Study Report:
High-Potential Aquaculture Zones of Khyber Pakhtunkhwa: A GIS-Based Zoning and Clustering Framework

Mapping High-Potential Zones for Cold (Trout), Semi-Cold and Warm-water Aquaculture across Khyber Pakhtunkhwa Province and Developing a Cluster-based Commercialization Strategy

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High-Potential Aquaculture Zones of Khyber Pakhtunkhwa: A GIS-Based Zoning and Clustering Framework

EXECUTIVE SUMMARY

This report presents the spatial mapping and delineation of high-potential aquaculture zones (HPZs) in Khyber Pakhtunkhwa (KP), Pakistan, based on a comprehensive GIS-based Multi-Criteria Analysis (MCA) framework and extensive field surveys. The analysis identifies and characterizes 10 distinct aquaculture zones across the province, providing a geographic framework for aquaculture development planning.

Key Spatial Findings

Survey Coverage: - Total sites surveyed: 347 across 36 districts - Cold-water zone: 119 sites (11 districts) - Semi-cold-water zone: 18 sites (3 districts) - Warm-water zone: 210 sites (20 districts).

Zones Identified: The Study has identified 4 Zones and 13 Sub-Zones with aquaculture potential based on agro-ecological characteristics, water resources, and geographic proximity.

Clusters Mapped: the study has also classified the zones into 24 Clusters and 58 sub clusters, representing geographically contiguous areas with shared water sources and infrastructure characteristics.

GIS Maps Produced: key spatial analysis maps showing water resources, elevation, slope, settlement proximity, and electricity infrastructure distribution.

Water Resources: Abundant and generally suitable for aquaculture across all zones, with temperature regimes supporting cold-water (8-16°C), semi-cold-water (15-24°C), and warm-water (18-32°C) species.

1. INTRODUCTION

1.1 Background

Khyber Pakhtunkhwa possesses exceptional geographic and hydrological conditions for freshwater aquaculture development. The province's elevation ranges from approximately 150 meters in the plains to over 7,000 meters in the high mountains, creating diverse agro-ecological zones. This topographic diversity, combined with abundant water resources from major river systems, creates distinct environmental conditions suitable for different aquaculture systems.

1.2 Purpose of Spatial Mapping

The systematic identification and mapping of high-potential aquaculture zones is essential for:

- Provide a multi-level geographic framework for planning, from macro-regional (Zone) to local (Sub-Cluster).
- Identify specific, geographically concentrated groups of sites (Clusters) that can serve as focal points for investment and infrastructure development.
- Enable the design of targeted interventions tailored to the unique conditions of each cluster and sub-cluster.
- Facilitate the development of cluster-based farmer associations and coordinated value chains.

1.3 Scope

This report remains strictly focused on spatial planning and geographic characterization. It includes:

- A four-tiered hierarchical structure: **Zones → Sub-Zones → Clusters → Sub-Clusters**.
- Delineation and characterization of 24 aquaculture clusters.
- Mapping of sub-clusters within each cluster.
- Summary tables of the site inventory data.
- The full site inventory as an annex.
- Production of GIS maps showing spatial distribution of key parameters

All strategic elements, such as needs assessment and commercialization plans, remain outside the scope of this document and are deferred to the Activity 2.8 report under output-2 of the study.

1.4 Current Aquaculture Baseline in Khyber Pakhtunkhwa

To contextualize the spatial mapping and future development potential, it is essential to establish the current baseline of aquaculture in the province. As of recent estimates, Khyber Pakhtunkhwa's aquaculture sector is characterized by:

- **Production Volume:** Approximately 5,022 metric tons annually, representing a significant increase from earlier baseline figures of 1,132 metric tons, demonstrating strong sector growth.
- **Primary Species:** Rainbow trout in cold-water zones (e.g., Swat, Kaghan); mahseer and various carp species in semi-cold and warm-water zones.
- **Infrastructure Base:** Carp fish farms are 1387 having an area of 2990 acres, while 308 trout farms with an area of 108 acres, while in public sector 8 trout hatcheries and 5 carp hatcheries have been established across the province.
- **Market Value & Export Potential:** the value of current fish production in KP is about 3.2 billion rupees. KP's contribution is negligible in fish export. The primary constraints are the lack of export-oriented processing facilities, stringent international quality standards (SPS measures), and logistical challenges. The immediate focus for KP should be on import substitution and serving the domestic market.

It is important to note that recent climate change impacts have highlighted the vulnerability of concentrated production, emphasizing the need for the diversified geographic distribution proposed in this spatial mapping exercise."

2 GIS-BASED SPATIAL PLANNING METHODOLOGY

2.1 Methodological Framework

The identification and delineation of high-potential aquaculture zones is based on a GIS-based Multi-Criteria Analysis (MCA) framework and tailored to freshwater aquaculture in KP. This approach integrates diverse spatial datasets to produce a transparent and reproducible assessment of aquaculture suitability.

2.2 Five-Phase MCA Process

Phase One: Contextualization and Scoping

This initial phase defined the scope of the spatial analysis, including the specific aquaculture systems (cold-water, semi-cold-water, warm-water) and species to be considered. A preliminary assessment of the overall geographic potential and key constraints for aquaculture development in KP was conducted based on existing data and expert knowledge.

Phase Two: Information and Data Collection

Comprehensive spatial data were gathered for all selected parameters. Data sources included:

- Government agencies
- Research institutions and universities
- Satellite remote sensing and topographic data
- Field surveys and ground-truthing
- Water resource assessments

Key spatial datasets collected included water resources (rivers, streams, springs, dams), water quality parameters, elevation and topography, slope and land suitability, land use/land cover, road networks, electricity infrastructure, and administrative boundaries.

Phase Three: Pre-selection and Site Screening

An initial screening was performed using exclusion criteria that render an area completely unsuitable for aquaculture. These included:

- Protected areas and wildlife sanctuaries
- Urban and densely populated centers
- Areas with severe pollution
- Locations with insufficient water availability
- Extreme water quality conditions

The output of this phase was a preliminary map showing broad areas potentially suitable for aquaculture.

Phase Four: Consultation and Validation

Preliminary suitability maps were presented to stakeholders including government officials, aquaculture experts, local farmers, and community representatives. This participatory process validated the selected parameters and ensured practical and social acceptability of the zone delineations. A two-day national validation workshop was conducted on February 11-12, 2026, at the Swat Hilton Hotel, Mangora, Swat, with participation from 33 representatives including the Fisheries Department of Khyber Pakhtunkhwa, FAO officials, aquaculture experts from research institutions, farmer associations, and community leaders. Key feedback endorsed the GIS-based zoning methodology and recommended the introduction of sub-zone classifications for enhanced spatial planning. Stakeholders confirmed the urgency of addressing the 94% fish supply-demand gap through local input supply chain development and essential infrastructure investments. The validation process resulted in strong consensus on the proposed commercialization strategy and a commitment to collaborative implementation.

Phase Five: Detailed Suitability Analysis

A detailed spatial analysis was conducted using a weighted linear combination formula to calculate a Degree of Compatibility (DC) score for each location. The formula applied was $DC = \Sigma(Wi \times Si)$, where Wi represents the assigned weight of a specific criterion (e.g., water quality, infrastructure) and Si represents the normalized score for that criterion at a given site. Sites were subsequently classified based on their DC scores: scores ≥ 0.70 indicated High Suitability, scores between 0.50-0.69 indicated Medium Suitability, and scores < 0.50 indicated Low Suitability. The final High-Potential Aquaculture Zones (HPAZs) were delineated by

aggregating contiguous high-suitability areas while incorporating geographic proximity and operational coherence to form manageable clusters.

3 FIELD SURVEY METHODOLOGY

3.1 Survey Design and Implementation

Comprehensive field surveys were conducted to collect ground-truth data and validate the GIS-based spatial analysis. The surveys followed a robust methodology integrating desk-based research, extensive field surveys, and spatial analysis.

Survey Period: October-November 2025

Survey Teams:

- **Team A (Cold Water Zone):** Led by Mr. Khalid Mahmood
- **Team B (Semi-Cold-Water Zone):** Led by Ms. Kanwal-Un-Nisa
- **Team C (Warm Water Zone):** Led by Mr. Muneer Hussain

Survey Coverage:

- Total sites surveyed: 347
- Districts covered: 36
- Farm surveys: 119
- Site assessments: 206
- Market surveys: 15

3.2 Priority System for Site Selection

Sites were classified using a three-tiered priority framework:

Priority Level	Criteria	Action
Priority 1 (Must Visit)	High suitability scores; strategic importance for zone formation	Mandatory visitation
Priority 2 (Should Visit)	Moderate suitability scores; potential with improvements	Visitation if resources permit
Priority 3 (Opportunistic)	Low suitability scores	Optional visitation

3.3 Data Collection Parameters

Site Identification Data:

- GPS coordinates (latitude, longitude) - Altitude (meters)
- District, Tehsil, and locality

- Land use type - Accessibility description

Water Resource Assessment:

- Water body type (stream, dam, spring, borewell, canal, river)
- Water availability (months of availability)
- Water flow rate (m^3/s)
- Seasonal variations

Water Quality Parameters:

- Temperature (°C)
- pH - Conductivity (µS/cm)
- Dissolved Oxygen (mg/L)
- Turbidity/Clarity (NTU)
- Alkalinity (mg/L $CaCO_3$)
- Hardness (mg/L $CaCO_3$)

Infrastructure Assessment:

- Road access type and quality
- Electricity availability and source
- Distance to nearest market (km)
- Distance to feed suppliers (km)
- Distance to hatcheries (km)

Existing Aquaculture:

- Farm presence (yes/no)
- Aquaculture system type
- Species cultured
- Production data (where available)

3.4 Multi-Criteria Suitability Assessment Framework

Each site was evaluated using a weighted criteria framework:

Criterion	Weight (%)	Score Range	Justification

Water Quality	15	1-5	Based on field measurements against species requirements
Water Availability	15	1-5	Year-round flow and volume for planned scale
Temperature Suitability	10	1-5	Seasonal range enabling multi-species production
Topography	10	1-5	Slope suitable for gravity-fed systems
Soil Suitability	5	1-5	Soil type and stability for pond construction
Accessibility	10	1-5	Road access, distance to markets and inputs
Infrastructure	10	1-5	Electricity, communications, services
Market Proximity	10	1-5	Distance to key markets, demand level
Social Acceptance	5	1-5	Community interest, land tenure security
Environmental Sustainability	5	1-5	No major environmental constraints
Economic Viability	5	1-5	Production costs, market prices, profitability
TOTAL	100	Max 100	Suitability Rating: High/Medium/Low

4 HIERARCHICAL MAPPING FRAMEWORK: ZONES, SUB ZONES AND CLUSTERS

To provide a more granular and actionable framework for development, a four-tiered hierarchical structure has been established. This structure organizes the all potential sites into a nested system, moving from broad regional zones down to specific, localized sub-clusters.

4.1 Framework Definition

The hierarchical structure operates as follows:

1. **Zones (4):** The highest-level planning units representing broad agro-ecological regions defined by water temperature regimes. Each zone spans multiple districts and covers large geographic areas.
2. **Sub-Zones (13):** Geographic subdivisions within each zone representing major geographic areas with similar characteristics. Sub-zones typically correspond to specific river valleys, districts, or geographic regions.
3. **Clusters (24):** The primary operational units for development planning and investment. Clusters are geographically concentrated groups of aquaculture sites typically centered around a major water body, town, or infrastructure hub.
4. **Sub-Clusters (58):** Specific, localized areas within a cluster forming a cohesive micro-unit.

4.2 Hierarchical Structure Overview

The following table provides a summary of the complete hierarchical structure, mapping the 4 Zones, 13 Sub-Zones, 24 Clusters and 58 Sub-Clusters.

Table 1: Summary of the complete hierarchical structure for identified clusters

Zone	Zone Name	Cluster ID	Cluster Name	Sub-Clusters
Z-1	High Altitude Trout & Premium Cold-Water Clusters	CW-C1	Chitral Cluster	1. Lower Chitral Sub-Cluster, 2. Kalash Valleys Sub-Cluster, 3. Garam Chashma Sub-Cluster, 4. Upper Chitral Sub-Cluster, 5. Kumrat Valley Sub-Cluster
	Emerging Premium Cold-Water Clusters	CW-C2	Kohistan Cluster	1. Pattan-Dassu Corridor Sub-Cluster
	Emerging Premium Cold-Water Clusters	CW-C3	Upper Kuram & South Waziristan Cluster	1. Spin Ghar (Kohi Safed) Sub-Cluster, 2. South Waziristan Upper Sub-Cluster

	Swat Established Trout Clusters	CW-C4	Swat Valley Cluster	1. Madyan-Bahrain Sub-Cluster, 2. Kalam-Utror Sub-Cluster, 3. Miandam Sub-Cluster
	Mansehra Established Trout Clusters	CW-C5	Kaghan Valley Cluster	1. Naran-Batakundi Sub-Cluster, 2. Kaghan-Jared Sub-Cluster, 3. Shino-Ghanool Sub-Cluster
Z-2	Northern Semi-Cold-Water Clusters	SC-C1	Hazara Semi Cold Cluster	1. Paras-Balakot Sub-Cluster, 2. Siran Valley Sub-Cluster, 3. Abbottabad-Havelian Pond Sub-Cluster, 4. Tor Ghar-Battagram-Shangla Sub-Cluster, 5. Kohistan Sub-Cluster, 6. Buner-Lower 7. Swat-Lower 8. Lower Dir-Bajaur Sub-Cluster.
		SC-C2	Swat-Panjkora Semi Cold Cluster	1. Buner-Swat Sub-Cluster, 2. Bajaur-Dir Sub-Cluster
	Western Semi-Cold-Water Clusters	SC-C3	Kurram-Orakzai Cluster	1. Orakzai Sub-Cluster 2. Kurram Sub-Cluster
		SC-C4	Waziristan Cluster	1. Wana Sub Cluster 2. Birmal Sub Cluster 3. Tiarza Sub Cluster 4. Serwakai Sub Cluster 5. Sararogha Sub Cluster 6. Shawal Sub Cluster
Z-3	Haripur-Swabi-Mardan Cluster	WW-C1	Haripur-Swabi-Mardan Plains Cluster	1. Haripur Sub-Cluster, 2. Swabi-Pehur Canal Sub-Cluster, 3. Mardan Sub-Cluster: Mardan district areas
	Peshawar Plain Warm-Water Clusters	WW-C2	Peshawar-Nowshera-Charsadda Cluster	1. Sherabad Sub-Cluster, 2. Azakhel-Pabbi Sub-Cluster
		WW-C3	Mahmad-Khyber Emerging Cluster	1. Mahmad Sub-Cluster: Mahmad area 2. Khyber Sub-Cluster: Khyber area
		WW-C4	Charsadda Canal-Fed Cluster	1. Charsadda Central Sub-Cluster, 2. Tangi-Shabqadar Sub-Cluster
	Kohat-Karak Clusters	WW-C5	Hangu-Lachi-Kohat Cluster	1. Tanda Dam Sub-Cluster, 2. Kohat Toi Sub-Cluster,
		WW-C6	Banda Daud Shah-Shakardara Cluster	1. Karak Central Sub-Cluster, 2. Shakardara Banda Daud Shah Sub-Cluster
	Hangu-Karak-North Waziristan-Bannu-Lakki Clusters	WW-C7	Hangu-North Waziristan Cluster	1. Hangu-North Waziristan Sub-Cluster
		WW-C8	Bannu-South Karak Cluster	1. Bannu Sub-Cluster, 2. South Karak Sub-Cluster
		WW-C9	Lakki Marwat Cluster	1. Lakki Marwat Sub-Cluster
		WW-C10	DI Khan Cluster	1. Gomal Zam Dam Sub-Cluster, 2. CRBC Sub-Cluster

	Di Khan-Tank–Lower South Waziristan Clusters	WW-C11	Tank-Zam Cluster	1. Tank Sub-Cluster, 2. Gomal Zam Sub-Cluster
		WW-C12	Lower South Waziristan Cluster	1. Lower South Waziristan Sub-Cluster
Z-4	Saline Water Mixed Clusters	SA-C1	Lakki Marwat Saline Cluster	1. Lakki Marwat Saline Sub-Cluster
		SA-C2	DI Khan-Tank Saline Cluster	1. DI Khan Saline Sub-Cluster, 2. Tank Saline Sub-Cluster
		SA-C3	Karak Saline Cluster	1. Karak Saline Sub-Cluster

5 HIGH-POTENTIAL AQUACULTURE ZONES: SPATIAL DELINEATION

5.1 Hierarchical Structure Summary

5.1.1 Zone-1: Cold-Water Zone (6 Clusters, 14 Sub-Clusters)

Sub-Zone 1.1: High Altitude Trout & Premium Cold-Water

- **CW-C1: Chitral Cluster** (5 sub-clusters) - Chitral, Dir Upper, Dir Lower - Lower Chitral, Kalash Valleys, Garam Chashma, Upper Chitral, Kumrat Valley

Sub-Zone 1.2: Emerging Premium Cold-Water

- **CW-C2: Kohistan-Shangla Cluster** (7 sub-cluster) – Kandia Valley, Dassu-Jalkot, Pattan-Dubair Corridor, Palas/Kolai, Alpuri, Battagram, Siran Valley
- **CW-C3: Upper Kuram – Orakzai – Khyber Cluster** (3 sub-clusters) – Upper-Kurram (Spin Ghar), Khyber, Lower Orakzai
- **CW-C4: Waziristan Cluster** (2 sub-clusters) – North Waziristan, South Waziristan Upper

Sub-Zone 1.3: Swat Established Trout

- **CW-C5: Swat Valley Cluster** (3 sub-clusters) - Kalam-Utror-Gabral, Madyan-Bahrain, Malam Jabba-Miandam-Beha/Gabin Jabba

Sub-Zone 1.4: Mansehra Established Trout

- **CW-C6: Kaghan Valley Cluster** (2 sub-clusters) - Naran-Batakundi, Kaghan-Jared, Shino-Ghanool

5.1.2 Zone-2: Semi-Cold-Water Zone (4 Clusters, 17 Sub-Clusters)

Sub-Zone 2.1: Northern Semi-Cold-Water

- **SC-C1: Hazara Semi Cold Cluster** (5 sub-clusters)
  Indus Gorge, Shangla-Torghar-Oghi (Mansehra), Mansehra-Abbottabad (Siran Catchment), Abbottabad-Havelian-Lower Tanawal Pond (Dhor Catchment), Khanpur, Balakot-Galiat (Jhelum river Catchment).

- **SC-C2: Buner-Swat-Panjkora Semi Cold Cluster** (3 sub-clusters)
  Buner, Lower Swat-Malakand, Lower Dir-Bajaur sub-clusters.

Sub-Zone 2.2: Western Semi-Cold-Water

- **SC-C3: Kurram-Orakzai-Khyber Cluster** (3 sub-cluster) – Central Kurram, Orakzai, Khyber.
- **SC-C4: Waziristan Cluster** (3 sub-cluster)- North Waziristan, South Waziristan Upper and South Waziristan Lower

5.1.3 Zone-3: Warm-Water Zone (12 Clusters, 22 Sub-Clusters)

Sub-Zone 3.1: Haripur-Swabi-Mardan

- **WW-C1: Haripur-Swabi-Mardan Plains Cluster** (3 sub-clusters) - Haripur, Swabi - Haripur, Swabi-Pehur Canal, Mardan

Sub-Zone 3.2: Peshawar Plain Warm-Water

- **WW-C2: Peshawar-Nowshera-Charsadda Cluster** (2 sub-clusters) - Peshawar, Nowshera, Charsadda - Sherabad, Azakhel-Pabbi
- **WW-C3: Mohmand-Khyber Emerging Cluster** (2 sub-clusters) - Peshawar, Nowshera, Charsadda, Mahmad, Khyber
- **WW-C4: Charsadda Canal-Fed Cluster** (2 sub-clusters) – Charsadda, Charsadda Central, Tangi-Shabqadar

Sub-Zone 3.3: Kohat-Karak

- **WW-C5: Hangu-Kohat Cluster** (2 sub-clusters) - Kohat, Hangu, Orakzai - Tanda Dam, Kohat Toi
- **WW-C6: Banda Daud Shah-Lachi-Shakardara Cluster** (2 sub-clusters) – Lachi-Shakardara, Banda Daud Shah.

Sub-Zone 3.4: Hangu-Karak-North Waziristan-Bannu-Lakki Marwat

- **WW-C7: Hangu-North Waziristan Cluster (2 sub-cluster**) – Lower Kurram-Tall (Hangu), North Waziristan
- **WW-C8: Bannu-South Karak Cluster (2 sub-clusters)-** Bannu, South Karak
- **WW-C9: Lakki Marwat Cluster (1 sub-cluster).** Lakki Marwat

Sub-Zone 3.5: DI Khan-Tank-Lower South Waziristan

- **WW-C10: DI Khan Cluster** (1 sub-cluster) – Kulachi, Paharpur-Paroha (CRBC command area)
- **WW-C11: Tank-South Waziristan Lower Cluster (2 sub-clusters)-** Tank, South Waziristan Lower-Gomal Zam
- **WW-C12: Darazinda Cluster (1 sub-cluster)-**Darazinda

5.1.4 Zone-4: Saline Water Aquaculture Zone (3 Clusters, 4 Sub-Clusters)

Sub-Zone 4.1: Saline Water Aquaculture - SA-C1: Lakki Marwat Saline Cluster (1 sub-cluster) - Lakki Marwat - Lakki Marwat Saline

- **SA-C2: DI Khan-Tank Saline Cluster** (2 sub-clusters) - Dera Ismail Khan, Tank
- **SA-C3: Karak Saline Cluster** (1 sub-cluster) - Karak

5.2 Zone Delineation Criteria

Each zone has been delineated based on:

- **Agro-Ecological Characteristics:** Temperature regime, elevation, rainfall, soil type
- **Water Resources:** River systems, stream networks, dam locations, groundwater availability
- **Geographic Proximity:** Contiguous districts and areas with shared water resources
- **Elevation Zones:** Altitude-based classification supporting different species
- **Existing Aquaculture Activities:** Current farm distribution and farmer networks.

6 ZONE & CLUSTER PROFILES

This section provides detailed profiles of each high-potential aquaculture Zones, Sub zones and Clusters identified within them. The focus is on geographic, hydrological, and spatial characteristics, integrating data from the comprehensive site-level inventory.

6.1 COLD-WATER ZONE (ZONE-1)

The cold-water zone comprises five sub-zones and five clusters with details as below:

6.1.1 Sub-Zone 1: High Altitude Trout & Premium Cold-Water Clusters

1. **Geographic Extent**: Chitral, Dir Upper, Dir Lower.
2. **Elevation Range**: 700-3,500 meters.
3. **Characteristics**: This zone represents the high-altitude, remote, and pristine environments of northern KP. It is characterized by its exceptional water quality, derived from glacial melt and high-mountain springs, making it ideal for premium, export-quality trout production. While infrastructure is a challenge, the unique environmental conditions offer a significant competitive advantage for high-value niche markets.

6.1.1.1 Cluster CW-C1: Chitral Cluster

1. **Districts**: Chitral
2. **Primary Water Source**: Chitral River and its numerous tributaries (e.g., Lutkho, Turikho, Mastuj), Panjkora River.
3. **Sub**-Clusters:

    - Sub-Clusters: Lower Chitral,
    - Sub-Clusters: Kalash Valleys,
    - Sub-Clusters: Garam Chashma,
    - Sub-Clusters: Upper Chitral,
    - Sub-Clusters: Kumrat Valley.

4. **Spatial & Hydrological Characteristics**: Water quality is excellent (7-18°C, high dissolved oxygen). The topography consists of steep, narrow valleys suitable for raceway systems. Accessibility has improved with the Lowari Tunnel, but upper valleys remain a challenge.

6.1.2 Sub-Zone 2: Northern Emerging Premium Cold-Water Clusters

1. **Geographic Extent:** Kohistan, Shangla, Upper Kuram, Orakzai, Khyber
2. **Elevation Range:** 600-2500 meters.
3. **Characteristics:** This zone represents a critical transitional ecological niche, where water temperatures are too warm for year-round trout production but cooler than the main carp-

producing plains. This allows for unique opportunities for multi-species and seasonal aquaculture, particularly for the native Mahseer.

