

Regional Development Plan **RAWALPINDI** Environment



The Urban Unit

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



Environment Sector

Rawalpindi Regional Development Plan



Team:

Authors:

Mr. Hassan Ilyas (Senior Program Manager – Environment)
Ms. Saba Sarfraz (Senior Program Manager – Environment)
Dr. Ammara Habib (Program Manager – Environment)
Dr. Amir Latif (Program Manager – Environment)
Ms. Amber Aleem (Program Manager – Environment)
Ms. Hira Nisaar (Project Officer – Environment)
Mr. Khalil Ali (Project Officer – Biodiversity)
Ms. Arsh Noor (Project Officer – Environment)
Mr. Adil Waqar (Project Officer – Legal)
Mr. Farrukh Zia (Project Officer – Water & Wastewater)

Maps prepared by:

Mr. Abu Huraira (Project Officer – GIS)

Rough Cost Estimations by:

Mr. Imran Khan (Quantity Surveyor)
Mr. Mahad Mobin (Quantity Surveyor)

Conceptual Drawings by:

Engr Abdul Moiz (Program Officer – Architect)
Mr. Hammad Ullah (Program Officer – AutoCAD Operator)

Reviewed and Finalized by:

Mr. Muhammad Omer Masud (Chief Executive Officer – Urban Unit)
Engr. Abid Hussainy (General Manager – Environment and Social Safeguards)

Suggested Citation:

The Urban Unit. 2023. *Environment Sector: Rawalpindi Regional Development Plan*.

Contents

01 Setting the Context	1
02 Rawalpindi Regional Profile	3
2.1. Climate Profile of Rawalpindi Region.....	4
2.2. Environmental Quality Assessment:	7
2.2.1. Air Quality Assessment	8
2.2.2. Water Quality Assessment.....	13
2.3. Green Spaces Assessment.....	15
2.3.1. Vegetation Dynamics	15
2.3.2. Assessment of Urban Recreational Parks	18
2.3.3. Local Community Perception Survey – Green Spaces Rawalpindi	20
2.4. Key Environmental Challenges – Rawalpindi Region.....	22
2.5. Biodiversity Conservation Area	23
2.5.1. Rawalpindi Conservation Areas.....	25
2.5.2. Jhelum Conservation Areas	26
2.5.3. Chakwal Conservation Areas	27
2.5.4. Attock Conservation Areas	28
2.6. Conservation Areas Diversity Analysis	29
2.6.1. Major Threats to Conservation Sites in Rawalpindi Region	29
03 Legal Landscape	30
04 Vision, Goals & Objectives	31
4.1. Vision	31
4.2. Goals	31
4.3. Objectives.....	31
05 Methodology	32
5.1. Desk Research for Secondary Data Collection	32
5.2. Primary Data Collection.....	33
5.2.1. Field Visits	33
5.2.2. Environmental Quality Assessment	35
5.3. Development of Short-Medium-Long term plan.....	36
5.4. Development of RDP Rawalpindi	36
5.5. Feedback visit	36

06 Regional Development Plan.....	37
6.1. Framework	37
6.2. Project Digest/ Investment Plan	37
6.3. Proposed Projects	38
6.3.1. PROJECT 1: Rewilding and Revival of Wildlife	42
6.3.2. PROJECT 2: Kallar Kahar Lake Rejuvenation Project	45
6.3.3. PROJECT 3: Reforestation and Dry Afforestation	48
6.3.4. PROJECT 4: Linear Plantation for Green Corridor.....	49
6.3.5. PROJECT 5: Forest Park Development & Rehabilitation	53
6.3.6. PROJECT 6: Development & Restoration of Urban Parks & Green Spaces	58
6.3.7. PROJECT 7: Themed Jhelum River Walkway.....	61
6.3.8. PROJECT 8: Installation of Air Quality Monitoring Equipment	63

Figures

Figure 1: Divisions of Punjab Province	1
Figure 2: Average Annual Temperature and Precipitation of Rawalpindi Region	5
Figure 3: Key factors affecting Environmental Quality of Rawalpindi Region	7
Figure 4: Industries in Rawalpindi Division	8
Figure 5: Number of Brick kilns in Rawalpindi Region	8
Figure 6: Registered Vehicles in Rawalpindi Region.....	9
Figure 7: PM _{2.5} and PM ₁₀ Concentrations of Rawalpindi Region	11
Figure 8: Concentration of Al, CO, NO ₂ and SO ₂ in Rawalpindi Region.....	12
Figure 9: TDS Concentration in Groundwater of Rawalpindi Region	13
Figure 10: Arsenic Concentration in Groundwater of Rawalpindi Region	14
Figure 11: Spatio-temporal trends of vegetation dynamics in the Rawalpindi Division during 2001 - 2023	17
Figure 12: Area statistics of vegetation types during 2001 – 2023.....	17
Figure 13: Location map of Parks Assessment Survey	18
Figure 14: Results of Parks Assessment Survey	19
Figure 15: Demographics of Public Perception	20
Figure 16: Availability of Parks	21
Figure 17: Local Community Visited Parks & Green Spaces	21
Figure 18: Community's Willingness to Pay for improvement of Parks and Green Spaces.....	22
Figure 19: Key Challenges & Issues of Rawalpindi Region.....	22
Figure 20: Map showing Visited Forest & Protected Areas of Rawalpindi Region.....	24
Figure 21: (a). Danhoi Reserve Forest (b). Margalla Reserve Forest (c). Kahuta Reserve Forest	25
Figure 22: (a). Rakh Kandel Reserve Forest (b). Tilla Jogian National Park (c). Jalalpur Sharif Wildlife Sanctuary.....	26
Figure 23: (a). Chinji National Park (b). Punjab Urial in Chumbi Surla Wildlife Sanctuary (c). Arra Wildlife Sanctuary	27
Figure 24: (a). Kala Chitta National Park (b). Kheri Murat National Park (c). Dakhnair Attock Reserve Forest	28
Figure 25: Shannon Diversity Index Analysis.....	29
Figure 26: Major Threats to Conservation sites of Rawalpindi Region	29
Figure 27: Methodology Map for Rawalpindi – RDP.....	32
Figure 28: Stakeholder's Consultations – Rawalpindi Region	34
Figure 29: Field Visits & Public Perception Survey – Rawalpindi Region	35

Figure 30: Proposed Interventions in Rawalpindi Region	41
Figure 31: (a). Barking Deer (b) Punjab Urial	42
Figure 32: Proposed Sites for Rewilding of Animals	43
Figure 33: Proposed Conceptual Design for Rewilding of Animals	44
Figure 34: (A): Lake View; (B): Walking Track	45
Figure 35: Schematic Diagram of SWAB Treatment	47
Figure 36: Conceptual Illustration	47
Figure 37: Conceptual Design for Linear Plantation along Road	51
Figure 38: Conceptual Design for Linear Plantation along Railway Lines	52
Figure 39: Conceptual Design for Development of Raka Nakka Forest Park, Rawalpindi.....	55
Figure 40: Conceptual Design for Rehabilitation of Lohi Bher National Park, Rawalpindi.....	56
Figure 41: Conceptual Design for Development of Panjar Forest Park, Rawalpind.....	57
Figure 42: Conceptual design of Kallar Syedan Park.....	59
Figure 43: Conceptual Design of Rehabilitation of Jinnah Park	60
Figure 44: Project Site Along River Jhelum	61
Figure 45: Conceptual Design for River walkways Along River Jhelum	62
Figure 46: Proposed Areas for Standard Air Quality Equipment	63

List of Tables

Table 1: Demographic Profile of Rawalpindi Region,	3
Table 2: Projected Population	4
Table 3: District-Level Climate Risk and Hazard Assessment Classification	6
Table 4: Years of Life Expectancy Gain through reducing PM _{2.5} from 2019 Concentration in Rawalpindi Region.....	9
Table 5: Satellite data used to assess the vegetation dynamics in Rawalpindi Division.....	35

01 | Setting the Context

Rapid urbanization, population expansion in urban centers and massive economic activities are among certain challenges that Punjab province is facing. To tackle these issues and improve Punjab's population's livability, development and planning at the regional level have been brought to attention.



There is a multifaceted way to express the terminology “**Region**” depending upon the scale of analysis. It could be any land that has common natural and artificial features. It could also be any basic administrative unit that either encompasses an area, division, or district for local government. More distinctively, it could be any administrative or politically/economically/spatially defined area that may cover different states/countries or could be at a national/sub-national/local scale and has a role in a certain level of development¹.

Punjab Spatial Strategy 2047 outlines division as a good region for achieving larger development goals in harmony with districts and cities as well as for assessing the comparative advantages at a macro scale. **The strategy identifies division as a ‘region’ which forms the economic units based on a regional vision and development plans that not only enhance competitiveness and productivity of the region but also enable efficient resource allocation and more economic returns.** In an international context, China has successfully achieved its economic transition from an agrarian economy to an industrialized economy by focusing on regional developments and integrated planning frameworks.

Rawalpindi Division (Region), is the situated sub-Himalayan Potohar region of northern Punjab and comprises of 04 districts; City District Rawalpindi, Jhelum, Chakwal and Attock. The region has a high potential for economic growth and providing higher opportunities for investments. However, this region is rich in natural resources that are facing various natural and anthropogenic



Figure 1: Divisions of Punjab Province

¹ Schmitt-Egner, P. 2010. The Concept of 'Region': Theoretical and Methodological Notes on its Reconstruction. *Journal of European Integration*. 24(3): 179-200.

hazards which include abrupt variations in temperature, industrialization, urbanization, deforestation and depletion of water resources.

This situation thus, demands a number of interventions with a range of amenity green structures and improved environmental quality in order to develop a proportion between grey and green areas of the region. Therefore, a regional development plan of the environment sector is being prepared for the spatial, economic, and environmentally sustainable development in the region. It also helps in managing the challenges, disparities and competition for development resources between cities in a region as well as keep the goods and resources available to them as per their needs.

02 | Rawalpindi Regional Profile

Geographically, the Rawalpindi Region lies from 33°10'0" North latitudes and 73°0'0" East longitudes covering a total area of about 22,255 km². According to Pakistan Population and Housing Census 2017, the Region has a population of about 10,006,624.² The average elevation of the Rawalpindi Region is about 502 meters above sea level.³ The Region comprises of 04 districts viz; City District Rawalpindi, Jhelum, Chakwal and Attock, among them Rawalpindi district is the largest district.⁴ Geographically, Rawalpindi Region is bordered by Azad Jammu and Kashmir to the northeast, Islamabad Capital Territory to the south, Attock District to the northwest, Jhelum District to the northeast, Chakwal District to the west, and Gujar Khan Tehsil to the southeast. The region is characterized by fertile plains and some hilly terrain, especially in the northern parts.

Topographically, Rawalpindi region is characterized by fertile plains and some hilly terrain, especially in the northern parts and its soil is generally comprised of sandy loam. Demographically, Rawalpindi Division exhibits a substantial rural-urban difference in population size. According to the Census 2017, the annual growth rate of Rawalpindi is estimated to be **2.16%**. This growth rate reflects the change in population size over the years and accounts for factors like birth rates, death rates, and net migration. Moreover, the divisional level analysis shows that the ratio of Urban and Rural population is 24.64% and 75.36% respectively for Rawalpindi Region. The detailed demographic profile of Rawalpindi Region is given below:

Table 1: Demographic Profile of Rawalpindi Region^{5,6}

Rawalpindi Region					
Sr. #	Particulars	Rawalpindi District	Jhelum District	Chakwal District	Attock District
1.	Location	33.4620° N 73.3709° E	32.9425° N73.7257° E	32.8322° N72.6151° E	33.7660°N 72.3609° E
2.	Area	8, 878 km ²	5,286 km ²	6,524 km ²	6,857 km ²
3.	Population (2017)	5,405,633	1,222,650	1,495,982	1,883,556
4.	Population Density (km²)	1022.21	340.79	166.1	275.10
5.	Urban Proportion	55.64	28.98	18.98	26.02
6.	Average Households	6.01	5.88	5.55	6.09
7.	No. of Tehsils	07 (Gujar Khan, Kahuta,	04 (Jhelum, Sohawa,	05 (Kallar Kahar, Choa Saidan	06 (Attock. Fateh Jang.

² https://rawalpindidivision.punjab.gov.pk/division_profile

³ https://www.getamap.net/maps/pakistan/punjab/_rawalpindidivision/

⁵ <https://www.pbs.gov.pk/sites/default/files/population/2017/tables/punjab/Table01p.pdf>

⁶ DISTRICT_WISE_CENSUS_RESULTS_CENSUS_2017.pdf

Rawalpindi Region					
Sr. #	Particulars	Rawalpindi District	Jhelum District	Chakwal District	Attock District
		Kallar Syedan, Kotli Sattian, Murree, Rawalpindi, and Taxila.)	Pind Dadan Khan and Dina.)	Shah, Chakwal, Talagang and Lawa.)	Hassan Abdal. Jand. Pindi Gheb. Hazro.)

By 2031, it is likely that the population of Rawalpindi Region will grow by 31.52 %. District-wise population projection is provided in the below tables;

Table 2: Projected Population⁷

Districts	Growth Rate (1998-2017)	2017	2023	2025	2030
Rawalpindi Region	2.13	2,111,324	2,345,965	2,499,088	2,776,823
Rawalpindi District	2.52	5,405,633	6,121,947	6,596,527	7,470,649
Attock District	2.08	1,883,556	2,087,766	2,220,771	2,461,541
Jhelum District	1.41	1,222,650	1,311,312	1,367,566	1,466,737
Chakwal District	1.71	1,495,982	1,628,338	1,713,309	1,864,893

With an increase in the population in the next 10 years, the stress on the natural resources and environment of the Rawalpindi Region could be much higher. Thus, demanding a regional-level development plan where development efforts are focused on the creation of a system of cities that foster intercity networking, create more jobs and increase productivity as well.

2.1. Climate Profile of Rawalpindi Region

According to Köppen Climate Classification, Cwa, the climate of Rawalpindi Region can be classified as humid subtropical climate, with cold winters and hot summers.⁸ The region generally experiences diversity in climatic patterns, owing to its topographical variations. The northern part of the division has a humid and sub-humid sub-tropical whereas the southern part has an arid and semi-arid sub-tropical climate. However, generally the summer season in Rawalpindi Region starts from mid-April and end on mid-October. May – July is considered as the hottest months in which average temperature may reach up to 40°C. The winter season generally begins from October and continues till the middle of March and the recorded average low temperature in winter is 09°C.⁹

During the monsoon period (July – Aug), the region receives the majority of its annual rainfall. However, the average annual rainfall varies from 400 mm in the plain areas to 1,710 mm in the hilly

⁷ Based on the Statistical Analysis done by the Urban Unit

⁸ https://en.wikipedia.org/wiki/Climate_of_Rawalpindi

⁹ Hussain, F., Nabi, G., & Wu, R. S. (2021). Spatiotemporal rainfall distribution of soan river basin, pothwar region, Pakistan. *Advances in Meteorology*, 2021, 1-24.

terrain. It is worth mentioning here that the Rawalpindi region falls in the rainfed agroecological zone of Punjab, therefore water availability for agriculture, domestic consumption, industrial uses, etc. is largely dependent on local rainfall. An assessment of historical trends in temperature and precipitation indicates the variations in different districts of the Rawalpindi division, represented in Figure below.

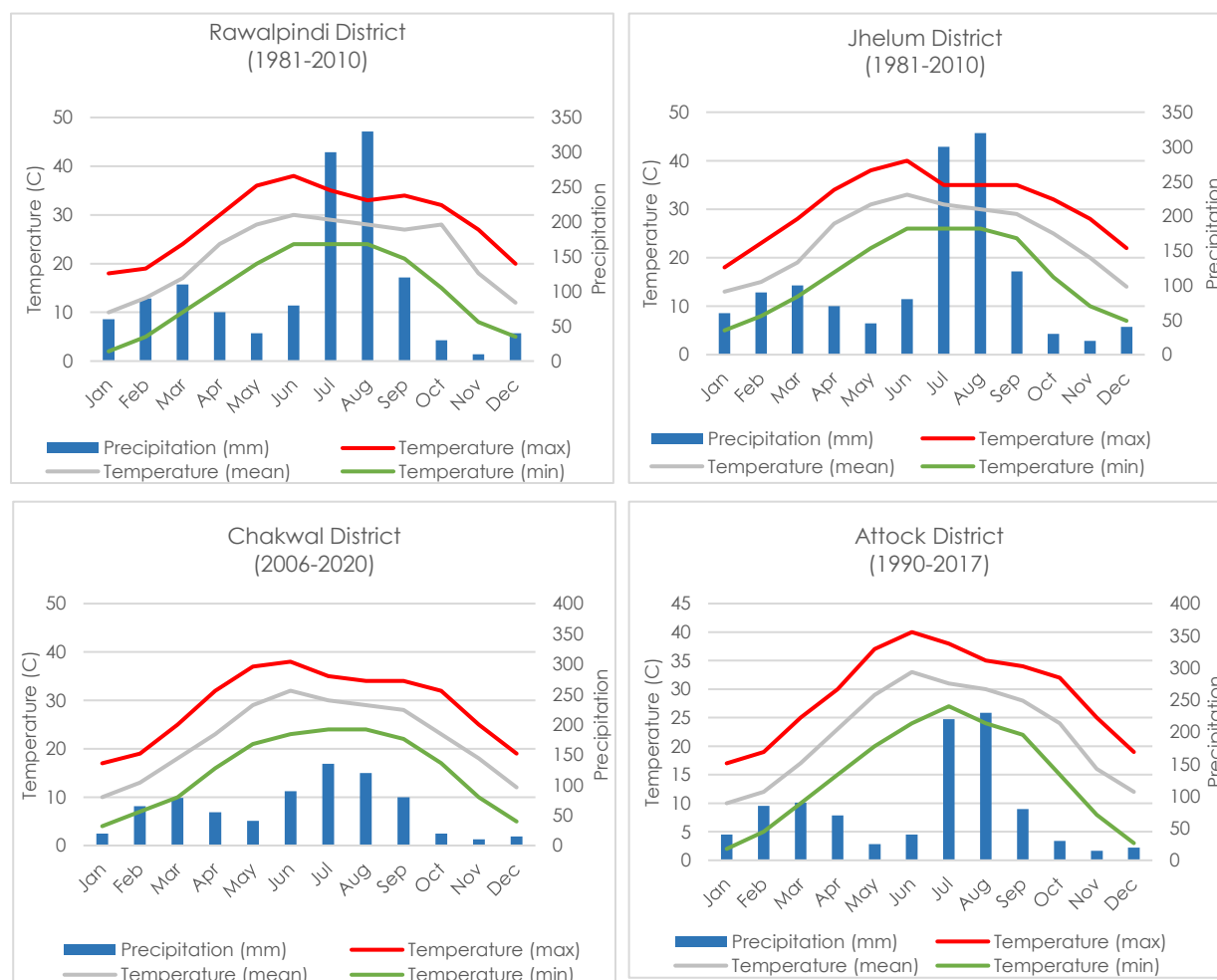


Figure 2: Average Annual Temperature and Precipitation of Rawalpindi Region

The above data clearly indicates that Jhelum is the hottest district whereas Chakwal receives the least amount of precipitation annually. The projection of future climate patterns using CMIP5 models suggests drastic variations in temperature and precipitation patterns by the end of the 21st century. The mean temperature will increase by 3.2°C and 3.9°C, under RCP4.5 and RCP8.5 scenarios respectively in Rawalpindi and Jhelum Districts. Moreover, the increase is projected to be 2.8°C and 4°C, under similar scenarios, respectively in the Attock and Chakwal districts. These patterns are likely to cause abrupt changes in weather patterns causing forest fires, changes in

crop productivity, floods, etc. along with consequent impacts on local communities, the local economy and local infrastructure¹⁰.

As per the Global Climate Risk Index 2021 ranking by Germanwatch, Pakistan ranked in the top ten countries that suffered the most from climate-related risks. A report by the Asian Development Bank on the Climate Profile of Pakistan provides district-wise ranking on the basis of vulnerability to different climate-related risks and hazards. The ranking of Rawalpindi Region is exhibited below in Table 3.

Table 3: District-Level Climate Risk and Hazard Assessment Classification ¹¹

Rank	Districts	Flood Risk	Landslide Risk	Earthquake Risk	Drought Risk	Cyclone Risk	Cumulative Risk Level
19	Rawalpindi	4	5	5	3	2	High
119	Attock	2	2	3	1	1	Low
118	Chakwal	2	1	3	2	1	Low
87	Jhelum	3	2	4	2	2	Medium
Scoring Key							
Very High		High		Medium		Low	
5		4		3		2	
						1	

According to this ranking, Rawalpindi district is most vulnerable to climate disasters, as compared to other districts in the region¹², particularly, with respect to landslide and earthquake risk. However overall, the Region faces high earthquake risk, followed by land sliding and flood risks.

Apart from that, the Rawalpindi Region belongs to Zone 2B of the Seismic Zone Area of Punjab. This means moderate to severe damage to property due to earthquakes could always be the potential risk.¹³

¹⁰ Bint-e-Mehmood, D., Awan, J. A., & Farah, H. (2023). Modelling temperature and precipitation variabilities over semi-arid region of Pakistan under RCP 4.5 and 8.5 emission scenarios. Modeling Earth Systems and Environment, 1-13.

