



Vulnerability Assessment of Water Resources to Environmental and Climate Changes in the Mountains of Oman

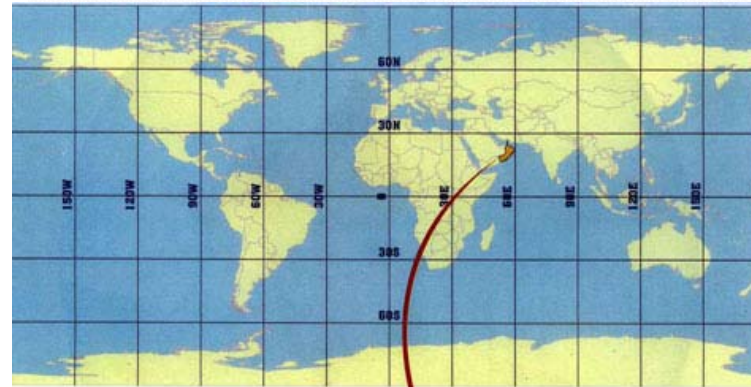
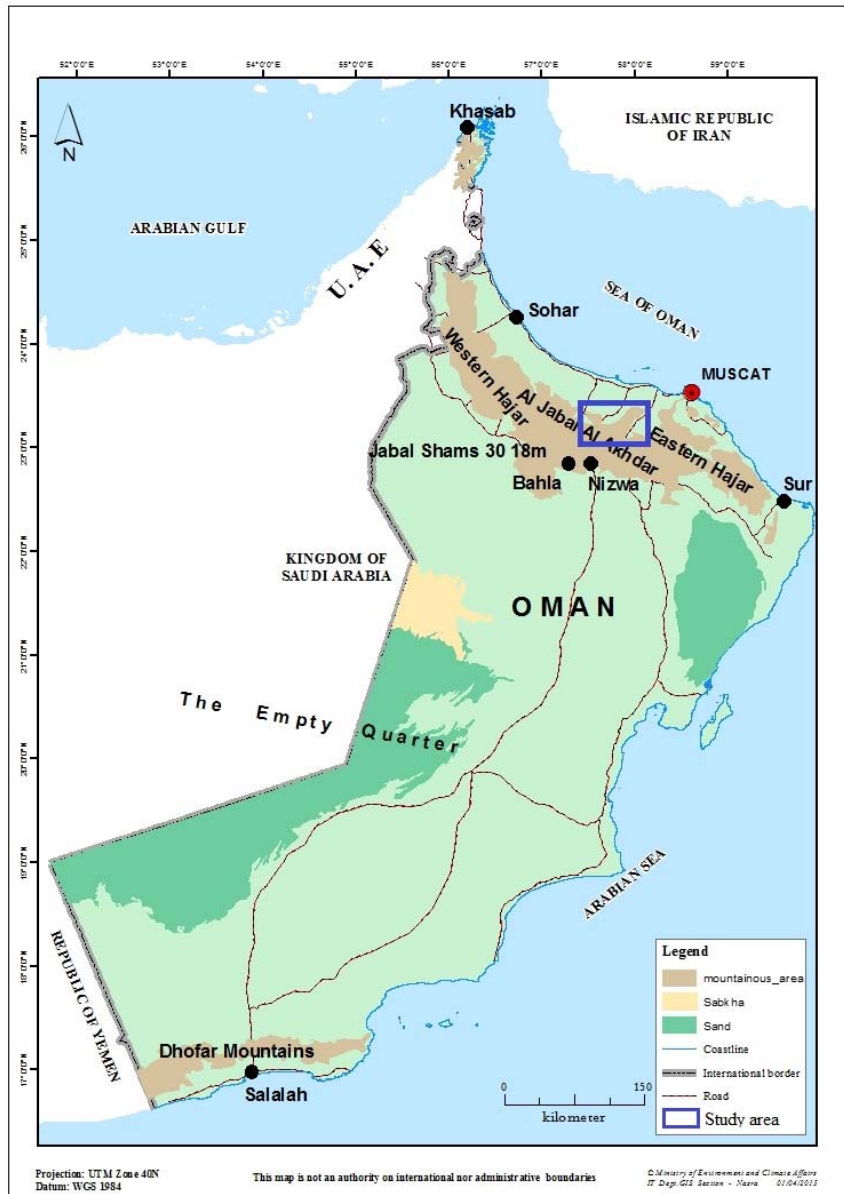
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OWS Member



Overview

- The Study Area
- What is the Problem?/ Research Objective
- Methodology
- Results of the Assessment
 - Environmental Changes
 - Climate change Impacts
- Conclusions & Recommendations