6.1.2.1 Cluster CW-C2: Kohistan-Shangla Cluster

1. **Districts:** Kohistan, Shangla
2. **Primary Water Source:** Indus River (upper reaches).
3. **Spatial & Hydrological Characteristics**: Water quality is excellent. The topography is extremely rugged and mountainous, with high risks of landslides. The Karakoram Highway (KKH) provides a strategic corridor, but access to lateral valleys is difficult.
4. **Sub-Clusters**:

    - Kandia Valley,
    - Dassu-Jalkot,
    - Pattan-Dubair Corridor,
    - Palas/Kolai,
    - Alpuri,
    - Battagram,
    - Siran Valley

- **Spatial & Hydrological Characteristics**: Water quality is excellent. The topography is extremely rugged and mountainous, with high risks of landslides. The Karakoram Highway (KKH) provides a strategic corridor, but access to lateral valleys is difficult.

6.1.2.2 Cluster CW-C3: Upper Kuram – Orakzai – Khyber Cluster

1. **Districts**: **Kuram – Orakzai – Khyber**
2. **Primary Water Source**: River Kuram, Zeran Khawarh, Shahlozan Khawarh, Malana Khawrh, Pawar stream, Karman Stream, Kot Ragha Small Dam, Dall Spring, Aka Khel Spring in Kurram; River Sarwakai, Madarsa stream, Majid Stream, Mole khan Sari cold water Stream, Haji Abad Stream, Peer Kalai Stream and River Makeen in South Waziristan.
3. **Sub-Clusters**:

    - Upper-Kurram Spin Ghar (Kohi Safed)
    - Khyber,
    - Lower Orakzai

4. **Spatial & Hydrological Characteristics**: Water quality is excellent. The topography is extremely rugged and mountainous, with high risks of landslides. The Karakoram Highway (KKH) provides a strategic corridor, but access to lateral valleys is difficult.

6.1.2.3 CW-C4: Waziristan Cluster

1. **Districts**: **North Waziristan, South Waziristan**
2. **Primary Water Source**: River Kuram, Zeran Khawarh, Shahlozan Khawarh, Malana Khawrh, Pawar stream, Karman Stream, Kot Ragha Small Dam, Dall Spring, Aka Khel Spring in Kurram; River Sarwakai, Madarsa stream, Majid Stream, Mole khan Sari cold water Stream, Haji Abad Stream, Peer Kalai Stream and River Makeen in South Waziristan.
3. **Sub-Clusters**:

    - North Waziristan
    - South Waziristan Upper

2. **Spatial & Hydrological Characteristics**: Water quality is excellent. The topography is extremely rugged and mountainous, with high risks of landslides. The Karakoram Highway (KKH) provides a strategic corridor, but access to lateral valleys is difficult.

6.1.3 Sub-Zone 3: Swat Established Trout Clusters

1. **Geographic Extent**: Swat.
2. **Elevation Range**: 800-2,500 meters.
3. **Characteristics**: This is the commercial heartland of trout farming in KP, benefiting from excellent water resources, established infrastructure, experienced farmers, and a strong tourism market.

6.1.3.1 Cluster CW-C5: Swat Valley Cluster

- **Districts**: Swat.
- **Primary Water Source**: Swat River and its tributaries.
- **Sub-Clusters**:

    - Kalam-Utror-Gabral,
    - Madyan-Bahrain,
    - Malam Jabba-Miandam-Beha/Gabin Jabba

- **Spatial & Hydrological Characteristics**: Water quality is generally excellent but faces pressure from tourism-related pollution. It is a well-defined, linear cluster along the Swat River with excellent road access.

6.1.4 Sub-Zone 5: Mansehra Established Trout Clusters

1. **Geographic Extent**: Mansehra, Abbottabad.
2. **Elevation Range**: 800-2,500 meters.
3. **Characteristics**: A major commercial trout farming zone with excellent water, infrastructure, and a strong tourism market, poised for significant expansion.

6.1.4.1 Cluster CW-C6: Kaghan Valley Cluster

1. **Districts**: Mansehra.
2. **Primary Water Source**: Kunhar River.

3. **Sub-Clusters**:
    - Naran-Batakundi
    - Kaghan-Jared, Shino-Ghanool

4. **Spatial & Hydrological Characteristics**: Excellent water quality from the Kunhar River. It is a linear cluster along the N-15 highway, though upper parts are inaccessible in winter.

SUB-ZONE 1.1: HIGH ALTITUDE TROUT & PREMIUM COLD-WATER

Chitral, Dir Upper, Dir Lower

Overview & Map

Key Metrics

Elevation
(700-3,500m)

Temp
(7-18°C)

Species
(Rainbow/Brown Trout)

Clusters & Characteristics

Cluster Details

Chitral Cluster (CW-C1)

- Lower Chitral
- Kalash Valleys
- Garam Chashma
- Upper Chitral
- Kumrat Valley

Strategic Rationale:
Premium Export Hub

SWOT Analysis

Pristine water, Optimal temp	Remote, Harsh winters
Organic Certification, Export	Climate change

Water Quality

Temp
(7-18°C)

pH
(7.0-8.0)

Source

Glacial Melt/Springs

Investment Potential

- ROI: 25-30%
- Payback: 3.5-4.5 Years
- Price: PKR 1,000-1,500/kg

Key Priorities

- ✓ Cold Chain
- ✓ Export Linkages

Development Roadmap

Short Term (1-2 Yrs)

- Capacity Building
- Infrastructure
- Quality Certification

Medium Term (3-5 Yrs)

- Local Processing
- Organic Status
- Agro-Tourism

Long Term (6+ Yrs)

- Export Hub
- Climate-Resilient Systems
- Tech Adoption

SUB-ZONE 1.2: NORTHERN EMERGING PREMIUM COLD-WATER

Kohistan

Overview & Map

Key Metrics

Elevation
(600-1,500m)

Temp
(12-20°C)

Species
(Mahseer, Seasonal Trout)

Clusters & Characteristics

Cluster Details

Kohistan Cluster (CW-C2)

Sub-Cluster:
Pattan-Dassu Corridor

- Lower Valley
- Pattan Chashma
- Kumrat Valley

Strategic Rationale:
Native Species Conservation & Breeding

SWOT Analysis

Excellent water, KKH access	Rugged terrain, Landslide risk
Eco-Tourism, Mahseer breeding	Geological hazards

Water Quality

Temp
(12-20°C)

pH
(7.0-8.0)

Source

Upper Indus River

Development Roadmap

Short Term (1-2 Yrs)

- Risk Assessment
- Mahseer Conservation
- Capacity Building

Medium Term (3-5 Yrs)

- Hatchery Infrastructure
- Pilot Cage Culture
- Eco-Tourism

Long Term (6+ Yrs)

- Regional Breeding Hub
- Native Species Market
- Sustainability

Investment Potential

ROI: 20-25%

Payback: 4-5 Years

Price: PKR 800-1,200/kg

Key Priorities

- ✓ Risk Management
- ✓ Mahseer Conservation

SUB-ZONE 1.3: WESTERN EMERGING PREMIUM COLD-WATER

Kurram, South Waziristan

Overview & Map

Key Metrics

Elevation (1,000-2,500m)

Temp (8-18°C)

Species (Rainbow/Brown Trout)

Clusters & Characteristics

Cluster Details

Upper Kuram & South Waziristan Cluster (CW-C3)

Sub-Cluster:

Spb-Clusters:

- Spin Ghar (Kohi Safed)
- South Waziristan Upper

Strategic Rationale: Peace Dividend Frontier

SWOT Analysis

Strengths	Weaknesses
Pristine water, Optimal temp	Extremely remote, Security
Opportunities	**Threats**
Peace Dividend, Organic potential	Security instability

Water Quality

Temp (8-18°C)

pH (7.0-8.0)

Source

Mountain Springs

Development Roadmap

Short Term (1-2 Yrs)

- Security Assessment
- Water Mapping
- Community Pilots

Medium Term (3-5 Yrs)

- Basic Infrastructure
- Pilot Farms
- Farmer Cooperatives

Long Term (6+ Yrs)

- Regional Hub
- Premium Market Positioning
- Export Chains

Investment Potential

ROI: 22-28%

Payback: 4-5 Years

Price: PKR 1,000-1,500/kg

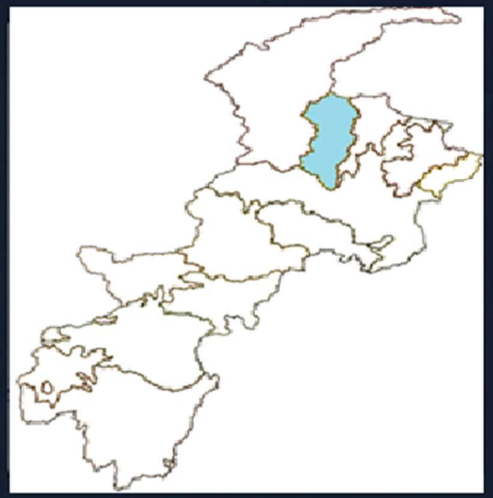
Key Priorities

- ✓ Security
- ✓ Basic Infrastructure

SUB-ZONE 1.4: SWAT ESTABLISHED TROUT

Swat

Overview & Map



Key Metrics

Elevation (800-2,500m)

***Temp** (8-18°C)

Species (Rainbow/Brown Trout)

Clusters & Characteristics

Cluster Details

Swat Valley Cluster (CW-C4)

- Madyan-Bahrain
- Kalam-Utror
- Miandam

Strategic Rationale: Commercial Heartland

SWOT Analysis

Strengths	Weaknesses
Established infrastructure, Strong market	Tourism pollution, Limited space
Opportunities	**Threats**
Value addition, Expansion	Environmental degradation

Water Quality

Temp (8-18°C)

pH (7.0-8.0)

Source (Swat River)

Investment Potential

ROI: 28-35%

Payback: 2.5-3.5 Years

Price: PKR 800-1,200/kg

Key Priorities:

- Processing Infrastructure
- Water Management

Development Roadmap

Short Term (1-2 Yrs)

- Pollution Control
- Tech Training
- Processing Feasibility

Medium Term (3-5 Yrs)

- Adjacent Valley Expansion
- Local Processing
- Agro-Tourism

Long Term (6+ Yrs)

- Commercial Export Hub
- Eco-Friendly Scale
- Premium Branding

SUB-ZONE 1.5: MANSEHRA ESTABLISHED TROUT

Mansehra, Abbottabad

Overview & Map

Key Metrics

Elevation (800-2,500m)

***Temp** (8-18°C)

Species (Rainbow/Brown Trout)

Clusters & Characteristics

Cluster Details

Kaghan Valley Cluster (CW-C5)

- Naran-Batakundi
- Kaghan-Jared
- Shino-Ghanool

Strategic Rationale: Islamabad Gateway Hub

SWOT Analysis

Strengths	Weaknesses
Excellent water, Islamabad proximity	Winter access, Limited space
Opportunities	**Threats**
Export gateway, Seed hub	Tourism pressure

Water Quality

Temp (8-18°C)

pH (7.0-8.0)

Source (Kunhar River)

Investment Potential

ROI: 30-38%

Payback: 2-3 Years

Price: PKR 800-1,200/kg

Key Priorities:

- Winter Infrastructure
- Processing
- Seed

Development Roadmap

Short Term (1-2 Yrs)

- Winter Access
- Seed Expansion
- Market Linkages

Medium Term (3-5 Yrs)

- Local Processing
- Adjacent Valleys
- Agro-Tourism

Long Term (6+ Yrs)

- Export Hub
- Seed Export
- Premium Branding

6.2 SEMI-COLD-WATER ZONES (ZONE-2)

The Semi-Cold-Water zone comprises two sub-zones and four clusters with details as below:

6.2.1 Sub-Zone 1: Northern Semi-Cold-Water Clusters

- **Geographic Extent**: Haripur, Abbottabad, Mansehra, Battagram, Shangla, Tor Ghar, Buner, Lower Dir, Swat (Lower reaches), Bajaur, Malakand (upper reaches).
- **Elevation Range**: 600-1,500 meters.
- **Characteristics**: This zone is a critical transitional ecological niche where water temperatures are too warm for year-round trout but cooler than the main carp-producing plains. This allows for unique opportunities for multi-species and seasonal aquaculture, particularly for the native Mahseer.

6.2.1.1 Cluster SC-C1: Hazara Semi Cold Cluster

- **Districts**: Mansehra, Abbottabad, Kohistan (low lying area), Battagram, Shangla (low lying area), Tor Ghar, Buner, Lower Dir and Swat (Lower reaches), Bajaur, Malakand (upper reaches).
- **Primary Water Source**: Siran River, Dor River, Haro River, Indus River and its tributaries.
- **Sub-Clusters**:
    - Paras-Balakot Sub Cluster
    - Siran Valley Sub Cluster
    - Abbotabad-Havelian Pond Sub Cluster
    - Tor Ghar-Battagram-Shangla Sub Cluster
    - Kohistan Sub Cluster
    - Buner-Lower Sub Cluster
    - Swat-Lower Dir-Bajaur Sub Cluster
- **Spatial & Hydrological Characteristics**: Water quality is good but more variable. The topography is a mix of river valleys and rolling hills, suitable for both pond and raceway culture. Accessibility is excellent.

6.2.1.2 Cluster SC-C2: Swat-Panjkora Semi Cold Cluster

- **Districts**: Swat (lower reaches), Buner, Lower Dir, Bajaur.
- **Primary Water Source**: Swat River, Panjkora River, and their tributaries.
- **Sub-Clusters**:
    - Buner-Swat sub-cluster
    - Bajaur-Dir sub-cluster.

- **Spatial & Hydrological Characteristics**: Good but variable water quality. Topography includes river valleys and hills suitable for ponds and raceways. Excellent accessibility to major urban centers.

6.2.2 Sub-Zone 2: Western Semi-Cold-Water Clusters

- **Geographic Extent**: Orakzai, Kurram, Hangu, Khyber, North Waziristan, Upper South Waziristan.
- **Elevation Range**: 600-1,500 meters.
- **Characteristics**: This zone represents a critical transitional ecological niche, ideal for multi-species and seasonal aquaculture, particularly for native Mahseer.

6.2.2.1 Cluster SC-C3: Kurram-Orakzai Semi Cold Cluster

- **Districts**: Orakzai, Kurram, Hangu
- **Primary Water Source**: Bara River, River Tochi, Kohat Toi, Hangu Toi, Khanki Toi, Sepaya River, River Sarwakai, Gomal Dam, Zawo Dam, Milward Dam, Spera Dam.
- **Sub-Clusters**:
    - Kurram Sub Cluster
    - Orakzai Sub Cluster.
- **Spatial & Hydrological Characteristics**: Water quality is generally moderate to good. The topography is mountainous and hilly, with accessibility being a challenge in remote areas. There is moderate to good development potential.

6.2.2.2 Cluster SC-C4: Waziristan Semi Cold Cluster

- **Districts**: North Waziristan, Upper South Waziristan.
- **Primary Water Source**: Tochi River, Gomal River, and various seasonal streams.
- **Sub-Clusters**:
    - Wana Sub Cluster
    - Birmal Sub Cluster
    - Tiarza Sub Cluster
    - Serwakai Sub Cluster
    - Sararogha Sub Cluster
    - Shawal Sub Cluster
- **Spatial & Hydrological Characteristics**: Water quality is dependent on seasonal flows. The topography is rugged and mountainous. Accessibility is limited, but there is potential for development focused on local markets.

SUB-ZONE 2.1: NORTHERN SEMI-COLD-WATER

Hazara, Swat-Panjkora Regions

Overview & Map

Key Metrics

Elevation (600-1,500m)

***Temp** (15-24°C)

Species (Mahseer, Carp)

Clusters & Characteristics

Cluster Details

Hazara Semi Cold Cluster (SC-C1)

- Swat-Panjkora Semi Cold Cluster (SC-C2)

Strategic Rationale: Transitional Ecological Niche

SWOT Analysis

Strengths	Weaknesses
Multi-species potential Excellent access	Variable water quality Limited Mahseer experience
Opportunities	**Threats**
Mahseer conservation Agro-integration	Pollution Water extraction

Water Quality

Temp (15-24°C)

pH (7.0-8.0)

Source (Siran, Swat Rivers)

Investment Potential

ROI: 18-25%

Payback: 3.5-4.5 Years

Price: PKR 600-1,000/kg

Key Priorities:

- Mahseer Breeding
- Agro-Integration

Development Roadmap

Short Term (1-2 Yrs)

- Water Monitoring
- Farmer Training
- Mahseer Pilots

Medium Term (3-5 Yrs)

- Breeding Centers
- Agro-Aqua Models
- Local Processing

Long Term (6+ Yrs)

- Regional Hub
- Premium Native Market
- Conservation

SUB-ZONE 2.2: WESTERN SEMI-COLD-WATER

Kurram, Orakzai, Waziristan Regions

Overview & Map

Key Metrics

Elevation (600-1,500m)

***Temp** (15-24°C)

Species (Mahseer, Carp)

Clusters & Characteristics

Cluster Details

Kurram-Orakzai Semi Cold Cluster (SC-C3)
- Waziristan Semi Cold Cluster (SC-C4)

Strategic Rationale: Emerging Dam-Based Frontier

SWOT Analysis

Strengths	Weaknesses
Dam resources Multi-species potential	Remote access Dependent on seasonal flows
Opportunities	**Threats**
Dam cage culture Peace dividend	Security instability Droughts

Water Quality

Temp (15-24°C)

pH (7.0-8.0)

Source (Rivers & Dams)

Investment Potential

ROI: 15-22%
Payback: 4-5 Years
Price: PKR 600-1,000/kg

Key Priorities:
- Security/Access
- Dam Cage Culture

Development Roadmap

Short Term (1-2 Yrs)
- Security Assessment
- Dam Surveys
- Farmer Awareness

Medium Term (3-5 Yrs)
- Dam Cage Pilots
- Breeding Centers
- Cooperatives

Long Term (6+ Yrs)
- Regional Hub
- Organic Market
- Integrated Development

6.3 WARM-WATER ZONES (ZONE-3)

The Warm-Water Zone comprises five sub-zones and twelve clusters with details as below:

6.3.1 Sub-Zone 1: Haripur-Swabi-Mardan Cluster

- **Geographic Extent**: Haripur, Swabi, Mardan.
- **Elevation Range**: 300-600 meters.
- **Characteristics**: A major agricultural zone with well-developed irrigation infrastructure, holding significant potential for integrating aquaculture into the existing agricultural landscape.

6.3.1.1 Cluster WW-C1: Haripur-Swabi-Mardan Plains Cluster

- **Districts**: Haripur, Swabi, Mardan.
- **Primary Water Source**: Swat River, Indus River, Pehur High-Level Canal.
- **Sub-Clusters:**
    - Haripur Sub-Cluster,
    - Swabi-Pehur Canal Sub-Cluster,
    - Mardan Sub-Cluster.
- **Spatial & Hydrological Characteristics**: Good water quality from reliable irrigation systems. The topography is flat plains, suitable for large-scale pond development. Excellent accessibility.

6.3.2 Sub-Zone 2: Peshawar Plain Warm-Water Clusters

- **Geographic Extent**: Peshawar, Charsadda, Nowshera, Khyber.
- **Elevation Range**: 250-500 meters.
- **Characteristics**: The most populous and economically active region of KP, with a huge unmet demand for fish. It is characterized by extensive irrigation infrastructure and proximity to the largest urban market in the province.

6.3.2.1 Cluster WW-C2: Peshawar-Nowshera-Charsadda Cluster

- **Districts**: Peshawar, Nowshera, Charsadda.
- **Primary Water Source**: Kabul River, Bara River, Warsak Dam canals.
- **Sub-Clusters**:
    - Sherabad Sub-Cluster
    - Azakhel-Pabbi Sub-Cluster.
- **Spatial & Hydrological Characteristics**: Moderate water quality with some pollution. Flat plains ideal for large-scale ponds. Excellent accessibility.

6.3.2.2 Cluster WW-C3: Mahmad-Khyber Emerging Cluster

- **Districts**: Peshawar, Nowshera, Charsadda, Khyber.
- **Primary Water Source**: Kabul River, Bara River, Warsak Dam canals.
- **Sub-Clusters**:

- Mahmad Sub Cluster
- Khyber Sub Cluster

- **Spatial & Hydrological Characteristics**: Water quality is moderate. Topography is mainly flat plains. Accessibility is good, providing potential for supplying nearby urban centers.

6.3.2.3 Cluster WW-C4: Charsadda Canal-Fed Cluster

- **Districts**: Charsadda.
- **Primary Water Source**: Swat River, Khyali River, Jindi River, and an extensive network of irrigation canals.
- **Sub-Clusters**:
  - Charsadda Central Sub-Cluster
  - Tangi-Shabqadar Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Generally good water quality from irrigation canals. Flat and fertile topography. Good accessibility to Peshawar and Mardan markets.

6.3.3 Sub-Zone 3: Kohat-Karak Clusters

- **Geographic Extent**: Kohat, Karak, Hangu.
- **Elevation Range**: 400-800 meters.
- **Characteristics**: An arid to semi-arid zone characterized by a cluster of small and medium-sized dams, with good potential for developing community-based aquaculture.

6.3.3.1 Cluster WW-C5: Hangu-Lachi-Kohat Cluster

- **Districts**: Kohat, Hangu, Orakzai.
- **Primary Water Source**: Tanda Dam, Kohat Toi, and other smaller dams.
- **Sub-Clusters**:
  - Tanda Dam Sub-Cluster
  - Kohat Toi Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Generally good water quality, but levels can fluctuate. Rolling hills and plains suitable for pond development near dams. Good road connections.

6.3.3.2 Cluster WW-C6: Banda Daud Shah-Shakardara Cluster

- **Districts**: Karak, Kohat.
- **Primary Water Source**: Numerous small dams.
- **Sub-Clusters**:

- Karak Central Sub-Cluster
- Shakardara Sub Cluster
- Banda Daud Shah Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Variable water quality. Arid and hilly topography with limited sites for pond development. Moderate accessibility.

6.3.4 Sub-Zone 4: Hangu-Karak-North Waziristan-Bannu-Lakki Clusters

- **Geographic Extent**: Hangu, Karak, North Waziristan, Bannu, Lakki Marwat.
- **Elevation Range**: 150-800 meters.
- **Characteristics**: This is a diverse warm-water zone with a mix of arid plains, rolling hills, and riverine systems. It has significant potential for carp and tilapia culture, leveraging water from rivers and dam projects.

6.3.4.1 Cluster WW-C7: Hangu-North Waziristan Cluster

- **Districts**: Hangu, North Waziristan.
- **Primary Water Source**: Tochi River, Kohat Toi, and various small dams.
- **Sub-Clusters**:
  - Hangu Dam Sub Cluster
  - Tochi River Basin Sub Cluster.

- **Spatial & Hydrological Characteristics**: Water quality is moderate and subject to seasonal variations. The topography is a mix of hilly areas and plains. Accessibility varies, with main roads providing good connections.

6.3.4.2 Cluster WW-C8: Bannu-South Karak Cluster

- **Districts**: Bannu, Karak.
- **Primary Water Source**: Kurram River, Baran Dam, and local irrigation systems.
- **Sub-Clusters**:
  - Bannu Plains Sub Cluster
  - Karak Dams Sub Cluster.

- **Spatial & Hydrological Characteristics**: Water quality is generally good, supported by dam releases and river flow. The topography consists of flat plains and rolling hills, ideal for pond culture. Good accessibility to local markets.

6.3.4.3 Cluster WW-C9: Lakki Marwat Cluster

- **Districts**: Lakki Marwat.
- **Primary Water Source**: Gomal River, Pezu canals, and various small dams.
- **Sub-Clusters**:

- Lakki Plains Sub Cluster,
- Pezu Canal-Fed Sub Cluster.

- **Spatial & Hydrological Characteristics**: Water quality is moderate, with some salinity in groundwater. The topography is mainly sandy plains and low hills. Good accessibility along the Indus Highway.

