GRC Environment
Research Bulletin
Gulf Research Center Knowledge for All

Climate change has taken centre stage in global forums and is now one of the most discussed issues around the world. The causes for climate change are often linked back to an industry widely associated with the Gulf – hydrocarbon production. As the international community recognize the collective effort required to combat climate change and other environmental issues such as desertification, the Arab Gulf States should seek greater advancement in areas such as cleaner alternative energy sources in order to reduce their carbon footprint, as these arid regions suffer from problems like water shortage that would only be exacerbated by the same greenhouse gas emissions that the region generates.

As the Arab Gulf States begin to seek cleaner energy solutions to curb the effects of climate change and global warming on the delicate ecology of the region, it is important to evaluate the type of alternative energy that would best suit the region. Is biofuel a viable option? What about nuclear power or solar energy? These are salient issues that need to be addressed when diversifying away from hydrocarbons and into the energy of the future.

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يدعو مركز الخليج للأبحاث بالتعاون مع المركز العربي لدراسات المناطق الجافة والأراضي القاحلة (أكساد) إلى المشاركة في

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- 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
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- استعمالات المياه متعددة النوعية في الزراعة
- زيارات لمنطقة حوض الزبداني ومنابع نهر بردي ومحمية التليلة ومحطة تغيرات مناخية ومنطقة تدمر

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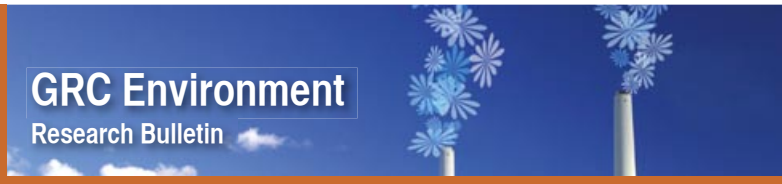

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Gulf Energy: Environmental Impact and Available Alternatives *

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Introduction

Oil and gas have been the prime movers behind the Gulf region's strategic position. The region is highly important due to its massive oil reserves which, according to Goldman Sachs Group Inc.'s Global, amount to 484.3 billion barrels of oil – 40.3 per cent of world oil reserves – and its huge quantity of gas (41.4 trillion cubic meters) – 23 percent of global reserves.

The region pumps 6.7 billion barrels of crude oil and 195.9 billion cubic meters of natural gas annually. These reserves have helped to improve living standards for Gulf citizens and have changed their once austere lifestyle into one of luxury. The GCC ranks 27th in GDP per capita, at around $20.500 in ? which is likely to increase to $115.000 by 2030. Improved living standards however, have been associated with excessive use of energy. Individual electricity consumption in GCC states has increased by six to eight per cent, against two to three per cent for the international rate.

Thanks to this wealth, all GCC states underwent a comprehensive development in a relatively brief period. The GCC states received high marks in UNDP's Human Development Report of 2007, with Kuwait ranking 33rd, Qatar 35th, UAE 39th, Bahrain 41st, Oman 58th and Saudi Arabia 61st out of 177 states. Oil reserves also enhanced the investment environment in the GCC states, notably in recent years, pushing Gulf competitive capabilities forward. GCC states stand high in the world competitiveness index, with Qatar ranking 24th, UAE 25th, Saudi Arabia 27th, Oman 32nd and Bahrain 39th out of 177 countries.

Excessive use of energy has proved very harmful to the environment. Oil is a non-renewable energy, which requires GCC states to search for alternative resources, an important step to retain oil and gas as long as possible and to put a sustainable energy strategy into effect. This paper discusses the grave environmental effects on maritime life, CO2 effluents and oil-related earthquakes.

Gulf environmental pollution can be attributed to oil drilling and transport which lie heavy on every inch of the local environment. Gulf water, renewed slowly due to its narrow basin, has been subject to contamination due to the 1980s and early 1990s Gulf wars where millions of barrels of oil leaked into Gulf waters and many maritime systems were damaged. Tanker spills, exploration activities and illegal cleaning and discharging into Gulf waterways are also to blame.