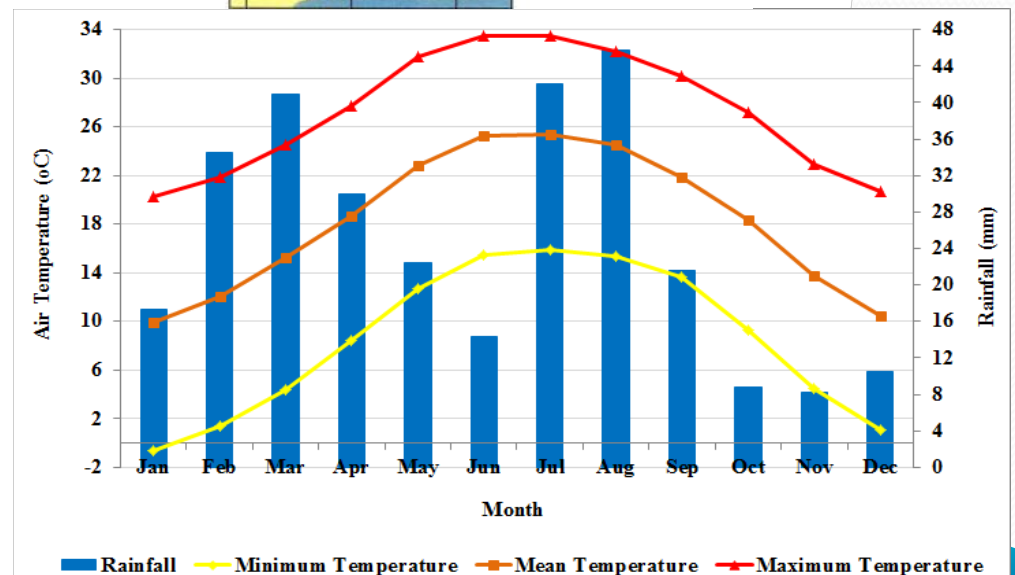
Al Jabal Al Akhdar (Green Mountain)



15-20%
3000 m

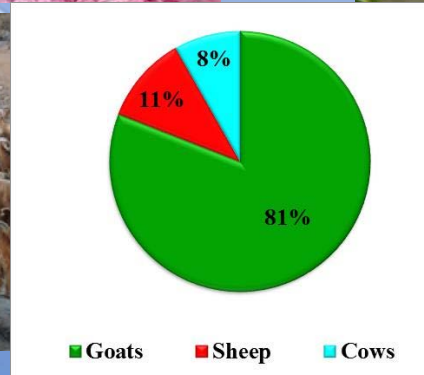
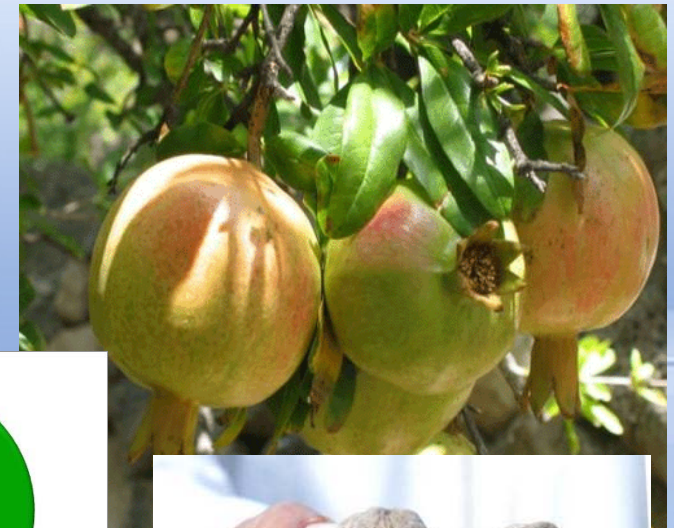
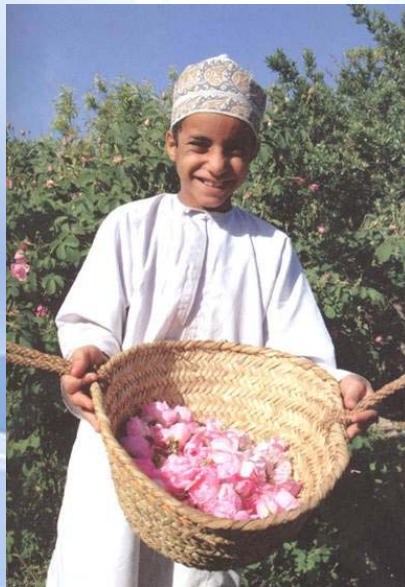
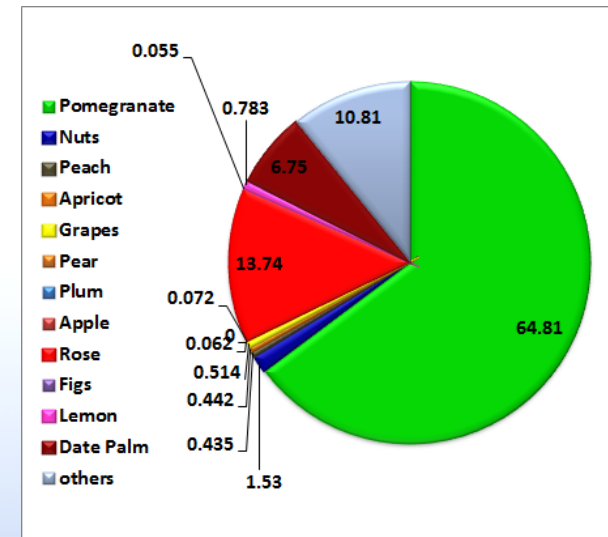


- Temperatures: 12°C lower than lands
- Annual mean Rainfall: 250-400 mm



Main Activities: Agriculture/Animal Husbandry

- **Agriculture** is the fundamental ecosystem for people's livelihood (70% inhabitants).
- **Pomegranates & rose extraction** are main contributors to farmer income and agricultural revenue
- **Traditional irrigation by flooding**





(Al-Moharbi, K.A. 1995)

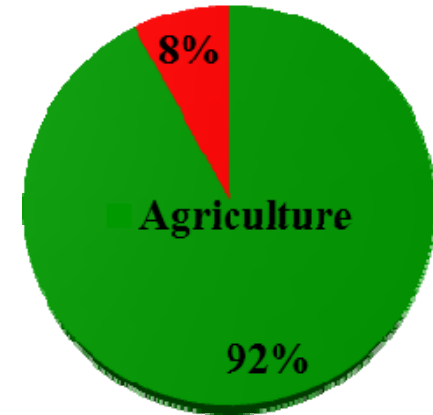
What is the Problem?