6.3.5 Sub-Zone 5: Di Khan-Tank–Lower South Waziristan Clusters

- **Geographic Extent**: Dera Ismail Khan, Tank, Lower South Waziristan.
- **Elevation Range**: 150-400 meters.
- **Characteristics**: The hottest and most arid region of KP. The development of the Gomal Zam Dam has created a major new water resource, transforming the potential for aquaculture in this zone.

6.3.5.1 Cluster WW-C10: DI Khan Cluster

- **Districts**: Dera Ismail Khan, Tank.
- **Primary Water Source**: Gomal Zam Dam, Chashma Right Bank Canal (CRBC).
- **Sub-Clusters**:
  - Gomal Zam Dam Sub-Cluster
  - CRBC Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Good water quality with a reliable supply. Flat plains ideal for large-scale pond development. Good accessibility.

6.3.5.2 Cluster WW-C11: Tank-Zam Cluster

- **Districts**: Tank, Lower South Waziristan.
- **Primary Water Source**: Gomal Zam Dam command area, local streams.
- **Sub-Clusters**:
  - Tank Sub-Cluster
  - Gomal Zam Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Moderate water quality. Flat plains suitable for pond culture. Good road connections.

6.3.5.3 Cluster WW-C12: Lower South Waziristan Cluster

- **Districts**: Lower South Waziristan.
- **Primary Water Source**: Gomal Zam Dam command area, local streams.
- **Sub-Clusters**:
  - Lower South Waziristan Sub-Cluster.

- **Spatial & Hydrological Characteristics**: Moderate water quality. Flat plains suitable for pond culture. Accessibility is improving.

SUB-ZONE 3.1: HARIPUR-SWABI-MARDAN

Agricultural Integration Zone

Overview & Map

Key Metrics

Elevation (300-600m)

***Temp** (18-32°C)

Species (Carp, Tilapia)

Clusters & Characteristics

Cluster Details

Haripur-Swabi-Mardan Plains Cluster (WW-C1)

- Sub-Clusters:
  - Haripur
  - Swabi-Pehur Canal
  - Mardan

Strategic Rationale: Agro-Integration Hub

SWOT Analysis

Strengths	Weaknesses
Irrigation infrastructure, Flat plains	Limited processing, Water competition
Opportunities	**Threats**
Agro-integration, Large-scale expansion	Agricultural runoff, Climate change

Water Quality

Temp (18-32°C)

pH (7.0-8.0)

Source (Swat, Indus Rivers, Canals)

Investment Potential

ROI: 25-32%

Payback: 2.5-3.5 Years

Price: PKR 400-800/kg

Key Priorities:

- Agro-Integration
- Processing
- Scale

Development Roadmap

Short Term (1-2 Yrs)

- Pilot Agro-Aqua Farms
- Farmer Training
- Market Linkages

Medium Term (3-5 Yrs)

- Local Processing
- Scale-up Ponds
- Strengthen Cooperatives

Long Term (6+ Yrs)

- Regional Hub
- Advanced Integration
- Export Capacity

SUB-ZONE 3.2: PESHAWAR PLAIN WARM-WATER

Commercial Urban Supply Hub

Overview & Map

Key Metrics

Elevation (250-500m)

Temp (18-32°C)

Species (Carp, Tilapia)

Clusters & Characteristics

Cluster Details

Peshawar-Nowshera-Charsadda Cluster (WW-C2)

- Mahmad-Khyber Emerging Cluster (WW-C3)
- Charsadda Canal-Fed Cluster (WW-C4)

Strategic Rationale: Provincial Commercial Hub

SWOT Analysis

Strengths	Weaknesses
Largest urban market, Massive demand	Urban pollution, Weak cold chain
Opportunities	**Threats**
Import substitution, Commercial scale	Industrial pollution, Urban expansion

Water Quality

Temp (18-32°C)

pH (7.0-8.0)

Source (Kabul, Bara Rivers)

Investment Potential

ROI: 28-35%

Payback: 2-3 Years

Market Gap: 4,000+ Tons

Key Priorities:

- Large-Scale Ponds
- Processing
- Urban Linkages

Development Roadmap

Short Term (1-2 Yrs)

- Commercial Pilots
- Water Monitoring
- Direct Linkages

Medium Term (3-5 Yrs)

- Commercial Processing
- Scale-up Ponds
- Cold Chain

Long Term (6+ Yrs)

- Provincial Hub
- Import Substitution
- Integrated Chain

SUB-ZONE 3.3: KOHAT-KARAK

Community-Based Dam Hub

Overview & Map

Key Metrics

Elevation (400-800m)

***Temp** (18-22°C)

Species (Carp, Tilapia)

Clusters & Characteristics

Cluster Details

Hangu-Lachi-Kohat Cluster Cluster (WW-C5)

- Banda Daud Shah-Shakardara Cluster Cluster (WW-C6)

Strategic Rationale: Community-Based Dam Hub

SWOT Analysis

Strengths	Weaknesses
Abundant small dams, Good water quality	Variable water levels, Arid climate
Opportunities	**Threats**
Community model, Dam cage culture	Water fluctuations, Competing demands

Water Quality

Temp (18-22°C)

pH (7.0-8.0)

Source (Tanda Dam, Kohat Toi)

Investment Potential

ROI: 22-28%

Payback: 3-4 Years

Price: PKR 350-700/kg

Key Priorities:

- Dam-Based Cages
- Community Cooperatives
- Local Processing

Development Roadmap

Short Term (1-2 Yrs)

- Pilot Cage Culture
- Community Training
- Form Cooperatives

Medium Term (3-5 Yrs)

- Expand Cage Culture
- Local Processing
- Regional Linkages

Long Term (6+ Yrs)

- Integrated Supply Chain
- Water-Efficient Systems
- Regional Hub

SUB-ZONE 3.4: SOUTHERN DIVERSE WARM-WATER

Multi-System Growth Zone

Overview & Map

Key Metrics

- **Elevation** (150-800m)
- ***Temp** (18-32°C)
- **Species** (Carp, Tilapia)

Clusters & Characteristics

Cluster Details

- Hangu-North Waziristan Cluster (WW-C7)
- Bannu-South Karak Cluster (WW-C8)
- Lakki Marwat Cluster (WW-C9)

Strategic Rationale: Diverse Warm-Water Growth Zone

SWOT Analysis

Strengths	Weaknesses
Diverse water sources, Good accessibility	Limited processing, Seasonal water
Opportunities	**Threats**
Diverse systems, Regional markets	Water fluctuations, Climate change

Water Quality

- **Temp** (18-32°C)
- **pH** (7.0-8.0)
- **Source** (Kurram, Tochi Rivers)

Investment Potential

ROI: 25-30%

Payback: 2.5-3.5 Years

Target: 800-1,200 Tons

Key Priorities

- ✓ Diverse Farming Systems
- ✓ Commercial Ponds
- ✓ Regional Linkages

Development Roadmap

Short Term (1-2 Yrs)

- Establish Pilots
- Farmer Training
- Form Cooperatives

Medium Term (3-5 Yrs)

- Scale Commercial Ponds
- Local Processing
- Market Ties

Long Term (6+ Yrs)

- Major Southern Hub
- Integrated Supply Chain
- Export Potential

SUB-ZONE 3.5: DI KHAN-TANK-LOWER SOUTH WAZIRISTAN

Southern Arid Frontier - Gomal Zam Transformation Zone

Overview & Map

Key Metrics

- **Elevation** (150-400m)
- ***Temp** (20-32°C)
- **Species** (Carp, Tilapia, Vannamei Shrimp)

Investment Potential

ROI: 28-35%

Payback: 2-3 Years

Target: 1,200-1,800 Tons

Key Priorities

- ✓ Gomal Zam Utilization
- ✓ Saline Shrimp Farming
- ✓ Processing Infrastructure

Clusters & Characteristics

Cluster Details

- DI Khan Cluster (WW-C10)
- Tank-Zam Cluster (WW-C11)
- Lower South Waziristan Cluster (WW-C12)

Strategic Rationale: Gomal Zam Transformation Zone

SWOT Analysis

Strengths	Weaknesses
Gomal Zam Dam, Flat plains	Limited processing, Arid climate
Opportunities	**Threats**
Dam expansion, Saline shrimp	Water allocation, Climate change

Water Quality

- **Temp** (20-32°C)
- **pH** (7.0-8.0)
- **Source** (Gomal Zam Dam, CRBC)

Development Roadmap

Short Term (1-2 Yrs)

- Pilot Farms (Fresh/Saline)
- Farmer Training
- Feasibility Studies

Medium Term (3-5 Yrs)

- Scale Commercial Ponds
- Develop Saline Shrimp
- Local Processing

Long Term (6+ Yrs)

- Major Southern Hub
- Shrimp Export Market
- Integrated Supply Chain

6.4 SALINE WATER AQUACULTURE ZONE (ZONE-4)

The Saline Water Zone represents a highly promising, emerging opportunity for aquaculture diversification in KP. The saline groundwater in these clusters originates primarily from natural rock salt deposits, resulting in salinity levels (typically 3-9 ppt) that are optimal for the cultivation of Vannamei shrimp (*Litopenaeus vannamei*). Vannamei shrimp are euryhaline, meaning they can adapt to a wide range of salinities, making them exceptionally well-suited for this unique inland environment. The strategic selection of this species is driven by its high global market demand, established intensive production protocols, and relatively high disease resistance. Development of these clusters could significantly elevate the economic value of aquaculture in regions traditionally considered unsuitable for conventional freshwater fish farming.

6.4.1 Sub-Zone 1: Saline Water Mixed Clusters

6.4.1.1 Cluster SA-C1: Lakki Marwat Saline Cluster

- **Districts**: Lakki Marwat.
- **Geographic Extent**: Identified saline groundwater areas within Lakki Marwat district.
- **Elevation Range**: 150-400 meters.
- **Primary Water Source**: Underground saline groundwater.
- **Sub-Clusters**:
    - Laki Marvat Sub-Cluster.
- **Characteristics**: The area contains saline to highly saline groundwater, identified as having high potential for Vannamei shrimp farming. This transforms previously low-productivity land into a high-value aquaculture zone.

6.4.1.2 Cluster SA-C2: DI Khan-Tank Saline Cluster

- **Districts**: Dera Ismail Khan, Tank.
- **Geographic Extent**: Identified saline areas in DI Khan (PaharPur: Toba, Band korai) and Tank (Paroa: Qayum Nagar).
- **Elevation Range**: 150-400 meters.
- **Primary Water Source**: Underground saline groundwater.
- **Sub-Clusters**:
    - Dera Ismail Khan Sub-Cluster
    - Tank Sub-Cluster.
- **Characteristics**: These areas possess saline to highly saline groundwater resources, making them prime locations for inland shrimp culture, following the successful models in other parts of Pakistan.

6.4.1.3 Cluster SA-C3: Karak Saline Cluster

- **Districts**: Karak.
- **Geographic Extent**: Identified saline areas in Karak (Sara e naurang: Dudhe wala, Gamila).
- **Elevation Range**: 400-800 meters.
- **Primary Water Source**: Underground saline groundwater, with salinity influenced by natural rock salt deposits.
- **Sub-Clusters**:
    - Karak Sub-Cluster.
- **Characteristics**: The presence of rock salt contributes to the high salinity of the groundwater, creating a unique opportunity for high-density shrimp farming in a region not traditionally associated with aquaculture.

SUB-ZONE 4.1: SALINE WATER AQUACULTURE

Lakki Marwat Saline Cluster (SA-C1) - High-Value Saline Transformation

Overview & Map

Key Metrics

Elevation
150-400m

Temp
24-30°C

Species
Vannamei Shrimp

Investment Potential

- **ROI:** 35-45%
- **Payback:** 1.5-2.5 Years
- **Target:** 150-250 Tons

Key Priorities

- ✓ Pilot Shrimp Farms
- ✓ Technology Transfer
- ✓ Export Processing Infrastructure

Clusters & Characteristics

Cluster Details

Lakki Marwat Saline Cluster (SA-C1)

Strategic Rationale: High-Value Saline Transformation. Leveraging untapped saline groundwater to convert low-productivity land into a high-value export-oriented Vannamei shrimp production zone

SWOT Analysis

Strengths
- Abundant saline groundwater
- Good accessibility

Weaknesses
- No existing operations
- High initial capital

Opportunities
- High-value export
- Technology transfer

Threats
- Disease risks
- Market volatility

Water Quality

Temp
24-30°C

pH
7.0-8.2

Source
Saline Groundwater
5k-15k µS/cm

Development Roadmap

Short Term (1-2 Yrs)
- Pilot Farms
- Tech Transfer (Punjab)
- Feasibility Studies

Medium Term (3-5 Yrs)
- Scale Commercial Shrimp
- Export Processing
- Dedicated Cold Chain

Long Term (6+ Yrs)
- Regional Export Hub
- Organic Certification
- Integrated Supply Chain

7 SUMMARY STATISTICS: ZONES AND CLUSTERS

Table 2: Zone, Sub Zone and Cluster Level Summary Statistics

Zone ID	Sub-Zones	Name of Clusters	Type	Districts	Elevation Range (m)	Primary Species	Avg. Water Temp (°C)
Zone-1	1.1: High Altitude Trout & Premium Cold-Water Clusters	CW-C1 (Chitral)	Cold-water trout farming	Chitral	700-3,500	Rainbow Trout, Brown Trout, Snow Trout	**7-18**
Zone-1	1.2: Kohistan Emerging Premium Cold-Water	CW-C2 (Kohistan)	Cold-water trout farming	Kohistan	600-1,500	Rainbow Trout, Brown Trout	**10-16**
Zone-1	1.3: Upper Kuram and South Waziristan	CW-C3 (Upper Kuram & S. Waziristan)	Cold-water trout farming	Kurram, South Waziristan	1,000-2,500	Rainbow Trout, Brown Trout	**8-15**
Zone-1	1.4: Swat Established Trout	CW-C4 (Swat Valley)	Cold-water trout farming	Swat	800-2,500	Rainbow Trout, Brown Trout	**8-18**
Zone-1	1.5: Mansehra Established Trout	CW-C5 (Kaghan Valley)	Cold-water trout farming	Mansehra, Abbottabad	800-2,500	Rainbow Trout, Brown Trout	**8-18**
Zone-2	2.1: Northern Semi-Cold-Water Clusters	SC-C1 (Hazara Semi Cold)	Semi-cold water (Mahseer, mixed species)	Mansehra, Abbottabad, Kohistan, Battagram, Shangla, Tor Ghar, Buner, Lower Dir, Swat (lower), Bajaur, Malakand	600-1,500	Mahseer, Rohu, Silver Carp, Grass Carp	**15-20**
Zone-2		SC-C2 (Swat-Panjkora Semi Cold)	Semi-cold water (Mahseer, mixed species)	Swat (lower), Buner, Lower Dir, Bajaur	600-1,500	Mahseer, Rohu, Silver Carp	**15-20**
Zone-2	2.2: Western Semi-Cold-Water Clusters	SC-C3 (Kurram-Orakzai)	Semi-cold water (Mahseer, mixed species)	Orakzai, Kurram, Hangu, Khyber, North Waziristan, Upper South Waziristan	600-1,500	Mahseer, Rohu, Carp species	**15-20**

Zone-2		SC-C4 (Waziristan)	Semi-cold water (Mahseer, mixed species)	North Waziristan, Upper South Waziristan	600-1,500	Mahseer, Carp species	**15-20**
Zone-3	3.1: Haripur-Swabi-Mardan	WW-C1 (Haripur-Swabi-Mardan Plains)	Warm-water carp and tilapia farming	Haripur, Swabi, Mardan	300-600	Rohu, Catla, Mrigal, Tilapia	**20-28**
Zone-3	3.2: Peshawar Plain	WW-C2 (Peshawar-Nowshera-Charsadda)	Warm-water carp and tilapia farming	Peshawar, Nowshera, Charsadda	250-500	Rohu, Catla, Mrigal, Tilapia	**20-28**
Zone-3		WW-C3 (Mahmad-Khyber Emerging)	Warm-water carp and tilapia farming	Peshawar, Nowshera, Charsadda, Khyber	250-500	Rohu, Catla, Mrigal	**20-28**
Zone-3		WW-C4 (Charsadda Canal-Fed)	Warm-water carp and tilapia farming	Charsadda	250-500	Rohu, Catla, Mrigal	**20-28**
Zone-3	3.3: Kohat-Karak	WW-C5 (Hangu-Lachi-Kohat)	Warm-water carp and tilapia farming	Kohat, Hangu, Orakzai	400-800	Rohu, Catla, Mrigal, Tilapia	**18-26**
Zone-3		WW-C6 (Banda Daud Shah-Shakardara)	Warm-water carp and tilapia farming	Karak, Kohat	400-800	Rohu, Catla, Mrigal	**18-26**
Zone-3	3.4: Hangu-Karak-Bannu-Lakki	WW-C7 (Hangu-North Waziristan)	Warm-water carp and tilapia farming	Hangu, North Waziristan	150-800	Rohu, Catla, Mrigal, Tilapia	**18-28**
Zone-3		WW-C8 (Bannu-South Karak)	Warm-water carp and tilapia farming	Bannu, Karak	150-800	Rohu, Catla, Mrigal, Tilapia	**20-28**
Zone-3		WW-C9 (Lakki Marwat)	Warm-water carp and tilapia farming	Lakki Marwat	150-400	Rohu, Catla, Mrigal, Tilapia	**22-30**
Zone-3	3.5: DI Khan-Tank-Lower South Waziristan	WW-C10 (DI Khan)	Warm-water carp and tilapia farming	Dera Ismail Khan, Tank	150-400	Rohu, Catla, Mrigal, Tilapia	**24-32**
Zone-3		WW-C11 (Tank-Zam)	Warm-water carp	Tank, Lower South Waziristan	150-400	Rohu, Catla, Mrigal	**24-32**

			and tilapia farming				
Zone-3		WW-C12 (Lower South Waziristan)	Warm-water carp and tilapia farming	Lower South Waziristan	150-400	Rohu, Catla, Mrigal	**24-32**
Zone-4	4.1: Saline Mixed Clusters	SA-C1 (Lakki Marwat Saline)	Saline water shrimp farming	Lakki Marwat	150-400	Vannamei Shrimp	**24-30**
Zone-4		SA-C2 (DI Khan-Tank Saline)	Saline water shrimp farming	Dera Ismail Khan, Tank	150-400	Vannamei Shrimp	**24-32**
Zone-4		SA-C3 (Karak Saline)	Saline water shrimp farming	Karak	400-800	Vannamei Shrimp	20-28

Table 3: Summary by zones

Zone	**Sub-Zones**	**Clusters**	**Primary Type**
Zone-1: Cold-Water	5	5	Trout
Zone-2: Semi-Cold-Water	2	4	Mahseer/Mixed
Zone-3: Warm-Water	5	12	Carp/Tilapia
Zone-4: Saline Water	1	3	Shrimp
TOTAL	13	24	Mixed

Table 4: Water Quality Summary by Zone

Zone	**Temp Range (°C)**	**Avg. Temp (°C)**	**pH Range**	**Avg. pH**	**DO Range (mg/L)**	**Avg. DO (mg/L)**	**Conductivity Range (µS/cm)**	**Avg. Conductivity (µS/cm)**
Zone-1: Cold-Water Zone	8-16	12.5	6.5-7.8	7.1	8.0-11.0	9.5	150-350	250
Zone-2: Semi-Cold-Water Zone	15-20	17.5	6.8-8.0	7.4	6.5-9.0	7.8	200-450	325
Zone-3: Warm-Water Zone	20-32	26.0	6.4-8.5	7.5	4.0-8.0	6.0	250-600	425
Zone-4: Saline Water Zone	20-32	26.0	7.0-8.2	7.6	5.0-8.5	6.8	5,000-15,000	10,000

7.1 Development Priority Classification

A. Very High Priority (Immediate Development - 8 Clusters)

These clusters have excellent infrastructure, good market access, established or emerging aquaculture activities, and minimal constraints. They are ready for immediate commercial development and investment.

Tier 1: Ready for Immediate Scaling:

- **Charsadda Canal-Fed (WW-C4)**: Optimal infrastructure, shortest market distance (8 km), grid electricity, canal water, established farms
- **Peshawar-Nowshera-Charsadda (WW-C2)**: Best market access (10 km), excellent infrastructure, major urban market
- **Hazara Semi Cold (SC-C1)**: Excellent infrastructure, best market access (15 km), diverse species potential
- **Swat-Panjkora Semi Cold (SC-C2)**: Excellent Road access, good market proximity (20 km), established supply chain.

Tier 2: Ready for Development with Minor Support

- **Swat Valley (CW-C4)**: Established farms, excellent infrastructure, good market access (25 km)
- **Kaghan Valley (CW-C5)**: Existing farms, good water resources, renewable energy
- **Haripur-Swabi-Mardan Plains (WW-C1)**: Excellent infrastructure, good market access (12 km), canal water availability
- **DI Khan (WW-C10)**: Excellent infrastructure, good market access (15 km), Indus River access
- **DI Khan-Tank Saline (SA-C2)**: Excellent infrastructure, good market access (15 km), saline groundwater

B. High Priority (Development with Infrastructure Support - 7 Clusters)

These clusters have good water resources, emerging aquaculture activities, and moderate infrastructure. They require targeted infrastructure development and technical support but have strong potential.

Tier 1: High Potential with Good Infrastructure

- **Chitral (CW-C1)**: Existing trout farms, good water quality, high altitude pristine water
- **Mahmad-Khyber Emerging (WW-C3)**: Good water resources, emerging farms, market proximity (18 km)

- **Hangu-Lachi-Kohat (WW-C5)**: Good water resources, dam availability, moderate market access (22 km) - **Banda Daud Shah-Shakardara (WW-C6)**: Water availability, growing farms, moderate market access (25 km)

Tier 2: High Potential with Infrastructure Needs

- **Bannu-South Karak (WW-C8)**: Good water resources, dam availability, moderate market access (28 km)
- **Lakki Marwat (WW-C9)**: Good water resources, moderate market access (20 km), canal availability
- **Lakki Marwat Saline (SA-C1)**: Saline groundwater availability, moderate market access (20 km)
- **Karak Saline (SA-C3)**: Saline groundwater potential, moderate market access (25 km)

C. Medium Priority (Development with Significant Support - 3 Clusters)

These clusters have potential but face moderate constraints. They require infrastructure development, technical capacity building, and careful planning before major investment.

- **Kohistan (CW-C2):** Good water resources, growing interest, renewable energy (hydro), but 40 km to market
- **Hangu-North Waziristan (WW-C7):** Water resources, emerging interest, but limited infrastructure and 35 km to market
- **Tank-Zam (WW-C11):** Water availability, growing interest, but limited infrastructure and 38 km to feed supplier

D. Low Priority (Long-term Development - 4 Clusters)

These clusters face significant constraints including remote location, limited infrastructure, security concerns, and poor market access. They require substantial infrastructure investment and security improvements before development.

- **Upper Kuram & S. Waziristan (CW-C3)**: Very remote, limited electricity, 50 km to market, security concerns
- **Kurram-Orakzai (SC-C3)**: Remote location, limited electricity, 45 km to market, security concerns
- **Waziristan (SC-C4)**: Very remote, limited infrastructure, 50 km to market, security concerns
- **Lower South Waziristan (WW-C12)**: Very remote, limited infrastructure, 40 km to market, security concerns

7.2 Current Status Classification

A. Established Clusters (8 clusters)

These clusters have existing aquaculture operations, established supply chains, and proven market demand. They require support for scaling and modernization.

1. Swat Valley (CW-C4) - Cold-water trout
2. Kaghan Valley (CW-C5) - Cold-water trout
3. Hazara Semi Cold (SC-C1) - Semi-cold water mixed species
4. Swat-Panjkora Semi Cold (SC-C2) - Semi-cold water mixed species
5. Haripur-Swabi-Mardan Plains (WW-C1) - Warm-water carp
6. Peshawar-Nowshera-Charsadda (WW-C2) - Warm-water carp
7. Charsadda Canal-Fed (WW-C4) - Warm-water carp
8. DI Khan (WW-C10) - Warm-water carp

B. Emerging Clusters (10 clusters)

These clusters have recent or growing aquaculture activities, developing supply chains, and increasing farmer interest. They require targeted support for growth and consolidation.