¹¹ <https://www.adb.org/sites/default/files/publication/357876/climate-change-profile-pakistan.pdf>

¹² Chaudhry, Q. 2017. Climate Change Profile of Pakistan. Asian Development Bank, Philippines. doi.org/10.22617/TCS178761

¹³ <https://cms.ndma.gov.pk/storage/app/public/publications/December2020/MzOtLevMsttKF7aaqb6X.pdf>

2.2. Environmental Quality Assessment:

Rawalpindi region is considered as the major logistics, military, economic and transportation center for northern Punjab. Despite this, the region is facing significant urban challenges in terms of air & water quality, inadequate infrastructure and municipal services as well as the well-being of local residents.

The whole region has been grappling with significant air pollution issues, in which particular sources are industrial activities, vehicular emissions, brick kilns, burning of crop residues & solid waste. Land use pattern in the region is characterized by mixed land uses and unplanned growth, leading to issues such as haphazard development and insufficient public spaces. The city center or Central Business District (CBD) of Rawalpindi has become highly congested, leading to traffic delays, jams, and high levels of air and noise pollution. The outdated water supply and sewerage system have become a problem, resulting in overflowing gutters and inadequate waste management. The increasing rate of car ownership in Rawalpindi, similar to other cities in Pakistan, is a sign of a major source that is causing a surge in air and noise pollution. Moreover, the region is also experiencing a shortage of urban green spaces.

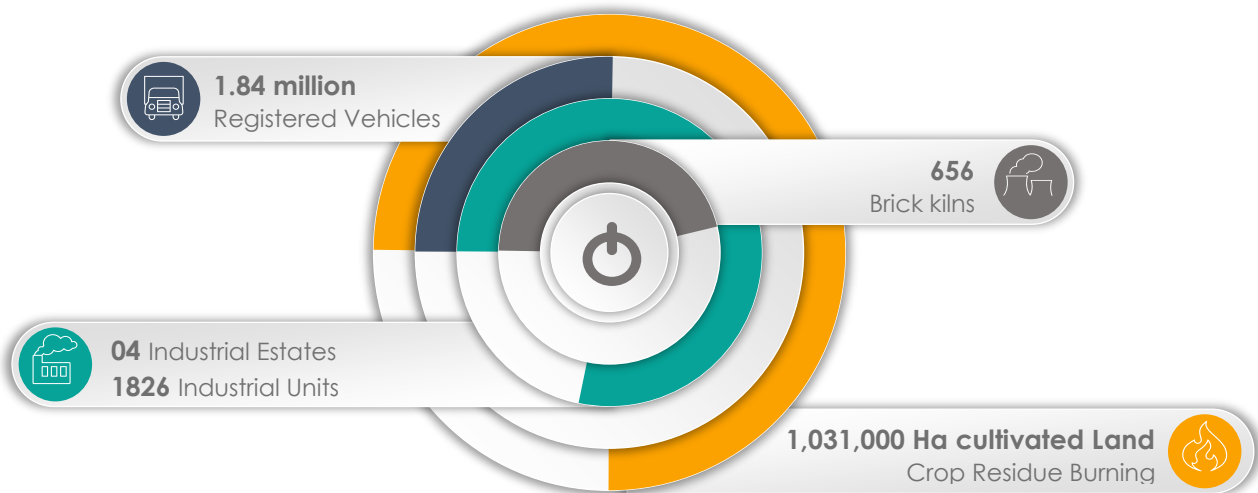


Figure 3: Key factors affecting Environmental Quality of Rawalpindi Region

2.2.1. Air Quality Assessment

Air quality of the Rawalpindi Region is largely influenced by industrial emissions, poor traffic management and inadequate transport infrastructure, polluting industries, insufficient availability of clean fuels, outdated technologies, absence of air quality monitoring equipment, open burning of wastes and crop residues, non-availability of resources for enforcement of regulations in emissions control, and ineffective implementation of legislations.

In Rawalpindi region, there are 03 industrial estates in the Rawalpindi district while 01 industrial estate each in Jhelum and Chakwal districts. Moreover, there is also a notable distribution of industrial units across various districts. Rawalpindi district hosts 1,001 industrial units, followed by 382 in Jhelum District, 300 in Chakwal District, and 143 in Attock District. These statistics serve as a valuable indicator of industrial activity within the respective districts. Major industrial sectors in Rawalpindi Region includes Stone crushing units, Gypsum Factories, Coal Mining, Salt Mining, Limestone Mining, Cement industries, oil & gas factories, tobacco Units, poultry farms, brick kilns etc.¹⁴ The total number and categories of registered industries, in Rawalpindi Region, recorded by the Census of Manufacturing Industries 2015-16, are given in Figure 4.

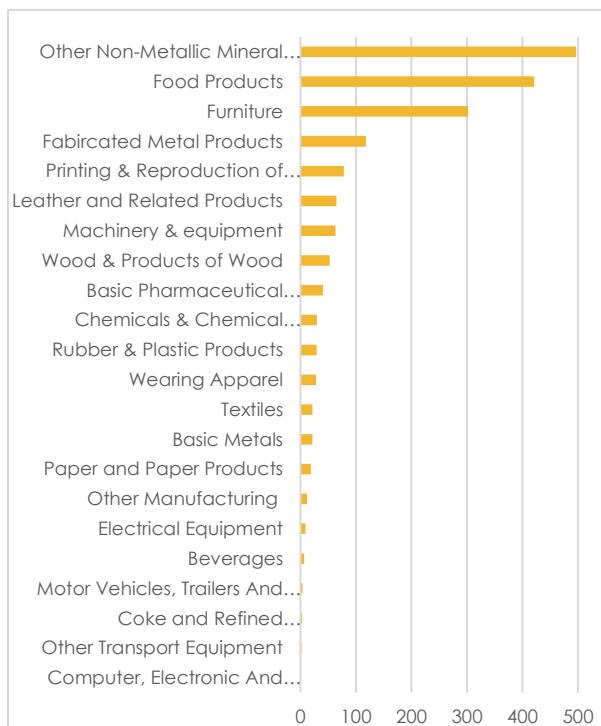


Figure 4: Industries in Rawalpindi Division
(Source: Census of Manufacturing Industries 2015-16)

According to the Punjab Brick Kilns Census 2016, there are a total of 656 brick kilns in Rawalpindi Division. The fuel source used in brick kilns is coal, mined in the coal mines of salt range. Permian and Tertiary coal are mined in the districts of Jhelum and Chakwal. An analysis of coal from 30 coal mines presents in the salt range reported that the coal has a very high sulfur content (3.3 – 11%), high ash content (14 – 50%), high concentration of volatile matter (24 – 41%), low moisture (3 – 10%), low carbon (23 - 57%), and moderate calorific value (10.2 – 25.7 MJ/kg)¹⁵, but available at cheaper rates to local

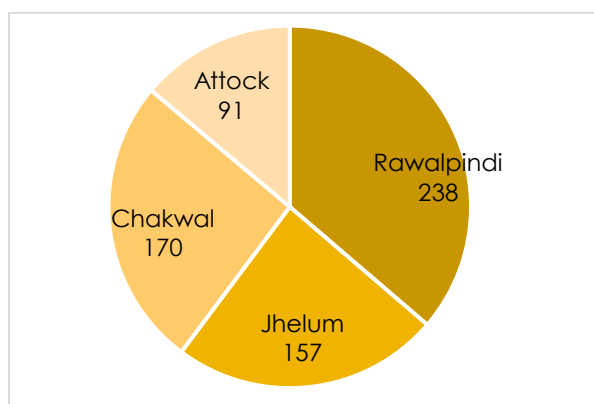


Figure 5: Number of Brick kilns in Rawalpindi Region
(Source: Punjab Brick Kilns Census 2016)

¹⁴ Census of Manufacturing Industries 2015-16

¹⁵ Rehman, S., Shah, A. N., Mughal, H. U., Javed, M. T., Akram, M., Chilton, S., & Nimmo, W. (2016). Geology and combustion perspectives of Pakistani coals from Salt Range and Trans Indus Range. *International Journal of Coal Geology*, 168, 202-213.

industrialists. The burning of poor-quality coal emits oxides of carbon (CO, CO₂) and sulfur (SO₂), particulate matter (PM₁₀, PM_{2.5}), Polycyclic aromatic hydrocarbons (PAHs), and Volatile organic compounds (VOCs)¹⁶. In addition, solid waste burning, power sector, crop residue burning, and other industrial processes also emit pollutants in the air¹⁷.

The transport sector is reportedly the major contributor to atmospheric emissions in Punjab. It emits CO, CO₂, NO₂, N₂O, SO₂, and PM. About 1.2 million vehicles have been registered in Rawalpindi Region, the majority being in the Rawalpindi district¹⁸. Inefficient vehicular engines, use of poor-quality fuel, broken road infrastructure in some places, and construction & other activities leading to traffic congestion are also responsible for traffic-related emissions.

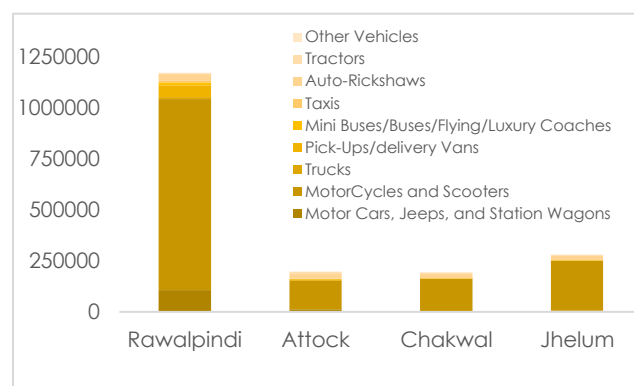


Figure 6: Registered Vehicles in Rawalpindi Region
(Source: Punjab Development Statistics 2022)

According to the Air Quality Life Index (AQLI), high particulate matter (PM_{2.5}) in the air is shortening the average Pakistani's life expectancy by 3.9 years annually, relative to what it would have been if the World Health Organization (WHO) guideline was met.¹⁹ Whereas, Life Expectancy Gain (Years) by 30% reduction in PM_{2.5} from 2019 concentration for Rawalpindi is 1.2; Attock 1.1; and Chakwal 1.0. AQLI 2021 Fact Sheet of Pakistan provides an analysis of Number of Years of Life Expectancy Gain through Reducing PM_{2.5} from 2019 Concentration to 30%, which is exhibited below.

Table 4: Years of Life Expectancy Gain through reducing PM_{2.5} from 2019 Concentration in Rawalpindi Region

District	PM _{2.5} Concentration (µg/m ³)	Life Expectancy Gain (Years) from Reducing PM _{2.5} from 2019 Concentration		
	2019	To WHO guideline of 10 µg/m ³	To Punjab EQS of 15 µg/m ³	By 30% Reduction
Rawalpindi	40	2.9	2.4	1.2
Attock	38	2.7	2.2	1.1
Chakwal	35	2.4	1.9	1.0
Jhelum	-	-	-	-

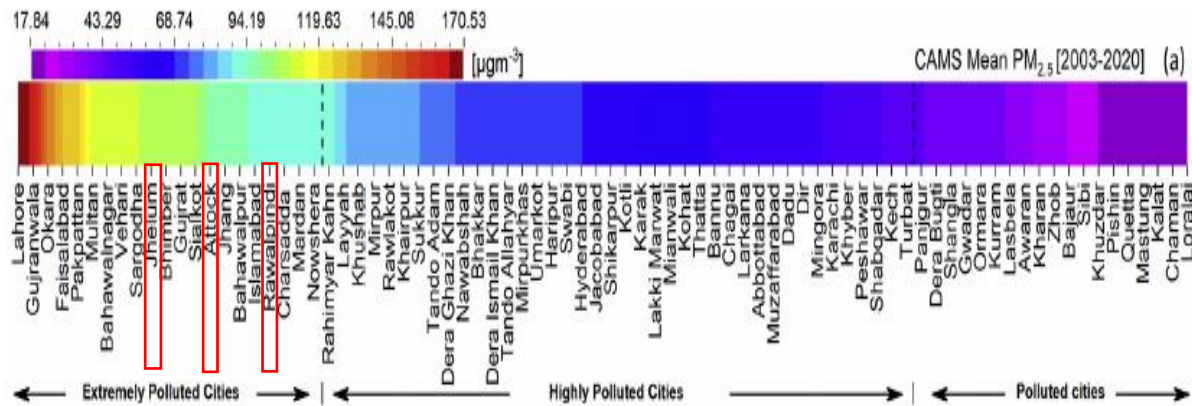
¹⁶ Pervaiz, S., Khan, F., Javid, K., Altaf, A., Aslam, F., Tahir, M., ... & Hayat, S. (2022). Development of air quality and brick kilns during the onset of COVID-19: An Analysis. Biological and Clinical Sciences Research Journal, 2022(1).

¹⁷ Tabinda, A. B., Ali, H., Yasar, A., Rasheed, R., Mahmood, A., & Iqbal, A. (2020). Comparative assessment of ambient air quality of major cities of Pakistan. Mapan, 35, 25-32.

¹⁸ Bureau of Statistics. Population Development Statistics Report, 2022. Government of Punjab.

¹⁹ Pakistan Fact Sheet, September 2021. Air Quality Life Index. University of Chicago.

The latest data shows average concentration of PM_{2.5} in Rawalpindi district is 92 ug/m³; Jhelum 110 ug/m³ and Attock 100 ug/m³ in comparison with PEQs concentration of PM_{2.5} i.e., 35ug/m³. These three cities have high pollution concentrations, as depicted below;



The environment team also monitored particulate matters (PM_{2.5} and PM₁₀) in the field with the help of portable air quality monitoring instruments in Rawalpindi Region. The monitoring results showed that the concentrations of PM_{2.5} were recorded above the Punjab Environmental Quality Standards i.e., 35 µg/m³ specifically in the urban centers of Rawalpindi and Jhelum. Main factors of high concentration are due to unpaved roads, traffic congestion, emissions from industries & brick kilns, and coal mining. Similarly, the monitoring done in the field showed that the concentrations of PM₁₀ are recorded higher than the permissible limit of PEQS i.e., 150µg/m³ mostly at the north-west and south-west of the Region (i.e., Attock and Chakwal Districts) due to fugitive dust from unleased roads, presence of highways/motorway, construction activities, agriculture waste and solid waste burning, and wind-blown dust particles on the roads. The effect of these pollutants is localized and temporarily affects the air quality of the Region. The results of survey-based monitoring of air quality are depicted in below Figure 7.

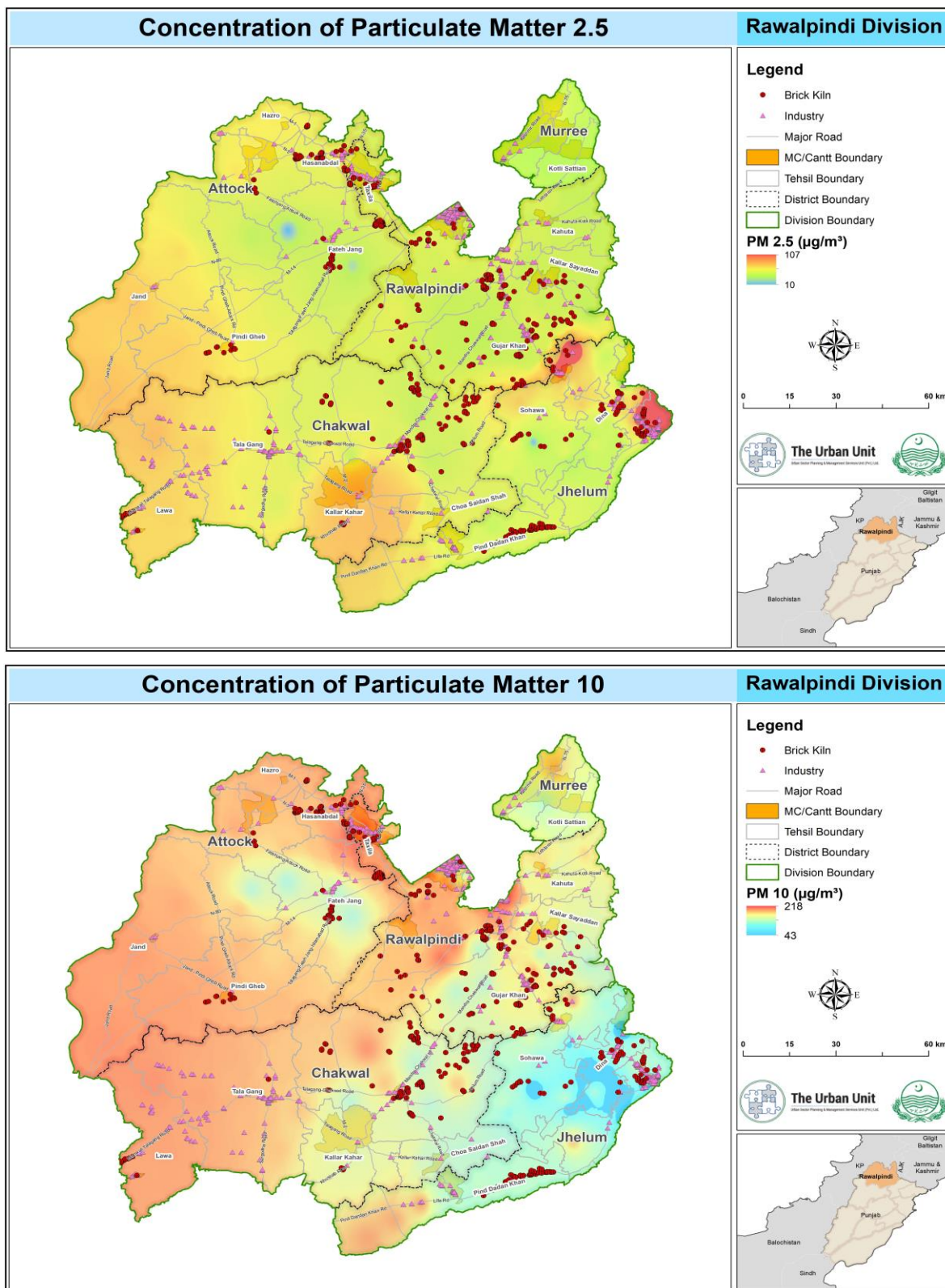


Figure 7: PM_{2.5} and PM₁₀ Concentrations of Rawalpindi Region
(Source: Field Survey, UU Team, 2023)

To complement air quality monitoring in the field, the research team at the Urban Unit uses remote sensing and satellite data to evaluate the pollution concentrations of Aerosol Index, Sulfur Dioxide and Nitrogen Dioxide in the region. The results of these spatial analyses are represented below.

This shows that Rawalpindi City is the most polluted city in the Rawalpindi Region, with respect to the concentrations of all pollutants.

- ▶ **Aerosol Index (AI):** Aerosol Index is higher in South-west region of districts Attock and Chakwal. Major sources include; Emissions from Industrial clusters & brick kilns, Heavy traffic movement and presence of Highway.
- ▶ **Carbon Monoxide (CO):** Carbon Monoxide (CO) is the major pollutant, with high concentrations in the northern borders and south-east parts of Rawalpindi Region. Possible sources are due to fumes from the burning of fuel in cars or trucks, fireplaces, or furnaces, crushing and mining units.
- ▶ **Nitrogen Dioxide (NO₂):** The concentration of NO₂ is higher at Northern border of the region due to emissions from Industrial clusters & brick kilns as well as domestic activities.
- ▶ **Sulfur Dioxide (SO₂):** Sulfur Dioxide pollution is distributed throughout the entire division. Major sources for this high concentration are Biomass burning, Industrial emission, Traffic congestion.

