

Establishment of Arfaj (*Rhanterium epapposum*) Community as Fundamental to Mitigate Climate Change in Kuwait

CEER 2014

Conference on Ecological and Ecosystem Restoration
July 28-August 1, 2014 New Orleans, Louisiana

Samira Omar Asem¹ and Jose Kaitharath²

¹Kuwait Institute for Scientific Research, Kuwait

²Faisal Sultan Al Essa: Al Faisaliya Farm, Kuwait



Kuwait Institute for Scientific Research

ENVIRONMENTAL
ENGINEERING
TECHNOLOGY



Contents

- ❖ Introduction
- ❖ Objective
- ❖ Methodology
- ❖ Results
- ❖ Conclusions





Introduction



Climate Change Impact on Biodiversity in Kuwait

- *The region is threatened physically and biologically by the global warming phenomena.*
- *More severe and harsh climatic conditions will cause increase in formation of sand dunes, sand encroachment, and extreme dust storms.*
- *Drought will cause more water demand for local consumption and irrigation.*
- *Losses in plant cover will be due to sand encroachment or erratic rainfall periods causing runoff and flooding*

Source: Omar S.A. and W. Roy. 2010
Biodiversity and climate change in Kuwait.
International Journal of Climate Change Strategies and Management, Vol. 2 Iss: 1, pp.68 - 83



Native Plants and Climate Change



- ❖ **“Many rare, threatened, and endangered native plants are more susceptible to extinction caused by climate change due to small population sizes and limited suitable habitat types.”** <https://www.dfg.ca.gov/habcon/plant/clima>.
- ❖ **“Invasive plant species pose a threat to native plants because invasives tend to do well in the changing conditions that climate change is thought to promote”**
<https://www.dfg.ca.gov/habcon/plant/clima>
- ❖ **Re-vegetating degraded lands is an effective tool to offset the carbon emissions.** Raj K. Shreshtha and Tattan Lal 2006. Ecosystem Carbon budgeting and soil carbon sequestration in reclaimed lands. Environment International (32): 781-796.



