MANAGING SYSTEMS UNDER STRESS: SCIENCE FOR SOLUTIONS IN THE INDUS BASIN

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BACKGROUND

- **INDUS IS LIFE LINE** → 91% of Pakistan (190 Mio of Total 207.77 Mio.)
- **COVERS LARGE AREA** → 65% of Pakistan (520,000 of 796,101 sq. km.)
- **IRRIGATION SYSTEM**
  - **WORLD'S LARGEST NETWROK** → 47% in Pakistan, IRRIGATES 40 mio. Acres of contiguous land
  - **STORAGE RESERVOIRS** → T7.59 MAF capacity: TARBELA, CHASMA, MANGLA
  - **HYDRO ENERGY** → 27% of TOTAL ENERGY
- **CHALLENGES**
  - **WATER AVAILABILITY** → STRESSED to SCARCITY (1088 - 858 cmpp )
  - **STORAGE CAPACITY** → 30 days
- **STAKE** VARIABILITY of HYDROLOGIC processes linkages with ecosystem & SOCIETAL impact
- **OUR ENGAGEMENT** 2006 ADDG → SAWI → INDUS FORUM → Projects WP2 + WP1
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KEY SYSTEMS ISSUES & PRESSURE POINTS ..........

**HOT SPOTS**

- **CLIMATE CHANGE**
  - **GLOBAL WARMING**: May alter proportion of solid & liquid precipitation
  - **UIB - VULNERABILITY TO MOUNTAIN DISASTERS**: Land slides, GLOF & rainfall
  - **LIB - CHANGING MONSOON PATTERNS**: Floods, droughts & coastal land erosion
  - **VARIABILITY IN WATER RESOURCES**: Hydro power gen. & agri. vulnerability
  - **DOWNSTREAM COUNTRY IMPLEMENTATION OF 1960 IWT**
  - **WATER QUALITY + DEPLETING SURFACE WATER**

**HOPE SPOTS**

- **DOUBLE-CROPPING SYSTEM** from current MONO-CROPPING due to **EXPANDING SUMMERS**
- **BETTER TOURISM** bringing livelihood to marginalized communities
- **HEALTHY LIVING** with hybrid energy (solar & hydel vs wood burning)
- **INDUS REGIONAL PROJECTS** Indus forum network
- **KABUL RIVER BASIN DIALOGUE** FOR BENEFIT SHARING
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KEY SYSTEMS ISSUES & PRESSURE POINTS

- **COUNTRY EFFORTS TO MEET THESE CHALLENGES**
  - **CLIMATE CHANGE SCIENCE STUDIES** at indigenous universities.
  - **CAPACITY BUILDING** of young faculty & graduates at universities.
  - **POLICIES**: 2018 NWP & 2013 NCCP
  - **ALTERNATE CLEAN ENERGY DEVELOPMENT**
  - **CLIMATE RESILIENCE & AWARENESS** of local communities thru knowledge sharing & training

- **FUTURE TRENDS**:
  - In UIB, need for **very credible historical simulation** of global climate models (GCM) & their downscaled versions, aligned with in-situ observational changes, i.e., Karakorun anomaly.
  - **Frequency of future extreme weather events** expected to increase, however, CGM are not good enough to resolve intensity, frequency & severity of such future extreme events in highly erratic topography as in UIB.
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CRITICAL KNOWLEDGE GAPS

• SYSTEMATIC STUDY OF PERMAFROST IN UIB

• INDIVIDUAL FOREIGN STUDIES AND RESEARCH PAPERS-YES, BUT RAW DATA-NO

• STATE OF ART CRYOSPHERE MONITORED WITHOUT LONG-TERM ASSESSMENTS

• ASSESSMENT OF MONSOON INTRUSION IN GLACIATED REGIONS FOR GLACIER IMPACT

• GLOF MECHANISM DUE TO TEMPERATURE INCREASE OR COMBINED EFFECTS OF MELTING & INCREASED MOSOON DOWN POUR.

