GRC Environment

Research Bulletin

Gulf Research Center Knowledge for All

The Arabian Gulf region is the world's richest in oil and gas reserves and the poorest in renewable water and arable land and continues to rely excessively on natural resources as a development strategy. Water and oil are being tapped at unsustainable levels. Gulf countries face several urgent environmental issues. So, the sustainable management of renewable resources in arid lands, throughout the Arabian Gulf region, is very crucial.

The Gulf Research Center (GRC), Dubai, UAE and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), Damascus, Syria organized a training program and a workshop in Arabic on the subject. The program titled "Toward Sustainable Management of Renewable Resources in Arid Lands" was held from April 5-16, 2007 in Syria.

The program covered issues such as: management and use of different types of water, protection of wildlife and biodiversity, use of remote sensing to monitor land degradation, rehabilitation of degraded areas, protected areas management and combating desertification. It also included field visits to a protected area, a research center for agriculture and water resources, and a combating desertification project (for more details, see page 28).

Issue No. 3, August 2007

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Strategic Water Reserve: New Approach to an Old Concept in GCC Countries

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In the last three decades, rapid population growth and accelerated socioeconomic development in the GCC countries have been associated with a substantial increase in water demands, from less than 5 billion cubic meters in 1970 to about 26.778 billion cubic meters in 2005. These demands have been driven mainly by agricultural consumption and rapid urban expansion. Efficient, sustainable and integrated development and management of water resources requires water policy reforms with emphasis on supply and demand management measures and improvement of the legal and institutional provisions.

Due to the deterioration of non-renewable aquifers, all GCC countries rely on desalinated water as a main source of domestic water supply. It has been argued that the best long-term solution for the water crisis in the domestic sector is to build a network of large-scale desalination plants. The problem facing the GCC countries, however, is the vulnerability of desalination plants to pollution and emergency conditions. For example, the maximum stored water in the ground reservoirs and distribution network is enough only for 24 hours, except in Saudi Arabia and Kuwait, where it is three and five days respectively, as shown in Figure 1. Thus, in any crisis or emergency, the stored water will not be enough to cover the demand. Also, the production of desalination plants is constant and the demand is not constant.

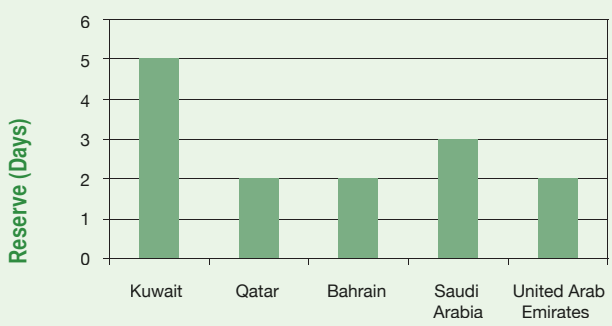
The possible alternatives for reserving fresh water sources for emergency and peak demand conditions are: 1) to increase ground reservoirs and distribution network storage capacity or 2) using a groundwater aquifer storage and recovery system (ASR). It has been proved that increasing the capacity of the ground reservoirs and network is very expensive and not environment-friendly. One solution is to store this water in groundwater aquifers.

Unlike groundwater aquifer storage, the fresh water cannot be reserved in surface reservoirs for more than 48 hours, otherwise it will become stagnant water and not suitable for domestic use. Aquifer systems allow for multi-year storage keeping water protected and in good quality. Usually, wells can be located where most needed and because wells require little land, the costs of large land acquisitions are avoided. Moreover, large water volumes can be stored underground, decreasing the need for the construction of surface reservoirs.

I What Is Aquifer Storage and Recovery?

Aquifer Storage and Recovery (ASR) is a proven way to safely store excess water underground when it is available, and recover that water for use when supplies are short. For fuller utilization of desalinated water, and hence further cost reduction, greater water storage capacity is required. To this end, ASR could be used. This is a system that has been in use in the US since 1984 and was developed to improve the use of water supply and water treatment facilities. The system involves the use of injection wells for the underground storage of treated drinking water in a suitable aquifer when the capacity of water supply facilities exceeds the

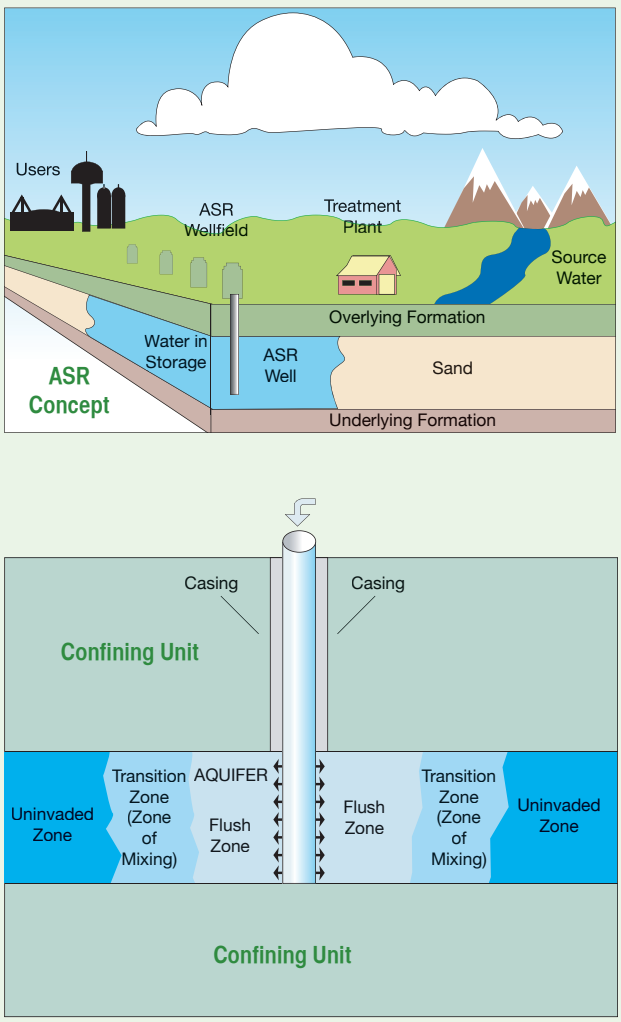
Figure 1: Storage Capacity for Emergency Water in GCC Countries



demand, and its subsequent recovery from the same well to meet seasonal, peak, emergency or long-term demand as shown in Figure 2. ASR may be used to store surplus water in this way. Also where electricity from a dual-purpose plant is in low demand ASR can be used to inject desalinated water into the aquifer as shown in Figure 3. Such seasonal storage may amount to millions of cubic meters through a single well, compared to a few hundred stored in conventional ground or elevated storage tanks. Aquifer storage recovery is low-cost where a suitable aquifer is available, since land requirements are minimal.

It has been shown that by making more efficient use of existing water supply systems, ASR can reduce capital costs by 50 to 90 percent. However, this system has not yet been widely used within GCC countries, although it has been tested in Kuwait, Saudi Arabia, United Arab Emirates and Oman. In each of these countries it has been planned in conjunction with desalination facilities to provide a strategic water reserve for emergency supplies while also meeting other secondary objectives such as seasonal peak demands, recharging brackish water reserves, and salinity intrusion control. In June 1993 there were approximately 60 ASR projects in operation or under development in the US. Treatment of the recovered water is generally unnecessary apart from disinfection. There is some evidence that ASR results in the elimination of the undesirable by-products of chlorination.

