

EFFECTS OF CLIMATE CHANGE ON PLANNING AND MANAGING WATER SERVICES IN THE POTOHAR REGION OF PAKISTAN

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Over View
Water and Sanitation Agency (WASA)
Rawalpindi - Pakistan

UTILITY PROFILE

- **Established** 1992
- **Fully Functional** 1998
- **Total Employees** 1170
- **Financially self sustainable**

OBJECTIVES

- PROVISION OF SAFE DRINKING WATER AND IMPROVED SANITATION FACILITIES TO ALL**
- ESTABLISHMENT OF EFFICIENT O&M MECHANISM FOR WATER SUPPLY AND SEWERAGE**
- DEVELOPMENT AND EXPOLITATION OF ADDL WATER SOURCES TO CATER FOR FUTURE NEEDS**

Water Demand And Availability

WATER DEMAND

<input type="checkbox"/> Population (WASA Area), 2007	1.10	Million
<input type="checkbox"/> Area	35	Sq km
<input type="checkbox"/> Planned Consumption	40	GPCD
<input type="checkbox"/> Total Demand	44	MGD

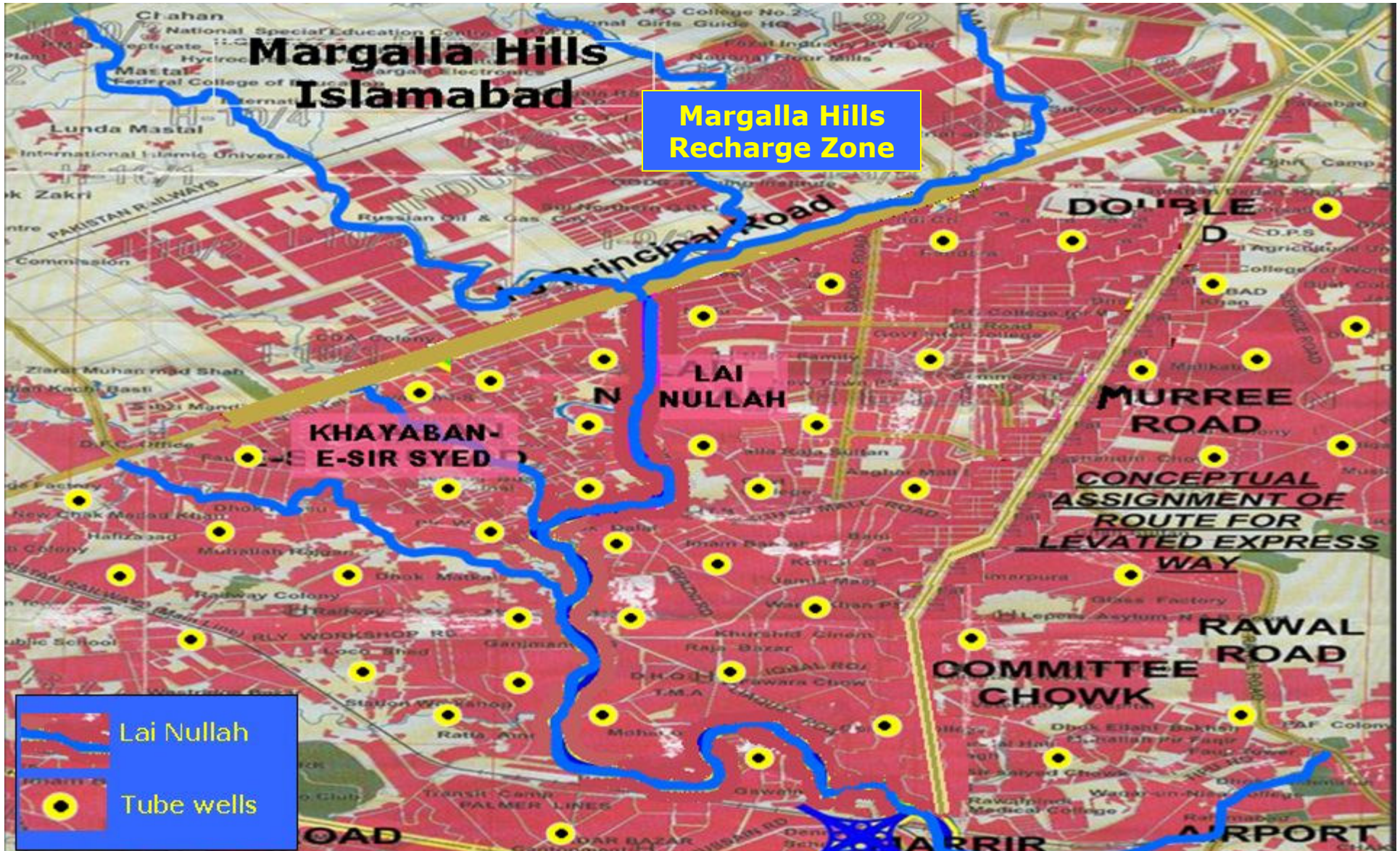
WATER SOURCES

<input type="checkbox"/> Rawal Dam	10	MGD
<input type="checkbox"/> Khanpur Dam	06	MGD
<input type="checkbox"/> Tube wells	26	MGD
<input type="checkbox"/> Total Production	42	MGD

GROUND WATER EXTRACTION THROUGH TUBE WELLS

Total No. of Tube Wells = 260

Total Water Production = 26 MGD



Issues and Challenges

- Encountered with multifarious watershed management issues due to adverse climate change impacts.
- Alarming levels of Bacterial contamination in Ground water and surface water
- Drastic ground water depletion
- Inadequate water supply and water sources management
- Water inefficiency
- Tracheotomy in management hierarchy, Unclear legal and administrative status
- Managerial intensive Organizational Structure
- Hand-in-gloves, water and sewerage lines.
- Faulty Data base
- Imbalance Funding and Budgeting
- In competency of most the tiers of management

