

Kuwait Arid Ecosystem: Can the Vetiver System Have a Niche?

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Introduction

Not far from where we are and very close to the shores of the Arabian Gulf, where the great rivers of Mesopotamia meet, man learned how to harness the erratic river flow by creating dams, irrigation channels and water reservoirs that ensured around the year flow of water. The Acadians and the Sumerians invented the science of irrigation, leading to the establishment of the first settled community in the world, transforming the hunter/gatherer humans into village dwellers. As agriculture flourished, more grain was available, attracting more people to settle and establish the family-based farming communities. However, the arid nature of the soil and the high rates of evaporation led to salinization and lower productivity. This lowered the income, leading to social struggle over food and more fertile soils and eventually weakened the governments and the settlements fell to invading powers. The invaders, settled to the north of the abandoned farms, and started the process again on fresh soils. They too ended up with the same fate. This succession was repeated, and one can see that the younger civilizations were always upstream of the defeated ones. The conclusion of this story is that flood irrigation, perhaps was one of man's greatest inventions, but it was also the main reason for the collapse of the old irrigation based civilization. The irony of this is that we still see flood irrigation dominating agriculture in most arid countries. The lesson was never learnt (Sandy Postel in Pillars of Sand).

What Postel described reflects the fragile nature of the fluvial deposits from rivers, which is still seen in the northern parts of Kuwait, Bubiyan and Warba Islands in Iraq, all of the southern and south western areas extending to the Fao Peninsula and in Iran the Abadan Island and the surrounding areas. It also shows that irrigation practices which have not changed since 6000 years ago remain a major source of desertification in arid regions of the world, where the climate is hot with periods of total dryness that fragments the river deposits, to be carried out by the dominant northwesterly winds towards Kuwait and the Arabian Gulf. This paints a familiar picture in the deltas of the great rivers in semi arid and arid

regions, e.g. the Nile valley, the great rivers in India and Bangladesh, China and in Latin America. Stalinization is one (significant) form of desertification, which may be simply defined as deterioration of the terrestrial ecosystem, including degradation of various forms of vegetation and destruction of the biological potential of the ecosystem.

Soil erosion, soil fragmentation and loss of plant cover does not only mean increasing the levels of suspended dust and particulate matter and drifting sands (with the potential health impacts and damage to installations and other human activities), but also means an increase in the rates of organic decay matter and thus the release of carbon (as CO₂) into the atmosphere. This would not seem so insignificant once it is recognized that the Arabian Peninsula represents 2% of the earth surface and more than 5% of the arid lands on earth.

In Kuwait, where rain is scarce and erratic (28-260 mm) and the annual temperature range (in the open) may be as high as 90°C, the eolian process is very active. Misak (1994) describes the eolian process as deflation-abrasion, transportation and accumulation of soil. The high wind activity, mostly NW winds, contributes to the combined effects of the scarcity and erratic nature of rain fall, occasional runoff resulting from flash flooding (30-40 mm of rain in 2-3 hours have been observed), the prevalence of long dry and hot periods (May through most of September), the highly susceptibility of the soil, limited biological soil stabilization (resulting from removal of natural vegetation cover due to overgrazing, urban encroachment, gravel and sand mining and off road traffic). War has had an added impact reaching catastrophic levels on the environment in Kuwait. The occupation, subsequent war of liberation and the clearing of mines and fortifications resulted in major alteration in the geomorphology of the desert in Kuwait. Kuwait soils are mostly developed from calcareous sandstones or gravelly sand that has consolidated with lime. Therefore, the top horizon of the soil often has sandy or sandy loam texture. In general, the soil has low water retention capacity and high levels of salt. In many areas of the country, sheets of eolian sands are observed, forming a cemented layer in 'wadis' and low laying areas. These characteristics make Kuwaiti soil vulnerable to the factors leading to desertification. The average rate of desertification in Kuwait has been estimated at 285 km² (Al-Awadi et al., 2003).