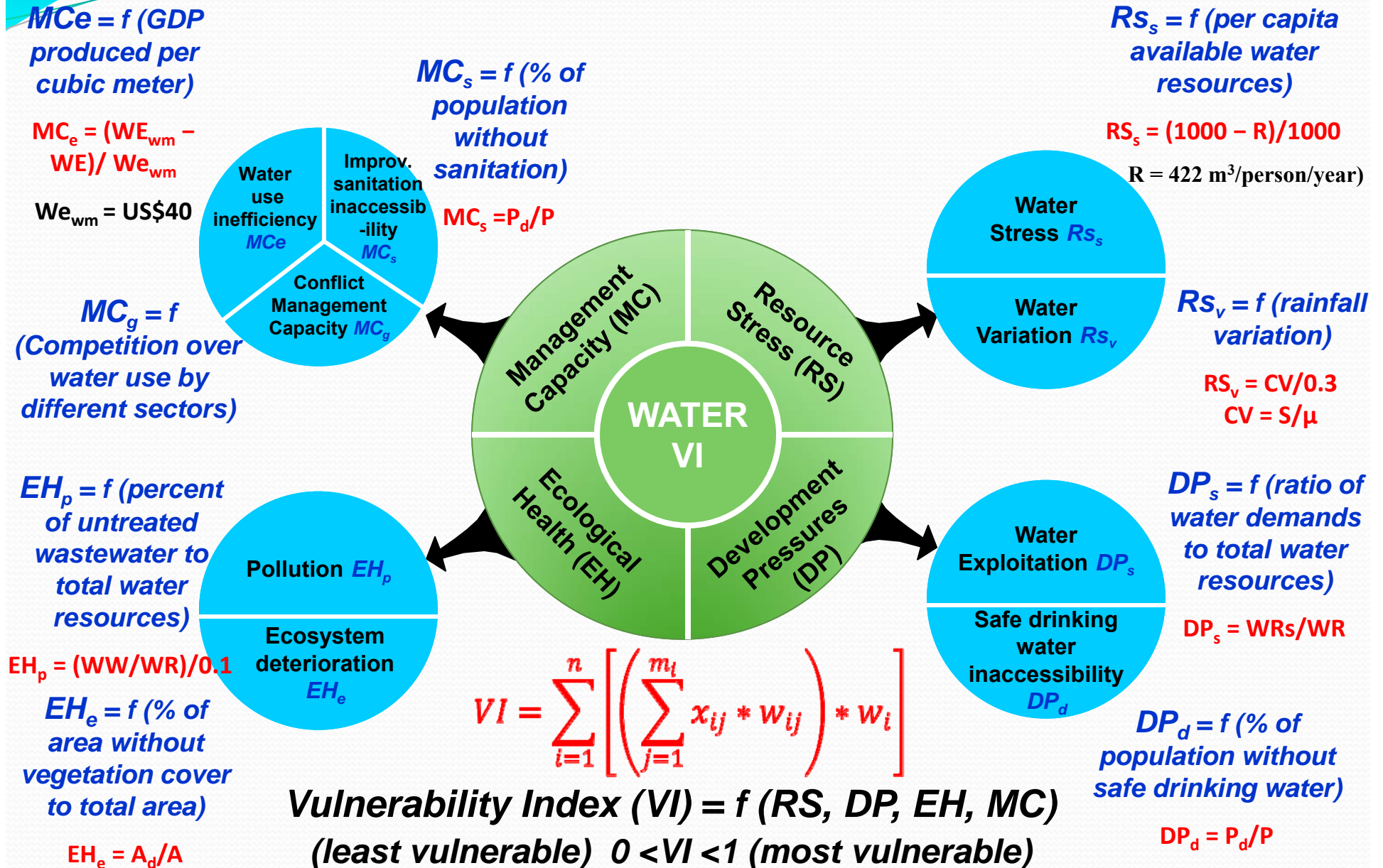
(Al-Kalbani, M.S. 2015)

Water Shortage

- **Water** is critical to the survival of the mountain agro-ecosystems and communities.
- Rainfall amount and availability, the dominant factors in supply of water resources:
 - Groundwater (wells): drinking resources
 - *Aflaj* (irrigation channels): fed by groundwater, springs or *wadis*.
 - Artificial dams
- **Objective: Assess the vulnerability of water resources to environmental and climate changes in Al Jabal Al Akhdar**