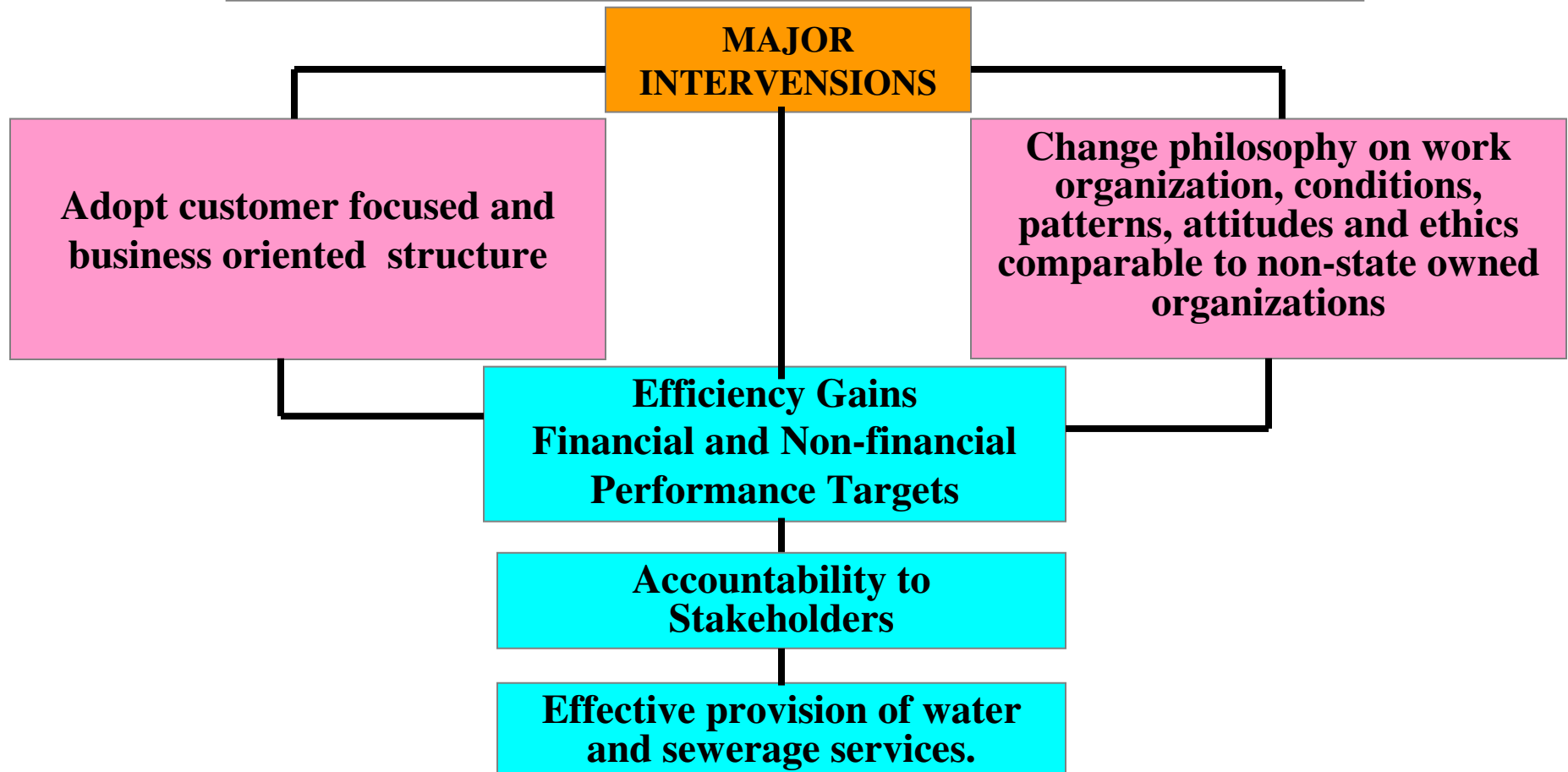
NEW INITIATIVES

- **Management Strategy for enhancing efficiency and output**
- **Continuous Improvement Benchmarking (CIB)**
- **Establishment of water districts -Decentralized concept**
- **Up-gradation of Database through consumer survey to enhance collection efficiency**
- **Online integrated complaint management system**
- **Online customer support services**
- **Web presence of WASA/RDA (wasa.rda.gov.pk)**
- **Establishment of Bank Cash counter at WASA HQ Building and Increasing the collection points**
- **Energy Audit – KSB Pumps**
- **Outsourcing of Tube wells**
- **Ground water modeling – TNO Netherlands**
- **Installation of Vehicle Tracking System and Geo Fencing**
- **Twinning of RWASA with 5 mega cities**
- **Membership of RWASA with World Water Council**
- **E-Governance (Intranet – Microsoft outlook)**
- **Community mobilization and participation - Regular Celebration of World Water Day – 22nd March and frequent field meetings with community**

