Women in Science and Technology for the Developing World

Fifth General Assembly and International Conference

May 16-19, 2016, Kuwait

KISR
Kuwait Institute for Scientific Research

LAND DEGRADATION IN KUWAIT: STATUS AND MITIGATION OPTIONS

M. K. Suleiman and N. R. Bhat

Introduction

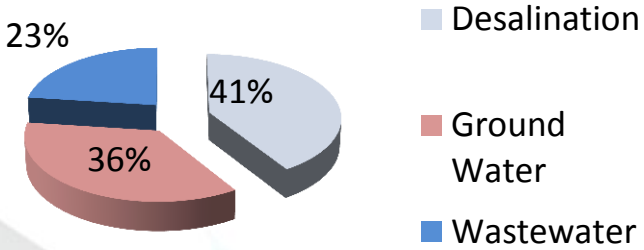
Introduction

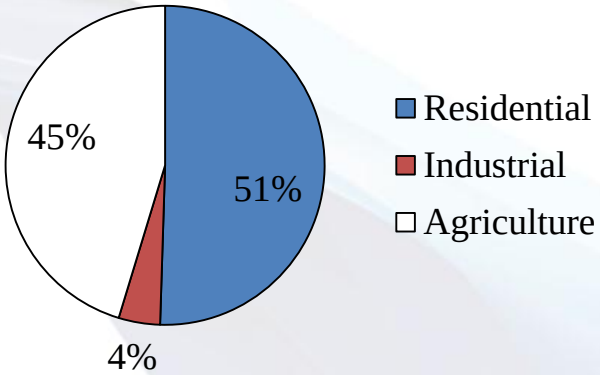
- Dryland
- Limited renewable resources
- Extreme temperatures
- High evaporation rates
- High level of soil salinity
- Prolonged summers
- Frequent sand storms
- Urban pollution
- Coastal air borne salt spray

Status

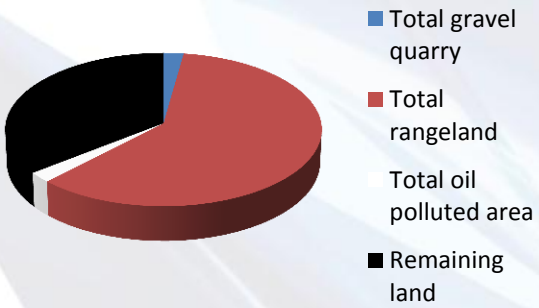
Status

- Climatic conditions
- Soil (loamy sand)
  - 85% sand and 15% silt
  - > 1% organic matter
  - High soil salinity
- Water
  - Scarce (low precipitation)
  - Expensive (2-2.7 KD/1000 gallons)
- Land degradation
  - Total rangeland 60 %
  - Total gravel quarry 6 %
  - Military activities 18 %
  - Camping activities 6 %
  - Total oil polluted 2 %





