Grey Parrot (b). Tiger (c). Indian Peafowl (d). Silver Pheasant (e). Sambar Deer (f). Marsh Crocodile

4.3 City Floral Profile

A total of 45 woody plant species has been recorded from the parks and gardens of Bahawalpur. The survey areas include Fareed Park, Shareef Park, Ghosia Park, Furniture Market Park, Milad Park, Royal City Park, Fareed Water Park, Park No. 1, Block F Government Employee Housing Society, Tanki Ground Park, Lal Suhanra National Park, and Bahawalpur Zoo. Out of 45 tree species recorded from Bahawalpur, 28 species were native, 11 were introduced, and 6 were invasive. The number of visited areas in Bahawalpur is showing that the highest

number of tree species were recorded from Bahawalpur Zoo (45), Gulzar-e-Sadiq Park (25), Fareed Park (23), Fareed Water Park (19), Milad Park (15), Ghosia Park (14), Furniture Market Park (11), Mango Orchard Park (9), Shareef Park (8) and Tanki Ground Park (7).

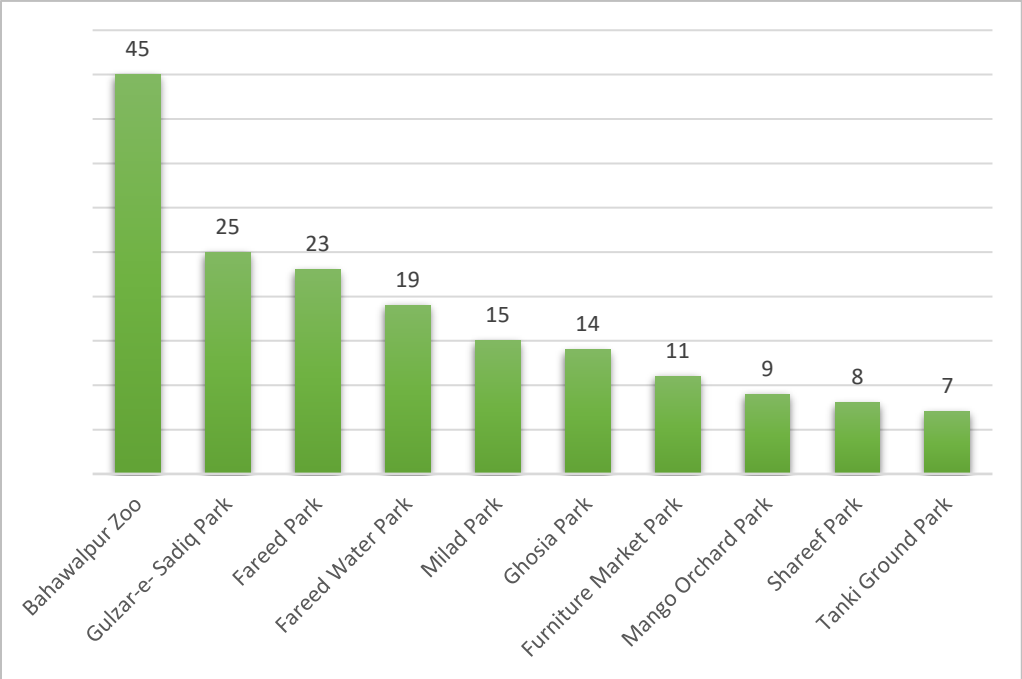


Figure 13. Tree Distribution in Different Areas of Bahawalpur

Species richness and diversity analysis is the tool to evaluate the habitat health, species richness, potential, and their significance level to other communities and habitats within the region. The Menhinick's Richness Index, Shannon Diversity index, and species evenness are measured for different parks and forest types of Bahawalpur to evaluate the health of habitat within each forest type on a scale of 0-1 and above. The Menhinick's Richness and Shannon diversity Index values greater than 1 indicate that the area has a diverse range of species, whereas index values below 1 indicate poor species richness and diversity. Whereas an evenness index value of 1 indicates excellent evenness, and decreasing values indicate a decreasing trend of evenness. The calculated value of Menhinick's Richness Index varied from 1.18 (Gulzar-e-Sadiq Park) to 4.7 (Ghosia Park). The Shannon Diversity Index values ranged from 1.51 (Tanki Ground Park) to 3.29 (Fareed Park). Similarly, the Evenness value (E5) ranged from 0.85 (Furniture Market Park) to 0.99 (Fareed Park).

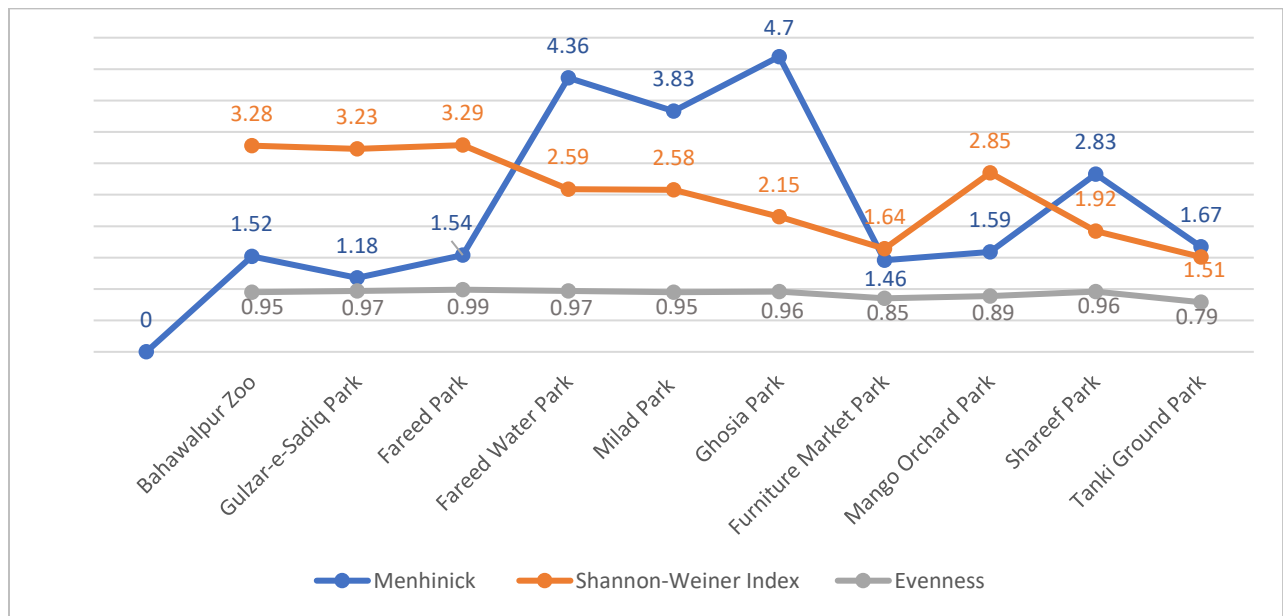


Figure 14. Biodiversity Indices of Different Sites of Bahawalpur

Exotic species of plants in Bahawalpur have posed a serious threat to biodiversity and the ecosystem, mainly because they are invasive. They usually replace the native species by taking away resources such as water, sunlight, and nutrients. The introduction of non-native species, such as Conocarpus and Paper Mulberry, is causing more harm than good. These invasive species are replacing native ones, leading to reduced biodiversity and ecosystem health. Moreover, they are also causing health concerns, including allergies. Consequently, native plants tend to decline or even become extinct. A detailed floral inventory has been constructed for Bahawalpur city and is attached as Annexure B.



Figure 15. Some Common Trees of Bahawalpur-(a). Kikar (b). Bottle Brush (c). Conocarpus (d). Terminalia (e). Sukh Cheen (f). Moringa

4.4 Vegetation Dynamics

Bahawalpur city currently has 1.53 million m² of urban green space (152.87 ha). With an estimated 2025 population of 970,074 residents, this covers only 17.6% of the WHO's recommended minimum urban green space per person. The WHO recommends providing at least 9 square meters of accessible, safe, and functional green space for each individual. To fully meet this guideline, Bahawalpur needs to increase its green space by approximately 82.4% relative to the WHO standard. Growing green spaces can improve air quality, reduce pollution, and offer recreational areas for residents. Rapid urbanization in Bahawalpur is causing a significant decline in green areas. The expanding built-up area results in the loss of natural habitats and ecosystems. Urban green spaces such as parks and gardens are vital for supporting urban biodiversity. These spaces provide habitats for various plant species, including trees, shrubs, and herbs. The 2014 NDVI map shows extensive moderate vegetation (0.4–0.6) and lighter areas (0.2–0.4), with an average around 0.3. The 2024 map shows more dark green areas (> 0.6), especially in the southern regions, indicating healthier and denser vegetation, bringing the average closer to 0.4. Over the decade, there has been a noticeable increase in vegetation vigor and coverage, likely driven by intensified agriculture and irrigation-driven greening.

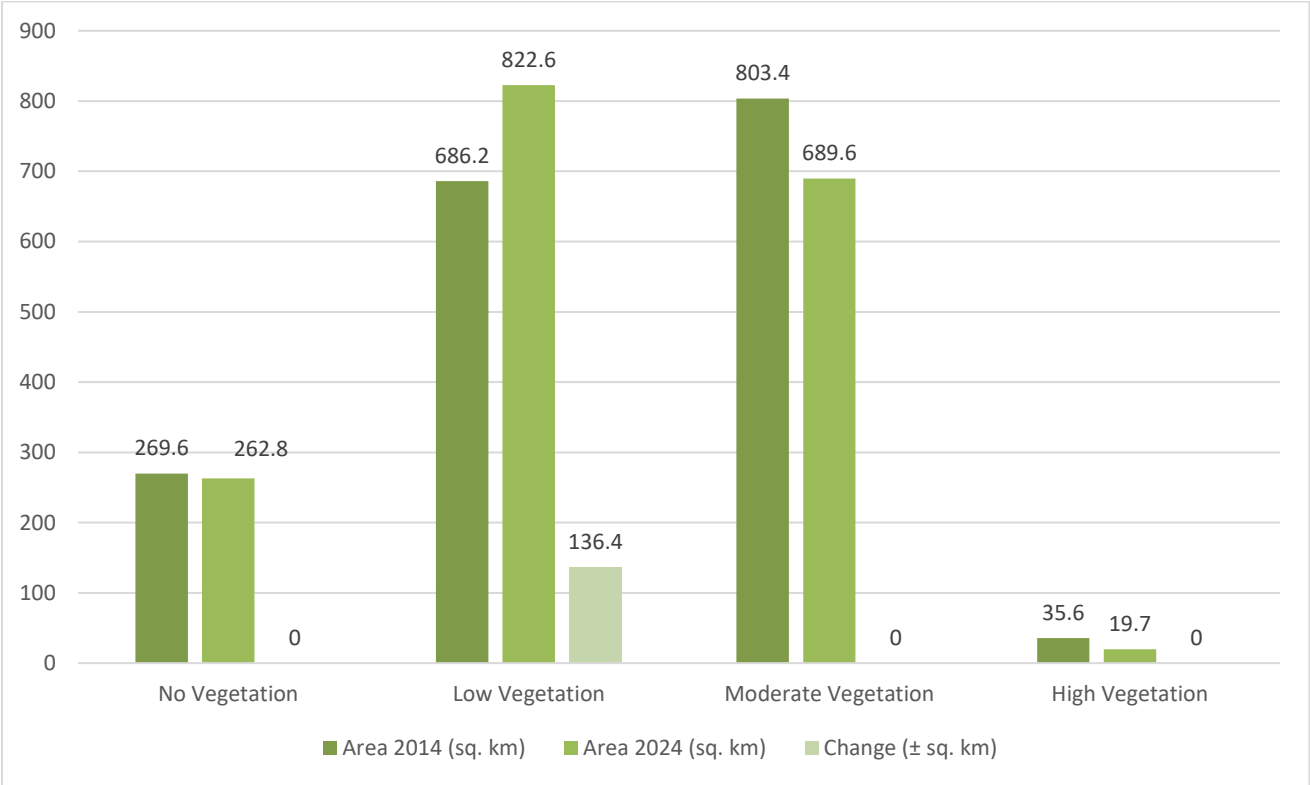


Figure 16 Vegetation Change Analysis in 2014 and 2024 of Bahawalpur

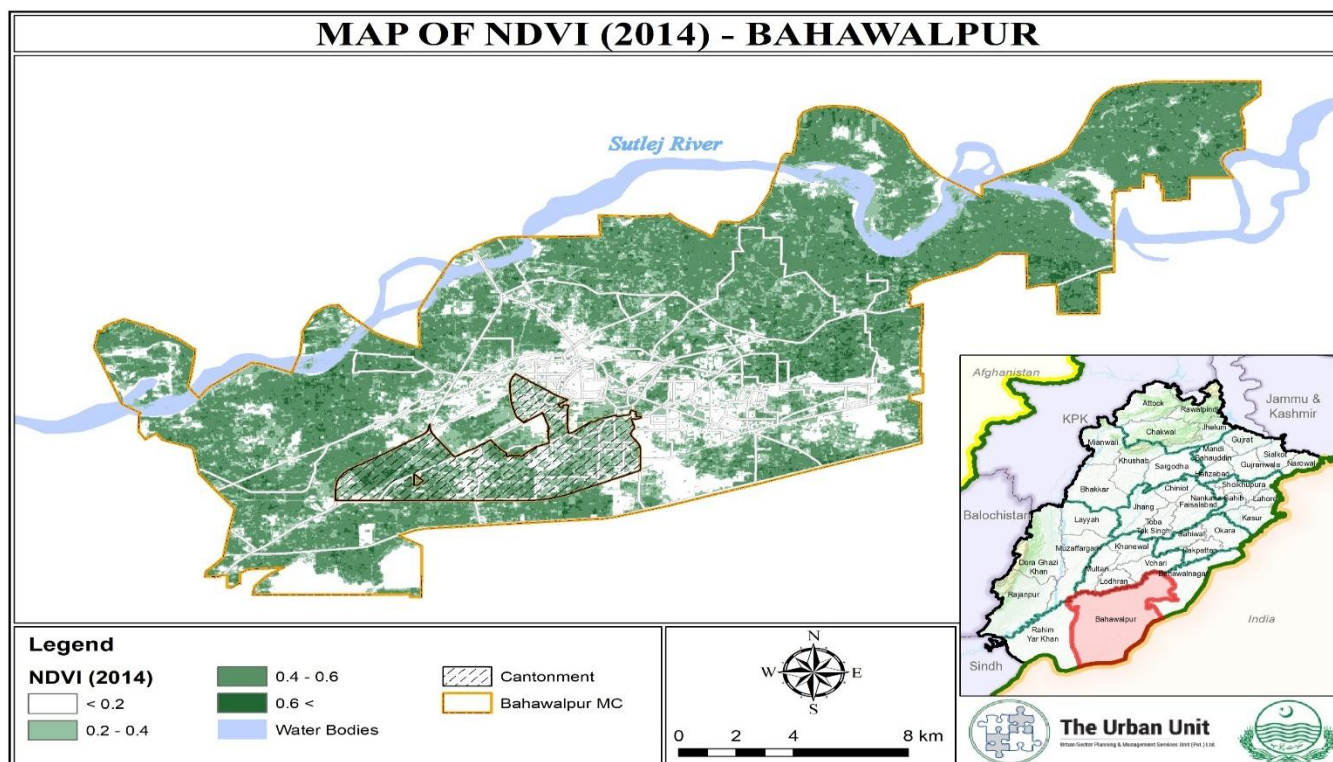


Figure 17: Vegetation Change Analysis in 2014 of Bahawalpur

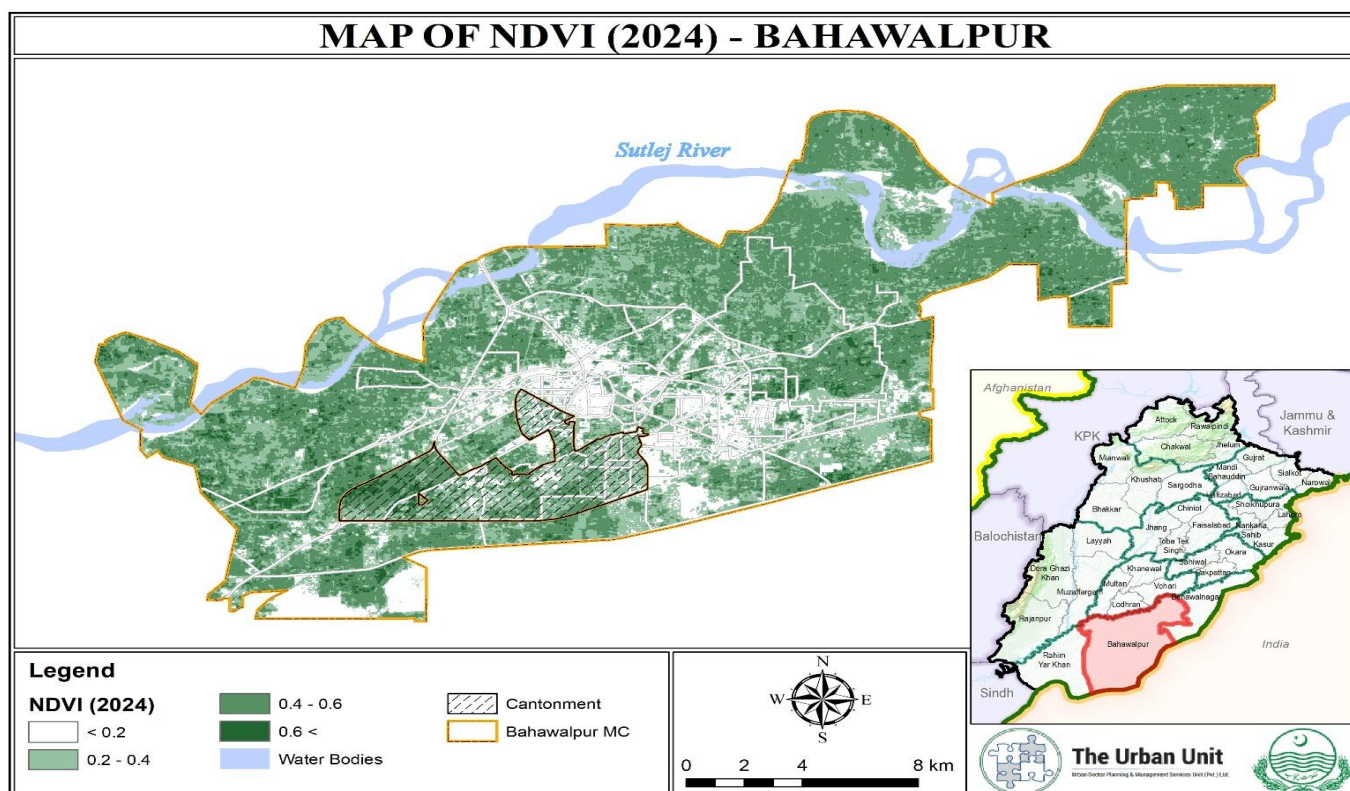


Figure 18: Vegetation Change Analysis in 2024 of Bahawalpur

4.5 Tree Biomass and Carbon Stock Estimation

The analysis of tree biomass and carbon stock estimation for different tree species revealed significant differences in biomass accumulation and carbon stock. Tree species that are native to the region, like Shisham, Kikar, Banyan, and Arjun, have the greatest AGB and BGB accumulation, as these species exhibit higher Diameter at Breast Height, indicating the mature and vigorous growth and development of trees.