1. Chitral (CW-C1) - Cold-water trout
2. Mahmad-Khyber Emerging (WW-C3) - Warm-water carp
3. Hangu-Lachi-Kohat (WW-C5) - Warm-water carp
4. Banda Daud Shah-Shakardara (WW-C6) - Warm-water carp
5. Bannu-South Karak (WW-C8) - Warm-water carp
6. Lakki Marwat (WW-C9) - Warm-water carp
7. Tank-Zam (WW-C11) - Warm-water carp
8. DI Khan-Tank Saline (SA-C2) - Saline water shrimp
9. Hangu-North Waziristan (WW-C7) - Warm-water carp (limited)

C. Pre-Development Clusters (6 clusters)

These clusters have limited or no current aquaculture activity but have potential based on water resources and geographic suitability. They require comprehensive development planning and infrastructure investment.

1. Upper Kuram & S. Waziristan (CW-C3) - Cold-water potential
2. Kurram-Orakzai (SC-C3) - Semi-cold water potential
3. Waziristan (SC-C4) - Semi-cold water potential
4. Lower South Waziristan (WW-C12) - Warm-water potential
5. Lakki Marwat Saline (SA-C1) - Saline water potential (emerging)
6. Karak Saline (SA-C3) - Saline water potential

7.3 Key Development Drivers Analysis

I. **Infrastructure and Market Access** (Most Critical) Clusters with excellent road access, grid electricity, and proximity to markets (8-15 km) show the highest development priority. Examples: Charsadda Canal-Fed (8 km), Peshawar-Nowshera-Charsadda (10 km), Haripur-Swabi-Mardan (12 km).

II. **Water Quality and Availability** High-quality water sources (pristine mountain streams, canal systems, Indus River access) are primary drivers. Cold-water zones with pristine springs and warm-water zones with canal/dam access show higher priority.

III. **Existing Aquaculture Activity** Clusters with established farms and supply chains (Swat and Kaghan valley, Hazara, Peshawar plains and DIKhan) demonstrate proven viability and require less risk mitigation. These are prioritized for immediate investment.

IV. **Species Suitability and Market Demand** Warm-water carp farming in plains areas has higher priority due to established market demand and lower production costs. Cold-water trout in established areas (Swat) has high priority. Emerging saline shrimp farming shows high priority due to novel opportunities.

V. **Renewable Energy Potential** Clusters with hydro-electric potential (Kohistan, Kaghan Valley) have advantages for cost-effective operations, though this is secondary to market access.

7.4 Primary Constraints Analysis

I. **Geographic and Infrastructure Constraints**

- **Remote Location** (50+ km to market): Upper Kuram, Kurram-Orakzai, Waziristan, Lower South Waziristan
- **Limited Electricity**: Upper Kuram, Kurram-Orakzai, Waziristan, Lower South Waziristan
- **Poor Road Access**: Same clusters plus Hangu-North Waziristan

II. Market and Supply Chain Constraints

- **Market Distance** (35-50 km): Chitral, Kohistan, Upper Kuram, Kurram-Orakzai, Waziristan, Lower South Waziristan
- **Limited Feed Supplier Access**: Upper Kuram (60 km), Kurram-Orakzai (55 km), Waziristan (60 km)
- **Limited Hatchery Access**: Upper Kuram (70 km), Kurram-Orakzai (65 km), Waziristan (70 km)

III. **Water Resource Constraints**

- **Seasonal Water Variation**: Swat Valley, Swat-Panjkora, Peshawar plains, Tank-Zam
- **Water Competition with Agriculture**: Peshawar plains, Charsadda, Haripur-Swabi-Mardan, DI Khan
- **Water Pollution Concerns**: Peshawar plains (urban influence), Indus River areas

IV. **Socio-Political Constraints**

- **Security Concerns**: Upper Kuram, Kurram-Orakzai, Waziristan, Lower South Waziristan, Hangu-North Waziristan
- **Land Scarcity**: Hazara, Swat-Panjkora (limited expansion space)
- **Limited Technical Expertise**: Emerging clusters, saline water clusters

V. **Technology and Capacity Constraints**

- **Emerging Technology Adoption**: Saline water shrimp farming clusters
- **Limited Technical Expertise**: Pre-development and emerging clusters
- **Developing Supply Chain**: Emerging clusters

7.5 Strategic Development Recommendations

Phase 1: Immediate Development (Year 1-2) Focus on Very High Priority clusters with established infrastructure and market access. Invest in scaling existing operations and modernizing production systems.

- **Target**: Charsadda, Peshawar plains, Hazara, Swat-Panjkora, Swat Valley, DI Khan, DI Khan-Tank Saline

Phase 2: Targeted Growth (Year 2-3) Support High Priority clusters with infrastructure development and technical capacity building. Establish supply chains and market linkages.

- **Target**: Chitral, Kaghan Valley, Mahmad-Khyber, Hangu-Lachi-Kohat, Banda Daud Shah, Bannu-South Karak, Lakki Marwat, Lakki Marwat Saline, Karak Saline

Phase 3: Infrastructure Development (Year 3-5) Invest in infrastructure development for Medium Priority clusters. Improve road connectivity, electricity access, and establish regional service centers.

- **Target**: Kohistan, Hangu-North Waziristan, Tank-Zam

Phase 4: Long-term Strategic Investment (Year 5+) Address constraints in Low Priority clusters through comprehensive infrastructure development and security improvements. Consider pilot projects to test viability.

- **Target**: Upper Kuram, Kurram-Orakzai, Waziristan, Lower South Waziristan

Table 5: Infrastructure Accessibility by Cluster

Cluster ID	***Cluster Name***	***Road Access***	***Electricity Access***	***Avg. Distance to Market (km)***	***Avg. Distance to Feed Supplier (km)***	***Avg. Distance to Hatchery (km)***
CW-C1	*Chitral Cluster*	*Excellent*	*Good (Grid + Solar)*	*35*	*45*	***50***
CW-C2	*Kohistan Cluster*	*Good*	*Fair (Grid + Hydro)*	*40*	*50*	***55***
CW-C3	*Upper Kuram & S. Waziristan Cluster*	*Fair*	*Fair (Limited Grid)*	*50*	*60*	***70***
CW-C4	*Swat Valley Cluster*	*Excellent*	*Excellent (Grid)*	*25*	*30*	***35***
CW-C5	*Kaghan Valley Cluster*	*Good*	*Good (Grid + Hydro)*	*30*	*40*	***45***
SC-C1	*Hazara Semi Cold Cluster*	*Excellent*	*Excellent (Grid)*	*15*	*20*	***25***
SC-C2	*Swat-Panjkora Semi Cold Cluster*	*Excellent*	*Excellent (Grid)*	*20*	*25*	***30***
SC-C3	*Kurram-Orakzai Cluster*	*Fair*	*Fair (Limited Grid)*	*45*	*55*	***65***
SC-C4	*Waziristan Cluster*	*Fair*	*Fair (Limited Grid)*	*50*	*60*	***70***
WW-C1	*Haripur-Swabi-Mardan Plains Cluster*	*Excellent*	*Excellent (Grid)*	*12*	*15*	***20***
WW-C2	*Peshawar-Nowshera-Charsadda Cluster*	*Excellent*	*Excellent (Grid)*	*10*	*12*	***18***
WW-C3	*Mahmad-Khyber Emerging Cluster*	*Good*	*Good (Grid)*	*18*	*22*	***28***
WW-C4	*Charsadda Canal-Fed Cluster*	*Excellent*	*Excellent (Grid)*	*8*	*10*	***15***
WW-C5	*Hangu-Lachi-Kohat Cluster*	*Good*	*Good (Grid)*	*22*	*28*	***35***

WW-C6	*Banda Daud Shah-Shakardara Cluster*	*Good*	*Fair (Grid)*	*25*	*32*	***40***
WW-C7	*Hangu-North Waziristan Cluster*	*Fair*	*Fair (Limited Grid)*	*35*	*42*	***50***
WW-C8	*Bannu-South Karak Cluster*	*Good*	*Good (Grid)*	*28*	*35*	***42***
WW-C9	*Lakki Marwat Cluster*	*Good*	*Good (Grid)*	*20*	*25*	***32***
WW-C10	*DI Khan Cluster*	*Excellent*	*Excellent (Grid)*	*15*	*18*	***25***
WW-C11	*Tank-Zam Cluster*	*Good*	*Fair (Grid)*	*30*	*38*	***45***
WW-C12	*Lower South Waziristan Cluster*	*Fair*	*Fair (Limited Grid)*	*40*	*48*	***55***
SA-C1	*Lakki Marwat Saline Cluster*	*Good*	*Good (Grid)*	*20*	*25*	***35***
SA-C2	*DI Khan-Tank Saline Cluster*	*Excellent*	*Excellent (Grid)*	*15*	*18*	***28***
SA-C3	***Karak Saline Cluster***	***Good***	***Fair (Grid)***	***25***	***32***	***40***

Table 6: Development Priority Classification

Cluster ID	Cluster Name	Current Status	Development Priority	Key Development Drivers	Primary Constraints
CW-C1	Chitral Cluster	Emerging	High	Existing trout farms, good water quality, high altitude pristine water	Remote location, limited market access (35 km), high elevation accessibility
CW-C2	Kohistan Cluster	Emerging	Medium	Good water resources, growing interest, renewable energy (hydro)	Remote location, limited infrastructure, 40 km to market
CW-C3	Upper Kuram & S. Waziristan Cluster	Pre-Development	Low	Excellent water quality, high altitude, pristine springs	Very remote, limited electricity, 50 km to market, security concerns
CW-C4	Swat Valley Cluster	Established	Very High	Existing farms, excellent infrastructure, good market access (25 km), established supply chain	Limited expansion space, seasonal water variation
CW-C5	Kaghan Valley Cluster	Emerging	High	Existing farms, good water resources, renewable energy, moderate market access (30 km)	Seasonal accessibility, limited feed supplier network
SC-C1	Hazara Semi Cold Cluster	Established	Very High	Excellent infrastructure, best market access (15 km), grid electricity, diverse species potential, established hatcheries	Limited expansion space, land scarcity
SC-C2	Swat-Panjkora Semi Cold Cluster	Established	Very High	Excellent road access, grid electricity, good market proximity (20 km), existing farms, established supply chain	Limited expansion space, seasonal water flow
SC-C3	Kurram-Orakzai Cluster	Pre-Development	Low	Good water resources, potential for Mahseer farming	Remote location, limited electricity, 45 km to market, security concerns, limited hatcheries
SC-C4	Waziristan Cluster	Pre-Development	Low	Water availability, potential species diversity	Very remote, limited infrastructure, 50 km to market, security concerns

WW-C1	Haripur-Swabi-Mardan Plains Cluster	Established	Very High	Excellent infrastructure, good market access (12 km), grid electricity, canal water availability, established farms	Water competition with agriculture, seasonal availability
WW-C2	Peshawar-Nowshera-Charsadda Cluster	Established	Very High	Best market access (10 km), excellent infrastructure, grid electricity, major urban market, established supply chain	Water pollution concerns, agricultural competition, seasonal flow
WW-C3	Mahmad-Khyber Emerging Cluster	Emerging	High	Good water resources, emerging farms, market proximity (18 km), good infrastructure	Developing supply chain, limited hatchery access, emerging security situation
WW-C4	Charsadda Canal-Fed Cluster	Established	Very High	Optimal infrastructure, shortest market distance (8 km), grid electricity, canal water, established farms	Water competition with agriculture, limited expansion space
WW-C5	Hangu-Lachi-Kohat Cluster	Emerging	High	Good water resources, dam availability, moderate market access (22 km), growing interest	Developing infrastructure, limited feed suppliers
WW-C6	Banda Daud Shah-Shakardara Cluster	Emerging	High	Water availability, growing farms, moderate market access (25 km)	Limited infrastructure, developing supply chain
WW-C7	Hangu-North Waziristan Cluster	Pre-Development	Medium	Water resources, emerging interest, moderate elevation	Limited infrastructure, 35 km to market, security concerns
WW-C8	Bannu-South Karak Cluster	Emerging	High	Good water resources, dam availability, moderate market access (28 km), growing farms	Developing infrastructure, limited hatchery access
WW-C9	Lakki Marwat Cluster	Emerging	High	Good water resources, moderate market access (20 km), growing interest, canal availability	Limited infrastructure development, emerging supply chain
WW-C10	DI Khan Cluster	Established	Very High	Excellent infrastructure, good market access (15 km), grid electricity, Indus River access, established farms	Water availability constraints, seasonal flow variation

WW-C11	Tank-Zam Cluster	Emerging	Medium	Water availability, growing interest, moderate market access (30 km)	Limited infrastructure, developing supply chain, 38 km to feed supplier
WW-C12	Lower South Waziristan Cluster	Pre-Development	Low	Water resources, potential for expansion	Very remote, limited infrastructure, 40 km to market, security concerns
SA-C1	Lakki Marwat Saline Cluster	Pre-Development	High	Saline groundwater availability, emerging shrimp interest, moderate market access (20 km)	Emerging technology adoption, limited hatchery access, developing supply chain
SA-C2	DI Khan-Tank Saline Cluster	Emerging	Very High	Excellent infrastructure, good market access (15 km), saline groundwater, grid electricity, growing shrimp farms	Emerging technology adoption, limited technical expertise
SA-C3	Karak Saline Cluster	Pre-Development	High	Saline groundwater potential, moderate market access (25 km), growing interest	Limited infrastructure, emerging technology adoption

8 WATER RESOURCES CHARACTERIZATION

8.1 Geographic & Hydrological Characteristics Summary

I. Cold-Water Zones (Z1)

The cold-water zones are characterized by high elevations (700-3,500 meters), pristine water sources from glacial melt and mountain springs, and water temperatures consistently below 18°C. These zones support premium trout production and are concentrated in the northern mountainous regions of KP. The primary constraints are accessibility and remoteness, but these are offset by the exceptional water quality and high-value market opportunities. The Swat Valley and Kaghan Valley clusters represent the most developed areas, with established infrastructure and experienced farming communities.

II. Semi-Cold-Water Zone (Z2)

The semi-cold zone represents a unique transitional ecology where water temperatures range from 15-25°C, allowing for both cool-season trout production and warm-season carp cultivation. This zone is strategically located between the high-altitude cold-water zones and the low-altitude warm-water plains. The Mansehra-Abbottabad cluster is the primary focus, with excellent market access to urban centers and strong potential for integrated multi-species systems.

III. Warm-Water Zones (Z3)

The warm-water zones are characterized by lower elevations (150-1,000 meters), extensive irrigation infrastructure, and water temperatures ranging from 20-35°C. These zones support large-scale carp and tilapia production and are concentrated in the agricultural plains and river valleys. The primary advantages are the large market demand, established agricultural communities, and good infrastructure. The main challenges are water quality management and the need for improved input supply chains.

IV. Saline Water Zone (Z4)

The saline water zones exhibit favorable conditions for Vannamei shrimp farming, with temperatures ranging from 20–32°C (average 26°C), which supports optimal growth. The pH remains neutral to slightly alkaline (7.0–8.2, average 7.6), suitable for shrimp health and survival. Dissolved oxygen levels (5.0–8.5 mg/L, average 6.8 mg/L) are adequate for good production, especially with proper aeration. High conductivity (5,000–15,000 µS/cm, average 10,000 µS/cm), equivalent to moderate salinity levels (3–9 ppt), provides ideal conditions for osmoregulation. Overall, these parameters indicate that saline groundwater zones are well-suited for efficient Vannamei shrimp farming.

8.2 Water Resource Inventory

I. RIVERS

The province is characterized by several major river systems that form the backbone of surface water resources:

Table 7: Main Rivers in KP

River Name	Catchment Area (km²)	Avg. Annual Flow (MAF)	Key Characteristics	Aquaculture Potential
Indus River	~1,120,000 (total basin; KP segments key)	~175 km³/year (total)	Primary system; tributaries include Swat, Kunhar, Kabul; perennial flow through Haripur, Kohistan.	Warm-water species (carp, tilapia, catfish); cage culture near Tarbela Dam.
Swat River	14,000	3.54	Northern KP (Swat Valley); formed by Gabrial/Ushu at Kalam; pristine, snow/glacier-fed; temp 8-16°C.	Cold-water trout, semi-cold species; high quality (DO 6.5-8.5 mg/L).
Panjkora River	13,000	2.6	Dir Upper/Lower; high-altitude tributaries (Kumrat-Patrak); pristine glacial sources.	Cold-water rainbow/brown trout.
Kabul River	66,000	19	Western KP (Nowshera, Peshawar); perennial; joins Indus.	Warm-water species; good for multi-species.
Kunhar River	~2,400	2.62	Originates in Kaghan Valley; length ~177 km; contributes ~11% to Mangla reservoir; moderate water quality (12-22°C).	Semi-cold/warm species.
Chitral River	~11,000	7	Glacial/snow-fed (~14.5% of basin); pristine quality (DO 8.0-9.8 mg/L); maintains cold temperatures (8-14°C).	Cold-water trout.
Others (e.g., Kurram, Siran, Haro, Dor, Bara, Gambila, Gomal)	Varies (e.g., Siran: 1,255 km², 0.47 MAF)	Varies	Distributed across KP; support local fisheries.	Varies by zone; potential for expansion.

II. STREAMS

Streams are abundant throughout the province, particularly in cold and semi-cold water zones. The initial field surveys identified 71 stream sites. Key streams mentioned in field observations include:

Table 8: Main Streams in KP

Stream Name	Location	Zone Type	Characteristics
Piya Stream	Bahrain, Swat	Cold-Water	Mountain stream with excellent water quality
Bombraite Stream	Lower Chitral	Cold-Water	Pristine glacial water source
Ghanaamaraga Stream	Swat	Cold-Water	High-altitude alpine environment
Patrak Stream	Kumrat-Patrak Valley, Dir Upper	Cold-Water	Panjkora River tributary; minimal existing infrastructure
Dubair Stream	Lower Kohistan	Semi-Cold	Mountain stream suitable for multi-species production
Pattan and Palas Nullah	Kohistan-Pattan Corridor	Cold-Water	Indus tributaries; high-altitude production (1,800-3,500m)
Jindi Stream	Kabul River Basin	Semi-cold	Perennial, originates in the hills of Malakand and flows through Charsadda district before joining the Swat River (via the Kabul River system).

III. RESERVOIRS AND DAMS

The province has several large dams and numerous smaller reservoirs providing reliable water for large-scale aquaculture operations:

Table 9: Main Reservoirs and Dams in KP

Dam/Reservoir Name	Location	District	Water Capacity & Characteristics	Primary Use
Tarbela Dam	Haripur	Haripur	World's largest earth-filled dam; massive water resource ideal for cage culture expansion	Irrigation, hydropower, aquaculture
Khanpur Dam	Haripur	Haripur	Huge water resource; proximity to Islamabad; popular recreational fishing spot	Irrigation, recreation, aquaculture
Gomal Zam Dam	DI Khan	DI Khan	Provides water for southern regions; warm-water zone	Irrigation, aquaculture
Kundal Dam	Swabi	Swabi	Emerging development; reliable water from irrigation systems	Irrigation, aquaculture
Sharki Dam	Karak	Karak	Dam-based aquaculture potential; availability of multiple dams in region	Irrigation, aquaculture
Tanda Dam & Multiple Dams	Kohat	Kohat	High productivity indicated by high lease values; established market channels	Irrigation, aquaculture

Azakhel Dam	Nowshera/Peshawar	Nowshera	Strategic location; proximity to Peshawar market	Irrigation, aquaculture
Baran Dam	Bannu	Bannu	Under development; will significantly increase water availability	Irrigation, future aquaculture

IV. SPRINGS

Springs were identified at 23 survey sites and are vital sources of high-quality water, particularly in cold and semi-cold zones. Springs provide:

- **Water Quality:** Excellent; pristine sources with optimal dissolved oxygen levels (6.5-8.5 mg/L in cold zones)
- **Temperature:** Cold-water springs (8-16°C) ideal for trout; semi-cold springs (15-24°C) suitable for mahseer and carp varieties
- **Reliability:** Perennial flow; minimal seasonal variation
- **Distribution:** Abundant in Chitral, Swat, Dir, Kohistan, and Mansehra districts
- **Aquaculture Suitability:** Premium for species-sensitive production; ideal for premium market positioning

V. GROUNDWATER RESOURCES (BOREWELLS)

Groundwater accessed through borewells was identified at 7 survey sites and serves as a supplementary water source:

Table 10: Characteristic of Groundwater Resources in KP

Characteristic	**Details**
Availability	Present in most parts of the province
Depth Range	10-100 meters depending on location
Water Quality	Generally suitable for aquaculture; low salinity levels
Suitability	Suitable for warm and semi-cold water aquaculture systems
Usage	Supplementary source; particularly valuable in semi-cold and warm water zones where surface water may be seasonal

8.3 Water Quality Parameters

Field surveys confirmed that water resources in KP generally meet optimal standards for aquaculture:

Table 11: Water Quality Parameters

Parameter	Optimal Range	Survey Findings	Assessment
pH	6.5-8.5	6.8-7.8 (most sites)	Good
Dissolved Oxygen	>6 mg/L (cold); >5 mg/L (warm)	6.5-8.5 mg/L (cold); 5.0-6.5 mg/L (warm)	Good to Acceptable
Conductivity	<500 µS/cm	150-450 µS/cm (most sites)	Good
Alkalinity	50-200 mg/L $CaCO_3$	80-180 mg/L (most sites)	Good
Hardness	50-300 mg/L $CaCO_3$	100-250 mg/L (most sites)	Good

8.4 Temperature Zones and Aquaculture Suitability

The province's diverse topography creates distinct temperature zones:

Table 12: The Temperature zones in KP:

Zone Type	Temperature Range (°C)	Elevation Range (m)	Suitable Species	Key Locations
Cold-Water	8-16	700-3,500	Rainbow trout, Brown trout	Chitral, Swat, Dir Upper, Kohistan
Semi-Cold-Water	15-24	600-1,500	Mahseer, Carp varieties	Mansehra, Mardan, Abbottabad, Battagram
Warm-Water	18-32	150-600	Carp, Tilapia, Catfish	DI Khan, Kohat, Karak, Charsadda, Nowshera

8.5 Water Availability and Seasonality

Table 13: Water availability and seasonality:

Season	Characteristics	Impact on Aquaculture
Monsoon (July-September)	High water flows; risk of flooding in river-adjacent areas	Abundant water; requires flood management
Winter (December-February)	Low water flows in some areas; manageable with storage	Reduced flow; storage systems essential
Summer (May-September)	Peak water demand for irrigation; potential competition with aquaculture	Water scarcity in some areas; requires planning
Year-Round Availability	Major rivers and tributaries provide perennial sources; seasonal variations 20-50% depending on zone	Reliable for planning; seasonal management needed

9 GIS MAPS AND SPATIAL ANALYSIS

9.1 GIS Maps Produced

Nine key GIS maps have been produced showing the spatial distribution of critical parameters:

Figure 1: Aquaculture Zones in Khyber Pakhtunkhwa

Map Shows Three distinct zones i.e. cold-water zone for trout farming, semi cold-water zone for carp and Mahseer farming and warm-water zones for Carp, Pangasius, Tilapia and Shrimp farming.