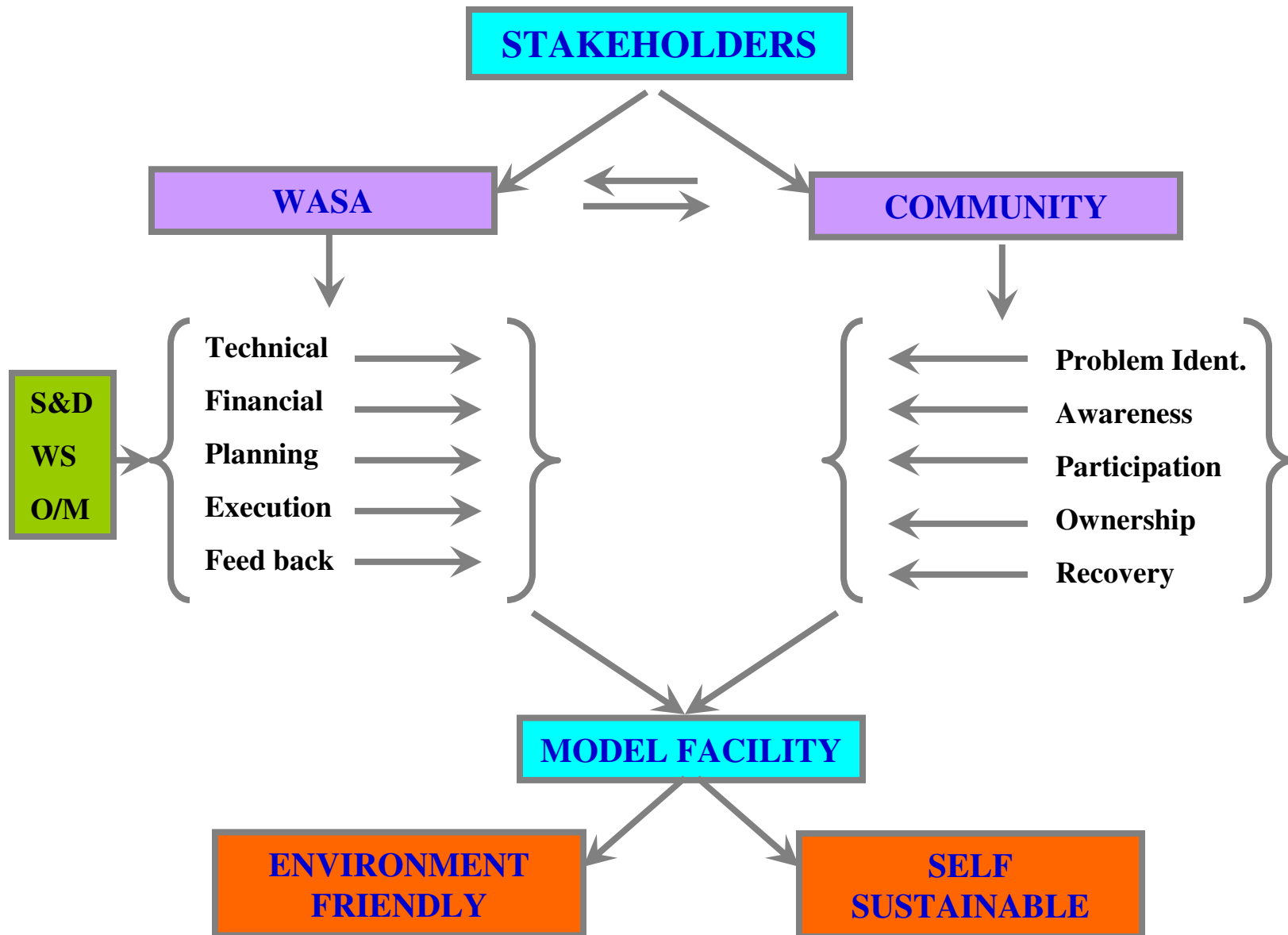
Transformation Process Map

Compatible with mission and objectives

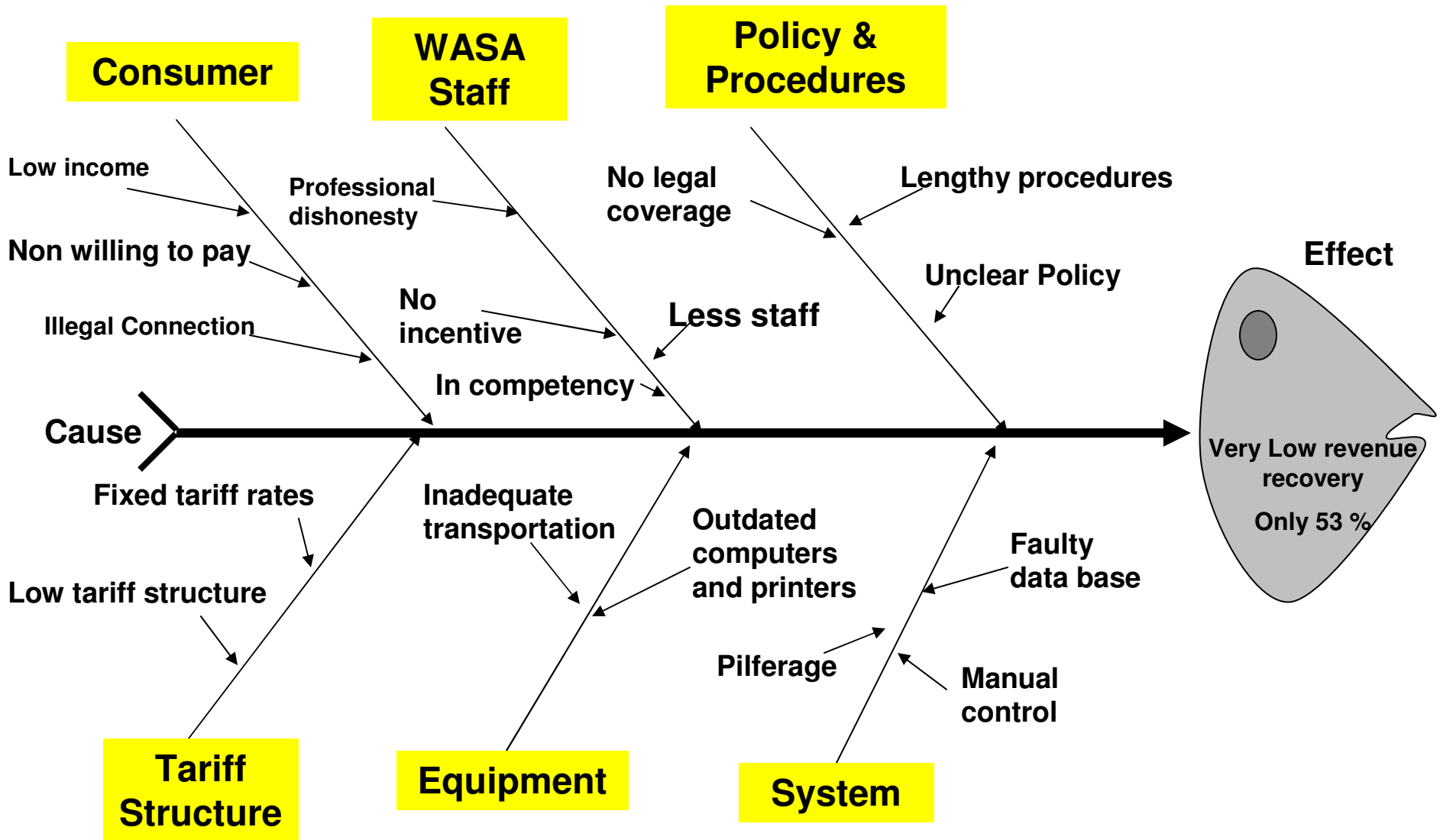
Transformation of WASA into a Sustainable, Efficient, Vibrant and User's Friendly Organization With Clear Social and Commercial Objectives



