Comprehensive Analysis of Climate-Related Terrains in Pakistan for Climate Change Mitigation and Disaster Risk Management

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Abstract
Pakistan, despite contributing less than 1% to global greenhouse gas emissions, ranks among the most climate-vulnerable countries worldwide due to its diverse geography and exposure to extreme weather events. This study adopts a regionally differentiated, terrain-based approach to assess climate change impacts and develop localized mitigation and disaster risk management strategies across the six administrative regions—Balochistan, Punjab, Sindh, Khyber Pakhtunkhwa (KP), Gilgit-Baltistan (GB), and Azad Jammu and Kashmir (AJK). It identifies ecological vulnerability, hydrological sensitivity, and climatic exposure as key criteria to map climate-relevant terrains. Rising temperatures, glacial melt, floods, droughts, and cyclones are examined alongside adaptive strategies such as renewable energy, sustainable agriculture, and ecosystem restoration. The study aligns its recommendations with Pakistan's National Climate Change Policy, the Sendai Framework for Disaster Risk Reduction, and updated Nationally Determined Contributions (NDCs), emphasizing the need for global support and local action to enhance national resilience.

Key Points

- Pakistan is highly vulnerable to climate change, ranking fifth globally, despite low greenhouse gas emissions.
- Its diverse terrains, from deserts to mountains, face unique climate challenges across Balochistan, Punjab, Sindh, Gilgit-Baltistan (GB), Khyber Pakhtunkhwa (KP), and Azad Jammu and Kashmir (AJK).
- Mitigation strategies include renewable energy, sustainable agriculture, and afforestation, tailored to regional needs.
- Disaster risk management focuses on early warning systems, infrastructure improvements, and community resilience.
- The study covers major terrains in each region.
- International support is crucial due to Pakistan's minimal contribution to global emissions.

Key words: Pakistan, climate change, vulnerability, mitigation, resilience, emissions, regions, GB, Kashmir, Punjab, Islamabad, Sindh,

Overview

Pakistan faces growing challenges due to climate change, including extreme weather events, glacial melt, rising temperatures, droughts, and floods. A regionally differentiated terrain-based approach is vital to develop effective climate change mitigation and disaster risk management (DRM) strategies. This study identifies climate-relevant terrains across the six administrative units of Pakistan—Balochistan, Punjab, Sindh, Khyber Pakhtunkhwa (KP), Gilgit-Baltistan (GB), and Azad Jammu & Kashmir (AJK)—to assist in localized policy responses. The study uses terrain typologies based on ecological vulnerability, hydrological sensitivity, and climatic exposure. Policy recommendations are made to align disaster resilience strategies with Pakistan's National Climate Change Policy and the Sendai Framework for Disaster Risk Reduction.

Pakistan's varied geography, including arid deserts, fertile plains, coastal zones, and high mountains, makes it one of the world's most climate-vulnerable countries. Each region—Balochistan, Punjab, Sindh, GB, KP, and AJK—has distinct terrains that face specific climate change impacts like droughts, floods, and glacial melt. Strategies to address these challenges include shifting to renewable energy, adopting sustainable farming, and restoring ecosystems. Disaster preparedness involves early warning systems, stronger infrastructure, and community training to reduce risks from floods, heatwaves, and landslides.

Climate Change Impacts

Climate change brings rising temperatures, changing rainfall patterns, and more frequent extreme weather to Pakistan. In Balochistan, deserts and coasts face droughts and sea-level rise. Punjab's plains suffer from floods and heatwaves, disrupting farming. Sindh's coastal and desert areas deal with cyclones and water scarcity. GB's mountains see glacial melt and flood risks, while KP's valleys face landslides and floods. AJK's forested hills are hit by deforestation and landslides, threatening communities.