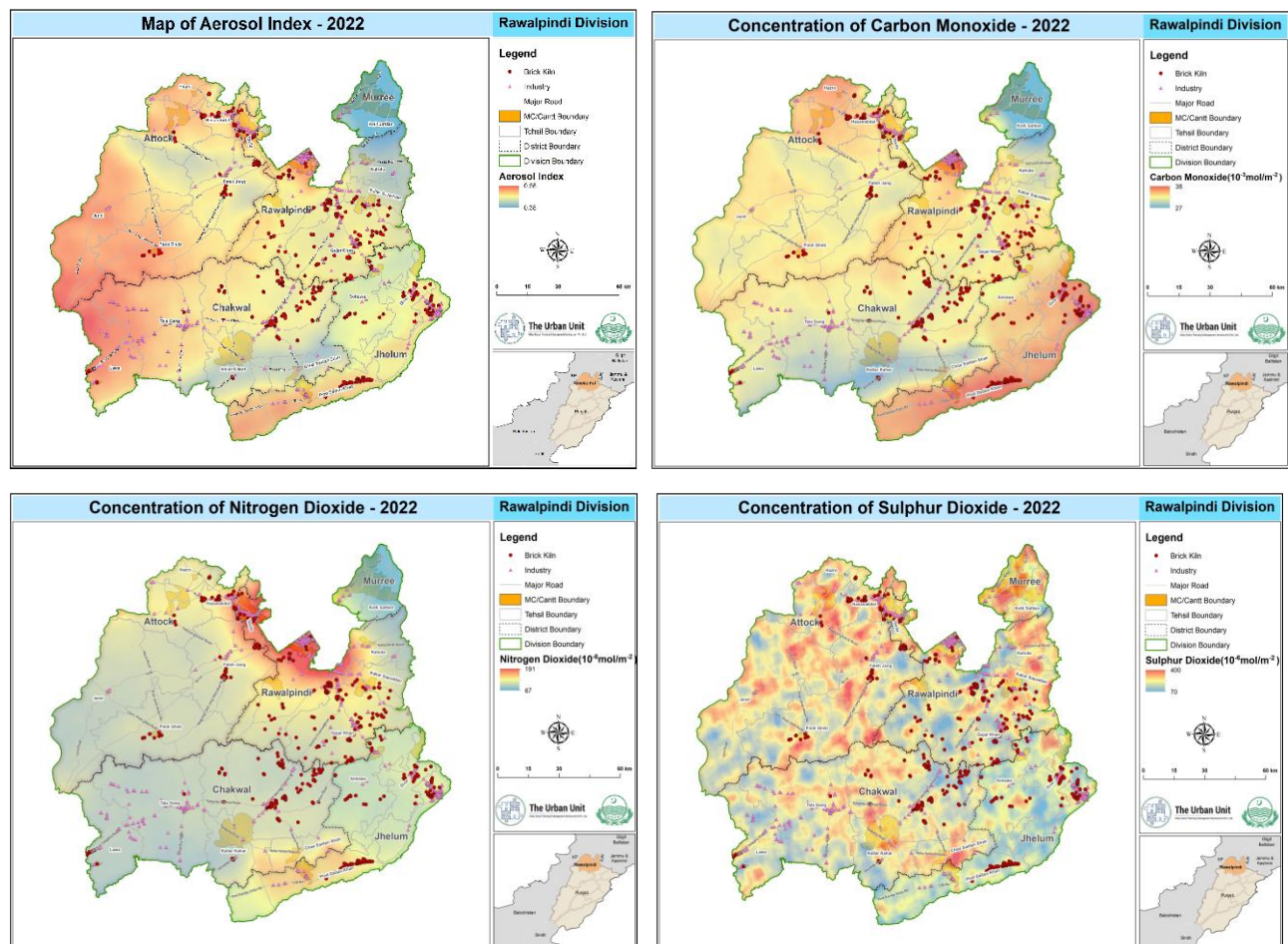


Figure 8: Concentration of AI, CO, NO₂ and SO₂ in Rawalpindi Region
(Source: Satellite Data)

2.2.2. Water Quality Assessment

Rawalpindi Division lies in the Potohari geological formation of the Salt range, where tectonic convolutions and geomorphology largely influence the composition of water in underground aquifers. The overlying quaternary stratification of igneous and sedimentary rocks fills the aquifer water. Therefore, the weathering phenomenon and breakage of rocks along with anthropogenic activities of mining cause the mixing of minerals into the water. Mining activities have been carried out in the salt range since ancient times, with high-grade gypsum, coal, limestone, and salt mined intensively. Groundwater contains high TDS concentration and is brackish/highly saline in the Rawalpindi Region.

During field visit of Rawalpindi Region, water samples from different sources, including hand pump, motor pump, household connection, RWSS source, irrigation tube well, etc. were collected. The samples were then analyzed to determine the concentrations of Arsenic and Total Dissolved Solids.

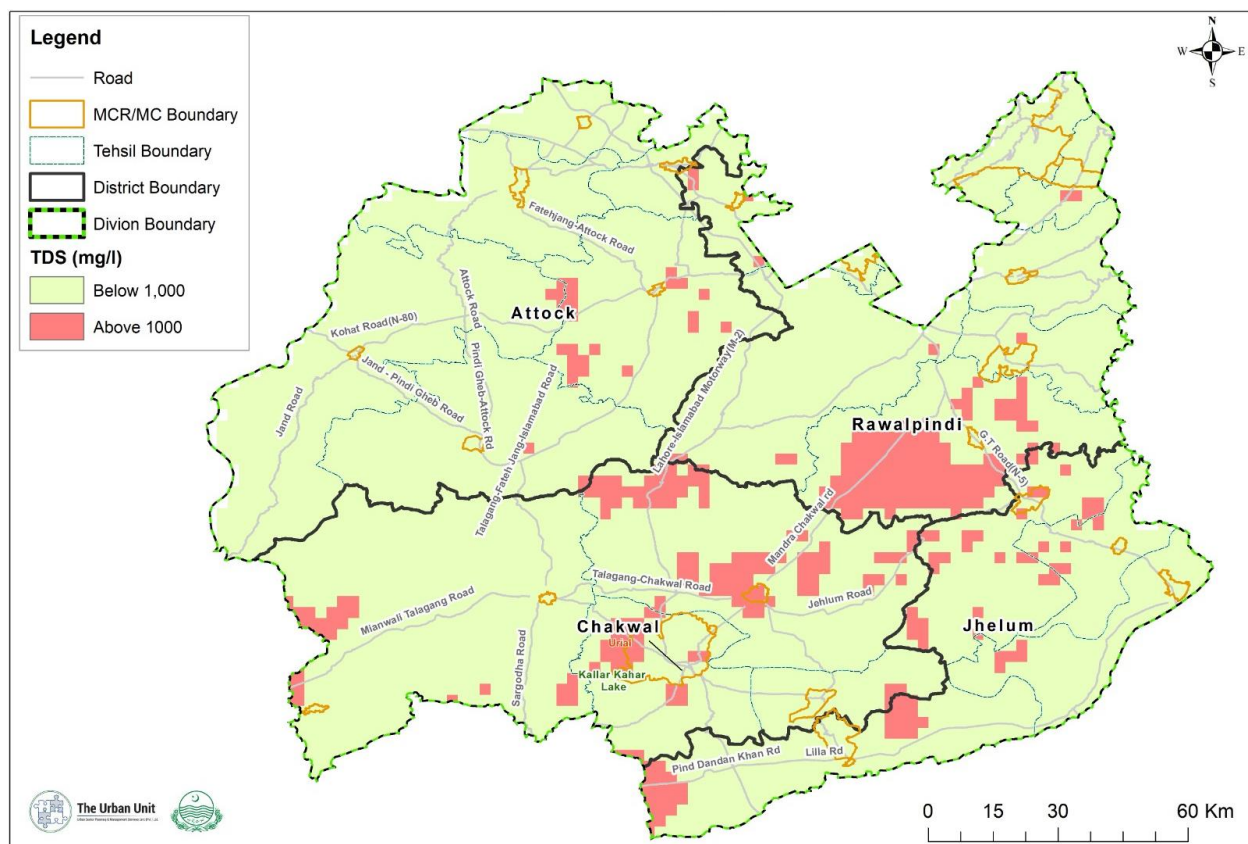


Figure 9: TDS Concentration in Groundwater of Rawalpindi Region

The permissible limit of TDS for drinking water quality specified by WHO and Punjab Environmental Quality Standards is 1000 mg/l. Figure 9 shows that the concentration of TDS in the obtained water samples exceeds the permissible limit in Rawalpindi district as well as in some pockets of Chakwal, Jhelum and Attock Districts. The TDS concentration in Nullah Lai, which is an open sewer stream flowing through Rawalpindi city and contains both domestic and industrial water, reported

elevated levels of TDS. Sources of this contamination are attributed to open solid waste dumping, untreated sewage, and industrial effluents^{20,21}. In addition, high TDS concentrations in Rawalpindi City are also attributed to rock-water interactions owing to the hilly geology of the area²². The elevated levels of TDS in Chakwal City are associated with its presence in the salt range and the calcareous nature of its geological features²³. Moreover, anthropogenic activities including mining and stone-crushing activities also cause contamination of water²⁴. High TDS values makes the water brackish and is responsible for kidney and stomach-related diseases.

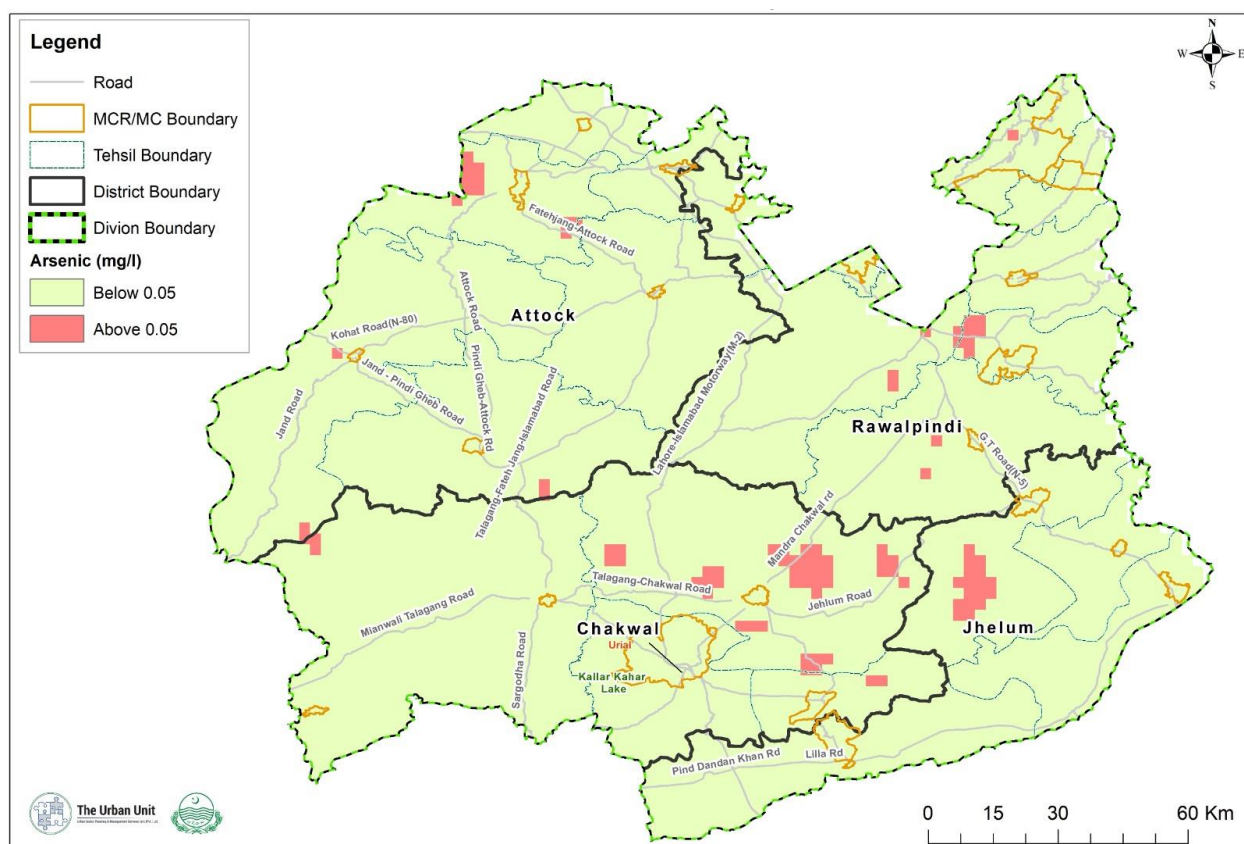


Figure 10: Arsenic Concentration in Groundwater of Rawalpindi Region

World Health Organization (WHO) and Punjab Environmental Quality Standards (PEQs) specify the permissible limits of 10 ppb and 50 ppb, respectively, for Arsenic concentration in drinking water. The results of Arsenic tests revealed that its concentration is below the permissible limits defined by

²⁰ Imtiaz, H., Khalid, S., Riaz, K., Ullah, M. A., & Rehman, Z. (2020). Assessment of hazardous impacts of open dumping on water quality of Nullah Lai stream Rawalpindi. *Pakistan Journal of Agricultural Research*, 33(3), 570-575.

²¹ Khan, S. A., Rafiq, M. T., Shah, F. A., Yasir, A., & Iqbal, A. (2022). Evaluating the impact of Nalla Lai contamination on drinking quality of groundwater in Rawalpindi city, Pakistan. *Water Practice & Technology*, wpt2022172.

²² Rana, S. A., Ali, S. M., Ashraf, M., Shah, A. A., Iqbal, K. M. J., Ullah, W., ... & Ulain, Q. (2022). GIS-based assessment of selective heavy metals and stable carbon isotopes in groundwater of Islamabad and Rawalpindi, Pakistan. *Frontiers in Environmental Science*, 10, 1027323.

²³ Batool, M., Toqeer, M., & Shah, M. H. (2023). Assessment of water quality, trace metal pollution, source apportionment and health risks in the groundwater of Chakwal, Pakistan. *Environmental Geochemistry and Health*, 1-26.

²⁴ Batool, M., & Shah, M. H. (2023). Appraisal of contamination, source identification and health risk assessment of selected metals in the agricultural soil of Chakwal, Pakistan. *Environmental Geochemistry and Health*, 1-22.

WHO and PEQs within most parts of Rawalpindi city²⁵. Arsenic concentration is reportedly higher in the Jhelum District in comparison to other areas of the Rawalpindi region²⁶. The findings from stakeholder consultation and field survey in the Rawalpindi division indicated that the drinking water is brackish and highly saline in the Jhelum and Chakwal districts. Another study on the determination of potentially toxic elements in water from coal mines present in the salt range reported higher risks of Mercury, Iron, Selenium, Cadmium, and Nickel. However, the concentration of these elements in the Jhelum River was very low²⁷.

2.3. Green Spaces Assessment

2.3.1. Vegetation Dynamics

Vegetation is a crucial part of terrestrial ecosystems as it serves as a natural linkage between the soil and atmosphere, and also an indicator of ecosystem stability from regional and global ecosystem levels. Vegetation cover is vital for sustainable terrestrial ecosystems; however, this cover has been experiencing substantial changes in different regions²⁸. Vegetation can be highly dynamic due to the influence of different drivers such as climatic factors and human activities. Quantifying vegetation variations is greatly important as it is a prerequisite to understanding its social and ecological consequences²⁹.

Global environmental changes significantly disturb the distribution and dynamics of vegetation and animal habitat which is an important concern for terrestrial ecologists to enable better predictions of the effects of global warming, biodiversity reduction or habitat degradation³⁰.

The changing global climate has caused alterations in terrestrial ecosystems, of which vegetation is an essential component. Many previous studies have displayed the sensitivity of vegetation in different regions of the world to environmental changes, where vegetation cover is extensively influenced by climate change, specifically in the arid and semi-arid zones³¹.

The advanced applications of remote sensing and geographic information systems (GIS) technology provide timely and updated information on a wide scale and time series phenological data from regional to global levels. Mapping large areas using traditional techniques, which are

²⁵ Rana, S. A., Ali, S. M., Ashraf, M., Shah, A. A., Iqbal, K. M. J., Ullah, W., ... & Ulain, Q. (2022). GIS-based assessment of selective heavy metals and stable carbon isotopes in groundwater of Islamabad and Rawalpindi, Pakistan. *Frontiers in Environmental Science*, 10, 1027323.

²⁶ Ullah, Z., Rashid, A., Ghani, J., Talib, M. A., Shahab, A., & Lun, L. (2023). Arsenic contamination, water toxicity, source apportionment, and potential health risk in groundwater of Jhelum Basin, Punjab, Pakistan. *Biological Trace Element Research*, 201(1), 514-524.

²⁷ Jabbar Khan, A., Akhter, G., Gabriel, H. F., & Shahid, M. (2020). Anthropogenic effects of coal mining on ecological resources of the Central Indus Basin, Pakistan. *International journal of environmental research and public health*, 17(4), 1255.

²⁸ Chang, J., Tian, J., Zhang, Z., Chen, X., Chen, Y., Chen, S., & Duan, Z. (2018). Changes of grassland rain use efficiency and NDVI in Northwestern China from 1982 to 2013 and its response to climate change. *Water*, 10(11), 1689.

²⁹ Yu, W., Zhou, W., Dawa, Z., Wang, J., Qian, Y., & Wang, W. (2021). Quantifying Urban Vegetation Dynamics from a Process Perspective Using Temporally Dense Landsat Imagery. *Remote Sensing*, 13(16), 3217.

³⁰ Pettorelli, N., Vik, J. O., Mysterud, A., Gaillard, J. M., Tucker, C. J., & Stenseth, N. C. (2005). Using the satellite-derived NDVI to assess ecological responses to environmental change. *Trends in ecology & evolution*, 20(9), 503-510.

³¹ Luo, N., Mao, D., Wen, B., & Liu, X. (2020). Climate change affected vegetation dynamics in the northern Xinjiang of China: Evaluation by SPEI and NDVI. *Land*, 9(3), 90.

primarily based on field surveys, has been a labor-intensive and time-consuming approach to observing vegetation dynamics. However, advancements in space technology are providing effective and inexpensive and improved methods for investigating vegetation dynamics. The vegetation indices extracted from remotely-sensed data have been widely used in many studies to comprehend vegetation dynamics and drought assessment etc.³².

The utilization of the normalized difference vegetation index (NDVI), has made it possible to effectively assess the vegetation cover across several scales. NDVI is considered the most common indicator in monitoring vegetation dynamics over large-scale areas and thus, it has been used to monitor vegetation greenness³³.

The pixels having NDVI values less than 0.1 were excluded to avoid the influence of water content, soil moisture, barren land, etc. displaying the white area (non-vegetation area) in maps. Vegetation cover based on the NDVI values are categorized on the basis of NDVI threshold values: Low vegetation (0.1 -0.2), Moderate vegetation (0.2- 0.4) and High vegetation (>0.4). The spatial pattern of NDVI derived from Landsat satellite data is displayed in Figure 11. During the first time interval (2001-2009) the area represented by low vegetation highly increased by 3274 km², the moderate vegetation area highly decreased by -3044 km² and the high vegetation cover area also decreased by 7434 km².

In contrast to first time interval, the second time interval (2009 – 2016) revealed the improving trends in all vegetation types. During 2009 – 2016, the low vegetation area increased by 1284 km², area having moderate vegetation increased by 2492 km² and high vegetation area greatly increased by 5957 km² respectively.

Like second interval, the third time interval (2016-2023) also showed the positive trends in all vegetation types. During 2016 – 2023, the low vegetation area increased by 164 km², area having moderate vegetation increased by 791 km² and high vegetation area greatly increased by 1636 km² are provided in Table.1.

The improved vegetation areas in third time interval could be linked with the post flood Tsunami Ten Billion Tsunami Program which initiated in 2018 across Pakistan. The findings of this scientific study also yielded valuable insights regarding adequate water supply in the low-lying areas of Rawalpindi division or making artificial water reservoirs and fencing around the forest reserves could reduce the grazing pressure, illegal cutting and reducing the mining activities could also improve the biodiversity of the division.

³² Measho, S., Chen, B., Trisurat, Y., Pellikka, P., Guo, L., Arunyawat, S., ... & Yemane, T. (2019). Spatio-temporal analysis of vegetation dynamics as a response to climate variability and drought patterns in the semiarid region, Eritrea. *Remote Sensing*, 11(6), 724.

³³ Yengoh, G. T., Dent, D., Olsson, L., Tengberg, A. E., & Tucker III, C. J. (2015). *Use of the Normalized Difference Vegetation Index (NDVI) to assess Land degradation at multiple scales: current status, future trends, and practical considerations*. Springer.