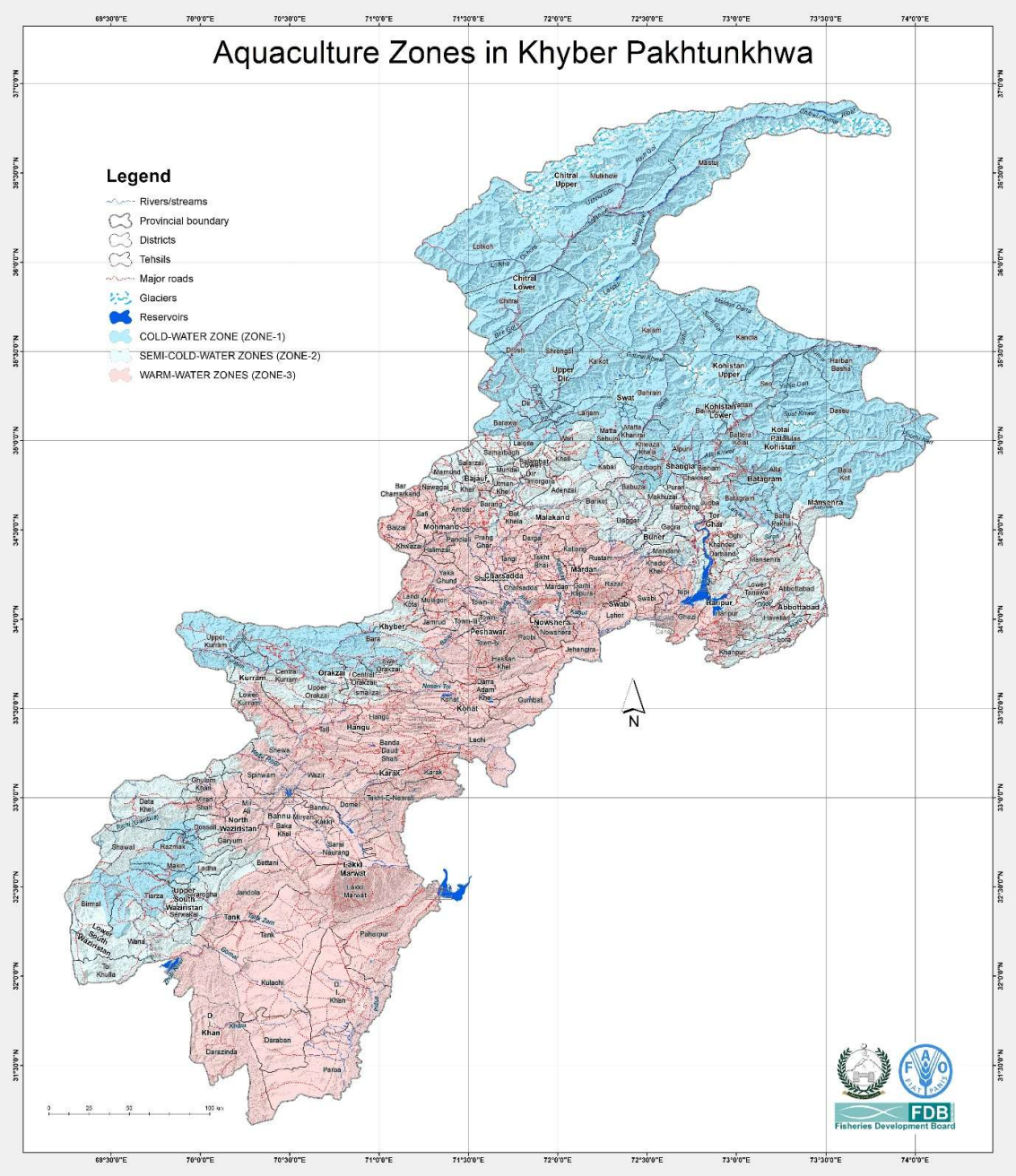


Figure 2: Aquaculture Prospects in Khyber Pakhtunkhwa

Map shows color-coded elevation zones - Delineates areas suitable for different aquaculture types - Shows topographic constraints and opportunities

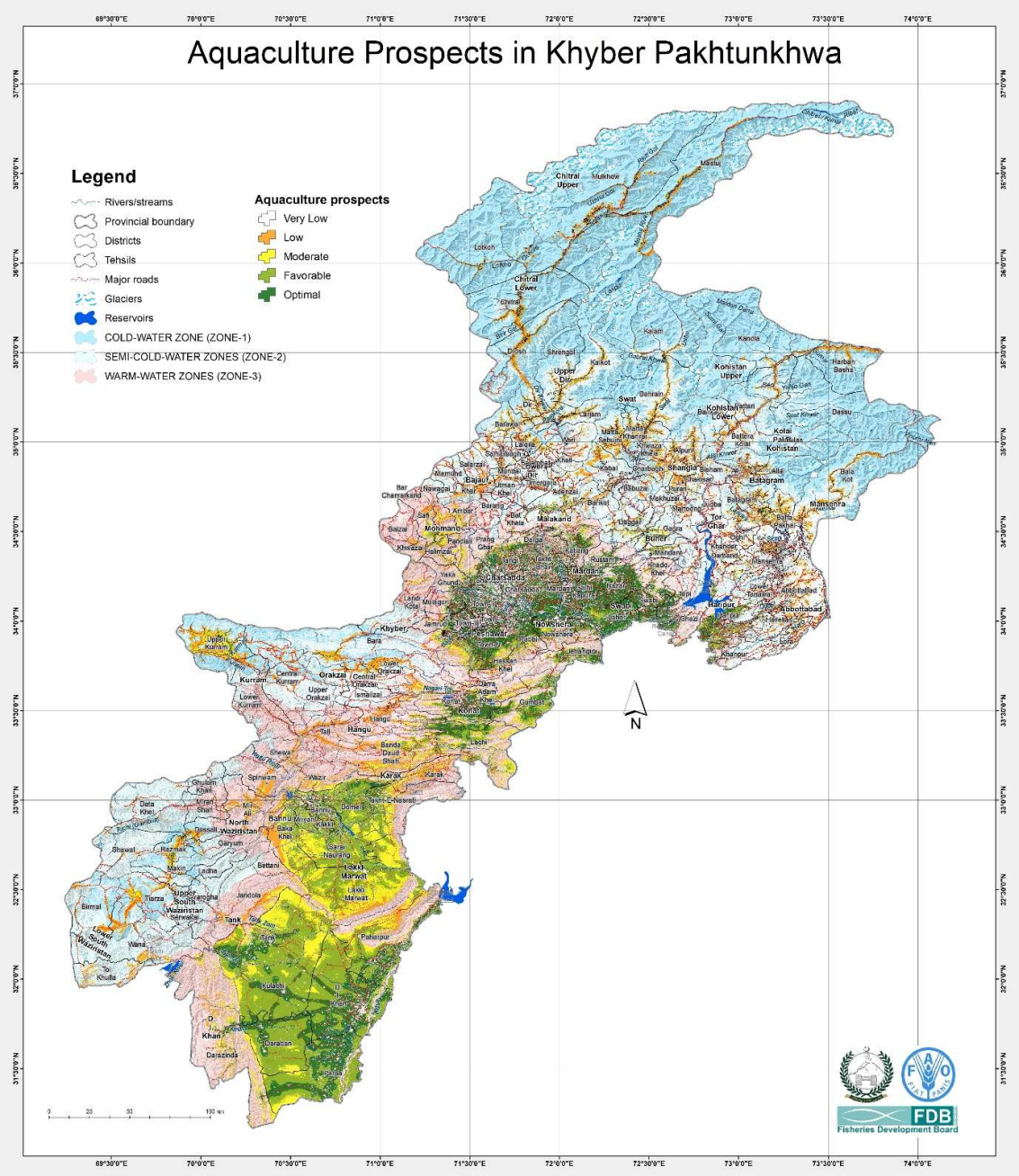


Figure 3: Sub-Zone-1: High Altitude Trout & Premium Cold-Water Clusters

Map shows Sub-Zone-1: High Altitude Trout & Premium Cold-Water Clusters.

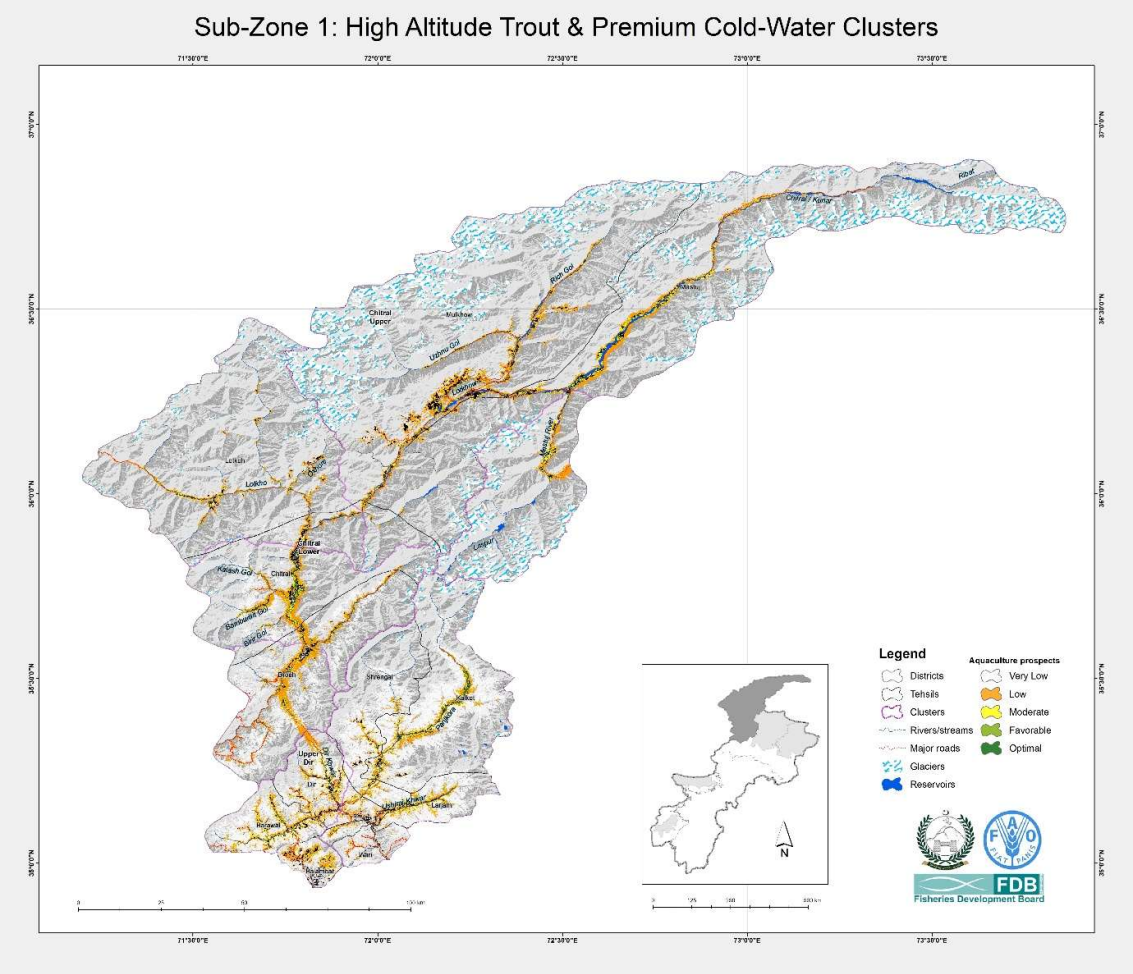
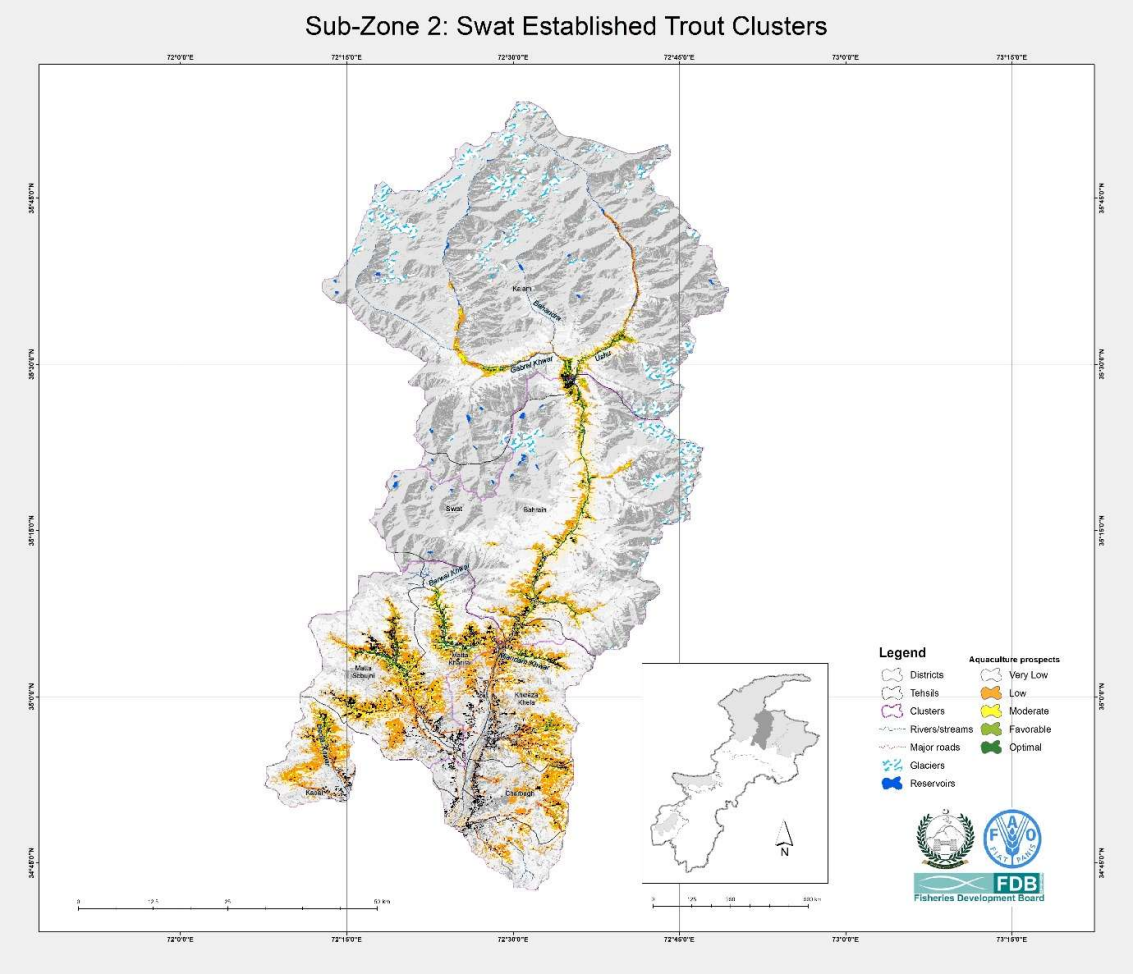


Figure 4: Sub-Zone- 02 Swat Established Trout Clusters

This zone is the commercial heartland of trout farming in KP, benefiting from excellent water resources, established infrastructure, experienced farmers, and a strong tourism market.



4. Figure 5: Sub-Zone 3: Emerging Premium Cold-Water Clusters, Kohistan

This zone represents a critical transitional ecological niche, where water temperatures are too warm for year-round trout production but cooler than the main carp-producing plains. This allows for unique opportunities for multi-species and seasonal aquaculture, particularly for the native Mahseer.

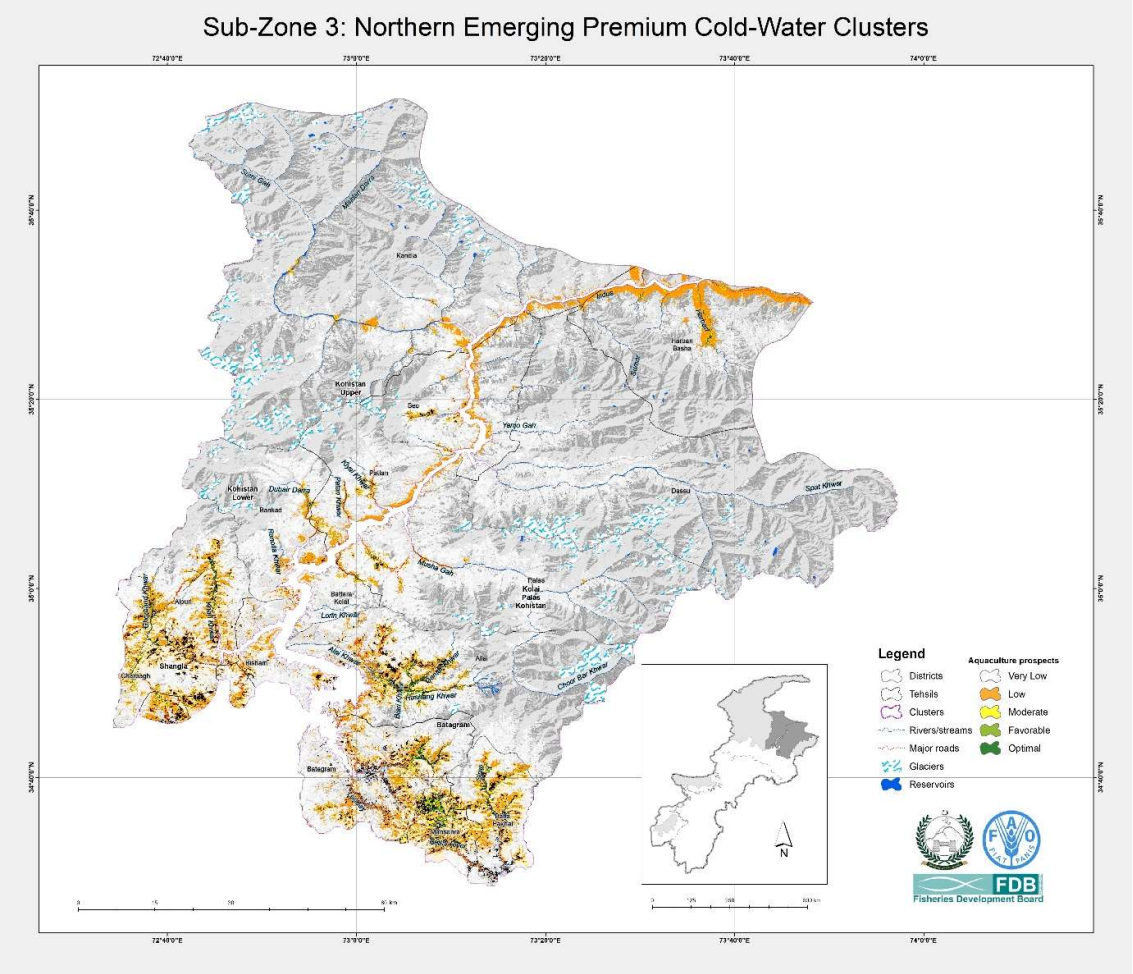


Figure 6: Sub-Zone-4: Mansehra Established Trout Clusters, Mansehra, Abbottabad.

This Sub-zone is a major commercial trout farming zone with excellent water, infrastructure, and a strong tourism market, poised for significant expansion.

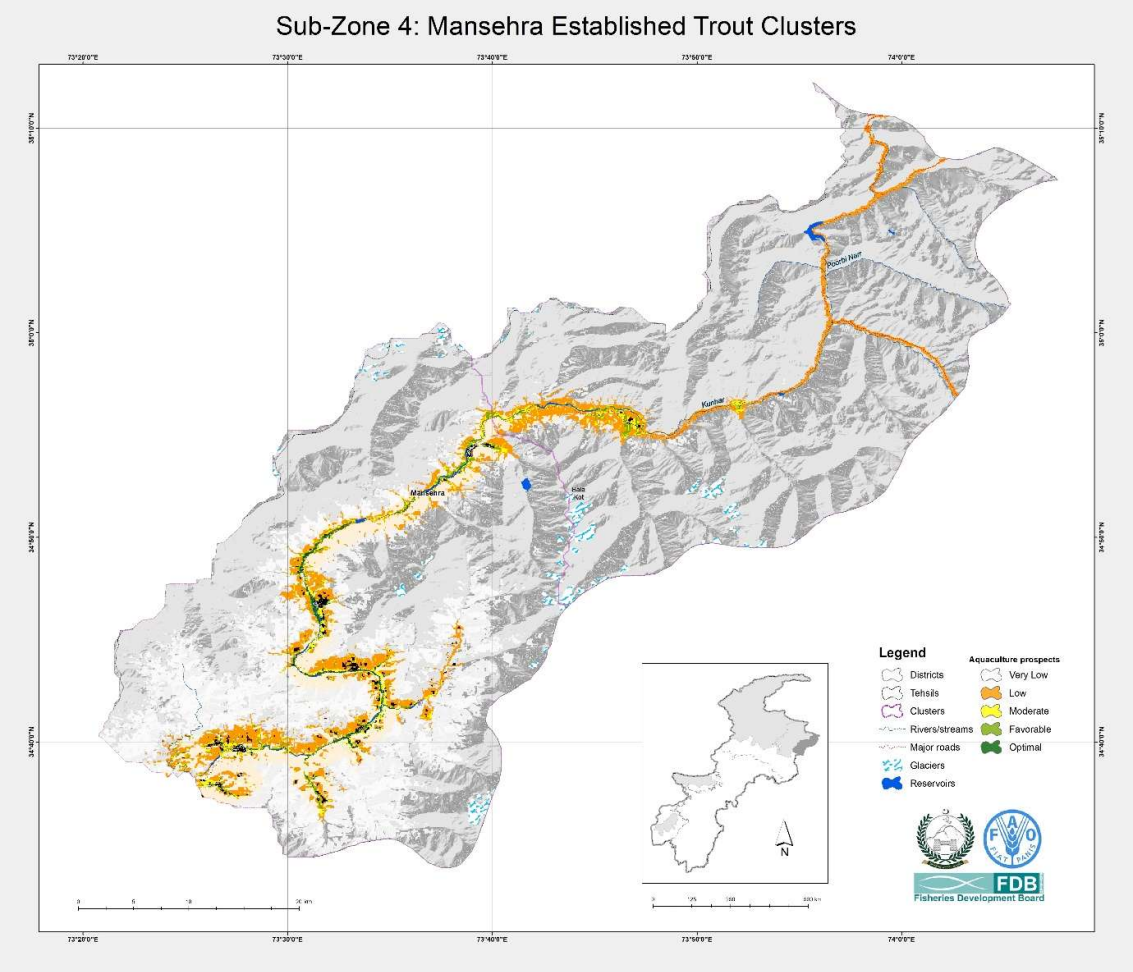


Figure 7: Sub-Zone 5: Emerging Premium Cold-Water Clusters: Kurran Khyber Orakzai

This emerging region features pristine water sources in a rugged, mountainous landscape. Security and access are key challenges, but the area holds potential for trout farming development.