Figure 2: Aquifer Storage and Recovery System

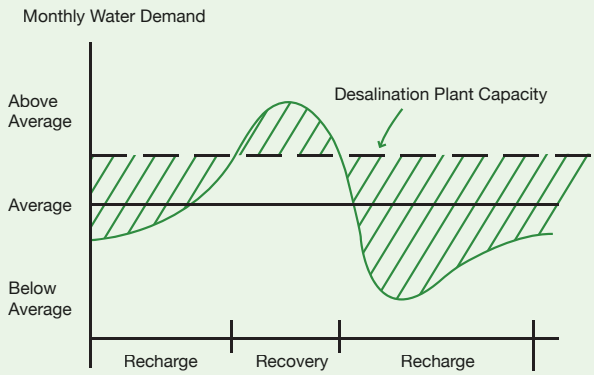


II GCC Countries' Experience in ASR

The concept of strategic water reserve in GCC countries is not new. Artificial recharge for the groundwater aquifer system was first tried in Kuwait by Parsons in 1964. A recharge basin in Rawdhatain depression was used to collect the surface run-off during the occasional rainstorm and then seeped to aquifer system by gravity. Another test in the same place was carried out during 1972-73 by injecting desalinated water in two wells over 27 days. To investigate the potentiality of injecting the fresh water in Dammam limestone formation in Sulabiya, in the mid 1990s, 4.3 million gallons were injected over a period of 30 days. The results were not conclusive and suggested limited storage and recovery potential.

In the United Arab Emirates (UAE), the first proposal was submitted to the government by the United States Geological Survey (USGS) and National Drilling Company (NDC) in 1998. It was proposed to inject 220,000 gallons a day for 200 days in the Eastern Region

Figure 3: Typical Aquifer Storage and Recovery Operating Schedule



near Al-Ain City. The proposal was not accepted due to the cost and limitation of the availability of fresh water. A pilot test to inject 2.5 million gallons a day of desalinated water through five injection wells and infiltration basin began in 2002 in the western region near Madinat Zayed. And in 2003, after the construction of a pipeline for Qedfaa desalination plant in Fujairah, a detailed feasibility study was done and a pilot test carried out in Al Shwieb area. Both pilot projects showed an efficiency rate of about 85 percent.

In Qatar, during 1992-94, a feasibility study for large-scale artificial recharge schemes evaluated the injection of desalination water in Rus and Umm er-Radhuma formation. The study concluded the potentiality of building up groundwater reserves in both aquifer systems.

III Conclusion and Recommendations

All GCC countries rely on desalinated water as a main source of domestic water supply. The maximum capacity of emergency reserve in the surface ground reservoirs and distribution network ranges between two to five days. This storage is not enough to cope with crises over long periods and increasing the storage capacity using surface reservoirs is costly and not environmentally friendly. Groundwater storage using the artificial recharge technique is a promising tool for strategic water reserves in all GCC countries. Storing the fresh water in groundwater aquifers is safer and more reliable in terms of time and location. It is recommended to carry out more extensive studies to evaluate the feasibility of artificial recharge schemes.

Emergency water storage in surface reservoirs is not an optimal solution

A desalination plant. Desalinated water is the main source of water for domestic use in GCC countries

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Toward Sustainable Development

Efficiency of Soil Solarization in Controlling Weeds, Enhancing Soil Fertility and Increasing Crop Yield in the UAE Environment

Dr. Ali El-Keblawy* and Fatima Al-Hammadi**

Introduction

The substantial expansion in agricultural production in the United Arab Emirates (UAE) in recent years has been associated with the growth and spread of several weeds and other soil-borne pathogens. Weed control through chemical means in the form of herbicides is commonly used to kill weeds or inhibit their growth throughout the world. Methyl bromide, the sodium salt of metham and dazomet are widely used in the UAE for soil fumigation in open fields and in green houses. In addition, many vegetable growers all over the world rely on methyl bromide or other soil fumigants to manage soil pathogens, nematodes, and weeds, as it has been very effective to produce high vegetable growth and yields. However, the use of herbicides and other fumigants has increased toxic residues dangerously, indiscriminately targeting organisms, the environment, and ground water and creating serious upheaval in the ecosystem. Soil solarization has been considered an appropriate, non-chemical, alternative to methyl bromide fumigation and the use of other chemicals. It is a promising method to reduce populations of soil-borne pests and weeds without the use of pesticides. Soil solarization is a natural, hydrothermal process of disinfesting soil of plant pests by using passive solar heating of moist soil mulched (covered) with polyethylene sheets. This technique consists of covering the soil with a transparent plastic film and exposing it to sunlight during high solar radiation periods. In this process, the soil temperature reaches lethal levels for many phytopathogens and seeds of weeds, and causes changes that bring gains in crop growth and yield.

The Gulf region is characterized by its higher air temperatures and intensive solar radiation for longer duration, especially during summer months. Soil solarization showed great efficiency in the UAE environment

The Gulf region is characterized by its higher air temperatures and intensive solar radiation for longer duration, especially during summer months. Soil solarization showed great efficiency in the UAE environment. The recorded temperatures in a solarization experiment during the summer in UAE were much higher than that recorded in most solarization studies in many parts of the world.

The combined effects of soil disinfestation of soilborne pathogens and weeds and the increase in soil fertility have resulted in the increase in yield of several crops. The aims of the present study were to evaluate the efficiency of soil solarization in (a) improving soil fertility, (b) controlling weeds, and (c) increasing yield of cabbage in the UAE environment. The differential response of the weeds to soil solarization will also be assessed.

I Materials and Methods

A field experiment was conducted during the hottest period of the year from June 10 to August 10, 2003 in a private farm near Al-Ain, UAE. The farm soil, which is sandy loam, was infested with the following weeds: *Amaranthus viridus, A. hybridus, Cenchrus ciliaris, Chenopodium murale, Launea mucronata,*

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Malva parviflora, Capsella bursa-pastoris, Echinochloa colona, Portulaca oleracea, and *Melilotus indica*. Seeds of the weeds were dispersed evenly on the soil surface.

Prior to solarization, the soil was plowed, rotovated to provide a smooth surface, and prepared according to the standard methods of cabbage cultivation. Treatment plots consisted of 12 rows 10 x 1 m each. The plots were completely randomized with seven and five replicates for solarized and non-solarized treatments, respectively. Drip irrigation lines were laid in the middle of the plots. The soil was heavily irrigated in early June 2003. Solarized plots were covered with 75 micrometer transparent polyethylene sheets. The edges of the sheets were buried 15 cm in the soil to prevent heated air and water vapor from escaping. In order to keep high soil moisture content throughout the experiment, soil was watered every week with the drip irrigation system.

After removal of polyethylene sheets on August 10, soil samples were immediately collected from the top 15 cm at the different solarized and non-solarized plots. Soil samples were air dried, homogenized and sieved to remove large particles. Macro- and micro-nutrients were estimated by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES)[1].

Cabbage seedlings were transplanted in the experimental plots on October 5, 2003, with minimum soil disturbance, according to the standard methods of cabbage cultivation. The effect of solarization on weed disinfestation was determined by collecting the available weeds in both the solarized and non-solarized plots after 60 days of cabbage transplantation (15 days before the final harvesting of cabbage). The different weed species were separated, counted and their densities and dry weights were estimated. Effect of soil solarization on crop yield was estimated by estimating the average cabbage head weight and total fresh weight of cabbage per acre.

II Results and Discussion

2.1 Effect of Solarization on Density, Dry Weight and Frequency of Weeds

One way Analysis of Variance (ANOVA)[2] showed significant effects of soil solarization on weed population density and dry weight. Weed density and dry weight in non-solarized plots were 14.6 individual/100 m^2 and 77.9 g//100 m^2, respectively, but were, 2.0 individual/100 m^2 and 9.9 g//100 m^2, respectively, in solarized plots. The most affected weeds by solarization were *Launea mucronata, Capsella bursa-pastors* and *Echinochloa colona*. These species were completely absent in the solarized plots. On the other hand, the less affected species by solarization process (i.e., which had higher density and greater dry weight in solarized plots) were *Portulaca oleracea* and *Melilotus indica*. This result agreed with several other studies, which examined the effect of solarization on *M. indica* and *P. oleracea*. However, *P. oleracea*, was reported as a susceptible weed to soil solarization in some other studies. Our results

Soil solarization is a natural, hydrothermal process of disinfesting soil of plant pests by using passive solar heating of moist soil mulched (covered) with polyethylene sheets

1 Inductively Coupled Plasma-Atomic Emission Spectrometry is the instrument that was used in estimating micro- and macro-nutrients.
2 One way ANOVA is a kind of "Analysis of Variance" which was used to test statistically the effect of soil solarization on weed density and weed dry weight.

recommend increasing the efficiency of solarization process and/or increasing the solarization period for farms infested with *P. oleracea* and *M. indica*.