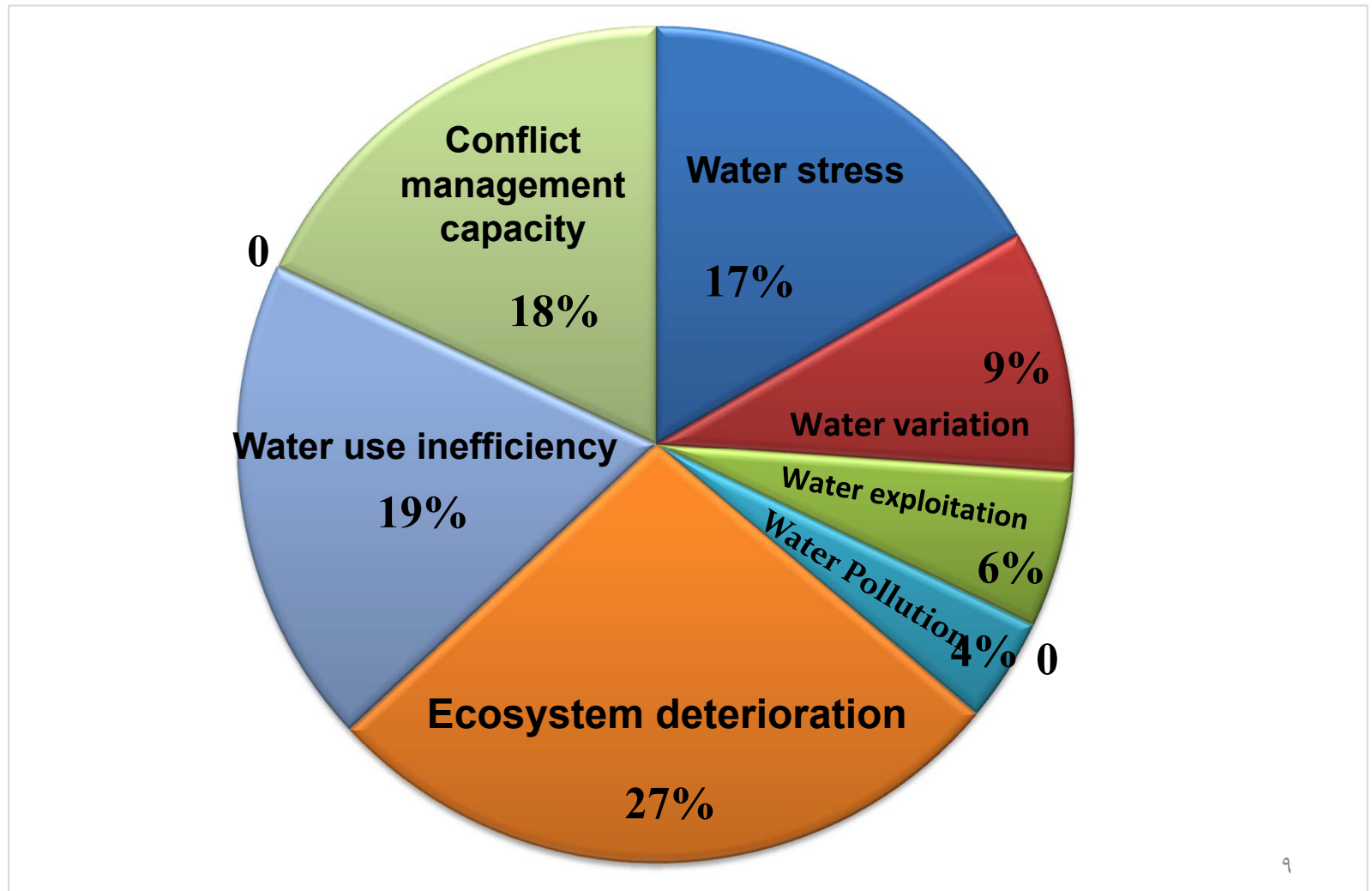


Methodological Guidelines (United Nations Environment Program and Peking University (Huang and Cai, 2009))