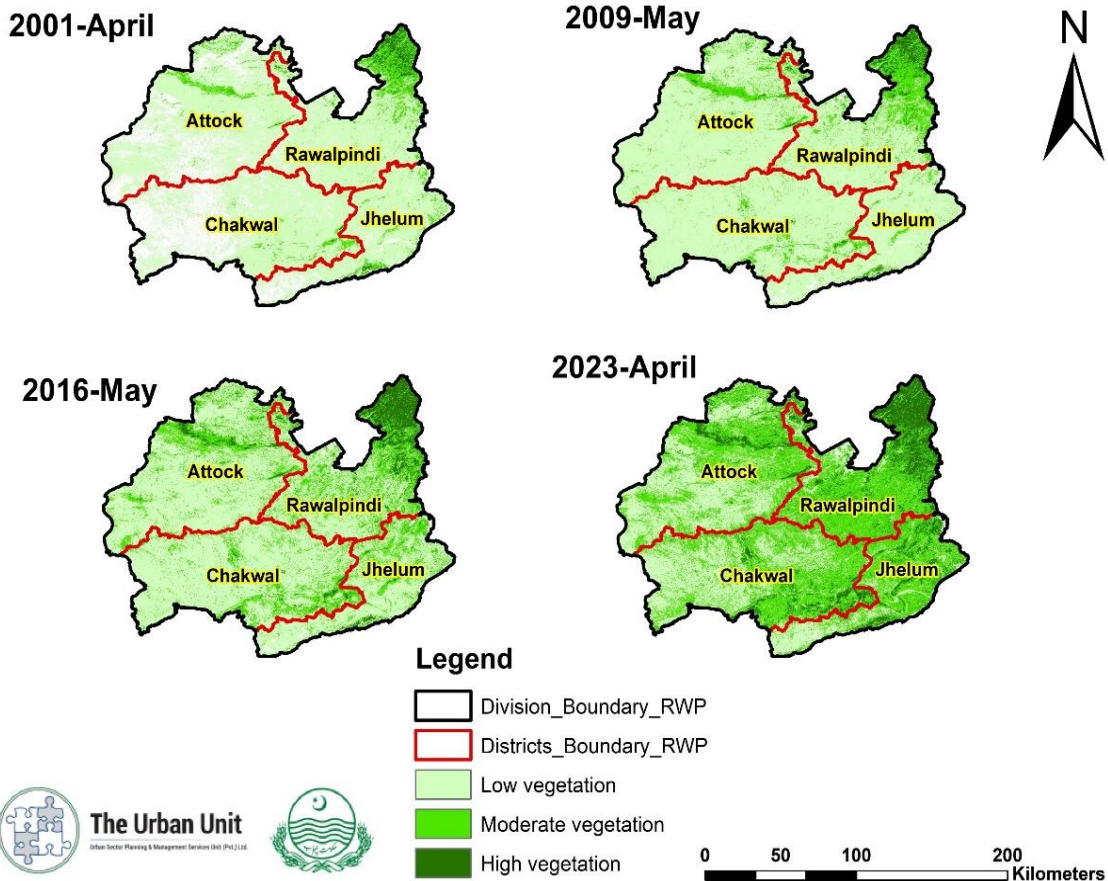


Figure 11: Spatio-temporal trends of vegetation dynamics in the Rawalpindi Division during 2001 - 2023

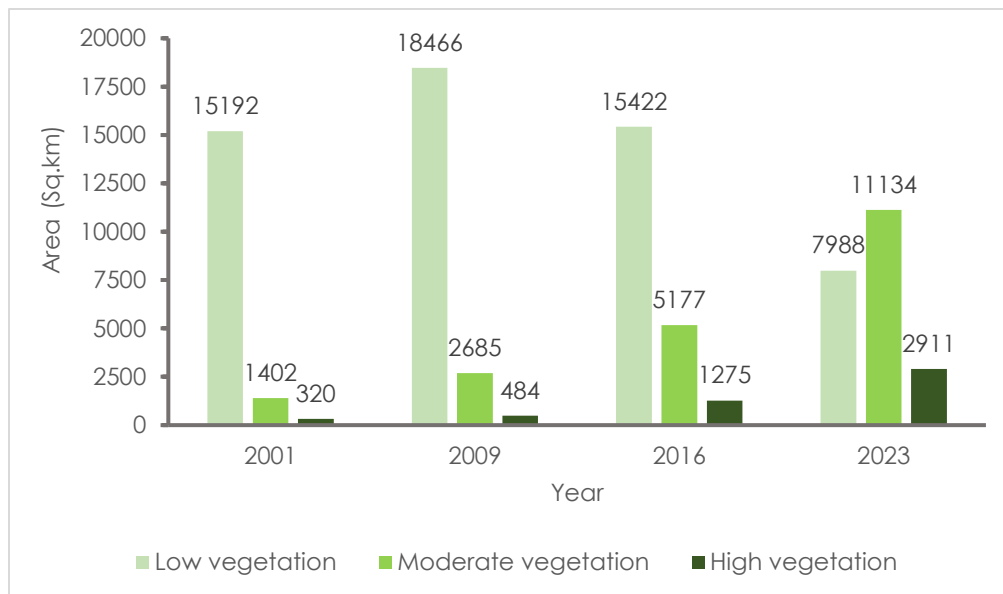


Figure 12: Area statistics of vegetation types during 2001 – 2023

2.3.2. Assessment of Urban Recreational Parks

Urban Recreational parks are a significant component of sustainable development planning and offer a wide range of benefits in terms of revitalization of the natural environment. Briefly, urban recreational parks have the following advantages;

- ▶ Recreational Opportunity for all Age-Groups
- ▶ Health & Safety Benefits
- ▶ Protection of Local Biodiversity and Natural habitat
- ▶ Improved provision of ecosystem services such as carbon sequestration, decontamination of water, climate regulation, etc.
- ▶ Centers for different community facilities, including zoos, historical sites, educational centers, community well-being and cultural centers, etc.
- ▶ Promote economic stability through tourism, creation of jobs, increased real-estate worth, etc.

Urban Recreational parks in urban centers in Rawalpindi were surveyed with the aim to assess their sufficiency and accessibility, existing conditions as well as areas for improvement through a survey-based tool. The employed assessment criteria include park ownership, status of maintenance, category of park, and availability of various facilities. A total of **31 Parks** were surveyed in Rawalpindi Division. The location map is given in Figure 13.

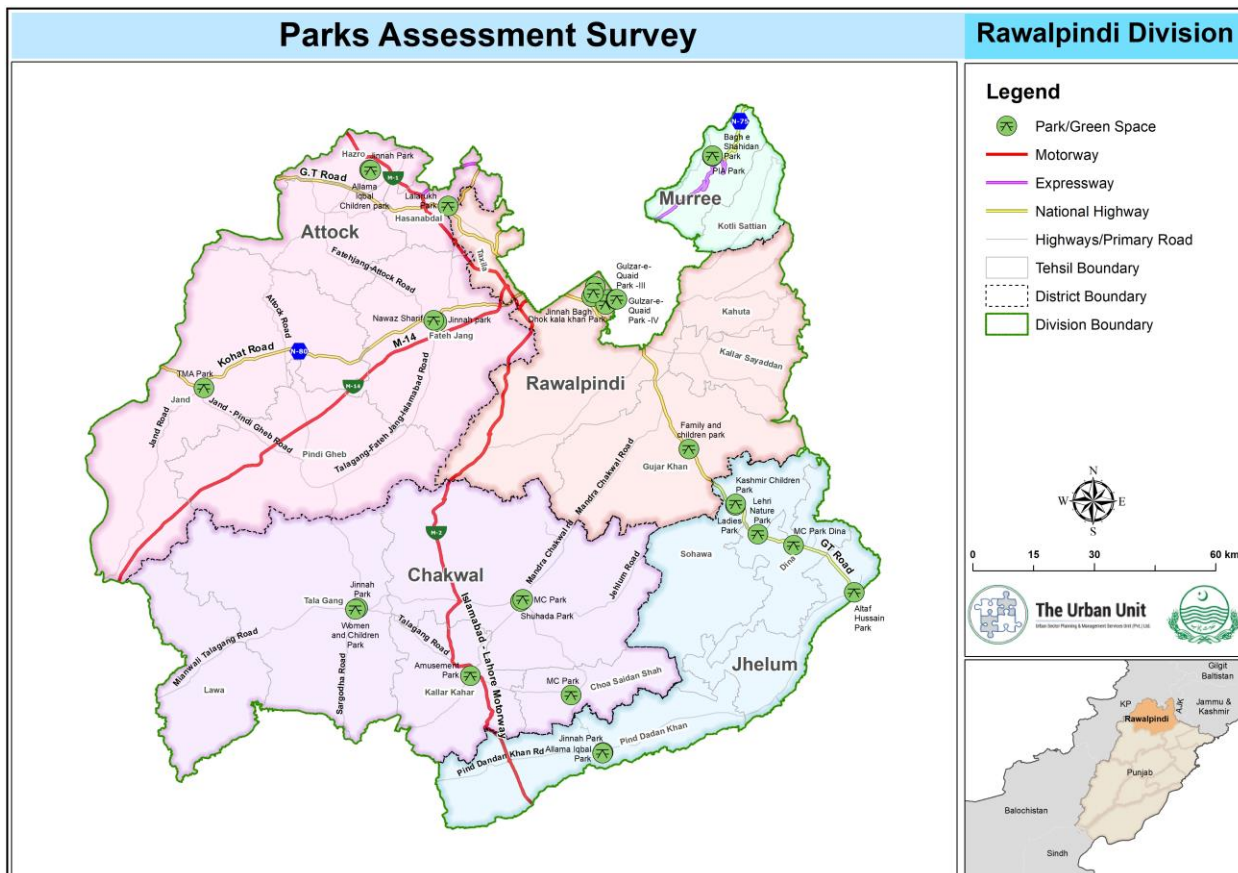


Figure 13: Location map of Parks Assessment Survey

All parks present in Rawalpindi City Tehsil are owned and maintained by the Punjab Horticulture Authority, whereas relevant local MCs are responsible for the development and maintenance of parks in other districts and tehsils. The forest parks are owned by relevant district forest departments. Amusement Park in Kallar Kahar tehsil is owned by TDCP. The findings of survey are given in Figure 14.

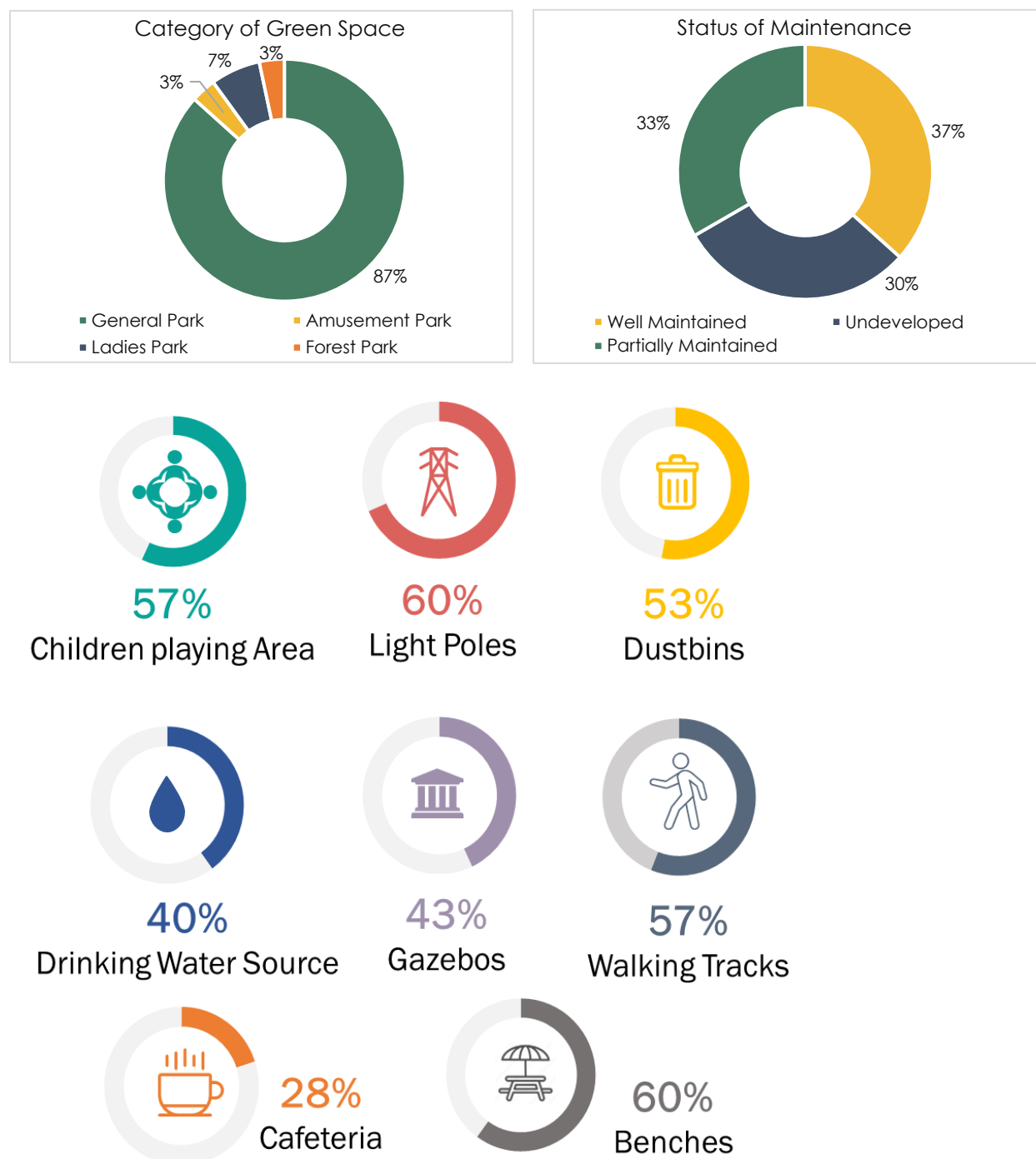


Figure 14: Results of Parks Assessment Survey

2.3.3. Local Community Perception Survey – Green Spaces Rawalpindi

To compliment Environment & Social Safeguard's Team survey, a perception survey with local community of Rawalpindi Region was also conducted in order to assess the local community perception regarding green spaces of Rawalpindi Region.

The planning team thus visited each tehsil of four districts of Rawalpindi Region (Rawalpindi, Jhelum, Chakwal and Attock) in August 2023. A Survey form (Attached as Annexure – A) was formulated to record people's perceptions and attitudes regarding urban green spaces as well as their willingness to pay for these services in their areas. The empirical analysis of the survey helped to conclude the perception and expectations of local community regarding urban green spaces in Rawalpindi Region.

The public effectively participated in the survey. The sample size was assigned on the basis of the population of districts of Rawalpindi Region; overall **35%** were **females** and **65%** were **male** participants in the perception survey. The data from the perception survey was analyzed and the results were considered in the prioritization of need-based development projects.

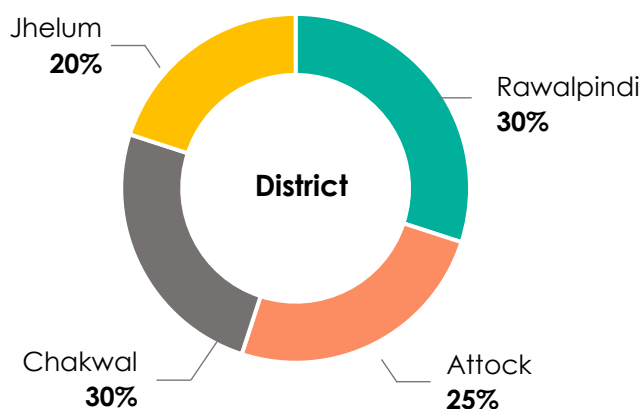
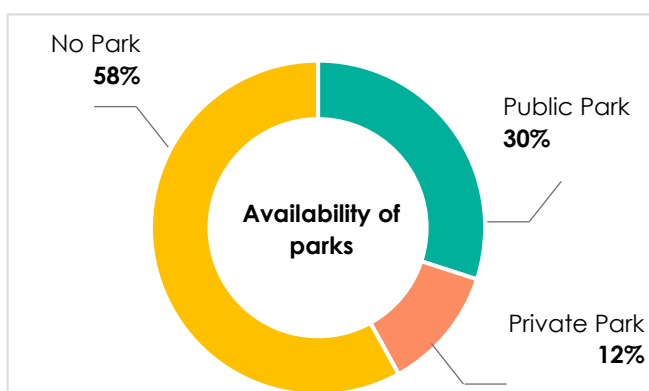


Figure 15: Demographics of Public Perception

Availability of Parks and Green Spaces in the Urban Areas

In Rawalpindi Region, the availability of Parks is generally limited and are usually present at a distant apart from residential areas. However, most of the parks are usually crowded all day more particularly in the evening. It is also worth mentioning here that the number of ladies parks is also significantly low in Rawalpindi Region to accommodate huge number of female populations.



Furthermore, the facilities present in the existing parks are also limited thus required urgent attention and proper management.

Most of the respondents have reported they never visited the parks due to lack of existence of parks in their areas. The most pressing concerns were the lack of drinking water, cafes, washrooms, insufficient lighting, and broken light poles, long distances, inadequate or missing play areas, damaged benches, and other infrastructure.

Figure 16: Availability of Parks

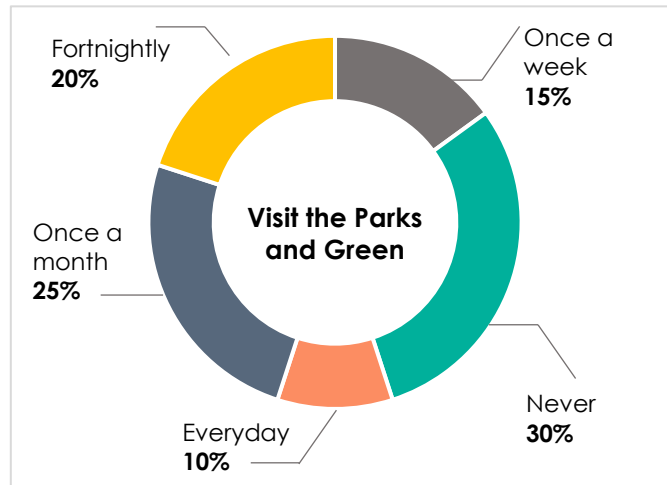


Figure 17: Local Community Visited Parks & Green Spaces

Community Participation and their Willingness to Pay

It's gratifying to comprehend that the Rawalpindi Region community is well aware of the significance of their active involvement in enhancing the current state of green spaces and parks. An impressive 90% of the surveyed individuals voiced their belief in the vital role their active participation plays in preserving the vitality of green areas. Furthermore, they also proposed that adding greenery to vacant spaces and planting trees along roadways could significantly augment the overall vegetation in their cities. It is reported in the study of Riaz *et al.*, that the local communities that are involved in the activities to manage the green spaces and plantations are more sustainable communities.³⁴ Similarly, another study also revealed that public participation is required to improve green spaces.³⁵

³⁴ Riaz, A., Younis, A., & Naveed, S. (2010, August). Impact analysis of urban and rural landscapes as perceived by respective communities: a case study of Multan city, Pakistan. 954 (pp. 99-107).

³⁵ Fors, H., Molin, J. F., Murphy, M. A., & van den Bosch, C. K. (2015). User participation in urban green spaces–For the people or the parks? *Urban Forestry & Urban Greening*, 14(3), 722-734.

Another critical aspect of the survey involves estimating a hypothetical value to determine how much respondents are willing to financially contribute towards the preservation and development of current and future environmental resources, such as parks and green spaces. Upon thorough investigation and analysis of the survey findings, it is confirmed that more than 50% of the participants are prepared to allocate an amount ranging from 50 to 100 Rs for the expansion and enhancement of green spaces in their vicinity. Remarkably, 25% of individuals from low-income backgrounds are also willing to contribute 50 Rs.

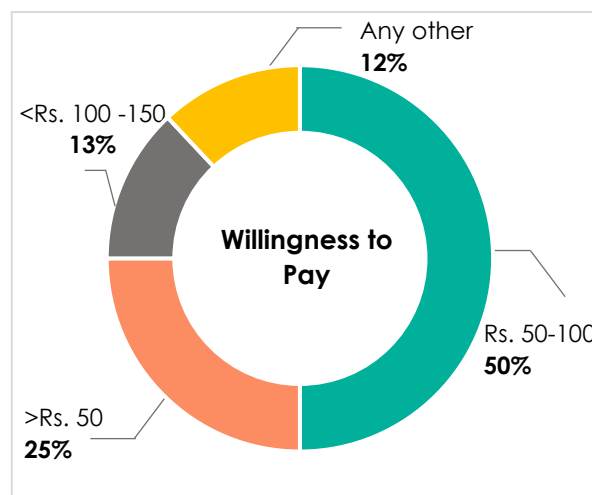


Figure 18: Community's Willingness to Pay for improvement of Parks and Green Spaces

This survey underscores that those who express a willingness to contribute financially are prepared to allocate a modest portion of their income to support the critical need for expanding and maintaining green spaces, especially given the rapid urbanization occurring in the Rawalpindi Region.

2.4. Key Environmental Challenges – Rawalpindi Region

Key Environmental Challenges and Issues that Rawalpindi Region is experiencing are:

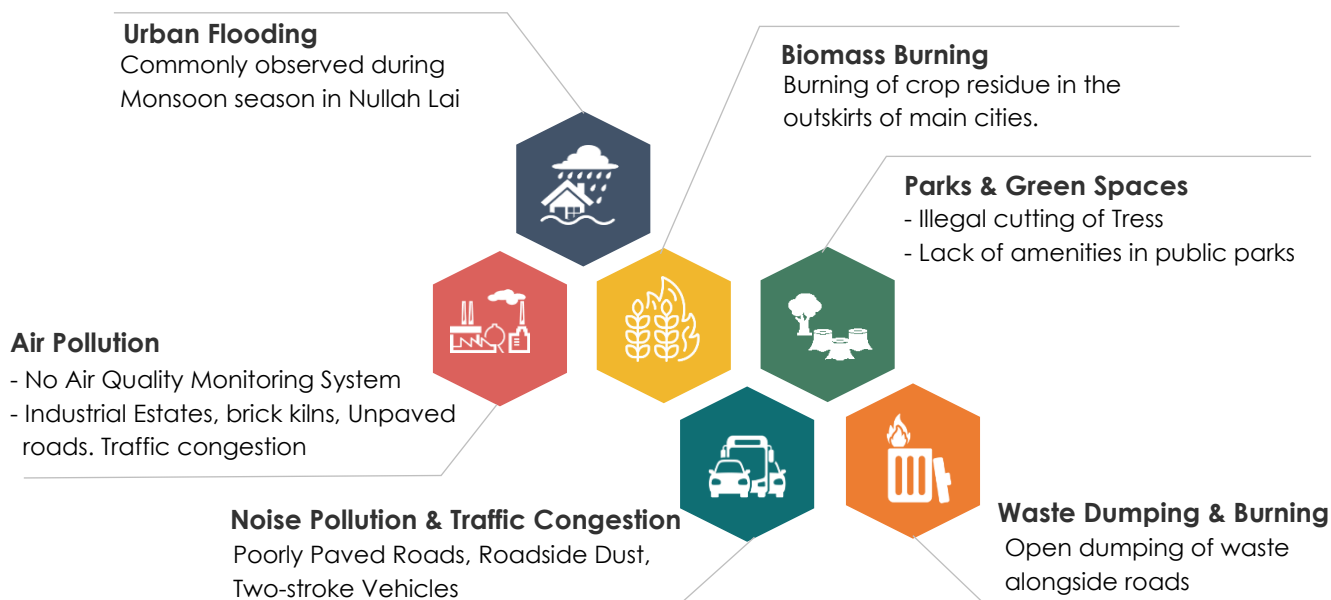


Figure 19: Key Challenges & Issues of Rawalpindi Region

To compliment Environment & Social Safeguard's Team findings, the local community of Rawalpindi Region is also consulted. Around 160 respondents (104 males; 56 females) from

Rawalpindi Region were consulted. It is observed that almost 28% of total respondents have reported that trees cutting and lack of green spaces is the major issue in their respective areas. 18% of the respondents claimed that Waste Burning & open dumping is the main environmental challenge they are facing every day. 12% respondents reported that air pollution and smog is the biggest environmental issues in their respective areas of the Rawalpindi Region due to industrialization and traffic congestion. 12% of the total respondents expressed their displeasure towards urban flooding challenges while 12% of the total respondents expressing their concerns on Noise pollution.