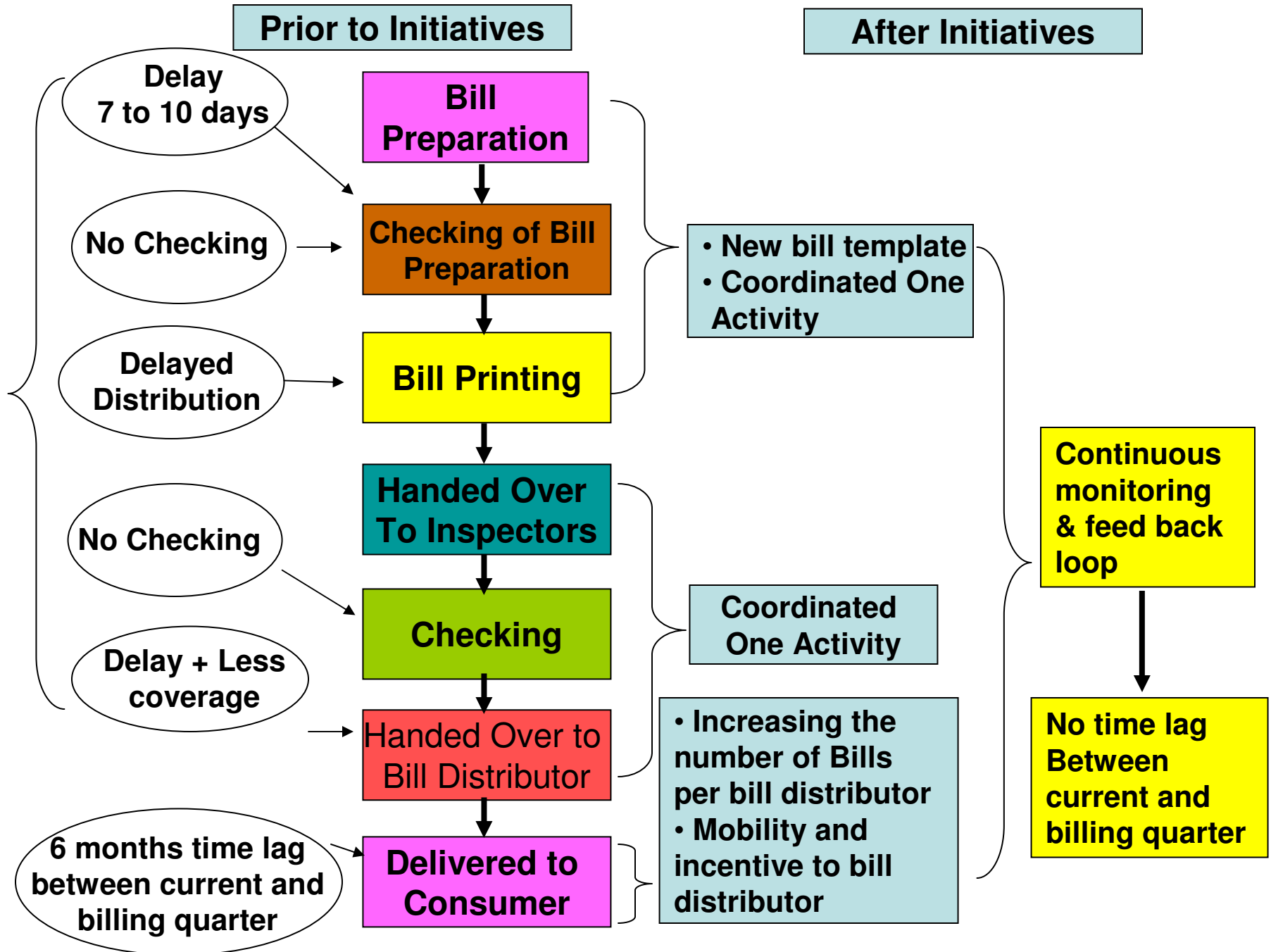
Right Based Integrated Approach



Cause and Effect Diagram - Low Recovery



Billing System - Process Map



Outcome of Managing and Planning Strategies

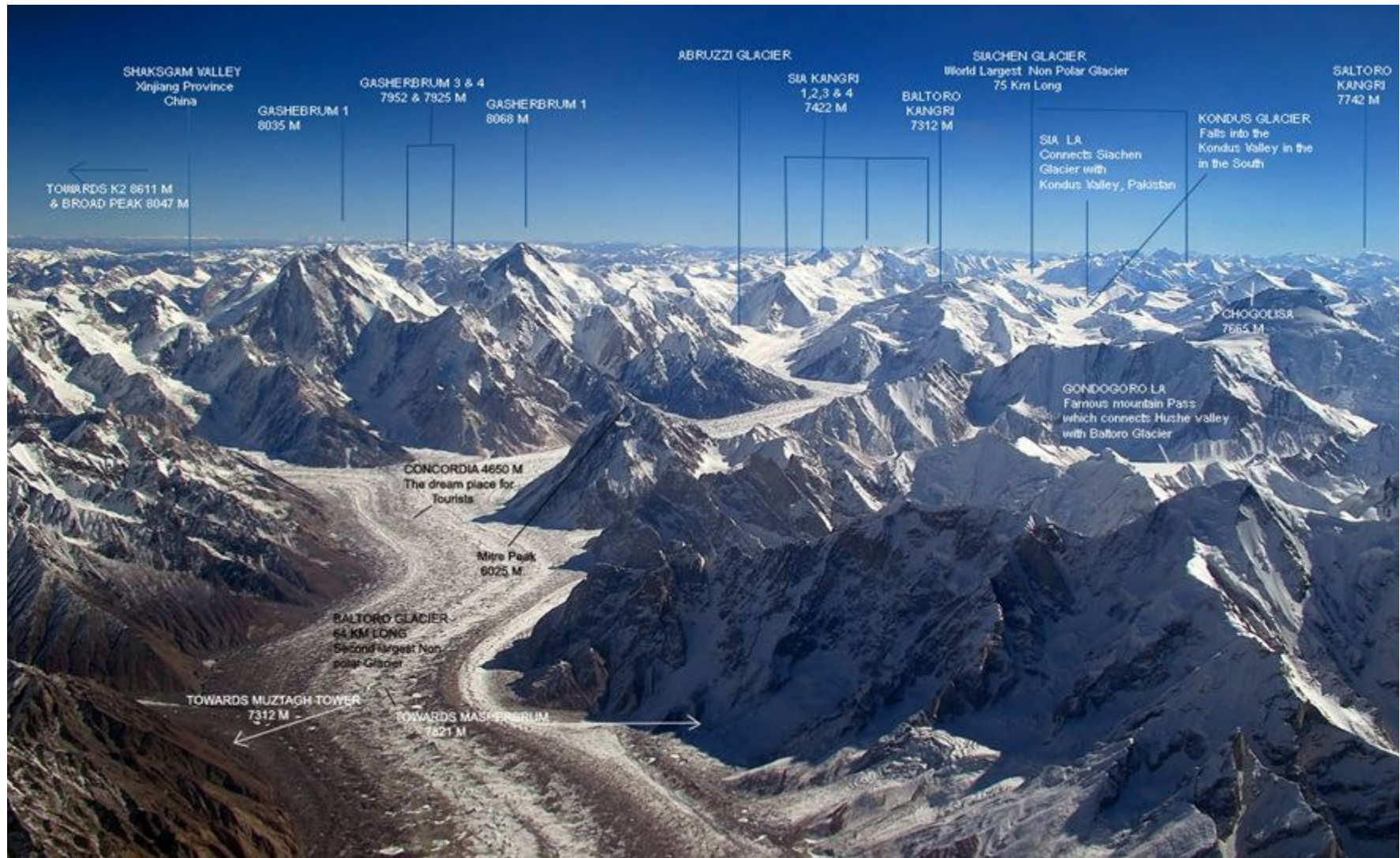
	Previous (2007)	Current (2008)	Remarks
• Consumers (Nos)	85718	102513	16795 (Net Inc)
• Revenue Recovery	53%	78%	25%
• Contamination level	64%	26%*	In high risk areas
• Water supply coverage	65%	90%	25%
• Energy expenditure	47%	37%	10% reduction in energy cost despite increase in electric tariff
• Salary Cost	37.61%	36.48%	1.13% reduction in salary cost
• Working ratio	1.35	0.9	nearing to developed Countries utilities

Adverse Climate Change Effects on Potohar Region – Rawalpindi Pakistan

INTRODUCTION

- Sixty-seven percent of world's glaciers are retreating at a startling rate in the Himalayas.
- Major casual factor has been identified as climate change (Ageta and Kadota, 1992; Yamada et al., 1996; Fushinmi, 2000).
- Glacial melt will affect freshwater flows with dramatic adverse effects on biodiversity and livelihood, with possible long-term implications on regional food security.
- Over the past 200 years, emissions of greenhouse gases due to human and industrial activities have accumulated in the atmosphere.
- The Himalayas have the largest concentration of glaciers outside the polar caps, with glaciers coverage of 33,000 km².
- The region is aptly called the "Water Tower of Asia" as it provides around 8.6X10⁶ m³ of water annually (Dyurgerov and Maier, 1997).
- These Himalayan glaciers feed seven of Asia's great rivers: the Ganga, Indus, Bhrhmaputra, Salween, Mekong, Yangtze and Huang Ho which ensure continuous water supply to the millions of people.

Sources of Water - Siachen and Baltoro glaciers



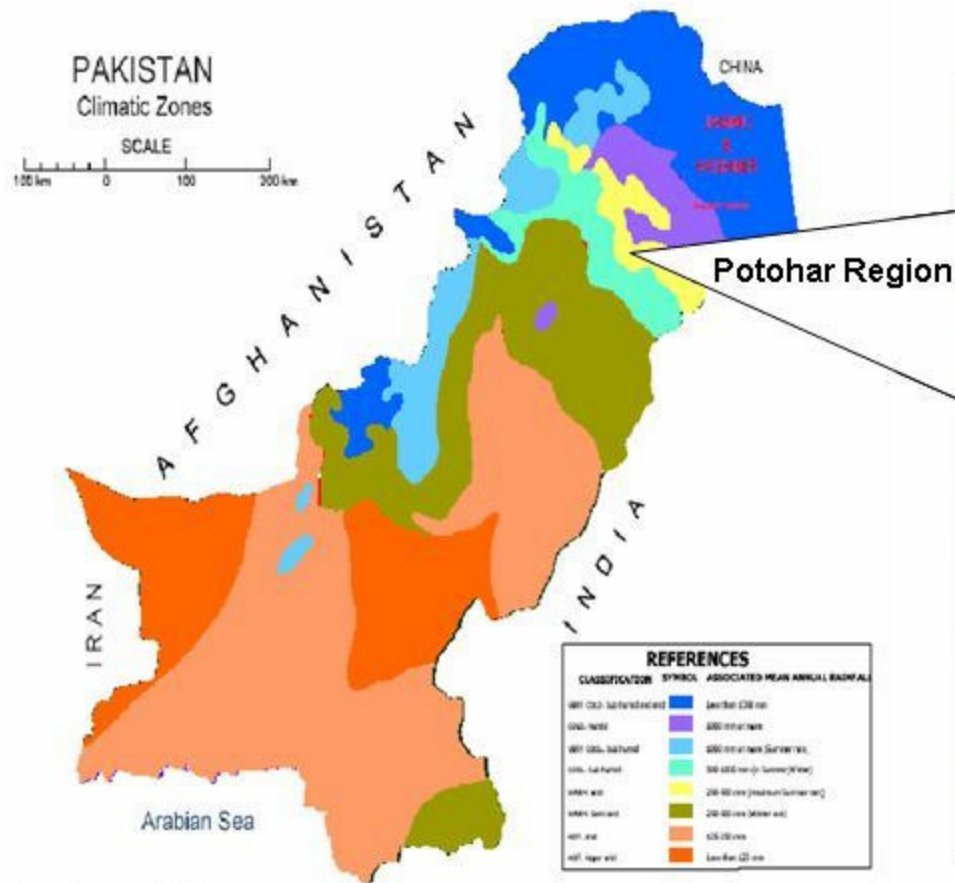
The beautiful coincidence point of Siachen and Baltoro glaciers (75 km & 64 km respectively) having 60 peaks (above 7000 meters).

Climate Variation in Pakistan

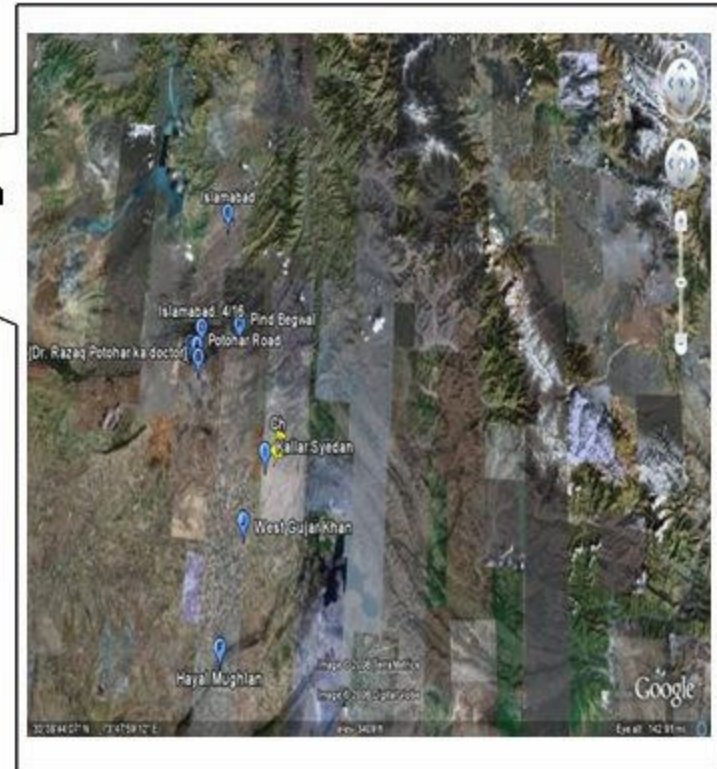
- Pakistan is a developing country whose economy mainly depends on agriculture which is more susceptible to the effects of climate changes.
- Due to lack of modern technical resources, Pakistan does not have adequate monitoring systems for the prediction of likelihood of occurrence of extreme events.
- Therefore, the assessment of possible changes in weather patterns, thus making the task extremely difficult to develop short term response or disaster mitigation strategies.
- There are several aspects that are circumstantial to the effects of climate change.
- In a country such as Pakistan, the pressures generated as a directly result of climate change impact multiple sectors including water, agriculture, forests, biodiversity, livestock, costal zones, etc.