2.2 Effect of Solarization on Soil Fertility

Solarization for two months did not significantly affect the concentrations of some macronutrients such as potassium, sodium and phosphates ($P>0.05$), but significantly increased the concentrations of calcium, magnesium, nitrate and sulfate ($P<0.05$). The level of calcium, magnesium, nitrate and sulfate increased in the solarized plots over that of non-solarized plots by 3.3 percent, 5.7 percent, 36 percent and, 24 percent, respectively.

The effect of soil solarization on concentration of micronutrients was more pronounced than that of macronutrients. The levels of three out of four estimated nutrients increased significantly after soil solarization. Solarization significantly increased the levels of copper, iron and zinc, over those of control, by 40 percent, 23.7 percent and 114 percent, respectively ($P<0.05$). Solarization increased the level of aluminum, over that of control, by 17.4 percent; so, the effect was not significant ($P>0.05$). Similar positive effects of soil solarization on soil chemical character have been documented in several studies around the world, such as India, California, Brazil and in the Mediterranean region. Increases in the mineral nutrient concentrations could be attributed to decomposition of organic components of soil during solarization, while other minerals might be virtually cooked off the mineral soil particles undergoing solarization.

2.3 Effect of Solarization on Cabbage Yield

Soil solarization significantly increased average fresh weight of cabbage ($P<0.05$) and average head weight ($P<0.01$). Solarization increased the average yield of cabbage from 7,443 kg/acre in non solarized plots to 8,857 kg/acre in solarized plots (about 19 percent increase). Similarly, the average head weight, which reflects the size and quality of cabbage, increased from 1.15 kg in non-solarized plots to 1.52 kg in solarized plots (about 32 percent increase).

The average head weight of cabbage increased about 32 percent in solarized plots

The practical value of soil solarization, as of any pest management strategy, must be assessed by several factors, including pesticidal efficacy, effect on crop growth and yield, economic cost benefit, and user acceptance. The present study documented a significant efficiency in controlling weed populations and increase in soil fertility and in cabbage yield and production. In the UAE, farmers leave their farms during summer without cultivation because of the extremely high temperatures at that time. During summer, mulching the soil with transparent polyethylene sheets would be effective, economical and acceptable to farmers, especially because it is simple, safe, involves no phytotoxicity or pesticide residues and does not require sophisticated mechanisms.

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Bioenergy Potential in Jordan

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Jordan

Introduction

The rapid increase in population and changes in lifestyle in Jordan have resulted in a dramatic increase in the quantity of municipal solid waste. This is dumped daily in landfills, resulting in large accumulation of waste, which in turn produces large amounts of biogas and greenhouse gases like methane and carbon dioxide.

I Quantities of Solid Waste

The generation rate per capita of solid waste in Jordan is 0.8 kg/day. However, this varies in cities and rural areas. The generation rate may be as high as 1.0 kg/day in big cities, while in small cities and rural areas it might be as low as 0.6 kg/day.

The quantity of solid waste generated in Jordan is estimated to be 4,600 tons per day (1,679,000 tons per year). Most of this waste is collected by municipalities and common service councils and transferred to the 21 landfills throughout the country.

II Method of Disposal

The method of final disposal of solid waste in Jordan is landfilling. It is considered the best method for the country due to its low cost and the availability of land.

Landfilling, as practiced in Jordan, is simply dumping the waste in trenches or cells with leveling and compacting by trash compactors to reduce the size and the thickness of the layers, and finally covering the waste with soil.

Landfilling using trench method is most popular, while cell method is used depending on the nature of the site. No lining system is applied to landfills and there is no leachate collection and biogas utilization, except in Russaifa and Ghabawi sites.

2.1 Private Sector Participation in Solid Waste Management

- Private contractors for waste sorting and separation in some landfills
- Limited recycling of specific types of waste (metals, plastic and paper)
- Collection and transport of commercial and industrial waste by private companies

2.2 Landfill Disposal Sites

There are 21 working landfill sites in Jordan after the recent closure of seven small sites. There are two categories of landfill sites:

- Working landfill sites that use land filling
- Working landfill sites that use open burning

III Biogas Utilization

Biogas is a mixture comprising mainly methane and carbon dioxide.

Table 1: Types of Landfills in Jordan

Working Landfills Using Landfilling	Working Landfills Using Open Burning
Akaider	North Badia
Mafraq (Huseniyat)	Al Ruaished
North Shuneh	Al Azraq
Al Ghabawi	South Shouneh
Dhuleil	Ghour Mazra
Salt (Humra)	Ghour Safi
Der Alla	Al Hussaineeh
Madaba	Alquairah
Karak (Allajoon)	
Tafila	
Shobak	
Ail (Annoaymat)	
Ma'an	
Aqaba	

It is produced when organic matter decomposes in the absence of oxygen. This can take place in landfill sites to give landfill gas, or in anaerobic digesters to give biogas. Sewage gas is produced by the digestion of sewage sludge. Landfill gas is a mixture consisting of mainly methane and carbon dioxide, formed when biodegradable wastes break down within a landfill as a result of anaerobic microbiological action. The biogas can be collected by drilling wells into the waste and extracting it as it is formed. It can then be used in an engine for power or heat generation. Landfill sites can generate feasible quantities of landfill gas for up to 30 years after waste deposition. Recovering the landfill gas and using it as a fuel not only ensures the continued safety of the site after land filling has finished, but also provides a significant long-term income from power and/or heat sales. Depending on the digestion process, the methane content of biogas is generally between 55 percent-80 percent. The remaining content is primarily carbon dioxide, with trace quantities (0-15,000 ppm) of corrosive hydrogen sulfide and water.

IV Benefits of Biogas Utilization

Utilization of biogas to produce energy has the following advantages:

- Reduction of greenhouse gas emissions (methane has a greenhouse effect of 24 times that of carbon dioxide)
- Reduction of use of non-renewable energy sources (i.e. oil)
- Reduction of greenhouse gas emissions and pollutants produced from the use of non-renewable energy sources.
- Reduction of odors and gases affecting health.
- Eliminating the risk of explosion of the gas trapped inside the landfill.
- Production of organic fertilizers.
- Creating job opportunities.

V Potential Energy in Landfill Sites

Because open burning is still being used in some landfills and because some of them receive small amounts of waste or are improperly situated, not all landfills are suitable for biogas utilization.

The quantity of landfill gas (LFG) that is produced in landfills can be estimated using several models. The simple equation of the IPCC Guidelines for National Greenhouse Gas Inventories is used here:

Methane emission (Gg /yr) = (MSWT x MSWF x MCF x DOC x DOCF x F x 16/12 - R) x (1-OX), where:

- MSWT = total MSW generated (G/yr)
- MSWF = fraction of MSW disposed to solid waste disposal sites
- MCF = methane correction factor (fraction)
- DOC = degradable organic carbon (fraction)
- DOCF = fraction DOC simulated
- F = fraction of CH4 in landfill gas (default is 0.5)
- R = recovered CH4 (Gg/yr)
- OX = oxidation factor (default is 0)

Table 2 shows the estimated values of methane gas in the disposal sites using the method of land filling. From this table it can be seen that the amounts of methane gas generated per year in most of the landfills are small and not exploitable. This

Table 2: Quantities of Methane Generated

Landfill	Period of landfill	Waste deposited (Gg)	Average yearly deposition (Gg)	Years remaining for closure	Quantity of methane generated per year (Gg)	Quantity of methane generated (Gg)-2005
Akaider	12	1,450.800	246	10	20.0	119.16
Mafraq	10	474.864	74	10	6.1	39
N.Shouneh	10	471.120	118	10	9.7	38.69
Russaifa	15	8,000.000	630	0	51.7	657.07
Al Ghabaw	25	1,606.000	803	23	66	131.9
Dhuleil	10	184.704	56	10	4.6	15.17
Salt	10	519.480	79	10	6.5	42.67
Der Alla	3	153.504	74	10	6.1	12.61
Madaba	14	780.312	182	10	14.9	64.09
Karak	10	510.744	89	10	7.3	41.95
Tafila	13	223.080	31	10	2.5	18.32
Shobak	9	122.304	22	10	1.8	10.05
Ail	10	122.928	20	10	1.6	10.1
Ma'an	9	243.360	44	10	3.6	19.99
Aqaba	4	–	–	–	–	–

is apparent when compared to the amounts of methane gas generated in Russaifa landfill.