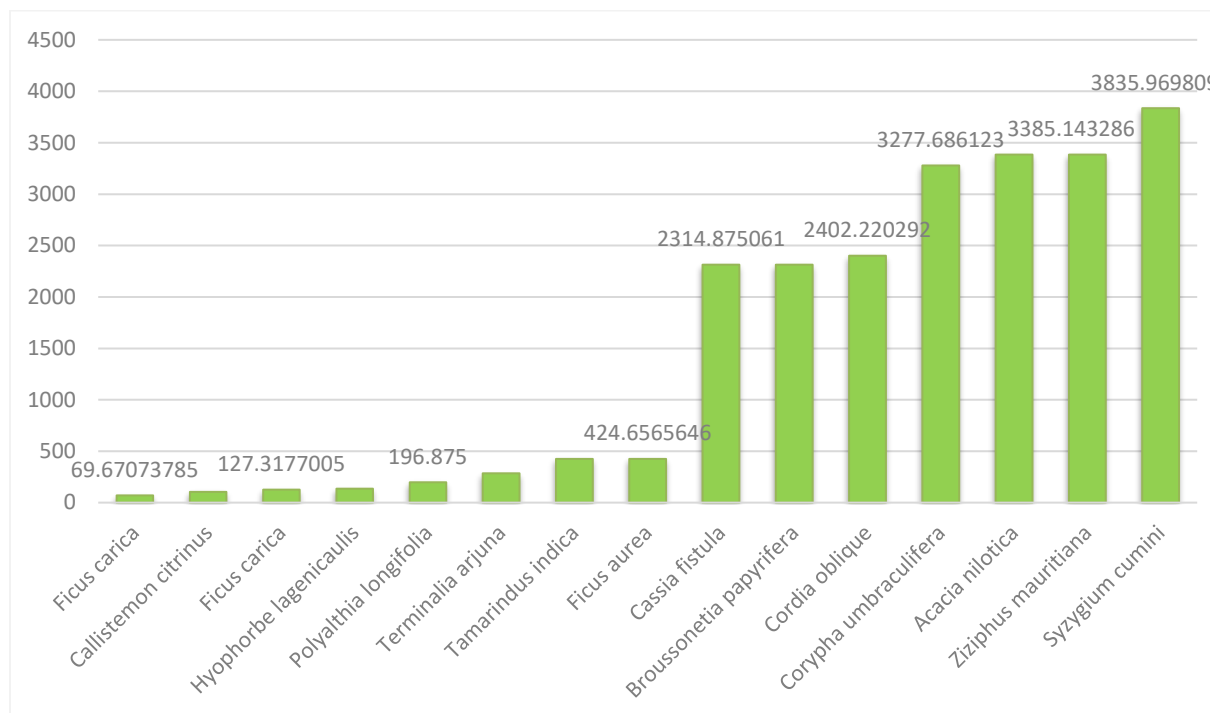


Figure 19. Tree Biomass and Carbon Stocking of different species in Bahawalpur

Similarly, the species with high accumulation of AGB and BGB can store up to 40,000 kg of carbon in individual plant species. It demonstrates that native species make a significant contribution to ecosystem services and carbon sequestration. A detailed analysis of all the sampled species studied was developed to represent the comparative analysis of aboveground, belowground biomass, and carbon storage potential.

Table 1. A Detailed Assessment of Tree Biomass and Carbon Stocking of Plants in Bahawalpur

Common Name	Scientific Name	DBH	AGB (cm)	BGB (kg)	Total Biomass (kg)	Carbon Stock (kg)
Aam	<i>Magnifera indica</i>	189	49108.25592	12768.14654	61876.40246	30938.20123
Amaltas	<i>Cassia fistula</i>	67	3674.404859	955.3452634	4629.750123	2314.875061
Anjeer	<i>Ficus carica</i>	16.5	110.5884728	28.75300292	139.3414757	69.67073785
Arjun	<i>Terminalia arjuna</i>	180	43469.16148	11301.98199	54771.14347	27385.57173
Bakain	<i>Melia azedarach</i>	167	36040.53074	9370.537993	45411.06873	22705.53437

Beri	<i>Ziziphus mauritiana</i>	78	5373.243311	1397.043261	6770.286572	3385.143286
Black Ficus	<i>Ficus benghalensis</i>	143	24453.44739	6357.896322	30811.34372	15405.67186
Black Pilcan	<i>Ficus virens</i>	114	13875.9309	3607.742033	17483.67293	8741.836465
Bordh	<i>Ficus sp.</i>	341	214726.6494	55828.92885	270555.5783	135277.7891
Bottle Brush	<i>Callistemon citrinus</i>	19.5	167.9138535	43.6576019	211.5714554	105.7857277
Bottle Palm	<i>Hyophorbe lagenicaulis</i>	21.5	214.3365075	55.72749194	270.0639994	135.0319997
Conocarpus	<i>Conocarpus erectus</i>	140	23191.03275	6029.668515	29220.70126	14610.35063
Date Palm	<i>Phoenix dactylifera</i>	152	28484.52422	7405.976298	35890.50052	17945.25026
Fig	<i>Ficus carica</i>	21	202.0915881	52.54381292	254.6354011	127.3177005
Golden Ficus	<i>Ficus aurea</i>	34	674.058039	175.2550902	849.3131292	424.6565646
Imli	<i>Tamarindus indica</i>	34	674.058039	175.2550902	849.3131292	424.6565646
Jamun	<i>Syzygium cumini</i>	82	6088.840967	1583.098651	7671.939618	3835.969809
Kachnar	<i>Bauhinia alba</i>	123	16778.87268	4362.506897	21141.37958	10570.68979
Kiker	<i>Acacia nilotica</i>	78	5373.243311	1397.043261	6770.286572	3385.143286
Lasura	<i>Cordia oblique</i>	68	3813.048083	991.3925015	4804.440584	2402.220292
Moringa	<i>Moringa oleifera</i>	108	12121.58437	3151.611937	15273.19631	7636.598154
Nag Phali	<i>Heterophargama adenopyllum</i>	123	16778.87268	4362.506897	21141.37958	10570.68979
Neem	<i>Azadirachta indica</i>	178	42271.72842	10990.64939	53262.37781	26631.18891
Paper Mulberry	<i>Broussonetia papyrifera</i>	67	3674.404859	955.3452634	4629.750123	2314.875061
Peepal	<i>Ficus religiosa</i>	190	49760.416	12937.70816	62698.12415	31349.06208
Pinus	<i>Pinus spp.</i>	89	7472.656455	1942.890678	9415.547133	4707.773566
Rubber	<i>Ficus elastic</i>	102	10507.52494	2731.956484	13239.48142	6619.740711
Shahtut	<i>Morus macroura</i>	89	7472.656455	1942.890678	9415.547133	4707.773566
Shisham	<i>Dalbergia sisso</i>	201	57278.30313	14892.35882	72170.66195	36085.33097
Silver Oak	<i>Grevillea robusta</i>	95	8796.481896	2287.085293	11083.56719	5541.783595
Silver Palm	<i>Corypha umbraculifera</i>	77	5202.676385	1352.69586	6555.372245	3277.686123
Sohanjana	<i>Moringa oleifera</i>	111	12980.97899	3375.054537	16356.03353	8178.016763

Sufaida	<i>Eucalyptus camaldulensis</i>	198	55164.91783	14342.87864	69507.79647	34753.89824
Sukh Cheen	<i>Eucalyptus camaldulensis</i>	178	42271.72842	10990.64939	53262.37781	26631.18891
Sumbul	<i>Bombax ceiba</i>	210	63906.97145	16615.81258	80522.78403	40261.39201
Tacoma	<i>Cassia fistula</i>	89	7472.656455	1942.890678	9415.547133	4707.773566
Terminalia	<i>Terminalia arjuna</i>	29	452.8923603	117.7520137	570.644374	285.322187
Ulta Ashok	<i>Polyalthia longifolia</i>	25	312.5	81.25	393.75	196.875

A remote sensing analysis of Bahawalpur has been carried out to evaluate the above-ground biomass of Bahawalpur from carbon stock has been predicted. The total above-ground biomass (AGB) of 38 tree species is approximately 1.04 million kg, while below-ground biomass (BGB) is about 0.27 million kg. Together, they store a total carbon stock of 0.66 million kg. On average, each kilogram of AGB stores 0.63 kg of carbon, and BGB stores 2.42 kg of carbon. AGB contributes the majority of biomass, but BGB shows higher carbon density per kg.

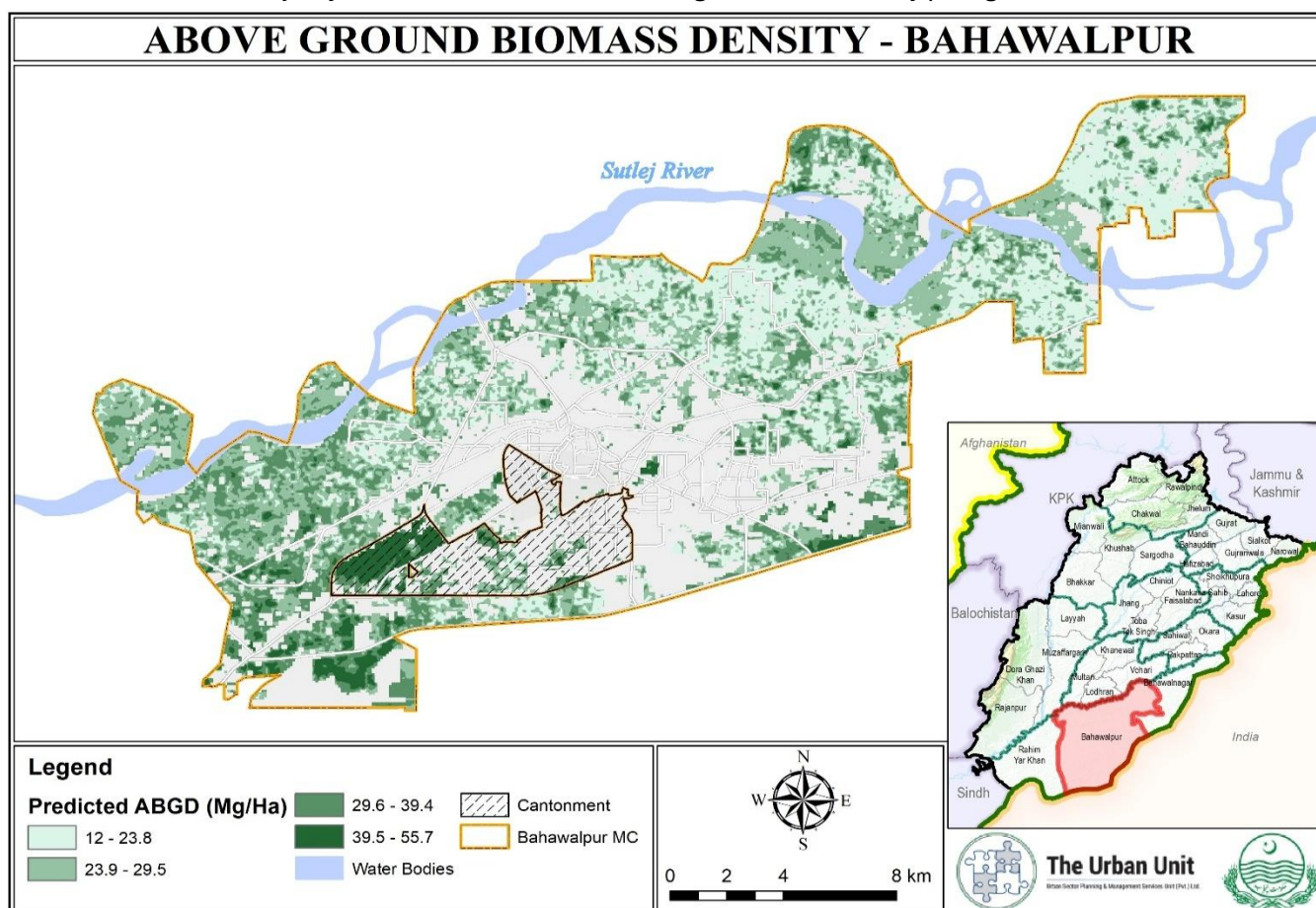


Figure 20: Aboveground Biomass Analysis of Bahawalpur – 2023-24

4.6 Green Spaces and Open Ground Audit

There are many historic parks and gardens in Bahawalpur, which play a key role in controlling air pollution and providing an excess supply of fresh air. The Parks and Horticulture Authority (PHA) develop and maintains the parks and gardens in Bahawalpur.

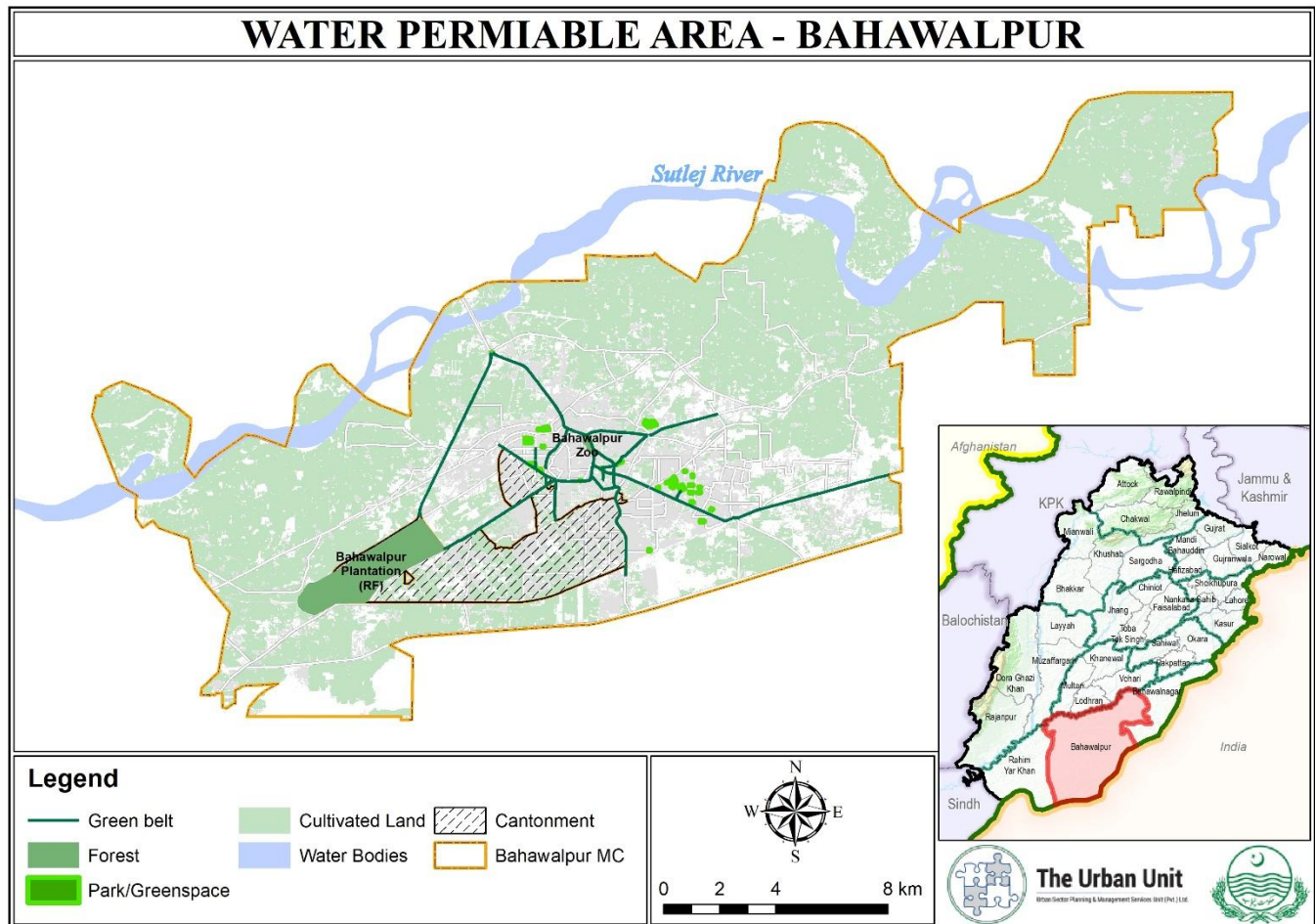


Figure 21: Spatial Distribution of Green Spaces and Open Ground in Bahawalpur

Gulzar-e-Sadiq Park

Gulzar-e-Sadiq Park sees an average of 400-500 visitors per day. The park is home to a variety of plants, with common species including Naghpali (1), Khira Bordi (4), Kikar (10), Naeem (63), Bottle Brush (2), Sukh Chan (47), Bakain (19), Amaltas (4), Tali (40), Lasoora (6), Termenalia (30), Arjun (20), Sherin (3), Berry (8), Farash (3), Simbal (3), Kachnar (6), Ficus virens (5), Mango (2), Date Palm (33), Conocarpus (14), Jaman (12), Shatoot (21), Peepal (10) and Moringa (30).

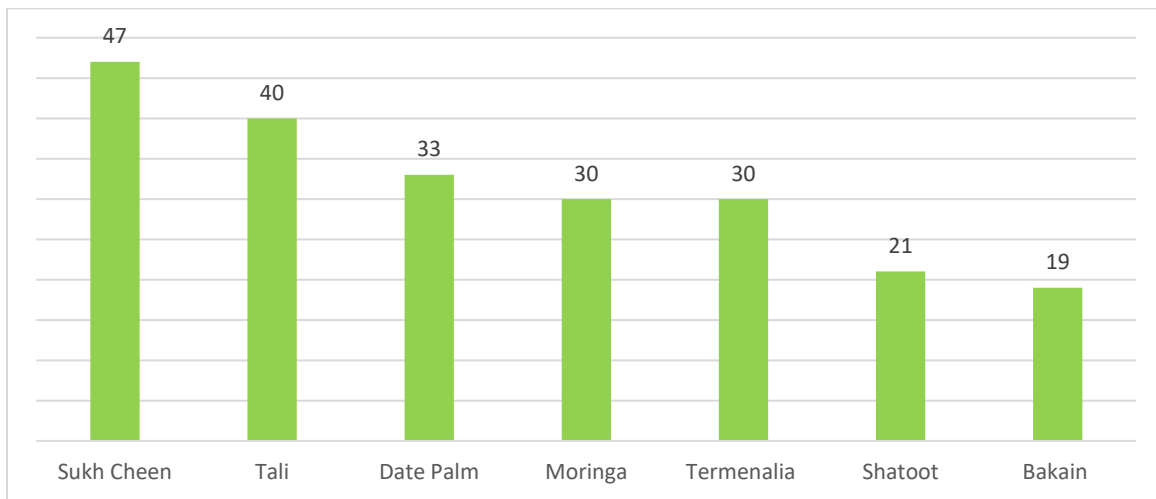


Figure 22. Most Abundant Trees of Gulzar-e-Sadiq Park, Bahawalpur

Despite the diversity of plants, the park faces challenges such as a shortage of staff and issues with cleanliness. However, it does provide proper washrooms for visitors. The park is also home to a variety of birds, including sparrows, crows, kites, and bulbuls.

Fareed Park

Fareed Park, located in the commercial area, hosts a total of 23 tree species, contributing to the park's rich biodiversity. The recorded tree species and their respective frequencies are as follows: Tali (11), Conocarpus (6), Neem (30), Arjun (11), Ficus virens (20), Desi Kikar (3), Peepal (1), Date Palm (20), Bottle Brush (31), Rubber Plant (10), Imlu (1), Mango (2), Mulsari (3), Gulmohar (3), Jamun (2), Bakain (5), Ulta Ashok (3), Yellow Ficus (30), Amaltas (2), Kanair (10), Black Ficus (2), Shatoot (1), and Terminalia (22).