• DISASTER ALERT SYSTEMS & TECHNOLOGY

• CAPACITY BUILDING

• WATER RESOURCE AVAILABILITY IN FUTURE CLIMATE CHANGE SCENERIOS

• SOCIO-ECONOMIC IMPACT ON LIVELIHOOD DUE TO CLIMATE CHANGE IMPACT

• EXCHANGE OF INFORMATION → RAW DATA → JOINT PROJECTS FOR BENEFIT SHARING
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CRITICAL KNOWLEDGE GAPS

• **KNOWLEDGE REQUIRED**

• **IN-SITU HYDRO-MET OBSERVATIONS**, FROM HIGH ALTITUDE TO IMPROVE UNDERSTANDING OF PROCESSES, FOR **CREDIBLE INFO FOR FUTURE CLIMATE CHANGE PROJECTIONS**

• **IMPROVED SOCIO-ECONOMIC SCENARIOS**, ON BASIS OF FUTURE WATER RESOURCE AVAILABILITY

• FOR USE IN

• **FUTURE POLICIES ON CLIMATE CHANGE IMPACT** FOR BUILDING **RESERVOIRS**, TO MEET NEEDS OF DOWNSTREAM PEOPLE

• **MITIGATION / ADAPTATION STRATEGIES** TO MEET CLIMATE CHANGE CHALLENGES
KNOWLEDGE & UNDERSTANDING THE RANGE OF AVAILABLE SOLUTIONS

• **UIB CLIMATE SCENARIOS AT FINEST POSSIBLE RESOLUTION NEEDED**, since EXISTING DOWNSCALED FUTURE CLIMATE SCENARIOS NOT SUFFICIENT TO CAPTURE MICRO-SCALE PHENOMENON.

• **UIB FREQUENCY OF FUTURE EXTREME WEATHER EVENTS EXPECTED TO INCREASE**, however, GCM NOT GOOD ENOUGH TO RESOLVE INTENSITY, FREQUENCY AND SEVERITY OF SUCH EVENTS IN HIGHLY ERRATIC TOPOGRAPHY

• **HYDROLOGICAL EXTREMES SHIFTING** DUE TO CLIMATE CHANGE

**IMPACT ON PEOPLE / ENVIRONMENT RESOURCES**

• **VULNERABILITY OF DIFFERENT INDUS BASIN REGIONS TO EXTREME EVENTS**
  - LOWER INDUS BASIN vulnerable to HEAT WAVES, DROUGHTS & FLOODING
  - CENTRAL INDUS BASIN exposed to HEAT & COLD WAVES, FLOOD & DROUGHTS
  - UPPER INDUS BASIN vulnerable to LAND SLIDING, GLOF & FLASH FLOODS

• **THESE EXTREME EVENTS WILL INCREASE IN FREQUENCY & CAN ONLY BE TRACED IN HIGH RESOLUTION CLIMATE SCENARIOS**

• **PMD WP**: PROVIDE FLOW, FLOOD & SOCIETAL SCENARIOS FROM CLIMATE CHANGE
Case 2: Karakoram Anomaly

• We need to know more & available solutions
  • Karakoram Anomaly from in-situ observations is established, but its future climate change scenarios yet to be understood.

• To know impact on people / environmental resources
  • Karakoram Anomaly tied to decrease in availability of inflows in Indus river that could affect summer water availability in lower Indus Basin and agriculture
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CONCLUSIONS & NEXT STEPS

• **WHAT IS NEEDED:**
  - **INCREASE IN-SITU HYRO-METEOROLOGICAL OBSERVATIONS** across Indus Basin, specially UIB
  - **DOWNSCALLING VARIOUS GCM (specially related to KORAKORUM ANAMOLY)** at a very fine resolution for credible info for future climate change
  - **BUILD CAPACITY OF LOCAL SCIENTISTS & ACADEMIA** for addressing CCC indigenously
  - **ESTABLISH TRANS-BOUNDARY COOPERATION & MULTILATERAL AGENCIES PARTICIPATION**
  - **INITIATE PERMAFROST STUDIES** to assess this important component of cryosphere.
  - **TRANSLATE PUBLICLY PUBLISHED RESEARCH INTO POLICY PAPERS**
  - **INCREASE KNOWLEDGE AND DATA SHARING PLATFORMS**

• **WORKING ACROSS BORDERS CAN HELP IN SOLUTIONS:**
  - **INSTITUTIONAL COOPERATION AMONG COUNTRIES**
  - **JOINT STUDIES ON IMPACT ASSESSMENT**
  - **SHARING SUCCESS STORIES & REPLICATION OF BEST PRACTICES**
  - **REGIONAL AND BILATERAL DIALOGUE & SCIENCE BASED SOLUTIONS**