Mitigation and Disaster Management

To combat these issues, Pakistan is promoting solar and wind energy, especially in arid regions, and hydropower in mountainous areas. Sustainable practices, like drought-resistant crops and efficient irrigation, help farmers in Punjab and Sindh. Tree-planting programs aim to stabilize soils and store carbon across regions. For disasters, Pakistan uses early warning systems for floods and heatwaves, builds flood defenses, and trains communities to prepare for emergencies. National policies guide these efforts, but local action and global funding are essential for success.

Pakistan ranks as the fifth most vulnerable country to climate change, according to the Global Climate Risk Index (Climate Change in Pakistan). Despite contributing less than 1% of global greenhouse gas emissions, its diverse geography—from arid deserts to fertile plains, coastal zones, and towering mountains—faces severe climate challenges (Pakistan and Climate Adaptation). This essay examines key climate-related terrains across Balochistan, Punjab, Sindh, Gilgit-Baltistan (GB), Khyber Pakhtunkhwa (KP), and Azad Jammu and Kashmir (AJK), analyzing climate change impacts, mitigation strategies, and disaster risk management approaches. Although this study specifies regional climate-related terrains. This analysis focuses on the major climate-related terrains in each region, as these are critical for developing effective, region-specific solutions to enhance resilience.

Climate Change and Disaster Risk Management Context

Pakistan's climate challenges include rising temperatures, altered precipitation patterns, and increased frequency of extreme weather events such as floods, droughts, and heatwaves (Climate Change in Pakistan). The country's vulnerability is evident in events like the 2022 floods, which affected over 30 million people, and the 2010 floods, which displaced millions (Climate Change in Pakistan). Pakistan's disaster risk management framework is anchored by the National Disaster Management Authority (NDMA) and Provincial Disaster Management Authorities (PDMAs), established under the 2010 Disaster Management Act (Disaster Management Handbook). National frameworks, including the National Disaster Management Plan (NDMP) 2012-2022, National Flood Protection Plan (IV) 2015-2025, and Pakistan Vision 2025, integrate disaster risk reduction and climate resilience (Disaster Management Handbook). Pakistan's Updated Nationally Determined Contributions (NDCs) outline mitigation goals, such as achieving 60% renewable energy by 2030 and promoting electric vehicles (Pakistan Updated NDC). These national strategies provide a foundation for region-specific actions tailored to the unique terrains of each region.

Regional Terrain Classification and Climate Vulnerabilities

1. Balochistan (Terrains Identification)

1. Makran Coastal Belt – vulnerable to sea-level rise and cyclones
2. Chagai Desert – prone to droughts and heatwaves
3. Zhob Highlands – increasing aridity
4. Sulaiman Range – erosion and flash floods
5. Quetta Valley – water scarcity and land degradation
6. Kharan Basin – desertification risks
7. Lasbela Plateau – seismic and flood-prone
8. Hingol National Park – biodiversity at risk due to heat stress
9. Dasht River Basin – extreme rainfall events
10. Panjgur Valley – declining groundwater and desertification

Aspect	Details
Terrains	Arid and semi-arid deserts (e.g., Chagai Desert), mountainous regions (e.g., Sulaiman Range, Toba Kakar Range), coastal areas (e.g., Makran Coast)
Climate Change Impacts	Rising temperatures (e.g., 53.7°C in Turbat, 2017), reduced precipitation, frequent droughts (e.g., 1998-2002 drought), sea-level rise, and cyclones affecting coastal areas (Climate Change in Pakistan)
Mitigation Strategies	- **Renewable Energy**: Leverage solar and wind potential in arid regions (Pakistan Updated NDC). - **Water Conservation**: Implement rainwater harvesting and sustainable land management to combat water scarcity (Pakistan and Climate Adaptation). - **Afforestation**: Plant drought-resistant species to reduce desertification.
Disaster Risk Management	- Early warning systems for droughts and heatwaves. - Coastal protection measures (e.g., embankments) to mitigate sea-level rise and cyclones. - Community training for drought preparedness (Disaster Management Handbook).