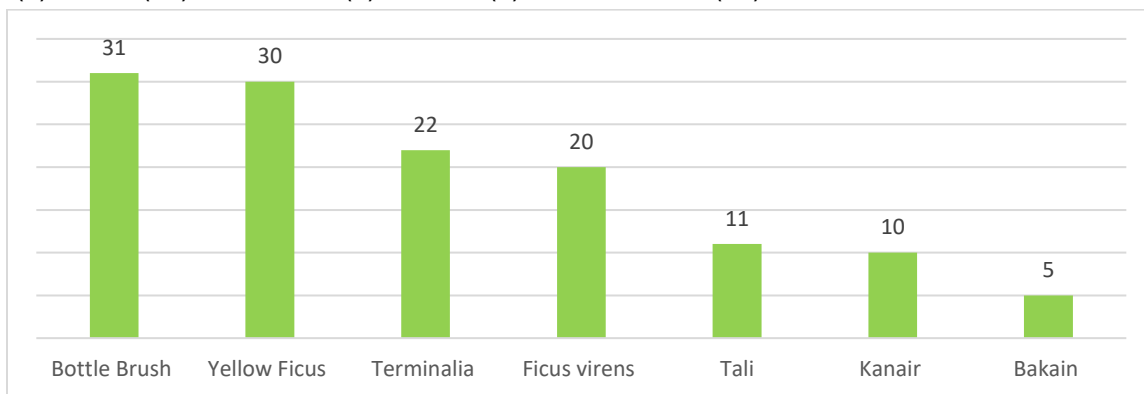


Figure 23. Most Abundant Trees of Fareed Park, Bahawalpur

The presence of such a variety of trees enhances the ecological value of the park, making it an important green space in the area. Additionally, 4 gardeners are maintaining the park's greenery. The park sees over 1,000 visitors per day, highlighting its popularity. Common birds found in the park include crows, sparrows, owls, bulbul, kites, and squirrels. However, the water body in the park is not functional at the moment.

Fareed Water Park

Fareed Water Park, which is exclusively for women and children, spans an area of approximately 8 acres. The park boasts a total of 19 different tree species, contributing to its rich greenery. Among these, the Silver Palm is represented by 12 trees and the Shahtoot by 34 trees. Other tree varieties include Anjeer (4), Conocarpus (1), Safaida (3), Naeem (17), Bakain (15), Tali (52), Ficus virens (16), Kachnar (3), Tacoma (1), Moringa (3), Sukh Chan (7), Bottle Palms (2), Rubber Plant (1), Kikar (2), Peepal (1) and Berry trees (2).

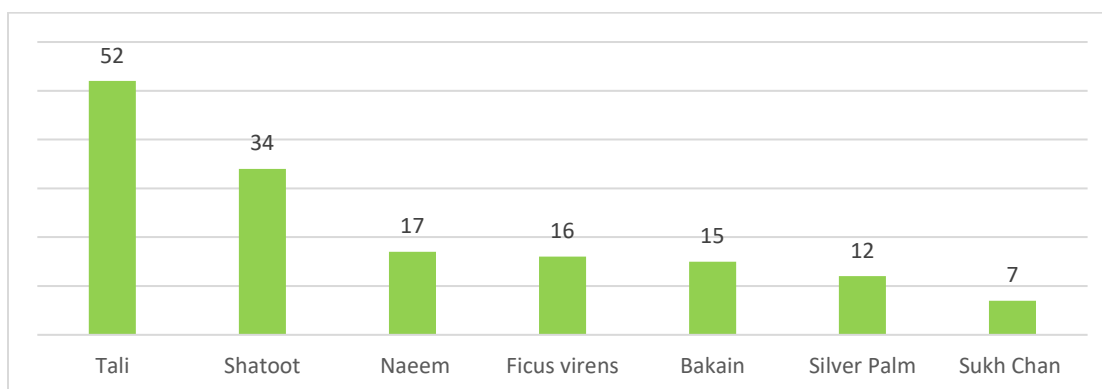


Figure 24. Most Abundant Trees of Fareed Water Park, Bahawalpur

The park is also home to a variety of birds, including Crows, Sparrows, pied bush chats, Kites, and Doves. Although the park is under construction, with ongoing work on the washrooms, it remains a popular destination for visitors, with an estimated 100-150 people visiting per day. One gardener is maintaining the park, and the water system is fully functional. However, some tree-cutting activities are being carried out as part of the maintenance process.

Milad Park

Milad Park, covering an area of 1 acre and 2 canals, is home to a diverse range of tree species, with a total of 15 species recorded. The trees and their respective frequencies are as follows: Bottle Palm (6), Silver Palm (3), Date Palm (3), Terminalia (21), Rubber Plant (2), Pinus (1), Bottle Brush (3), Tali (2), Peepal (1), Ulta Ashok (5), Anjeer (1), Golden Ficus (1), Black Ficus (1), Conocarpus (7), and Moringa (2).

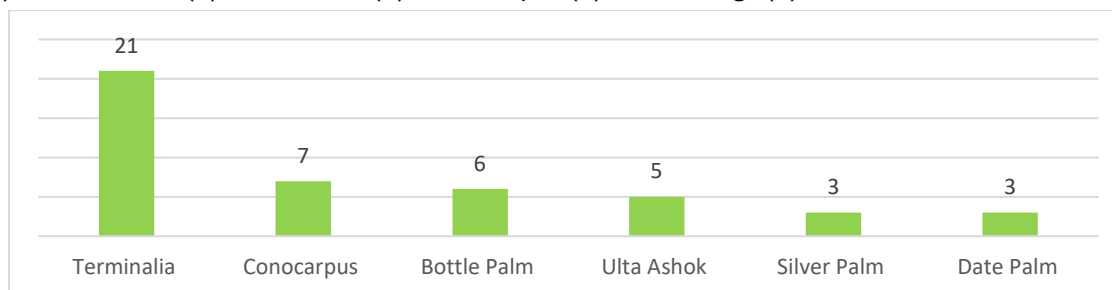


Figure 25. Most Abundant Trees of Milad Park, Bahawalpur

The park attracts around 150-200 visitors per day and features a functional water body, adding to its beauty

and charm. There is one gardener responsible for maintaining the park. The park is a well-maintained and valuable green space in the community.

Ghosia Park

Ghosia Park is home to a diverse range of tree species. The trees and their respective frequencies are as follows: Terminalia (6), Neem (11), Moringa (7), Black Pilcan (Ficus virens) (9), Jamun (2), Desi Kikar (1), Bakain (7), Conocarpus (19), Sukh Chan (2), Safeda (1), Beri (1), Tali (2), Paper Mulberry (1), and Kanair (6).

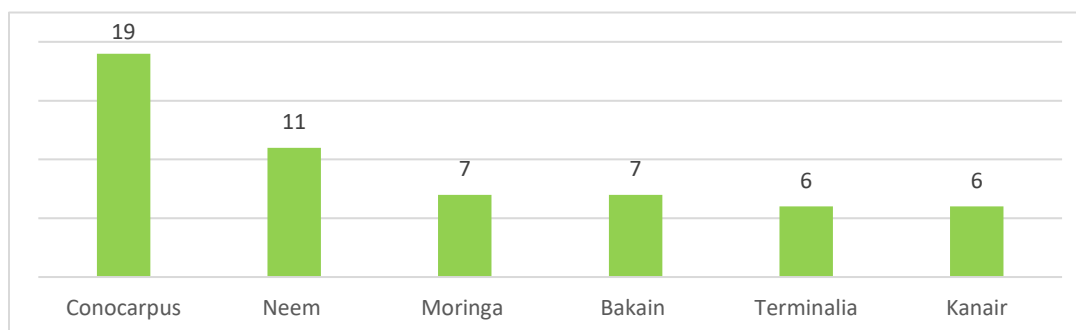


Figure 26. Most Abundant Trees of Ghosia Park, Bahawalpur

The park attracts around 200 visitors per day, making it a popular local destination. The water body in the park is functional, adding to its aesthetic appeal. However, there are no washrooms available, and the park is maintained by a single gardener. Despite the lack of certain facilities, the park remains a well-visited and valued green space in the community.

Furniture Market Park

Furniture Market Park is home to a variety of 11 tree species. The recorded tree species and their respective frequencies are as follows: Kikar (2), Bordh (3), Moringa (5), Tali (12), Neem (3), Shatoot (11), Oak (2), Fig (1), Sukh Chan (1), Peepal (3), and Date Palm (14).

The park does not have a gardener and lacks a water body, which could enhance its appeal. Additionally, there is no formal maintenance in place, which affects the overall upkeep of the park.

Mango Orchard Park

This covers an area of 13 acres and is home to a variety of trees, including Silver Palms (14), Terminalia (19), Jamun (7), Amaltas (13), Mango trees (97), Simbal (1), Bordh (1), Arjun (1), and Shahtoot (1). The park is not well-maintained, though washrooms are available for visitors. Children often play cricket in the playground. The park is also frequented by various bird species, including crows, kites, and sparrows, adding to its natural appeal.

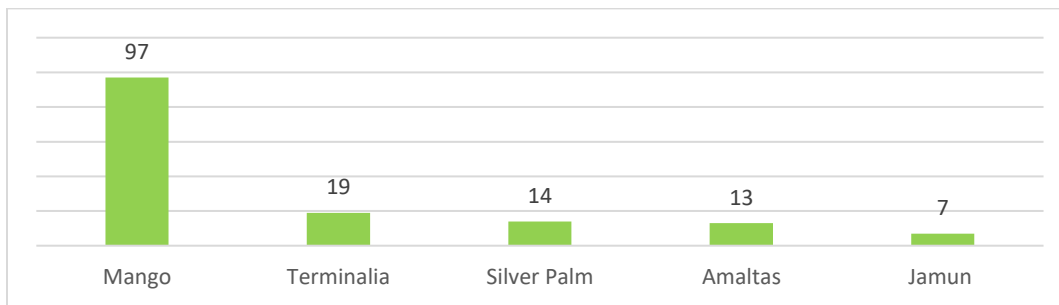


Figure 27. Most Abundant Trees of Mango Orchid Park, Bahawalpur

Shareef Park

Shareef Park, covering an area of 2 acres, is home to a total of 8 tree species. The recorded tree species and their respective frequencies are as follows: Conocarpus (6), Bakain (16), Arjun (10), Peepal (1), Moringa (1), Tali (1), Terminalia (2), and Sukh Chan (1).

The park attracts around 30-32 visitors per day, making it a quiet and peaceful spot for locals. The water body in the park is functional, adding to its charm. However, there are no washrooms available, and the park is self-maintained by the local community with the help of a single gardener. There is no involvement from PHA in the maintenance of the park. Despite these challenges, the park remains a valuable green space for the area.

Tanki Ground Park

Tanki Ground Park spans an area of 1 acre and features a variety of trees, with a total of 7 different species. The park is dominated by Conocarpus trees (146) along with Sukh Chan trees (2), Narium trees (7), Naeem trees (3), Imli tree (1), Safaida trees (11), and Tali trees (2).

Although the park has a dedicated gardener for maintenance, there are still several issues that impact its condition. The washrooms are not well-maintained, and water issues persist, despite the water system being functional. Residents also express concerns over the Conocarpus trees, citing the spread of their roots as a problem. These maintenance and environmental challenges continue to affect the overall quality of the park.

Special Children's Park

Special Children Park is home to a variety of trees, including Bakain (27), Amaltas (9), Shahtoot (2), Kikar (7), Silver Palms (2), Ulta Ashoq (7), Gul-e-Chen (3), *Ceiba Insignis* (5), Date Palms (6), and Arjun trees (2). The park is well-maintained, with proper water availability and an open-air gym. Children frequently play cricket in the playground. There is one gardener taking care of the park. Birds such as crows and kites are commonly spotted in the area.

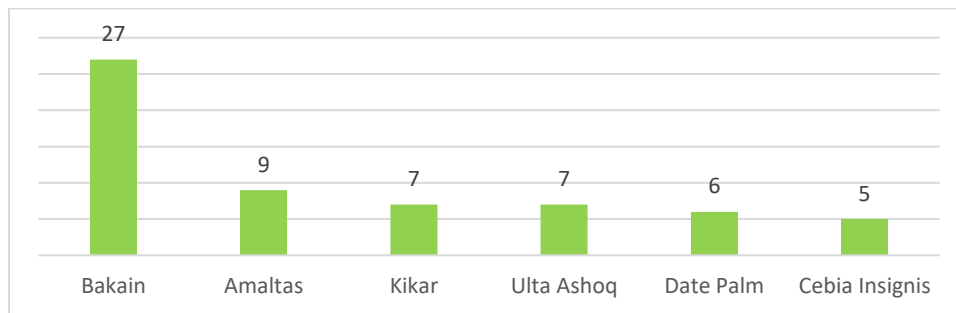


Figure 28. Most Abundant Trees of Special Children Park, Bahawalpur

Bahawalpur Zoo

Bahawalpur Zoo is home to a diverse range of plants, with varied frequencies. Common species include Iple Iple (7), Lasoori (7), White Sherin (4), Bakain (25), Alstonia (4), Shahtoot (19), Bottle Brush (29), Kikar (17), Peepal (21), Terminalia (9), Tali (33), Jaman (49), Berry (14), Sukh Chan (8), Simbal (9), Safaidda (63), Date Palm (39), Naghpali (16), Amaltas (42), Moringa (27), Salix (3), Tectona Grandis (1), Naeem (31), Mango (19), Conocarpus (25), Ulta Ashoq (9), Ficus virens (3), Seirus (3), Salvadoria (2), Farash (4), Gul Chen (10), and Kachanar (1).

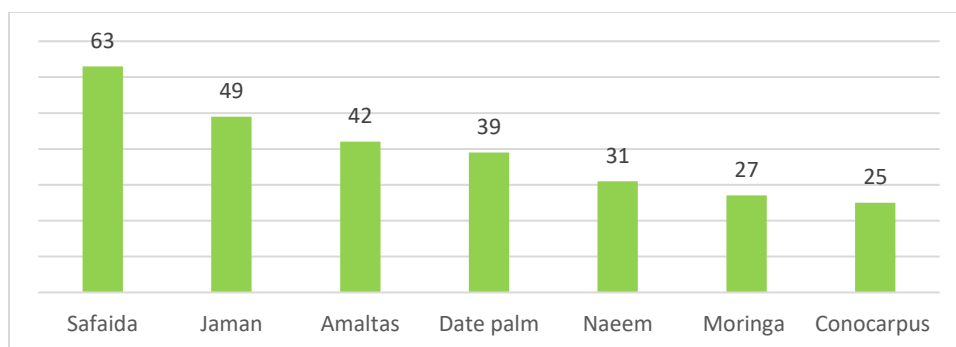


Figure 29. Most Abundant Trees of the Bahawalpur Zoo

4.7 HEALTH & WELLBEING IMPACT ASSESSMENT

Health and well-being assessment in Bahawalpur is crucial due to the city's growing environmental challenges and insufficient public health infrastructure. The health of residents is adversely affected by various factors, including poor drinking water quality, air pollution, and inadequate waste management. According to Mohsin et al. (2013), groundwater in several areas of Bahawalpur contains contaminants such as arsenic, total dissolved solids, and elevated conductivity levels, which exceed WHO safe limits.²⁸ This contributes to a higher prevalence of waterborne diseases like diarrhea and cholera, especially in low-income neighborhoods such as Islamic Colony, where 36% of the population reports health complications linked to poor water quality.

²⁸ Mohsin, M., Safdar, S., Asghar, F., & Jamal, F. (2013). Assessment of drinking water quality and its impact on resident health in Bahawalpur city. *International Journal of Humanities and Social Science*, 3(15), 114-128.

Spatial analysis of park accessibility in Bahawalpur shows that only a limited share of the urban population lives within comfortable walking distance to green space. Using a 400-meter buffer around all mapped public parks and green areas, GIS estimates indicate that approximately 35% of the city's 815,202 residents live within 400 m of at least one park or recreational green space, corresponding to a CBI Indicator 13 score of 2 (moderate accessibility). When assessing the quantity of green space relative to population (Indicator 12), the total recreational natural area estimated at 72 hectares across Bahawalpur's parks and urban green zones translates to only 0.09 ha of accessible park space per 1,000 residents. This figure is significantly lower than international benchmarks (such as the WHO standard of 9 ha per 1,000 people), underscoring substantial gaps in park provision, equitable distribution, and everyday access to green space for the city's residents.

Air quality also remains a concern in Bahawalpur. As per Khan et al. (2014), the Air Quality Index (AQI) in various parts of the city often exceeds safe thresholds, increasing the risk of respiratory and cardiovascular diseases.²⁹ Access to green spaces is a critical determinant of urban health. According to a study published in the *Pakistan Journal of Social Sciences*. Improving green space availability and environmental quality alongside clean water access and pollution control can significantly enhance the health and well-being of Bahawalpur's urban population.

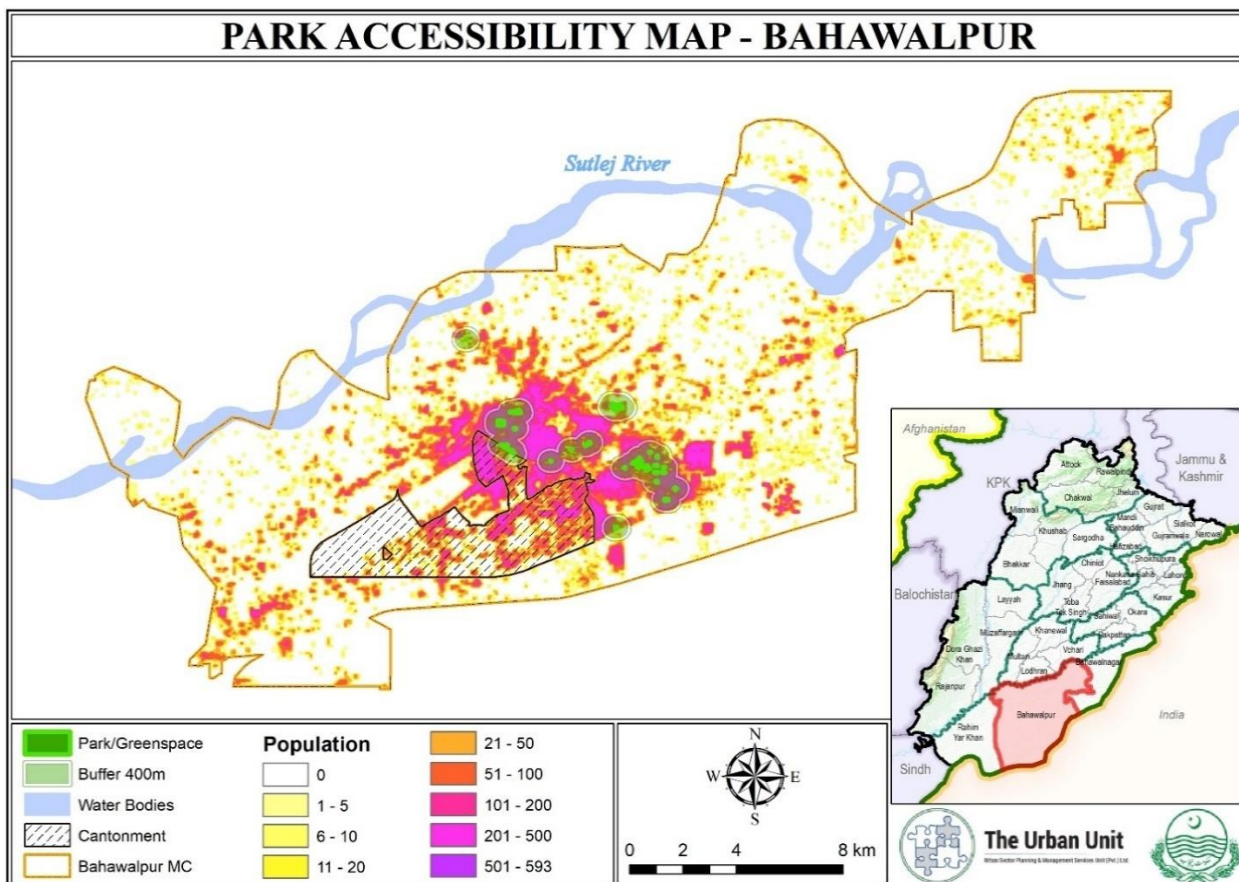


Figure 30: Population Living Near Green Spaces and Open Ground in Bahawalpur

²⁹ Khan, A. A., Fatima, M., & Khan, K. (2014). Spatial analysis of environmental health risks: A case of Bahawalpur district, Pakistan. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, 8(1), 238-257.