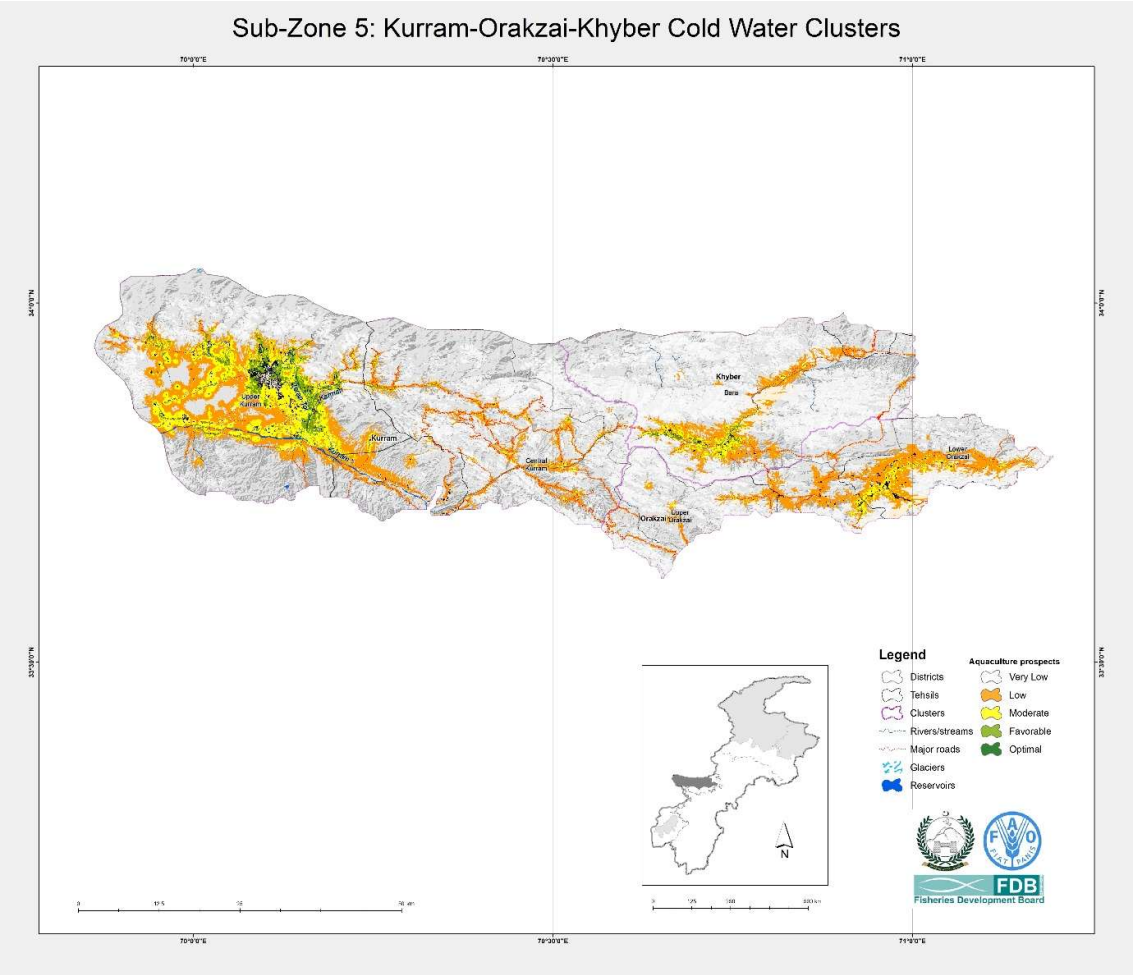


Figure 8: Sub-Zone 5: Emerging Premium Cold-Water Clusters: Waziristan

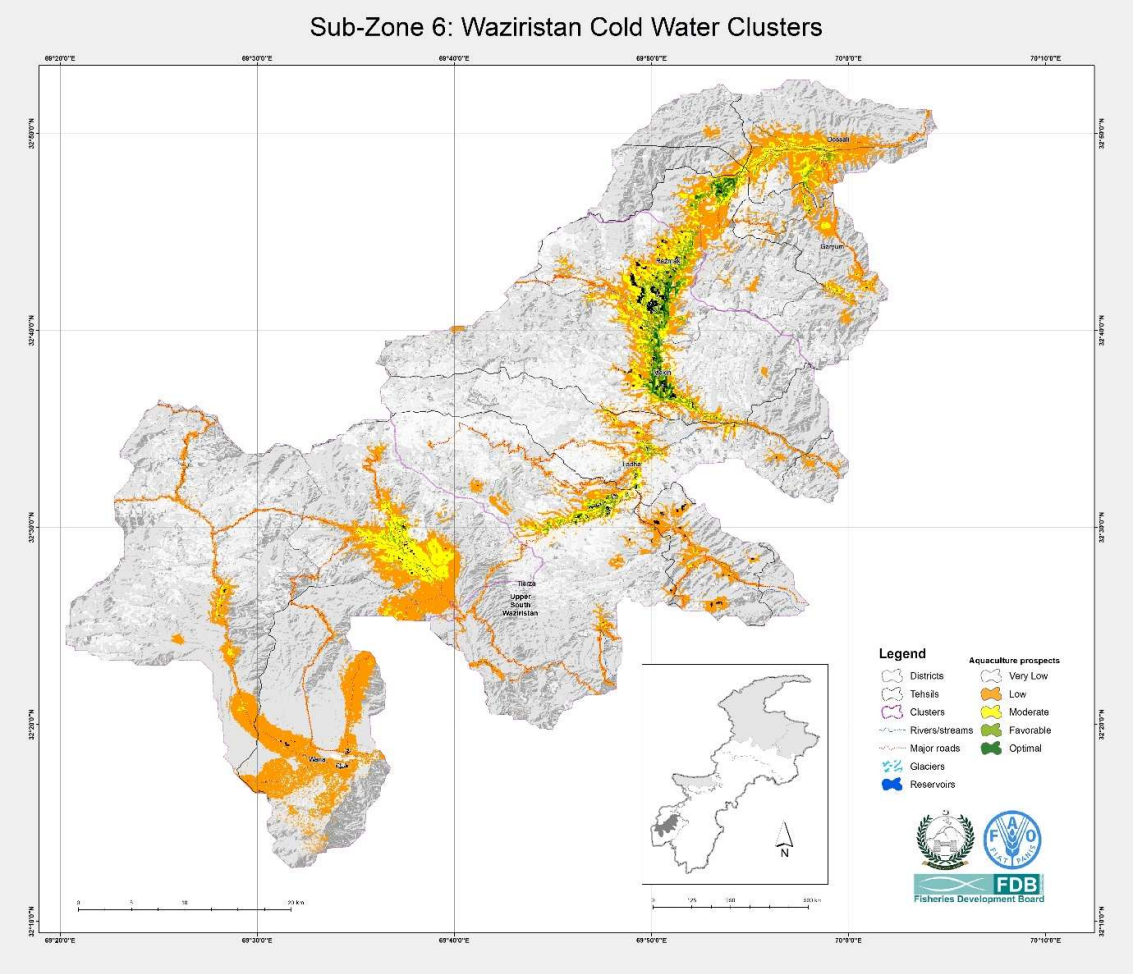


Figure 9: Sub-Zone-SC-01: Northern Semi-Cold-Water Clusters, Indus

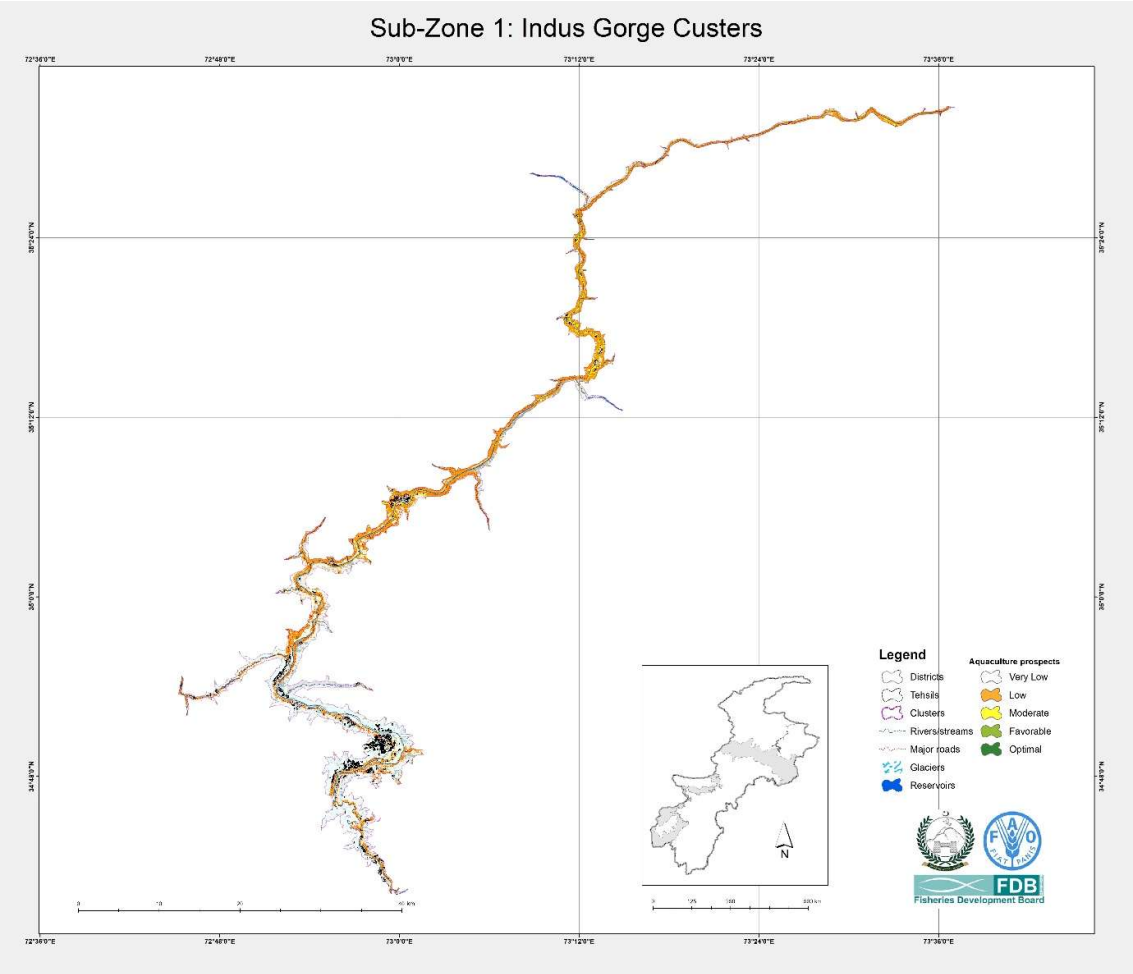


Figure 10: Sub-Zone SC_02: Northern Semi-Cold-Water Clusters: Hazara

This zone is a critical transitional ecological niche where water temperatures are too warm for year-round trout but cooler than the main carp-producing plains. This allows for unique opportunities for multi-species and seasonal aquaculture, particularly for the native Mahseer.

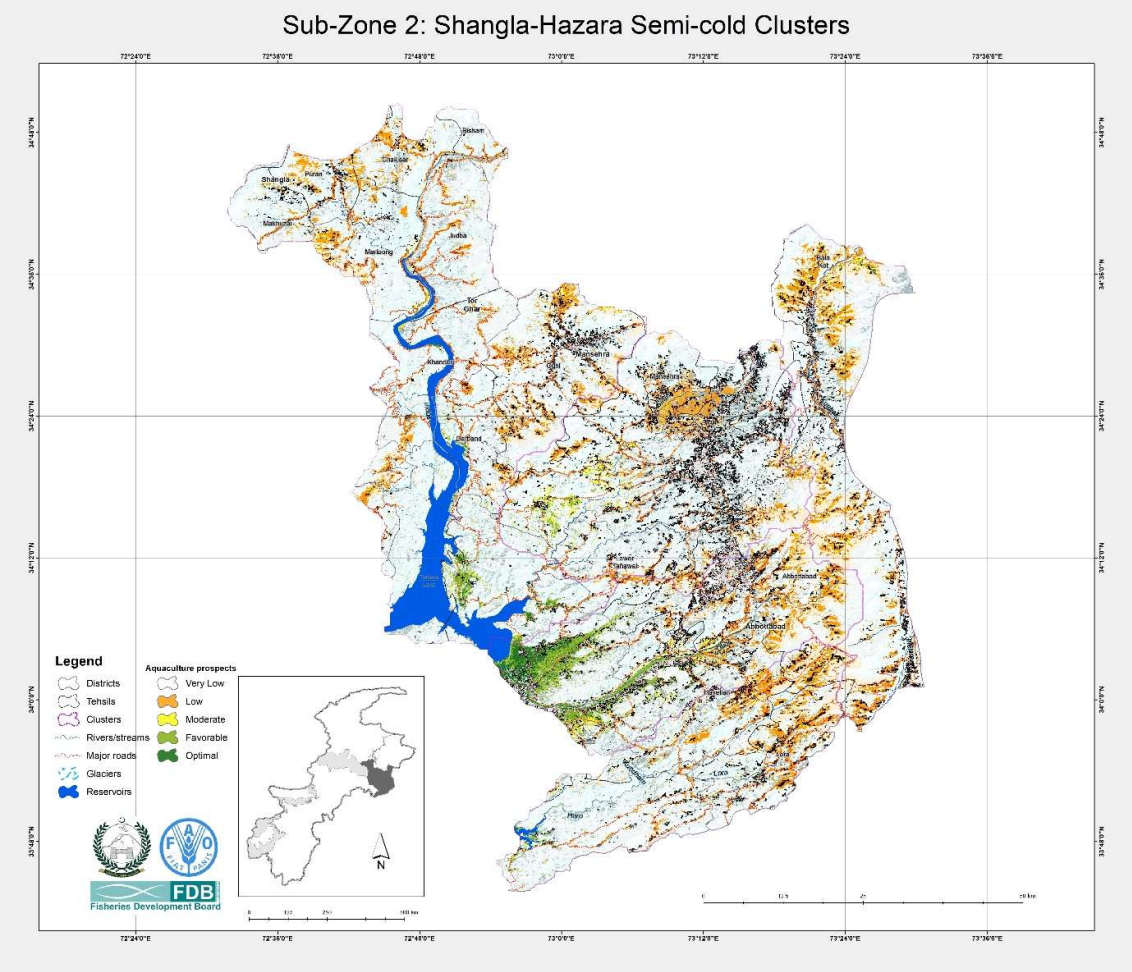
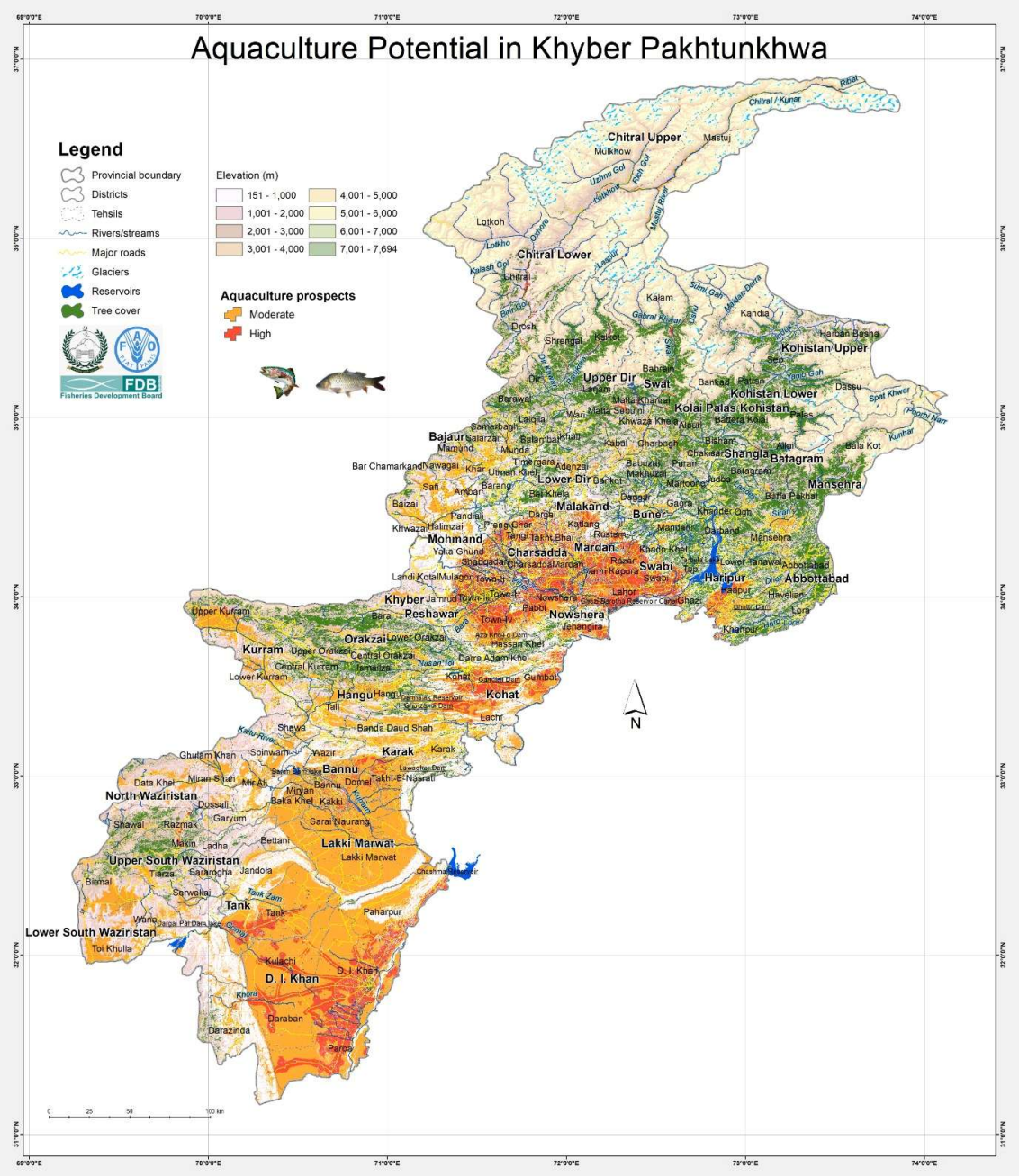


Figure 11: Sub-Zone SC_03: Malakand

Figure 12: Overall aquaculture potential in KP.



9.2 Spatial Analysis Findings

Zone Distribution:

The 3 identified zones cover approximately 85,000-90,000 km² of KP's total area of 101,740 km², representing the primary aquaculture potential areas.

Elevation-Based Suitability:

- Cold-water zones (>700m): Concentrated in northern and eastern regions
- Semi-cold-water zones (600-1,500m): Distributed in transition areas
- Warm-water zones (<600m): Concentrated in plains and river valleys

Water Source Proximity:

- 347 surveyed sites show good proximity to water sources
- Average distance to water source: <5 km for 85% of sites
- Remote areas (>10 km from water): <5% of surveyed sites

Infrastructure Accessibility:

- Road access: 68.4% of sites have paved all-weather roads
- Electricity access: 42.2% have grid electricity; 57.8% alternative sources
- Market proximity: Average distance 26.4 km

9.3 Study Limitations and Assumptions

This spatial mapping study relies on several key assumptions and is subject to certain limitations:

Assumptions:

1. Water availability and flow data derived from secondary sources remain accurate and reflect current conditions.
2. Planned provincial infrastructure developments (e.g., road networks, grid extensions) will proceed as scheduled.
3. Market demand for both cold-water and warm-water aquaculture products will remain stable or increase.

Limitations:

1. Survey Scope: Field surveys were extensive (347 sites) but could not cover every potential location within the 36 districts.
2. Seasonality: Field data was collected during a specific window (October-November 2025); year-round seasonal variations in water flow and temperature require continuous monitoring.
3. Groundwater Data: Detailed hydrogeological data for saline groundwater zones is limited and requires further specialized assessment.

10 CONCLUSION

This spatial analysis provides a robust, multi-tiered hierarchical framework for aquaculture development in Khyber Pakhtunkhwa. By organizing 347 sites into a structured system of **3 Zones, 13 Sub-Zones, 24 Clusters, and 58 Sub-Clusters**, this report moves beyond broad regional planning to provide an actionable geographic basis for targeted investment and development.

The identification of specific clusters as primary operational units allows for the focused implementation of infrastructure projects, extension services, and value chain development. This hierarchical approach will be the foundational spatial framework for the commercialization strategy to be developed under Activity 2.8 of output-2 of the TCP Study, ensuring that strategic planning is directly linked to the geographic realities and opportunities on the ground.

11 ANNEXURES

11.1 Pictorial Overview

PICTORIAL OVERVIEW OF THE FIELD SURVEY

Figure 13: Pictorial overview of visit to Cold water areas:

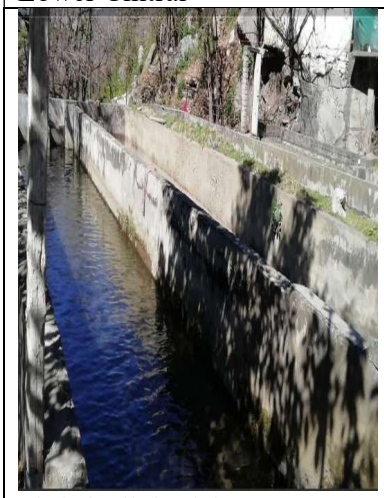
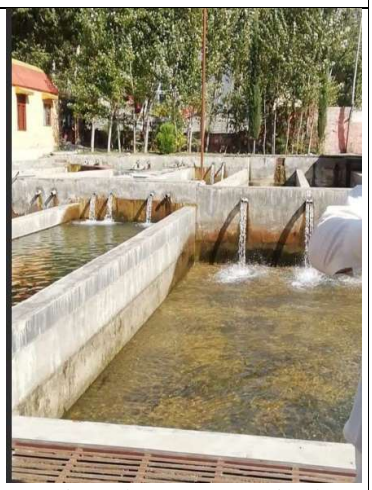
<table>
<tr>
<td> 
Elsia Fish Farm Bombraite Lower Chitral</td>
<td> 
Ghanaamaraga Stream Swat</td>
<td> 
Baboozai Fish Market Swat</td>
</tr>
<tr>
<td> 
Shrief Ulluh Fish Farm Beshband Swat</td>
<td> 
Piya Stream Bahrain Swa</td>
<td> 
Fazal Karim Farm, Bahrain Swat</td>
</tr>
</table>

Figure 14: Pictorial overview of visit to Semi-Cold-Water Areas:

 Dubair Stream, Lower Kohistan	 Katlang Chichar Canal, Mardan	 Fish market, Abbottabad
 Kabul River, Nowshera	 Kundal Dam, Swabi	 Khan pur Dam, Haripur

Figure 15: Pictorial overview of visit to Warm water areas:

 Usman Fish Farm D.I Khan	 Sharki Dam, Karak	 *Draban Drain, D.I Khan*
 *Sahbqadar Fish Market, Mohmand*	 *Govt. Rutta Kulachi Carp Hatchery D.I Khan*	 *River Indus Khushal Garh Kohat*

