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Research Bulletin
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The Arab Gulf States are leaders in hydrocarbon production and most of the world's hydrocarbon supply comes from this relatively small area. However, due to a combination of economic, environmental and political factors there has been a noticeable shift towards alternative energy as far as these states are concerned. In the 3rd OPEC summit, $450 million was pledged for research in alternative and renewable energy sources.

Gulf States have undertaken several alternative energy projects. These projects include but are not limited to: solar energy for heating, cooling and power generation; wind energy for power generation and pumping; waste to energy conversions and much more. The Gulf States' focus on alternative energy will lead to more research and development, impact the issue of climate change and allow these states to play a vital role in the emissions trading market.

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مركز الخليج للأبحاث
المعرفة للجميع

بعد النجاح الذي حققه في العام السابق:
يدعو مركز الخليج للأبحاث بالتعاون مع المركز العربي لدراسات المناطق الجافة والأراضي القاحلة (أكساد) إلى المشاركة في

البرنامج التدريبي الثاني

نحو إدارة مستدامة للموارد الطبيعية

محاور البرنامج:

- نظم دعم القرار في الإدارة المتكاملة للموارد المائية
- إدارة المساقط المائية وحصاد المياه
- صيانة التنوع الحيوي وحمايته
- الحزم المتكاملة لإعادة تأهيل المناطق المتدهورة
- حلقة دراسية
- استخدام تقنيات الاستشعار عن بعد في مراقبة تدهور الأراضي
- استعمالات المياه متعددة النوعية في الزراعة
- زيارات لمنطقة حوض الزبداني ومنابع نهر بردي ومحمية التليلة ومحطة تغيرات مناخية ومنطقة تدمر

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نحو إدارة مستدامة للموارد الطبيعية

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Editorial Policy

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A Lead-Free Life

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Introduction

If you drive from Abu Dhabi to Dubai and back, you will have driven for more than 500 kilometers. It might not occur to you that during the journey, your car, provided its engine is in a good condition, has pumped more than 105 kg of pollutants including 30 kg of carbon dioxide, which is not only hazardous to human beings, but is also the main factor behind global warming. Your trip has also produced 2.9 kg of unburned hydrogenized colas, 1.1 kg of nitrogen oxides, 0.24 kg of lead and 70 kg of Benzo pyrene. All these components are harmful to human health and some of them are cancerous. You may argue that the total amount of fuel consumed during the 500 km trip does not exceed 30 kg (about 40 liters), so where do the 105 kg of pollutants come from?

The answer is quite simple: every one kg of fuel needs 14.7 kg of air to burn. You may also say that 0.245kg of lead is not really a big quantity. But the truth is that this quantity is not only big but a matter of concern too. If you take this amount and divide it into 350 parts and one of them reaches the blood of a child, it will put his life at risk. But if 10 parts find a way into the blood of this child, he will become slow-minded and a slow learner too. More parts would render him blind and deaf or force him to live with kidney and heart problems for the rest of his life. You should take into consideration that we are only talking about your trip. If you take the time to calculate the number of cars that make the same trip, you will be shocked. This has motivated me to write about the adverse effects of lead pollution on health and highlight the important role of the concerned authorities in trying to reduce this pollution for the general good of the people. Fresh natural air is essential for all living things. It is the main component of the stratosphere which protects our planet. But because of industrial developments and population growth, the air has become polluted by harmful gases such as carbon monoxide, Volatile Organic Compounds, Nitrogen Oxides, and Carbon Dioxide in addition to poisonous lead components from car exhausts.

An individual inhales about 13 kg of air per day and needs between 2-3 liters of water and about 1 kg of food. While man can survive without food or water for days, he cannot live without air for more than a few minutes regardless of the quality of the available air.

Where Does Lead Come from and How Does It Reach Our Bodies?

Leaded fuel is responsible for more than 90 percent of the lead scattered in the air, while the remaining 10 percent comes from other sources such as paints, cosmetics, the ink used in printing newspapers and magazines, pencils, insecticides and petrol derivatives. The most dangerous of all is the paint used in children's plastic toys which contains a high percentage of lead and cadmium. Lead is also used in manufacturing many electronic devices.

After fuel combustion in the engine, 20-30 percent of the lead sticks to the exhaust and the rest is scattered in the air. The diameter of the gas particle ranges between 0.01 and 0.7 microns. Light particles remain afloat in the air and enter the body through the respiratory system, while bigger particles remain in the soil for a very long period of time. Children are more likely to inhale lead from the air or absorb it from the soil simply because they are more exposed to the soil and they need much more air than adults. Seafood is also considered one of the main sources of the lead that finds its way into our bodies, because it is polluted by oil leaking from tankers in areas like the Arabian Gulf, where the percentage of pollution is one of the highest in the world, because it is a closed sea and the volume of production and exports is large.

Effects of Lead on Public Health

The harmful effect of lead on the health of both children and adults is already an established fact. A study conducted by the Environment Agency in Abu Dhabi proved that there is a strong

link between the percentage of lead in the hair and its storage in the bones that causes the following:

- Headache accompanied by acute muscle spasms.
- Extra secretion of Bulic Acid and its accumulation in joints and kidneys.
- Reduction in the amount of hemoglobin which results in anemia and weak lymph nodes. It also accumulates in bone tissues at the expense of calcium.
- Insomnia, nightmares and stress.
- Lack of concentration in children. It might cause mental retardation too.
- Accumulation of lead in embryonic layers may lead to embryonic mutations and abortions.

Key Facts

- When a car travels for 100 km, it consumes the same amount of oxygen as a human being needs in a whole year.
- A light vehicle consumes 100 times more oxygen than man.
- If a car travels for 500 km, it produces 105 kg of pollutants.
- The maximum amount of lead allowed in water is 0.05 ml gram per liter.
- In January 2003, the UAE introduced lead-free fuel in the country; this was a very welcome achievement.
- Clean air means clean environment, and a clean enviroment means good health for us and for future generations.
- Forty percent of the space around residential buildings, 50 percent of the areas around schools and universities,60 percent around hospitals and 70 percent around resorts should be green areas.
- In dense forests, each square km produces about 350 kg of water vapor per day.
- Each kg of fuel needs 14.7 kg of air to burn.
- The amount of lead brought to the environment from natural resources annually is estimated at 24,700 tons. But the amount of lead generated because of human activities is estimated at about 450,000 tons, of which about 60 percent is a result of leaded fuel combustion.