Vincent K., M. Al-Otaibi, 2011

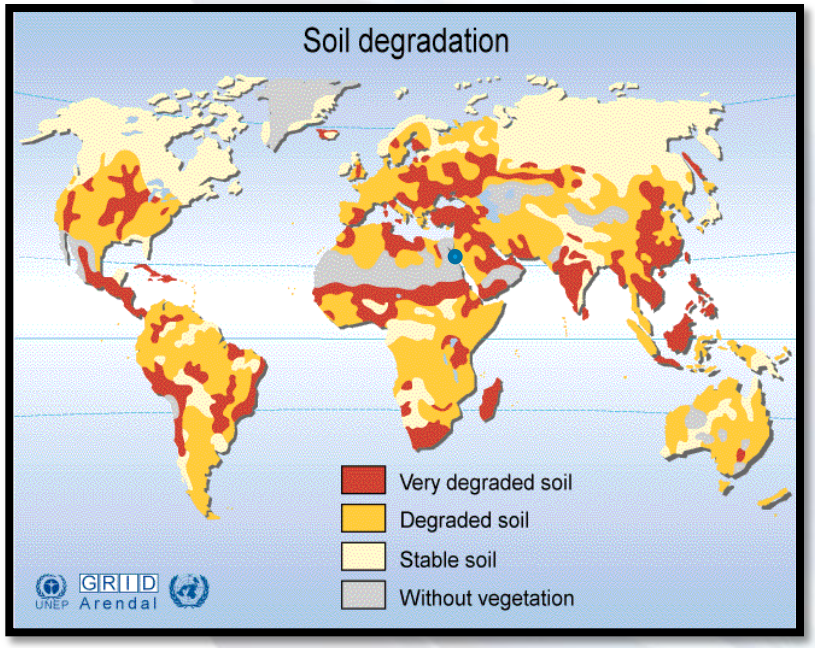


Misak et al, 2011

Status

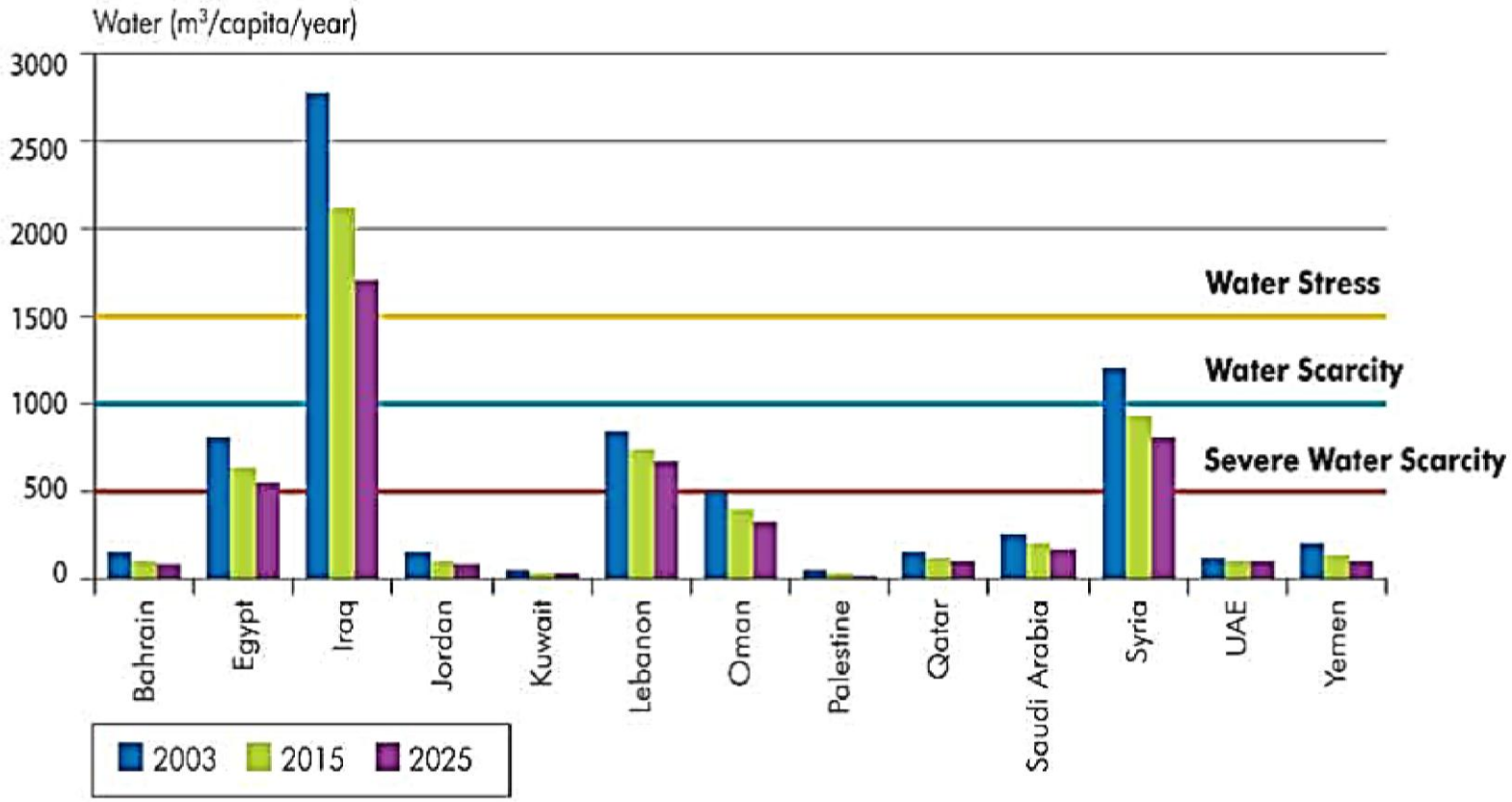
KISR
Kuwait Institute for Scientific Research
Kuwait

- Loss of top soil.
- Soil degradation.
- Soil compaction.
- Surface crusting.
- Vegetation degradation.
- Loss of biodiversity.