Several studies have been carried out to assess the extent and understand the dynamics of desertification and sand sheet movements in Kuwait. KFAS, the EPA and the Ministry of Defense have funded research in this area which has been carried out by KISR scientists over the years (e.g. Al-Awadi et al, 2003).

Control of Desertification

Scientists debate whether desertification is a reversible process. Most agree that it is, but requires an integrated and multi disciplinary effort that is costly and of a long-term nature. It is also observed that leaving recovery to nature would be very slow and may be only partial. What they all agree upon is prevention.

Mechanical methods, mostly fencing are often used to control the movement of sand sheets. Porous, non-porous, palm tree leaves, wood posts, soil or cement ridges and fences have been used to protect installations and farms. They all rely on wind speed attenuation, leading to sand deposition at the fence. Chemical stabilization has been advocated. Low gravity asphaltic oil, used oils and other sand particles binding materials have been used to stabilize such fences. High gravity oils, although more effective, tend to soil vehicles, animals and people crossing such fences. It's difficult to find chemical stabilizer that have good binding properties and which are non-toxic and cost-effective.

To mitigate the impacts from sand encroachment, shelter belts “green belts” have been proposed to constrain and manage large-scale sand movement. Shelter belts act as a barrier to settle moving sands, and have been used in Kuwait to protect oil field installations and other infrastructure. Five rows of drought-resistant trees, with 5 meter spacing between rows and 5 meter spacing between the trees have been found to be effective in other studies.

The Challenges:

The challenge we face in Kuwait is two folds:

1. Can a preventive approach be developed and adopted to prevent, attenuate the rates of desertification?
2. Can we develop a strategy for the control of desertification, reduction of soil erosion and sand sheet movement that depends on biological and cost-effective methods?

While we cannot address the first question at this workshop, it is important to agree that there is no single approach that would achieve this objective. As the factors leading to desertification are many and are interlinked, the prevention and remediation approaches to control and prevent desertification must also be integrated and complementary.

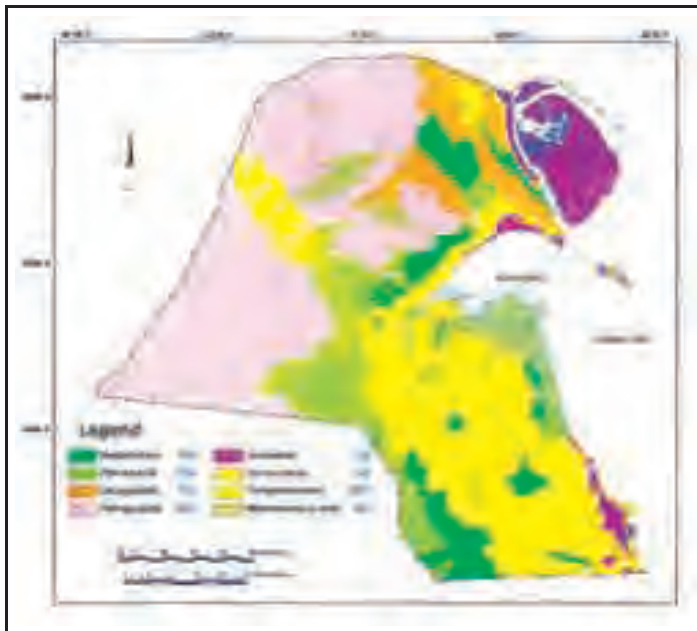
From the experience of other countries, the introduction of Vetiver System is seen to be promising, as we shall hear from our distinguished guests.