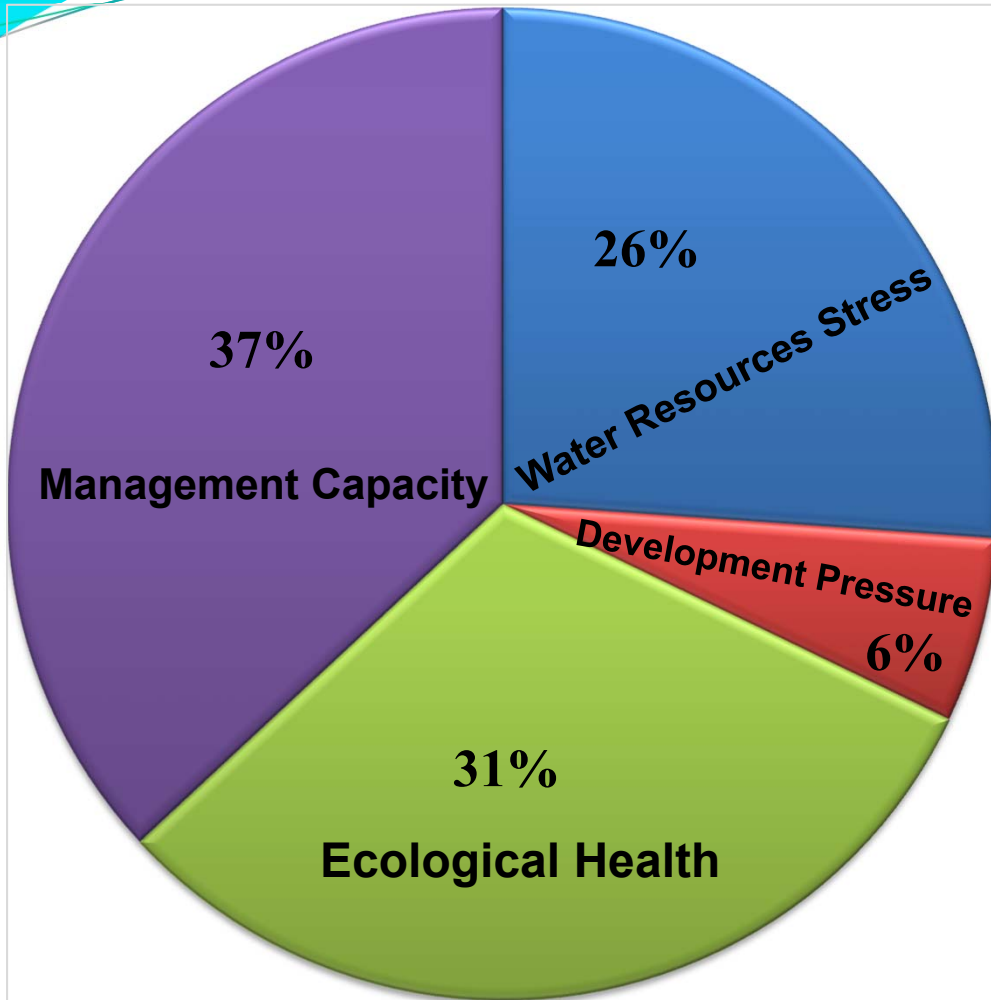


Results: VI Contribution by Parameter

- The vulnerability assessment indicated VI (0.436): High (0.4-0.7); highly vulnerable and experiencing high stresses



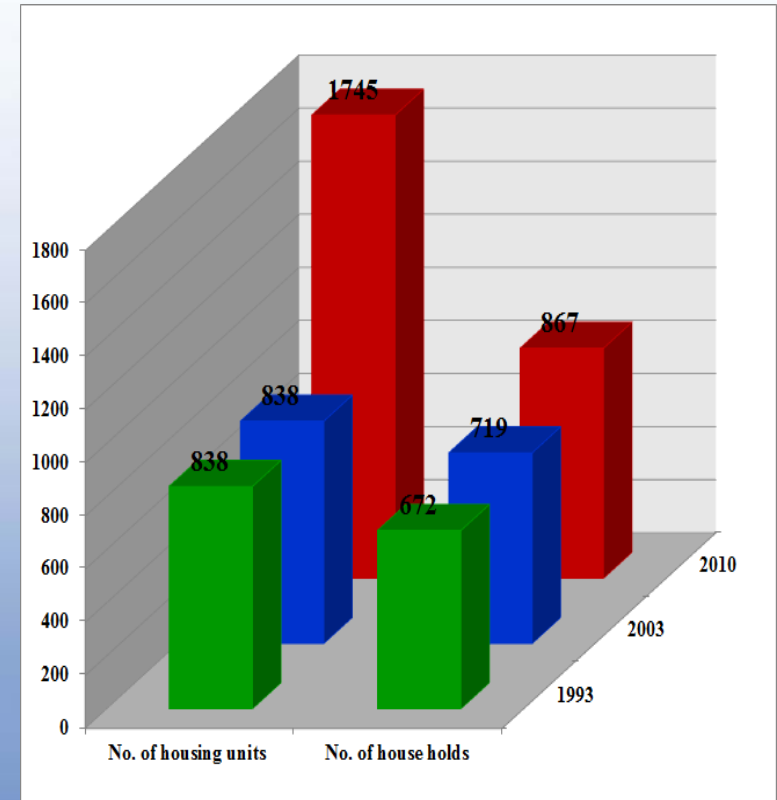
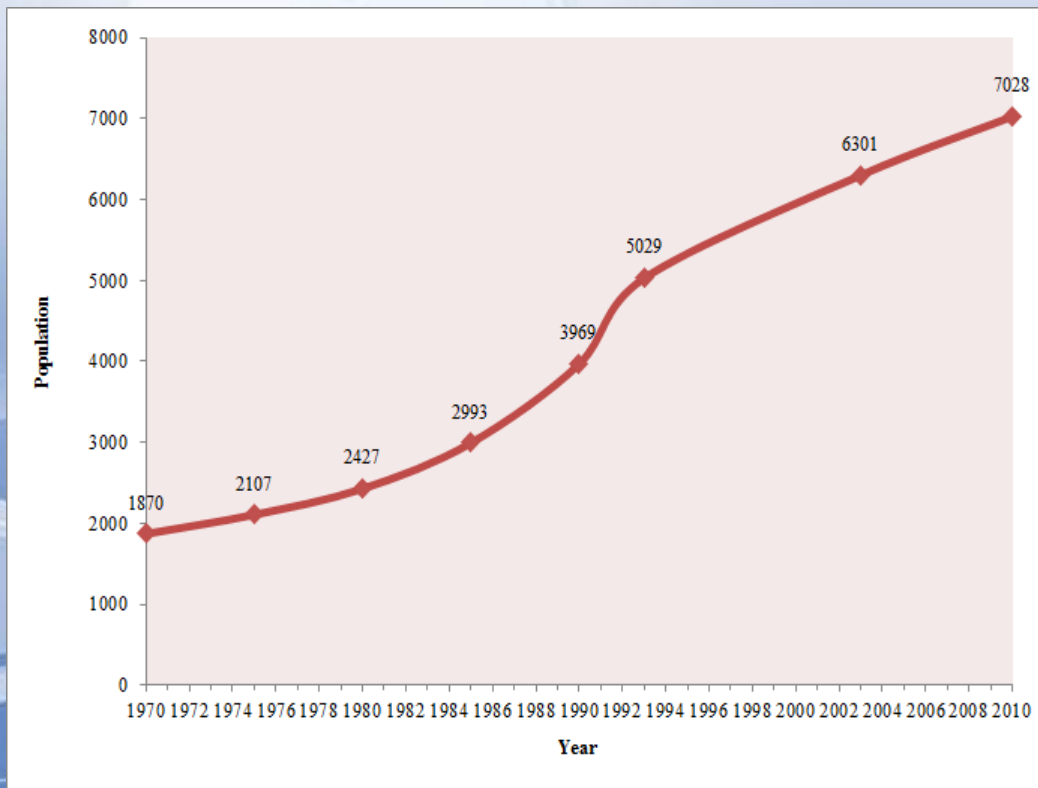
Results: VI Contribution by Category