4.8 Water Bodies and Wetlands

The total blue area (ponds, lakes, and other water bodies) in Bahawalpur is approximately 12.6 square kilometers, which is about 0.8% of the total area of Bahawalpur. The blue areas in Bahawalpur include River Sutlej, the Bahawalpur Canal, Lal Suhanra Lake, Parks and botanical gardens water bodies.

The Sutlej River, once a lifeline for the region, has witnessed a drastic decline in flow due to upstream diversions following the Indus Waters Treaty, reducing it to a seasonal stream that dries up for most of the year.³⁰ A key ecological zone is Lal Suhanra National Park, which spans over 127,000 acres and houses Patisar Lake, a vital wetland system that supports a range of aquatic plants such as *Hydrilla* and *Vallisneria*, as well as large populations of migratory birds, including herons, ducks, and the endangered common coot (*Fulica atra*).³¹

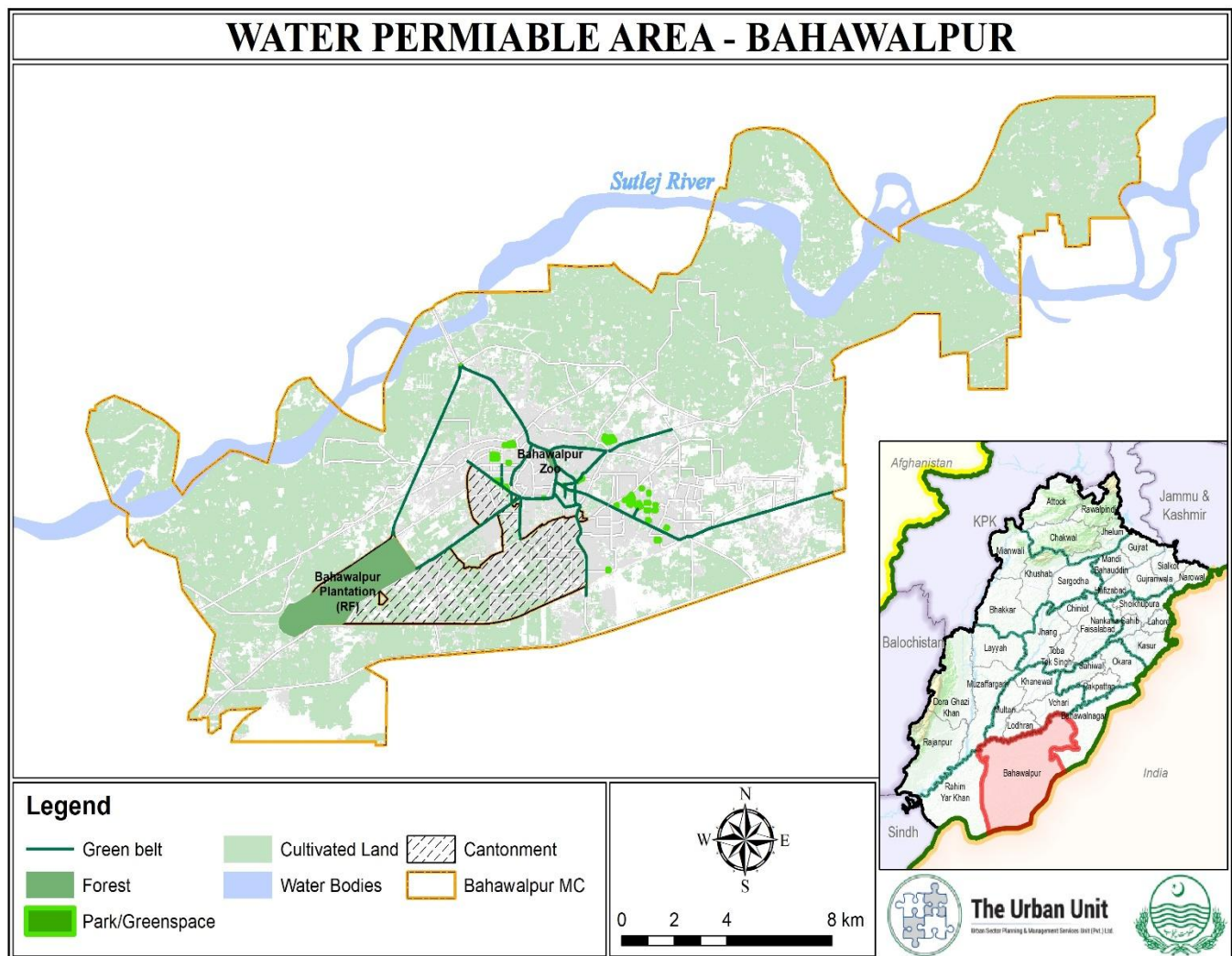


Figure 31 Water Bodies and Water Permeable Areas of Bahawalpur

³⁰ <https://dailytimes.com.pk/1243017/key-to-reviving-bahawalpur/>

³¹ Tasleem, M. W., Rajpoot, S. R., Ashraf, I., Baqir, G., Irfan, M., & Kamran, M. Population Status and Habitat Requirement of Endangered Migratory Waterfowl of Patisar Lake, Bahawalpur, Pakistan.

4.9 Temperature

Bahawalpur experiences a hot desert climate, classified under the Köppen–Geiger system as BWh, a dry, arid subtype with extremely low annual rainfall (~143–223 mm) and very high summer temperatures (often peaking at 47–48 °C)^{32,rev33}.

Average temperature ranges during winter months (December to February) from 14°C (57.2°F) in January to 16.9°C (62.4°F) in February. Average temperature ranges during summer months (June to August) to 35.5°C (95.8°F) in June, making it the hottest month. Average temperatures are relatively mild during Spring and autumn months, ranging from 22.6°C (72.6°F) in March to 30.9°C (87.7°F) in September.³⁴

The satellite-based of land surface Temperature reveals striking land surface temperature variations across Bahawalpur city, showing in 2024LST acquired from MODIS, how land surface temperature varies between the city's urban and suburban peripheries. The hottest areas reach a scorching 40.9°C, while the lowest temperature remains at 33.3°C—a 7.6°C gap that means a drastic difference annually.

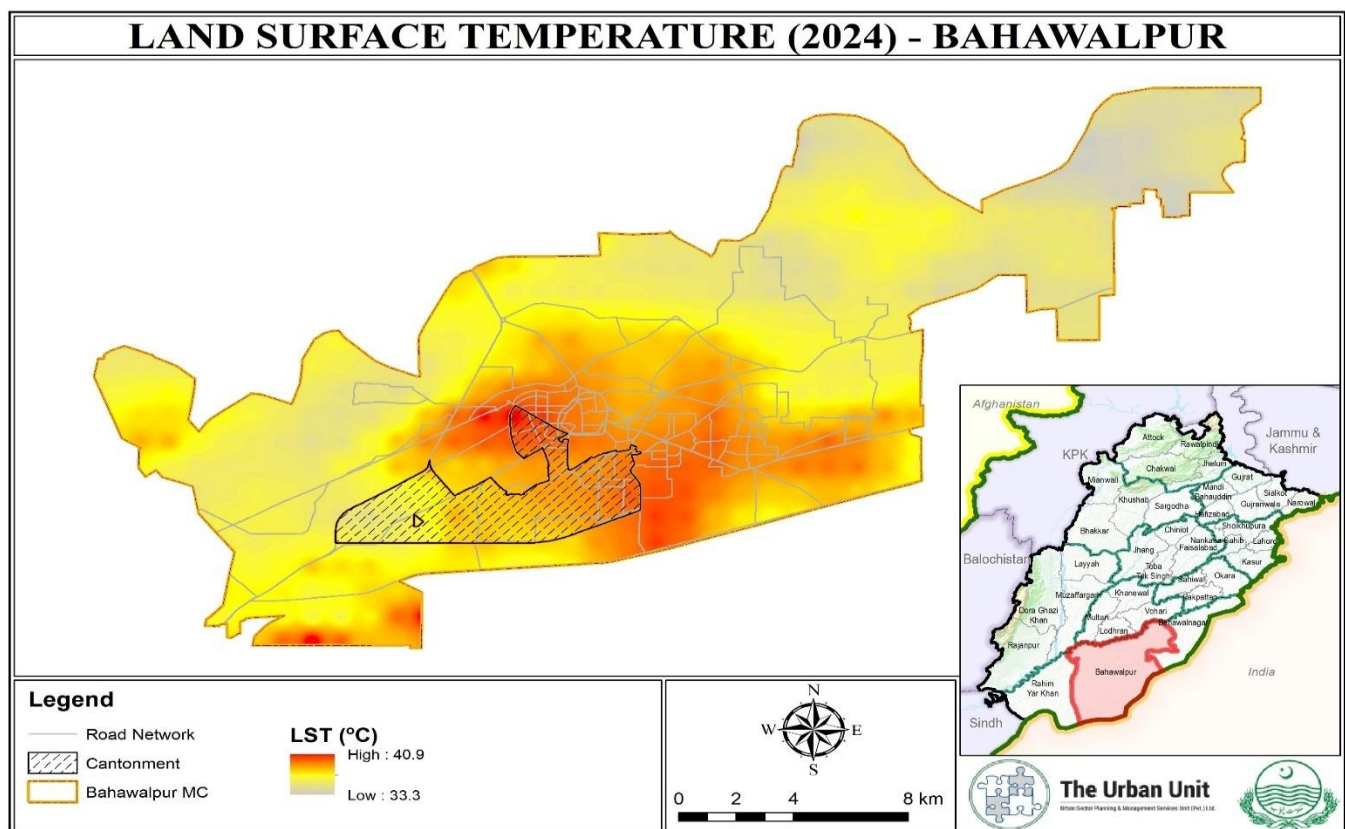


Figure 32 Annual Temperature average of Bahawalpur - 2024

³² <https://www.scribd.com/document/638693827/Koppen-climate-CLASSIFICATION-in-Pakistan>

³³ Shafqat, A., & Noor, S. (2014). Distribution and Sustainable Management of Roadside Trees in Bahawalpur, Pakistan. <https://euacademic.org/UploadArticle/585.pdf>

³⁴ <https://www.google.com/search?q=Bahawalpur+city+temperature+2024&client=app-meta-whatsapp-sa-r>

4.10 Precipitation

Bahawalpur City receives very low rainfall, with an average annual rainfall of 20-25 cm (8-10 inches). The rainfall is mostly limited to the monsoon season, which typically occurs between July and September.³⁵ The low rainfall can lead to water scarcity and droughts, which can have significant impacts on the city's agriculture, industry, and residents. The city's water management systems and infrastructure, such as water storage and conservation measures, are critical in addressing these challenges.³⁶

The precipitation is mostly concentrated during the summer months, with July being the wettest month, receiving an average of 58 mm (2.3 inches) of rainfall. During the winter months of December to February, the city experiences very little rainfall, with an average of only 5-7 mm (0.2-0.3 inches) per month. In contrast, the summer months of June to August receive most of the annual rainfall, while the spring and autumn months experience moderate rainfall, with an average of 9-11 mm (0.4-0.5 inches) per month. The city's natural water absorption capacity is not significantly altered due to urbanization, as the city's expansion is relatively slow-paced compared to other major cities in Pakistan. The city's drainage system is relatively effective in handling the occasional heavy rainfall events, and flooding is not a major concern. However, the city's water management practices can be improved to ensure sustainable use of water resources.³⁷

The annual precipitation map of Bahawalpur is depicted the spatial distribution of rainfall within the Bahawalpur city highlighting key areas in south eastern part of city residential and semi-urban areas such as Model Town C, Cheema Town, Yazman Road vicinity, Islamia Colony, and Lodhran Bypass surroundings etc. has received the highest rainfall up to 338.1 mm (high), some areas received the lowest 240.2 mm during the 2024.

³⁵ Shafqat, A., & Noor, S. (2014). Distribution and Sustainable Management of Roadside Trees in Bahawalpur, Pakistan. <https://euacademic.org/UploadArticle/585.pdf>

³⁶ <https://www.google.com/search?q=precipitation+of+bahawalpur+city&client=app-meta-whatsapp-sa-r>

³⁷ <https://weather-and-climate.com/average-monthly-precipitation-Rainfall,bahawalpur-pk,Pakistan>

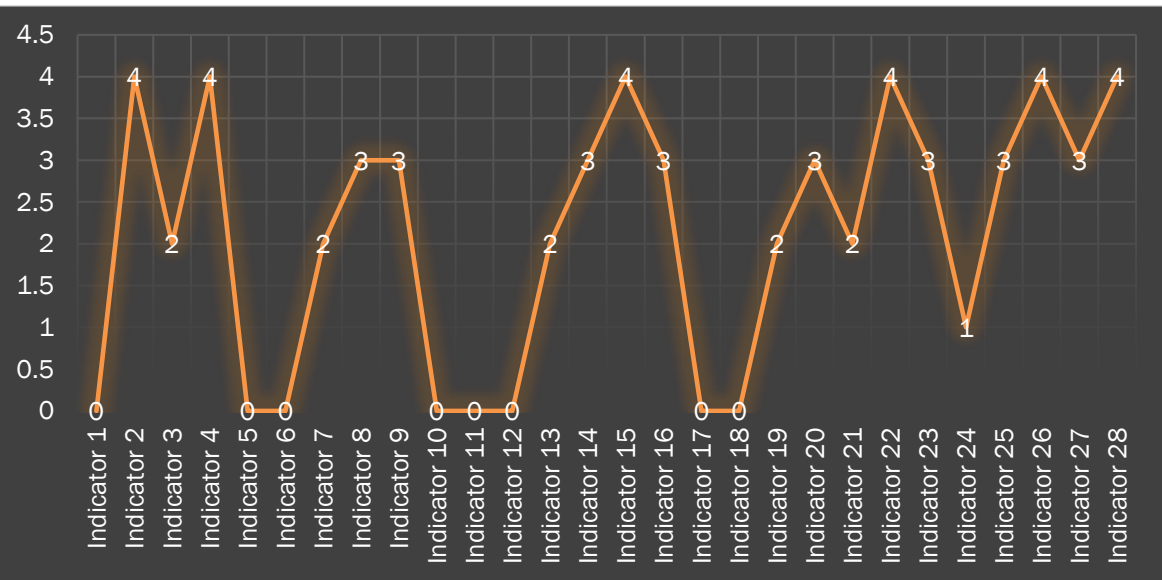
4.12 City Biodiversity Index

The 9th Conference of the Parties to the Convention on Biological Diversity (CoP IX) in 2008, which took place in Germany. Following the initial proposal, a series of expert workshops was held from 2009 to 2011 by the National Parks of Singapore, the Secretariat of the Convention on Biological Diversity (SCBD), and the Global Partnership on Local and Subnational Action for Biodiversity to prepare the CBI. Subsequently, in 2021, a guiding document was developed, known as the User's Manual on Singapore's Cities' Biodiversity.⁴¹.

CBI is a self-assessment tool that cities can use to evaluate effectively their efforts to conserve biodiversity align with their unique baselines. It consists of two parts: (a) the "Profile of the City," which gives background information about the city; and (b) the twenty-eight indicators, which are based on the guidelines and methodology provided in the User's Manual on the SI on Cities' Biodiversity and measure native biodiversity, ecosystem services provided by biodiversity, and governance and management of biodiversity. The index computation must be performed every five years so that the city may assess its progress in mainstreaming biodiversity protection.

CBI Summary

*The City Biodiversity Index of Bahawalpur has been calculated and prepared based on the user manual handbook CBI Technical Series No. 98, 2021, approved by the Secretariat of the Convention on Biological Diversity and the National Parks Board, Singapore. The defined criteria and calculations for each indicator have been evaluated to avoid a biased approach and to ensure the accuracy of the results. A total of 28 indicators have been taken and calculated based on available data sets and Bahawalpur city obtained a total of **59** points out of **112** in the baseline year 2025. as recommended in the user manual.*



⁴¹ Chan, L., Hillel, O., Werner, P., Holman, N., Coetzee, I., Galt, R., and Elmqvist, T. 2021 Handbook on the Singapore Index on Cities' Biodiversity (also known as the City Biodiversity Index). Montreal: Secretariat of the Convention on Biological Diversity and Singapore: National Parks Board, Singapore.

Core Components	Sr. #	Indicators	Maximum Score	Obtained Score
Native Biodiversity in the City	1	Proportion of Natural Areas in the City	4 Points	0
	2	Connectivity Measures or Ecological Networks to Counter Fragmentation	4 Points	4
	3	Native Biodiversity in Built Up Areas (Bird Species)	4 Points	2
	4	Change in Number of Vascular Plant Species	4 Points	4
	5	Change in Number of Native Bird Species	4 Points	0
	6	Change in Number of Native Arthropod Species	4 Points	0
	7	Habitat Restoration	4 Points	2
	8	Proportion of Protected Natural Areas	4 Points	3
	9	Proportion of Invasive Alien Species	4 Points	3
Ecosystem Services provided by Biodiversity	10	Regulation of the Quantity of Water	4 Points	0
	11	Climate Regulation Benefits of Trees and Greenery	4 Points	0
	12	Recreational Services	4 Points	0
	13	Health and Wellbeing Proximity/Accessibility to Parks	4 Points	2
	14	Food Security Resilience Urban Agriculture	4 Points	3
Governance and Management of Biodiversity	15	Institutional Capacity	4 Points	4
	16	Budget Allocated to Biodiversity	4 Points	3
	17	Policies, Rules, and Regulations: Existence of Local Biodiversity Strategy and Action Plan	4 Points	0
	18	Status of Natural Capital Assessment in the City	4 Points	0
	19	State of Green and Blue Space Management Plans in the City	4 Points	2
	20	Biodiversity Related Responses to Climate Change	4 Points	3
	21	Policy and/or Incentives for Green Infrastructure as Nature-based Solutions	4 Points	2
	22	Cross-sectoral and Inter-agency Collaborations	4 Points	4
	23	Participation and Partnership: Existence of Formal or Informal Public Consultation Process About Biodiversity Related Matters	4 Points	3
	24	Participation and Partnership: Number of Agencies/Private Companies/ NGOs/Academic Institutions/International Organisations with which the city is Partnering in Biodiversity Activities, Projects and Programmes	4 Points	1
	25	Number of Biodiversity Projects implemented by the City Annually	4 Points	3
	26	Education	4 Points	4
	27	Awareness	4 Points	3
	28	Community Science	4 Points	4
Maximum Total:			112 Points	59



Issues & Challenges

Bahawalpur city is currently experiencing a lot of issues & challenges that are significant components of ecosystem services, biodiversity conservation, and ecotourism, but a variety of leading issues and challenges need to be overcome to improve the management efforts and goals to be achieved.

5.1 Swot Analysis

The SWOT analysis of Bahawalpur city has been conducted based on the field assessment, biodiversity evaluations from reports, articles, scientific research publications, and repeated consultation sessions with the department, community, institutions, and stakeholders, and is represented as given.