11.2 Complete Site Inventory

Figure 16: Field observation data: Cold Water Zone Sites

Cold Water Zone Sites

Site ID	District	Tehsil	Locality / V	Latitude (N	Longitude	Water bod	Temperatu	pH	Conductivi	Dissolved	Accessibili	Road Acce	Electricity	Existing Aq	Species Cu	Avg. Prod.(kg/yr)
col-Swa-1	Swat	Babozai	Bishband,	34.79453	72.5187	other	13.5	8	190	6.7	moderate	acc_dirt	grid	yes	rainbow	6000
col-Swa-1	Swat	Babozai	Bishband	34.7989	72.51524	stream	11	7.6	200	7.3	easy	acc_road	grid			
col-Swa-1	Swat	Charbagh	Ghanamra	34.81673	72.52873	stream	14	8	250	7	easy	acc_road	grid			
col-Swa-2(	Swat	Babozai	Mingora	34.77245	72.36163						easy					
col-Swa-1	Swat	Kabal	Kanju	34.80353	72.34373						easy					
col-Swa-1	Swat	Babozai	Manglawar	34.81338	72.4461						easy					
col-Swa-1	Swat	Bahrain	Kulakarai	35.05996	72.53183	stream	15	8	150	6.9	easy	acc_road	grid	yes	rainbow	2000
col-Swa-1	Swat	Bahrain	Madyan	35.14075	72.54845	other	14.5	8	70	6.4	easy	acc_road	grid,genera	yes	rainbow	10000
col-Swa-1	Swat	Bahrain	Madyan	35.14092	72.54803	other	14	8	70	6	easy	acc_road	grid	yes	rainbow	2000
col-Swa-1	Swat	Bahrain	Madyan	35.14177	72.54929	stream	14	7.9	70	6	difficult	acc_foot	grid,genera	yes	rainbow	1000
col-Swa-1	Swat	Bahrain	Cheel Bad	35.14289	72.55619	other	14.2	7.9	72	6.7	difficult	acc_foot	grid	yes	rainbow	10000
col-Swa-1(	Swat	Bahrain	Piya,	35.10781	72.51532	other	13.5	7.5	325	6.8	easy	acc_road	grid			
col-Swa-1	Swat	Bahrain	Tirat	35.11982	72.50172	other	13.5	7.81	225	6.2	easy	acc_road	grid	yes	rainbow	4000
col-Swa-2(	Swat	Matta	Hussainab	35.0758	72.45795	stream	16	8	170	6.5	easy	acc_road	grid			
col-Swa-2(	Swat	Matta	Koz lalko			other	16.8	8	120	5.8	easy	acc_road	grid	yes	rainbow	3000
col-Swa-2(	Swat	Matta	Bar Lalko			stream	14.5	8	170	6.8	easy	acc_road	grid			
col-Swa-2(	Swat	Matta	Bar Lalko			other	14	8	175	6	easy	acc_road	grid	yes	rainbow	40000
col-Swa-2(	Swat	Matta	Gabin Jaba top			other	12	8	155	6.1	moderate	acc_dirt	none			
col-Swa-1	Swat	Matta	Rordingar			stream	15	8	100	9	easy	acc_road	grid,genera	yes	rainbow	1500
col-Swa-1	Swat	Matta	Charma			other	13.8	7.7	70	7.8	difficult	acc_foot	grid	yes	rainbow	1200
col-Swa-1	Swat	Matta	Solatan			other	13.8	7.8	82	7.1	moderate	acc_dirt	grid	yes	rainbow	
col-Swa-1(	Swat	Matta	Nargat, Biha			other	14	8	105	6.5	easy	acc_road	grid	yes	rainbow,br	2000
col-Swa-1(	Swat	Bahrain	Matilthan			other	14	8	210	7.5	easy	acc_road	hydro			
col-Swa-1(	Swat	Bahrain	Gulshanabad utror			other	13.8	8	170	6.2	easy	acc_dirt	grid	yes	rainbow	0
col-Swa-1(	Swat	Bahrain	Kogunal, Kalam			other	13.8	8	210	6.2	moderate	acc_dirt	grid	yes	rainbow	1000
col-Swa-1(	Swat	Bahrain	Kalam			stream	9.4	8	30	7	moderate	acc_dirt	grid			
col-Swa-1(	Swat	Bahrain	Gahilt			stream	14.3	8	30	6.8	moderate	acc_dirt	grid	yes	rainbow	800
col-Swa-1(	Swat	Bahrain	Laikot			stream	11	7.8	50	6.8	moderate	acc_dirt	grid			
col-Swa-2(	Swat	Bahrain	Monkiyal			stream	13	8	120	7	moderate	acc_dirt	grid			
col-Swa-2(	Swat	Bahrain	Satal			stream	14	7.95	85	6.8	difficult	acc_foot	grid			
col-Swa-2(	Swat	Bahrain	Kuzagari			stream	14	7.95	90	6.2	difficult	acc_foot	grid	yes	rainbow	200
col-Sha-2(	Shangla	Alpuri	Alpuri			other	16.8	8	180	9	easy	acc_road	grid	yes	rainbow	0
col-Sha-2(	Shangla	Alpuri	Lilownai	34.94589	72.63769	stream	16.9	8	180	9	easy	acc_road	grid			
col-Sha-2(	Shangala	Alpuri	Barkana			stream	14.8	8	180	7	moderate	acc_dirt	grid			
col-Bun-1(	Buner	Chagharza	Battarha	34.535	72.63915	stream	22.1	8	360	8	easy	acc_road	grid			
col-Bun-1(	Buner	Gagra	Matwani	34.48215	72.61101	other	21.8	7.9	450	5	easy	acc_road	solar	yes	grass,rohu	1000
col-Bun-1(	Buner	Gagra	Falang baji	34.47233	72.573	spring	22	7.9	450	4		acc_road	solar	yes	rohu,gulfar	2500
col-Mal-22	Malakand	Dargai	Sakhakot	34.47902	71.90624	stream	22.4	8	420	5.2	easy	acc_road				
col-Mal-23	Malakand	Batkhela	Totakan			river	21.5	8	450	7		acc_road	grid			
col-Low-2(	Lower DIR	Chakdara	Fishing Hut	34.64852	72.03198	stream	24.1	8	600	6	moderate	acc_road	grid			
col-Low-2(	Lower Dir	Chakdara	Badwan chowk								easy					
col-Low-2(	Lower Dir	Adenzai	Kashmir	34.79441	72.149	spring	20	8	430	5.3	difficult	acc_foot	grid	yes	rohu,silver	2000
col-Dir-11(	Dir Lower	Timergara	Saddo shekwali			other	20.9	8	280	5.8	moderate	acc_dirt	grid	yes	rohu,mriga	1000
col-Low-1(	Lower Diru	Balambat	Odigram	34.87692	71.8695	stream	21.2	8	390	9	moderate	acc_dirt	grid			
col-Low-1(	Lower Dir	Khal	Rabat			spring	21	8	430	6	easy	acc_road	grid	yes	rohu,grass	2000
col-Cht-21	Chtral	Chitral	Jugoor golc	35.82281	71.78633	stream	11.7	8	220	9	easy	acc_road	grid	yes	rainbow	500
col-Chi-23	Chitral chi	Chitral	Jagoor gulc	35.82301	71.78685	stream	12.2	8	220	9	easy	acc_road				
col-Chi-22	Chitral	Drosh	Gureen lus	35.62336	71.87701	stream	14.6	8	220	8	difficult	acc_dirt	hydro	yes	rainbow	400
col-Chi-23	Chitral	Drosh	Gureen lusht stream			stream	10	8	250	9	difficult	acc_dirt	hydro			
col-Chi-22	Chitral	Drosh	Shishikoh stream at fursat purtgo			stream	11.5	8	250	9	difficult	acc_dirt	grid			
col-Chi-21	Chitral Lov	Chitral	Bomboraite			stream	11	7.91	190	8.2	difficult	acc_dirt	grid	yes	rainbow,br	0
col-Low-2(	Lower Chit	Chitral	Bumboraite			spring	11.5	7.41	260	7.2	moderate	acc_dirt	grid	yes	rainbow,br	100
col-Low-2(	Lower Chit	Chitral	Sheikhand	35.68335	71.64968	spring	13.5	8	250	8	difficult	acc_dirt	grid	yes	rainbow	1000
col-Chi-21	Chitral low	Chtral	Batreek Bu	35.69496	71.67788	spring	12.3	7.71	210	8	difficult	acc_dirt	hydro	yes	rainbow,br	1000
col-Low-2(	Lower Chit	Chitral	Bumboraite			stream	11	7.9	230	8.7	moderate	acc_dirt	grid			
col-Low-2(	Lower Chit	Chitral	Rumbor			stream	11.5	7.8	230	8.6	moderate	acc_dirt	hydro			
col-Low-2(	Lower Chit	Chitral	Ayun			stream	12.3	8	230	8	easy	acc_road	grid			
col-Low-2(	Lower Chit	Chitral	Jaghoor, Cl	35.8186	71.77253	other	10.4	8	230	7	easy	acc_road	grid	yes	rainbow	1000
col-Chi-20	Chitral Lov	Chiyral	Jughoor Sh	35.81977	71.77072	stream	13	7.92	415	6	moderate	acc_foot	grid	yes	rainbow,gu	1500
col-Chi-20	Chitral Lov	Chitral	Mogh	36.00949	71.64768	spring	8.9	7.8	190	8.3	easy	acc_road	hydro	yes	rainbow	0
col-Low-2(	Lower Chit	Chitral	Mogh			stream	11	7.9	210	9	easy	acc_road				
col-Low-2(	Lower Chit	Chitral	Mogh			other	10	7.8	130	7.8	easy	acc_road	hydro	yes	rainbow	800
col-Low-2(	Lower Chit	Chitral	Baka, Golein			stream	10.2	7.8	230	9.8	moderate	acc_dirt	grid,hydro			
col-Low-2(	Lower Chit	Chitral	Izghor Golein			other	8.8	7.91	250	8.5	moderate	acc_dirt	grid,hydro	yes	rainbow,br	2000
col-Low-2(	Lower Chit	Chitral	Izghoor, Golein			spring	8.1	7.8	260	9	moderate	acc_dirt	grid,hydro			
col-Upp-1(	Upper Chit	Mustuj	Sarghooz, Mastuj			other	9	7.93	210	8.7	moderate	acc_dirt	hydro			
col-Upp-1(	Upper Chit	Mutuj	Mustuj			other	9	7.9	230	8.9	moderate	acc_dirt	hydro			
col-Upp-1(	Upper Chi	Mustuj	Laspur Stream at Sor Laspur			other	8.6	7.4	130	9.5	moderate	acc_dirt	hydro			

col-Upp-1	Upper Chit	Mustuj	Miragram No. 1			stream	9.6	7.89	260	9	moderate	acc_dirt	hydro			
col-Upp-1	Upper Chit	Mustuj	Harchin Laspur			other	97	7.95	430	8.3	moderate	acc_dirt	hydro	yes	rainbow,br	300
col-Upp-1	Upper Chit	Mustuj	Yukum, Yarkhoon			other	6.2	8	470	9	moderate	acc_dirt	hydro			
col-Upp-1	Upper Chit	Mustuj	Dizg, Yarkhoon			spring	11.5	7.71	910	8.8	moderate	acc_dirt	hydro			
col-Upp-1	Upper Chit	Mustuj	Sonoghur Area			other	9.5	7.9	295	9	moderate	acc_dirt	hydro			
col-Dir-12	Dir Upper	Kalkot	UC Kalkot (	35.41582	72.17504	stream	14.8	7.84	130	7	moderate	acc_dirt	hydro		rainbow	0
col-Upp-1	Upper Dir	Shringal	Patrak			stream	13.5	7.92	160	7.3	moderate	acc_dirt	grid,hydro			
col-Upp-1	Upper Dir	Shringal	Salool LACASA Resorts			river	12.1	7.78	140	7.5	moderate	acc_dirt	hydro	yes	rainbow	0
col-Upp-1	Upper Dir	Larjan	Surdum Kairdara			stream	12	8	140	7	moderate	acc_dirt	grid			
col-Upp-1	Upper Dir	Barawal	Marawro			spring	12	7.88	230	8	moderate	acc_dirt	hydro			
col-Upp-1	Upper DIR	Larjam	Garkoi			stream	6	7.71	80	9	moderate	acc_dirt	hydro			
col-Kur-15	Kurram	Parachinar	Dall	33.823	70.154	spring	16	6.53	220	10	moderate	acc_dirt	none			
col-Kur-11	Kurram	Parachinar	Shalozan	33.957	70.022	stream	12	6.58	220	11	easy	acc_road	none,grid			
col-Kur-12	Kurram	Parachinar	Malana	33.962	70.089	stream	11	6.42	220	11.5	easy	acc_road	grid			
col-Kur-14	Kurram	Parachinar	Zeran mast	33.941	70.124	stream	11	6.41	220	12	difficult	acc_foot	grid			
col-Kur-15	Kurram	Parachinar	Shublan ta	33.821	70.164	spring	15	6.53	220	9.5	easy	acc_road	solar	yes	rainbow	1000
col-Swa-1	Swat	Bahrain	Dhamaka lake			river	6	7.7	70	9	moderate	acc_dirt	grid	yes	Trout	
col-Swa-1	Swat	Bahrain	Surrounding of kharkhary lake			river	5.6	6.6	70	9.5	moderate	acc_dirt	hydro			
col-Swa-1	Swat	Bahrain	Gujjar Gabral			river	7.6	7.3	70	8	moderate	acc_dirt	hydro			
col-Swa-1	Swat	Bahrain	Shahi bagh lake			river	4	7	50	10.5	moderate	acc_dirt	generator			
col-Swa-1	Swat	Bahrain	Blue water lake			river	7	7.2	60	7	moderate	acc_dirt	grid			
col-Swa-1	Swat	Bahrain	Tangy banda			stream	6.6	7	70	8	difficult	acc_dirt	hydro			
col-Swa-1	Swat	Bahrain	Beshigram			stream	7	7	70	8	moderate	acc_dirt	hydro			

Figure 17: Field observation data: Semi-Cold Water Zone Sites

Semi Cold Water Zone Sites

Site ID	District	Tehsil	Locality / V	Latitude (N	Longitude	Water bod	Temperatu	pH	Conductiv	Dissolved	Accessibil	Road Acce	Electricity	Existing Aq	Species Ca	Avrg Prod.(k
sem-Har-1	Haripur	Haripur	Changi Bar	33.99406	73.03373	spring	24	7.73	590	4	moderate	acc_dirt	none	yes	rohu,mash	4000
sem-Har-1	Haripur	Haripur	Bagra	33.97957	73.07422	stream	24.7	7.87	386	7.3	easy	acc_road	none			
sem-Abb-1	Abbottaba	Havelian	Kanryala	33.93634	73.15769	stream	18.8	7.73	449	6.9	easy	acc_road	none			
sem-Har-1	Haripur	Haripur	Jabri	33.89523	73.16022	river	21.2	7.7965	441	6.5	easy	acc_road	none			
sem-Har-1	Haripur	Haripur	Kamal Pur	33.78786	72.94902	stream	24.4	7.72	536	6.5	easy	acc_road	grid			
sem-Har-1	Haripur	Khanpur	Khanpur D	33.8164	72.92172	other	25.1	7.99	405	6.5	easy	acc_road	grid			
sem-Har-1	Haripur	Haripur	Samla Nag	34.04765	72.97343	borewell	20	7	494	7.8	moderate	acc_road	grid,solar			
sem-Har-1	Haripur	Haripur	Jhatti Pind			borewell	23.5	7.13	494	7.5	moderate	acc_road	grid			
sem-Swa-(	Swat	Barikot	Nagoha Fis	34.69639	72.19866	spring	19	7.9	450	7.2	easy	acc_road	grid	no	masheer,thaila,grass	
sem-Swa-(	Swat	Barikot	Nagoha	34.69708	72.19828	spring	18	7.7	400	6.7		acc_road	grid			
sem-Abb-1	Abbottaba	Havelian	Wazeeran			river	23.3	8	434	8.4	easy					
sem-Abb-1	Abbottaba	Havelian	Lagra			other	24.4	7.5	306	8.1	easy	acc_road	grid	yes	masheer,g	500
sem-Abb-1	Abbottaba	Havalian	Malkan			river	23.5	8	438	8.5	easy	acc_road	hydro,generator			
sem-Abb-1	Abbottaba	Lower Tan	Ratiyan			spring		7	0	0	difficult	acc_road	grid			
sem-Abb-1	Abbottaba	Abbottaba	Main Bazar Abbottabad								easy					
sem-Abb-1	Abbottaba	Abbottaba	Namli Maira			spring	12.6	7.3	178	9.6	easy	acc_dirt	grid	no	rainbow	
sem-Abb-1	Abbottaba	Abbottaba	Karlan			stream	16.5	7.68	359	10	moderate	acc_dirt	grid			
sem-Abb-1	Abbottaba	Abbottaba	Bara Hotar			spring	22	7.93	432	8.9	easy	acc_road	grid	yes	rohu,grass	2500
sem-Abb-1	Abbottaba	Abbottaba	Hotar Kasi			spring	17.5	7.9	336	9.5	difficult	acc_dirt	solar	yes	rainbow	500
sem-Man-:	Mansehra	Balakot	Khaniyan			spring	11	7.7	387	11	easy	acc_road	grid	yes	rainbow	2700
sem-Man-:	Mansehra	Balakot	Lohar Banda			stream	13	7.86	274	11.8	easy	acc_road	grid	yes	rainbow,br	1000
sem-Man-:	Mansehra	Balakot	Jared Ochri			stream	10.5	7.89	511	10.4	moderate	acc_dirt	grid	yes	rainbow,br	20000
sem-Man-:	Mansehra	Balakot	Bhoonja Kafar Kasi			spring	10.5	7.85	304	11.5	easy	acc_road	grid	yes	rainbow,br	18000
sem-Man-:	Mansehra	Balakot	Fareed Abad			stream	10.6	7.6	219	11.5	easy	acc_road	hydro	yes	rainbow	5000
sem-Man-:	Mansehra	Balakot	Kiwai			spring	109	7.75	220	118	moderate	acc_dirt	grid	yes	rainbow	4000
sem-Man-:	Mansehra	Balakot	Ghanool Valley			stream	14	8	356	11.5	moderate	acc_dirt	grid			
sem-Man-:	Mansehra	Baffa	Salar Bagh			river	23	8	398	12.5	easy	acc_road	grid	yes	grass,rohu	24000
sem-Man-:	Mansehra	Baffa Pakh	Jabori			river	18.9	8	199	10.5		acc_road	grid			
sem-Man-:	Mansehra	Baffa	Domail			river	14.5	7.6	142	10.3	easy	acc_road	grid	yes	rainbow	2000
sem-Man-:	Mansehra	Baffa	Sachan Banda			spring	14.4	7.62	170	10.8	moderate	acc_road	grid			
sem-Bat-1	Battagram	Battagram	Shumlai Hill			stream	12.4	7.2	74	11	moderate	acc_dirt	grid			
sem-Bat-1	Battagram	Battagram	Jesol			river	16.7	8	100	9	easy					
sem-Bat-2	Battagram	Allai	Rashang			stream	12.3	7.7	174	11.8	difficult	acc_dirt	hydro	yes	rainbow,br	100
sem-Koh-1	Kohistan L	Bankhar R	Sholgra			stream	17.7	7.8	219	9.5	easy	acc_road	grid,hydro			
sem-Koh-1	Kohistan L	Bankhar R	Dubair			stream	13.7	7.27	89	11	moderate	acc_dirt	grid,hydro			
sem-Koh-1	Kohistan L	Pattan	Chawadara			stream	13.2	6.75	160	10.8		acc_dirt	grid			
sem-Koh-1	Kohistan U	Dassu	Goshali			stream	12	7.1	69	12.4	moderate	acc_dirt	grid,hydro			
sem-Kol-1	Kolai Palas	Palas	Shariyal Stream			stream	10.9	7.13	54	12.7	difficult	acc_dirt	hydro			
sem-Kol-1	Kolai Palas	Palas	Bela Gadar Haran Bridge			stream	8.5	7.52	109	13.3		acc_dirt	hydro,solar			
sem-Kol-1	Kolai Palas	Palas	Marhu Ù...Ù'Ù¯Ù			stream	10.58	7.18	36	12	moderate	acc_dirt	hydro,solar			
sem-Mal-1	Malakand	THANABAZ	Thana	34.64452	72.04875	stream	16.7	8	210	5.56	easy	acc_road	grid,solar	yes	masheer	1000
sem-Swa-:	Swabi	Swabi	Panjman			borewell	23.2	7.8	845	9.1	easy	acc_road	solar	yes	silver,gras	3500
sem-Swa-:	Swabi	Swabi	Kundal Dam			dam	24	8	220	6.4	easy	acc_road	grid			
sem-Swa-:	Swabi	Topi	Maini (Shakrai)			other	21.9	7.7	229	8.3	easy	acc_dirt	grid,solar	yes	rohu,mriga	10000
sem-Swa-:	Swabi	Swabi	Marghuz			borewell	23	7.37	566	7.2	easy	acc_road	grid,solar	yes	grass,rohu	300
sem-Swa-:	Swabi	Razzar	Asota Sharif Mohallah Sabirabad			borewell	23.4	8	168	7.8	easy		grid	yes	rohu,mriga	3200
sem-Swa-:	Swabi	Razzar	Kalu Khan			borewell	24	8	386	9.4	easy	acc_dirt	grid	yes	gulfam,ma	4000
sem-Mar-1	Mardan	Mardan	Charbanda Hatchery			borewell	22.6	7.33	929	5.7	easy	acc_road	grid	yes	grass,gulfa	400000
sem-Mar-1	Mardan	Takhtbai	Miangano Kaley			borewell	22.3	8	272	6.5	easy	acc_road	grid	yes	rohu,mriga	3200
sem-Mar-1	Mardan	Katlang	Katti Ghari			other	22.8	7.9	225	6.1	easy	acc_road	grid	yes	rohu,mriga	8000
sem-Mar-1	Mardan	Takht Bhai	Sara Shah			canal	21.3	7.92	474	9	easy	acc_dirt	grid			
sem-Mar-1	Mardan	Takht Bhai	Umarabad			borewell	23.3	8	521	10	easy	acc_road	grid			
sem-Mar-1	Mardan	Rustam	Mir Bahadar Khan Banda			borewell	21.5	7.66	391	7	moderate	acc_road	grid,solar			
sem-Mar-1	Mardan	Rustam	Chargulli			borewell	22.2	8	180	11	easy	acc_road	grid			
sem-Mar-1	Mardan	Rustam	Kamar Gai			borewell	22.6	8	390	7	easy	acc_road	grid	yes	rohu,grass	3000
sem-Mar-1	Mardan	Toru	Sheikh Maltoon			borewell	23.5	8	1042	7.7	easy	acc_road	grid,solar	yes	rohu,mriga	3750
sem-Mar-1	Mardan	Mardan	Taru Maira			borewell	23.2	8	391	7.4	easy	acc_road	grid,solar	yes	rohu,mriga	3000
sem-Cha-1	Charsadda	Charsadda	Nisatta Patwari Kaley			canal	23	7.21	360	7.2	easy	acc_road	grid	yes	rohu,grass	120
sem-Cha-1	Charsadda	Charsadda	Azizabad Nisatta			borewell	25	8	753	7.8	easy	acc_road	grid,solar	yes	rohu,grass	16000
sem-Cha-1	Charsadda	Charsadda	Shabra			borewell	25.3	7.56	358	5.6	easy	acc_dirt	solar	yes	rohu,mriga	4800
sem-Cha-1	Charsadda	Charsadda	Tarnab			borewell	22.4	8	271	6.1	moderate	acc_road	solar	yes	rohu,mriga	1200
sem-Mar-1	Mardan	Katlang	Katlang Chichar			canal	20.5	8	186	9.5	easy	acc_road	grid			
sem-Cha-1	Charsadda	Charsadda	Nisatta	34.136	71.18	borewell	26	7.65	350	190	easy	acc_road	solar	yes	rohu,mriga	2000
sem-Cha-1	Charsada	Charsadda	Nisatta	34.21	71.8	borewell	26	7.28	380	8	easy	acc_road	solar	yes	gulfam,gra	6000
sem-Mar-1	Mardan	Katlang	Katti Garhi			canal	22.9	8	218	9.5	easy	acc_road	grid			
sem-Mar-1	Mardan	Katlang	Katti Garhi Jalal Shah Fish Farm			canal	20	7.2	273	7.4	easy	acc_road	grid	yes	rohu,silver	70000
sem-Mar-1	Mardan	Katlang	Katti Ghari			canal	22	8	185	8.3	easy	acc_road	grid	yes	rohu,mriga	4000
sem-Mar-1	Mardan	Katlang	Katti Ghari Malik Irfan Fish Farm			canal	22	8	185	8.3	easy	acc_road	grid	yes	rohu,mriga	4000
sem-Mar-1	Mardan	Katlang	Malosha			spring	21.8	7.44	346	7.2	easy	acc_road	grid			
sem-Pes-1	Peshawar	Peshawar	Dalazak			spring	22.2	8	740	7.2	easy	acc_road	solar	yes	rohu,grass	2500
sem-Pes-1	Peshawar	Akbarpura	Jabba Daudzai			spring	16.4	7.47	811	6.6	easy	acc_road	grid			

sem-Pes-1	Peshawar	Akbarpura	Naguman River			river	21.1	7.47	557	7.3	easy	acc_dirt	grid			
sem-Pes-1	Peshawar	Terae Paya	Akbar Khan Kilah			spring	23.8	7.52	681	8.1	easy	acc_road	grid	yes	grass	4000
sem-Pes-1	Peshawar	Mathra	Chaghar Matti			canal	19.7	7.79	342	9.2	easy	acc_road	grid			
sem-Pes-1	Peshawar	Mathra	Haryan Garh			canal	19.4	7.83	349	9.1	easy	acc_road	grid			
sem-Pes-1	Peshawar	Mathra	Shahi Bala Fish Farm			spring	24.1	8	556	10.1	easy	acc_dirt	solar	yes	rohu,grass	10000
sem-Pes-1	Peshawar	Mathra	Kabul River Canal			canal	19.3	7.69	329	8.7	easy	acc_road	grid			
sem-Naw-	Nawshera	Pabbi	Village Qasim			other	21.6	7.97	375	8.8	easy	acc_road	grid	yes	grass,silve	7000
sem-Now-	Nowshera	Pabbi	Jalozai Dam			dam	21	7.75	749	7.2	easy	acc_road	solar			
sem-Now-	Nowshehr	Akbarpura	Garhi Momin			spring	21	8	950	8.2	easy	acc_road	grid			
sem-Kur-1	Kurram	Parachinar	Aka khel	33.809	70.151	spring	13	6.5	220	9	easy	acc_road	none			
sem-Too-1	Toorghar	Kandar ha	Chund			canal	18	6.93	0	0	easy	acc_road	solar			
sem-Tor-1	Torghar	Kandar ha	Chund			canal	18	6.96	0	0	easy	acc_road	solar			
sem-Man-	Mansehra	Balakot	Naran			stream	-5	6.9	0	0	moderate	acc_dirt	grid			
sem-Tor-1	Torghar	Khandar h	Mera mada khil		1	spring	20	6.62	20	6.3	easy	acc_none	grid	no	rohu,thaila	
sem-Tor-1	Torghar	Dourmaira	Mangri			dam	16	6.9	0	0	easy	acc_dirt	hydro			
sem-Man-	Mansehra	Balakot	Batakundi nalla			stream	-5	6.97	0	0	easy	acc_road	hydro			
sem-Tor-1	Torghar	Khandar h	Chound m	0	6.62	spring	20	6.62	0	0	difficult	acc_foot	none			
sem-Tor-1	Torghar	Dourmaira	Mangri			canal	16	6.94	0	0	moderate	acc_dirt	hydro			
sem-Man-	Mansehra	Oghi	Unhar River Dogai			stream	16	6.5	0	0	easy	acc_road	grid			
sem-Tor-1	Torghar	Khandar h	Chound	0	0	spring	20	6.55	0	0	difficult	acc_foot	none			
sem-Man-	Mansehra	Oghi	Bandi parha			stream	15	6.5	0	0	easy	acc_road	grid			
sem-Man-	Mansehra	Oghi	Darband			river	25	6.5	0	0	easy	acc_road	grid			
sem-Man-	Mansehra	Balakot	Naran (Chapra)			spring	8	6.9	249	6	difficult	acc_dirt	grid			
sem-Man-(	Mansehra	Balakot	Lulusar Lake			stream	8	6.69	0	6		acc_road	none			
sem-Upp-	Upper koh	Harban ba	Sazin gah nala			spring	9	6.94	0	5.4	moderate	acc_foot	none			
sem-Upp-	Upper koh	Dasu	Uchar nala/strea/Dasu nala			spring	13	7.09	0	0	moderate	acc_dirt	none			
sem-Upp-	Upper koh	Kondia	Kondia river			river	12	7.02	0	0	easy	acc_foot	none			
sem-Upp-	Upper Koh	Kondia	Kondia Nala			spring	12	7.09	0	0	difficult	acc_dirt	none			
sem-Man-(	Mansehra	Oghi	Belian Dewal Oghi			stream	15	6.75	0	0	easy	acc_road	grid			