2.5. Biodiversity Conservation Area

Rawalpindi Region is rich in forest and wildlife areas (in all 04 Districts viz; Rawalpindi, Jhelum, Chakwal and Attock) under different categories of forest and protected areas act of Punjab. Forests are determined both by the presence of trees and the absence of other leading land use areas. The Forest is a broader terminology used for the conservation, protection and production of natural resources e.g., Forest cover in National Parks are important areas to conserve habitats, natural reserves and other protected areas.

The Urban Unit team visited **24** environmentally sensitive and high conservation value areas during the field visit of Rawalpindi Region. These includes:

Rawalpindi	Jhelum	Chakwal	Attock
▶ Murree Kotli Satian Kahuta National Park ▶ Loi Bher Wildlife Park ▶ Maira Reserve Forest ▶ Margalla Reserve Forest ▶ Dungi Reserve Forest	▶ Tilla Jogian National Park ▶ Domeli Wildlife Sanctuary ▶ Jalalpur Sharif Wildlife Sanctuary ▶ Rakh Kandal Public Wildlife Reserve ▶ Lehri Nature Park & Reserve Forest ▶ Bajwala Forest	▶ Chinji National Park ▶ Salt Range National Park ▶ Chumbi Surla Wildlife Sanctuary ▶ Diljaba Wildlife Sanctuary ▶ Arra/Parera Wildlife Sanctuary ▶ Malot Reserve Forest Wildlife Sanctuary	▶ Kala Chita National Park ▶ Kheri Murat National Park ▶ Dakhnair Forest ▶ Malaitola Forest ▶ Kherimer Reserve Forest ▶ Gulyal Reserve Forest ▶ Dani Reserve Forest

Detailed assessments of these visits were conducted which provides a basis to understand the key challenges of biodiversity and its habitat in the region. Details of forest lands in each district, key field observations and threats of these sites are presented in the subsequent sections.

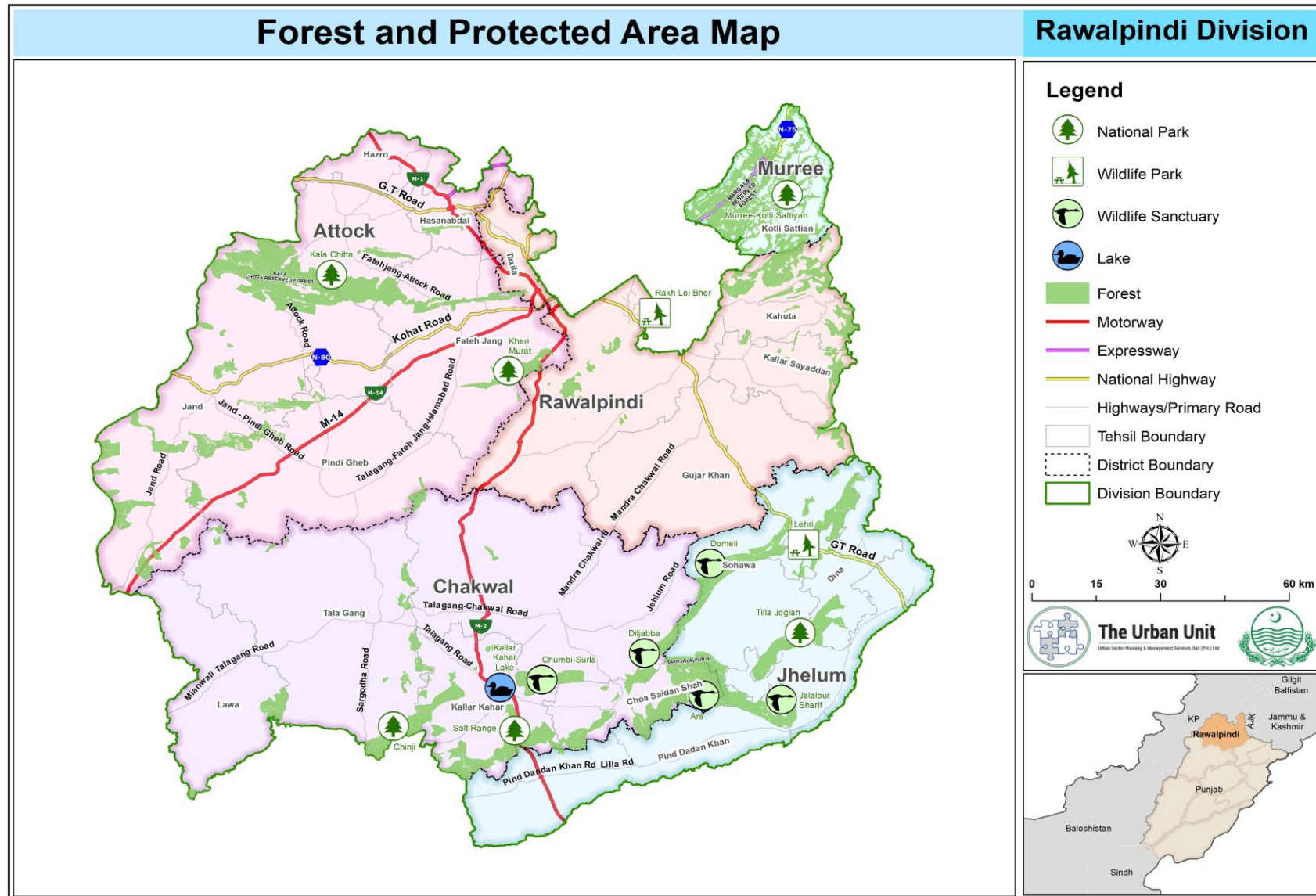


Figure 20: Map showing Visited Forest & Protected Areas of Rawalpindi Region

2.5.1. Rawalpindi Conservation Areas

Rawalpindi, a hill station of Punjab province hosted a variety of biodiversity at conservation potential sites. In Rawalpindi District, various designated forest types i.e. reserved and protected forest which is ground to Mediterranean floristics composition are found. These forests are habitat to distinct faunal diversity includes barking deer, common leopard, Indian pangolin, monkey, khali pheasant, black partridge, grey partridge, wild hare, wild boar, and diversified herpetofauna. The geographic and mountainous terrain featuring to diverse range of biodiversity distribution, varies with elevation of district. The floristic composition of Rawalpindi district includes Phulai (*Acacia modesta*); which is the common tree found at low elevation areas whereas Wild olive (*Olea ferruginea*), Diar (*Cedrus deodara*), Chir (*Pinus wallichiana*) are commonly distributed on high elevated region within district. Along with tree covers some others associated shrubs are also groundcover the Rawalpindi region which includes *Grewia spp*, *Zizyphus spp*, *Salix acmophylla* along with bushes, grasses and herbs. The herbaceous plant species associated to terrain uniqueness evident to diverse range of plant biodiversity throughout the year in different seasons. The biodiversity conservation areas of the district are as follows:

- ▶ Murree Kotli Satian Kahuta National Park
- ▶ Loi Bher Wildlife Park
- ▶ Maira Reserve Forest
- ▶ Takhat Pari Reserve Forest
- ▶ Bagham Reserve Forest
- ▶ Margalla Reserve Forest
- ▶ Dungi Reserve Forest
- ▶ Tumair Reserve Forest
- ▶ Panjar Reserve Forest
- ▶ Lehtrar Reserve Forest
- ▶ Kahrar Reserve Forest
- ▶ Kallar Reserve Forest
- ▶ Danhoi Reserve Forest

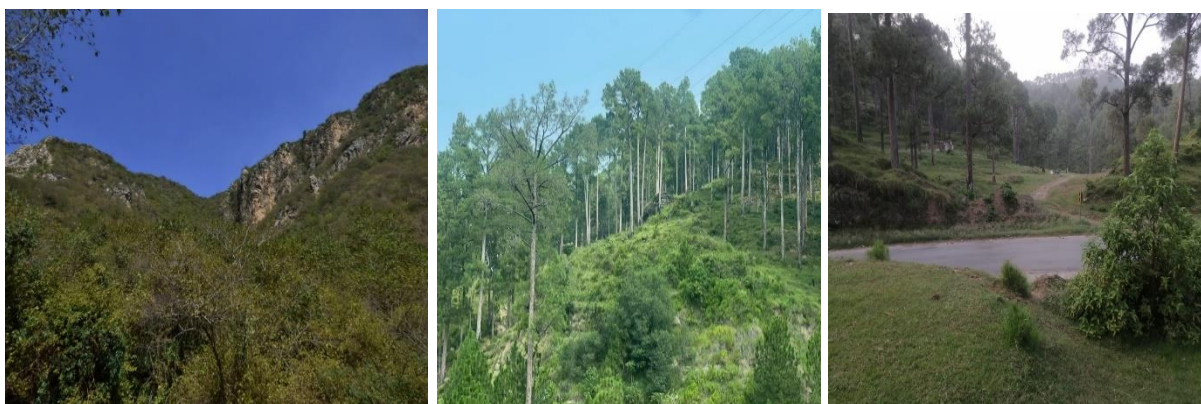


Figure 21:(a). Danhoi Reserve Forest (b). Margalla Reserve Forest (c). Kahuta Reserve Forest

Key Observation & Threats

- ▶ Illegal hunting, poaching and trading of game birds like partridges from National Park by locals.
- ▶ Human Wildlife conflict whenever Leopard and jackals visit to human settlements.
- ▶ Forest Fire incidence in Kotli Satian National Park
- ▶ Invasive alien flora e.g., *Parthenium hysterophorus* and *Prosopis juliflora* throughout the Rawalpindi region.

2.5.2. Jhelum Conservation Areas

The Jhelum district is located to the northern side of Jhelum River and bounded by Rawalpindi on north and Sargodha on south, the Chakwal district on west. The climate of Jhelum district varies throughout the years making it semi-arid, warm subtropical climatic region. The semi-mountainous steeps of district are enriched with subtropical thorn forest type where some of key plant species are *Acacia modesta* (Phulai), *Acacia nilotica* (Kikar), *Olea ferruginea* (Wild Olive), *Dodonea viscosa* (Snatha), *Justicia adhatoda* (Vaheker). The Jhelum River is an important habitat for aquatic wildlife, that extended over an area approx. 1,000 square kilometres on Jhelum plains.

The Jhelum district have the world's second-largest salt mine i.e. Khewra salt mine, where the diversified *halophytic herbaceous* season diversity is reported. The diversified ecological habitat is ground to key wildlife species includes Punjab Uril, Jackal, wolf, porcupine, wild hare and wild boar among mammalian fauna and game birds like grey partridge, chakur and black partridge.

In Jhelum for the conservation and protection of biodiversity following are the key conservation areas notified by the department:

- ▶ Tilla Jogian National Park
- ▶ Bajwala Forest
- ▶ Domeli Wildlife Sanctuary
- ▶ Lehri Nature Park & Reserve Forest
- ▶ Rakh Kandal Public Wildlife Reserve
- ▶ Jalalpur Sharif Wildlife Sanctuary
- ▶ Jhindi Reserve Forest
- ▶ Nili Reserve Forest
- ▶ Barali Reserve Forest



Figure 22: (a). Rakh Kandel Reserve Forest (b). Tilla Jogian National Park (c). Jalalpur Sharif Wildlife Sanctuary

Observation and Threats

- ▶ Mining and crushing units in protected areas
- ▶ Tree cutting by local for fuel wood collection
- ▶ Illegal hunting, poaching and trading of game birds like partridges by locals.
- ▶ Invasive alien flora e.g., *Parthenium hysterophorus* and *Prosopis juliflora* throughout the Rawalpindi region.

2.5.3. Chakwal Conservation Areas

Chakwal is a Barani climatic district of Rawalpindi division, situated between Indus River and Jhelum River, forming Pothwar plateau. The Chakwal district has the famous hill steeps namely Salt Range, where the complex topography are rich in diversified biodiversity. The extensive forest cover spread all around the district making it a unique habitat of undulated hills. Some of the key wildlife species of this district Includes Punjab urial, Red fox, Jackal, Asiatic Wolf, Porcupine, Pangolins, wild hare and wild boar among mammals. Whereas, avifaunal diversity includes See-See Partridge, Grey Partridge, Common Peacock, Chakur, Black Partridge, Grey Horn-billed, and others common birds.

The hill steeps of Chakwal are mountainous extensions with undulated areas making small rills to large gullies enriching extensive floristic composition. The key floral species includes Phulai (*Acacia modesta*), Wild Olive (*Olea ferruginea*), Snatha (*Dodonea viscosa*), Vaheker (*Justicia adhatoda*), with some invasive species like Musqat (*Prosopis juliflora*), Gajarghas (*Parthenium hysterophorus*), and Lantani (*Lantana camara*). The mountainous ranges of Chakwal district is distinctive and diverse for the regional diversity. To protect and conserve the precious habitat, the Forest, Wildlife and Fisheries Department has notified new protected areas under Punjab Wildlife Act 2015, of which Salt Range National Park is of prime important as Punjab Urial is the key inhabitant with Jackal and wolf as climax predators helping to stabilize the ecosystem. The notified protected areas and forest areas are as follows:

- ▶ Chinji National Park
- ▶ Chumbi Surla Wildlife Sanctuary
- ▶ Diljaba Wildlife Sanctuary
- ▶ Arra & Parera Wildlife Sanctuary
- ▶ Malot Reserve Forest Wildlife Sanctuary
- ▶ Salt Range National Park
- ▶ Kussak Reserve Forest Wildlife Sanctuary
- ▶ Karangal & Drangan Wildlife Sanctuary
- ▶ Simbli Reserve Forest wildlife Sanctuary
- ▶ Noorpur Reserve Forest



Figure 23: (a). Chinji National Park (b). Punjab Urial in Chumbi Surla Wildlife Sanctuary (c). Arra Wildlife Sanctuary

Key Observation and Threats

- ▶ Mining and crushing units in protected areas, a cluster of coal mining in Salt Range National Park
- ▶ Land degradation stone localization in Arra and Sumbi Surla wildlife Sanctuary
- ▶ Forest fire incidence in Parrera Reserve Forest
- ▶ Invasive alien flora e.g., *Parthenium hysterophorus* and *Prosopis juliflora* throughout the region.
- ▶ Illegal hunting and poaching game birds like partridges by locals.

2.5.4. Attock Conservation Areas

Attock is the district bordering with Kohat district of KPK, where the habitat type is subtropical thorn forest with scrub forest type. In Attock, *Dodonia viscosa* and *Acacia modesta* are the dominant species along with associated flora includes *Acacia nilotica*, *Ziziphus nummularia*, *Prosopis juliflora*, *Parthenium hysterophorus*, and grasses. The notified protected areas of Attock i.e., Kala Chita National Park and Kheri Murat National Parks are the ground to key wildlife species. The wildlife protected areas are breeding ground to Grey Partridge, Black Partridge, See-see partridge, Chakur Partridge, wild hare, wild boar, porcupines, Punjab urial, jackals and fox. In District, approx. 685 square kilometre land under forest enactment of reserved forest, resumed forest and Section-38 forest land type.

These conservation areas are as follows:

- ▶ Kala Chita National Park
- ▶ Kheri Murat National Park
- ▶ Kherimer Reserve Forest
- ▶ Attock Reserve Forest
- ▶ Kawagar Reserve Forest
- ▶ Dhoke Jawanda Reserve Forest
- ▶ Dheri Chohan Reserve Forest
- ▶ Choi Reserve Forest
- ▶ Sojhanda Reserve Forest
- ▶ Dhoke Tohli Reserve Forest
- ▶ Minhali Reserve Forest
- ▶ Boota Reserve Forest
- ▶ Gulyal Reserve Forest
- ▶ Dani Reserve Forest
- ▶ Akhori Reserve Forest and others



Figure 24: (a). Kala Chitta National Park (b). Kheri Murat National Park (c). Dakhnair Attock Reserve Forest

Key Observation and Threats

- ▶ Illegal hunting, poaching and trading of game birds like partridges from Kheri Murat National Park by locals.
- ▶ Invasive alien flora e.g., *Parthenium hysterophorus* and *Prosopis juliflora* throughout the region.
- ▶ Water Resources unavailability in Kala Chitta and Kheri Murat National Park.
- ▶ Wood theft by the local for fuel wood collection.

2.6. Conservation Areas Diversity Analysis

The diversity analysis is the key to understand the habitat potential and their significance level to others habitat within the region. In Rawalpindi Region, different habitat and forest types are studied and their alpha diversity were recoded. The Shannon Diversity index is measured to evaluate the species diversity richness within each particular forest type on scale of 1 and above. Shannon diversity Index greater than 1 indicate that the area has diverse range of species whereas index value below 1 indicate the poor species richness. In Chakwal Arra and Diljaba Reserve Forest has the diversified plant species richness with stable plant community.

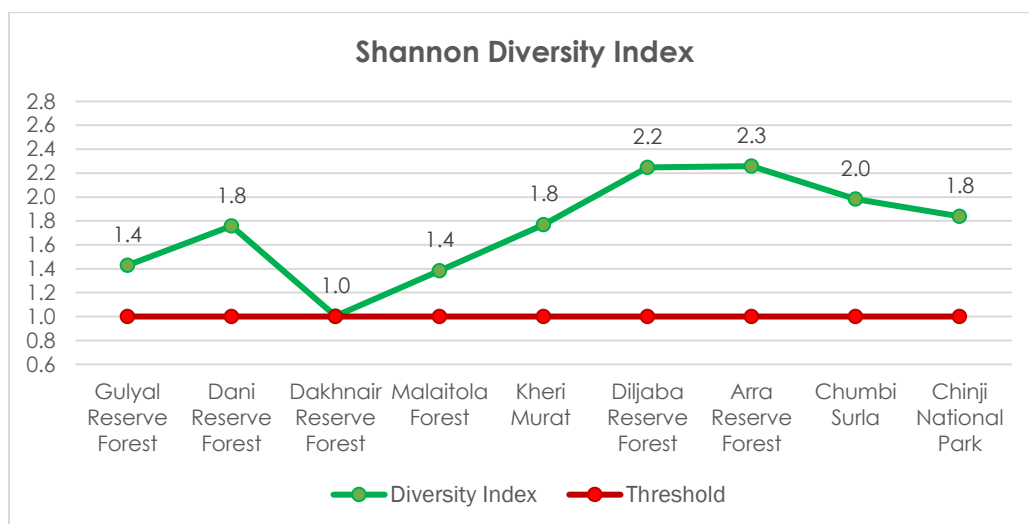


Figure 25: Shannon Diversity Index Analysis

2.6.1. Major Threats to Conservation Sites in Rawalpindi Region

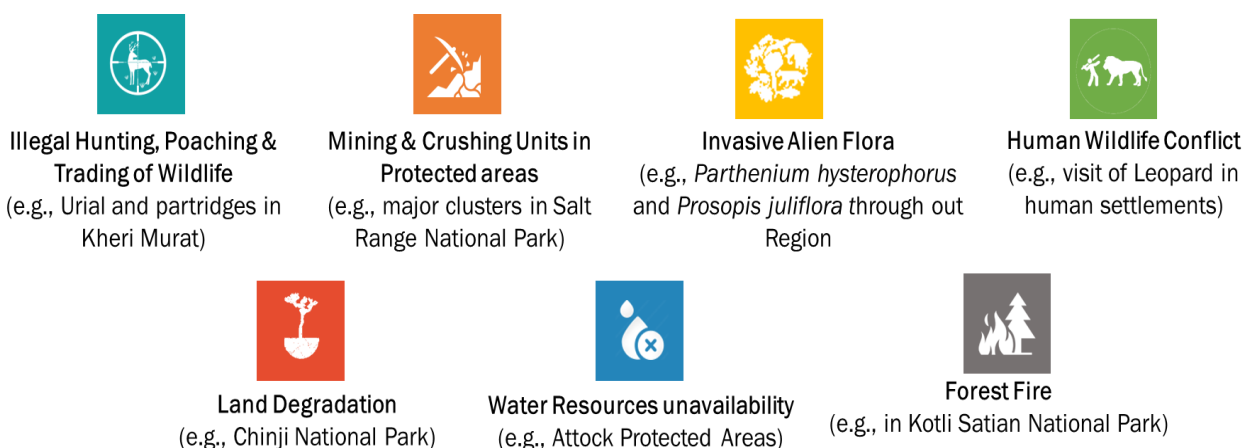


Figure 26: Major Threats to Conservation sites of Rawalpindi Region

03 | Legal Landscape

The constitution of Pakistan has substantially altered the allocation of legislative powers between the National and Provincial Assemblies, resulting in more Provincial autonomy. Powers have been assigned to provincial Environmental Protection Agencies/Departments (EPAs/EPDs) Some of the key national/provincial regulations that are considered related to the Regional Development Plan of Rawalpindi is enlisted below:

National Framework	Provincial Framework
▪ Pakistan Climate Change Act, 2017	▪ Punjab Environment Protection Act, 2017
▪ Forest Act, 1927	▪ Policy on Controlling Smog, 2017
▪ Pakistan Environmental Protection Act, 1997	▪ Punjab Environmental Protection (Delegation of Powers for Environmental Approvals) Rules, 2017
▪ National Climate Change Policy, 2012	▪ Punjab Hospital Waste Management Rules, 2014
▪ Framework for Implementation of Climate Change Policy, 2013	▪ Punjab Environmental Protection Motor Vehicle Rules, 2013
▪ National Sustainable Development Strategy, 2012	▪ Punjab Environmental Protection Administrative Penalty Rules, 2013
▪ National Disaster Risk Reduction Policy, 2013	▪ Regulation of Disclosure of Environmental Information and Citizen Engagement, 2020
▪ National Forest Policy, 2015	▪ Environmental Sampling Rules, 2001
▪ National Rangeland Policy, 2010	▪ Pollution Charge Rules, 2001
▪ Review of IEE / EIA Regulations, 2000	▪ Environmental Tribunal Rules, 2012
▪ National Conservation Strategy, 1992	▪ Punjab Forest Policy, 2019
▪ Biodiversity Action Plan for Pakistan, 2000	▪ Punjab Environmental Quality Standards (municipal and liquid effluents, drinking water, motor vehicles, ambient air, noise, treatment of liquid and disposal of biomedical waste and Industrial gaseous emission), 2016
▪ Guidelines for sensitive and critical areas, 1997	

04 | Vision, Goals & Objectives

4.1. Vision

A vibrant and internationally competitive region with sustainable development in a conducive environment whilst protecting and improving biodiversity where ecological resources are proficiently managed and conserved, cleaner environment, climate resilience and recreational facilities may be important indicators of the region's macro-level socio-economics.