Balochistan's arid and semi-arid terrains experience wind erosion and extreme heat, exacerbated by climate change (Climate Zones of Pakistan). The Makran Coast faces sea-level rise and cyclones, such as Cyclone Yemyin in 2007, which killed 380 people (Climate Change in Pakistan). Mitigation efforts focus on renewable energy, given the region's high solar potential, and water conservation to address scarcity. Disaster risk management includes early warning systems and coastal defenses to protect vulnerable communities.

Punjab (Terrains Identification)

1. Thal Desert – desertification and water stress
2. Potohar Plateau – soil erosion and temperature spikes
3. Salt Range – deforestation and landslides
4. Indus Floodplain – seasonal flooding
5. Sialkot-Narowal Belt – riverine flooding and monsoon variability
6. Cholistan Desert – desertification and heatwaves
7. Ravi River Basin – water pollution and flood risk
8. Murree Hills– landslides and heavy rainfall
9. Southern Punjab Canal Areas – irrigation stress and waterlogging
10. Margalla Hills and Islamabad – ecological fragility and urban encroachment

Aspect	Details
Terrains	Alluvial plains (e.g., Indus River Basin), semi-arid areas in the south

Aspect	Details
Climate Change Impacts	Floods (e.g., 2010 floods displaced 6 million), heatwaves, shifting monsoon patterns reducing crop water availability (Climate Change in Pakistan)
Mitigation Strategies	- **Sustainable Agriculture**: Promote precision farming and drought-resistant crops (Pakistan Updated NDC). - **Renewable Energy**: Expand solar and wind energy. - **Afforestation**: Plant trees along riverbanks to stabilize soil.
Disaster Risk Management	- Strengthen flood control infrastructure (e.g., dams, levees). - Implement heatwave action plans and early warning systems (Disaster Management Handbook).

Punjab's fertile plains are Pakistan's agricultural heartland but are vulnerable to floods and heatwaves (Climate Change in Pakistan). Monsoon shifts have reduced water availability, impacting crops ([Spatial Shift in Monsoon](web result 3)). Mitigation includes sustainable farming practices and renewable energy adoption. Disaster risk management focuses on flood defenses and early warning systems to mitigate extreme weather impacts.

Sindh (Terrains Identification)

1. Indus Delta – sea intrusion and mangrove loss
2. Thar Desert – drought and food insecurity
3. Kirthar Range – wildfires and habitat loss
4. Karachi Coastline – urban flooding and heat island effect
5. Nara Canal Region – saline intrusion and water scarcity
6. Larkana Basin – high temperature and crop stress
7. Badin Lowlands – coastal flooding
8. Dadu Floodplain – dam-induced changes and flooding
9. Keenjhar Lake Catchment – pollution and biodiversity loss
10. Thatta Hinterland – sea intrusion and soil salinity

Aspect	Details
Terrains	Coastal areas (e.g., Indus Delta), arid regions (e.g., Thar Desert), riverine areas along the Indus
Climate Change Impacts	Sea-level rise, cyclones, droughts, monsoon floods (e.g., 2010 floods affected 20 million) (Climate Change in Pakistan)
Mitigation Strategies	- **Mangrove Restoration**: Protect coastlines and sequester carbon (Pakistan Updated NDC). - **Solar Energy**: Expand solar power in desert regions. - **Water Management**: Efficient irrigation and rainwater harvesting.
Disaster Risk Management	- Build coastal defenses (e.g., sea walls). - Develop flood management and drought preparedness plans (Disaster Management Handbook).

Sindh's coastal zones face sea-level rise and mangrove degradation, while the Thar Desert suffers from prolonged droughts (Climate Zones of Pakistan). Floods, like those in 2022, have caused widespread devastation (Climate Change in Pakistan). Mitigation strategies include mangrove restoration and solar energy expansion. Disaster risk management emphasizes coastal defenses and water management systems.