Our principle tasks here include:

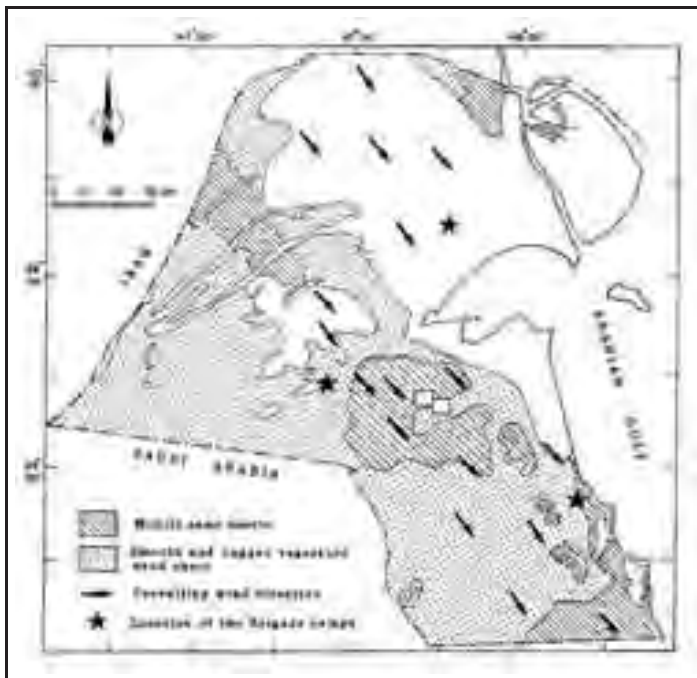
- a. Understanding the nature, physiology and requirements for introducing the Vetiver system.
- b. Understanding the ecological consequences of introducing this plant.
- c. Proposing areas of possible application
- d. Discussing methods and requirements of propagation
- e. Developing precautionary measures and a monitoring system to ensure that the plant would not become invasive or have adverse effects on native vegetation.

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General distribution of soils in Kuwait



Distribution of sand sheet areas in Kuwait. (after Foda *et al.*, 1984 with modifications).



Examples of Human Activities leading to Desertification in Kuwait (Continued)



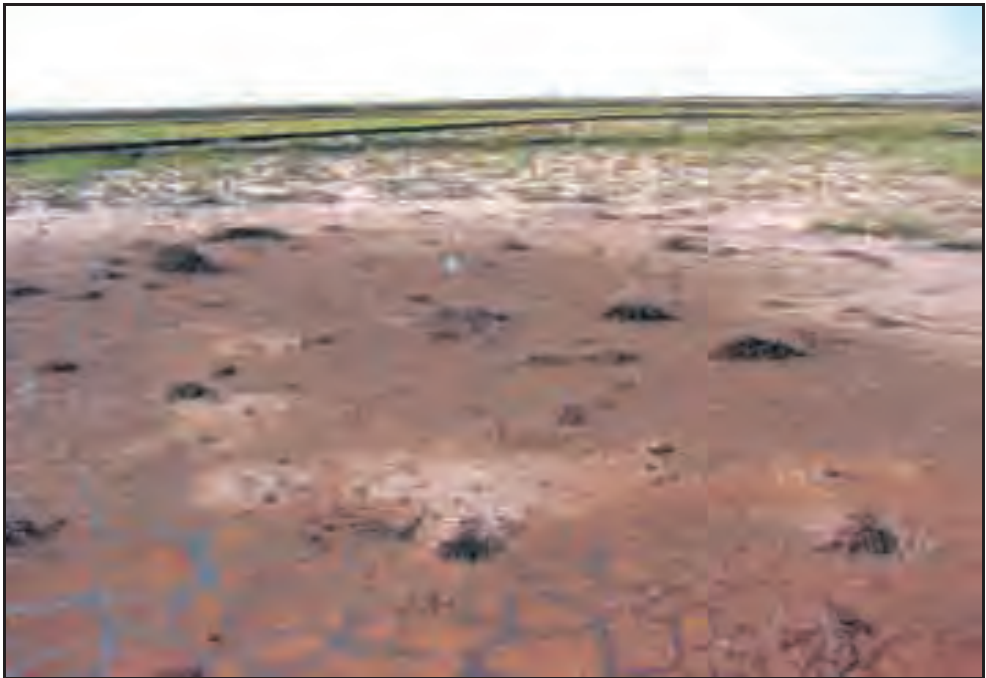
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