4.2. Goals

To protect, conserve and retain the ecological values as well as sustainable development of the region for current and future generations, predominantly as a derivation of glory, inspiration, education, recreation and enhance the local community's livelihood.

4.3. Objectives

This plan helps to prioritize development projects at the regional level based on current conditions and future growth needs. Specific objectives of the plan are as follows:

- ▶ To identify potential projects & programs that can contribute to sustainable growth, environment protection, conservation, employment opportunities and exploit competitive benefits of the region.
- ▶ Improve the overall state of environment in the Rawalpindi Region.
- ▶ Project Prioritization and capacity needs to improve livability and competitiveness.
- ▶ Such a plan will fulfill a longstanding demand of local officials to have a document that can provide them with a strategic vision for the development of the region and have a voice in the overall planning process in the province.

05 Methodology

Rawalpindi Regional Development Plan for the Environment sector was developed to prioritize the most resilient and sustainable solutions for the mitigation of the baseline environmental issues. The plan focuses on adopting a combined approach of data collection from field visits and literature while involving all regional and provincial stakeholders (government organizations and local community) and using modern remote sensing technology for impact assessment on the ground scale. It provides a framework of interventions for environmental improvement, divided into short, medium, and long-term plans spanning from three to ten years. The methodology adopted for the purpose of this plan is given below:

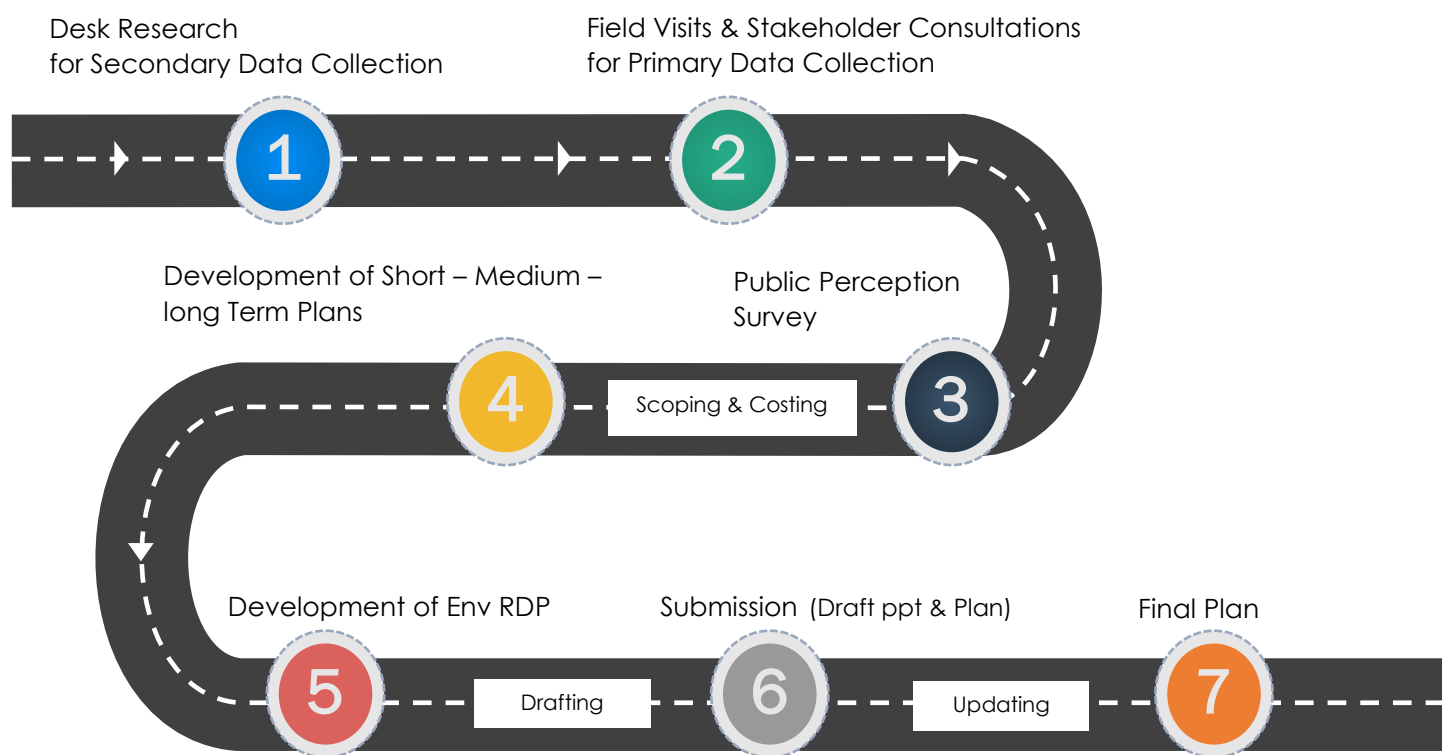


Figure 27: Methodology Map for Rawalpindi – RDP

5.1. Desk Research for Secondary Data Collection

A comprehensive desk research was conducted in order to understand the state of environment of the Rawalpindi Region during the past decade. Existing legal landscape, administrative and institution set-up, North Punjab ADP Schemes, relevant reports and journals as well as similar projects and programs executed in the previous years for the improvement of environmental conditions and green spaces were also assessed.

5.2. Primary Data Collection

5.2.1. Field Visits

For on-ground information, the team of experts consisting of environmental scientists, environmental engineers, biodiversity professionals, and archaeological experts from the Environment and Social Safeguards Division visited the Rawalpindi Region. Field Visits were conducted in three phases;

Inception Visit:

The inception visit of Rawalpindi region was conducted between July 15th, 2023 – July 17th, 2023 by the senior officials of the Environment Team. During this visit, meeting with key stakeholders which include; meetings with the Commissioner of Rawalpindi Region as well as Deputy Commissioners of Rawalpindi, Jhelum, Chakwal and Attock Districts were conducted.

Rapid Assessment Visit:

After inception visit, a team of experts from the Environment & Social Safeguards Team conducted Rapid Assessment Survey of Rawalpindi region between August 07th, 2023 – August 12th, 2023. During this course, a series of meeting with various stakeholders as well as Rapid assessment surveys of the major urban centers of Rawalpindi, Jhelum, Chakwal and Attock Districts were conducted.

The institutional hierarchies, inter-linkage of departments, key concerns of the stakeholders, and technical and capacity-building issues were identified during this survey. In addition, air quality and noise quality were monitored, key sources of air and water pollution were identified, and existing biological, cultural and archaeological conditions were also assessed in major urban centers of Rawalpindi Region. Apart from that, key areas of interventions for environmental improvement were also identified and documented.

Public Perception Survey/ Community Consultation:

The Environment & Social Safeguards Team also held a detailed Public Perception visit between August 21st, 2023 – August 26th, 2023. This survey mainly focused on assessing the concerns of local inhabitants regarding public and green spaces as well as existing environmental conditions. The community recorded their perception about current changes in the environmental quality over the years, sources of air and water pollution and causes of the negative environmental impacts due to development and construction activities in the region. All of these issues have been considered during the development of this regional plan in order to ensure the benefit of the community.

Stakeholder Consultation:

A total of 29 Consultation Meetings with key government officials in the Rawalpindi Region were conducted by the Environment & Social Safeguards team. During these meetings, the key concerns of relevant departments and suggestions for environmental improvements were documented. In addition, institutional capacities were also examined. All key stakeholders

provided complete support in the development of a practical and attainable regional development plan.



Figure 28: Stakeholder's Consultations – Rawalpindi Region



Figure 29: Field Visits & Public Perception Survey – Rawalpindi Region

5.2.2. Environmental Quality Assessment

Air Quality Assessment

Data of four air quality parameters (A₁, NO₂, SO₂ and CO) were downloaded from **Copernicus website** for year 2022, to analyze their spatial pattern over Rawalpindi Region.

Vegetation Cover Assessment

The NDVI dataset for the assessment of vegetation dynamics in the Rawalpindi Division is extracted from Landsat satellite data.

Table 5: Satellite data used to assess the vegetation dynamics in Rawalpindi Division

Sr. No	Division	Satellite/Sensor	Spatial Resolution	Year of Acquisition
1	Rawalpindi	Landsat 5 (ETM)	30m	2001-April
2		Landsat 7 (ETM+)		2009-May
3		Landsat 8 (OLI)		2016-May
4		Landsat 8 (OLI)		2023-April

5.3. Development of Short-Medium-Long term plan

Based on the exercise discussed above, schemes / projects were identified and prioritized for each district. This ten-year plan provides short term (up to 3 years), Medium Term (3 to 6 years) and long term (up to 10 years) projects focusing on improved service delivery, better environmental quality, enhanced climate resilience along with increased economic growth of the region.

5.4. Development of RDP Rawalpindi

Finally, a sectoral plan for Environment component was developed for Rawalpindi Region with a comprehensive investment Plan for the period of 10 years (2023-2033). Each project contains its title, cost, category (short/medium/long term) and mode of investment (Government / Donor / PPP).

5.5. Feedback visit

Consultation is an essential step to engage the multi-stakeholders and get their feedback and ownership in finalizing the project digest for the Rawalpindi Region. Therefore, a feedback visit will be conducted for final consent from the relevant department before submitting it to the Planning and Development Board, Government of Punjab.

06 | Regional Development Plan

6.1. Framework

Punjab is the most vibrant as well as the populous province of Pakistan. However, from past few decades the province has been facing challenges not only from the economic front but also from the ecological side. The Government of Punjab is well cognizant to the myriad problems that the province is facing. Therefore, in order to tackle these challenges Government of Punjab has taken series of initiatives and drafted various regulation/policies/strategies that address such issues (viz., rapid urbanization, unreliable service provision, low municipal service recovery, high environmental pollution and so forth) and create a regionally equitable economy across the province. As in the province, the public spending is distributed on the basis of administrative jurisdiction i.e., division (region), districts and tehsils, it is desired to consider spatial and socio-economic dimensions for improved service delivery and environmentally sustainable development at a macro scale

Keeping in view of all the facts; such as present challenges, risks, gaps, needs and priorities for future economic development, a Framework for Environment Sector of Regional Development Plan of Rawalpindi Region is designed. Each component of this framework is passed through a lens of existing infrastructure, governance and population factor. Comparative advantage is gained by using credible mapping resource and Geographic Information Systems (GIS) for spatial representation of relevant data along with current state of environmental conditions. Consultation is another keystone of the RDP drafting process which is done through meetings, data collection forms, field visits, planning exercises and feedback sessions. Finally, the framework is drafted which enlisting the priority projects at district level which are consolidated as one broader plan/project digest of Rawalpindi Region.

6.2. Project Digest/ Investment Plan

Based on the framework of regional development plan, desk review/secondary information, on-ground survey, perception and expectation survey, consultations with local community and meetings with local authorities, a Project digest is developed for Rawalpindi Region, which can also call as Investment Plan. These projects are divided based on their urgency / priority for a ten-year span and divided in to short, medium and long term.

The total cost of the environmental sector project digest for Rawalpindi Region is **Rs. 1,358.5 million**.

6.3. Proposed Projects

The proposed projects for the improvement of environmental values and biodiversity conservation of Rawalpindi Region are as follows:

A. Short – Term Plan (Up To 03 Years) Estimated

Sr. No.	Proposed Projects	Government Entity	Estimated Cost (PKR million)
1.	Rewilding of Animals		
	▪ Murree Kotli Satian Kahuta National Park, Rawalpindi (Barking Deer)	FWF	47.23
	▪ Tilla Jogian National Park, Jhelum (Punjab Urial)	FWF	47.23
	▪ Salt Range National Park, Chakwal (Chakwal)	FWF	47.23
2.	Reforestation		
	▪ Bajwala Forest – Jhelum (250 acres)	FWF	93.7
3.	Linear Plantation		
	▪ Along Rawat Industrial Estate Main Road, Rawalpindi (5kms)	FWF, Railways, Highways, MCs	5.2
	▪ Along Railway Line Taxila, Rawalpindi (3kms)		
	▪ Along Dubairan Road, Kallar Syedan, Rawalpindi (4kms)		
	▪ Along Kallar Byapss, Kallar Syedan, Rawalpindi (4kms)		
	▪ Along Chowk Akhteeb, Kallar Syedan, Rawalpindi (3kms)		
4.	Jhelum Riverside Walkways	MC	97.3
5.	Forest Parks –Development & Rehabilitation		
	▪ Rehabilitation of Lohi Bher Wildlife Park, Rawalpindi	FWF	156
	▪ Rehabilitation of Lehri Nature Park, Jhelum	FWF	156
6.	Development & Rehabilitation of parks and Green Spaces		
	▪ Rehabilitation of PIA Park, Kashmir Point Murree, Rawalpindi (2.55 acres)	PHA	6.8
	▪ Rehabilitation of Bagh-e-Shahidan Park, Kashmir point Murree near PHA Camp Office (4.98 acres)	PHA	13.2
	▪ Rehabilitation of Kashmir Children Park Sohawa, Jhelum (0.28 acres)	MCs	0.7
	▪ Rehabilitation of Ladies Park, Sohawa, Jhelum (0.35 acres)	MCs	0.9
	▪ Rehabilitation of Allama Iqbal Park, Pind Dadan Khan Jhelum (0.63 acres)	MCs	1.7

	Rehabilitation of Women Park, Talagang, Chakwal (2.48 acres)	MCs	6.6
7.	Installation of Air Quality Monitoring System (2 BAM & 50 Low cost equip)		
	- Rawalpindi District - Attock District	EPA	42.4
Total			722.2

B. Medium – Term Plan (Up To 05 Years) Estimated

Sr. No.	Proposed Projects	Government Entity	Estimated Cost (PKR million)
1.	Rewilding of Animals		
	Kheri Murat National Park, Attock (Punjab Urial)	FWF	47.23
	Chinji National Park, Chakwal (Punjab Urial)	FWF	47.23
	Jalalpur Sharif Wildlife Sanctuary, Jhelum (Punjab Urial)	FWF	47.23
2.	Kallar Kahar Lake – Rejuvenation	MC, FWF	7.4
3.	Dry Afforestation		
	Mamdot Forest – Chakwal (10 acres)	FWF	1.25
4.	Linera Plantation		
	Chakwal – Talagang Highway, Chakwal (38.2kms)	Highways	10.5
5.	Forest Parks –Development & Rehabilitation		
	Development of Punjar Forest Park, Rawalpindi	FWF	20.8
	Development of Kamra Forest Park, Rawalpindi	FWF	20.8
6.	Development & Rehabilitation of parks and Green Spaces		
	Development of Zia ul aloom park, Rawalpindi (0.72 acres)	PHA	2.0
	Development of Dhok kala khan Park, Rawalpindi (0.56 acres)	PHA	1.5
	Development of Gulzar-e- Quaid Park -III, Rawalpindi (0.5 acres)	PHA	1.3
	Development of Gulzar-e- Quaid Park -IV, Rawalpindi (0.5 acres)	PHA	1.3
	Development of Recreational Area/ Park, Taxila, Rawalpindi (2.37 acres)	PHA	7.6
7.	Installation of Air Quality Monitoring System (1 BAM & 25 Low cost equip)		
	Jhelum District	EPA	21.2
Total			237.34

C. Long – Term Plan (Up To 10 Years) Estimated

Sr. No.	Proposed Projects	Government Entity	Estimated Cost (PKR million)
1.	Rewilding of Animals		
	▪ Chumbi Surla wildlife Sanctuary, Chakwal (Punjab Urial)	FWF	47.23
	▪ Diljaba Reserve Forest wildlife Sanctuary, Chakwal (Punjab Urial)	FWF	47.23
	▪ Domeli Reserve Forest wildlife Sanctuary, Jhelum (Punjab Urial)	FWF	47.23
2.	Linera Plantation		
	▪ M-14 Motorway, Attock (23kms)	Highways	6.3
3.	Forest Parks –Development & Rehabilitation		
	▪ Development of Rakh Nakka Kahut Forest Park, Rawalpindi	FWF	65
	▪ Development of Dhan Gali Forest Park, Rawalpindi	FWF	20.8
4.	Development & Rehabilitation of parks and Green Spaces		
	▪ Development of Kallar Syedan Park, Rawalpindi (05 acres)	PHA	16.5
	▪ Development of Kallar Syedan Urban Forest Park, Rawalpindi (45 acres)	PHA	90
	▪ Development of Urban Forest, Taxila, Rawalpindi (3.77 acres)	PHA	10.0
	▪ Development of Jinnah Park Pind Dadan Khan, Jhelum (2.0 acres)	MC	16
	▪ MC Park Choa Saiden Shan, Chakwal (4.35 acres)	MC	11.5
5.	Installation of Air Quality Monitoring System (1 BAM & 25 Low cost equip)		
	▪ Chakwal District	EPA	21.2
Total			399

D. Proposed Interventions Map

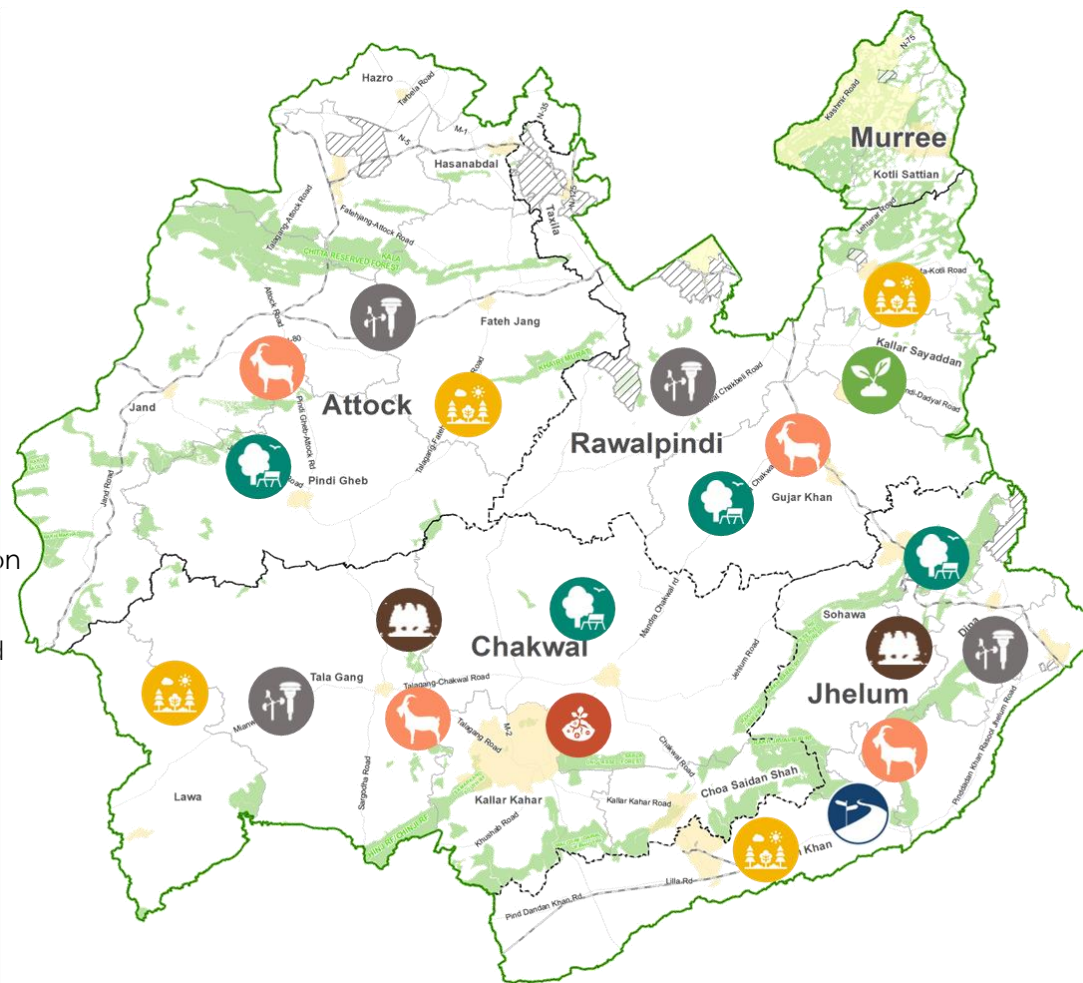


Figure 30: Proposed Interventions in Rawalpindi Region

6.3.1. PROJECT 1: Rewilding and Revival of Wildlife

Rewilding is an in-situ conservation strategy that aims to conserve ecosystem services and associated biodiversity by reintroducing the wild animal species that were predominantly threatened and decreased in region by human activities. The rewilding of animal species in protected areas of Rawalpindi division, can help to regulate ecosystems and return to stabilize their natural processes. Rewilding of Punjab Uril and Barking deer, both are native species of Rawalpindi Division, can help to regeneration and restoration of natural habitat and revival of associated biodiversity like predators within protected areas. These species may also serve in following ways:

- ▶ Rewilding will help to increase population size by lowering the threats and issues.
- ▶ It promotes seed dispersal to increase the ground cover within the protected areas.
- ▶ It promotes reshaping and restoration of naturalized forest.
- ▶ It helps to promote ecotourism and research facilities for researchers and wildlife lovers.
- ▶ It also helps to stabilize the forest ecosystem services.
- ▶ Rewilding of native species will also socialize the conservation and protection practice among local resident.