In order to utilize solid waste for the production of biogas and electricity it is necessary to have large landfill sites to accumulate enough waste to produce biogas. For example, if three large landfill sites were constructed for the disposal of solid waste in the northern, central and southern regions of Jordan, there will be enough quantities of waste that will produce exploitable quantities of biogas. Tables 3 and 4 show the quantities of waste in the three regions and the quantities of methane gas generated per year for the year 2006 with a projection for the year 2030, in addition to the energy that can be produced.

VI Environmental Measures

6.1 Short Term Plan

- Closure of small, improperly sited, and random landfill sites;
- Banning of open burning of waste;
- Conduct landfill gas extraction tests in the biggest landfills in order to find out if they contain exploitable biogas quantities. And if so, utilize such quantities;
- Choose the best locations for the transfer stations.

6.2 Long Term Plan

- Establishing two sanitary landfill sites, with lining and leachate collection and biogas utilization systems, in the northern and southern regions. Al Ghabawi site will serve the central region;
- Establish transfer stations to cover the collection areas;
- Make use of international experts for the selection of proper locations for landfill sites and transfer stations taking into consideration all environmental and economic aspects;
- Privatizing the waste sector, partially or fully;
- Utilizing aerobic treatment and recycling in areas where biogas utilization is not feasible.

Table 3: Quantities of Waste in the Northern Region and Projection for the Year 2030

Landfill sites in the northern region	Total waste generated (Gg/yr)	Quantity of methane gas generated (Gg/year)	Total waste generated (Gg/yr) 2030	Quantity of methane gas generated (Gg/year) 2030	Energy produced 2030
Akaider	334	27	1,131	93	104 MWe
Mafraq (Huseniyat)					
North Badia					
Al Ruaished					
Al Azraq					
North Shuneh					

Table 4: Quantities of Waste in Southern Region and Projection for the Year 2030

Landfill sites in the southern region	Total waste generated (Gg / yr)	Quantity of methane gas generated (Gg /year)	Total waste generated (Gg / yr) 2030	Quantity of methane gas generated (Gg /year) 2030	Energy produced 2030
Karak	197	16	670	55	49 MWe
Ghour Mazra					
Ghour Safi					
Tafila					
Al Hussaineeh					
Shobak					
Ail					
Ma'an					
Alquairah					
Aqaba					

Common Reptiles of Abu Dhabi Emirate's Coastline and Offshore Islands

Pritpal S. Soorae
Associate Scientist
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Introduction

Walking along a beach on one of Abu Dhabi's islands, or along the coastline, it is common to see darting lizards among the beach litter. One wonders how these species can live under such harsh conditions but surprisingly a large variety of reptile species can be found on the islands and coastal habitats of the Emirate of Abu Dhabi. The most common form of reptiles found along the coastal habitats are the marine turtles, lizards, geckos, skinks, snakes and an amphisbaenid species.

I Marine Turtles

Marine turtles are large reptiles with carapaces to protect their internal organs and limbs modified into large flippers for traversing the tropical oceans. They only visit land to lay their eggs on sandy beaches. The two predominant species of sea turtles within Abu Dhabi Emirate are the Hawksbill (*Erethmochelys imbricata*, see photo below) and Green (*Chelonia mydas*). Occasionally, the Leatherback (*Dermochelys coriacea*), Olive Ridley (*Lepidochelys olivacea*) and Loggerhead (*Caretta caretta*) turtle species are recorded in UAE waters as evidenced by dead specimens and by-catch of deep-sea trawlers. Hawksbill Turtles are known to nest on over 15 islands within Abu Dhabi Emirate. On Jernain Island (N 24.925364°, E 052.85684°), there is a small-scale turtle head-starting program where Hawksbill turtles come to the sandy beaches to lay their eggs. During hatching about 20 percent of hatchlings are collected and reared in aquaculture facilities for about six months after which they are released back into the sea.

A Hawksbill turtle returning to sea after nesting, Jernain Island, Abu Dhabi ©-MERC

II Lizards

Lizards are usually four-legged reptiles with tails and which normally have external ear-openings and movable eyelids. The three commonly encountered species are the Spiny-tailed Lizard or *dhub* (*Uromastyx aegyptia microlepis*), Spotted Toad-headed Agama (*Phrynocephalus maculatus*) and the Short-nosed Sand Lizard (*Mesalina brevirostris*). The *dhub* is a large, mainly herbivorous lizard which lives in colonial burrows that it makes in sandy soil. *Dhubs* can normally be seen basking outside their burrows and if threatened will rapidly run and hide in their burrows. They are large lizards growing to about 60 cm in length. *Dhubs* are mainly under threat from development activities which can destroy their colonial burrows. Recently there have been attempts at translocating *dhubs* from the sites of many proposed development activities in the UAE, such as airport expansion projects, sites for new cities and coastal property development projects. This species is found in various places along the coastal areas and there is also a population on Marawah Island (N 24.300913°, E 53.284551°). The Short-nosed Sand Lizard is another very common species found along the coastline and islands. A small lizard which grows to about 12 cm in length, it is an active day-time hunter that chases insects. It has a brownish coloration which helps it blend into the sand and is usually found under beach litter. The Spotted Toad-headed Agama is a largish lizard which reaches over 40 cm in length and is recognized by its large toad-like head and brownish bars along its dorsal surface. This species will usually be encountered patiently waiting for suitable prey on a raised surface like a rock or some vegetation.

III Geckos

Geckos are small- to medium-sized lizards. What makes them different from lizards is their lack of moveable eyelids. Instead, they have a transparent membrane similar to a hard contact lens. They use their tongue to keep this membrane clean. Most geckos are superb climbers and have well-developed toe-pads that enable them to stick to vertical surfaces. Many gecko species are also nocturnal, that is, they are active at night time and usually can be seen near light bulbs trying to catch insects attracted by the light. The five commonly encountered species of geckos in coastal habitats are the Yellow-bellied House Gecko (*Hemidactylus flaviviridis*), Turkish Gecko (*Hemidactylus turcicus*), Rock Semaphore Gecko (*Pristurus rupestris*), Arabian or Baluch Desert Gecko (*Bunopus tuberculatus*, see photo) and Gulf Sand Gecko (*Stenodactylus khobarensis*).

The Yellow-bellied and Turkish Geckos are normally associated with human habitation and have been recorded in most areas along the coast and on islands where there is human presence and related infrastructure like buildings, oil installations, etc. A herpetological island survey recorded these two species on islands with a high human presence e.g. Arzanah (N 24.791378°, E 052.561383°), Jernain and Sir Bani Yas Islands (N 24.320425°, E 052.600950°). They were notably absent from islands with little or no human habitation. The Rock Semaphore Gecko is a small gecko (<10 cm) with half its body length being its tail. This is a species which has been recorded on two offshore islands Arzanah and Zirku (N 24.883274°, E 053.072456°) which are both oil-field islands and have large rocky outcrops. Their highly territorial behavior has enabled these species to be recorded on multiple visits to these islands where they have always been found in the same location in a wadi on Zirku Island and on some old buoy mooring chains on Arzanah. The Arabian Desert Gecko is one of the most commonly encountered ground gecko species found under beach litter both on islands and the coastline. This species is quite fast and agile and will rapidly move and hide under beach litter when disturbed. The Gulf Sand Gecko, on the other hand, is a very slow-moving gecko which is usually found on or near *sabkhas* (Arabic for 'salt flats'). They have largish heads and a small body which somehow gives them an emaciated look. They can be found around *sabkhas* on the coastline, usually under some litter. On Marawah Island in the

Arabian Desert Geckos on Muhyyamat Island, Abu Dhabi
© P. S. Soorae

winter months we found large numbers under wooden planks, the only cover available in a large area around a *sabkha*.