Gilgit-Baltistan (Terrains Identification)

1. Hunza Valley – GLOFs and glacier retreat
2. Skardu Basin – water resource fragility
3. Naltar Forests – ecosystem vulnerability
4. Gilgit River System – hydrological variability
5. Khunjerab Pass – permafrost melt
6. Astore Valley – snowmelt irregularities
7. Shigar Valley – sedimentation and drought
8. Nagar Highlands – deforestation and land degradation
9. Gupis-Yasin – alpine changes and biodiversity loss
10. Deosai Plains – ecosystem sensitivity

Aspect	**Details**
Terrains	High mountains (e.g., Karakoram Range), glaciers, glacial valleys
Climate Change Impacts	Glacial melt, glacial lake outburst floods (GLOFs), landslides, reduced snowfall (Climate Change in Pakistan)
Mitigation Strategies	- **Glacial Monitoring**: Use remote sensing to predict GLOFs (Pakistan and Climate Adaptation). - **Hydropower**: Harness renewable energy potential. - **Sustainable Tourism**: Promote eco-friendly practices.
Disaster Risk Management	- Early warning systems for GLOFs and landslides. - Slope stabilization and community resilience programs (Disaster Management Handbook).

GB's alpine terrains are critical for water regulation but face glacial melt and GLOF risks ([Climate Change Impacts in GB](web result 20)). These changes disrupt water supplies and increase disaster risks. Mitigation includes glacial monitoring and hydropower development. Disaster risk management prioritizes early warning systems and community preparedness.

Khyber Pakhtunkhwa (KP)

Khyber Pakhtunkhwa (Terrains Identification)

1. Swat Valley – glacier melt and flash floods
2. Dera Ismail Khan Plain – desertification and heatwaves
3. Dir Highlands – snow variability and landslides

4. Kohistan Mountains – glacial lake outburst floods (GLOFs)
5. Peshawar Valley – urban flooding and groundwater depletion
6. Bannu Basin – aridification
7. Hazara Hills – forest loss and landslides
8. Chitral River Basin – glacier retreat and water stress
9. Malakand Hills – ecosystem disruption
10. Kurram Agency Uplands – changing precipitation patterns

Aspect	Details
Terrains	Mountainous areas (e.g., Hindu Kush), valleys (e.g., Swat Valley), semi-arid plains
Climate Change Impacts	Floods (e.g., 2010 floods killed 1,540), landslides, heatwaves, altered weather patterns (Climate Change in Pakistan)
Mitigation Strategies	- **Hydropower**: Develop small-scale projects. - **Forest Conservation**: Protect ecosystems to reduce landslides. - **Renewable Energy**: Expand solar and wind energy.
Disaster Risk Management	- Improve drainage systems for flood control. - Early warning systems for floods and landslides (Disaster Management Handbook).

KP's mountainous regions and valleys are prone to floods and landslides, exacerbated by climate change (Climate Zones of Pakistan). Mitigation focuses on hydropower and forest conservation. Disaster risk management includes flood control and landslide prevention measures.

Azad Jammu & Kashmir (Terrains Identification)

1. Neelum Valley – landslides and cloudbursts
2. Jhelum River Belt – flooding and riverbank erosion
3. Bagh District Hills – soil erosion and deforestation
4. Rawalakot Valley – changing cropping patterns
5. Leepa Valley – snow variability and land instability
6. Sudhan Gali Hills – temperature rise and forest degradation
7. Poonch River Catchment – flood exposure
8. Muzaffarabad Basin – seismic and hydrological risk
9. Kotli District Plains – agricultural vulnerability
10. Samahni Valley – habitat loss and water stress

Aspect	Details
Terrains	Forested mountains (e.g., Himalayas), river valleys (e.g., Neelum Valley)
Climate Change Impacts	Deforestation, landslides, floods, temperature variations ([Climate Crisis in Pakistan](web result 17))

Aspect	Details
Mitigation Strategies	- **Reforestation**: Restore forests to stabilize slopes. - **Sustainable Land Use**: Promote agroforestry. - **Renewable Energy**: Develop small hydropower projects.
Disaster Risk Management	- Landslide prevention (e.g., terracing, slope stabilization). - Flood management and community-based adaptation (Disaster Management Handbook).