- Competition between sectors; agriculture is the main water consumer
- No application of modern irrigation system
- Imbalance between water supply and demand
- No implementation of conservation practices
- No communication and implementation capacity
- Absence of adequate vegetation cover
- Land degradation/use changes & sustained urbanization
- Overwater consumption, decreased rainfall

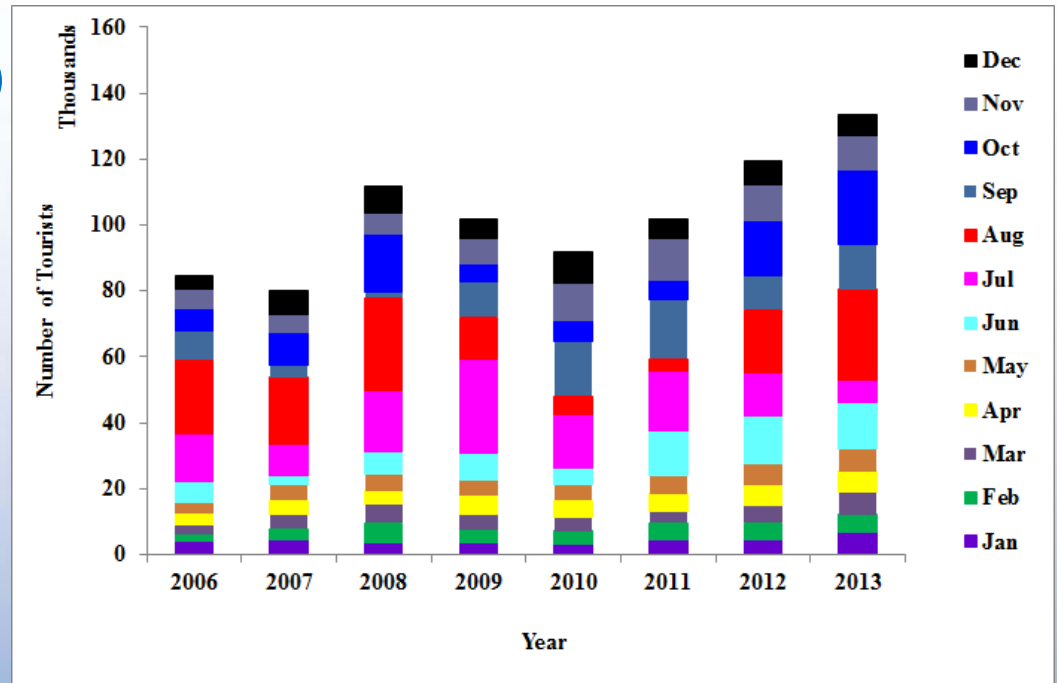
Environmental Changes: Population

- **1970-2010:**
- Population increased by 276%
- **1993-2010**
 - Households increased by 30%
 - Housing units: 108%



Environmental Changes: Tourism

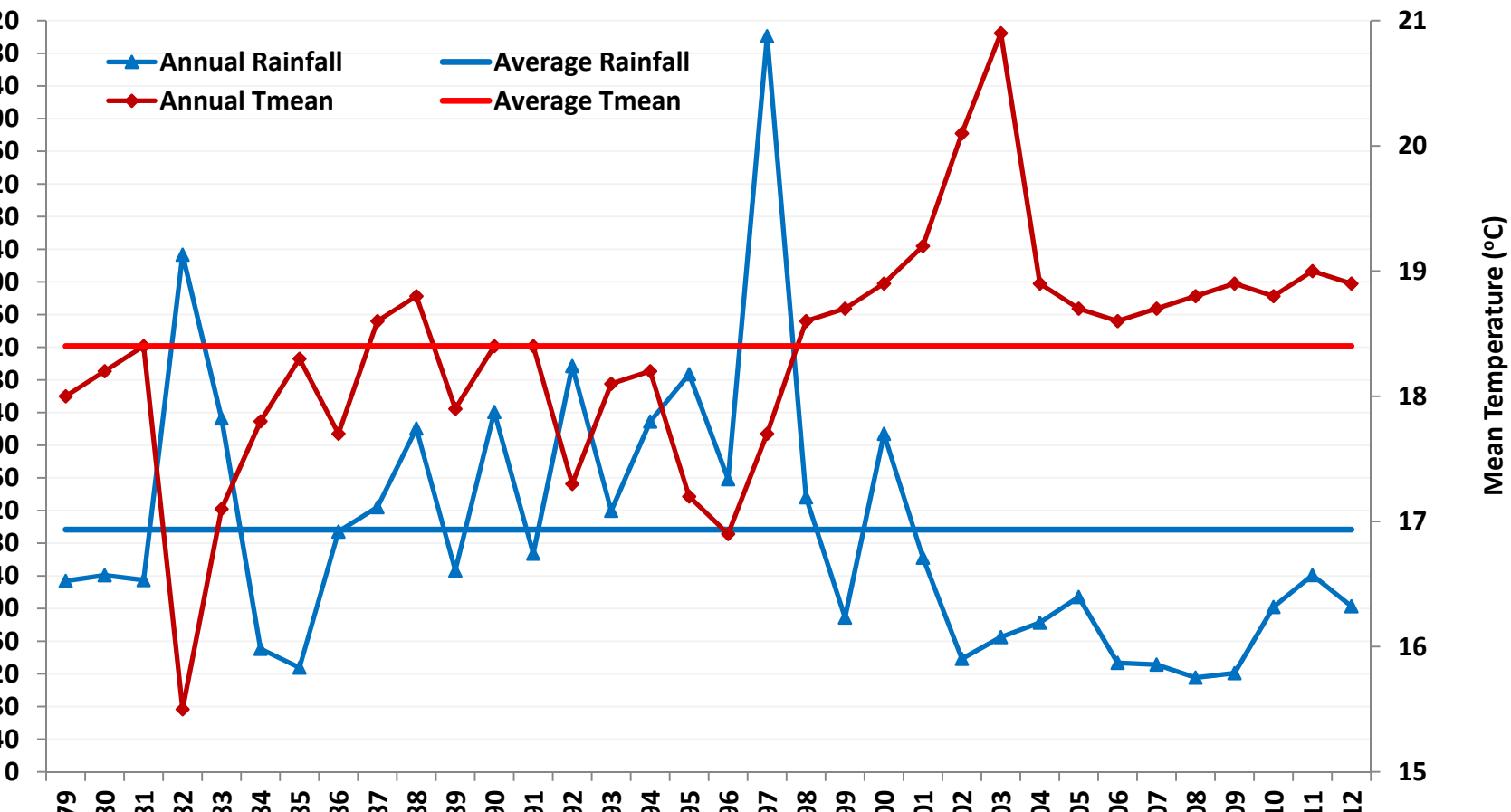
- Increase of tourists from 85,000 to 135,000 (by 58%)
- Summer (May-October): 67%
- Winter (November-April): 33%
- July-August: 266,000 (32%)
- Number of hotels increased from one in 2006 to 5 in 2017