IV Skinks

Skinks are similar to true lizards but generally have no visible neck and have small or reduced limbs and glossy scales with thick tails. In April 2004, a skink was found on Jernain Island. Upon further identification it was found to be the Golden Skink (*Mabuya aurata septemtaeniata*), which was a first for the UAE where this species had not previously been recorded. This raised the number of skink species found within the UAE from five to six. Its location on Jernain Island is either part of its southernmost distribution range or it is an introduced population. The Ocellated Skink (*Chalcides ocellatus*) is the other species that is commonly seen and is more common in urbanized areas.

Jayakar's Sand Boa © P. S. Soorae

V Snakes

Snakes have scales and are usually without limbs (though some pythons possess vestigial hind limbs) and are elongated in physical structure. Snakes are found both in terrestrial and marine habitats. Snakes can be broadly divided into non-poisonous with normal fangs, semi-poisonous snakes which are usually back-fanged and poisonous snakes which are either front-fanged with small fixed front fangs (e.g. sea-snakes), or with large, moveable front-fangs (e.g. vipers). We have recorded a total of eight species of snakes on the islands and coastal belt of Abu Dhabi Emirate. The species are as follows.

- **Non-poisonous snakes:** Rat Snake (*Coluber ventromaculatus*), Diadem Snake (*Spalerosophis diadema*), Jayakar's Sand Boa (*Eryx jayakari*, see photo, below left).
- **Poisonous back-fanged snakes:** Schokari Sand Racer (*Psammophis schokari*).
- **Poisonous front-fanged snakes:** Saw-scaled Viper (*Echis carinatus*), Arabian Gulf Sea Snake (*Hydrophis lapemoides*), Yellow-bellied Sea Snake (*Pelamis platurus*) and Short Sea Snake (*Lapemis curtus*). The Rat Snake, Diadem Snake and Scholari Sand Racer have been recorded from Sir Bani Yas Island. The Arabian Sand Boa has been recorded both from Sir Bani Yas and Al Aryam Islands (N 24.283659°, E 054.149341°).

Sea snakes have been recorded at various offshore locations within the Arabian Gulf and along Abu Dhabi island. Though they spend most of their time in the sea, sluggish specimens are sometimes washed up on the beaches. These dead-looking specimens are capable of giving a fatal bite if handled. Therefore, it is important to not handle any sea-snakes that are found washed up on the beaches or the coastline.

VI Amphisbaenid

Amphisbaenid are limbless and look like large earthworms. Related to lizards and snakes, even their name Amphisbaena means a mythical serpent with a head at both ends. This is due to the head not being visibly distinct. The Zarudny's Worm Lizard (*Diplometon zarudnyi*) has been recorded along the Abu Dhabi coastline in sandy areas near the sea. They are secretive, spend most of their time burrowing underground, and thus are rarely seen. All the specimens we recorded were found under wooden planks and upon being disturbed they quickly burrowed into the sand.

Conclusion

We hope this general account of the interesting herpetofauna of Abu Dhabi's islands and coastline provides some useful information on the various species that can be found in our desert ecosystem and which contribute to the rich biodiversity of the region.

www.wwf.org
World Wide Fund for Nature

Established in 1961, WWF operates in more than 100 countries working for a future in which humans live in harmony with nature. WWF is one of the world's largest independent conservation organizations, with almost 5 million supporters and a global network active worldwide. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, promoting the reduction of pollution and wasteful consumption, and building concrete conservation solutions through a combination of field based projects, policy initiatives, capacity building and education work.

http://unfccc.int/2860.php
United Nations Framework Convention on Climate Change

The website of the secretariat of the United Nations Framework Convention on Climate Change is maintained to support arrangements for meetings organized under the Convention, to transmit official documents and reports, and to assist Parties in communicating other information related to the Convention; it also serves the Kyoto Protocol.The website is targeted primarily at people working in government who have policy or technical responsibilities related to the Climate Change Convention. Members of non-governmental organizations – be they environmental, business, or related to local-government – will find the latest information on what is happening. In addition, staff of United Nations and other international organizations, researchers, academics, and journalists will find a valuable information resource.

Heat: How to Stop the Planet from Burning

by George Monbiot
South End Press (April 2007)

With many politicians and scientists asserting that the Kyoto Protocol emissions levels cannot be met, should we abandon it for an "alternative solution"? George Monbiot says that's the wrong question. The proper query is: "Have we really tried?" Monbiot thinks not and lists numerous cases of inattention, indifference and downright dishonesty in why our society continues to pour greenhouse gases into the air we breathe. However, unlike so many viewing our climate situation with alarm, Monbiot is neither a "calamity howler" nor a hand-wringing commentator waiting for somebody else to set a good example. Instead, this book is a catalogue of solutions to the problem.

Source: www.amazon.com

Reactive Nitrogen in the Environment: Too Much or Too Little of a Good Thing

by UNEP 2007

This review examines the impacts of reactive nitrogen on the environment, human health and economies from local to global scales. About 40 percent of the human population depends upon food production made possible by synthetic nitrogen fertilizers. Combustion of fossil fuels adds more reactive nitrogen to air, water and soil. This distortion of the global nitrogen cycle, while raising agricultural yields, causes degradation of water and air quality, biodiversity, ecosystem services and human health. Meanwhile, reactive nitrogen deficiencies on farmland in many developing countries continue to create economic and health hardships, and accelerate land degradation.

Source: www.earthprint.com

Where the Land is Greener: Case Studies and Analysis of Soil and Water Conservation Initiatives Worldwide

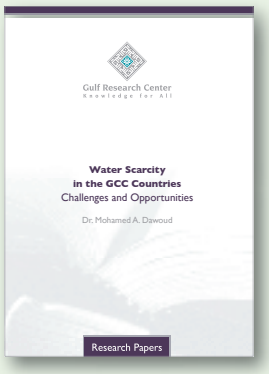
by EP Lib 2007

Where the Land is Greener looks at soil and water conservation from a global perspective. In total, 42 soil and water conservation technologies and 28 approaches are described – each on four pages with photographs, graphs and line drawings – from more than 20 countries around the world. This unique presentation of case studies is drawn from WOCAT's extensive database. These and many other experiences deserve to be documented, analyzed and used for decision support. The book is, furthermore, a prototype for national and regional compilations of sustainable land management practices.

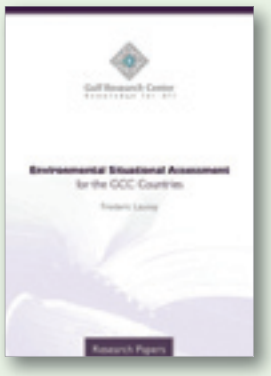
Source: www.earthprint.com

Green Gulf Report

Youth and Environment Research



Water Scarcity in the GCC Countries: Challenges and Opportunities



Environmental Situational Assessment for the GCC Countries

The Consequences of Climate Change on the GCC Countries and Mitigation Policies

(Language: Arabic)

Carrot and Stick: Environmental Policies of the GCC Countries

By Mohamed A. Raouf

There is no doubt that the planet today is suffering from negative environmental impacts as a result of different development activities. The GCC countries face numerous environmental challenges as they seek to deal with the many conflicting priorities relating to economic diversification, water supply and food security, and environmental conservation issues. However, most of these countries have a big advantage in that they are affluent and the funding possibilities available to them are significant and, therefore, choices on development paths are possible. It is now upto the decision-makers of the various GCC countries to develop environmental policies that will protect the environment and preserve resources for future generations.

There has been a significant increase in national commitments to environmental issues and sustainable development in the GCC countries. Environmental institutions have been given high priority and status. However, Economic Instruments (EI) have not been introduced yet in these countries.