What You Can Do

- Use public transportation whenever possible.
- Use lead-free fuel.
- Maintain your car in good condition.
- Avoid driving during rush hour.
- Use your bike or walk whenever you can.
- Do not use newspapers or magazines to wrap food stuff or to absorb excess oil after frying vegetables.

Recommendations

- Reduce the emission of air pollutants.
- Endorse laws and regulations that will reduce air pollution.
- Good urban and environmental planning.
- Regularly monitor air pollutants.
- Strict control and supervision of industrial facilities and other sources of pollution.
- Proper disposal of garbage.
- Extend parks and plant more trees inside and out side cities.
- Enhance environment awareness among individuals and encourage them to cooperate with municipalities.
- Environmental education is crucial to help reduce the adverse effects of pollution. This eduction should enhance awareness, knowledge, skills and participation.
- Reduce traffic jams.

Greening the Gulf Region with Native Plants: An Eco-friendly Experiment in Saudi Arabia

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The Gulf region is graced with one of the most fascinating ecological frameworks, including a most spectacular spectrum of the underwater world and amazing desert species. However, not much is being done to preserve these treasures for the future generation (Ishaque 2007).

Land degradation, loss of biodiversity and desertification are among the most important environmental concerns in the region. Extensive farming, overgrazing, off-road driving and recreational activities have accelerated the desertification process.

Potable water is scarce in the GCC countries because of scanty rainfall, high rate of evapotranspiration and extremely high consumption ranging between 300-750 liters per person per day (Datt and Nischal 2006).

Saudi Arabia comprises a major part of the Arabian Peninsula, covering 2,250,000 km^2 and represents four-fifth of the region (Chaudhary 1999). It lies between 15^o 45' and 34 ^{o} 34' North latitude and 34^o 40' and 55^o 45' East longitude. Latitude-wise, Saudi Arabia is part of a desert zone containing the great Sahara in the west and Sind desert in the east. The vast landscape is composed of a variety of habitats such as sandy and rocky deserts, mountains, valleys, salt pans and lava areas. About 30 percent of the Arabian Peninsula is covered with sand dunes. Climate is characterized by cloudless days, with low relative humidity and high evaporation rates.

Proximity of the area to the equator coupled with the tropical arid location cause diurnal and seasonal variations of temperature (Al-Khalifah and Shanavaskhan 2005). Rainfall is expected occasionally, with winter generally being the wet season.

During cooler months, the cyclonic depression that originates in the Atlantic or Mediterranean Sea, results in some sporadic rains in the Northern regions. During hot months, the area is dominated by dry wind with no rainfall expected. Annual precipitation is very low, less than 150 mm.

Floristically, Saudi Arabia is one of the poorest countries of the phytogeographical zone of the Middle East in terms of species diversity and endemism, except the south-western highlands which harbor different types of vegetation and climatic conditions. The extra arid tropical regions and fluctuating climates are factors contributing to sparse vegetation. Demand for green areas is increasing in Saudi Arabia (Okawara et al. 2003) and people in the region are looking for suitable plant species that will perform well in the harsh environmental conditions and provide shade which would lower the heating effects of the high radiation intensity that is associated with the sunny climate of the desert.

Drylands accommodate over 2 billion people, representing nearly 35 percent of the world population, living in rural areas and urban centers of some 100 countries. In many of these areas, the destruction of the indigenous vegetation has led to rapid expansion of desertification.

The cause of destruction of this indispensable sand-fixing vegetation cover is overuse caused by growing demand for livestock feed and fuel. To prevent land degradation, while meeting the people's demand for fuel wood and fodder, the vegetation consisting of indigenous species must be regenerated and maintained.

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Table 1. List of Exotic Species Planted in Saudi Arabia for the Greening Programs

Sl.No.	Scientific name	Arabic name	Habit	Nativity
1	Albizzia lebbeck (L.) Benth.	Leback	Tree	Tropical Asia
2	Aloe vera (L.) Burm.f.	Sabbar	Succulent herb	North Africa
3	Alternanthera sessilis (L.) DC	Varag shai	Small herb	Tropics and subtropics
4	Atriplex nummularia L.	Betrix	Shrub	Australia
5	Azadirachta indica L.	Neem	Tree	India, Burma
6	Bougainvillea spectabilis L.	Jahannamiya	Straggling shrub	South America
7	Carissa macrocarpa (Eckl.)A.DC.	Karissa	Shrub	Tropical Africa, Asia
8	Casuarina equisetifolia L.	Kasurina	Tree	Australia, Hawaii
9	Celosia argentae	Urfuddique	Herb	Tropics
10	Clerodendrum inerme (L.)Gaert.	Jasmin zyphr	Shrub	India
11	Conocarpus lancifolius Engl.	Konocarpus	Tree	North Eastern Africa
12	Dodonaea viscosa (l.)Jacq.	Dodonia (Shate)	Shrub	Cosmopolitan
13	Eucalyptus camaldulensis Dehnh.	Kene, Kafur	Tree	Australia
14	Euphorbia tirucalli L.	Uphorbia	Small tree	Semi-arid tropics
15	Ficus benjamina L.	Teen zena	Tree	Asia, Australia
16	Gazania heterochaeta DC	Jazania	Prostrate herb	South Africa
17	Hibiscus rosa-sinensis L.	Hibiscus	Shrub	East Asia
18	Ipomoaea pescapre (L.) R.Br.	Dabbayya	Climbing shrub	Seashores of tropical Oceans
19	Lantana camara L	Lantana	Shrub	Tropical America and Africa
20	Ocimum basilicum l.	Reyhan	Herb	Asia
21	Olea europaeae L.	Zeytoon	Shrub	Mediterranean region
22	Opuntia ficus-indica (L.) Miller.	Pershume	Succulent shrub	India
23	Parkinsonia aculeata L.	Parkinsonia	Tree	North and South America
24	Pennisetum setaceum (Forssk.) Chiov.	Pennisetum	Herb	North Africa
25	Petunia hybrids	Petunia	Herb	South America
26	Pithecellobium dulce (Roxb.)Benth.	Los hindi	Tree	Mexico
27	Plumeria rubra L.	Jasmin hindi	Tree	Tropical America
28	Prosopis juliflora (SW)DC	Prosobis	Tree	North & South America
30	Sansevieria roxburghiana Schultes & Schultes f.	Jildemar	Succulent herb	Old world tropics
31	Tamarindus indica L	Tamar hindi	Tree	East Africa
33	Tecoma stans (L.) Juss. Ex Kunth	Tekoma	Small tree	South and Central America
34	Thevetia peruviana (Pers.) K.Schum	Thefeetia	Shrub	Tropical America
35	Washingtonia filifera (Lindl.) H.Wendl.	Nakheel mur-wahy	Tree	America
36	Sphagneticola trilobata (L.C. Rich.) Pruski = Wedelia trilobata	Sherania	Prostrate herb	Central America
37	Paliurus spina-christi Mill. =Ziziphus spina-christi	Sidr	Tree	Mediterranean region
38	Sesuvium portulacastrum (L.) L.	Hay alam	Prostrate herb	North America