Strength	Weakness
❖ Bahawalpur is home to over 23 parks and gardens, forming a sustainable network of green spaces that contribute to local climate regulation, support urban biodiversity, and provide essential recreational opportunities for residents. ❖ Prominent green spaces such as Lal Suhanra National Park, Fareed Park, and Bahawalpur Zoo play a significant role in conserving regional flora and fauna. These areas offer habitats for native wildlife and promote public awareness of biodiversity and conservation. ❖ Situated near the seasonal River Sutlej and within the Cholistan Desert ecosystem, Bahawalpur serves as a critical resting and feeding ground for migratory birds, including herons, ducks, and coots during the winter season. ❖ The city's network of irrigation canals and artificial water bodies supports a range of aquatic and semi-aquatic species. These features aid in urban cooling, water retention, and air purification, enhancing the city's environmental health. ❖ Parks like Fareed Park attract over 1,000 visitors daily, offering natural beauty and a variety of recreational facilities. Ghosia Park serves as a hub for community activity with amenities such as a library, gym, and jogging track. Lal Suhanra National Park also includes a dedicated children's park with swings and recreational spaces, attracting families and tourists alike. ❖ Several green spaces hold cultural and historical value. Fareed Park is recognized as a cultural landmark in Bahawalpur, while Ghosia Park is noted for hosting community events and enhancing the city's cultural life through its beautiful gardens and public spaces. ❖ Bahawalpur is gradually becoming a center for ecological studies and conservation efforts, particularly due to initiatives in Lal Suhanra	❖ Rapid urban development in Bahawalpur has led to neglect in the upkeep of natural and semi-natural spaces. For example, the water body in Fareed Park is currently non-functional, and though the water system in Tanki Ground Park is operational, water shortages persist, indicating poor resource management and infrastructure maintenance. ❖ Several parks, including Shareef Park, Ghosia Park, and the park in Block F of the Government Employees Housing Society, lack basic amenities such as functional washrooms. The absence of such essential facilities negatively impacts visitor comfort and accessibility, especially for families and elderly individuals. ❖ Inadequate staffing is a key issue affecting park upkeep. Shareef Park and Ghosia Park each have only one gardener responsible for large areas, making it difficult to ensure proper maintenance. Although Fareed Park is better staffed with four gardeners, the overall staff-to-area ratio across the city's parks remains insufficient. ❖ Poor sanitation and inadequate waste disposal affect the environmental quality of several parks. Gulzar-e-Sadiq Park and Furniture Market Park, for example, suffer from visible littering and uncollected waste, reducing both the aesthetic and ecological value of these green spaces. ❖ Some parks are not under the formal management of local authorities such as the Parks and Horticulture Authority (PHA), resulting in inconsistent maintenance. Shareef Park is maintained by local community members, while the park in Block F lacks even a dedicated gardener, leading to deteriorating conditions over time. ❖ Inadequate safety measures make some parks unsafe for visitors. Ghosia Park lacks a complete boundary wall, allowing unauthorized entry by drug addicts and creating security risks. Similarly, Furniture Market Park and Milad Park suffer from

National Park. Research on migratory birds and desert ecosystems is contributing to national environmental knowledge.	insufficient security personnel and a lack of CCTV surveillance, undermining the sense of safety for families and women visitors.
❖ The city holds strong potential for future urban forestry and afforestation efforts. Community-led tree plantation drives and proposed green belts along city roads can contribute to carbon sequestration and improve overall urban sustainability.	Threats Climate change poses a serious threat to Bahawalpur’s ecosystems. Increased temperatures and irregular rainfall patterns are stressing native flora and fauna, altering habitats, and contributing to the decline of sensitive species. Notably, sightings of Indian Peafowl, Red-headed Vulture, and White-backed Vulture have declined, and changes in migratory bird patterns have been reported.
Opportunities	
❖ Integrating green infrastructure into urban development projects such as green roofs, vertical gardens and eco-friendly zoning regulations can enhance biodiversity and climate resilience. This can be supported by making it mandatory for housing societies to allocate at least 15% of land for green areas and offering incentives for households that adopt green roofing or vertical gardening practices.	Rapid urbanization in Bahawalpur is leading to the destruction and fragmentation of critical natural habitats, such as wetlands, forests, and riverbanks. For instance, parts of the wetland area in Lal Suhanra National Park have been drained or converted for urban and industrial use, displacing many species that rely on these habitats.
❖ Expanding green spaces and incorporating biodiversity-friendly practices into urban planning can support wildlife and restore ecological balance. Initiatives like the Punjab Horticulture Department’s development of green belts across Bahawalpur’s roads can help connect isolated green spaces and improve habitat continuity for flora and fauna.	Like other urban centers, Bahawalpur’s green spaces suffer from poor upkeep. Parks like Block F Park and Ghosia Park-2 are visibly deteriorating due to insufficient maintenance, including unmanaged vegetation, littering, and broken infrastructure.
❖ Promoting eco-tourism in parks such as Fareed Park, Ghosia Park, and Lal Suhanra National Park offers opportunities for conservation-linked economic development. These sites, with their ecological richness and cultural value, can become eco-tourism destinations, supporting both biodiversity protection and local livelihoods.	Overuse and poor planning have led to the degradation of ecological functions in public parks. Limited funding exacerbates the issue, making it difficult to maintain infrastructure, sustain biodiversity, or implement restoration projects.
❖ Developing naturalistic habitats in key green areas like Bahawalpur Zoo and Lal Suhanra National Park can improve animal welfare and contribute to regional conservation efforts, especially for threatened or endemic species.	The lack of gardeners, maintenance workers, and veterinary officers significantly affects the upkeep of parks and the health of captive or free-ranging animals. This shortfall hampers cleanliness, security, and ecological care in key public spaces. Human activities like indiscriminate tree cutting and unmanaged plantations threaten biodiversity.
❖ Upgrading infrastructure in parks, such as restoring water bodies (e.g., in Fareed Park), and	In the Fareed Water Park, maintenance activities

providing washrooms, drinking water, and parking facilities can significantly improve visitor experience and increase park usage, thereby reinforcing the importance of these green spaces in urban life.

- ❖ Hosting community events and programs in parks like Fareed Park and Ghosia Park can strengthen social cohesion and public participation. These parks, with facilities such as libraries, gyms, and jogging tracks, can serve as hubs for community development and environmental education.
- ❖ Engaging students from schools, colleges, and universities in tree plantation drives, biodiversity monitoring, and park maintenance can build ecological awareness and community stewardship. These activities also provide practical learning experiences aligned with conservation goals.
- ❖ Partnering with private entities and NGOs can support conservation education and biodiversity initiatives. Collaborative projects involving Lal Suhanra National Park and other green areas can enhance research, promote sustainable tourism, and strengthen institutional capacity for environmental governance.
- ❖ Parks such as Royal City Park and Tanki Ground Park have the potential to evolve into community hubs. Their development can promote inclusive public spaces, contributing to community development while simultaneously supporting environmental conservation.

have included tree removal, affecting ecological integrity. Additionally, the spread of *Conocarpus* in Tanki Ground Park is raising concerns due to its invasive potential.

- The non-functional water bodies in several parks, such as Fareed Park, reflect broader water management issues. Scarcity of water not only diminishes aesthetic and recreational value but also affects local biodiversity and vegetation health.
- The unchecked introduction of non-native plant species like Poplar and Eucalyptus, and animals such as the Common Myna and House Sparrow, threatens native biodiversity. These species compete for food, space, and nesting sites, often displacing local flora and fauna.



3. Vision & Objectives

6.1 Vision

The Bahawalpur City Biodiversity Action Plan is aimed at supporting the vision:

Conservation and revival of Bahawalpur's natural habitats, integrated green spaces, enrich native biodiversity, support climate resilience, and sustainable, healthier, and livable urban ecosystem.

6.2 Mission

The Bahawalpur City Biodiversity Action Plan is aimed at

Protect, restore, and sustainably

manage the city's natural ecosystems by implementing biodiversity conservation into urban planning and development. Conserve native species, improve ecological connectivity, and promote nature-based solutions that strengthen climate resilience and support sustainable livelihoods. Through inclusive governance, community engagement, and responsible land-use practices, create a healthier, more livable, and sustainable city.

6.3 Objectives

The Bahawalpur Biodiversity Action Plan was developed to achieve the following objectives:

- To assess the status of fauna and flora and their distribution within urban spaces.
- To track the impact of urbanization, climate change, and other environmental factors on biodiversity over time.
- To provide a framework for incorporating biodiversity into urban development and land-use planning.
- To identify actions to improve green spaces, water management, and the preservation of local ecosystems.
- To engage the community in biodiversity monitoring and conservation efforts.
- To develop a strategic document for policymakers to adopt informed strategies and policies for biodiversity conservation in urban areas.

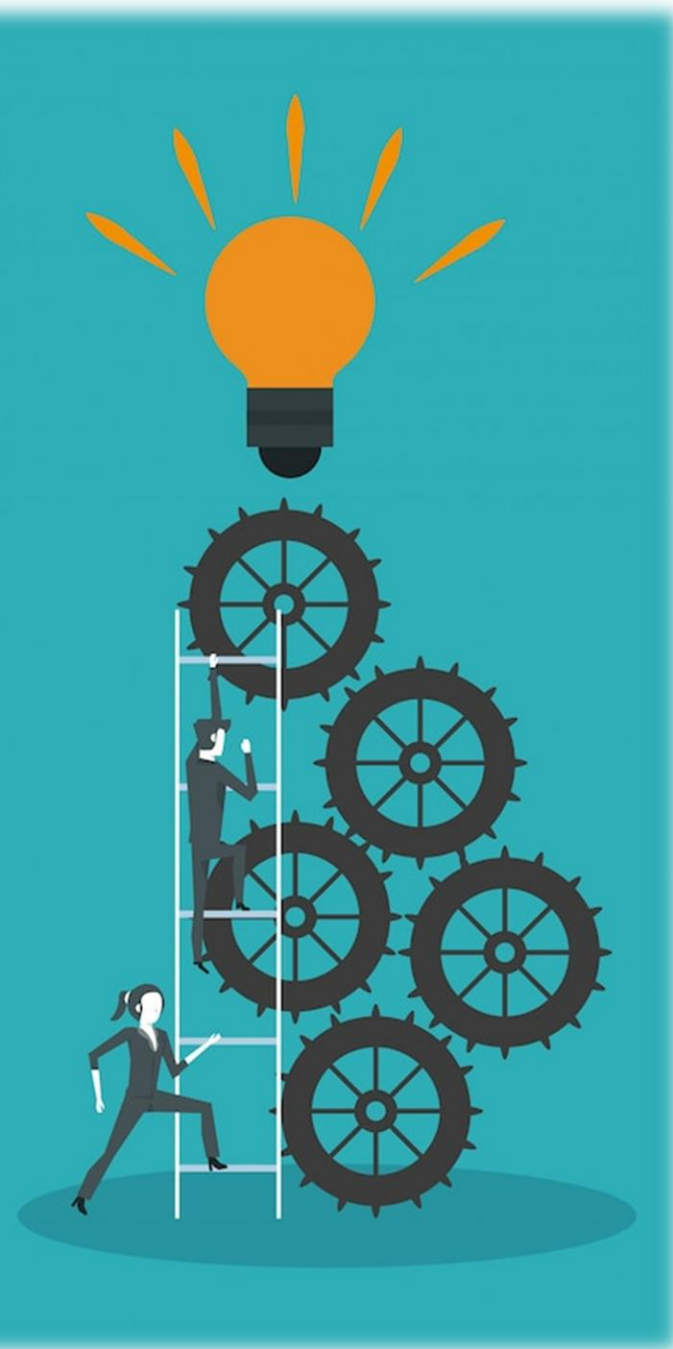
Biodiversity Actions & Strategies

7.1 Habitat & Conservation Areas

The objective of this theme is to ensure the restoration, conservation, and sustainable management of critical biodiversity and habitat areas in Bahawalpur. These actions aim to enhance ecological resilience, protect native species, and regulate urban ecological balance in the region. The following strategies and actions have been identified to achieve this objective:

- Launch large-scale reforestation projects aimed to increase green cover by 20% by 2030 through the planting of over 100,000 native trees such as Kikar, Jand, Ber, Lasura, Jamun, Kachnar, and Shisham. Replace invasive exotic species with indigenous flora to restore natural habitats and support biodiversity.
- Officially declare the Cholistan Desert Wildlife Sanctuary as a Protected Area and enhance management plans for key protected sites, including Cholistan and Lal Suhanra National Park.
- Establish a 500-acre urban wetland reserve along the River Sutlej to improve water quality and provide habitat for aquatic and migratory wildlife.
- Develop green corridors connecting protected areas and urban green spaces to reduce habitat fragmentation and facilitate wildlife movement.
- Implement measures to reduce vehicle, plastic, and water pollution impacting biodiversity. Promote drought-resistant native plants in urban landscaping and encourage multi-story buildings to increase green space and reduce the urban heat island effect.

- Strengthen habitat restoration campaigns in protected areas and enhance ex-situ conservation through captive breeding and educational programs at the Bahawalpur Zoo and related facilities.
- Bahawalpur Zoo is in a highly congested area and space is not sufficient to accommodate large numbers of animals as per space requirement as per international standards. Animals are also stressed due to noise pollution. It is recommended that strict measures be taken to minimize the impact



of noise pollution on animals, as it affects their behavior and breeding of animals.

- Enforce wildlife protection laws to prevent illegal hunting and deforestation. Expand rescue and rehabilitation programs for injured or displaced wildlife.
- Promote native flowering plants and install insect hotels in urban areas to support insect pollinators critical for ecosystem health.
- Foster community involvement through citizen science initiatives, awareness campaigns, and incentives for native tree planting. Encourage academic partnerships to support research and conservation efforts.

7.2 Sustainable Agriculture and Agroforestry

The objective of the Sustainable Agriculture and Agroforestry theme is to promote agricultural sustainability and farmland health in the city. By integrating trees with crops, soil health will improve, climate resilience will increase, carbon sequestration will be enhanced, and native wildlife habitats will be supported across key agricultural zones. The following location-specific actions and strategies are proposed:

- Encourage organic farming practices in key crop-producing areas such as Khanqah Sharif, Lodhran, Yazman Mandi, and Khairpur Tamewali. Provide incentives to farmers growing organic fruits, vegetables, and staple crops to reduce pesticide use and increase pollinator diversity.
- Support planting of native trees like Kikar, Beri, Kachnar, and Jand alongside crops in Bahawalpur city, Yazman, and the Cholistan Desert's irrigated agricultural belts. Distribute free native tree saplings to farmers in these zones to improve soil health and provide wildlife habitats.
- Provide financial incentives for regenerative farming practices in areas such as Bahawalpur, Khairpur, Tamewali, and the Cholistan Desert fringes, promoting soil conservation and sustainable land use.
- Implement afforestation with fast-growing, drought-tolerant species like Shisham and Kikar in Bahawalpur, Yazman, and along canal irrigation systems to increase green cover and enhance climate resilience.
- Facilitate access to loans and technical support for farmers in Yazman and Cholistan to adopt drip irrigation and other water-efficient technologies, improving water use efficiency in these arid agricultural zones.

7.3 Wetland and Water Bodies Management

Urban water bodies and wetlands are essential ecological resources that sustain biodiversity, recharge groundwater, regulate microclimates, and buffer flooding. The wetland and water body management theme under the Bahawalpur Biodiversity Action Plan (BBAP) focuses on the conservation, restoration, management, and development of aquatic habitats that align with sustainability in urban planning. The water bodies must be protected and revitalized in order to conserve the local aquatic flora and fauna as well as to improve water security, climate resilience, and the city's ecological health. This strategy encourages a move toward blue-green infrastructure and nature-based solutions that benefit urban inhabitants and wildlife. The

following are the key actions to achieve the theme's objectives:

- Develop buffer zones along the Sutlej River banks near Bahawalpur city to prevent water pollution and protect critical aquatic habitats.
- Implement river training works along the Sutlej River and seasonal canals to stabilize banks and increase riparian green cover, reducing erosion and improving habitat quality.
- Initiate restoration projects for degraded ponds and wetlands such as the Lal Suhanra wetlands, ponds near Bahawalpur Zoo, and smaller urban water bodies in residential areas using phytoremediation, floating wetlands, and constructed wetland techniques.
- Form local task forces to engage communities in activities such as riverbank cleanups, plantation drives, aquatic biodiversity monitoring, and public awareness programs focused on water conservation.
- Promote nature-based solutions, including rain gardens, permeable surfaces, and constructed wetlands within Bahawalpur's urban and peri-urban areas to conserve groundwater and manage stormwater.
- Conduct regular desiltation and management of key urban ponds and reservoirs in Bahawalpur to restore water storage capacity and improve aquatic habitat quality.
- Carry out seasonal surveillance and aquatic species census in wetlands and water bodies like the Sutlej riparian zone and Lal Suhanra wetlands to monitor ecosystem health and guide conservation efforts.
- Implement strict enforcement against the dumping of industrial effluents, sewage, and solid waste into rivers, canals, and urban water bodies to safeguard water quality and aquatic biodiversity in Bahawalpur.

7.4 Open Spaces Management and Conservation

Urban resilience, public health & wellbeing, and ecological balance all depend on open spaces including urban forests, greenbelts, parks, gardens, and undeveloped natural areas. The theme of open spaces management and conservation focuses on conservation, protection, and development of green spaces to sustain urban biodiversity, improve air quality, mitigate urban heat islands, provide recreational opportunities, and cultural value. Some of the following key actions & strategies are identified to address the theme's objectives.

- Ensure the planting of fruiting and flowering trees like Jamun, Ber, Lasura, and Loukat to attract the pollinators and birds within Parks and green spaces.
- Urban afforestation or Miyawaki forests should be developed by having native tree plantations, which will provide urban biodiversity, improve air quality, increase carbon sequestration, and provide aesthetic beauty.
- The IoT-based security cameras and tracking system should be installed in parks to improve the watch and ward strategies.
- The IoT-based irrigation system, i.e., smart sensors and devices, should be introduced in parks and

green spaces to monitor soil moisture, optimize water usage, and ensure efficient watering of plants in real-time.

- Development of new green spaces and parks to improve population accessibility for the unserved 35% population who don't have 400m accessibility to parks and green spaces as per the standards of the WHO and UN-Habitat.
- The Park and Horticulture Authority should ensure the establishment of a native flowering bed to attract and promote the native pollinators.
- In Bahawalpur, urban greening efforts can be focused on converting underutilized public lands near Airport Road, University Road, and Yazman Road into native green spaces and mini urban forests. These areas will act as biodiversity hotspots, reduce the urban heat island effect, and provide habitat for native birds, pollinators, and small mammals.

7.5 Grey Infrastructure & Built Environment Management

The Grey Infrastructure & Built Environment of an urban area like Bahawalpur includes buildings, bridges, drainage systems, roads, and other man-made structures. The unplanned and rapid urbanization with poorly designed grey infrastructure frequently contributes to pollution, surface water runoff, urban heat islands, habitat fragmentation, and biodiversity loss in Bahawalpur. The transformation of conventional grey infrastructure into climate-resilient and eco-friendly infrastructure will protect and conserve urban biodiversity and mitigate the urban impact. The theme can be achieved with the adaptation of the following key strategic actions.

- The current and newly constructed building should transform into climate-resilient and eco-friendly infrastructure, like vertical gardening, rooftop gardening, and planters will help to protect and conserve the urban biodiversity and mitigate the urban impact.
- The development of permeable pavements and bio-retention basins in urban areas will help to lower the water runoff, improve stormwater management, and the water table.
- The roads, underpasses, and highway medians and green belts can be a connected network of green corridors with native, drought-resistant plant species. These dense green buffers and corridors with trees will transform concrete-dominated areas into flourishing ecological zones and absorb pollutants, reduce noise, and improve the air quality of Bahawalpur.
- The biomaterial-manufactured bird-friendly artificial nesting boxes should be installed under shaded areas of the building to provide sheltering habitat for native birds.
- Enforce annual plantation drives and green structure improvement schemes by housing societies to improve habitat quality.

- The temporarily vacant spaces of Bahawalpur that are being left undeveloped can be planted with wildflower species to enhance the aesthetic look and improve pollen and nectar availability for native biodiversity.

7.6 Community Engagement and Participation

The theme of community engagement and participation is key to biodiversity action plan initiatives and is targeted to a high degree of volunteerism and community involvement that can be crucial for the city's biodiversity. Thus, some of the key actions and strategies should be taken to improve community engagement and participation.

- Implementation and structuring of frameworks and policies linked to community multicultural strategies to engage them in the conservation and restoration of natural resources.
- The initiation of community volunteering strategies ensures community facilitation.
- The development and integrational management of agreements with local communities to take part in conservation and protection.
- Consultation and collaboration with natural areas neighboring landowners should be taken to ensure their interests are not affected.
- Arrange seminars and awareness campaigns to engage the local communities, neighboring stakeholders, academia, and conservation organizations to boost participation.
- Conservation organizations and private stakeholders should encourage them to initiate ecological activities and conservation campaigns for the sustainability of natural resources in the city.
- Encourage and offer opportunities for individuals having an extensive understanding of biodiversity and natural resources to collaborate with strategy implementation, share and apply their expertise to enhance city biodiversity conservation and management strategies, and also enhance the operational capabilities.