The purpose of this research is to illustrate the role of market-based instruments or EIs in tackling different environmental problems. As a means of achieving environmental management objectives, non-economic regulatory measures have been adopted worldwide as well as in the Gulf region. However, in recent years, Economic Instruments are being increasingly implemented in many countries, both developed and developing.

This paper focuses on the two approaches adopted in environmental management policy: direct regulatory instruments approach, i.e. Command and Control (CAC), and the more recent market-based Economic Instruments (EI) approach. The EI approach should be of some relevance to GCC countries in their environmental policy formulation as, at present, these countries are proceeding with economic diversification, liberalization, and privatization. The paper also discusses the role of the principal environmental protection laws in each GCC country, multilateral environmental agreements, institutional setup, and civil society in relation to CAC and EIs.

State of Kuwait

Strategically located on the western side of the head of the Arabian Gulf, the 17,820 square kilometer State of Kuwait borders Iraq to the north and west and Saudi Arabia to the south. With some 499 km of coastline, its territory mainly consists of dry, flat or slightly undulating desert. This gives it no arable land, woodland or permanent crops, with only some 8 percent of its territory permanent pasture.

The climate is one of very hot summers and short, cool winters, with temperatures reaching an average high of around 38° C in August and 13° C in January; the highest recorded temperature is 51.5° C. Rainfall is scarce, averaging only around 26 rainy days per year and it varies from 75 to 150 millimeters a year across the country; actual rainfall has ranged from 25 millimeters a year to as much as 325 millimeters. However, sudden cloudbursts during the winter and spring months can bring heavy downpours.

Kuwait's wild plant-life is one of its unique natural heritages. Plants are adapted to survive in the harsh conditions and extreme temperatures. Unfortunately, they have suffered due to the intense pressure caused by grazing, collection of fuel, etc. Kuwait is home to numerous species of insects, animals and birds. Among the diverse insects the most attractive group is that of butterflies. Several beautiful varieties are found in the country and the best time to see them is spring.

A sad by-product of Kuwait's rapid growth and socio-economic development has been deterioration in the natural eco-systems. Prior to the discovery of oil there were natural checks and balances which protected the environment. Today things are no more the same.

I Environmental Resources

1.1 Water Resources

Desalinated seawater is the main water resource for potable water, besides low salinity brackish well water.

1.2 Natural Resources

Petroleum, fish, shrimp, natural gas.

1.3 Environmental Challenges

Limited natural fresh water resources (some of the world's largest and most sophisticated desalination facilities provide much of the water); air and water pollution; desertification.

Facts	
Official name	State of Kuwait
Capital	Kuwait City
Population	3.1 million
Location:	Middle East, bordering the Arabian Gulf, between Iraq and Saudi Arabia
Total area	17,820 km^2
Total land	17,820 km^2
Total water	Negligible
Length of coastline	499 km
Climate	Intensely hot and dry in summers; short, cool winters
Terrain	Flat to slightly undulating desert plain
Land use	Arable land: 0.73%; permanent crops: 0.11%; other: 99.16%
Irrigated land	130 km^2

Mountains of the World – Ecology, Conservation and Sustainable Development

Muscat, Sultanate of Oman
10 -14 February 2008

Centre for Environmental Studies and Research (CESAR) at Sultan Qaboos University in association with the Ministry of Regional Municipalities, Environment and Water Resources (MRMEWR) and Aquatic Ecosystem Health and Management Society (AEHMS) – Ecovision, North America is organizing this international conference. The themes covered by this conference are (1) Climate and Physical Environment (2) Biodiversity and Nature Conservation (3) Rangelands and Animal Resources (4) Water and Soil Resources and (5) Tourism and other Socioeconomic Issues. The conference language is English. Circulars and call for papers are now being sent. Participants interested in attending and presenting papers in oral or poster sessions should contact one of the two Secretariats listed below for full details as soon as possible.

All relevant information needed is also posted on the conference website: http://www.squ.edu.om/cesar/index.htm Abstract and registration forms could also be downloaded from here. Contact details:

1. **Centre for Environmental Studies and Research (CESAR)** Attention: Ms. Rahma Al-Siyabi, Sultan Qaboos University, P.O. Box 17, PC 123, Sultanate of Oman, Tel: + (968) 2414 1442, Fax: + (968) 2441 4012, Email: rsiyabi@squ.edu.om

2. **AEHMS – Ecovision** Attention: Ms. Jennifer Lorimer, Fisheries & Oceans Canada, Canada Centre for Inland Waters, 867 Lakeshore Road, P.O. Box 5050, Burlington, Ontario, Canada L7R 4A6, Tel: + 905-336-4867, Fax: +905-634-3516 or 336-6437, Email: LorimerJ@DFO-MPO.GC.CA

Gulf Research Center
Knowledge for All

UNEP

Kuwait has a serious water problem that can become a real crisis in the near future. The country's only natural water resource is 60 m3/y per capita of renewable water wells; while well extraction is 307 m3/y per capita. The absolute and normal water poverty lines are defined by 200 and 1000 m3/y per capita respectively. Desalinated seawater is the main water resource for potable water, besides low salinity brackish well water (7 percent of potable water). In 2002, the average daily water production (and consumption) was: 248 million imperial gallons (MIG) distilled water, 268 MIGD fresh water, and 70 MIGD brackish water. The water problem is due to many factors. One reason for failure to match the consumed water increase by a comparable desalination capability increase is the lack of steam turbines to combine with multi-stage flash (MSF) units.

1.4 Environment Agreements

The agencies concerned in Kuwait support regional and international conventions for the protection of the environment. Kuwait is party to the following conventions: Biodiversity, Climate Change, Desertification, Endangered Species, Environmental Modification, Hazardous Wastes, Law of the Sea, and Ozone Layer Protection.

II Environmental Authorities

- Environment Public Authority (EPA)
- Regional Organization for Protection of Marine Environment (ROPME)

2.1 Environmental Public Authority (EPA)

The Environment Public Authority (EPA) is the premier Kuwaiti organization working in the field of environment protection. The Authority was established in 1995. This law was later amended in 1996. According to this amendment, the authority consists of the High Council, which defines EPA's aims, objectives and policy. It is headed by the First Deputy Prime Minister and the foreign minister.

The responsibilities of the EPA are to:

- Prepare and apply public policy for the protection of the environment and prepare strategies and action plans to achieve sustainable development.
- Prepare and supervise the execution of the complete action plan relating to the protection of the environment. Control the activities, procedures and practices concerned with the protection of the environment.
- Identify pollutants and specify environmental criteria and standards and prepare regulations and systems for the protection of the environment.
- Prepare and participate in directing and supporting environmental research and studies.
- Identify the problems resulting from environmental pollution and deterioration with the assistance of the state agencies.
- Study and review the ratification of or accession to the regional or international conventions related to environmental protection.
- Prepare an integral action plan for training citizens on the ways and means of environmental protection
- Study environmental reports submitted to it relating to environmental conditions of the country.

III Impact of the Gulf War

The Gulf War demonstrated the manner in which natural resources could be manipulated as weapons of war. The Arabian Gulf's shallow and highly productive waters and the surrounding region suffered an unprecedented environmental onslaught, triggered by Iraq's invasion of Kuwait. Black slicks and toxic smoke from blazing oil wells combined to create one of the world's largest ecological catastrophes, severely affecting both people and wildlife. The war nearly pushed some species to the very edge of extinction.

The daily burning of three million barrels of crude oil created half a ton of air pollutants that filled the entire atmosphere. The heavy smoke even hid the sun. Evaporation of the spilled oil also added toxic chemicals in the atmosphere. The water cycle of Gulf was affected and the quantity of bacteria at the seashore level increased significantly causing great damage to availability of purified drinking water.

The fires also deposited a layer of soot over the desert and its plants. In places, everything was coated with an oil mist, while in others there were extensive oil slicks with a thick layer of crude oil lying across the soil.