Table 2.Threatened Plants of Saudi Arabia			
Sl.NO	**Scientific Name**	**Common Name**	**Status**
1	Catha edulis (Vahl.) Forssk. Ex Endl.	Qat (A)	Lower risk/least concerned
2	Dracaena ombet Kotschy& Peyr.	Dracena (A)	Endangered
3	Dracaena serrulata Bak.	Airoub (A-Oman)	Endangered
4	Euphorbia ammak Schweinf.	Euforbia (A)	Vulnerable
5	Juniperus phoenicea L.	Arayar (A)	Lower risk/least concerned
6	Juniperus procera Hochst. ex.Endl.	African pencil cedar (E) Arar (A)	Lower risk/near threatened.

Local multipurpose shrubs are important natural resources which help people in arid lands to combat their major problems of shortage of food, fodder, fuel and various problems related to the harsh environmental conditions (Deborah and Eckman 1993). They ameliorate the microclimate by reducing the temperature and potential evapotranspiration.

Many such plants restore and improve soil fertility, stabilize moving sands, and prevent the spread of drought and desertification. Over the past few decades, increasing emphasis has been placed on promoting fast growing multipurpose species that produce fuel-wood, timber, fodder, and other forest byproducts, besides stabilizing sand dunes and improving the environment.

However, much of the emphasis on multipurpose trees has focused on exotic species because their silviculture and propagation know-how is well known. The authors have enumerated the exotic plant species that have been used in the greening activities of Saudi Arabia for the last few decades in Table 1.

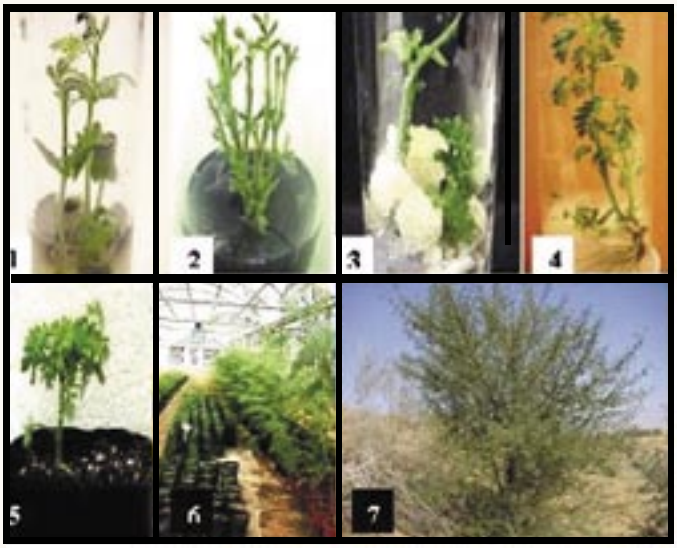
At the same time, people continue to use indigenous species for their various needs and many populations of these natural species face heavy pressure due to intensive grazing and illicit cutting. There is an urgent need to find easy methods of propagating and regenerating natural plants to ensure the sustainability of indigenous species.

Table 3. Flower Color and Fruiting Time of 10 Indigenous Species			
Scientific Name	**Arabic Name**	**Fruiting Time**	**Flower Color**
Haloxylon persicum	Ghada	November	White
Calligonum comosum	Ertaa	April	White with green nerves
Acacia tortiis	Samar	July	Creamy white
Acacia ehrenbergiana	Salam	June	Bright yellow
Acacia seyal	Seyal	April	Golden yellow
Acacia nilotica	Garadh	July	Golden yellow
Acacia farnesiana	Fotnah	May	Golden yellow
Acacia mellifera	Kitr	April-May	Creamy white
Fidherbia albida	Haraz	April-May	White spikes
Acacia gerrardii	Thalh	June	Creamy white

These plants grow in a harsh environment, fix sand dunes, improve the environment, and provide local populations with fuel and fodder. In the arid and semi-arid regions with increasing desertification fears, sustainable development becomes the most important issue. Sustainability is partly a question of technologies or techniques, which must be supported by appropriate policies that reflect the socio-economic needs of the society (Witig 2003).

As part of the continuing greening programs in Saudi Arabia, the first author decided to explore the possibility of raising indigenous multipurpose firewood trees as an eco-friendly substitute to the widely used exotic species.

Fig.1. In vitro regeneration of Acacia tortilis: (1) Seed germination, (2) Multiple shoot induction, (3) Induction of callus and shoot, (4) Rooting stage, (5) In vitro derived potted plant, (6) Plants in the nursery, (7) Plant in the field



Invaluable Trees

At one time, much of the land area was covered by trees. These ancient forests had an important effect on the climate which influenced the evolution of other flora and fauna. Trees are the tallest, most massive, longest-living organisms ever to grow on earth.