Potohar Region

Map of Climatic Zones of Pakistan



Source: Survey of Pakistan



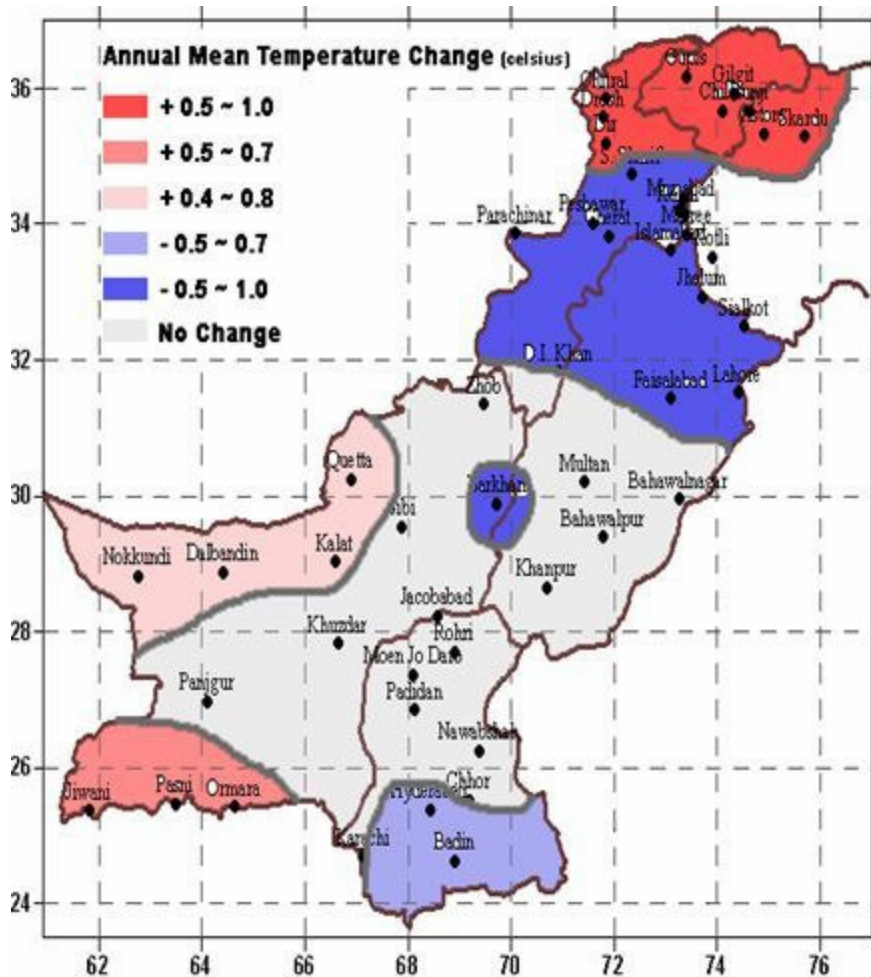
Location of Rawalpindi and Islamabad in Potohar Region

Climate Change Components Affecting Planning and Managing Water Services

Temperature variation

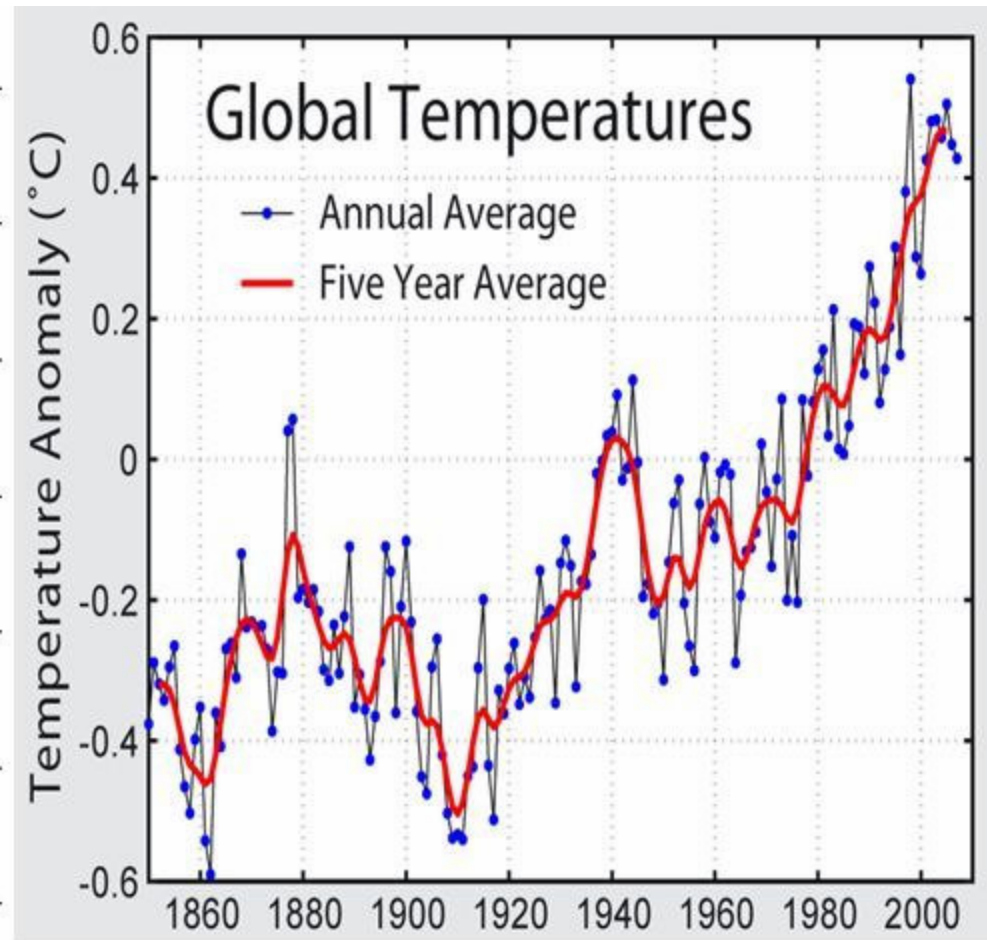
- There has been a considerable temperature variation all over the country especially in the Northern Punjab and Potohar region, resulting in creating favorable conditions for the extreme weather patterns.
- The increased temperature pattern being experienced can be compared with global temperatures , (from 1860 – 2000) which is showing the same pattern as observed in Pakistan in the recent years.