Figure 18: Field observation data: Warm Water Zone Sites

Warm Water Zone Sites

Site ID	District	Tehsil	Locality / V	Latitude (N	Longitude	Water bod	Temperatu	pH	Conductivi	Dissolved (	Accessibili	Road Acce	Electricity.	Existing Aq	Species Ca	Avrg Prod.(k
war-Baj-15	Bajaur	Salarzai	Gabar spri	34.91432	71.502	spring	15.9	6.5	210	10.8	easy	acc_road	solar			
war-Baj-17	Bajaur	Khar	Raghagan	34.78857	71.57997	dam	22.1	7.8	340	7.9	easy	acc_road	grid			
war-Baj-06	Bajaur	Salarzai	Talay	34.77425	71.58897	dam	18.6	8	210	6.5	easy	acc_road	solar			
war-Baj-1C	Bajaur	Khar	Haji Lawar	34.76074	71.5714	stream	17.5	8	460	12	easy	acc_road	solar			
war-Baj-1C	Bajaur	Khar	Kabari Mar	34.73532	71.52503						easy					
war-Moh-1	Mohmand	Yaka Ghun	Shah Alam	34.21564	71.4454	canal	23.2	7.7	600	4	easy	acc_road	grid	yes	rohu,thaila	450
war-Moh-1	Mohmand	Ekka Ghun	Musal kor	34.22199	71.44074	canal	19.7	8	370	7.9	easy	acc_road	grid,solar			
war-Moh-1	Mohmand	Upar Mohr	Abazai	34.331	71.571	canal	18.9	7.9	150	8.1	easy	acc_road	grid			
war-Moh-1	Mohmand	Upar Mohr	Mohmand	34.319	71.575	canal	18.9	7.8	290	8.9	easy	acc_road	grid			
war-Moh-1	Mohmand	Sahabqadi	Shabqadar	34.222	71.567						easy					
war-Moh-1	Mohmand	Ekka Ghun	Shermakh	34.26	71.467	dam	23.8	7	430	4	easy	acc_road	solar,grid			
war-Moh-1	Mohmand	Ekka Ghun	Ekka Ghun	34.24	71.5	canal	23.3	8	350	7.5	easy	acc_road	grid	yes	rohu,mriga	500
war-Moh-1	Mohmand	Ekka Ghun	Maichni pu	34.178	71.425	river	19.1	8	370	9.3	easy	acc_road	grid			
war-Khy-0	Khyber	Bara	Sepah	33.87	71.366	canal	16.7	8	470	9.7	easy	acc_road	grid,solar			
war-Khy-1	Khyber	Bara	Digra	33.894	71.425	river	18.1	8	430	9.5	easy	acc_road	grid,solar			
war-Khy-1	Khyber	Bara	Bara Mark	33.916	71.462						easy					
war-Khy-1	Khyber	Jamrud	Sakhi pull	34.072	71.39	canal	19.5	8	370	8.8	easy	acc_road	grid,solar			
war-Khy-1	Khyber	Jamrud	Baqarabac	34.081	71.359	dam	23.8	8	200	6.1		acc_road	none			
war-Khy-1	Khyber	Jamrud	Ghundi Jar	34.029	71.378	borewell	25	7.6	560	6.6	easy	acc_road	grid,solar			
war-Khy-1	Khyber	Jamrud	Jaba strea	33.975	71.324	stream	23.3	7.71	480	7	moderate	acc_dirt	solar			
war-Pes-2	Peshawar	Pishtakhar	Main Ring I	33.961	71.516	borewell	21.3	7.04	790	4.5	easy	acc_road	grid,solar	yes	gulfam,roh	20000
war-Khy-0	Khyber	Mullagori	Loramiana	34.104	71.342	dam	22.1	7.8	260	4.8	easy	acc_road	solar			
war-Khy-1	Khyber	Jamrud	Lala china	34.002	71.273	stream	24.3	8	570	8.1	easy	acc_road	solar,grid			
war-Pes-1	Peshawar	Peshawar	Shairabad	34.095	71.51	borewell	23.5	7.7	740	5.2	easy	acc_road	grid,solar			
war-Khy-2	Khyber	Jamrud	Shahkas	33.972	71.399	borewell	22.5	8	450	11.5	easy	acc_road	solar	yes	pangasis	3000
war-Koh-1	Kohat	Kohat	Tanda Fish	33.568	71.397	dam	20	8	250	9.3	easy	acc_road	grid	yes	rohu,grass	6000000
war-Koh-1	Kohat	Kohat	Tanda Dan	33.577	71.407	dam	22.2	8	470	6.5	easy	acc_road	solar,grid			
war-Koh-1	Kohat	Kohat	Jurma	33.5	71.458	borewell	22.7	7.31	1050	7	easy	acc_road	grid,solar	yes	rohu,grass	500
war-Koh-1	Kohat	Kohat	Dhoda	33.545	71.472	borewell	24.3	8	260	4.5	easy	acc_road	grid,solar	yes	rohu,grass	1000
war-Koh-1	Kohat	Lachi	Darmalak I	33.423	71.244	dam	24.8	8	440	7.4	easy	acc_road	none			
war-Koh-1	Kohat	Lachi	Darwezi Ba	33.381	71.448	dam	24.8	8	640	10.2	easy	acc_road	grid,solar			
war-Koh-1	Kohat	Kohat	Poultry & F	33.588	71.441						easy					
war-Koh-0	Kohat	Gumbat	Gandyali	33.534	71.624	dam	22.1	8	460	5.1	easy	acc_road	none			
war-Koh-0	Kohat	Ghumbat	Chorlaki ca	33.512	71.769	dam	20.2	8	280	7.8	easy	acc_road	grid	yes	rohu,silver	1800
war-Koh-1	Kohat	Gumbat	Ghurzai pa	33.511	71.76	dam	21.1	7.5	350	4.7	easy	acc_road	grid	yes	gulfam,tha	1000
war-Koh-1	Kohat	Gumbat	Auxillary K	33.55	71.824	dam	23.2	7.5	270	4.9	easy	acc_road	none			
war-Koh-1	Kohat	Gumbat	Kandar	33.562	71.845	dam	23.5	7.6	240	4.7	easy	acc_road	grid			
war-Koh-1	Kohat	Gumbat	Khushal Ga	33.484	71.907	river	17.8	7.8	290	9.2	easy	acc_road	grid			
war-Koh-1	Kohat	Gumbat	Nakband	33.481	71.856	dam	21.5	7.4	370	5.4	easy	acc_road	none	yes	rohu,gulfa	3000
war-Koh-1	Kohat	Kohat	Kharmatu	33.512	71.531	borewell	24	7.4	850	3.1	easy	acc_road	grid,solar	yes	grass	200
war-Koh-1	Kohat	Kohat	Orakzai Ba	33.479	71.534	borewell	22.3	8	700	9.5	easy	acc_road	grid,solar	yes	grass,silve	400
war-Koh-1	Kohat	Kohat	Shadi khail	33.452	71.552	borewell	22.2	8	1650	9.3	easy	acc_road	grid,solar	yes	rohu,thaila	400
war-Ora-1	Orakzai	Lower Okr	Zeera	33.744	71.188	river	14.6	8	400	9.1	easy	acc_road	grid	yes	rohu,grass	500
war-Okr-1	Okrakzai	Lower Oral	Sepay	33.747	71.193	river	15	8	460	9.2	easy	acc_road	grid			
war-Ora-1	Orakzai	Lower Oral	Undkhil Ba	33.776	71.145	river	16.8	7.6	420	9.2	easy	acc_road	grid			
war-Ora-1	Orakzai	Lower Oral	Tazikhail	33.771	71.132	spring	17.3	7.3	520	4.9	easy					
war-Ora-1	Orakzai	Lower Oral	Saam fero	33.765	70.966	river	17.2	7.9	420	10	easy	acc_road	grid			
war-Ora-1	Orakzai	Center Ora	Naka Mela	33.729	70.898	stream	16.5	8	390	9.5	easy	acc_road	grid			
war-Ora-1	Orakzai	Center ora	Ganghana	33.729	70.875	stream	15.6	7.9	430	8.8	easy	acc_road	grid			
war-Ora-1	Orakzai	Lower Oral	Kalaya Hea	33.746	70.954	stream	14.5	8	420	8	easy	acc_road	grid			
war-Han-0	Hangu	Hangu	Jouzara	33.586	71.21	stream	14.5	7.9	490	10	easy	acc_road	grid			
war-Han-1	Hangu	Hangu	Muhamma	33.458	70.93	dam	17.9	8	180	7.8	easy	acc_road	grid	yes	silver,gulfam,grass,roh	
war-Han-1	Hangu	Thal	Mamabadi	33.357	70.585	spring	19.5	7.7	750	8.5	easy		solar	yes	rohu,mriga	3000
war-Han-1	Hangu	Thal	Shakaly Ba	33.357	70.584	spring	21.7	8	730	8.8	moderate	acc_dirt	none			
war-Han-1	Hangu	Thal	Thal city	33.356	70.545	river	18.6	8	530	9.3	easy	acc_road	grid			
war-Han-1	Hangu	Hangu	Main Mark	33.531	71.06						easy					
war-Kar-1	Karak	Banda Dau	Sharki	33.292	71.977	dam	20.6	8	490	5.2	easy	acc_road	grid			
war-Kar-11	Karak	Banda Dau	Banda Dau	33.273	71.176	dam	17.9	7.7	3240	6.5	easy	acc_road	grid			
war-Kar-1	Karak	Babda Dau	Ahmad Ba	33.254	71.193	dam	19.9	7.9	510	7.5	easy	acc_road	none			
war-Kar-1	Karak	Banda Dau	Inzar paya	33.231	71.178	dam	21.6	8	410	8.3	easy	acc_road	none			
war-Kar-1	Karak	Banda Dau	Niku Banda	33.234	71.182	dam	20.7	8	500	8.3	easy	acc_road	none	no		
war-Kar-1	Karak	Danda Dau	Peerdak	33.234	71.17	dam	21.1	8	380	7	easy	acc_road	none			
war-Kar-1	Karak	Danda Dua	Dangai Pir	33.225	71.17	dam	22.3	7.6	360	4.8	easy	acc_road	solar			
war-Kar-1	Karak	Danda Dau	Nari Panos	33.191	71.175	dam	22.1	8	330	6.3	easy	acc_road	none	yes	rohu,grass	0
war-Kar-1	Karak	Karak	Chambai k	33.108	71.162	dam	20.2	8	30	8.5	easy	acc_dirt	none			
war-Kar-0	Karak	Karak	Mithakhel	33.13	71.196	dam	18.7	8	310	6	moderate	acc_road	none			
war-Kar-0	Karak	Karak	Zabi Dam	33.174	71.276	dam	18.7	8	710	5.8	easy	acc_road	solar			
war-Kar-0	Karak	Karak	Makh Banc	33.174	71.352	dam	19.6	8	370	7.5	easy	acc_road	grid			
war-Kar-11	Karak	Karak	Karak mair	33.115	71.0941						easy					
war-Kar-1	Karak	Danda Dau	Ghoul Dan	33.192	70.878	dam	22.5	7.7	770	5.4	easy	acc_road	none			
war-Kar-1	Karak	Karak	Latamber I	33.125	70.864	dam	23.6	8	470	6.8	easy	acc_road	none			

war-Kur-2(	Kurram	Parachinar	Mali khel	33.747	70131	dam	17	6.55	220	10	easy	acc_dirt	none			
war-Kur-1!	Kurram	Parachinar	Agra	33.801	70.162	river	13	6.95	220	15	easy	acc_road	none			
war-Kur-1(	Kurram	Parachinar	Sidara	33.834	70.161	stream	15.5	6.78	220	7.5	easy	acc_road	none,grid	yes	grass,silve	800
war-Kur-1'	Kurram	Parachinar	Shublan	33.823	70.18	borewell	16	7.2	220	9	easy	acc_road	solar	yes	grass,silve	800
war-Ban-0	Banu	Domail	Hikmatabz	33.006	70.742	borewell	16.4	8	380	9.5	easy	acc_road	grid,solar	yes	rohu,mriga	600
war-Ban-1	Banu	Banu	Daramakh	33	70.631	river	17.5	8	260	7.7	easy	acc_road	grid			
war-Ban-1	Banu	Ghouriwal	Degan	32.933	70.699	canal	19.6	7.7	1010	6	easy	acc_road	solar,grid			
war-Ban-1	Banu	Banu	Ghouriwal	32.932	70.7	borewell	20	7.01	500	7	easy			yes	rohu,grass,silver,mriga	
war-Ban-1	Banu	Banu	Govt. Carp	32.942	70.67	borewell	18.9	8	970	7	easy	acc_road	grid	yes	rohu,mrigal,grass,gulfa	
war-Ban-1	Banu	Banu	Kachkot ca	32.994	70.586	canal	15.6	8	270	7.4	easy	acc_road	grid,solar			
war-Ban-1	Banu	Baka khel	Baran Dam	33.01	70.499	dam	21	8	370	9.7	easy					
war-Ban-1	Bannu	Bannu	City Bannu	33.014	70.695						easy					
war-Luc-0	Lucky Man	Sara e nau	Dudhe wal	32.78	70.874	river	11.9	8	3000	10.4	easy	acc_road	grid			
war-Luc-0	Lucky Man	Sarai Nour	Gamila	32.682	70.778	river	15	8	1700	100	easy	acc_road	solar,grid			
war-Luc-1(	Luck Marw	Ghazni Kha	Pezu Dam	32.335	70.745	dam	18.2	8	200	9	easy	acc_road	none			
war-Luc-1'	Lucky Man	Lucky Man	Thanedar s	32.607	71.118	borewell	18.9	8	1810	8	easy	acc_road	solar	yes	rohu,thaila	90000
war-Luc-1!	Lucky Man	Batanni	Awtkhil	32.651	70.494	canal	19.6	8	680	8	easy	acc_road	solar			
war-DI -10	DI Khan	DI Khan	CRBC Can	31.983	70.839	canal	17.7	7.9	310	7.5	easy	acc_road	grid,solar			
war-DI -11	DI Khan	DI Khan	Govt. Fish	31.886	70.89	borewell	20.7	7.7	890	6	easy	acc_road	grid,solar	yes	rohu,thaila,mrigal,silve	
war-DI -12	DI Khan	Paharpur	Awan Nala	32.001	70.983	canal	21.1	8	660	6.1	easy	acc_road	grid			
war-DI -13	DI Khan	PaharPur	Civil rakh /	32.09	70.962	borewell	22.5	8	980	6	easy	acc_road	solar	yes	rohu,thaila	15000
war-DI -14	DI Khan	Paharpur	Wandha kh	32.091	70.958	borewell	23.5	7.8	990	5.2	easy	acc_road	solar	yes	rohu,thaila	62000
war-DI -14	DI Khan	PaharPur	Toba	32.074	70.901	borewell	23.6	8	3590	5.5	easy	acc_road	solar	yes	rohu,thaila	32000
war-DI -15	DI Khan	Paharpur	Baili / New	32.06	70.964	other	23.5	7.7	810	6.2	easy	acc_road	grid,solar			
war-DI -16	DI Khan	Paharpur	Khaki T sip	32.059	71.073	river	19.8	7.9	310	5.6	easy	acc_dirt	none			
war-DI -17	DI khan	Paharpur	Khoji wali c	32.079	71.067	dam	21.1	7.6	860	5.2	moderate	acc_dirt	none			
war-DI -08	DI Khan	DI Khan	Masood Fi	31.829	70.912						easy					
war-DI -08	DI Khan	DI Khan	Daman Lal	31.777	70.896	dam	16.7	7.7	740	6.3	easy	acc_road	grid			
war-DI -09	DI Khan	DI Khan	Custom La	31.761	70.931	dam	18.4	7.8	350	6.3	easy	acc_road	grid			
war-DI -09	DI Khan	DI Khan	Roshan DI	31.767	70.88	dam	18.1	8	1730	5.9		acc_road	grid			
war-DI -10	DI Khan	Prova	Shahpasar	31.732	70.819	canal	16.9	8	780	5.6	easy	acc_road	grid	yes	rohu,mriga	1000
war-DI -11	DI Khan	Paroa	Qayum Na	31.737	70.82	borewell	20.4	8	6000	6	easy	acc_dirt	solar,grid	yes	rohu,thaila	2000
war-DI -12	DI Khan	Paroa	Draban kh	31.698	70.816	borewell	21.2	8	2340	6	easy	acc_road	solar	yes	rohu,thaila	44000
war-DI -13	DI Khan	Poroa	Fareed wal	31.397	70.742	dam	23.7	7.8	710	4.4	moderate	acc_road	none			
war-DI -14	DI khan	Poroa	Nai wali DI	31.396	70.75	dam	22	7.8	1600	5	moderate	acc_dirt	grid,solar			
war-DI -16	DI Khan	Poroa	Makar Dha	31.528	70.773	dam	22.7	7.7	1900	4.7	easy	acc_road	none			
war-DI -17	DI khan	Prova	Prova city	31.562	70.763	canal	22.4	7.9	1190	4.4	easy	acc_road	grid	yes	rohu,mriga	800
war-Tan-0(	Tank	Tank	Ranwal/wa	32.182	70.432	dam	19.2	8	1130	4.6	easy	acc_road	grid,solar			
war-Tan-0(	Tank	Tank	Tank bypas	32.184	70.406	dam	19	8	830	4	easy	acc_road	grid			
war-Tan-1(	Tank	Tank	Warana ca	32.18	70.336	canal	18	8	1200	4.2	easy	acc_road	grid			
war-Tan-1'	Tank	Sub divion	Karwam , J	32.304	70.172	stream	20.5	7.8	390	5	easy	acc_road	grid			
war-Tan-1!	Tank	Tank	Tank city fi	32.21	70.388											
war-Tan-1(	Tank	Tank	Kot pathan	32.228	70.396	canal	21.5	8	2200	4.6	easy	acc_road	grid	yes	rohu,mriga	300
war-Nor-1'	North Waz	Miransha	Marsikhel			dam	0	7.91	0	0	moderate	acc_dirt				
war-Nor-1'	North Waz	Miransha	Chashma			stream	0	8	0	0	easy	acc_road	grid			
war-Nor-1(	North Waz	Hulam Kha	Dandy Derdoni			dam	0	7.89	0	0	easy	acc_dirt	grid			
war-Nor-1(	North Waz	Datakhel	Boya			stream	0	8	0	0	easy	acc_road	grid			
war-Nor-1!	North Waz	Miransha	Hamzony Alikhel			river	20	8	270	5	easy	acc_road				
war-Nor-0!	North Waz	Miransha	Miransh			canal	0	8	0	0	easy	acc_road	grid			
war-DI -09	DI Khan	Paharpur	Band korai	32.082	70.948	borewell	17.2	8	3020	7.5	easy		solar	yes	rohu,thaila	42000
war-Tor-12	Torghar	Khandar ha	Chound mada	khil		spring	18	6.65	0	6.4	difficult	acc_foot	none			
war-DI -13	DI khan	Paharpur	Kacha mal	32.422	71.316	dam	19.5	8	250	6.5	easy	acc_road	solar,grid			
war-DI -13	DI khan	Parhapur	Kacha cha	32.445	71.325	canal	17.2	8	150	7.2	easy	acc_road	grid,solar			
war-DI -14	DI khan	Paharpur	Chashma I	32.451	71.331	dam	21.5	8	320	6.5	easy	acc_road	grid,solar			
war-DI -15	DI Khan	Paharpur	Atthog	32.348	71.228	canal	20	7.7	420	5.5	easy		none,grid	yes	rohu,mriga	10000
war-DI -17	DI Khan	Paharpur	Hafiz Abad	32.08	71.038	canal	17.9	8	310	7	easy	acc_road	grid			
war-DI -11	DI Khan	Prova	Qayum naj	31.74	70.822	borewell	20.4	8	3660	7	easy	acc_road	grid,solar	yes	rohu,thaila	70000
war-DI -12	DI khan	Prova	Draban vill	31.701	70.807	dam	20.1	8	630	5.5	easy	acc_road	solar,grid			
war-DI -13	DI khan	Prova	Dayrra kha	31.756	70.934	river	22	8	310	6.7	easy	acc_road	grid			
war-DI -16	DI khan	DI khan	CRBC Gon	31.878	70.824	canal	19.1	8	290	6.8	easy	acc_road	solar,grid			
war-Sou-1	South wazi	Sarwekai	pir kalai	32.281	69.916	stream	19.5	7.06	360	5.6	easy	acc_road	none			
war-sou-1	south wazi	serwekai	mowlekha	32.283	69.92	stream	17.5	7	300	6.2	easy	acc_road	solar,grid			
war-Sou-1	South wazi	sarwekai	haji abad k	32.26	69.886	stream	19	6.5	280	7	easy	acc_road	grid,solar			
war-Sou-1	South wazi	Wana	Nili kach	32.117	70	stream	25.4	7	215	5	easy	acc_road				
war-Sou-2	South wazi	Tehsil wan	Gomal zan	32.129	69.897	river	21	6.95	225	5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Wana	Dargai pall	32.174	69.722	dam	20	6.5	270	4.5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Wana	Gardai dhc	32.162	96.723	canal	18.7	6.75	265	5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Wana	Tanai stree	32.218	69.68	stream	17.2	6.52	275	5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Wana	Samar bag	32.195	69.614	stream	21.4	7.3	290	5.5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Bermal	Raghzai ba	32.437	69.469	stream	8.9	7.5	280	5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Bermall	khamrang	32.494	69.462	stream	7	7.4	300	8.5	easy	acc_road	grid,solar			
war-Sou-2	South wazi	Wana	Tiarza Fish	32.314	69.614	borewell	16.5	6.75	270	4.5	easy	acc_road	grid,solar	yes	rohu,silver	1500
war-Sou-2	South wazi	Wana	Mechan ba	32.289	69.629	stream	21.6	7.5	250	4	easy	acc_road	solar,grid			
war-Sou-2	South wazi	Wana	Karab kot s	32.265	69.644	stream	19	6.5	275	4.5	easy	acc_road	grid			
war-Sou-2	South wazi	Wana	Wana baza	32.305	69.589						easy					