Figure 31: (a). Barking Deer (b) Punjab Uril

Proposed Sites

- ▶ Murree Kotli Satian Kahuta National Park, Rawalpindi (Barking Deer)
- ▶ Salt Range National Park, Chakwal
- ▶ Chinji National Park, Chakwal
- ▶ Tilla Jogian Nation Park, Jhelum
- ▶ Kheri Murat National Park, Attock
- ▶ Diljaba Reserve Forest wildlife sanctuary, Chakwal
- ▶ Chumbi Surla wildlife Sanctuary, Chakwal
- ▶ Jalalpur Sharif Wildlife Sanctuary, Jhelum
- ▶ Domeli Reserve Forest wildlife Sanctuary, Jhelum

Conceptual Design

- ▶ Establishing of 200 Acres in-situ captive grounds for rearing and grazing of animals.
- ▶ Reintroduction of 5 pairs of Punjab Urial per captive ground to increase the population size.
- ▶ Establishment of Veterinary and monitoring offices for wildlife management and post-rewilding care.
- ▶ Demarcation of Zoning i.e., core, buffer and transition for rewilding of animals.
- ▶ The proper tagging and monitoring of animals within the protected areas.
- ▶ Community engagement through Community-Based Organizations.
- ▶ Trophy hunting on an International Scale through the Punjab Urial Conservation, Protection and Trophy Hunting Rules, 2016.

Estimated Cost

MRS	Item No	Description	Unit	Qty	Rate (Rs)	Amount (Rs)
Ch:- 26/42-ii	1	Barbed Wire Fencing				
		Providing and fixing barbed wire fencing, with 4 horizontals and two cross wires, with R.C.C. 1:2:4 posts, 5.5'x6"x9" (1.68mx150mmx225 mm) at 8 ft. (2.45 m) centre to centre, reinforced with 4 No. 3/8" (10 mm) dia vertical bars and 1/8" (3 mm) dia stirrups 12" (300 mm) centre to centre, complete in all respects.				
		ii) in cement concrete 1:4:8 base of size 12"x12"x21" (300x300x525 mm).	100Rf t.	18,504.84	66,352.70	12,278,460.97
	2	Office				
		Construction of Admin office	LS	1.00	10,880,000.00	10,880,000.00
		Construction of Monitoring office	LS	1.00	8,704,000.00	8,704,000.00
		Construction of veterinary office	LS	1.00	5,440,000.00	5,440,000.00
	3	Animals				
		Urial (Male)	Each	5.00	133,600.00	668,000.00
		Urial (Female)	Each	5.00	200,400.00	1,002,000.00
		Barking Deel (Male)	Each	5.00	35,400.00	177,000.00
		Barking Deel (Female)	Each	5.00	63,500.00	317,500.00
Sub Total Amount						39,466,961
Add 2% Contingency Charges						789,339.22
Add 5% PST						1,973,348.05
03 Year O&M Cost						5,000,000.00
Total Amount R. s						47,229,648.24
Millions						47.23

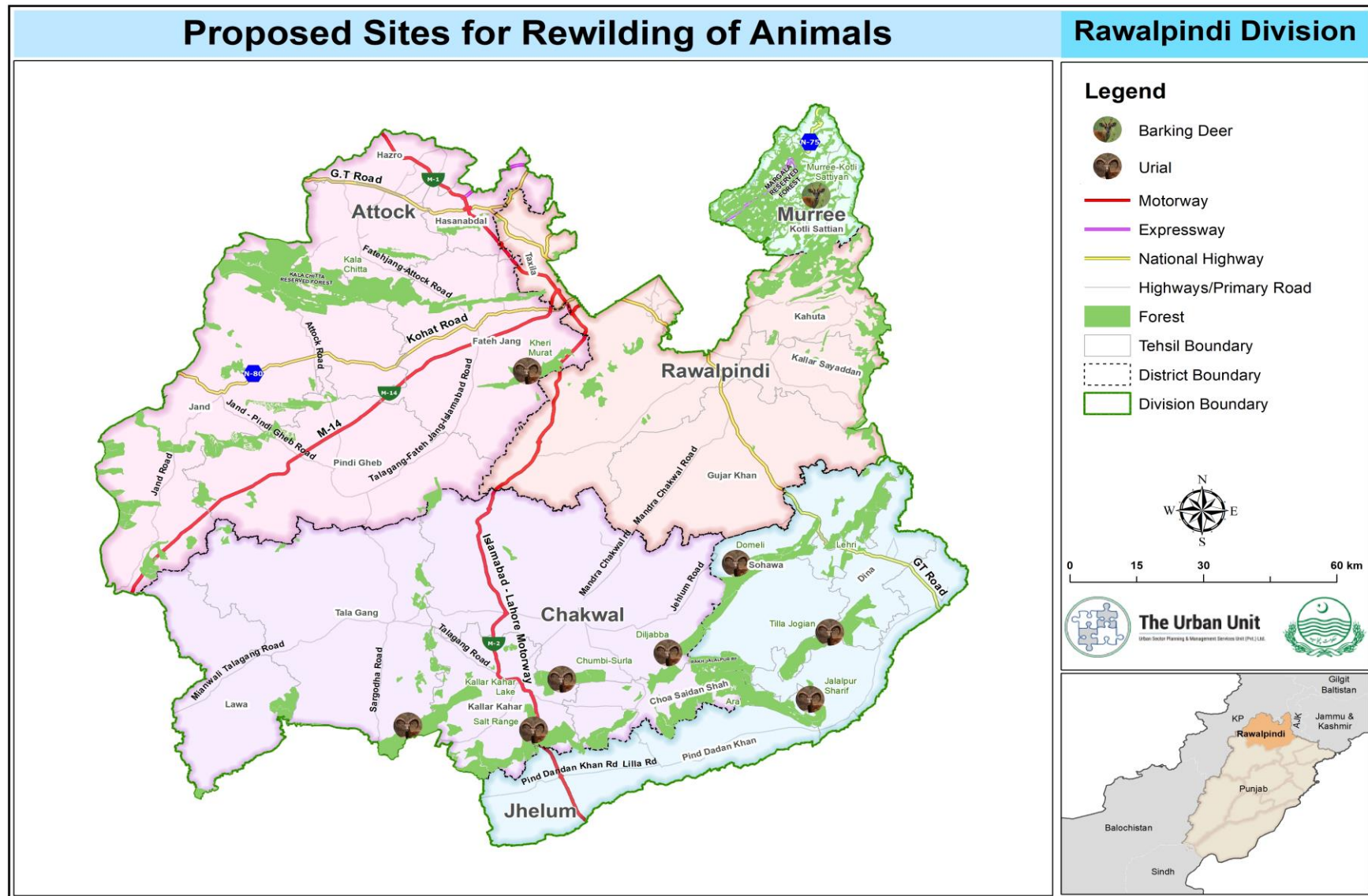


Figure 32: Proposed Sites for Rewilding of Animals

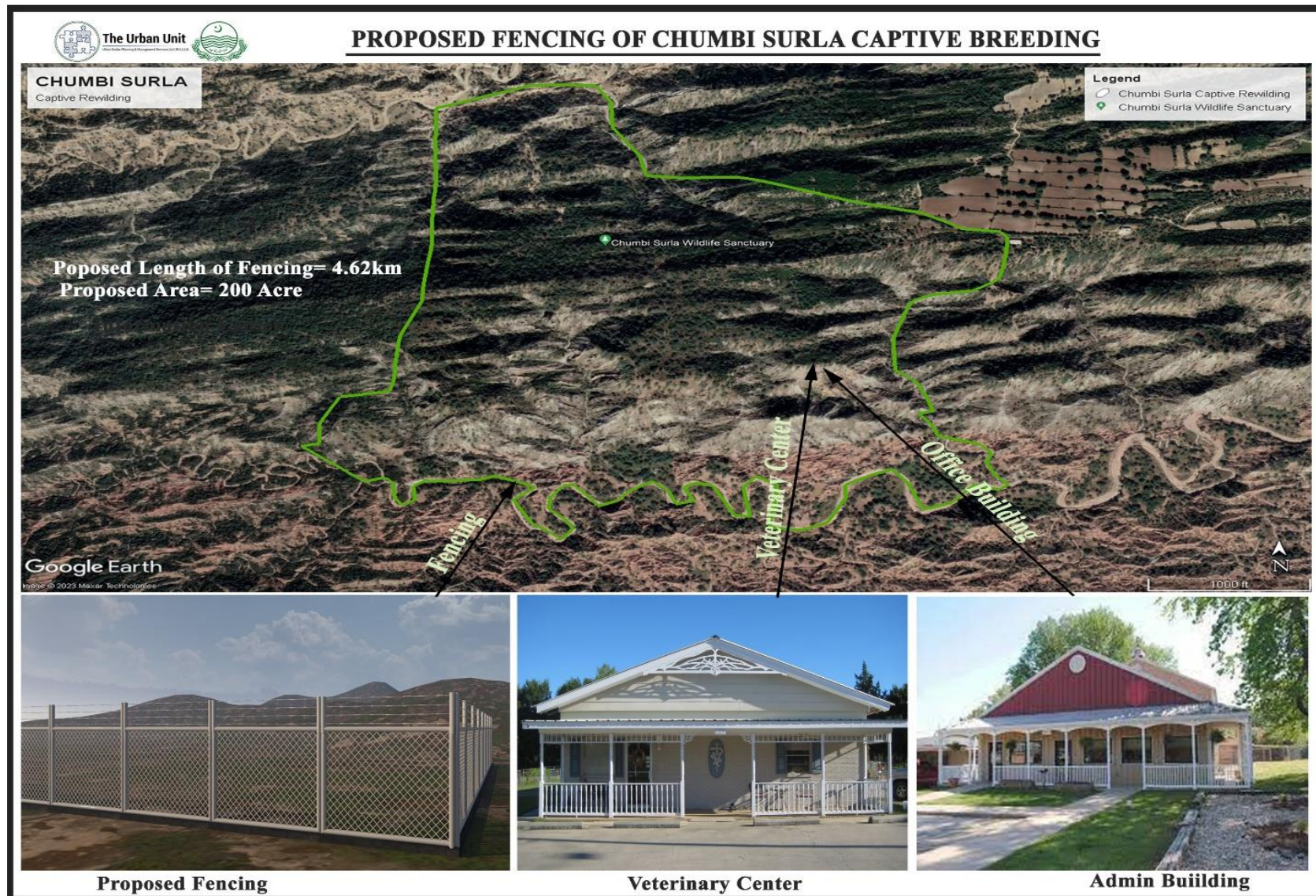


Figure 33: Proposed Conceptual Design for Rewilding of Animals

6.3.2. PROJECT 2: Kallar Kahar Lake Rejuvenation Project

Kallar Kahar Lake is located in Tehsil Kallar Kahar of district Chakwal, at an elevation of 556 a.s.l. and spans 1.33 km² of area. The lake is present in the Slat Range Nature Complex, which is a designated protected area. The lake is fed by streams flowing from the hills of mountains. However, the lake is facing environmental degradation, due to untreated wastewater discharge, tourism activities, increased sedimentation, deforestation, and mining activities in the catchment areas. Literature studies indicate the increase in eutrophication of the lake evidenced by the low concentrations of DO (<3 mg/l), high BOD (810 mg/l), and high COD (2,044 mg/l) in its water. In addition, elevated ecological risk has been reported from the increased concentrations of heavy metals in the lake sediments³⁶.

The proposed project aims to conserve the biodiversity value, ecosystem services value, and economic value of the Kallar Kahar Lake through SWAB (Scientific Wetlands with Active Biodigester) based bioremediation system, restoration of walking trail along the lake, and introduction of recreational activities. SWAB treatment involves decontamination of water through a combination of layers formed from gravel and plants. The details of the project are discussed below;

Proposed Sites:

- ▶ Coordinates: 32.7759286°N 72.7117928°E
- ▶ Gravel Bed Location: 32.769869° N 72.708337° E



Figure 34: (A): Lake View; (B): Walking Track

³⁶ Javed, T., Ahmad, N., Mashiatullah, A., & Khan, K. (2021). Chronological record, source identification and ecotoxicological impact assessment of heavy metals in sediments of Kallar Kahar Lake, Salt Range-Punjab, Pakistan. *Environmental Earth Sciences*, 80, 1-18.

Scope:

- ▶ Bio-remediation of Lake through SWAB Treatment
- ▶ Designated Bird-Watching Sites
- ▶ Restoration of Walking Trail
- ▶ Installation of Gazebos
- ▶ Complete ban on Motor Boats and replace them with manual boats to avoid pollution
- ▶ Ban all types of boats in the lake during the season of migratory birds.
- ▶ Allocating fines for littering, increasing the number of boats, and wastewater drainage in the lake.

Components:

SWAB Treatment System

- ▶ Dimensions of Gravel Bed
 - Length: 25 m, Width: 10.11m, Depth: 2.0 to 2.6m;
 - No. of chambers: 5;
 - Filler stone aggregate of nominal size of 200 to 300mm over a depth of 77cm, 100mm over a depth of 38cm, 80mm over a depth of 115cm;
 - Five manholes for sewage collection;
 - 200mm sewage collection pipe;
- ▶ Bird Watching Tower
- ▶ Gazebo
- ▶ Walking Trail

Proposed Plantation:

- ▶ *Pistia stratiotes* (Water Lettuce)
- ▶ *Nelumbo nucifera* (Indian Lotus)
- ▶ *Lemna minor* (Duckweed)
- ▶ *Typha domingensis* (Cat tail)
- ▶ *Phragmites australis* (Common Reed)

Conceptual Design:

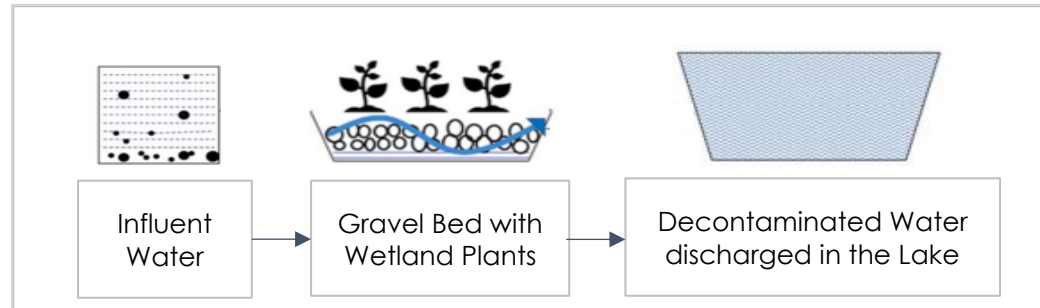


Figure 35: Schematic Diagram of SWAB Treatment



Figure 36: Conceptual Illustration

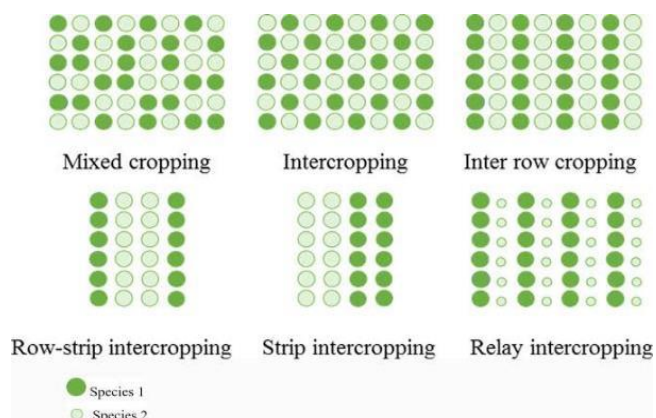
6.3.3. PROJECT 3: Reforestation and Dry Afforestation

Forest plantations in any area have a primary objective to increase the forest cover by planting trees on barren lands, degraded areas and other suitable sites of forest land. Forest plantations help to improve native tree species richness that is suitable to the local climate, soil conditions, and ecological requirements. Forest plays a significant role in conserving the biodiversity of any region, the scope of forest plantation includes the selection of tree species that support local biodiversity, provide habitat for wildlife and contribute to ecological services.

Planting diverse tree species and creating forest corridors can help maintain connectivity between habitats and support the survival of various plant and animal species. Forest plantation is an important step towards environmental stability, which contributes to carbon sequestration and helps to mitigate climate change. Forest plantations will also be focused on mitigating key issues like deforestation by replanting trees in areas that were once covered by forests but have now been degraded due to human activities or natural causes.

Conceptual Design:

- ▶ The seedling plantation and seed dispersal for dry afforestation should be based on mixed indigenous plantation to attract and conserve the wild diversity of the region.
- ▶ The species selection based on indigenous plant species which are native to the division includes:
 - *Acacia modesta* (Phulai)
 - *Acacia nilotica* (Kikar)
 - *Ziziphus nummularia* (Beri)
 - *Dodonia viscosa* (Snatha)
 -



Estimated Cost:

Sr. #	Site	Description	Unit	Qty	Rate (Rs)	Amount (Rs. Million)
1	Reforestation at Bajwala Forest – Jhelum (250 acres); Mixed Seedling plantation	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering completes in all respect.	No's of Plants	187,500	400.00	93.75
2	Dry Afforestation at Mamdot Forest – Chakwal (10 acres); Mixed Native plant seed dispersal	Providing of seeds, the cost of dispersal, pitting and digging, complete in all respect.	Acres	10	400.00	1.25
Total Amount						95.00

6.3.4. PROJECT 4: Linear Plantation for Green Corridor

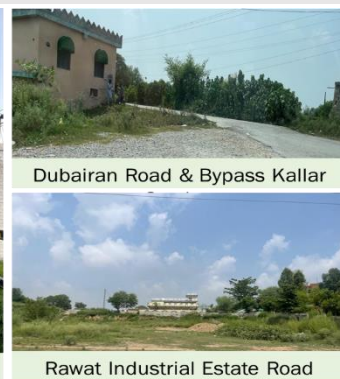
The networks of linear corridor which are connecting pathway among green belts, green spaces and linear plantation along roads, canals and tracks are designed to improve the environmental qualities of the district. Green corridors are especially beneficial for regional biodiversity as they create cool air pathways that cool cities and improve air quality. Additionally, green corridors help to improve the aesthetic view of highways and offer locals recreational opportunities. In order to improve the environmental values of division, the networks of linear green corridors are need of districts to frequently developed along green belts and increase the green infrastructure.

Proposed sites

- ▶ Rawat Industrial Estate Main Road, Rawalpindi: 5kms (2250 Plants)
- ▶ M-14 Motorway: 23 km (10350 Plants)
- ▶ Chakwal-Talagang Highway: 38.2 km (17190 Plants)
- ▶ Railway Line, Taxila: 4.1 km (1845 Plants)
- ▶ Dubairan Road: 4 km (1800 Plants)
- ▶ Kallar Bypass: 4 km (1800 Plants)
- ▶ Chowk Akhteeb: 4 km (1800 Plants)



Railway Track, Taxila



Rawat Industrial Estate Road

Proposed Species for Plantation:

- ▶ Acacia modesta (Phulai)
- ▶ Acacia nilotica (Keekar)
- ▶ Ziziphus nummularia (Beri)

Conceptual Design:

- ▶ The green corridor should be a connected network of green cover and green spaces to achieve the basic aim of the project.
- ▶ The plantation along water channel should be planned and based on stratification to enhanced the beauty of the region.
- ▶ Number of rows based on the availability of spaces along the planting area.
- ▶ The placement of vegetation around developments and the maintenance of larger, interconnected green spaces throughout regions should be done to promote air quality improvement.