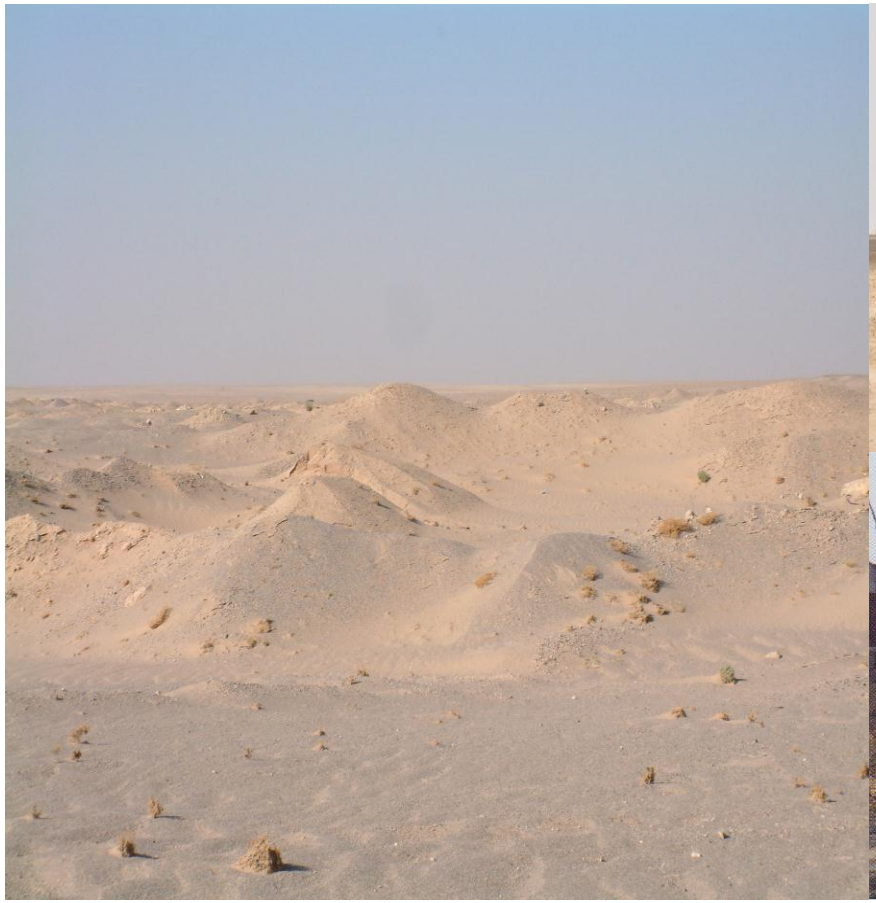
KISR
Kuwait Institute for Scientific Research

FIGURE 1 **WATER STRESS, WATER SCARCITY, AND SEVERE WATER SCARCITY IN THE ARAB COUNTRIES IN THE YEARS 2003, 2015, AND 2025**



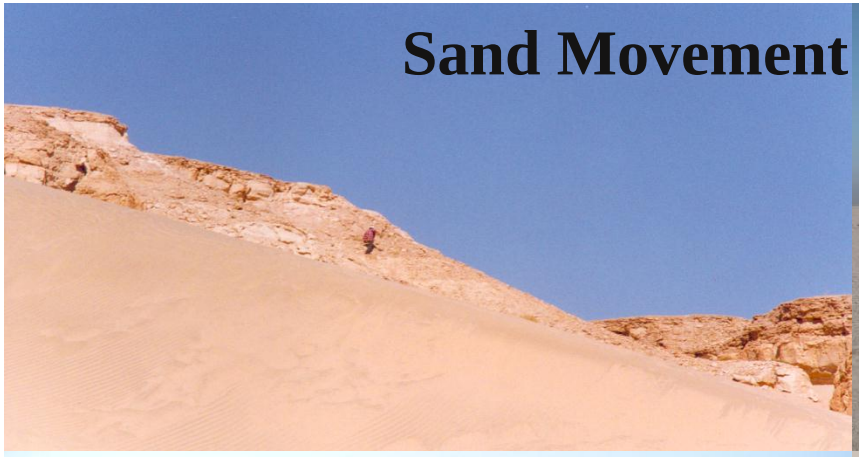
Source: Proceedings of the Symposium on challenges facing water resources management in arid and Semi-arid regions. American University of Beirut, Oct 7-9, 2004. (CD Publication