Temperature variation



The annual Mean Temperature Change in Pakistan

Source: Metrological Department of Pakistan



Global Temperature Variation from 1860 - 2000

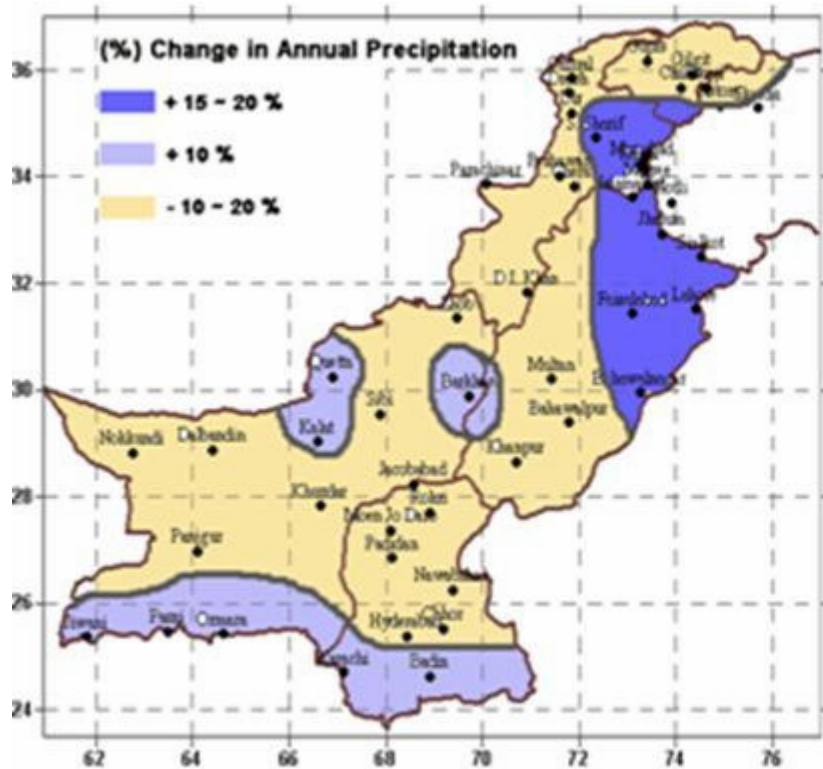
Source: Wikipedia, the free encyclopedia

Change in precipitation pattern

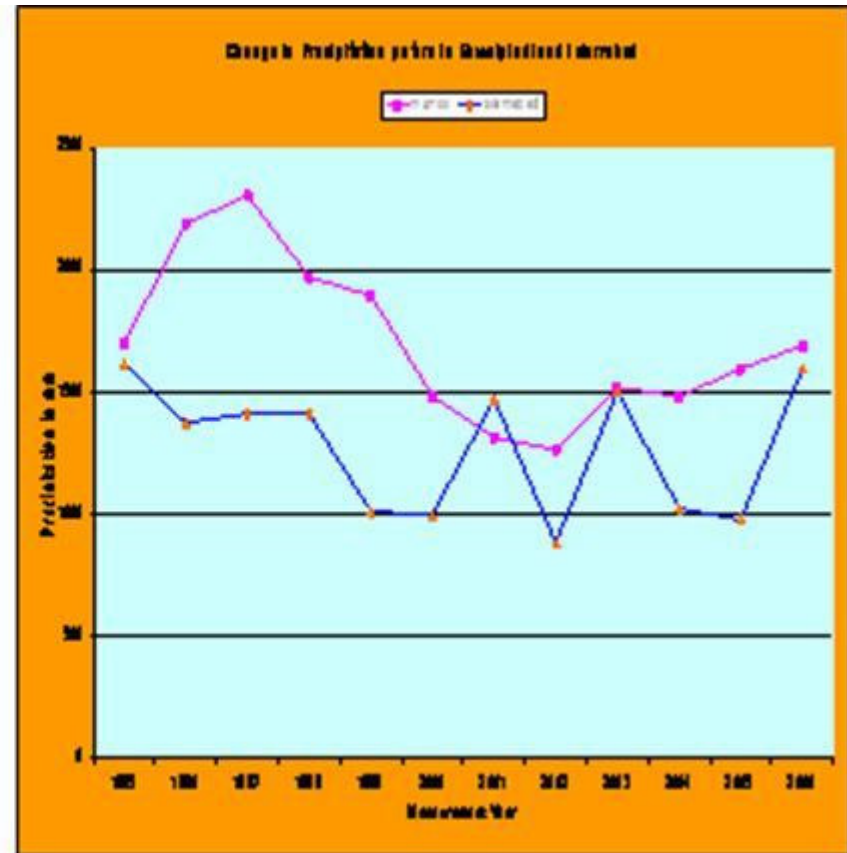
Annual Rainfall (mm)		
YEAR	MURREE	ISLAMABAD
1995	1702.9	1615.2
1996	2192.0	1376.1
1997	2307.0	1413.8
1998	1972.5	1411.6
1999	1897.3	1012.3
2000	1484.3	999.1
2001	1317.1	1472.1
2002	1264.4	885.4
2003	1520.5	1503.3
2004	1485.1	1026.3
2005	1596.2	979.0
2006	1691.3	1598.0

10 years rain fall in Murree and Islamabad (catchments area of Rawal Lake)

Change in precipitation pattern



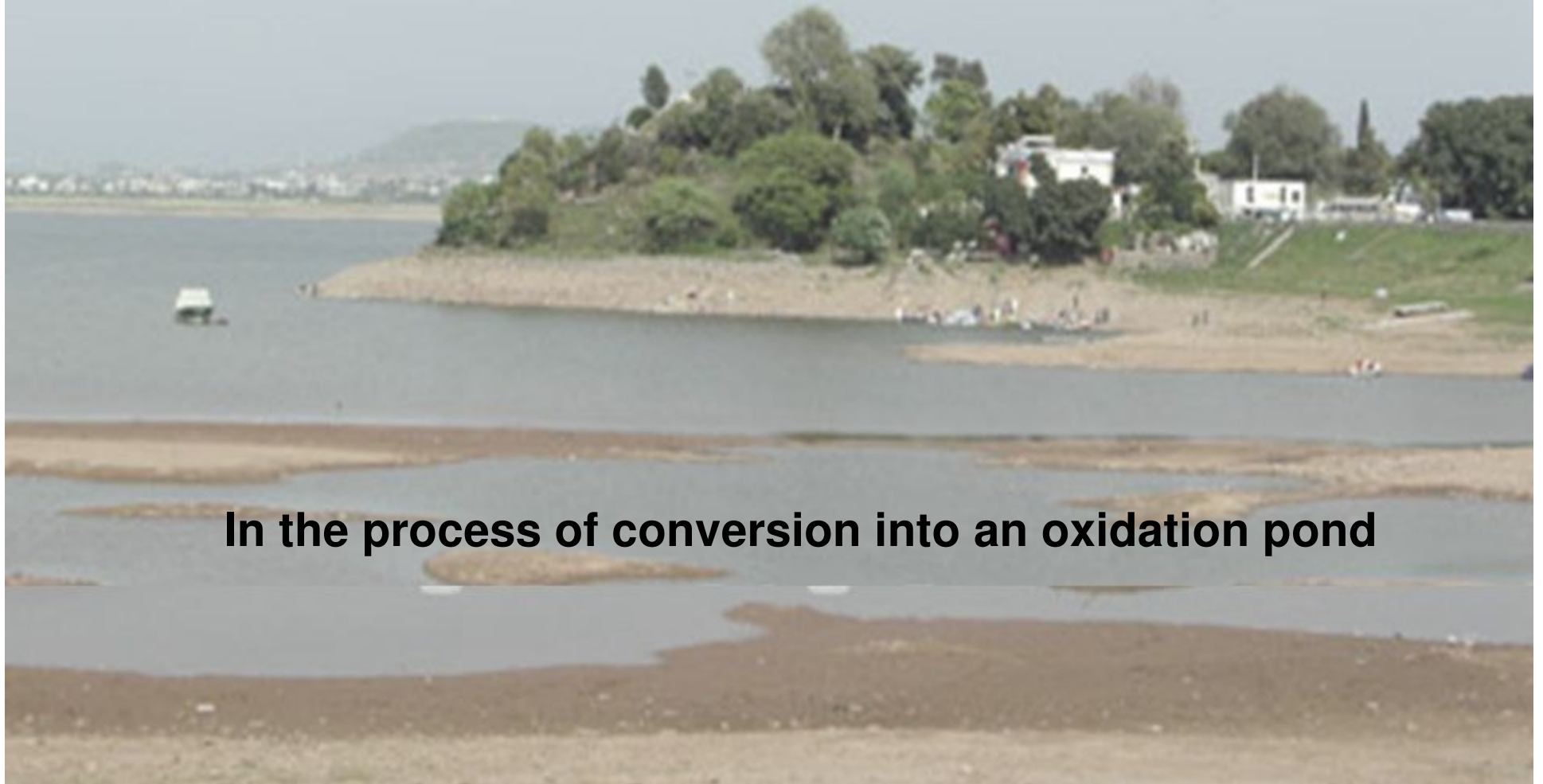
% Age change in precipitation variation in Pakistan
Source: Pakistan Meteorological Department, Islamabad