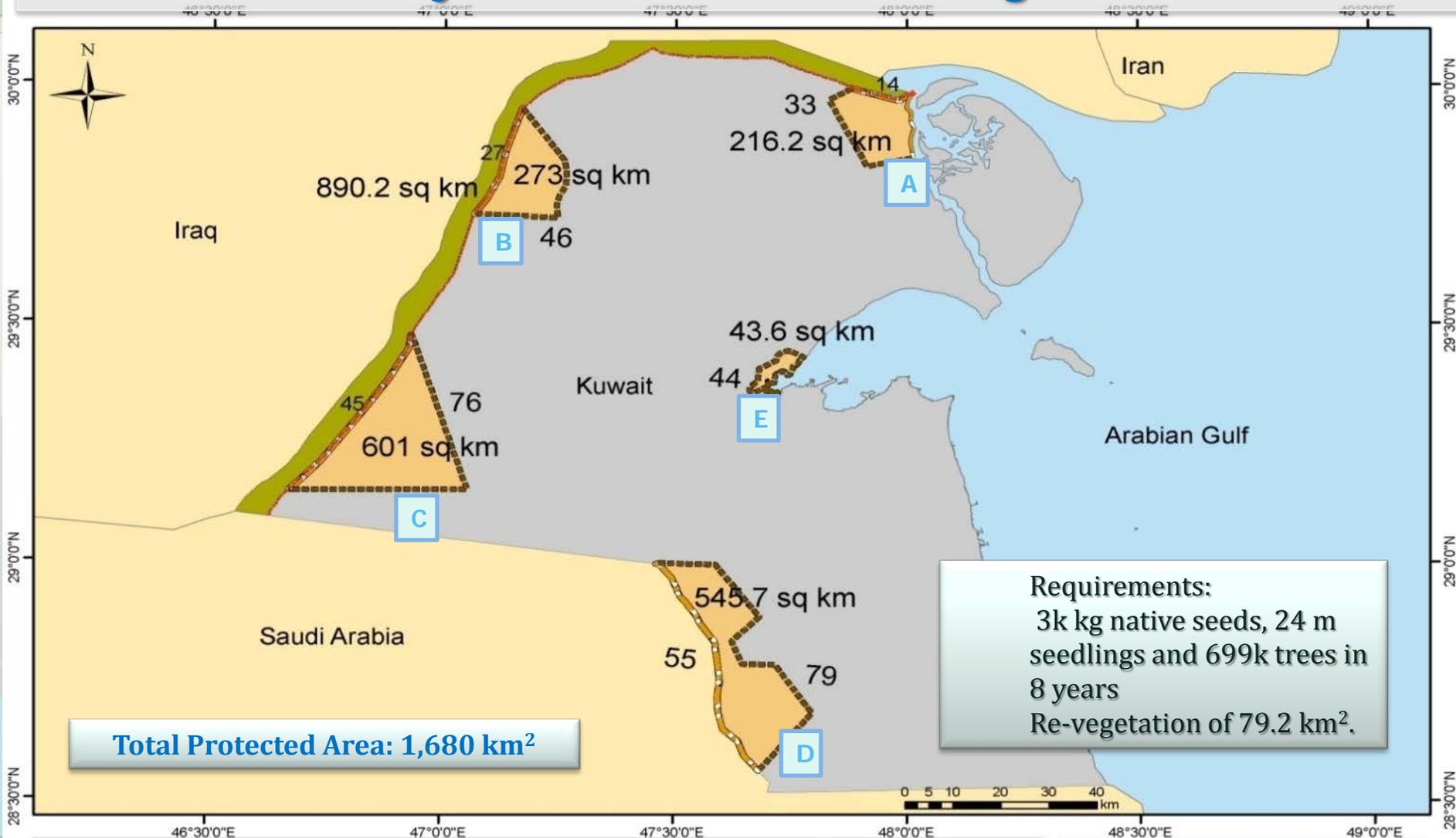


Large-scale Restoration Program

- ❖ The United Nations Compensation Commission awarded the State of Kuwait about 800 m USD for restoration of damaged lands due to the invasion of Kuwait in 1990-91. “Kuwait Environmental Remediation Program (KERP)”
- ❖ Five areas have been designated for restoration of damaged ecosystems.
- ❖ A revegetation program is established for re-vegetation of damaged lands by massive production of native plants involving private producers.



Designated Areas for Restoration & Revegetation Projects under KERP Program



Legend

- Existing UNIKOM Security Fence (km)
- UNIKOM Security Area
- Protected Area
- Border

Kuwait Institute For Scientific Research



Geoinformatics Center



Key native plants of Kuwait





Rhanterium epapposum
Asteraciaea



Farsetia aegyptia
Brassicaceae



Calligonum comosum
Polygonaceae



Cenchrus ciliaris
Poaceae





Panicum turgidum
Poaceae



Pennisetum divisum
Poaceae



Lasiurus scindicus
Poaceae



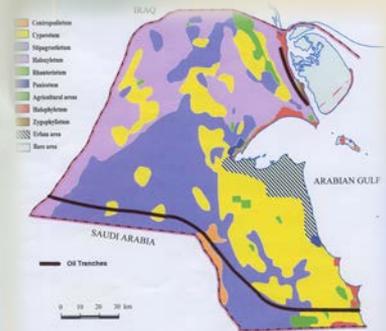
Cyperus conglomeratus
Poaceae



Arfaj (*Rhanterium epapposum* Oliv,)



- ❖ It is the national plant of Kuwait and one of the two climax plant species covering 2% of Kuwait,
- ❖ It is a C_3 desert shrub that can form monotonous stands covering vast areas of north-eastern Arabia and grows as a perennial woody shrub approximately 80 cm high with many stems branching out from the base.
- ❖ Its restoration is essential to maintaining cultural heritage, ecological integrity, conservation of wildlife habitat and species, environmental sustainability and preserving recreation opportunities.
- ❖ Was selected for this study because of its widespread appearance, versatile use and potential to adapt to most of Kuwait's landscapes.