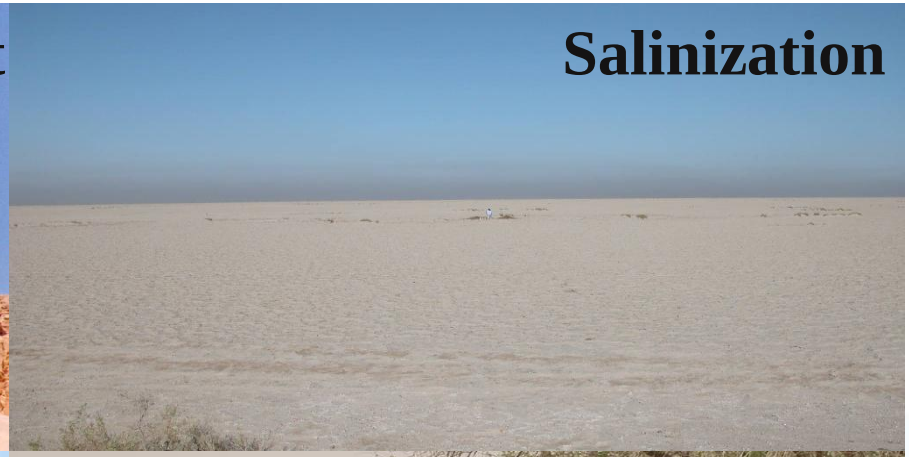
Loss of Native Flora

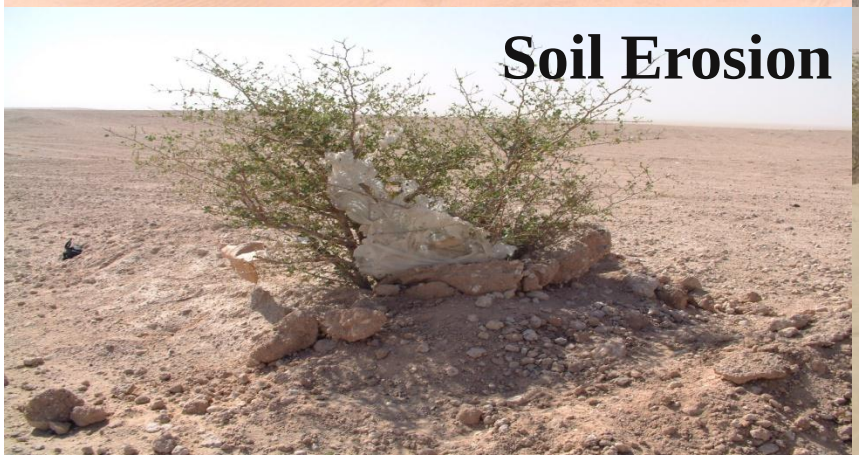


Gravel Quarry

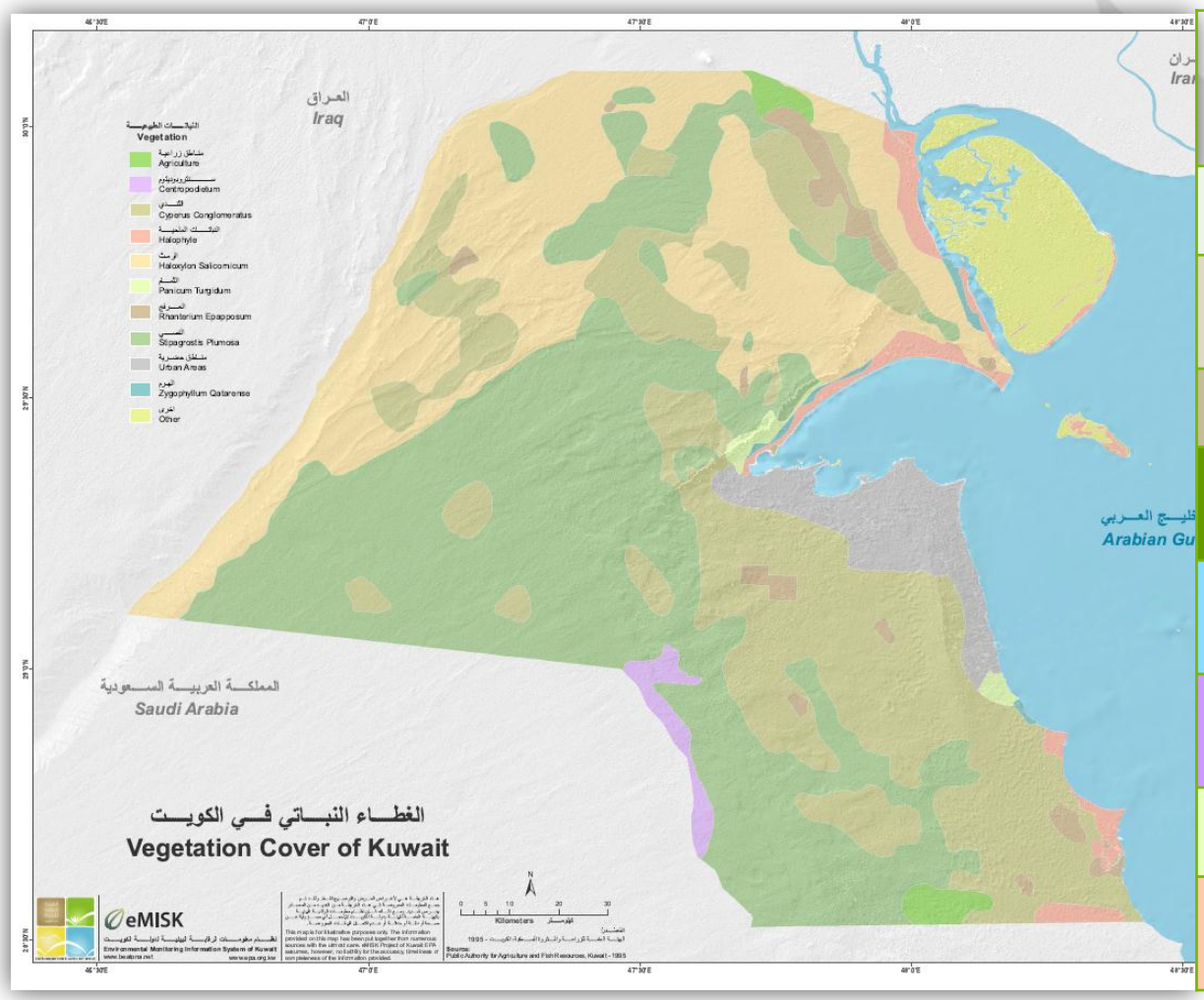
Loss of Native Flora (Cont'd)