The wonder and the mystery of trees is such that they have an important place in religion, myth, folklore, superstition and story telling; as a consequence, the tree has been a powerful cultural symbol in many societies from primitive times to the present.

A mature tree offers many goods and services to the human beings. It provides shelter, food, furniture, medicines, firewood, charcoal, tannins, resins, dyes, fodder and so on.

Most of the valuable furniture and carvings which decorate our home are the gift of trees. In addition to these, trees help the environment. Besides having aesthetic value, trees provide shade, nesting space for birds, release oxygen, prevent soil erosion, air and sound pollution, and enrich the soil water column.

Rainwater is able to penetrate in to the sub-soil by passing down the sides of tree roots. Through transpiration a mature tree brings back about 1,000 gallons of water in to the atmosphere from deep soil. The roots and mulches provided by the trees help the soil from washing away during heavy rain. A live hedge, which allows 40 percent permeability to moving air, is always superior to a concrete wall or fence.

Solid barriers not only tend to break or blow down in high wind conditions, they themselves cause disturbances in the air flow and at ground level, which can extend upwards to disturb the surface wind. In the GCC countries, where the dust winds are a serious problem, concrete walls add to the problem. If we replace the concrete walls with hedges, at least to a small extent it can be prevented. Considering the immense contribution of trees in our lives, the responsibility is on us protect our existing indigenous trees and plant maximum to number of trees.

To achieve this goal a thorough knowledge of trees which can be planted in our surroundings is needed. There are about 70 species of plants (trees and shrubs) in Saudi Arabia. The natural tree forms of Saudi Arabia are adapted to the country's two climatic extremes. Among the genera contributing tree forms to Saudi vegetation Acacia occupies first position followed by Ficus, Phoenix, Commiphora, Cordia, Ziziphus, Juniperus etc.

Fig.2. Field evaluation 1. Plants in the Bukayriah Municipality plantation site

Fig.3. Field evaluation 2. Ghada plants in Al-Qassim research station

Mimusops laurifolia forms the largest evergreen tree form and all others are small in size when compared to the other trees of tropical evergreen forests. The IUCN Red list of threatened species has enlisted six plant species out of which two are endangered and one vulnerable (Table 2). The selected species include indigenous and some widely naturalized exotic species, whose leaves are smaller with low transpiration rate and which consume little water for sustenance. For the sandy areas, two indigenous psammophytes with high economic potential and for the wadi areas with clayey soil, Acacias were selected.

Implementation of the Program

Flowering and fruiting time of the selected species were carefully observed in their natural habitats (Table 3). Fruits were collected during the peak fruiting time using appropriate collection techniques. Seeds were separated from the fruits, cleaned and stored in a refrigerator. To facilitate easy germination, seeds were subjected to different scarification techniques (Table 4). Using simple and easy methods, seedlings were raised in large quantities and nurtured in the nurseries. As an alternative technique to raise true-to-type genotypes, tissue culture protocols were also developed for the selected species. For a pictorial representation of the developmental stages of in vitro culture of Acacias, see Fig 1. To evaluate the growth response of these plants in different type of soils, multi-location trials were conducted throughout the central part of Saudi Arabia. Municipalities of the Kingdom of Saudi Arabia are performing remarkable services in the greening process throughout the country by planting and maintaining garden and avenue plants.

The infrastructure facilities and manpower available with them have helped to solve many problems associated with planting operations. For the implementation of the multipurpose, indigenous tree plantation program municipalities of the Al-Qassim province were effectively utilized.

A wild plant conservatory of 200 km^2 area developed by the Agriculture department at Zilfi actively participated in this program. Along with planting instructions, thousands of plants were distributed to nine municipalities in the Qassim region.

A feedback form was also supplied to them for recording the performance of these seedlings in their respective areas. All the acacia species planted in the clayey soil showed promising growth (Fig 1) and the two psammophilous species 'Ertaa' and 'Ghada' performed well in the deep sandy areas (Figs. 2&3) with minimum irrigation.

All the selected species of this program had reduced leaves or very small leaves, which prevent excessive transpiration and therefore consume little water, and therefore are regarded as eco-friendly in the water scarce desert environment. The active participation of people and local bodies in this program encouraged the bringing of more and more indigenous plant species for further study and enabled us to conserve the local biodiversity through people's participation.

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Renewable Energy in the Arab Gulf States: Current Situation and Prospects

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The countries of the Arabian Gulf have always been leading hydrocarbon producers. According to Richard Price of www.energyme.com, "There are 114 active power generation projects of all types in the Gulf Cooperation Council (GCC) countries of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates worth a combined total of well over $160 billion." However, due to a combination of economic, environmental, political and security reasons, these countries have begun, in varying degrees, to explore the possibility of alternative means of energy production and use. The International Energy Agency (IEA) has compiled production data for 2004, which is represented in Table 1. The figure shows energy source dependency in the Arab world as a whole. As shown in the data, the Arab Gulf countries had not placed much stock in commercial use of alternative sources of energy in the past.