Monitoring & Evaluation Plan

Monitoring and Evaluation (M&E) is a critical component of the Bahawalpur City Biodiversity Action Plan. It enables tracking of progress, measuring the effectiveness of implemented actions, identifying emerging challenges, and ensuring that biodiversity conservation goals are achieved in a timely and adaptive manner. This chapter outlines the framework, indicators, responsibilities, and reporting mechanisms for M&E to support evidence-based decision-making for urban biodiversity conservation in Bahawalpur. This plan aims to provide a sound framework to identify challenges, track progress, and ensure evidence-based decision-making for long-term biodiversity conservation in Bahawalpur.

The prime objective of the M&E Plan is to

8.1 Monitoring Plan

Each target will be monitored using a Results-Based Management (RBM) approach, with clearly defined outputs, outcomes, indicators, baselines, and targets. The Key Performance Indicators chalked out for the Bahawalpur City Biodiversity Action Plan are presented as under.

Thematic Area	Monitoring Indicators	Description	Frequency	Responsibility
Species Conservation	Species Population Trends	Monitoring population of key species, including plants, birds, insects, mammals, and reptiles	Annually	Punjab Forest, Wildlife and Fisheries Department / PHA, Bahawalpur

Habitat Health	Habitat Condition Scores	Assessment of vegetation cover, species richness, and habitat quality	Annually	Environment Protection Department / Punjab Forest, Wildlife and Fisheries Department / PHA, Bahawalpur
Invasive Species Control	Presence of Invasive Species	Regular detection and mapping of invasive flora and fauna	Semi-annually	Punjab Forest, Wildlife, and Fisheries Department / PHA, Bahawalpur
Pollution Monitoring	Air, Water & Soil Quality	Monitoring pollutants (e.g., PM2.5, BOD, pH levels)	Quarterly	EPA Bahawalpur
Urban Pressures	Land Use Change	Tracking urban expansion, infrastructure projects, and encroachment	Quarterly	/ PHA / Local Government

Climate Impact	Temperature and Rainfall Trends	Analyzing local climate changes and extreme events Events	Annually	PMD
Water Ecosystems	Water Quality Index	Regular testing of key water bodies	Monthly	WASA / EPA / Parks Department/ Local Government
Green Connectivity	Connectivity Index of Green Spaces	GIS-based mapping of habitat corridors between parks and forests	Annually	Punjab Forest, Wildlife and Fisheries Department / PHA, Bahawalpur
Ecosystem Services	Service Valuation Metrics	Identification and valuation of key biodiversity Contributions	Every 2 years	Environment Department / Academia
Community Engagement	Participation Rates & Outreach Events	Tracking public involvement in conservation activities	Annually	The Urban Unit / NGOs / Local Government/ Punjab Forest, Wildlife and Fisheries Department / PHA, Bahawalpur

Monitoring Methods

Effective biodiversity monitoring in Bahawalpur requires a combination of modern tools and conventional ecological techniques to provide accurate and actionable insights. The following monitoring methods are recommended for assessing biodiversity health and tracking environmental changes:

- I. **Field Surveys:** Seasonal field surveys should be conducted to monitor variations in bird and insect populations. Regular vegetation assessments should be carried out to document species composition and abundance across urban green spaces. The population dynamics of mammals can be tracked using non-intrusive techniques such as camera traps installed at strategic locations.
- II. **Remote Sensing and GIS Mapping:** Geospatial technologies such as remote sensing and Geographic Information Systems (GIS) are essential for tracking changes in land use, vegetation cover, and fragmentation of habitats. These tools provide a reliable and scalable method to assess spatial patterns

and trends in urban biodiversity.

- III. **Soil and Water Quality Testing:** Periodic sampling of soil and water from various ecosystems—including parks, rivers, canals, and ponds—should be conducted to evaluate contamination levels and assess ecosystem health. Testing should include parameters such as pH, heavy metals, nutrients, and biological oxygen demand (BOD).
- IV. **Drone and Satellite Imagery:** The use of drones and high-resolution satellite imagery enables real-time monitoring of deforestation, vegetation health, and urban expansion. These tools are particularly useful for identifying habitat degradation and encroachments at a landscape level.
- V. **Acoustic Monitoring:** Traditional species counts may overlook cryptic or nocturnal species. Bioacoustics sensors offer a non-invasive technique to monitor biodiversity through soundscapes. This method is effective for tracking bird calls, amphibian vocalizations, and insect activity, providing insights into species richness and behavior.
- VI. **DNA Barcoding and Environmental DNA (eDNA) Sampling:** Advanced molecular tools such as DNA barcoding and eDNA analysis allow for species detection in complex environments. By analyzing water, soil, or sediment samples, researchers can identify the presence of species, including rare or elusive ones, without direct observation.

8.2 Evaluation Plan

The Evaluation Plan for the Bahawalpur City Biodiversity Action Plan is designed to systematically assess the effectiveness of conservation initiatives and inform adaptive management strategies. It focuses on key criteria such as species diversity and population stability, control of invasive species, habitat quality, pollution reduction, and community engagement. Evaluation methods will include comparisons with baseline data, stakeholder surveys, and assessments of past conservation interventions. This structured approach ensures that progress is measured over time, gaps are identified, and successful strategies are scaled, ultimately supporting evidence-based decision-making for biodiversity conservation in Bahawalpur. Key evaluation criteria and methods are explained below.

Evaluation Criteria

- I. **Species Diversity and Population Stability:** Assessing the number of species in urban green spaces and built-up areas, and the stability of their populations over time.
- II. **Control of Invasive Species:** Evaluating the success of measures taken to manage non- native species in previous years.
- III. **Improvement or Decline in Habitat Quality:** Analyzing changes (positive or negative) in habitat health and green cover over the period.
- IV. **Reduction in Pollution Levels:** Evaluating the success of pollution management efforts in targeted areas over time.
- V. **Community Engagement and Awareness:** Assessing the success of awareness campaigns and the level of local community participation in conservation efforts.

Evaluation METHODS

- I. **Comparison with Baseline Surveys:** Comparing new data with initial survey data to identify trends and changes.

- II. **Interviews and Surveys:** Gathering feedback from local communities and conservation teams regarding ongoing efforts and future improvements.
- III. **Assessment of Conservation Interventions:** Analyzing the outcomes and effectiveness of specific actions taken in previous years for the protection of biodiversity.

8.3 Data Management

All biodiversity-related data should be systematically collected, validated, and stored within a centralized, integrated data management system to ensure consistency, accessibility, and long-term usability. This system should support seamless data entry, retrieval, and analysis for stakeholders involved in biodiversity planning and monitoring.

To promote transparency and support evidence-based policymaking, non-sensitive datasets should be made openly accessible to researchers, academics, and government institutions through user-friendly platforms. The development of live dashboards and online portals is essential to visualize real-time biodiversity trends, environmental indicators, and spatial analyses, enabling timely and informed decisions.

Furthermore, to facilitate broader comparative analysis and align with global conservation efforts, Bahawalpur's biodiversity data should be interoperable with international biodiversity information platforms (e.g., GBIF, IUCN, UNEP-WCMC). This will enhance knowledge exchange, enable benchmarking, and promote collaboration on regional and global biodiversity goals.

8.4 Reporting And Communication

Effective reporting and communication are key to ensuring transparency, accountability, and the continued success of the Bahawalpur City Biodiversity Action Plan. The following strategies will be implemented to disseminate findings, engage stakeholders, and inform future biodiversity conservation efforts:

- I. **Annual Evaluation Reports:** Detailed annual monitoring and evaluation reports will be prepared to track progress, document successes, and identify challenges encountered during the implementation of this plan. These reports will be shared with key stakeholders, including local government agencies, environmental organizations, and policymakers. The objective is to provide actionable insights that will inform the development of policies and interventions aimed at improving biodiversity conservation and ensuring alignment with urban planning and development goals.
- II. **Public Awareness Campaigns:** To foster public support and community involvement, this plan will actively communicate its progress through targeted public awareness campaigns. These campaigns will highlight success stories, share key milestones, and raise awareness about ongoing challenges in biodiversity conservation. By keeping the public informed and engaged, the program will build a stronger connection between citizens and the natural environment, empowering local communities to actively contribute to conservation efforts. Social media, community events, educational workshops, and local media will be key tools in these campaigns.
- III. **Policy Recommendations:** Based on annual monitoring and evaluation findings, comprehensive policy recommendation documents will be developed to guide the formulation of future biodiversity

conservation strategies. These recommendations will be tailored for both national and international audiences, ensuring that they reflect the most up-to-date scientific research and local realities. They will align with global frameworks such as the United Nations Sustainable Development Goals (SDGs) and the Convention on Biological Diversity (CBD), facilitating the integration of Bahawalpur biodiversity priorities into global and regional conservation agendas.

- IV. **International Collaboration:** Strengthening international collaboration will be a central aspect of this city's biodiversity action plan, reporting, and communication strategy. The plan will engage with international organizations, researchers, and policymakers from leading countries in biodiversity conservation. These collaborations will foster knowledge exchange, allow for the sharing of best practices, and encourage the adoption of innovative solutions that can be implemented in Bahawalpur unique urban context. Participation in international biodiversity forums and conferences will further enhance Bahawalpur's standing as a leader in urban conservation initiatives.

4. Project Digest and Interventions

Enhancing biodiversity in Bahawalpur is essential for safeguarding ecological stability, strengthening climate resilience, and conserving the city's unique desert-edge ecosystems. Rapid urbanization, habitat fragmentation, and declining water quality are intensifying pressures on native flora, fauna, and the ecosystem services that support human well-being. Biodiversity enhancement is therefore critical for maintaining ecological functionality, regulating urban microclimates, and reversing the degradation of high-value natural habitats. Strategic, nature-based interventions, including the establishment of urban nature zones and biodiversity parks, restoration of wetlands, and reforestation of riparian and canal-side corridors, are required to improve ecological connectivity, protect pollinators and native species, and embed biodiversity conservation into urban development planning.

Project Digest/Intervention

Based on a comprehensive assessment, desk review, secondary data information, on-ground survey, perception and expectation survey, consultations with the local community, and meetings with key stakeholders of the districts, detailed actions and strategies were defined for the district of Bahawalpur to conserve and protect the city's biodiversity. A project digest is developed for Bahawalpur from the key actions, which are potential interventions to revive the urban biodiversity and help to mitigate the leading threats.

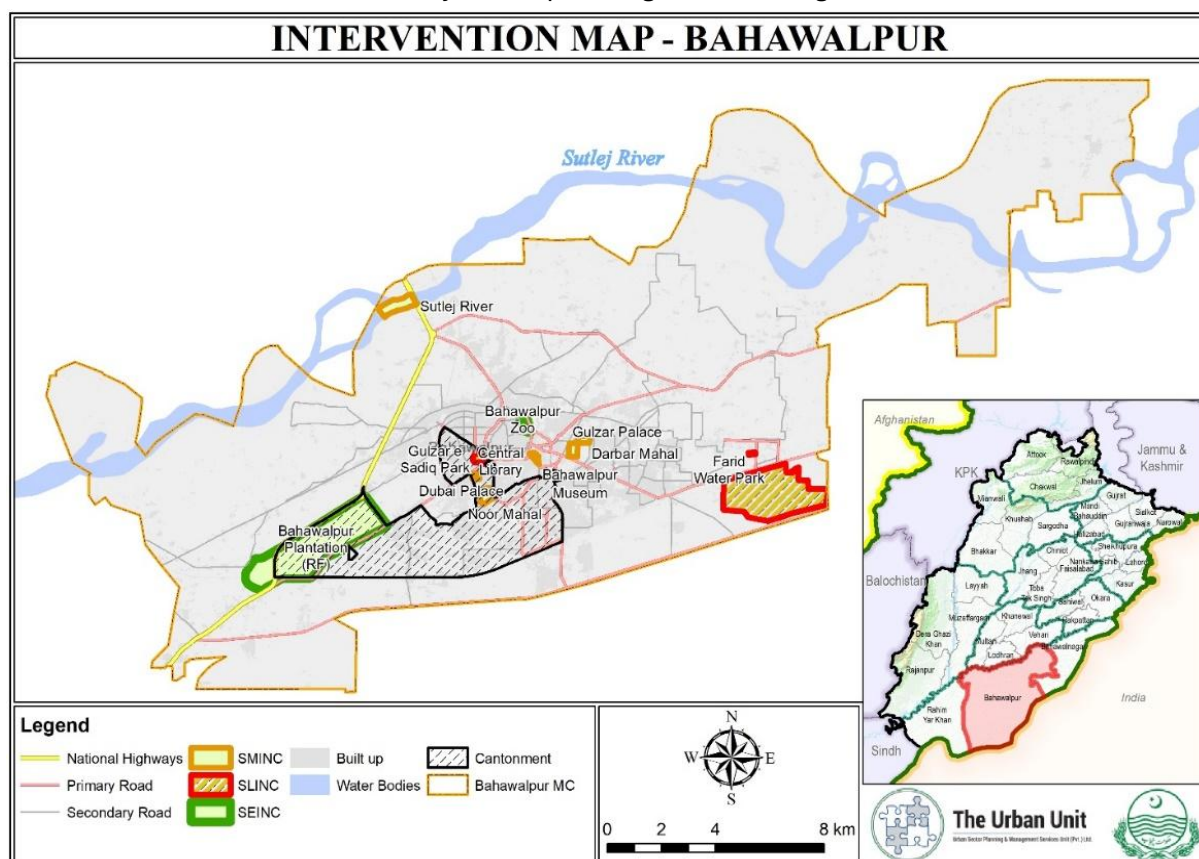


Table 1 Short, Mid, and Long-Term Projects of Bahawalpur

Projects Summary				
Sr. #	Projects	Proposed Location	Timeline	Estimated Cost (Millions Rs.)
S. No.	Project Name	• Location	Approx. Coordinates	Cost
1.	Bahawalpur Plantation (RF) – SEINC	• Western edge, near Dubai Palace	29° 21' 58"N 71° 37' 31"E	7.80
2.	Farid Water Park – SLINC	• Southeastern Bahawalpur	29° 23' 33"N 71° 45' 28"E	11.00
3.	Sadiq Park & Central Library Zone	• Cantonment Area, Central-West, Bahawalpur	29° 23' 32"N 71° 40' 05"E & 29° 23' 28"N 71° 41' 06"E	17.00
4.	Green Corridor SEINC Green Corridor SLINC Red Corridor	• From RF to Central City (East-West), From Farid Park to East Bahawalpur	29° 24' 52"N 71° 40' 47"E & 29° 22' 17"N 71° 42' 01"E 29° 23' 46"N 71° 39' 39"E	44.10 37.25
5.	Sutlej Riparian Revival Initiative	• Sutlej river bank	29° 26' 25"N 71° 39' 03"E	53.00
6.	Cholistan Buffer Zone Agroforestry	• Near Lal Suhanra Park and Khairpur Tamiwali	29° 21' 06"N 72° 05' 01"E & 29° 18' 24"N 71° 35' 55"E	75.00
7.	Nature-Based Wastewater Treatment Site	• Library pond, Islamic colony	29° 21' 57"N 71° 41' 52"E & 29° 23' 32"N 71° 41' 03"E	6.10
Grand Total Amount				283.9 million

Urban Green Corridors

The urban green corridors are the networks of interconnecting green pathways, including green spaces, linear parks, linear plantations, and green belts, within Bahawalpur city along major roads, water channels, tracks, and nullahs to provide an interconnected habitat and enhance the environmental qualities of cities. Green corridors help to mitigate habitat fragmentation, provide pathways for urban biodiversity roaming, and serve as cool air pathways that cool cities and improve air quality. Additionally, green corridors help to improve the aesthetic view of metropolitan areas, offer sustainability, and promote the motive of “man with wildlife” in urban centers.

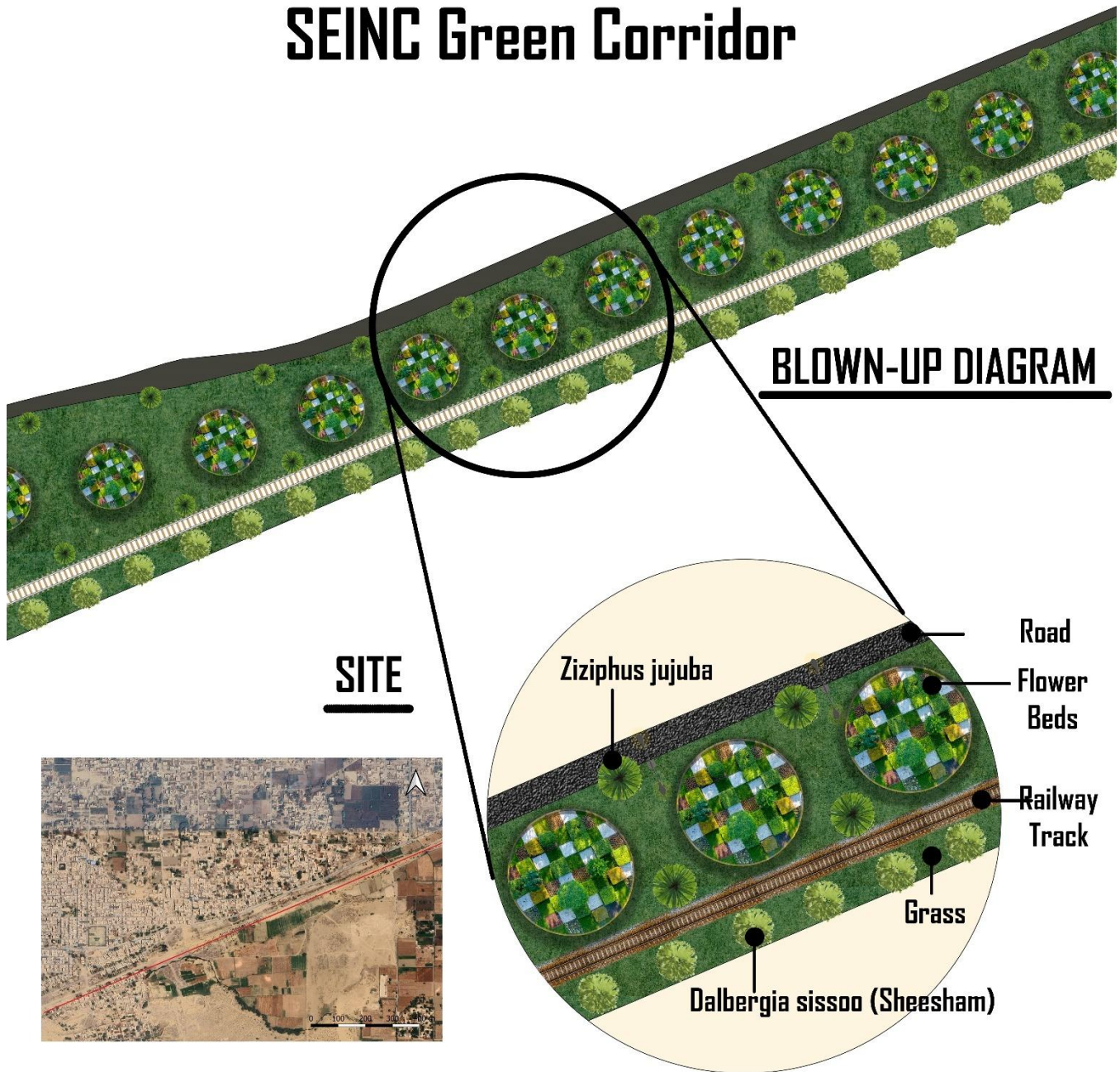
Proposed Locations

This corridor is planned to stretch from Bahawalpur plantation, an RF, to Central City in an East-West direction and from Farid Park to East Bahawalpur. Its geographical extent is broadly defined by the coordinates:

Conceptual Design

- The corridor will form a continuous, interconnected system of green spaces, utilizing linear parks, avenues, pocket parks, and potentially green bridges to link existing green areas like Bahawalpur Plantation (RF) and Farid Park.
- A multi-layered planting strategy will be used, including canopy (sheltering/fruitletting), understory (flowering/sheltering), shrub (sheltering/foraging), and ground cover (pollinator/soil health) layers, using native species to support diverse urban biodiversity.
- The number of planting rows will vary (1-5+) based on available space along roads, canal banks, and within parks, maximizing green cover while respecting infrastructure.
- Vegetation will be strategically placed along urban edges, riparian zones, and connectivity hotspots to create buffers, filter runoff, and link fragmented habitats.
- The design emphasizes sufficient corridor width, diverse native species, and minimized impervious surfaces to allow for wildlife movement and enhance ecological value.
- A robust maintenance plan will include efficient watering, regular pruning, waste management, and community involvement to ensure the long-term health and sustainability of the green spaces.