Vegetation Map



Community	% Cover
Haloxyletum	22.7
Rhantereitum	2.1
Cypertum	26.9
Stipagrostietum	39.3
Zygophylletum	0.3
Centropodietum	1.0
Panicetum	0.7
Halophyletum	1.9

Terrestrial Biodiversity

Mammalian Species:28

Extirpated large mammals: 4 (dorcas gazelle, mountain gazelle, the Arabian sand gazelle and the Asiatic cheetah).

Extremely rare carnivores: 3 (wolf, caracal and jackal)

Endangered mammalian species: 5 (fennec fox, the red fox, honey badger, Indian grey mongoose and the wild cat).

Avifauna: More than 350 species recorded:

18 species breed locally

332 species passage migrants

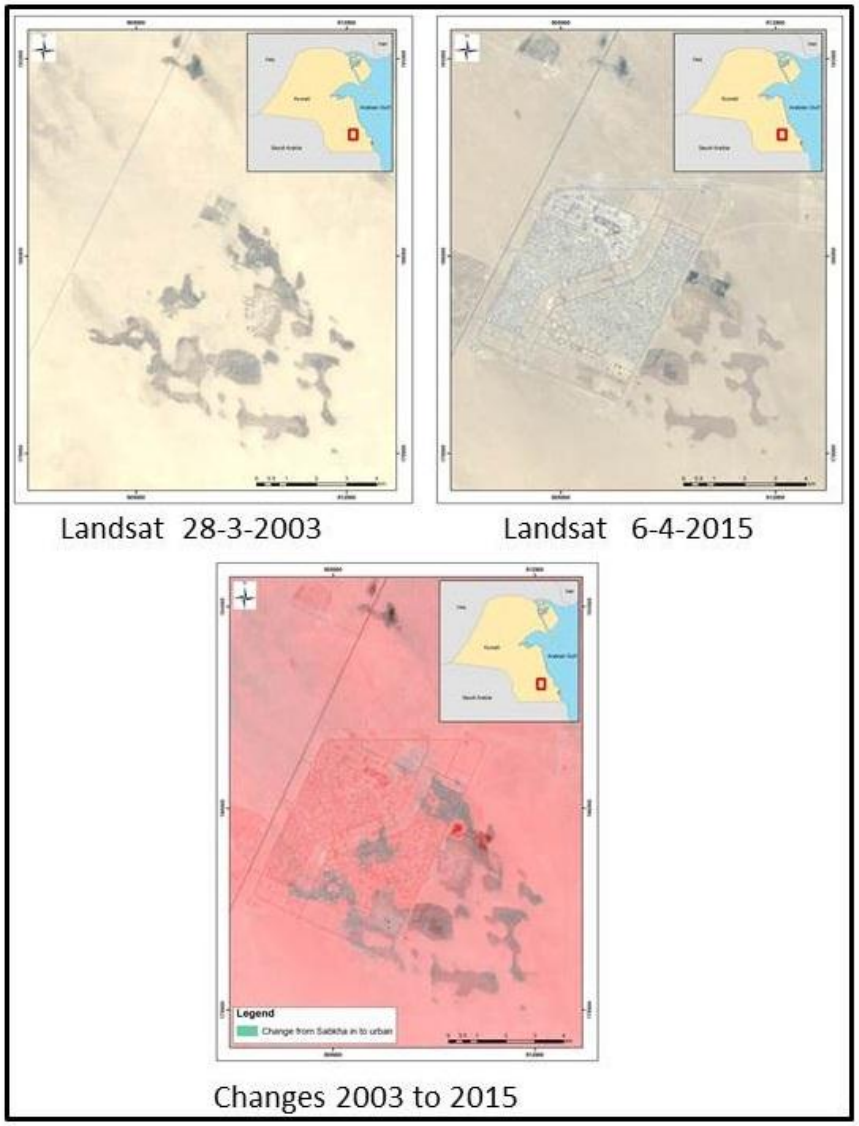
Plant Species:

Recorded species: 374 (250 annuals, 83 herbaceous perennials and 34 shrubs and under-shrub species and one tree species)

Plant Families: 55

Consequences

- Narrow plant base
- Irrigation induced salinization
- Greater stress on plant growth
- Insufficient greenery Impact
- Land degradation



Land degradation Indicators

- Soil erosion by wind and water.
- Deterioration of vegetation cover.
- Soil crusting and scaling.
- Soil compactness.
- Soil contamination by oil.
- Soil salinization.