AJK's forested mountains face deforestation and landslides, worsened by unsustainable land use ([Climate Crisis in Pakistan](web result 17)). Mitigation includes reforestation and sustainable land practices. Disaster risk management focuses on landslide prevention and community resilience.

Policy Recommendations

1. **Terrain-Based Early Warning Systems (EWS):** Invest in localized meteorological stations and real-time data collection tailored to the identified terrains.
2. **Integrated Watershed Management:** For high-altitude terrains (GB, KP, AJK), focus on glacial and snowmelt monitoring, afforestation, and slope stabilization (Rasul, 2012).
3. **Coastal and Desert Ecosystem Restoration:** In Sindh and Balochistan, reforestation and saline-resistant crops can mitigate desertification and sea intrusion.
4. **Climate-Resilient Infrastructure:** For urban flood-prone terrains in Punjab and Sindh, upgrade drainage systems, zoning laws, and green infrastructure (ADB, 2020).
5. **Community-Based DRM:** Engage local populations in climate education and risk preparedness, especially in terrains prone to floods and landslides.
6. **Data-Driven Policy Integration:** Use GIS mapping and terrain-specific risk indexing to inform federal and provincial climate resilience policies (World Bank, 2021).

Synthesis and Future Directions

Pakistan's regional terrains present distinct climate change challenges, necessitating tailored mitigation and disaster risk management strategies. The National Climate Change Policy and NDCs provide a guiding framework, but success depends on coordinated federal-provincial efforts (Climate Change in Pakistan). Technologies like remote sensing for glacial monitoring and climate-smart agriculture can enhance resilience (Pakistan and Climate Adaptation). Given Pakistan's low contribution to global emissions, international support is vital for funding adaptation and mitigation initiatives (Pakistan and Climate Adaptation). Community-level capacity building, such as training on flood-resistant technologies, is also critical (Pakistan and Climate Adaptation). By

aligning national policies with regional needs, Pakistan can build a climate-resilient future.

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Annexure: A

Terrain-Specific Trainings for Climate Change Mitigation and Disaster Risk Management (DRM)

This document outlines terrain-specific training programs categorized by strategic, tactical, implementation, and community levels for each of the 60 climate-vulnerable terrains identified across Pakistan's provinces and territories: Balochistan, Punjab, Sindh, Khyber Pakhtunkhwa (KP), Gilgit-Baltistan (GB), and Azad Jammu & Kashmir (AJK).

Balochistan (10 Terrains)

1. **Makran Coastal Belt**

- Strategic: Marine disaster planning & coastal zone management
- Tactical: Cyclone response and sea intrusion modeling
- Implementation: Mangrove restoration, early warning systems (EWS)
- Community: Coastal evacuation drills and sustainable fishing practices

2. **Chagai Desert**

- Strategic: Desertification mitigation policy
- Tactical: Drought forecasting systems
- Implementation: Water harvesting, solar desalination
- Community: Rainwater storage, crop rotation education

3. **Zhob Highlands**

- Strategic: High-altitude climate vulnerability mapping
- Tactical: Soil erosion control techniques
- Implementation: Check dams and windbreaks
- Community: Terracing and agri-forestry practices

4. **Sulaiman Range**

- Strategic: Landslide and erosion risk modeling
- Tactical: Vegetation belts for slope stabilization
- Implementation: Rock netting and drainage channels
- Community: Reforestation awareness

5. **Quetta Valley**

- Strategic: Urban climate adaptation planning
- Tactical: Water-efficient city planning

- Implementation: Leak detection and storm drainage
- Community: Water conservation habits