Table 1: Production of energy as of 2004 in GWh

Scientific Name	Bahrain	Kuwait	Oman	KSA	Qatar	UAE
Unit	GWh	GWh	GWh	GWh	GWh	GWh
Coal	0	0	0	0	0	0
Oil	0	32,787	2,070	81,279	0	1,329
Gas	8,448	8,469	9,429	78,596	13,233	51,088
Biomass	0	0	0	0	0	0
Waste	0	0	0	0	0	0
Nuclear	0	0	0	0	0	0
Hydro	0	0	0	0	0	0
Geothermal	0	0	0	0	0	0
Solar PV	0	0	0	0	0	0
Solar thermal	0	0	0	0	0	0
Other	0	0	0	0	0	0
Total	8,448	41,256	11,499	159,875	13,233	52,417

However, there have been some changes recently. The third OPEC summit, which was held in Riyadh from November 18 to November 19 of 2007, showed a strong initiative in the Gulf region toward promoting research in cleaner sources of energy. The Kingdom of Saudi Arabia announced that it would pledge $300 million towards research pertaining to energy, environment, and climate change. The UAE, Kuwait, and Qatar followed suit and announced the allocation of $150 million for the same cause. In 2006, IEA estimated that the investment required in energy infrastructure in developing countries to meet growing energy needs will exceed $300 billion/year over the period 2001-2030. In fact, there is a double challenge for energy and climate change policies today: first, to find ways to attract enough direct investment to meet the growing energy supply infrastructure needs of GCC countries to sustain their economic development, and second, to drive these direct investments towards lower carbon technologies in order to avoid dangerous climate change. One of the main sources that can be utilized by GCC countries is solar energy.

According to a regional expert, "The region is exposed to direct sunlight, as well as a reduction in the percentage of clouds. The usual Direct Natural Exposure (DNE) in the Gulf region is about 1800 kilowatt/h per every square meter and this makes the adoption of solar energy in the region technically

and economically feasible. Statistics show that both the Middle East and North of Africa are equipped to deal with this technology..." [1]

The following section takes a closer look at the individual efforts of each GCC country in pursuing alternatives to traditional hydrocarbon usage:

Bahrain

Bahrain has a small hydrocarbons production capacity, much of which is obtained from Abu Safa field, which it jointly uses with Saudi Arabia. However, the country compensates for low crude productivity by getting involved in activities such as refining and by exporting refined products.

Bahrain has also explored the possibility of wind energy. The Bahrain World Trade Centre towers will be the first of their kind in the world to use wind energy in power generation. Wind power will be harnessed by the building's three turbines, and will provide around 11-15 percent of the electricity needs of the center.

Also underway in Bahrain, is the $1.3 billion Financial Harbor project. This project will be fed by the North Shore District Cooling Network, providing around 30,000 tons of refrigeration to the complex as a whole. District cooling is gaining popularity because it delivers value to customers in comparison with conventional approaches to building cooling, and it consumes less energy. It is expected that the use of district cooling will reduce peak power demand in Bahrain by over 400 MW by 2020. According to www.middleeastelectricity.com, a leading Bahraini scientist has stated that a great increase in energy demand can be expected for the next decade, and that Bahrain must lay the groundwork and allocate a budget for new solar technologies. Another project already running is a mobile reverse osmosis desalination unit operated by solar power with a capacity of 200 gallons per day and a mobile generator operated by solar and wind power with a capacity of 1.5 kilowatts.

A model of Bahrain Financial Harbor

Kuwait

Kuwait is a mature oil producer with capacity of just over 2.5 million b/d. Kuwait had invested heavily in harnessing solar energy. Prior to the Gulf War in 1990, research was carried out on solar lakes, air conditioning and photovoltaic systems projects. However, efforts to use solar energy on a commercial scale were discontinued as none of the applications were found to be cost effective and the Kuwaiti government decided to adopt an energy conservation approach instead. However, as mentioned earlier, at the OPEC meeting of 2007, Kuwait pledged resources for alternative energy research. Newer technology could allow for more economically feasible alternatives which could be adopted.

Oman

Oman is facing declining oil production as a result of maturity of available fields although recovery work and new exploration are expected to result in an increase in hydrocarbon production. The Ministry of Environment and Climate Change has made efforts to exploit the Sultanate's alternative energy potential. For example, groundwater from Heelat Ar Rakah camp's well was found unfit for consumption due to high concentrations of

1- Dr. Basel Al-Yousafy and Dr. Aly Alkorah, "Environmental and Economic Feasibility of Renewable Energy in the Arab Region", Dar Alhayat newspaper, March 5, 2007.

fluoride and hydrogen sulphide gas. Solar power was used to run a reverse osmosis desalination plant to produce fresh water for the camp and a wind turbine was used to generate electricity to operate the well pumping system. Photovoltaic systems with a capacity of 352 kwt were built for pumping water, lighting and communications. Oman is also studying the feasibility of installing a $1 billion clean burning coal-fired power generation plant in southern Oman.

Saudi Arabia

According to IEA, Saudi Arabia has the world's largest proven oil reserves and production capacity in excess of 10 million b/d. It is the leading player in OPEC. As mentioned earlier, Saudi Arabia pledged significant resources for alternative energy research. It is currently in the process of considering potential alternative energy sources for the Kingdom with the focus on solar. Currently, solar energy is used for oilfield lighting systems, advertising signs and traffic signals. Projects in the fields of solar cooking, solar desalination, thermal and solar electricity and photovoltaic systems were implemented through the American Cooperation Program that has carried out many research and development programs in the last two decades of the 20th century. Saudi Arabia has also been considering plans for waste to energy plants. These plants convert commercially hazardous, organic and toxic wastes into electricity and usable water.

Qatar

Qatar is mainly known as a gas producer, with its reserve base centered on the offshore Northern fields. Energy City Qatar, which Qatar hails as the region's future hydrocarbon hub that could become the Gulf's first hydrocarbon trading hub, is promoting 'green building' practices.

UAE

The use of solar energy in the country is increasing with solar energy now commonly used in powering parking meters, offshore buoys and water heating in hotels. There is potential, according to experts and www.middleeastelectricity.com, for the country to produce 1000 MW of electricity a year from wind energy alone.

Abu Dhabi

The UAE has recently set up a wind power plant on Sir Baniyas Island, which is the first-ever wind power project in the entire region. The plant is the first in the world designed to sustain harsh climatic conditions such as high temperatures and humidity. Abu Dhabi will also build a $350 mn, 500 megawatt solar power plant, which is expected to begin operations in 2009. Similar to Oman, Abu Dhabi has considered the prospect of clean-burning, coal-fired power stations.