Kuwait's Co-operations/ Commitments and Legislations

KISR
Kuwait Institute for Scientific Research

International Cooperation

- United Nations organizations including United Nations Environment Programme (UNEP)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)
- World Health Organization (WHO)
- United Nations Development Programme (UNDP)
- United Nations Food and Agriculture Organization (FAO)
- Convention on Biological Diversity (CBD)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- International Union for Conservation of Nature (IUCN)

Kuwait's International Commitments

***~~International Environmental Conventions:~~ Kuwait has international commitment towards protection and restoration of biodiversity. Signed and ratified international environmental conventions include:**

- CBD - Convention on Biological Diversity (ratified, 2002).
- UNFCCC - United Nations Framework Convention on Climate Change (ratified, 1994).
- Kyoto Protocol of the UNFCCC (ratified, 2005).
- UNCCD - United Nations Convention to Combat Desertification (ratified, 1995).
- CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora, (ratified, 2002).

*SEEKING SUSTAINABILITY AND COST EFFICIENCY: ***A UNDP Environment Program for Kuwait, July 2011***

Regional Cooperation

- The Cooperation Council for the Arab States of the Gulf (GCC): In 2002, Kuwait issued legislation No. 312/2002 joining the Regional Agreement on Conservation of Wildlife and their Natural Habitats in the GCC Countries.

- Regional Organization for the Protection of the Marine Environment (ROPME).

- The Council of Environmental Affairs Ministers - Arab League.

Local Cooperation

- National Biodiversity Committee: Developed by EPA,
  - EPA, KU, KISR, PAAFR, Kuwait Municipality, Ministry of Foreign Affairs and the Kuwait Environment Protection Society

- CITES Committee:
  - EPA, PAAFR, KISR, Kuwait Municipality, Customs Authorities and other related government organizations.

- IUCN National Committee:
  - EPA, KISR and KEPS.

Related Projects

KISR
Kuwait Institute for Scientific Research

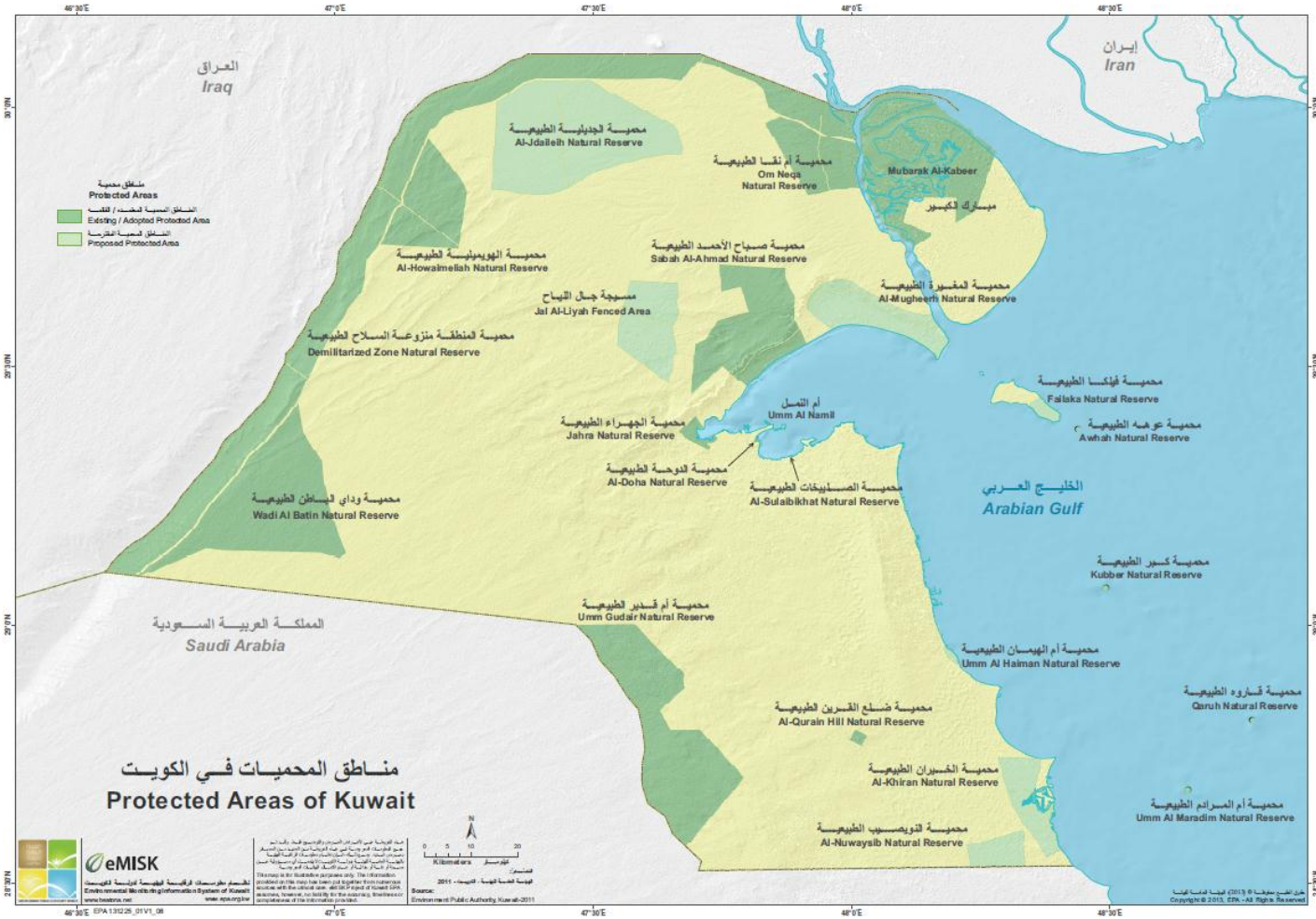
Kuwait Environmental Remediation Program