SEINC Green Corridor



THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)				
Bahawalpur Biodiversity Action Plan				
Rough Cost Estimate of Green Corridor				
ABSTRACT OF COST				
SEINC Green Corridor				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Green Transit Infrastructure	km	7	5,000,000	35,000,000
Tree Plantation (Linear)	Nos.	7,000	300	2,100,000
Pedestrian Path & Benches	km	7	1,000,000	7,000,000
			Total	44,100,000
SLINC Red Corridor				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Urban Boulevard Dev.	Km	7	4,000,000	28,000,000
Native Shrubs & Grasses	m ²	15,000	150	2,250,000
Pedestrian Facilities	km	7	1,000,000	7,000,000
	Amount in Million		14000,000	

9.1 Cholistan Buffer Zone Agroforestry

Agroforestry is to socialization of the forest bioscape over agricultural land by the integration of trees on agricultural and farmland of the area. Agroforestry is the best practice adopted by developing countries where forest cover is

less than the required statistics. It involves planting trees alongside crops to provide multiple benefits such as improved soil fertility, enhanced water retention, reduced soil erosion, and also diversifying native habitat and enhancing urban biodiversity. Agroforestry also acts as a wind barrier for weak crops, which are down due to wind flow and cause great loss to farmers. Trees along crops protect ten times larger area of crops than their height from being blown down by the wind.

Proposed Location

The following are the potential identified locations for agroforestry in Bahawalpur.

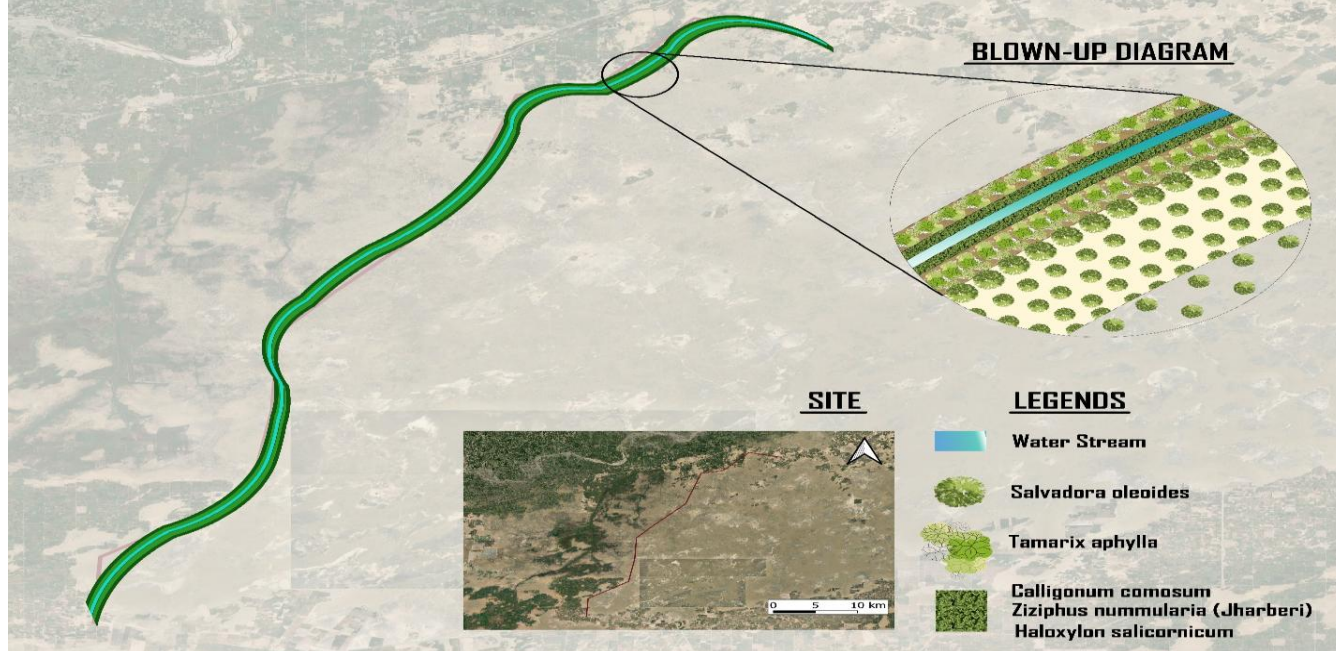
- 29°18'24"N 71°35'55"E
- 29°21'06"N 72°05'01"E

Conceptual Design

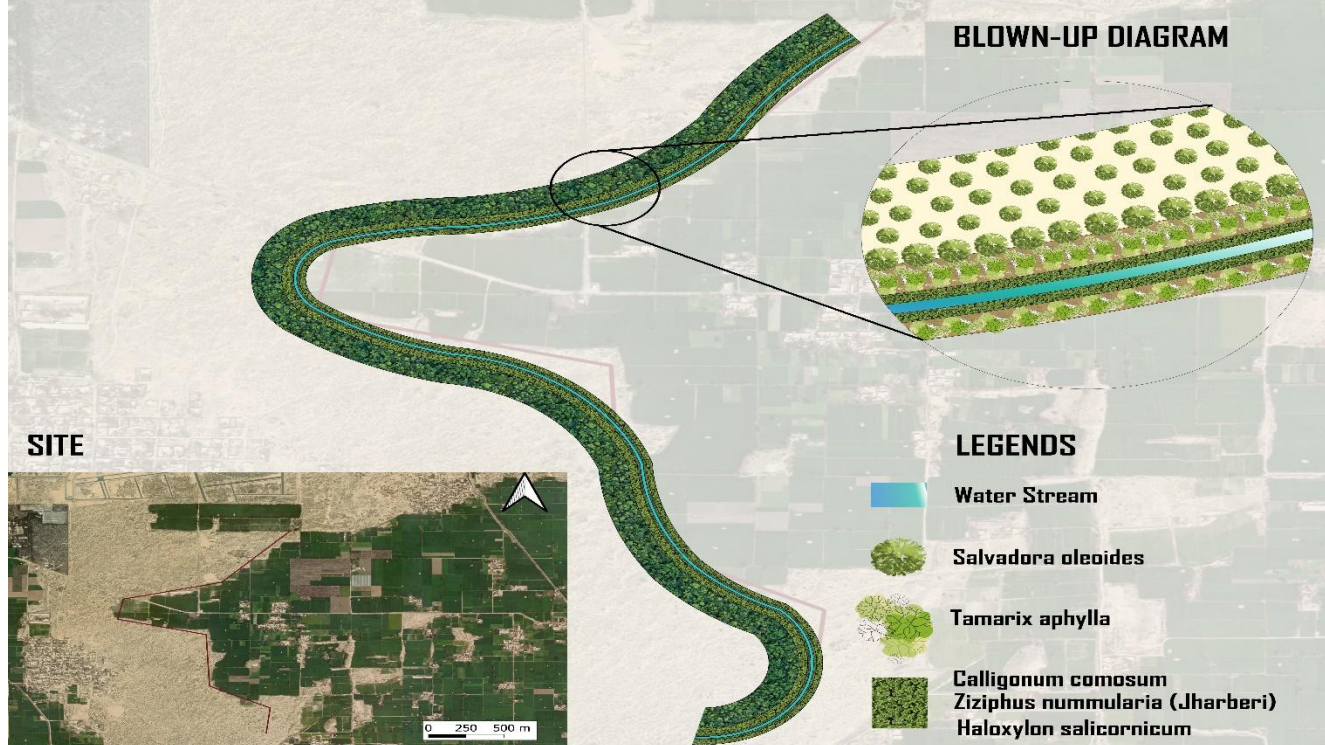
- Establish a multi-functional agroforestry system that combines woody perennials (trees and shrubs) with crops and/or livestock grazing.
- The primary ecological function will be to act as a buffer against desertification. Trees will help stabilize sandy soils, reduce wind erosion, improve soil organic matter, and enhance water infiltration and retention in the arid environment.
- Prioritize drought-tolerant, deep-rooted, and salt-tolerant plant species suitable for the Cholistan desert environment.
 - **Fodder Trees:** *Prosopis cineraria* (Khejri/Jand), *Acacia nilotica* (Babul), *Ziziphus mauritiana* (Ber), *Tamarix aphylla* (Farash). These provide valuable resources and shade.
 - **Drought-Resistant:** *Ziziphus mauritiana* (Ber), *Salvadora oleoides* (Pilu/Jal), *Capparis decidua* (Kair). These offer food and economic potential.
 - **Understory/fodder:** *Calligonum polygonoides* (Phog), *Cenchrus ciliaris* (Dhaman Grass), *Lasiurus scindicus* (Khabbal Grass). These provide ground cover and fodder.

❑ Implement efficient irrigation techniques such as drip irrigation or sprinkler irrigation for initial establishment.

Cholistan Buffer Zone Agroforestry Near Lal Suhanra Park



Cholistan Buffer Zone Agroforestry Near Khairpur tamiwali



Estimate Cost

THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)					
Bahawalpur Biodiversity Action Plan					
Rough Cost Estimate of Agroforestry					
ABSTRACT OF COST					
S.No	Description of Work	Unit	Quantity	Rate (PKR)	Amount (PKR)
Cholistan Buffer Zone Agroforestry					
Component		Unit	Qty	Rate (PKR)	Amount (PKR)
Native Planting		km	50	800,000	40,000,000
Toba Restoration		Nos.	10	1,000,000	10,000,000
Wildlife Corridors		km	50	500,000	25,000,000
				Total	75,000,000

9.2 Afforestation

Reforestation or afforestation aims to increase the forest cover by planting trees on barren lands, degraded areas, and other suitable sites of forest land. Afforestation will help to improve native tree species richness that are suitable to the local climate, soil conditions, and ecological requirements. Planting mixed indigenous tree species and improving forest canopies can help to maintain connectivity between natural habitats and support the survival of various plant and animal species. Forest plantations key source of environmental stability, which contributes to carbon sequestration and helps to mitigate climate change.

Proposed Location

The following are the potential identified locations for afforestation in Bahawalpur.

- 29°18'24"N 71°35'55"E
- 29°21'06"N 72°05'01"E

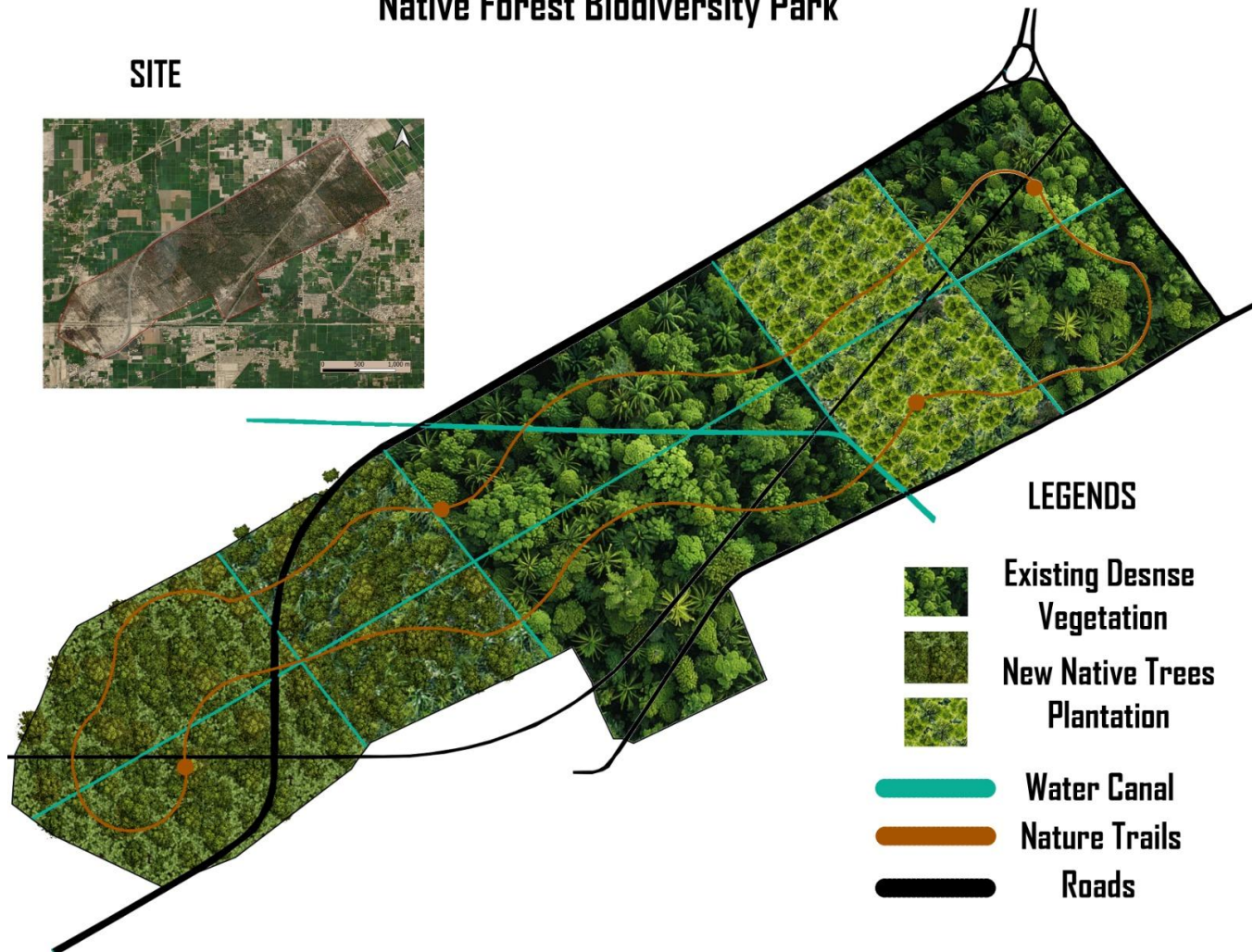
Conceptual design

- Implement large-scale planting of diverse native and locally adapted tree and shrub species across the 250-acre barren land. This includes species like *Dalbergia sissoo* (Sheesham), *Acacia nilotica* (Babul), *Prosopis cineraria* (Khejri), *Azadirachta indica* (Neem), and various indigenous shrubs and grasses to create a multi-layered forest structure.
- The fencing should be installed will serve to protect young saplings from livestock grazing, human encroachment, and other disturbances, ensuring their successful establishment and growth.
- Develop an efficient water management plan for the initial establishment phase of the plantation.

- Design and construct a network of well-marked nature trails throughout the forested area.
- **Permeable Surfaces:** Utilizing natural materials such as compacted earth, wood chips, or gravel to facilitate water infiltration.
- **Interpretive Signage:** Informative signs about local flora, fauna, and the importance of afforestation.
- **Resting Points:** Benches and shaded areas are strategically placed along the trails.

Bahawalpur Plantation (RF) – SEINC

Native Forest Biodiversity Park



Estimate Cost

THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)				
Bahawalpur Biodiversity Action Plan				
Rough Cost Estimate of Afforestation				
ABSTRACT OF COST				
1. Bahawalpur Plantation (RF) – SEINC				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Site Preparation	m ²	20,000	45	900,000
Tree Plantation	Nos.	10,000	350	3,500,000
Fencing	Rft	5,000	500	2,500,000
Nature Trails	m ²	3,000	300	900,000
			Total	7,800,000

9.3 Riparian zone rehabilitation

Riparian zone rehabilitation focuses on restoring the vital strip of land bordering a river or other body of water. This process involves strategically planting a diverse array of native, water-loving, and flood-tolerant vegetation, such as willows, sheesham, and tamarix, directly along the riverbanks. The primary goals are to stabilize the soil, prevent erosion, and naturally filter pollutants from runoff, thereby significantly enhancing the overall water quality of the river. Beyond these ecological benefits, a healthy riparian zone also creates crucial habitats, fostering biodiversity and supporting a thriving ecosystem.

Proposed Location

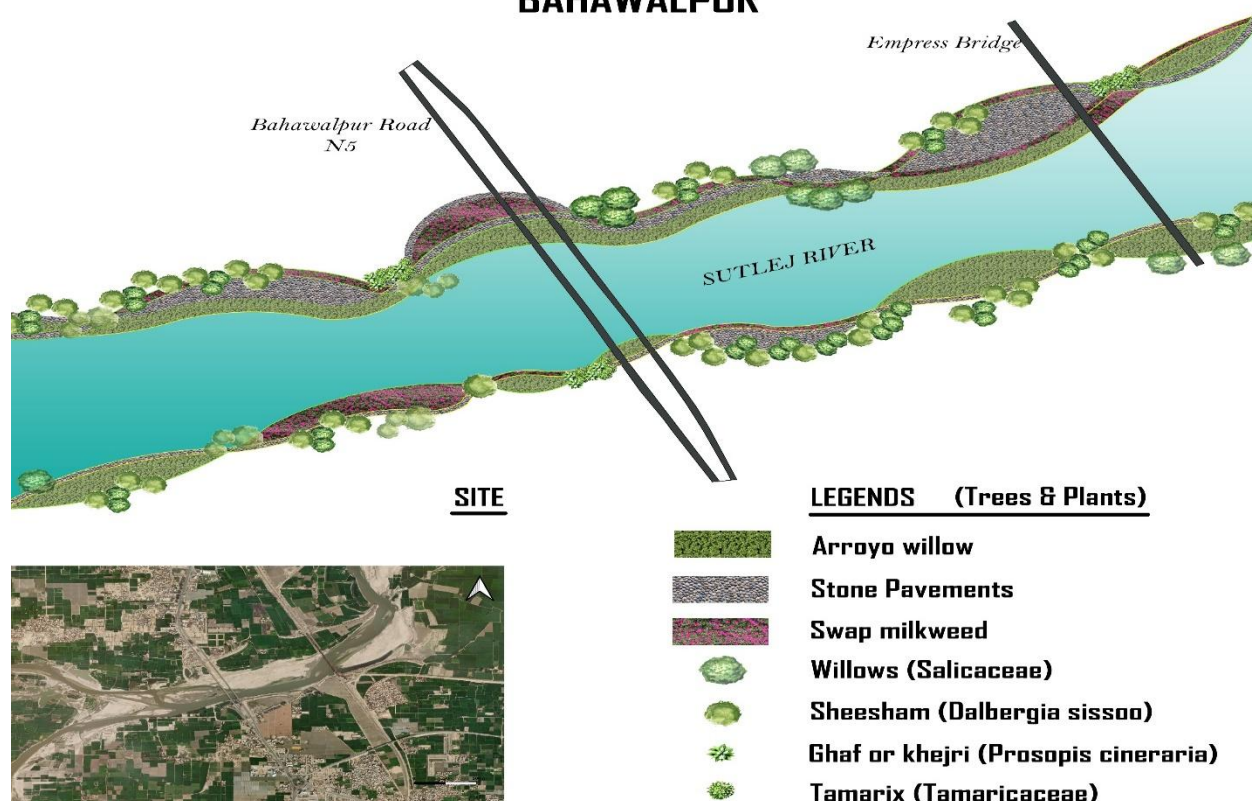
The following are the potential identified locations for riparian zone rehabilitation in Bahawalpur.