A study on clean burning, coal-fired power plants is being carried out by Taqa, the Abu Dhabi National Energy Company. As part of a new vision, the Masdar Company intends to build a new carbon-free community as a unique integrated "green community." This "green" energy and technology campus will offer a sustainable living environment and state-of-the-art office and research facilities based on green construction, desalination, bio-fuels, sustainable transport, water recycling, waste water management, solar cooling, sustainable irrigation, and other renewable aspects.

Although difficult to precisely measure, the following direct results are expected from the project by 2015:

A model of the Qatar Energy City

- 10,000 new high-quality jobs in the clean energy and sustainable technologies sector in Abu Dhabi.
- 800 full-time Masters and Ph.D. students at the Masdar Institute specializing in clean energy and sustainable technologies.
- A multi-billion dollar expansion of the Abu Dhabi non-oil economy.
- The creation of a world-class scientific and research hub which is currently non-existent in the Gulf region; such a hub can become the core of other knowledge-based activities and industries in addition to research on clean energy.

Dubai

Meanwhile, Dubai is taking a lead in wind power research. A study is being carried out for Dubai Electricity and Water Authority (DEWA) for a $1 billion wind farm project, the aim being to shift 10 percent of Dubai's energy dependence to wind energy.

The Government of Dubai recently announced its adoption of a Sustainable Development Policy. A newly created Renewable Energy Division will be responsible for 'green' building standards, energy and water conservation and management, and green power generation. The government hopes this initiative will set an example for other entities within the emirate to adopt sustainable development. The Dubai government, in line with this policy, has created a team of experts in LEED – Leadership in Energy and Environmental Design. LEED is one of the premier certifications on sustainable building practices and is assigned by the US Green Building council.

Fujairah

Fujairah has plans to create several wind parks. Each wind park is expected to generate up to 200 megawatts a year. The first solar-cell production line has recently been opened in the Fujairah Free Zone.

A Solar energy operated parking meter in Dubai

Solar energy has been used for the first time in the Middle East to cool an apartment complex in Dubai, which has cut utility bills by a third. Solar energy has also been used to power the hot water system for a hotel in Dubai which overshoots their daily requirement.

GCC countries face numerous environmental challenges and have to reconcile the many conflicting priorities, from economic diversification, water supply and food security, environmental protection and conservation to newly hazardous impacts of global warming.

Summary table of Current and Future Renewable Energy Projects in GCC Countries		
Country	**Current projects**	**Future projects**
Bahrain	- Wind Generation in Trade Center - North Shore district cooling network for Financial Harbor - Solar powered reverse osmosis unit - Solar/wind powered generation	- Scientist calls for solar energy research
Kuwait		- Pledged money for research
Oman	- Solar powered reverse osmosis unit - Photovoltaic system for water pumping and electricity generation - Wind energy for water pumping	- Studying feasibility of clean burning coal plant
Saudi Arabia	- Using solar energy for oilfield lighting systems, advertising signs and traffic signals. - Progress has been made in the field of solar cooking, solar desalination, thermal and solar electricity and photovoltaic systems.	- Pledged money for research - Waste to energy research
Qatar	- Energy city will adopt green building practices	- Pledged money for research
UAE	- Solar energy used in powering parking meters, offshore buoys, water heating in hotels and cooling - Wind power plant in Sir Bani Yas island, Abu Dhabi - Masdar initiative in Abu Dhabi - Dubai adopts sustainable development policy - Solar cell production line in Fujairah free zone	- Solar power plant in Abu Dhabi - Abu Dhabi considering clean burning coal power plant - Studies in Dubai for $1billion wind farm. - Wind power generation in Fujairah

The Gulf region's traditional view on the whole issue of climate change, renewable energy and traditional fossil energy sources has changed significantly in the last year. There is a shift toward energy diversification with more research and initiatives in the field of renewable energy and a resolve to fight climate change and play a vital role in the emissions trading market. Over the next two years, with negotiations of the Bali roadmap, there is a very good opportunity for GCC countries to garner financial and technical support from the industrial world to help them combat the negative impacts of desertification and climate change. In the medium- to long-term, the share of renewable energy in the energy pie in the Middle East is only likely to increas.

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The emirates of the UAE experienced record rainfall during the week of January 13-17, 2008. According to the Dubai Meteorology Office, Dubai received 110 mm of rainfall in five days. More than 1,500 traffic accidents were reported due to the rainy conditions. The rains brought more vegetation and flowing water to the wadis.

An official at the Northern Region Department of the Ministry of Environment and Water said that the water levels in various dams in the UAE had risen considerably. This would be useful for recharging underground aquifers as the country lacks renewable freshwater resources and arable lands. The rainfall recorded in the GCC countries this year has been the highest in several years.

We would like you to share with us your photos relating to the environment, which capture the beauty of nature or highlight problems such as pollution. The photo may be sent with a short caption to: raouf@grc.ae

Kingdom of Bahrain

Bahrain, meaning "two seas" in Arabic, has a total land area of 665 Km^2 and is known as the "Pearl of the Gulf." The main island of Bahrain is by far the largest, with an area of 562 Km^2. The country does not have dramatic topographical features, such as mountains or valleys. The main island consists of a low desert plain that rises to a low central escarpment where Bahrain's highest point, Jabal al Dukhan (134 m), is located. The smaller islands, which include Al Muharraq, Sitrah, Jiddah, and the Dawar Islands, are generally low-lying, some only a few feet above sea level. Bahrain has an arid desert climate characterized by very hot summers with high humidity while winters are relatively cooler. Average annual precipitation is only 76 mm. Various winds influence the temperatures and include the Bara from the north, which is a cool wind that sometimes reduces the temperature in June, the Shamal from the northeast which is a moist wind that dominates all year round, and the Quss from the south or southwest, which is a hot, dry sand-laden wind.

Environment Agreements

Bahrain supports regional and international conventions for the protection of the environment. Bahrain is party to the following conventions: Biodiversity, Climate Change, Desertification, Hazardous Wastes, Law of the Sea, Ozone Layer Protection, Wetlands

Environmental Authorities (Local & Regional)

- Ministry of Public Commission for the Protection of Marine Resources, Environment and Wildlife, and Governor of the Southern Governorate
- Ministry of Environment
- Environment and Wildlife Affairs Agency
- Ministry of Housing, Municipalities and Environment Regional Agencies:
- Regional Organization for Protection of Marine Environment (ROPME)
- UNEP-West Asia.