KISR
Kuwait Institute for Scientific Research

KERP

- KT sustained significant environmental damage from the Iraqi War in 1990.
- Restoration was based on establishment of 5 protected areas totaling 1600 sq km.
- Remediation of oil lakes and spills
- Kuwait will develop a viable native seed industry to supply 23 tons of seeds and over 35 million seedlings and 700,000 trees for the next 10 yrs.

Establishment of Protected Areas for Restoring Native Biodiversity



1. Um Gudair
2. Wadi Al-Batin
3. Demilitarized Zone
4. Al-Howaimilyah
5. Al-Jdailiya
6. Omm Nigga
7. Sabah Al-Ahmad
8. Jal Al-Liyah
9. Mubarak Al-Kabeer
10. Al-Mugheerah
11. Al-Jahra
12. Al-Doha
13. Al-Sulaibikhat
14. Al-Qurain
15. Al-Khairan
16. Al-Nuwayseb

Kuwait Environmental Remediation Program (KERP)

Remediation	Restoration	Environmental Monitoring and Assessment	Data & Information Management
Remediation of areas damaged by oil lakes, oil contaminated piles, oil trenches (5000454). Remediation of areas damaged by Tarcrete (5000450). Remediation of areas in and around wellhead pits (5000450). Remediation of damage to marine and coastal resources (5000259). Remediation/restoration of groundwater resources (5000256).	Re-vegetation of damaged terrestrial ecosystems (5000450). Re-vegetation of damaged terrestrial ecosystems in Burgan and Northern well field (5000454). OB/OD damaged areas restoration (5000466). Marine protected areas (5000460). Restoration of areas damaged by military fortifications (5000450	EIA AQC (analytical quality control) QA/QC Long term ecological monitoring for ecosystem Functioning (terrestrial) monitoring of the water quality (chemical) in the groundwater	IMS Documentation of Information Data repository and communication with appropriate parties.

Cluster's Units

Kuwait Environmental Remediation Program (KERP)

Rehabilitation of tarcrete affected area in Burgan

Kuwait Environmental Remediation Program (KERP)

Revegetation Island at ARS

Performance Evaluation of Vetiver System under Kuwait's Climatic Conditions

KISR
Kuwait Institute for Scientific Research

Objectives

- Evaluation of plant performance in roadway embankment for slope stabilization.
- Evaluation of plant performance in the open desert for soil stabilization purposes.
- Vetiver Cv ODV-3, ODV-7, ODV-9, ODV-13, ODV-14, ODV-16, ODV-23, Urlikal, Morocco, and Sunshine.

Slope Stabilization in Roadway Embankment using Vetiver

Results/ Roadway Embankment

- Reduction of 91% in sand erosion and 56% water runoff from the experimental area observed confirming earlier reports on the effectiveness of Vetiver in stabilizing soil.

KISR
Kuwait Institute for Scientific Research

Soil Stabilization in Desert Conditions using Vetiver

Results/ Stabilization Purposes

- Planted area reduced the sand movement and trapped greater quantities of sand than the control (226%).
- Soil microbial population increased by 457% in the planted area with 10 m row spacing, while control area recorded only 19.42% increase.
- Significant variation in the average native plant population and diversity of annuals and total native plants among the planted and control areas during spring observed.