Estimated Cost:

Sr. #	Site	Description	Unit	Qty	Rate (Rs)	Amount (Rs. Million)
1	Along Rawat Industrial Estate Main Road, Rawalpindi (5kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering completes in all respect.	No's of Plants	2250	500.00	1.125
2	Along Railway Line Taxila, Rawalpindi (3kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	1350	500.00	0.675
3	Along Dubairan Road, Kallar Syedan, Rawalpindi (4kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	1800	500.00	0.9
4	Along Kallar Byapss, Kallar Syedan, Rawalpindi (4kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	1800	500.00	0.9
5	Along Chowk Akhteeb, Kallar Syedan, Rawalpindi (3kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	1350	500.00	0.675
6	Chakwal – Talagang Highway, Chakwal (38.2kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	17190	500.00	8.595
7	M-14 Motorway, Attock (23kms)	Providing and planting of trees including the cost of pitting, digging, fertilizer, watering complete in all respect.	No's of Plants	10350	500.00	5.175

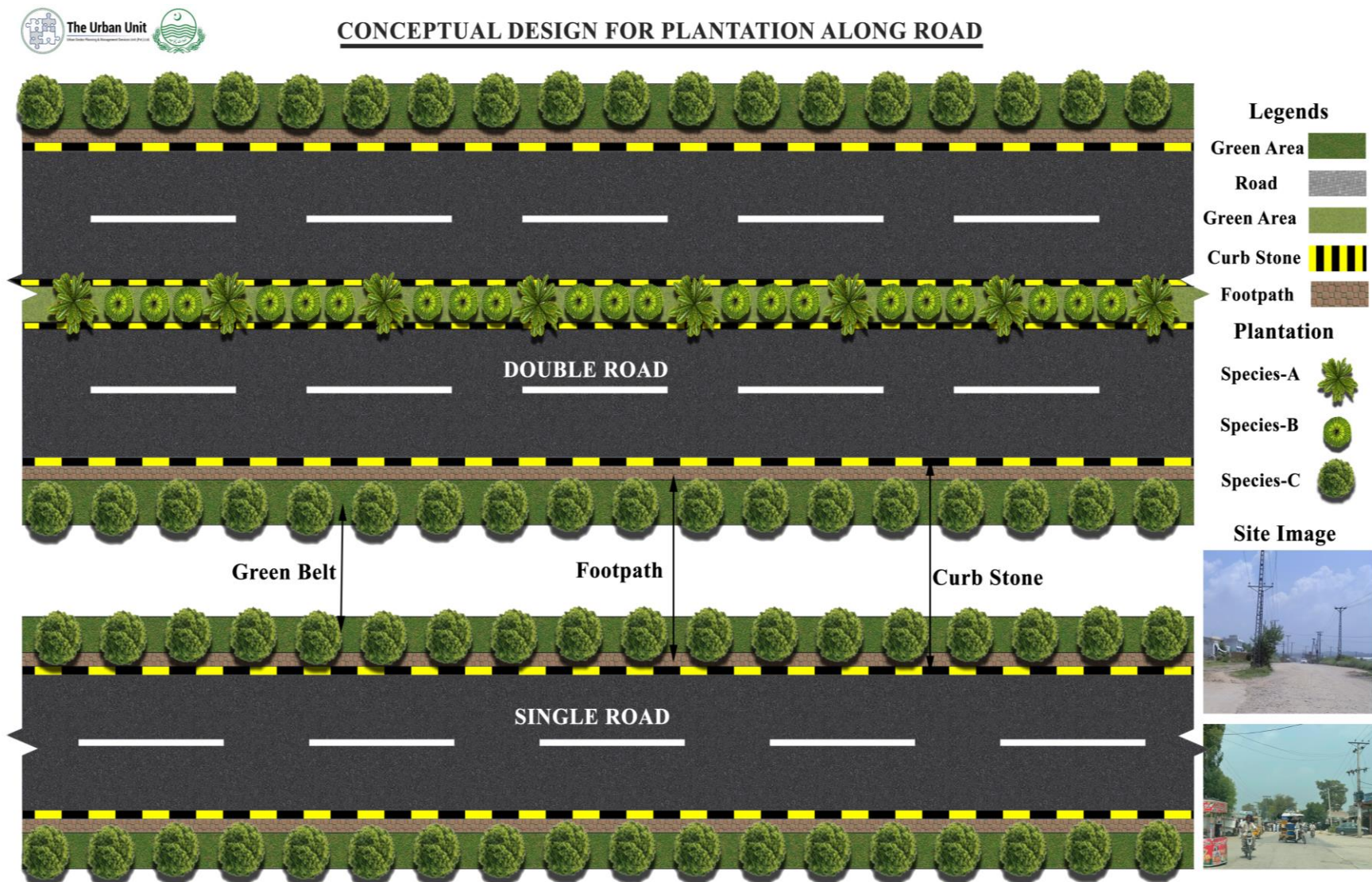


Figure 37: Conceptual Design for Linear Plantation along Road



Conceptual Design For Forest Plantation Along Railway Line



Figure 38: Conceptual Design for Linear Plantation along Railway Lines

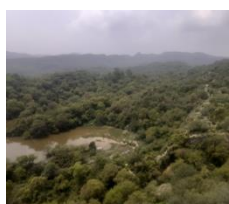
6.3.5. PROJECT 5: Forest Park Development & Rehabilitation

The Forest Park is a recreational and diversified natural area where the socialization of forest with regulation of significant ecological values and climatic condition. A forest park helps to promote urban forestry and also helps to stabilize air quality while mitigating the impacts of climate change. A land area with tree cover within urban centre is the key habitat for urban biodiversity and helps to conserve in rapidly urbanized area. Forest Park also serve as a mitigation to climate change to reduce the presence of pollutants and particulate matter through air filtration, enhanced oxygen production, and improve aesthetic look of the urban centre by natural environment stabilization.

Forest Parks or green space also provides recreational opportunities and promote the physical activities for children to improve mental health. Moreover, forest parks serve as tourist attractions and vital to enjoyable and sustainable urban environment.

Proposed Sites:

- ▶ Development of Punjar Forest Park, Rawalpindi
- ▶ Development of Kamra Forest Park, Rawalpindi
- ▶ Development of Dhan Gali Forest Park, Rawalpindi
- ▶ Development of Rakh Nakka Kahut Forest Park, Rawalpindi
- ▶ Rehabilitation of Lohi Bher Wildlife Park, Rawalpindi
- ▶ Rehabilitation of Lehri Nature Park, Jhelum



Contaminated Pond



Broken Gazebo



Damaged Bird Cages



Vegetation loss due to water scarcity



Poor Condition of Walking Trail



Absence of Benches in Sitting Area

Scope:

- ▶ Provision of Recreational Facilities
- ▶ Improved the social forestry
- ▶ Improved Ecosystem Services
- ▶ Climate change mitigation
- ▶ Improved human-biodiversity interaction

Conceptual Design:

- ▶ The park with the provision of softscape including arboretum, Grassy lawns, Lakes, Rose Garden, and scattered plantation.
- ▶ The Plantation of park includes indigenous, ornamental, medicinal, flowering and fruiting plants to attract faunal diversity especially avifaunal of the region.
- ▶ The hardscaping component of park includes forest trail, animal enclosures, swing area, admin office, parking area, toilet block, jogging track and cycling track to enhance recreational and public use opportunities.

Estimated Cost:

Sr. No	Description	Amount in PKR	Millions
1	Construction of Walking Trail	3,260,668.57	3.26
2	Construction of Brid Cages	105,332.94	0.11
3	Construction of Butter Fly House	4,549,204.48	4.55
4	Construction of Information Center/ Cafeteria	8,423,447.26	8.42
5	Construction of Toilet Block (Women and Men)	1,561,045.19	1.56
6	Construction of Parking Area	16,166,353.14	16.17
7	Construction of Admin Office	5,477,071.30	5.48
8	Construction of Rose Garden	2,933,663.17	2.93
9	Construction of Lake	15,988,278.86	15.99
10	Construction of Natural Soil	7,750,130.06	7.75
11	Plantation (Arboretum, Fruticetum, Orchidarium & Scatter Plantation)	2,701,687.50	2.70
	Sub- Total Amount	68,916,882.46	68.92
	Add Contingencies Cost (2.5%)	1,722,922.06	1.72
	Add PST (5%)	3,445,844.12	3.45
	Grand Total Amount with Contingencies and PST	74,085,648.65	74

CONCEPTUAL DESIGN FOR RAKA NAKKA FOREST PARK



Figure 39: Conceptual Design for Development of Raka Nakka Forest Park, Rawalpindi



REHABILITATION PLAN FOR LOHI BHER NATIONAL PARK



Figure 40: Conceptual Design for Rehabilitation of Lohi Bher National Park, Rawalpindi

CONCEPTUAL DESIGN FOR PUNJAR FOREST PARK



Figure 41: Conceptual Design for Development of Panjar Forest Park, Rawalpind

6.3.6. PROJECT 6: Development & Restoration of Urban Parks & Green Spaces

Urban parks are designated open areas, typically characterized by a prevalence of vegetation and water features, and are typically set aside for public use. These parks play a significant role in urban amenity green spaces and serve as crucial yardsticks for assessing the sustainability of cities.

The presence of green spaces within urban areas is instrumental in promoting sustainable urban planning. Conversely, haphazard urban expansion with limited green or open public spaces not only undermines the sustainability of an area but also has adverse effects on human health and well-being.

Prioritizing the establishment of urban green spaces is a major focus in creating cities that are pleasant to live in. The total count of green spaces within a city serves as a pivotal indicator of a city's sustainable urban ecosystem and the overall quality of urban life.

Scope of the Project

The scope of the project aims to provide the following facilities in the parks:

- ▶ Children's Play Area
- ▶ Gazebos
- ▶ Walking Track & Pathways
- ▶ Drinking Water faucets Fountain
- ▶ Rest areas/washrooms
- ▶ Parking area
- ▶ Cafeteria
- ▶ Benches

Proposed Site for Development of New Parks:

- ▶ 08 Parks – Rawalpindi District
- ▶ 01 Park – Jehlum District
- ▶ 1 Park – Chakwal District

Proposed Site for Restoration & Improvement of Parks:

- ▶ 03 Parks – Jehlum District
- ▶ 02 Parks – Murree District
- ▶ 01 Parks – Chakwal District



Park space in Kallar Syedan



PIA Park, Murree



Shaheedan Bad Park,
Murree



Women & Children Park,
Talang

Conceptual Design for Parks



CONCEPTUAL DESIGN FOR PUBLIC PARK-KALLAR SYEDAN

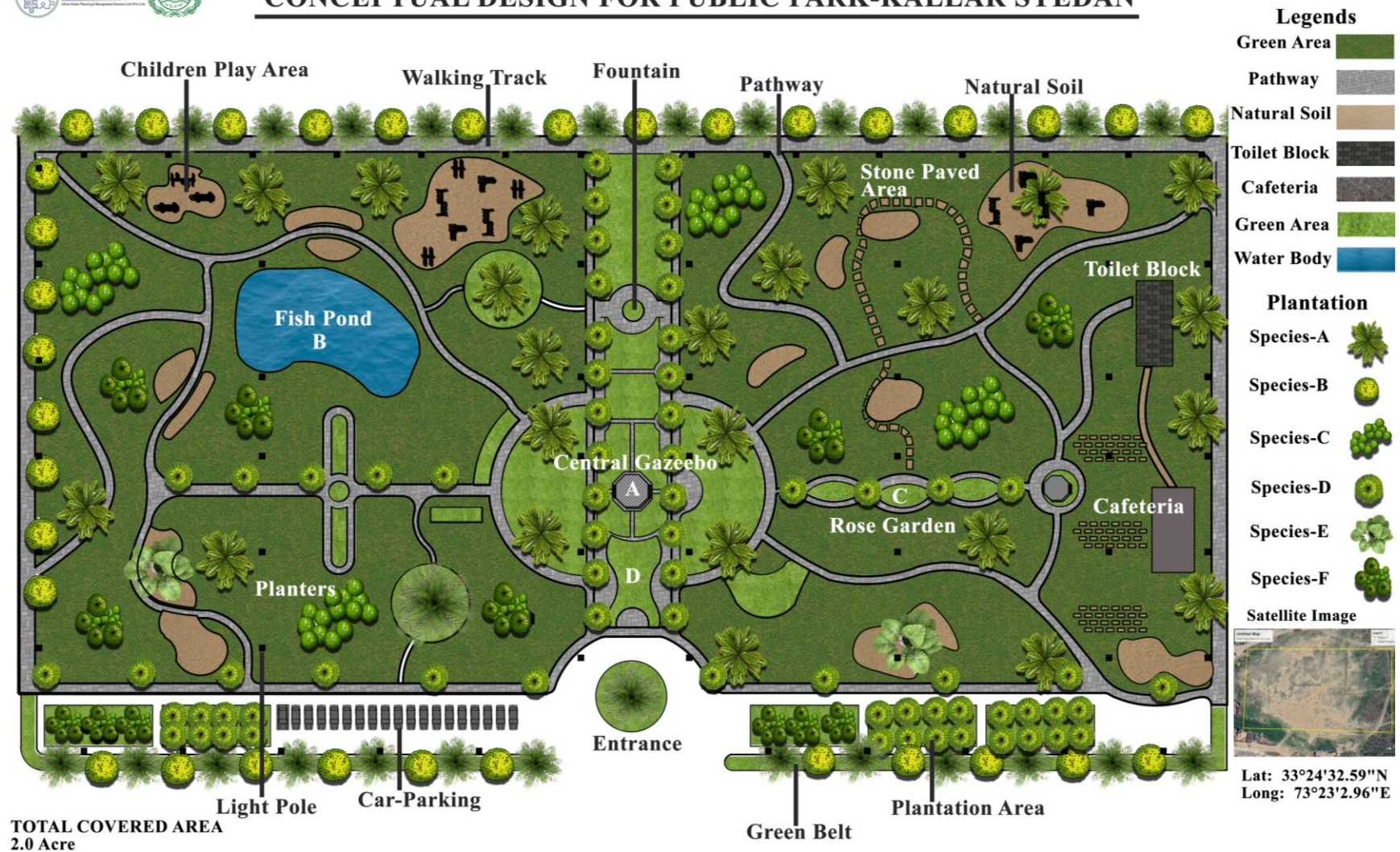


Figure 42: Conceptual design of Kallar Syedan Park



CONCEPTUAL DESIGN FOR REHABILITATION OF JINNAH PARK



Figure 43: Conceptual Design of Rehabilitation of Jinnah Park

6.3.7. PROJECT 7: Themed Jhelum River Walkway

Sustainable development strategies are immediately required to stop catastrophic ecological degradation in our metropolitan environments as the global population keeps growing and the population of cities increases. Rivers play a significant role in stabilizing the viable ecosystem by serving as ecological corridors, which are narrow stretches of habitat that link the wildlife and sustain environmental coherence through blue and green landscapes. River connects city sites and wildlife populations with their rural counterparts.

Jhelum riverside area strip of 6.5km is an unused area adjacent to Jhelum city. There is plenty of scope to design a river corridor having an information center, walkways, and cycling track within the realistic constraints of an urban setting. The existing open space seeks to address the development of an ecological corridor along the riverside and to conserve the ecology of the area. This ecological restoration and accessibility intervention aims to transform the Jhelum River into a blue and green landscape which benefits the local population of the area and sustains future growth for the Jhelum District.

Scope of work

The blue and green landscape Jhelum River walkway area is an open space plan that developed concepts for:

- ▶ the open green space along the city and Jhelum
- ▶ the prevention from floods
- ▶ the integration of active sustainability, biodiversity and resilience

Benefits:

- ▶ Improvement of Local Environment
- ▶ Improved Ecosystem Services
- ▶ Improved human-biodiversity interaction

Proposed Area

- ▶ 6.5 Km along Jhelum River and Jhelum City



Figure 44: Project Site Along River Jhelum

Conceptual Design

Untitled Map
Write a description for your map.

River Embankments
Jhelum River

Level 3
Level 2
Level 1
Ground Level

Benches
Planters
River walkway
Canteen
Office
Entrance for level 3
Entrance for level 2
Entrance for level 1
Parking Area
Primary Road

Project City: Jhelum
Total Covered Area: 2 Acre

Green Zone
Pedestrian Zone
Cycling Track
Green Zone

10 Feet wide
4 Feet wide
6 Feet wide

Footpath

Google Earth
Write a description for your map.

Visitors Facilities
Walkways with Cycling Track
Walking Trails
Gazebo

Key Features:
1- Total Length of Proposed Walways = 4km
2- Total Area of Visitor Facilities = 2acre

Legend

- Feature 1
- Feature 2
- Govt. Post Graduate College Jhelum
- Hospital Jhelum
- Jhelum Embankment Area
- Khanda Chowk
- Pakistan
- Shadpur Shareef
- U Mart

LIMITS OF DIST. (GRASS) 8'
VERTICAL CLEARANCE
TRAIL SURFACE
6" PREFERRED SEPARATION BUFFER FROM EDGE OF TRAIL SURFACE
3'
TYPICAL TRAIL WIDTH 6'
SUB BASE
BASE
3'
PLANTS AND TREES RECOMMENDED
TRAIL SURFACE EDGE
TRAIL SURFACE 8'-0" WIDE
SEPARATION BUFFER ZONE FROM EDGE

Figure 45: Conceptual Design for River walkways Along River Jhelum

6.3.8. PROJECT 8: Installation of Air Quality Monitoring Equipment

Nowadays, mega cities across the globe are facing major problem of deteriorating air quality which is impacting the ecosystem, human health, and economy. Unplanned urbanization, industrialization and traffic congestions are major contributors to air pollution in both developing and developed countries. Air quality monitoring is an important factor in enabling effective monitoring decision-making on-air quality issues. One of the biggest challenges in air quality management is proper access to air quality data. The Pakistani government has started to respond to this air pollution challenge. The proposed project is to establish an air quality monitoring system in major hotspots of Pollutant concentration in the Rawalpindi Division.

Scope of Project

The project aims to record air pollutant concentrations (PM_{2.5}, PM₁₀) in each district of the Rawalpindi Division.

Proposed Areas

- ▶ Rawalpindi City
- ▶ Attock
- ▶ Jehlum
- ▶ Chakwal

Air Quality Monitoring Equipment

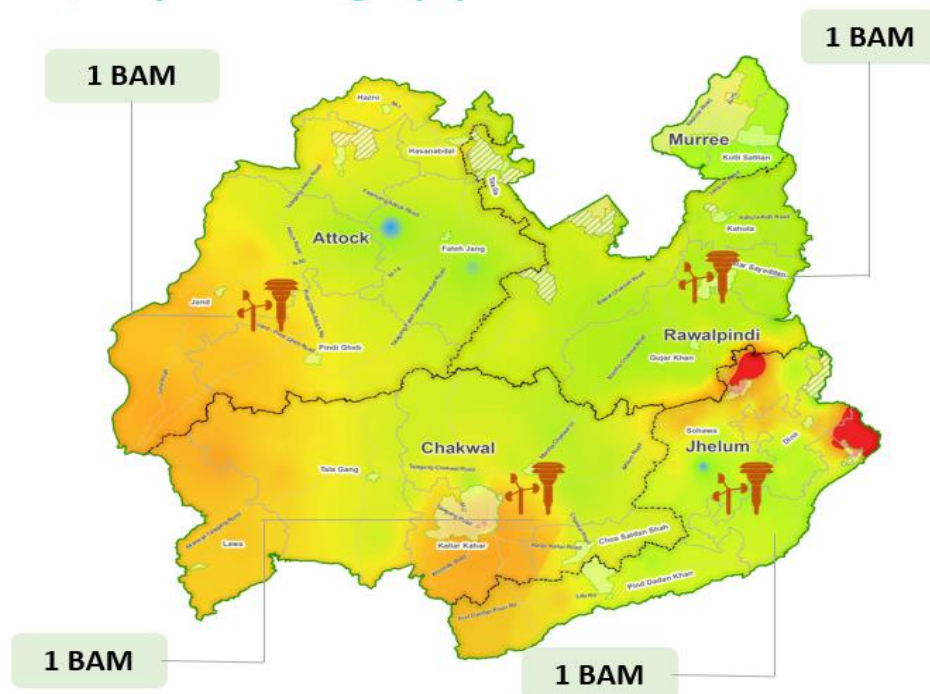


Figure 46: Proposed Areas for Standard Air Quality Equipment

Activities

Installation of air quality monitoring equipment (US-EPA Approved BAM 1025) and low-cost sensors in hotspot areas of Rawalpindi Division.



**Low Cost air
quality equipment**



The Urban Unit

Urban Planning & Management Services for Punjab



TheUrbanUnit



urbanunitGop



urban_unit



urban-unit

503 - Shaheen Complex, Edgerton Road, Lahore - Pakistan

☎ 042-99205316-22

📠 042-99205323

✉ uspmu@punjab.gov.pk

🌐 www.urbanunit.gov.pk