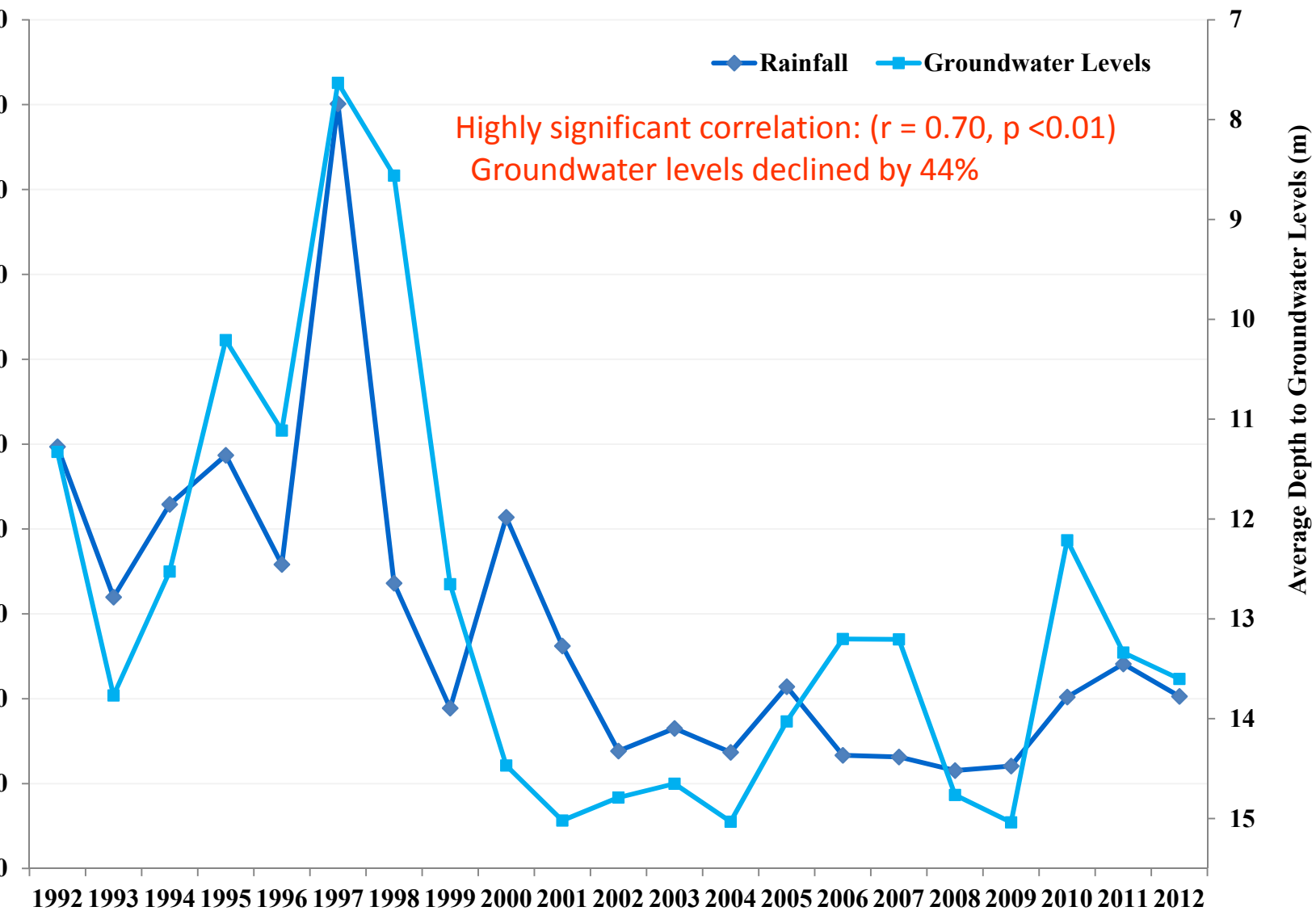
Climate Change Impacts

Tmin Increase: 0.8°C/decade
Tmean Increase: 0.3°C/decade
Tmax Increase: 0.2°C/decade
Rainfall: -9.42 mm/decade