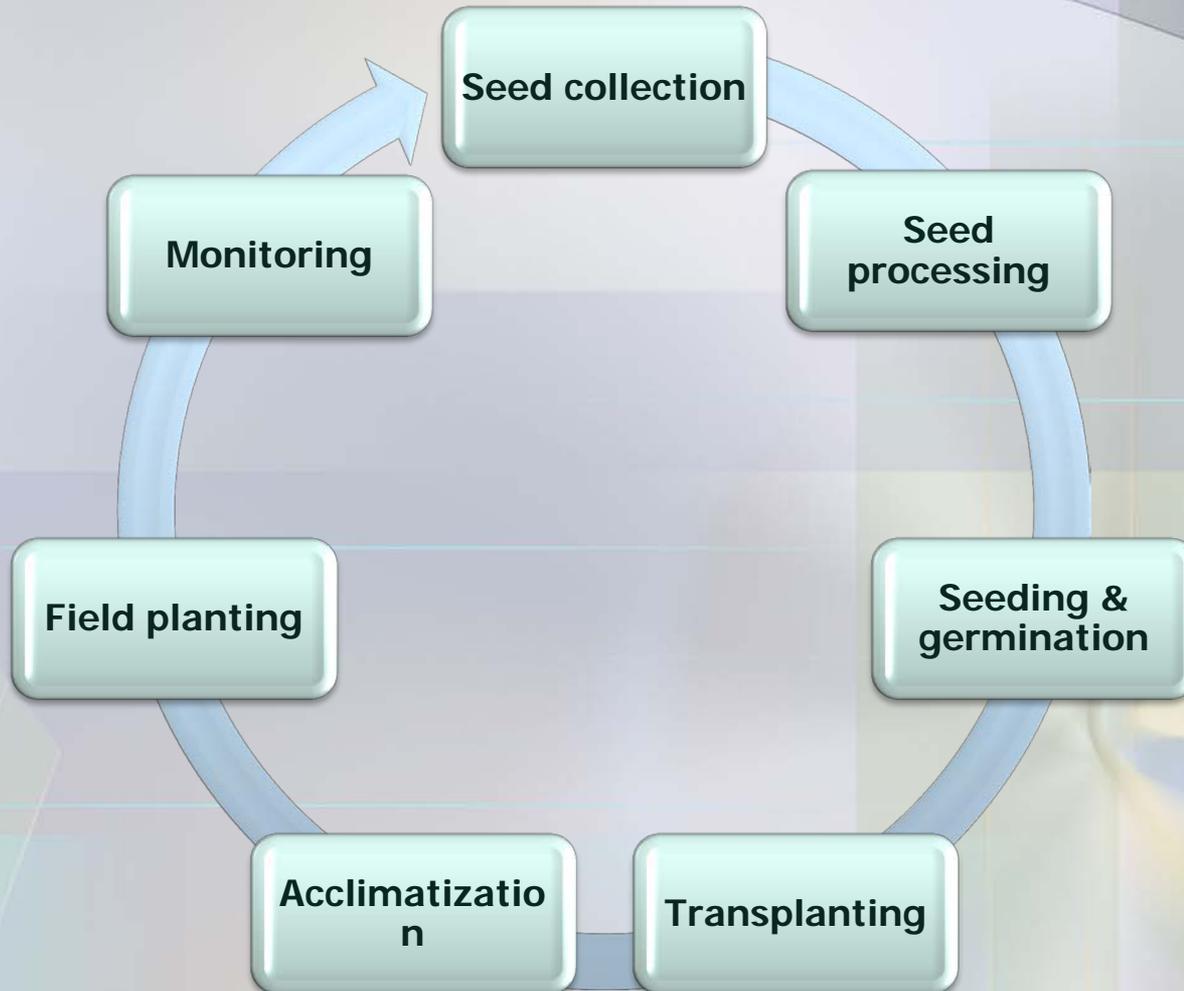
Objective



To establish simple and economically feasible method to propagate *Rhanterium* massively by involving local producers so that it can be used in revegetation of degraded lands.