Change in precipitation pattern Murree and Islamabad

Adverse Effects of Climate Change on Planning and Managing Water Sources

Rawal Lake



In the process of conversion into an oxidation pond

Overall Major Adverse Effects on Water Management System

Following are the major adverse effects envisaged which are directly or indirectly related to water management;

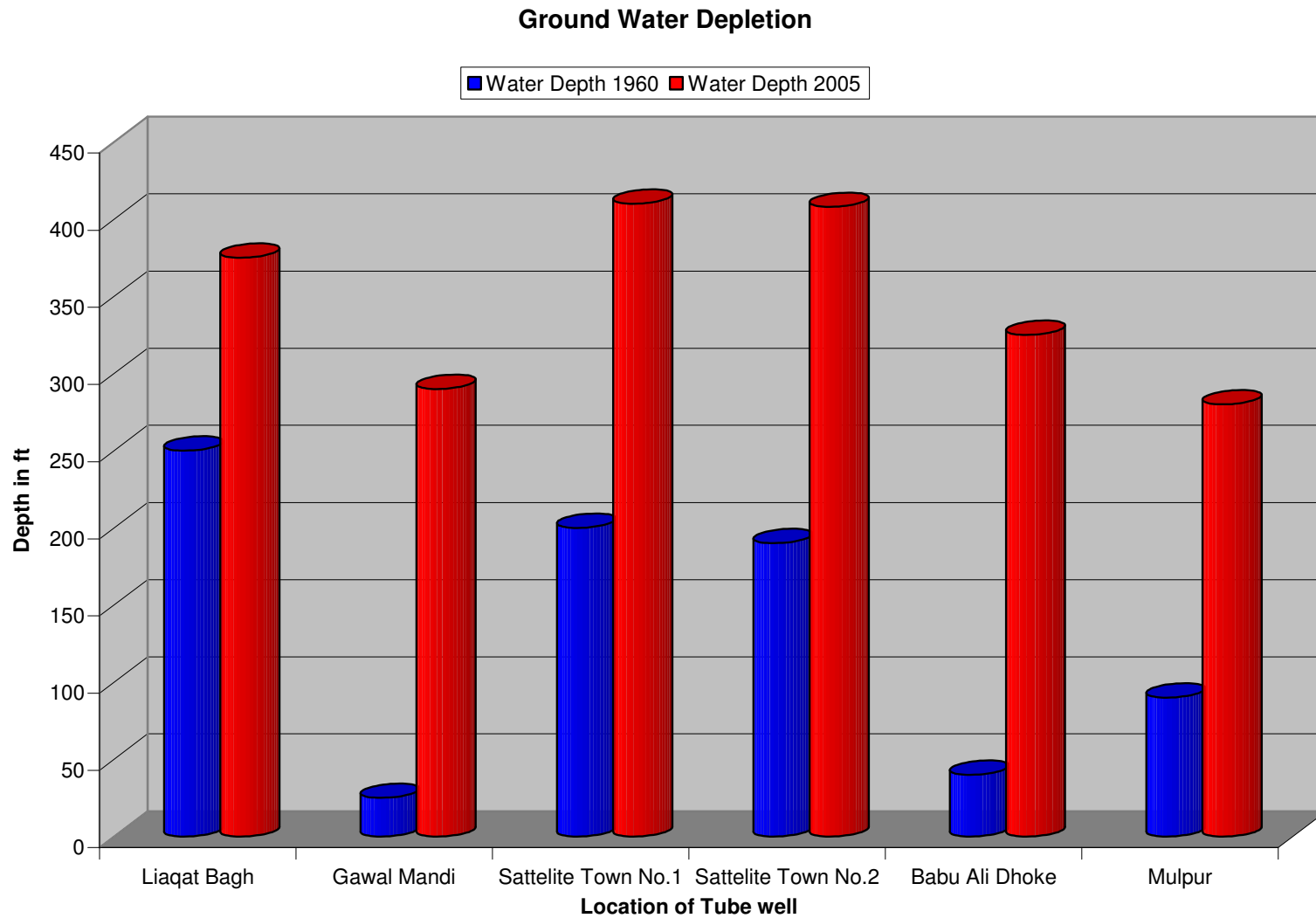
- Increased variability of Monsoon.
- More rapid recession of Kara Kuram Highway Glaciers threatening IRS (Indus Rivers System) Flows.
- Reduction in capacity of natural reservoirs due to rise in snowline.
- Increased risks of floods / drought and increased water demand
- Severe water-stressed conditions in arid and semi-arid regions- Food insecurity
- Upstream intrusion of saline water in the Indus delta; and risk to mangroves, coral reefs and breeding grounds of fish.
- Increased health risks (heat strokes, malaria and other vector-borne diseases).

Adverse Effects of Climate Change on Rawalpindi Water Utility Specific

- **Decreased quantum of Water sources – Surface and ground water**
- **High levels of Bacterial Contamination – in Ground and Surface Water**
- **Bacteriological Water Quality Of Streams Recharging Rawal Lake**
- **Increased Turbidity**
- **Low efficiency of coagulants at sub zero temperatures**
- **Flash flooding**
- **Deforestation – Transport of sediments into water sources**
- **Effects on Glaciers**
- **Increased water treatment cost**

Effect on Water Resources

Ground Water Aquifer Depletion:



High levels of Bacterial Contamination - Ground and Surface Water

Latest Ground Water Quality Survey 11 Union Councils

Location /UC	Total No. of Samples	Water Quality at Source		
		Fit	Unfit	%age Unfit
2	6	2	4	66
3	7	4	3	43
6	12	3	9	75
9	14	0	14	100
13	18	10	8	44
14	8	6	2	25
15	8	4	4	50
16	4	1	3	75
17	12	5	7	58
18	6	2	4	66
Total	95	37	58	61 %

Bacteriological Water Quality Of Streams Recharging Rawal Lake

Sample Code	Sample Location	Study Conducted by WASA in 2004
		Total Coliform Bacteria / 100 ml
aS-4	Stream Coming from Noor Pur Shahan near Bari Imam Village	TNTC (Too numerous to count)
aS-5	Stream from Quaid-e-Azam University	Purely raw sewage Not Detectable
aS-6	Up Stream of bridge at Bara Kahu	> 5000/ 100 ml
aRD-3	Korang River before chatter park near Sanam gardens	1320/ 100 ml
bRD-3	Korang River near chatter park	2200/ 100 ml
cRD-3	Stream at Chatter Park before entering Korang River	4200 / 100 ml

*

Increased Turbidity

- Rawal Dam was constructed in 1960 on Korang River to meet the water supply requirement of Rawalpindi.
- At the time of its construction Rawal Lake was one of the cleanest drinking water lakes of the area.
- The intense rains and human activities (unplanned urbanization) in its catchments area has contributed towards increased turbidity.
- Massive erosion in the catchments area, the turbidity of the lake now ranges up to 2700 NTU.
- Significant effects of climate change on physical parameters on drinking water.

Increased Turbidity



Deforestation – Sediment transport

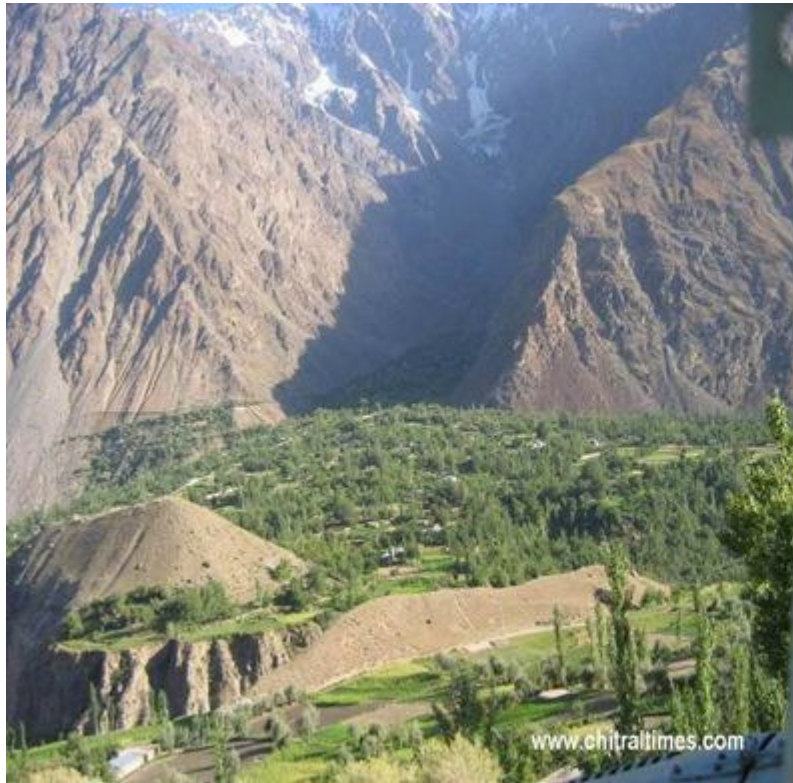
Massive erosion due to intense rains which are causing sediment transport into Rawal Lake – More turbidly with increased levels of contamination