Mass Propagation of *Acacia pachyceras*

Objectives

- Mass propagation *Acacia pachyceras*.
- Conservation of the Lonely tree as there is only one living specimen of this species preserved in Sabah Al-Ahmed Nature Reserve.

Lonely Tree – *Acacia pachyceras* conserved in Sabah Al-Ahmed Natural Reserve

Results

The plants established effectively and the native plant biodiversity in the area was also improved and the area serves as a seed reserve for various native plants.

Evaluation of Restoration Potential of Selected Native Species in Kuwait (FA112C)

Objectives

- Standardize the effective planting technique of selected native plants for use in mass plantations.
- Develop a salinity tolerance matrix of the selected species which will be used in future re-vegetation and restoration projects based on prevailing levels of soil salinity in desert areas.
- Effect of Rhizobial inoculation on growth, nodulation and nutrient uptake in *Acacia pachyceras*.
- Effect of free-living N-fixing bacterial inoculation in *Rhanterium epapposum*, *Farsetia aegyptia*, *and Haloxylon salicornicum* on seedling growth and nutrient uptake performance, and the fertility of the soil in Kuwait.

Evaluation of Restoration Potential of Selected Native Species in Kuwait (FA112C)

Scope of Research

- The main focus of this proposal is on evaluation of plant growth and nutrition, salinity tolerance, and establishment of *Acacia pachyceras*, *Rhanterium epapposum*, *Farsetia aegyptia*, and *Haloxylon salicornicum* in Kuwait's desert ecosystem.

- Recommendations will be provided at project termination in terms of plant performance, adaptability to the recommended site under adverse and amended conditions and its effectiveness in accomplishing the objectives of the proposed work plan.

Evaluation of Techniques to Enhance Seed Germination and Seedling Establishment in Selected Native Plants (FA125K)

Objectives

- To standardize suitable seed enhancement techniques for selected native seeds of Kuwait.
- To standardize optimum storage conditions for primed and pelleted seeds.
- To evaluate the effectiveness of seed enhancement techniques on the growth and survival of native seeds under desert conditions.

Evaluation of Techniques to Enhance Seed Germination and Seedling Establishment in Selected Native Plants (FA125K)

KISR
Kuwait Institute for Scientific Research

Scope of Research

The main focus of this proposal is to study the effect of selected seed enabling techniques to optimize germination rate, storage conditions and seedling performance in the field conditions for further use in desert restoration projects.

Plants involved in the project

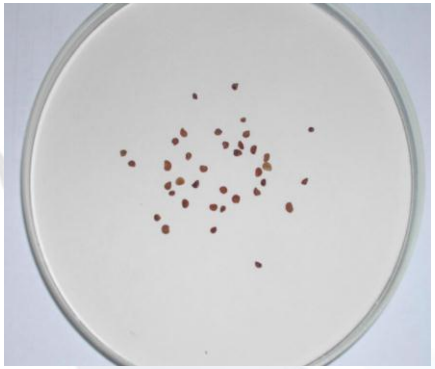
1 TREE SPECIES

Acacia pachyceras

4 SHRUBS

Rhanterium epapposum

Nitraria retusa



Lycium shawii

Convolvulus oxyphyllus

2 GRASS SPECIES

Lasiurus scindicus

Panicum turgidum

Concluding Remarks

- Huge percent of land in Kuwait is degraded due to natural and anthropogenic factors such as overgrazing, sand and gravel quarrying, off road traffic etc. resulting in vegetation loss and desertification.

- Reclamation and re-vegetation of damaged land is essential for restoring such ecosystems.

- Utilization of adapted native plants for such programs can serve in desert rehabilitation and biodiversity conservation.

- Native plants provide the proper habitat for the best wildlife to develop thus enriching the ecosystem with a diverse collection of flora and fauna.

Concluding Remarks

Land degradation is a result of natural processes and anthropogenic activities.

Although several research studies are being conducted to minimize land degradation and restore damaged terrestrial ecosystems, a gap of knowledge still exists due to the lack of integration of efforts in this regard.

It is crucial to link all undertakings under one forum to unify and combine efforts on the regional level.

KISR
Kuwait Institute for Scientific Research

THANK YOU

Kt is situated in the North-eastern corner of the Arabian desert
It is bordered at the North and west by Iraq
to the south by Saudi Arabia
to the east by the Gulf.

Total Area: 17,818 sq km
Coastal strip 125 km
9 islands

This arid region has severely suffered in recent years from prolonged disaster of drought and has been subjected to moisture deficiency. This has ultimately conducted to a decline in soil and plant productivity leading to further desertification.