In general, the authorities' responsibilities are: (i) to formulate a National Environmental Strategy; (ii) to coordinate and follow up on environmental activities within the Kingdom; and (iii) to establish the Kingdom's position on environmental issues at the national, regional and international levels.

Facts	
Official Name	Kingdom of Bahrain
Capital	Manama
Population	689,418 including 235,108 non-nationals
Location	The Middle East, archipelago in the Gulf, east of Saudi Arabia
Total Area	665 Km2
Length of Coastline	161 km
Climate	Arid; mild, pleasant winters; very hot, humid summers
Terrain	Mostly low desert plain rising gently to low central escarpment
Land Use	Arable land: 2.82%, permanent crops: 5.63%, other: 91.55%

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Journals and Newsletters Published by GRC

- *Gulf-Asia Research Bulletin*
- *GCC-EU Research Bulletin*
- *Gulf Monitor*
- *GRC Economic Research Bulletin*
- *Security & Terrorism Research Bulletin*
- *GRC Newsletter*

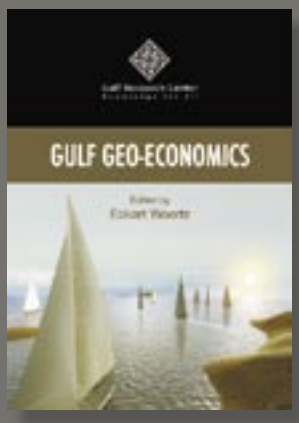
Arab Environment Day
October 14, 2007

On October 14, 1986, the First Conference of Arab Ministers Responsible for the Environment (CAMRE) was held in Tunisia. Since then, October 14 every year is designated as "Arab Environment Day."

On this day, Arab ministries, agencies and NGOs try to show the importance of working together in order to protect and serve the environment. The day also helps in promoting the notion of Arab unity by addressing environmental issues which affect the region as a whole. The day is an occasion to raise environmental awareness. Universities, environment ministries, and civil societies hold lectures, seminars, drawing competitions, clean-up campaigns and other activities to mark the day. As part of the activities to celebrate the 20th Arab Environment Day, GRC made a presentation titled "Economic Instruments and Environmental Policy of GCC Countries" in the Faculty of Health Science, Sharjah University, on October 31, 2007.

The presentation showed the important role of economic instruments in promoting better environmental practices by individuals and corporations as well as the relation between economic instruments, legislations and multilateral environmental agreements.The GRC was presented with a plaque for its participation in this event.

GRC PUBLICATION



Gulf Geo-Economics
Edited by Eckart Woertz

The integration of the Gulf Cooperation Council (GCC) countries into the world economy is increasingly multifaceted. Although oil and gas revenues are still of paramount importance, the GCC countries have developed a diversified economic structure with new sectors emerging in the fields of petrochemicals, heavy industries and services. Apart from new import requirements for these industries, the focus of the GCC's trading relations has moved eastwards. The US only accounts for 10 percent of imports nowadays while the European Union and Asia each roughly contribute one third of overall imports. Furthermore, Asia purchases about two-thirds of GCC energy exports. This has naturally raised questions about potential political realignments although Asia still lags far behind Western markets in terms of cross border investments. Through broad-based strategic analyses and specific sector studies, this edited volume covers various aspects of this ongoing geo-economic positioning, from trade relations, power politics and petrodollar recycling to regional integration, foreign direct investment and labor issues.

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http://www.global-politics.info/ir-online

Green Gulf 2020 Project

The earth's finite natural resources and the environment are under tremendous pressure today. Different human activities are taking their toll and governments across the globe are fast realizing the need to introduce corrective policies and pursue a path of sustainable development.

Governments in the GCC region are definitely putting environment issues on top of their agendas, but it is the duty of research centers and institutions to bridge the data gap that exists in this area and make sure that regional policies evolve further and make their mark in the international arena as well.

Therefore, in 2005, the GRC widened the scope of its activities to include environmental research and awareness activities to facilitate solutions to the problems faced by the Gulf region and the world due to the degradation of precious natural resources.

The preliminary Green Gulf study aimed to raise awareness about the environmental issues in the region; create networking among experts, governmental and non-governmental bodies; highlight the need for more in-depth research; and pave the road for further comprehensive and resource-specific studies.

After analyzing the findings of the preliminary study, resource teams will probe into the causes for the current environmental threats that the region is facing, suggest long-ranging solutions and prepare a policy-oriented document, which it is hoped will influence policy- and decision-makers to institute legislations and implement measures that will help achieve our vision of an environmentally friendly Gulf by the year 2020.

The main features of the Green Gulf 2020 study are as follows:

- The timeframe of the study will be two years.
- The main aim will be to develop a comprehensive Sustainable Development Plan that covers all environmental issues in the region and their economic and social impacts.
- The GRC will work as a focal point for the project and bring together experts and researchers from inside and outside the region and involve different stakeholders such as governments, industry, media, corporate organizations and multilateral and international institutions.
- The study intends to focus on the six GCC countries –Yemen, Iraq and Iran will be included if possible.
- Six regional expert teams will be established, which will be headed by a leading regional environmentalist. Each team will focus on resource-specific issues and concerns such as biodiversity issues, land degradation, coastal environment, water, air pollution, and solid waste management, and suggest possible solutions.
- UNEP, through ROWA office and Nairobi Center for Environmental Assessment, and the Arab League have agreed to technically support the GG2020 Project.

Who Will Benefit from This Study?

This study can be very beneficial for various sectors in and outside the region. Beneficiaries would include:

government bodies dealing with environmental issues such as environmental, agricultural, industrial, planning ministries and authorities, municipalities and local authorities; companies such as oil, gas, petrochemicals, cement, steel, glass, and aluminum; banks; tourism industry; academia and research institutes; non-governmental organizations, including local, regional and international organizations, interested in environmental issues.