Methodology



Seed Collection

1-Abdali

2-Subbiya

3-Sulaybia

4-Wafra





Seed processing



Seed processing equipment & tools



Seed storage room





Seed Germination





Transplanting





Acclimatization





Irrigation system installation





Monitoring



Results



Result and analysis of *Rhanterium* seed germination during late summer (season 1) and late winter (season 2)

Treatment	Season 1		Season 2	
Groups	Average	Variance	Average	Variance
1.Seeds without any treatment (control)	78	5.33	80	27.33
2.Seeds without any treatment, roofed	69	5.33	66	28.67
3.Seeds oven dried, unroofed	89	40.00	85	28.67
4.Seeds oven dried, roofed	70	12.67	73	16.67
5.Seeds wetted with water, unroofed	75	3.33	77	48.67
6.Seeds wetted with water, roofed	65	28.67	60	56.67
7.Seeds oven dried and wetted, unroofed	72	22.67	75	50.67
8.Seeds oven dried and wetted/roofed	92	2.67	88	31.33
9.Seeds threshed, unroofed	82	34.67	79	2.00
10.Seeds threshed, roofed	85	54	80	29.33

Findings

- ❖ The upright positioning and exposed nature of capitulum in the soil are the two important things to consider for good seed germination.
- ❖ Acclimatization of container grown plants after germination is of importance in developing proper root system before planting into the field.
- ❖ the optimal season remains the month of November.



Drip irrigation system details

1



2



3



	Drip Irrigation Details	Emitter Status	Pipe Status	Dripper Output
1	Central line gives water through flexible hoses on either side of the main line	Attached with flexible hose	Exposed to open sunlight	2 liter/ hour
2	Central line gives water through flexible hoses on either side of main line	Attached with hose but 10cm above ground with support of pipe	Covered except emitters	2 liter/ hour
3	Central line gives water direct by making special holes on the pipe	No emitters, holes on pipe	Exposed	2 liter/ hour
4	No irrigation lines, depended on rainfall	NA	NA	NA

Average height of the plants under three drip irrigation systems

Groups	Average	Variance
Drip 1	47.71	29.24
Drip 2	53.71	47.24
Drip 3	48.71	36.24
Control	25.43	81.62



Average quantity of capitulum of the plants under three drip irrigation systems

Groups	Average	Variance
Drip 1	2,923.86	1,540,368
Drip 2	3,174.71	3,296,647
Drip 3	3,153.86	957,432
Control	1,014.00	476,611



Arfaj Farm



Conclusions

- ❖ The establishment of *Arfaj* (*Rhanterium epapposum*) community has been a great success at the farm level and can be adopted in other farms.
- ❖ The economic feasibility of establishing *Arfaj* community in a large scale has been assessed and found that the reported methodology could be effectively used with some modifications of the irrigation system in the field.



Conclusions (cont.)

- ❖ **The present methodology proved to be highly effective to establish native plant communities in order to restore degraded lands.**
- ❖ **The resultant plant community will soon start hosting a number of insects, rodents, birds, and other fauna, which eventually help to create an ecosystem within a limited time period.**
- ❖ **Local producers can be involved in restoration programs by producing native plants for multiple uses**
- ❖ **The impact of present strategy on mitigating greenhouse emissions needs further study.**



Kuwait Climate, Water and Vegetation Programme

KISR

Development of decision support tool for the terrestrial biodiversity of Kuwait

Eng. Waleed Roy

KUWAIT UNIVERSITY

Remote sensing project

Dr. Hala

*Kuwait Climate, Water and
Vegetation Programme*

MIT

Climate Modelling project

Pro. Fatih

MIT

Eco- Hydrological modelling

Pro. Rafael



Funded by Kuwait Foundation for Advancement of Sciences





MIT MODELS

- *Tin-Based Real-Time Integrated Basin Simulator (t-RIBBS) model* that simulates future predictions of biodiversity when coupled with two other models.
- These other coupled modules are the *Bartlett Lewis Model* for stochastic generation of rainfall, which captures high intensity spatially variable events
- And the *VEGGIE Model* to incorporate dynamic vegetation. The latter model simulates how different plant functional types survive in such arid conditions.

The interaction of these projects will give a clearer vision and understanding of past, present and future aspects of the biodiversity of Kuwait.



THANK YOU



somar@kisar.edu

www.kisar.edu