6. **Kharan Basin**

- Strategic: Arid land development strategy
- Tactical: Renewable energy integration (solar farms)
- Implementation: Irrigation canals and water-saving tech
- Community: Drip irrigation and drought crop training

7. **Lasbela Plateau**

- Strategic: Seismic-sensitive construction policies
- Tactical: Flash flood pathways mapping
- Implementation: Check dams and flood barriers
- Community: First aid and hazard response drills

8. **Hingol National Park**

- Strategic: Biodiversity and eco-tourism strategy
- Tactical: Habitat fragmentation control
- Implementation: Anti-poaching and waste control
- Community: Wildlife protection education

9. **Dasht River Basin**

- Strategic: Inland flood management framework
- Tactical: Dam operation and reservoir capacity planning
- Implementation: River embankment
- Community: Flood awareness and safe relocation plans

10. **Panjgur Valley**

- Strategic: Groundwater conservation policy
- Tactical: Hydrological data collection
- Implementation: Borewell monitoring and licensing
- Community: Aquifer recharge awareness

Punjab (10 Terrains)

(Identical four-level structure repeated for each terrain)

11. **Thal Desert**
    Strategic: Desert management strategy
    Tactical: Wind erosion modeling

Implementation: Shelterbelt planting
Community: Water reuse and sandstorm safety

12. **Potohar Plateau**
    Strategic: Urban-rural interface planning
    Tactical: Rain-fed agriculture resilience
    Implementation: Farm bunds and terraces
    Community: Rainwater harvesting
13. **Salt Range**
    Strategic: Mining and reforestation balance policy
    Tactical: Landslide hazard assessment
    Implementation: Slope stabilization
    Community: Tree plantation drives
14. **Indus Floodplain**
    Strategic: Riverine flood mitigation
    Tactical: Embankment design and forecasting
    Implementation: River diversion canals
    Community: Flood shelters and drills
15. **Sialkot-Narowal Belt**
    Strategic: Cross-border flood warning protocols
    Tactical: Rain gauge station management
    Implementation: Drainage and waterlogging control
    Community: Flood early warning education
16. **Cholistan Desert**
    Strategic: Drought preparedness plan
    Tactical: Camel farming and fodder conservation
    Implementation: Solar-powered wells
    Community: Indigenous knowledge preservation
17. **Ravi River Basin**
    Strategic: Urban River pollution control
    Tactical: Riparian buffer zoning
    Implementation: Water testing and treatment units
    Community: Wastewater awareness
18. **Murree Hills**
    Strategic: Hill station climate strategy
    Tactical: Slope safety audits
    Implementation: Retaining walls and drainage
    Community: Land-use management workshops
19. **Southern Punjab Canal Areas**
    Strategic: Irrigation modernization roadmap
    Tactical: Canal leakage mapping
    Implementation: Lining and water metering
    Community: Irrigation schedule training
20. **Margalla Hills**
    Strategic: Urban fringe climate strategy
    Tactical: Fire risk zoning

Implementation: Firebreaks and watchtowers
Community: Fire awareness campaigns

Khyber Pakhtunkhwa (10 Terrains)

21. **Swat Valley**
    Strategic: Mountain hydrology and tourism resilience
    Tactical: Avalanche and flash flood training
    Implementation: Forest fire control and slope stabilization
    Community: Watershed conservation and ecotourism
22. **Chitral Valley**
    Strategic: Glacier melt risk modeling
    Tactical: Snow monitoring and bridge reinforcement
    Implementation: Climate-smart farming
    Community: Livelihood diversification
23. **Kohat Hills**
    Strategic: Semi-arid region planning
    Tactical: Seepage loss control
    Implementation: Rain-fed farming techniques
    Community: Soil conservation practices
24. **Peshawar Basin**
    Strategic: Urban heat island mitigation
    Tactical: Stormwater and drainage planning
    Implementation: Permeable pavements
    Community: Water-saving awareness
25. **Dera Ismail Khan Desert Fringe**
    Strategic: Drought-resilient infrastructure
    Tactical: Arid agriculture support
    Implementation: Solar-powered irrigation
    Community: Traditional farming innovation
26. **Dir-Kumrat Forest Zone**
    Strategic: Forest-based carbon sequestration strategy
    Tactical: Firewatch and illegal logging detection
    Implementation: Plantation and conservation training
    Community: Participatory forestry
27. **Hazara Hills**
    Strategic: Risk-sensitive urban expansion
    Tactical: Seismic zoning and hazard mapping
    Implementation: Road slope protection
    Community: Evacuation route planning
28. **Kurram Valley**
    Strategic: Border zone environmental strategy
    Tactical: Flash flood path identification
    Implementation: Flood retention structures
    Community: Traditional adaptation techniques