The project's materials will be initially circulated among the supporting institutions, advisory bodies and researchers. Publication is envisaged in various forms after a delay of one year, or earlier, if the clients and supporting institutions approve.

Project Timetable and Budget

The Green Gulf 2020 will serve as a regional reference, which will be used to present environmental and development information on the GCC in any international platform or global forum. Each of the six areas mentioned earlier will need a budget ranging from $125,000 to $150,000.

The project will be launched as soon as the six areas are fully covered by sponsors. The project will extend over 24 months from the inception date.

April 2007	Project is Launched: First meeting of Steering Committee
May 2008	First Workshop
August 2008	Second Workshop and Second meeting of Steering Committee
December 2008	Third Workshop and Third meeting of Steering Committee
April 2009	Fourth Workshop and Fourth meeting of Steering Committee
November 2009	Project Wrap-up and Conclusion

Teams

Six teams will be formed covering the six main areas of the study; each team will be headed by a regional environmental expert in the area under study. GRC and the team leader will define the composition of the team according to the needs.

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Economic Instruments, Legislations, and Environmental Policies in the GCC

July 1, 2007

A presentation and roundtable discussion on "Economic Instruments, Legislations, and Environmental Policies in the GCC Countries" was held on July 1, 2007 in the Gulf Research Center, Dubai.

The event was attended by 20 participants from government organizations, NGOs, academia, private sector and the media. The purpose of this presentation was to illustrate the role of market-based instruments or Economic Instruments (EIs) in tackling different environmental problems.

As a means of achieving environmental management objectives, non-economic regulatory measures have been adopted world-wide as well as in the Gulf region. However, in recent years, Economic Instruments are being increasingly implemented in many countries, both developed and developing. A number of issues were discussed in the session including the benefit of adopting a single policy approach, the importance of firm environmental legislation and punishment especially in the case of hazardous and nuclear wastes, the role of environmental legislation to promote both approaches of environmental policy i.e. CAC and EIs, examples of EIs adopted in GCC countries especially in agriculture and water sector and the newly introduced SALIK road fee system in Dubai to overcome the traffic congestion. In addition, different economic, social, administrative aspects when applying EIs were taken into consideration.

Finally, the importance of a step-by-step approach when adopting the EIs as an environmental policy to overcome the public reluctance and to guarantee that environmental institutions are experienced enough to handle the newly introduced EIs was highlighted. 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. In addition, the discussion also considered 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.

Visitors

September 5, 2007

Mariam Al-Hamady, Head of Environmental Awareness Department at the Federal Environment Agency (FEA), discussed future cooperation between GRC and FEA in environmental awareness, training and research.

August 10, 2007

Daniel Mokari, Associate – Middle East & Eastern Africa, Swedish Trade Council, Dubai discussed possible cooperation between GRC and STC in environmental research and awareness.

Participation

October 22, 2007

Delivered a lecture titled “Environmental Legislation and Environmental Policy in GCC Countries” at the American University of Sharjah for students of the School of Engineering and School of Science.

October 25, 2007

The GRC was invited to participate in the “Ecological Footprint-UAE” workshop organized by the Environment Agency-Abu Dhabi and Emirates Wildlife Society (EWS).

November 5-7, 2007

*T*he GRC was invited to participate in the Fourth International Conference on Federalism (Unity in Diversity – Learning from Each Other), in New Delhi, India.
The event was organized by the Inter-State Council Secretariat, Government of India and the Forum of Federations. This conference is the fourth in a series organized in partnership between host governments and the Forum of Federations (an NGO created and supported by the government of Canada).
GRC took part in the workshop and discussions on the sub-

theme focusing on "Water Issues and Federalism". Some case studies from India and Australia showed that water can sometimes cause conflicts or unity and showed different policies pursued at federal and regional levels to handle water scarcity and quality. This big event was attended by around 900 participants, including experts from various fields like politics, education, economics, environment, government representatives and civil society organizations.

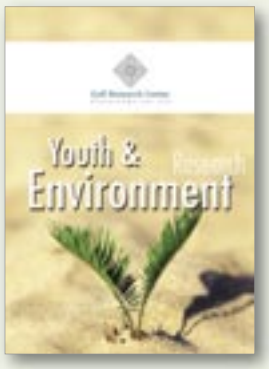
Internship

Abdulla Saif is a senior student at the American University of Sharjah (AUS), majoring in Environmental Science with a concentration in biology and ecosystems and minoring in Economics. He joined GRC as an intern in the Environmental Program and is currently working on several research projects under the supervision of Dr. Raouf. Being a GCC citizen, the region’s environment especially is of great interest to him. Abdulla believes that the experience he gains in GRC will provide him with the insight and experience he needs to further both his career prospects and plans for graduate studies in Environmental Economics.

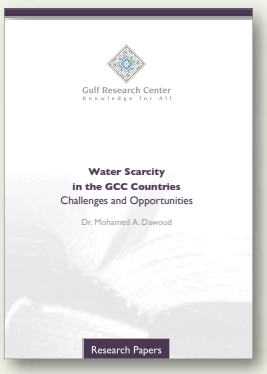
Consultancy

GRC delivered a presentation and submitted a report entitled “Climate Change and Clean Development Mechanism (CDM): Challenges and Opportunities for the Gulf Region” to Shell International Gas & Power Limited (October and November 2007).

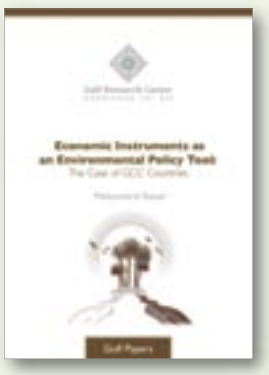
Green Gulf Report



Youth and Environment Research



Water Scarcity in the GCC Countries: Challenges and Opportunities



Economic Instruments as an Environmental Policy Tool: The Case of GCC Countries

Environmental Situational Assessment for the GCC Countries

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

(Language: Arabic)

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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