Flooding

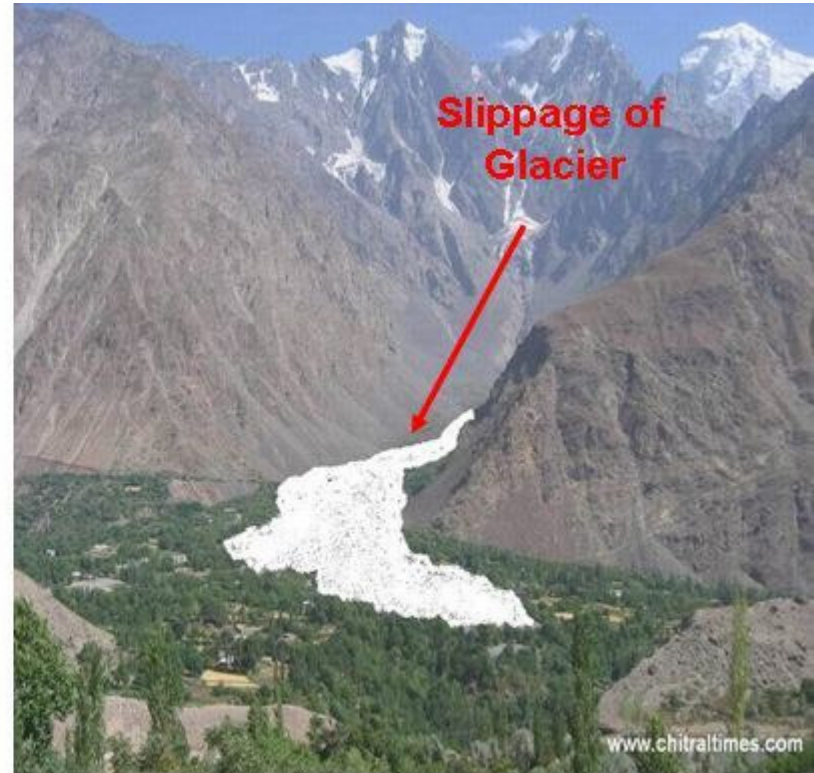


Devastating flooding of Murree Road (commercial hub of Rawalpindi city) during intense rains in 2001, which claimed over 100 lives.

Slippage of Sonoghur Glaciers in Chitral Pakistan



Sonoghur village before disaster



Sonoghur village after disaster

Issues / Challenges

- Less water availability
- Increased water demand
- Irrational water allocation
- Water distribution conflicts
- High cost of water treatment
- Increased energy requirements
- Financial un-sustainability of water utility
- Environmental degradation – Eutrophication of water bodies (Rawal Lake)

Adaptation Strategies

Mitigation Measures

- **Policy formulation**
 - Legislation on ground water extraction
 - Sound water resource management – defining climate scenarios, vulnerabilities assessments, priority adaptation options for water conservation and judicious use
 - Integration with other sectors – agriculture, irrigation and industry
 - Three dimensional ground water modeling to ascertain ground water potentials
- **Technical solutions**
 - Water demand management
 - Development of water supply and alternative water resources
 - Installation of dry weather wastewater treatment plants on wastewater streams entering into Rawal Lake.
 - Construction of delay action / recharge reservoirs in the upstream

Adaptation Strategies

Mitigation Measures

- **Technical solutions**
 - Rainwater harvesting
 - Reuse of wastewater – Trading for irrigation
 - Water efficiency and conservation – use of water efficient appliances
 - Metered water supply – domestic, commercial and industrial purposes proactive, leak detection and repair program
 - Conservative water allocation
- **Cross-cutting measures**
 - Increase awareness
 - Capacity building
 - Consultation and involvement of stakeholders
 - Integration with other sectors

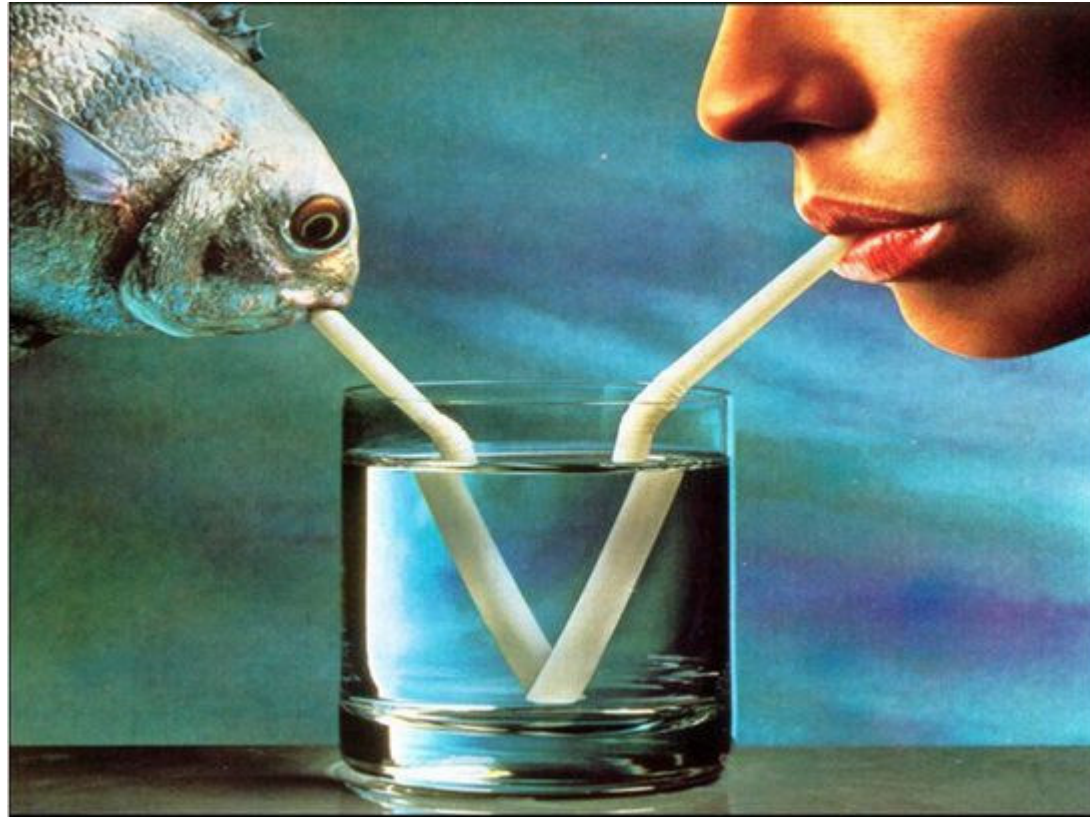
Conclusion

- Amongst the possible effects of climate change is the likelihood of increased frequency, and severity of occurrence of extreme events such as floods and droughts.
- Since Pakistan is particularly susceptible to such events, and has experienced large scale destruction on these accounts in the recent past, the analysis of possibility of occurrence of extreme events, and their impacts becomes all the more essential.
- Both macro and micro management of water sources is becoming difficult both qualitatively and quantitatively with high cost.
- Pakistan's vulnerability to the impacts of climate change guides its overall national response in dealing with the issue.
- In view of limited resources, the level of studies and work undertaken has largely been in the area of mitigation, although a few important studies have also been conducted on impacts and adaptation.

Conclusion

Water is going to be a petroleum in 21st Century which is a warning for decision makers and water sector professionals to act on fast track basis for integrating all the resources in water services management

Otherwise ????



Thanks!