29. **Bannu Basin**
    Strategic: Groundwater table management
    Tactical: Sinkhole monitoring and crop zoning
    Implementation: Subsurface drainage
    Community: Water-efficient farming
30. **Orakzai Highland Zone**
    Strategic: Conflict-sensitive ecosystem planning
    Tactical: Community-based early warning systems
    Implementation: GLOF (glacial lake outburst flood) adaptation
    Community: Risk culture development

Gilgit-Baltistan (10 Terrains)

31. **Hunza Valley**
    Strategic: Glacier protection and water diplomacy
    Tactical: GLOF risk reduction and early warnings
    Implementation: Climate-resilient housing
    Community: Snow hazard drills and awareness
32. **Skardu Basin**
    Strategic: Cold desert adaptation plan
    Tactical: Remote sensing for river encroachment
    Implementation: Water-efficient irrigation
    Community: Winter preparedness training
33. **Astore Valley**
    Strategic: Alpine ecosystem conservation
    Tactical: Glacial monitoring and risk zoning
    Implementation: Stone bunds and trails
    Community: Livestock disaster protection
34. **Ghanche Highlands**
    Strategic: High-mountain risk mapping
    Tactical: Wind and snow load-resistant housing
    Implementation: Micro-hydro and solar heating
    Community: Shelter maintenance and emergency kits
35. **Diamer Region**
    Strategic: Deforestation reversal strategy
    Tactical: Reforestation and soil preservation
    Implementation: Forest nursery and afforestation
    Community: Replantation campaigns
36. **Ghizer Valley**
    Strategic: Transboundary watershed management
    Tactical: Ice lake burst modeling
    Implementation: Landslide warning systems
    Community: Resettlement preparedness
37. **Nagar Valley**
    Strategic: Green tourism and eco-economy development

Tactical: Climate vulnerability audits
Implementation: Green building code enforcement
Community: Energy efficiency awareness

38. **Baltoro Glacier Zone**
    Strategic: Cryosphere preservation protocols
    Tactical: Glacier degradation monitoring
    Implementation: Satellite data collection
    Community: Eco-volunteer training
39. **Shigar Valley**
    Strategic: Flash flood buffer development
    Tactical: Retention wall and slope mapping
    Implementation: Riverbank stabilization
    Community: Relocation simulation drills
40. **Yasin Valley**
    Strategic: Highland climate smart development
    Tactical: Traditional weather forecasting
    Implementation: Resilient livestock shelters
    Community: Animal care in disasters

Sindh (10 Terrains)

41. **Indus Delta**

- Strategic: Deltaic ecosystem restoration strategy
- Tactical: Saltwater intrusion modeling
- Implementation: Mangrove afforestation
- Community: Fisheries conservation and climate literacy

42. **Karachi Urban Zone**

- Strategic: Coastal megacity resilience planning
- Tactical: Urban flood simulation and modeling
- Implementation: Rainwater storage and stormwater drains
- Community: Emergency response and shelter management

43. **Thar Desert**

- Strategic: Heatwave preparedness and water security policy
- Tactical: Livelihood diversification for arid zones
- Implementation: Solar-powered reverse osmosis units
- Community: Traditional water harvesting revival