In addition, the movement of huge military tanks, the digging of trenches by Iraqi troops, the bombardment, and even the subsequent movement of fire-fighting equipment into well areas, damaged the soil layer and affected its ability to sustain life in the desert. Plants and animals were crushed to death. Besides,

the extensive use of sea water in combating the oil fires led to increased salinity in areas close to wells which had been on fire.

The soil composition and porosity were also altered, both by the oil soot, mist and sludge resulting from the blow-out of the oil wells and by the earth movement. In a region, which has high incidences of dust storms, increased erosion had its own catastrophic consequences.

The War affected the desert in many ways, not all of them as immediately obvious as the towering infernos of the oil fires. Every form of life in the desert suffered. For instance, thousands of birds, especially migratory species such as herons, swallows and cormorants, were trapped by the shiny surface of the oil lakes, as were mammals.

The Kuwaiti desert still remains littered with hidden mines, which are being discovered even now. The oil lakes, created by flowing oil wells, have wreaked severe damage on soil, plants and underground reservoirs. The gallons of oil spilled in the Gulf, has already threatened the oceanic marine ecosystem.

For many years, the Kuwaiti government has supported environmental protection measures, and the damage caused by Iraq's invasion has only strengthened that resolve. Kuwaiti initiatives have been supported by entities such as the Kuwaiti Institute for Scientific Research (KISR), and the Gulf Regional Organization for the Protection of the Marine Environment, headquartered in Kuwait.

International Day for Biological Diversity: Biodiversity and Climate Change

May 22, 2007

I Historical Background

The United Nations has proclaimed May 22, the International Day for Biological Diversity, to increase understanding and awareness of biodiversity issues. Biodiversity is the source of the essential goods and ecological services that constitute the source of life for all. The celebration each year of the International Day for Biological Diversity is an occasion to reflect on our responsibility to safeguard this precious heritage for future generations.

Themes of Previous International Days for Biological Diversity

Year	Theme
2006	Protecting Biodiversity in Dry Lands
2005	Life Insurance for our Changing World
2004	Food, Water and Health for All
2003	Biodiversity and Poverty Alleviation - Challenges for Sustainable Development
2002	Forest Biodiversity

II What Is the Importance of Celebrating the Day of International Biological Diversity (IBD)?

While awareness of Biodiversity issues should never be far from our thoughts, the fact of concentrating public awareness efforts on a single date enables the Convention of Biological Diversity (CBD) to focus attention on biodiversity issues and the goals of the Convention around the world at a single time.

III What Happens on International Biodiversity Day?

On an international level, National Focal Points are invited to give consideration to participation in an ongoing global celebration of CBD's 10th anniversary whereby schools and/or community-based organizations might celebrate IBD by selecting and exchanging messages with a partner school or community in another country, with a view to identifying and implementing a joint biodiversity-related undertaking within the context of the national priority biodiversity-related projects and programs.

IV Expected Activities

- Organizing exhibits, accompanied by presentations and documents, emphasizing the importance of Biodiversity to the surrounding region. Offering free access for the day, or special admission fees to teachers, students and community groups.
- Designating the IBD 2006 theme "Protect Biodiversity in Drylands," for adoption in natural history and science museums for the period surrounding May 22, accompanied by special exhibits or special events.
- Creating a "Biodiversity Garden" or park.
- Promoting Biodiversity and the theme as the subject for exhibits, lectures, and presentations in science museums.
- Introducing a program of consultation on Local Biodiversity Action Plans (LBAPs) to stimulate effective local action for priorities identified in the national Biodiversity Action Plan, as well as for species and habitats which are particularly cherished or valued in local areas.
- In cooperation with local or national media, organizing contests in one or more categories, such as essay, photography, art, website and poster design, dance or drama; and organizing cooperative ventures with media, on-line discussions or workshops for schools, community groups and/or the public to illustrate the IBD theme.

V Biodiversity and Climate Change

5.1 May 22, 2007

This complements the designation of 2007 as the International Polar Year and coincides with UNEP'S World Environment Day theme of Climate Change. Lectures, seminars, film presentations, cultural events, exhibitions and school outreach activities are just some suggestions for programs that may be

implemented to help draw attention to one of the most critical issues facing our planet today.

5.2 Facing Climate Change

Since the mid-1800s global temperatures have increased by about 0.6°C, impacting the entire world, from low-lying islands in the tropics to the vast Polar Regions. During the last century:

- the largest glacier on Mount Kenya has lost 92 percent of its mass
- sea levels have risen by 10-25 cm
- the thickness of sea ice in the Arctic has decreased by 40 percent

Current climate change predictions are not encouraging; they estimate further increases in temperatures of 1.4°C to 5.8°C by 2100. Predicted impacts from a temperature increase of only 2.5°C include:

- 210 million more people at risk from malaria
- up to 3.1 billion more people suffering from water scarcity
- 50 million more people facing hunger.

Even if all human sources of greenhouse gas emissions are stopped immediately, the impacts of climate change would continue for 50 years.

VI The New Great Threat to Biodiversity

Climate change is already forcing biodiversity to adapt either through shifting habitat, changing life cycles, or the development of new physical traits. Impacts already observed include:

- Coral bleaching, caused by increased sea temperatures, is causing die-offs amongst coral reef communities from Australia to the Caribbean.
- The Common Murre has advanced breeding by 24 days per decade over the past 50 years in response to higher temperatures.
- The Baltimore oriole is shifting northward and may soon disappear entirely from the Baltimore area.
- Polar bear populations are coming under threat as food becomes harder to hunt.

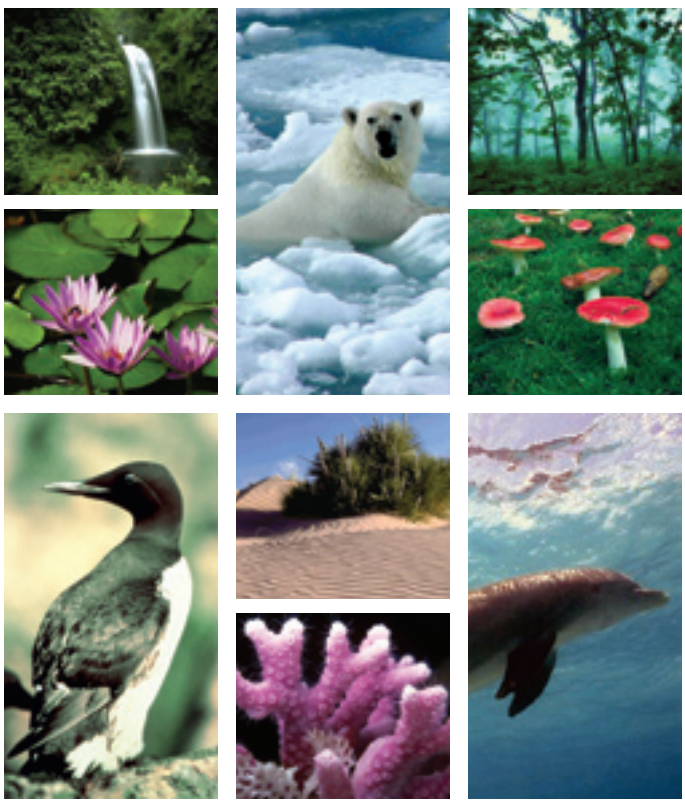
Other species will face more unusual challenges. The sex of sea turtle hatchlings, for example, is temperature dependent with warmer temperatures increasing the number of female sea turtles at the expense of males.

Those species that are unable to adapt are facing extinction. In fact, predictions estimate that up to 1 million species may become extinct as a result of climate change including Boyd's forest dragon and Brazil's Virola sebifera tree. The recently extinct Golden Toad and Gastric Brooding Frog have already been labeled as the first victims of climate change.