Highly significant correlation: ($r = -0.60, p < 0.01$)

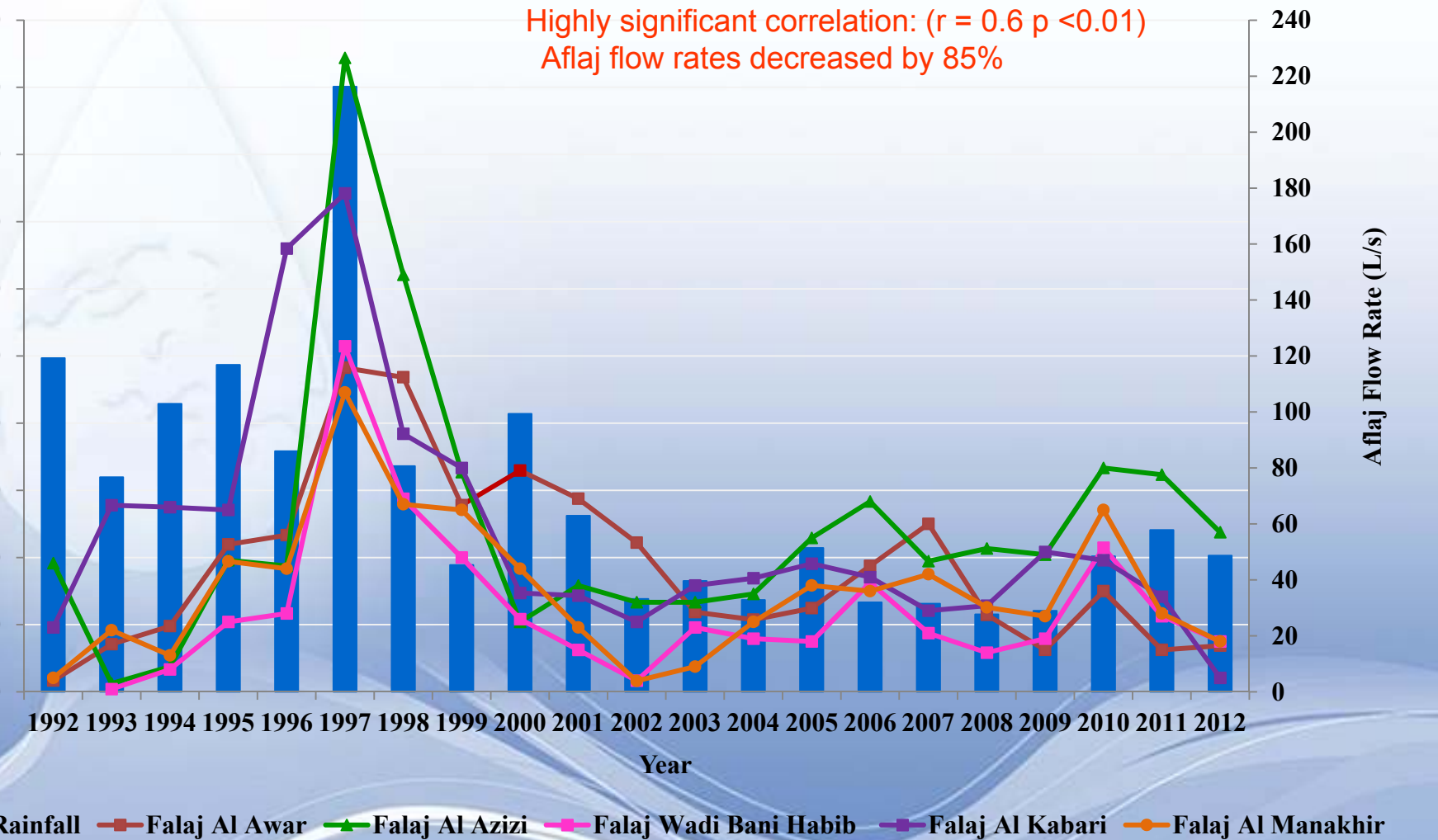


Climate Change Impacts



Climate Change Impacts

Highly significant correlation: ($r = 0.6$ $p < 0.01$)
 Aflaj flow rates decreased by 85%



Conclusions & Recommendations

Most comprehensive vulnerability assessment

The vulnerability assessment indicated high VI (0.436)

System deterioration is the dominant parameter (27%)

High degree of water use inefficiency (19%), conflict management capacity (18%), water stress (17%)

Management capacity is the dominant category (37%)

Highly influenced by ecological health (31%), water stress (26%)

Indicators for vulnerability of water resources to environmental and climate changes in the area

Improve irrigation water use efficiency, conservation technologies, rainwater harvesting, reuse of treated wastewater/grey water to reduce some of the agricultural pressures

Investigation and adaptation to climate change impacts

Multi-sectoral coordination, integration and awareness programs should be closely connected to development plan, policies and integrated water resources management across all sectors

Acknowledgements



وزارة البيئة والشؤون المناخية
MINISTRY OF ENVIRONMENT AND CLIMATE AFFAIRS



الجمعية العمانية للمياه
OMAN WATER SOCIETY

Symposium on
Sustainable Water Management in Fragile Mountain Ecosystems”



Thank You