44. **Kirthar Range**

- Strategic: Highland conservation and biodiversity strategy
- Tactical: Fire mapping and illegal grazing control
- Implementation: Soil check dams and native plantation

- Community: Conservation volunteering training

45. **Thatta and Badin Wetlands**

- Strategic: Wetland protection and sustainable agriculture policy
- Tactical: Flood route mapping and early warning
- Implementation: Raised farming beds and embankments
- Community: Community-based wetland monitoring

46. **Nara Canal Command Area**

- Strategic: Canal water equity and modernization plan
- Tactical: Water theft monitoring
- Implementation: Canal lining and smart irrigation tech
- Community: Farmer training on crop-water budgeting

47. **Upper Sindh Floodplain**

- Strategic: Riverine population relocation planning
- Tactical: Inundation and levee risk modeling
- Implementation: Levee construction and spillways
- Community: Evacuation route awareness

48. **Manchar Lake Region**

- Strategic: Lake ecosystem restoration strategy
- Tactical: Water quality and fish population monitoring
- Implementation: Silt traps and treatment systems
- Community: Sustainable fishing and pollution prevention

49. **Rann of Kutch Border Belt**

- Strategic: Transboundary desertification management
- Tactical: Border climate impact surveillance
- Implementation: Salt-resistant crops and windbreaks
- Community: Border community resilience education

50. **Larkana Upland Zone**

- Strategic: Heatwave risk and health infrastructure planning
- Tactical: Urban-rural heat index mapping
- Implementation: Green corridors and shaded public zones
- Community: Heatstroke first aid training

Azad Jammu & Kashmir (10 Terrains)

51. **Neelum Valley**

- Strategic: Cross-border climate diplomacy and water treaty monitoring
- Tactical: Glacier hazard identification
- Implementation: Climate-resilient shelter construction
- Community: Relocation protocols and awareness

52. **Bagh Region**

- Strategic: Earthquake-climate risk integration strategy
- Tactical: Seismic vulnerability assessment
- Implementation: Seismic-safe retrofitting
- Community: Emergency drills and preparedness

53. **Muzaffarabad Basin**

- Strategic: Urban landslide and flood integration framework
- Tactical: Multi-hazard zoning and evacuation planning
- Implementation: Retaining walls and flood drains
- Community: Multi-hazard response education

54. **Rawalakot Uplands**

- Strategic: Cold region livelihood adaptation policy
- Tactical: Livestock shelter and fodder buffer mapping
- Implementation: Heating-efficient building practices
- Community: Winter care and adaptation training

55. **Jhelum Valley**

- Strategic: River catchment and land use strategy
- Tactical: Sediment load forecasting
- Implementation: Riverbank erosion controls
- Community: Soil preservation workshops

56. **Leepa Valley**

- Strategic: GLOF mitigation and forest fire prevention strategy
- Tactical: GLOF risk mapping and slope fire zoning
- Implementation: Fire lines and GLOF diversion channels
- Community: Early warning and forest watch teams

57. **Poonch Highlands**

- Strategic: High-altitude agricultural resilience strategy

- Tactical: Terrace farming modernization
- Implementation: Climate-smart seeds and irrigation
- Community: Farmer-to-farmer learning networks

58. **Hattian Bala**

- Strategic: Seismic-climate nexus strategy
- Tactical: Emergency shelter zone planning
- Implementation: Shock-proof shelter deployment
- Community: Volunteer disaster responder training

59. **Kotli Semi-Arid Zone**

- Strategic: Water-stressed area climate action plan
- Tactical: Spring monitoring and recharge assessments
- Implementation: Gravity-based irrigation and rooftop harvesting
- Community: Water conservation education

60. **Bhimber Border Region**

- Strategic: Borderland ecological resilience policy
- Tactical: Cross-border flood and fire surveillance
- Implementation: Agroforestry and buffer zone plantations
- Community: Community-led hazard preparedness