- 29°26'25"N 71°39'03"E

Conceptual Design

- Focus on restoring the natural riparian buffer along the Sutlej Riverbanks. This involves planting a diverse array of native vegetation to stabilize banks, reduce erosion, filter pollutants from runoff, and enhance water quality.
- Prioritize the use of indigenous, water-loving, and flood-tolerant plant species to ensure ecological compatibility and resilience. Key species for the plantation will include:
 - Arroyo Willow
 - Willows (*Salicaceae*)
 - Sheesham (*Dalbergia sissoo*)
 - Ghaf or Khejri (*Prosopis cineraria*)
 - Tamarix (*Tamaricaceae*)
 - Swap Milkweed

Sutlej Riparian Revival Initiative BAHAWALPUR



Estimate Cost

THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)				
Bahawalpur Biodiversity Action Plan				
Rough Cost Estimate of Riparian Zone Rehabilitation				
ABSTRACT OF COST				
Sutlej Riparian Revival Initiative				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Riparian Tree Plantation	km	10	3,000,000	30,000,000
Floodplain Wetlands	km	10	2,000,000	20,000,000
Community Guardians Program	Lump Sum	1	3,000,000	3,000,000
			Total	53,000,000

9.4 Parks Rehabilitation

Urban parks are defined as delineated open space areas, mostly dominated by vegetation, grassy lawns, water bodies, and play areas, generally reserved for public use. Urban parks are a significant component of urban amenity green spaces. These are significant key tools for measuring the sustainability of cities. Green spaces in the cities facilitate sustainable urban planning. Unplanned urban growth with limited green spaces / open public spaces not only decreases the sustainability of the area, declines biodiversity and natural habitat, but also negatively impacts human health and wellbeing. The provision of urban green spaces is one of the major priorities in the livable city. The total number of green spaces in a city is one of the important indicators of a sustainable urban ecosystem and quality of urban life.

Proposed Location

The following are the undeveloped parks of Bahawalpur, which can be restored to improve the green health of urban areas.

- 29°23'33"N 71°45'28"E
- 29°23'32"N 71°40'05"E
- 29°23'28"N 71°41'06"E

Conceptual Design

- Rehabilitate each park to serve as a vibrant, multi-functional green space, enhancing urban biodiversity and providing diverse recreational opportunities for all age groups.
- Implement stratified native planting (canopy, understory, shrub, ground cover) to restore ecological balance, attract local wildlife, and integrate wild flowering patches for pollinators.
- Upgrade existing amenities and introduce new ones, such as improved walking/jogging tracks, shaded seating areas, children's play zones, and designated community gathering spaces.
- Optimize water features (e.g., at Farid Water Park) for efficiency, integrate rainwater harvesting, and promote drought-tolerant landscaping to conserve water resources.
- Ensure all parks are easily accessible to pedestrians and cyclists, with clear pathways, proper lighting, and seamless integration with the broader green corridor network where applicable.
- Mango Park focuses on preserving and enhancing its unique mango tree collection while integrating recreational elements. For the Central Library Zone, create serene, green reading and contemplation areas that complement the library's function.
- Foster community involvement in the design and upkeep of the parks, establishing robust maintenance plans to ensure their sustained beauty, safety, and ecological health.

Sadiq Park



SITE



LEGENDS

-  Pollinator gardens
-  Dalbergia sissoo (Sheesham)
-  Hedge Shrubs
-  Ziziphus jujuba
-  Grass Lawns
-  Wooden Canopy
-  Walking Track

Estimate Cost

THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)					
Bahawalpur Biodiversity Action Plan					
Rough Cost Estimate of Parks Rehabilitation					
ABSTRACT OF COST					
S.No	Description of Work	Unit	Quantity	Rate (PKR)	Amount (PKR)

Farid Water Park – SLINC				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Pollinator Gardens	m ²	10,000	200	2,000,000
Landscaping & Seating	Lump Sum	1	3,000,000	3,000,000
Water Body Development	m ²	5,000	1,200	6,000,000
			Total	11,000,000
Sadiq Park & Central Library Zone				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Library Renovation	Lump Sum	1	10,000,000	10,000,000
Birdhouses & Insect Hotels	Nos.	1,000	2,500	2,500,000
Solar Lighting	Nos.	100	45,000	4,500,000
			Total	17,000,000

9.5 Constructed Wetland

The abundance of heavy metals has increased in the environment with the rapid increase of urban sprawl and Industrialization in the past few decades, which has raised serious concerns globally. The disposal of residuals and waste products into water bodies may have devastating effects on aquatic ecosystems, posing serious threats to the natural environment and human health. Natural treatment of wastewater systems is the most suitable treatment technology for various types of wastewaters, which has attracted much attention in recent years. The use of plants to purify water supplies makes it both helpful to surrounding employees and communities and environmentally benign. By using plants, bacteria, or other related microbial organisms to absorb toxins from water, it is feasible to purify water and wastewater.

Proposed Location

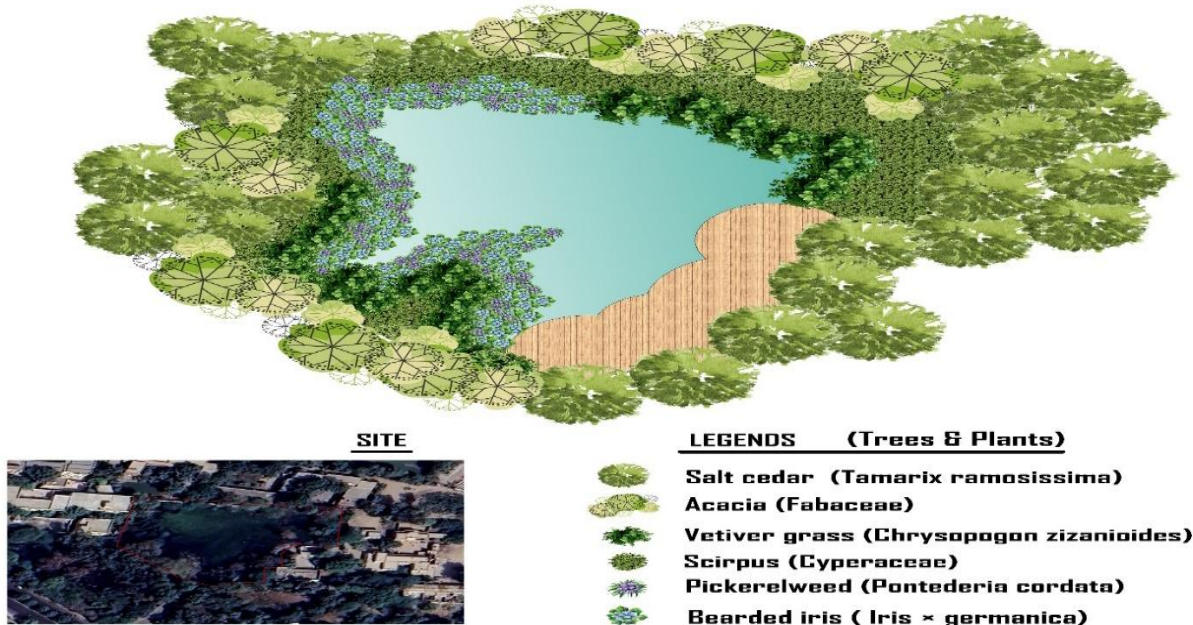
The following are the wastewater ponds identified during the surveys of Bahawalpur, which can be potential water bodies to treat and restore the aquatic fauna and flora of Bahawalpur.

- 29°21'57"N 71°41'52"E
- 29°23'32"N 71°41'03"E

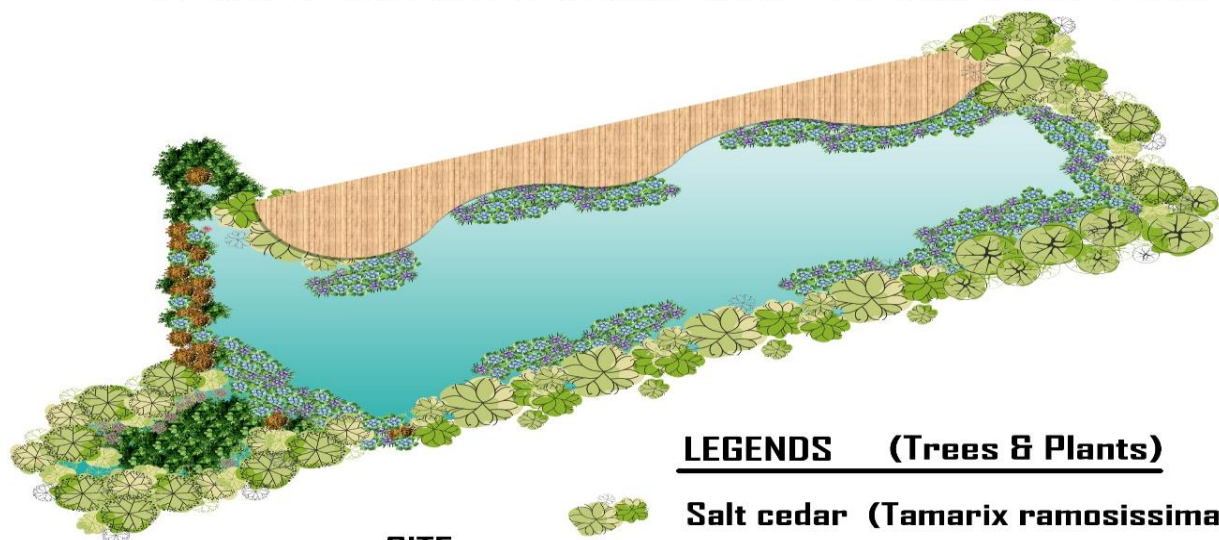
Conceptual Design

- Implement a variety of aquatic and semi-aquatic plants specifically chosen for their ability to absorb and break down pollutants. Key species will include
 - Bearded Iris (*Iris x germanica*),
 - Pickerelweed (*Pontederia cordata*),
 - Scirpus (*Cyperaceae*)
- Plant robust, drought-tolerant trees and shrubs like Salt Cedar (*Tamarix ramosissima*) and various Acacia (*Fabaceae*) species around the perimeter of the treatment site.
- Utilize Vetiver Grass (*Chrysopogon zizanioides*) in specific sections for its dense root system, which is highly effective in filtering suspended solids, absorbing heavy metals, and improving soil structure in the treatment beds.
- The diverse plantation will create a rich mosaic of habitats, attracting and supporting local biodiversity, including insects (especially pollinators), birds, and small aquatic life, transforming the site into a thriving ecological space.

Nature-Based Wastewater Treatment Site



Nature-Based Wastewater Treatment Site



SITE



LEGENDS (Trees & Plants)

-  **Salt cedar (Tamarix ramosissima)**
-  **Acacia (Fabaceae)**
-  **Bearded iris (Iris × germanica)**
-  **Vetiver grass (Chrysopogon zizanioides)**
-  **Scirpus (Cyperaceae)**
-  **Pickerelweed (Pontederia cordata)**

Estimate Cost

THE URBAN UNIT (URBAN SECTOR PLANNING & MANAGEMENT SERVICES UNIT PVT.LTD)				
Bahawalpur Biodiversity Action Plan				
Rough Cost Estimate of Nature-based Wetland				
<u>ABSTRACT OF COST</u>				
Nature-Based Wastewater Treatment Site				
Component	Unit	Qty	Rate (PKR)	Amount (PKR)
Wetland Construction	m ²	3,000	1,200	3,600,000
Buffer Planting Zones	m ²	2,000	250	500,000
Water Quality Monitoring	Lump Sum	1	2,000,000	2,000,000
			Total	6,100,000



ANNEXURES

Annexure A

ANNEXURE A

Sr. No.	Common Name	Scientific Name	Status	Wild	Captive
1.	Alexandrine Parakeet	<i>Psittacula eupatria</i>	NT	√	√
2.	Asian Koel	<i>Eudynamys scolopaceus</i>	LC	√	
3.	Barn Owl	<i>Tyto alba</i>	LC	√	
4.	Black Drongo	<i>Dicrurus macrocercus</i>	LC	√	
5.	Cattle Egret	<i>Bubulcus ibis</i>	LC	√	
6.	Common Hoopoe	<i>Upupa epops</i>	LC	√	
7.	Common Myna	<i>Acridotheres tristis</i>	LC	√	
8.	Common Tailorbird	<i>Orthotomus sutorius</i>	LC	√	
9.	Eurasian Collared Dove	<i>Streptopelia decaocto</i>	LC	√	
10.	House Crow	<i>Corvus splendens</i>	LC	√	
11.	House Sparrow	<i>Passer domesticus</i>	LC	√	
12.	Indian Pond Heron	<i>Ardeola grayii</i>	LC	√	
13.	Indian Robin	<i>Copsychus fulicatus</i>	LC	√	
14.	Indian Roller	<i>Coracias benghalensis</i>	LC	√	
15.	Jungle Babbler	<i>Argya striata</i>	LC	√	
16.	Little Brown dove	<i>Spilopelia senegalensis</i>	LC	√	
17.	Little Egret	<i>Egretta garzetta</i>	LC	√	
18.	Oriental Magpie-Robin	<i>Copsychus saularis</i>	LC	√	
19.	Pied Bush Chat	<i>Saxicola caprata</i>	LC	√	
20.	Purple Sunbird	<i>Cinnyris asiaticus</i>	LC	√	
21.	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	√	
22.	Rock Pigeon	<i>Columba livia</i>	LC	√	
23.	Rose-ringed Parakeet	<i>Psittacula krameria</i>	LC	√	√
24.	Shikra	<i>Accipiter badius</i>	LC	√	
25.	Spotted Owlet	<i>Athene brama</i>	LC	√	
26.	White-throated Kingfisher	<i>White-throated Kingfisher</i>	LC	√	
27.	White Indian Peafowl	<i>Pavo cristatus</i>	LC		√
28.	Red-wattled Lapwing	<i>Vanellus indicus</i>	LC	√	
29.	Jungle Myna	<i>Acridotheres fuscus</i>	LC	√	
30.	Common Coot	<i>Fulica atra</i>	LC	√	
31.	Greater Coucal	<i>Centropus sinensis</i>	LC	√	
32.	Guinea Fowl	<i>Numida meleagris</i>	LC		√
33.	Great White Pelican	<i>Pelecanus onocrotalus</i>	LC		√
34.	Common Crane	<i>Grus grus</i>	LC	√	
35.	Chakor Peafowl	<i>Alectoris chukar</i>	LC		√
36.	Common Moorhen	<i>Gallinula chloropus</i>	LC		√
37.	Asiatic Jackal	<i>Canis aureus</i>	LC	√	

38.	Asiatic Lesser Yellow House Bat	<i>Scotophilus kuhlii</i>	LC	√	
39.	House Mouse	<i>Mus musculus</i>	LC	√	√
40.	House Rat	<i>Rattus rattus</i>	LC	√	√
41.	Indian Crested Porcupine	<i>Hystrix indica</i>	LC	√	
42.	Indian Grey Mongoose	<i>Herpestes edwardsii</i>	LC	√	
43.	Indian Hare	<i>Lepus nigricollis</i>	LC	√	
44.	Indian Pipistrelle	<i>Pipistrellus coromandra</i>	LC	√	
45.	Jungle Cat	<i>Felis chaus</i>	NT	√	
46.	Small Indian Civet	<i>Viverricula indica</i>	LC	√	
47.	Blackbuck	<i>Antelope cervicapra</i>	LC		√
48.	Squirrel	<i>Funambulus pennantii</i>	LC	√	
49.	Rhesus Macaque	<i>Macaca mulatta</i>	LC		√
50.	Hog Deer	<i>Axis porcinus</i>	EN		√
51.	Nilgai	<i>Boselaphus tragocamelus</i>	LC		√
52.	Chinkara	<i>Gazella bennettii</i>	LC		√
53.	Indian Cobra	<i>Naja naja</i>	V	√	
54.	Oriental Garden Lizard	<i>Calotes versicolor</i>	LC	√	
55.	Yellow-bellied House Gecko	<i>Hemidactylus flaviviridis</i>	LC	√	
56.	Checkered Keelback	<i>Xenochrophis piscator</i>	LC	√	
57.	Saw-scaled Viper	<i>Echis carinatus</i>	LC	√	
58.	Indian Flapshell Turtle	<i>Lissemys punctate</i>	V	√	
59.	Bengal Monitor lizard	<i>Varanus bengalensis</i>	V	√	
60.	Crocodile	<i>Crocodylus palustris</i>	V		√

Note: In above table LC= Least concerned; D=Domesticated; V= vulnerable; NT= Nearly threatened

ANNEXURE B

Sr.No.	Common Name	Scientific Name	Introduced/Local/Invasive
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1.	Aam	<i>Magnifera indica</i>	Introduced
2.	Amaltas	<i>Cassia fistula</i>	Local
3.	Anjeer	<i>Ficus carica</i>	Introduced
4.	Arjun	<i>Terminalia arjuna</i>	Local
5.	Ashoka	<i>Saraca asoca</i>	Introduced
6.	Bakain	<i>Melia azedarach</i>	Local
7.	Beri	<i>Ziziphus mauritiana</i>	Local
8.	Black Ficus (Weeping fig)	<i>Ficus benjamina</i>	Local
9.	Black Pilcan	<i>Ficus virens</i>	Local
10.	Bordh	<i>Ficus benghalensis</i>	Local
11.	Bottle Brush	<i>Callistemon citrinus</i>	Introduced
12.	Bottle Palm	<i>Hyophorbe lagenicaulis</i>	Introduced
13.	Conocarpus	<i>Conocarpus erectus</i>	Introduced
14.	Date Palm	<i>Phoenix dactylifera</i>	Local
15.	Fabaceae	<i>Acacia modesta</i>	Local
16.	Ficus	<i>Ficus spp.</i>	Local
17.	Golden Ficus	<i>Ficus aurea</i>	Introduced
18.	Imli	<i>Tamarindus indica</i>	Local
19.	Jamun	<i>Syzygium cumini</i>	Local
20.	Jand	<i>Prosopis cineraria</i>	Local
21.	Kachnar	<i>Bauhinia variegata</i>	Introduced
22.	Kaneer	<i>Nerium oleander</i>	Invasive
23.	Kiker	<i>Acacia nilotica</i>	Local
24.	Lasura	<i>Cordia myxa</i>	Local
25.	Moringa	<i>Moringa oleifera</i>	Local
26.	Mulbery	<i>Morus alba</i>	Local
27.	Nag Phali/ Beri Patta	<i>Heterophargama adenophyllum</i>	Introduced
28.	Neem	<i>Azadirachta indica</i>	Local
29.	Paper Mulberry	<i>Broussonetia papyrifera</i>	Introduced
30.	Peepal	<i>Ficus religiosa</i>	Local
31.	Pinus	<i>Pinus spp.</i>	Introduced
32.	Rubber Plant	<i>Ficus elastica</i>	Introduced
33.	Shahtoot	<i>Morus alba</i>	Local
34.	Sagwan	<i>Tectona grandis</i>	Introduced
35.	Shamma	<i>Sophora secundiflora</i>	Introduced

36.	Silver Oak	<i>Grevillea robusta</i>	Introduced
37.	Silver Palm	<i>Corypha umbraculifera</i>	Introduced
38.	Sufaida	<i>Eucalyptus camaldulensis</i>	Invasive
39.	Sukh Cheen	<i>Pongaima glabra</i>	Introduced
40.	Sumbul	<i>Bombax ceiba</i>	Local
41.	Tabebuia	<i>Tabebuia rosea</i>	Introduced
42.	Tecoma	<i>Tecoma stans</i>	Local
43.	Tali	<i>Dalbergia sissoo</i>	Introduced
44.	Terminalia	<i>Terminalia mentalis</i>	Local
45.	Ulta Ashok	<i>Polyalthia longifolia</i>	Introduced



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