VII Right Response

Given the importance of climate change-biodiversity links, it is important to:

- conserve biodiversity that is especially sensitive to climate change
- preserve habitats so as to facilitate the long-term adaptation of biodiversity
- improve our understanding of climate change-biodiversity linkages
- fully integrate biodiversity considerations into mitigation and adaptation plans



Executive Learning Program on Sustainable Management of Renewable Resources

In view of the high importance of sustainable management of renewable resources in arid lands throughout the Arabian Gulf region, the Gulf Research Center (GRC), Dubai, UAE and the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD), Damascus, Syria organized a training program in Arabic on the subject. The program titled "Toward Sustainable Management of Renewable Resources in Arid Lands" was held from April 5-16, 2007 in Syria.

This was a pioneering program which included state-of-the-art lectures, case studies and field visits, as well as a workshop. The lectures were delivered by a group of experts from the various departments of ACSAD.

The program covered issues such as: management and use of different types of water, protection of wildlife and biodiversity, use of remote sensing to monitor land degradation, rehabilitation of degraded areas, protected areas management and combating desertification. It also included field visits to a protected area, a research center for agriculture and water resources, and a combating desertification project.

An interesting workshop was held towards the end of the program where the main topic of discussion was "Is man managing the environment or vice-versa?" In this context, environmental, economic, and political issues relating to Sudan were taken up for discussion as a case study.

I Participants

- Aly bin Naser bin Mohamed Al-Rasbi, Head of Plants and Animals Section at the Regional Municipalities, Environment and Water Resources in the Sultanate of Oman.
- Adel Mohamed Zaini Qasti, Natural Resources Manager, Metrology, KSA.
- Manal Mohamed Mubarak Aldelimy, Head of Protected Areas Section, Environment Protection Agency, Kuwait.
- Lina Abdel Rahman Al-Awady, Biodiversity Specialist, Environment Protection Agency, Kuwait.
- Abdel Rahim Loulu, Land Use Department, ACSAD, Syria.
- Mohamed A Raouf, Senior Environment Researcher, Gulf Research Center, Dubai.

II Program Outline

2.1 Lectures

- Integrated water resources management with case studies
- Managing waterfalls
- Water harvesting techniques
- Using different kinds of water in agriculture
- The United Nations Convention on Biological Diversity
- The environmental and economic importance of palm trees
- Livestock status and importance in the Arab world
- Development of Hamad Area between Iraq, Jordan and KSA
- GIS and remote sensing to monitor land degradation
- Land degradation issues
- United Nations Convention to Combat Desertification
- Rehabilitation of agriculture in the mountain areas
- Rehabilitation of grazing areas

Taking a close look at a biogas unit

2.2 Visits

- Alzabadany River basin west of Damascus.
- Talelah Protected Area.
- Metrological center in Tadmor.

2.3 Workshop

The program also included a workshop and discussion on a case study of rehabilitation of the Kurdifan area.

III Environment Forum: Participants' Views

Manal Al-Deliemi

"This forum organized by the Gulf Research Center in cooperation with the Arab Center for the Studies of Arid Zones and Drylands (ACSAD) is a positive step because not only did it shed light on GRC and its activities, but it was highly educational too. Lectures were presented by a distinguished group of Arab scientists. We enjoyed the field visits during which we were briefed on the state-of-the-art techniques in crop cultivation, irrigation systems and cattle breeding. During our visits to the desert, we were introduced to pioneering experiments in developing water resources as well as the flora and fauna of the desert."

Lina Al-Awad

"The forum provided us with a lot of information especially about the Biodiversity Convention and its application in Kuwait as well as other practical information which we will try to implement in our field of work."

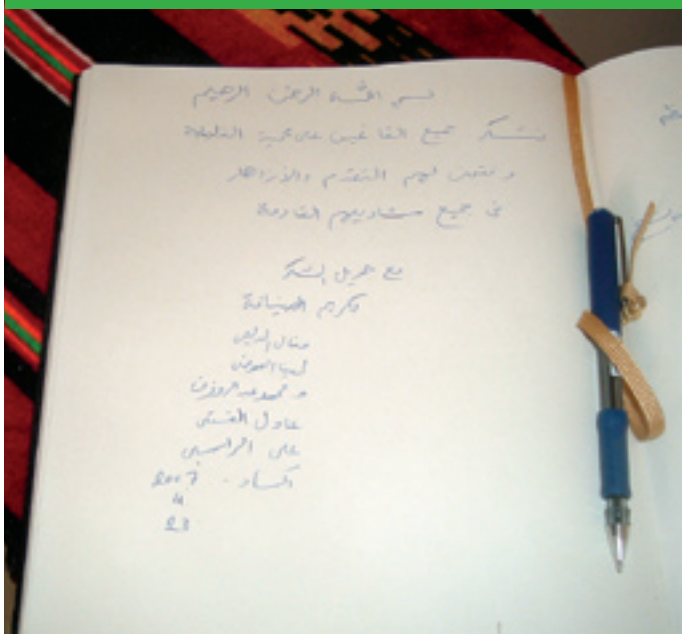
Ali Al-Rasi

"This forum has provided us with an excellent opportunity to familiarize ourselves with the experience gained by ACSAD and GRC. All Arab countries can benefit from this experience. I would like to stress the need for the establishment of a genetic bank to preserve the biodiversity of the Arab world."

Adel Qesti

"I believe that this forum was useful for specialists in the field of combating desertification and agriculture engineers. Lectures provided information on how comprehensive environment management can help sustainable development. Other topics such as environmental contamination and the need to preserve and develop natural resources through people's participation via civil society should be included in future forums."

A thank you note to the Talelah Protected Area staff



Participants with ACSAD Vice Chairman, Training Manager and GRC Environment Manager

Visitors

June 19, 2007

Nathali Fustier, chief executive officer of International Decision, a non-profit think tank based in France, exchanged ideas about sustainable development in the Gulf region.

May 30, 2007

A delegation from the European Parliament responsible for relations with the Gulf States, including Yemen, was briefed by the GRC research team. The delegation was led by Bernard Savage, Head of the EU Delegation Office in Riyadh, and Lilli Gruber from Italy, Chair of the Committee in the Parliament. Other members of the delegation included Tobias Pluger of Germany (vice-chairman of the committee); Ms. Roberta Anastase and Mr. Eugen Mihaescu from Romania; and Mr. Patrick Louis from France.

May 24, 2007

A group of 10 students from the American University in Washington, D.C., accompanied by Dr. Isa Blumi of Georgia State University, was briefed about current regional issues and different environmental problems facing the region.

May 1, 2007

Dheeraj Chhabra, Manager, Dubai Industrial City/Business Development, and Vimal Kumar Jaiswal, Manager (Standards), Maqayees, Dubai Centre for Industrial Standards, discussed future cooperation in environmental training, climate change and carbon trading issues as well as consultation possibilities with GRC.

Jeffrey Black, green energy analyst and journalist, exchanged ideas about the future of green energy and related environment issues in the UAE.

Participation

June 5, 2007

Presented a paper at the "Middle East Waste and Water Congress." This event was organized by Marcus Evans in Dubai. The presentation titled "Effectively Managing GCC Waste through the Fortification of Market-Based Instruments" focused on the trends in waste generation, collection, disposal and their negative impacts. It introduced and highlighted the importance of using market-based instruments for better management of solid waste.

Internship

Shirin Samadpour is a 3rd year student at American University of Sharjah (AUS), majoring in Chemistry and Analysis of Environmental Science and minoring in Psychology. She has been working in the only Psychology laboratory located in AUS as a research assistant. In GRC she was actively involved in various research activities in the GCC Environment program under the supervision of Dr. Mohammed Raouf. Shirin believes her internship was a very rewarding experience and it will help her in achieving her desired career goals.

Based in Dubai, UAE, the Gulf Research Center (GRC) began its activity in 2000 as a privately-funded, non-partisan think tank, education provider and consultancy specializing in the Gulf region. The GRC produces recognized research from a Gulf perspective, redressing the current imbalance in Gulf area studies, where regional opinions and interests are underrepresented.

The GRC believes that the Gulf Cooperation Council has transcended the initial reasons for its establishment, to become a fundamental right of its citizens in the development of the region. The GRC seeks to further this belief by being an institution of distinction and innovative research that advances different aspects of development to ultimately benefit the people of the region.

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