Although all GCC states signed the Kyoto Agreement they are largely accountable for global warming. The Kyoto Agreement seeks to reduce gas emissions, mainly CO2 diffused by the buring

Country	Life expectancy	Literacy rate	Education entries	Income per capita/ purchasing power (Dollar)	Rank in Human Development Report
Kuwait	77.3	93.3	74.9	26.321	33
Qatar	75.0	89.0	77.7	27,664	35
UAE	78.3	88.7	59.9	25.514	39
Bahrain	75.2	86.5	86.1	21.482	41
Oman	75.0	81.4	67.1	15.802	58
Saudi Arabia	72.2	82.9	76.0	15.711	61

Source: UNDP's Human Development Report 2007

of fossil energy. Two GCC states are among the world's biggest CO2 emitters with Saudi Arabia ranking 20th and UAE 29th.

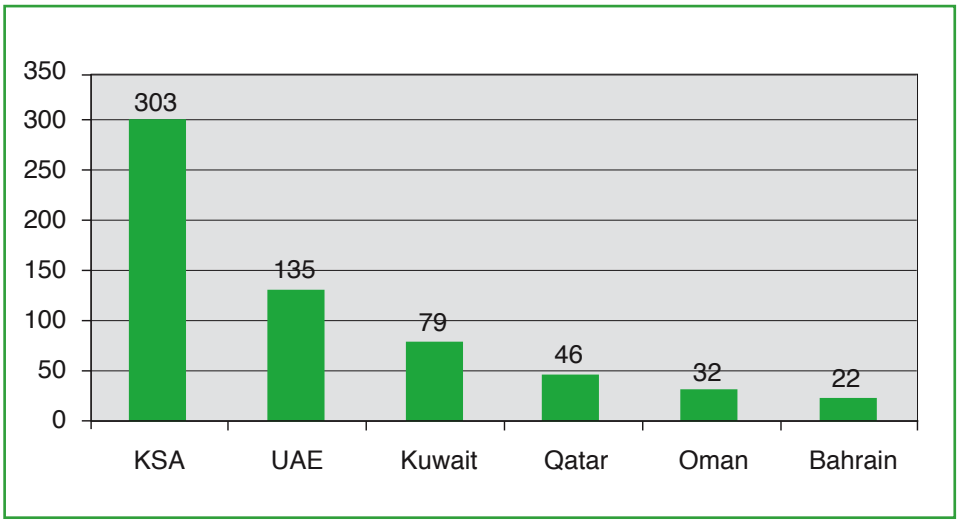
Generally speaking, CO2 emissions in GCC states are low except for Saudi Arabia and relatively UAE. Nevertheless, the rate per capita is the world's highest due to the low population. Qatar, for example, comes in first worldwide with 63.1 ton per capita while its total CO2 emissions are very limited, specifically 46 million tons annually.

Table (2): World's Biggest CO2 Emitters

Country	Total emissions (metric ton)		Increase (%)	Global share (%)		Emission per total population (%)	Emission per capita (tons)		Forest absorption of CO2 emissions (metric tons/year)
	1990	2004	1990-2004	1990	2004	2004	1990	2004	1990-2005
United States	4,818	6,046	25	21.2	20.9	4.6	19.3	20.6	-500
China	2,399	5,007	109	10.6	17.3	20.0	2.1	3.8	-335
Russia	1,984	1,524	-23	8.7	5.3	2.2	13.4	10.6	72
India	682	1,342	97	3.0	4.6	17.1	0.8	1.2	-41
Japan	1,071	1,257	17	4.7	4.3	2.0	8.7	9.9	-118
Germany	980	808	-18	4.3	2.8	1.3	12.3	9.8	-75
Canada	416	639	54	1.8	2.2	0.5	15.0	20.0	..
UK	579	587	1	2.6	2.0	0.9	10.0	9.8	-4
Korea	241	465	93	1.1	1.6	0.7	5.6	9.7	-32
Italy	390	450	15	1.7	1.6	0.9	6.9	7.8	-52
Mexico	413	438	6	1.8	1.5	1.6	5.0	4.2	..
South Africa	332	437	32	1.5	1.5	0.7	9.1	9.8	(.)
Iran	218	433	99	1.0	1.5	1.1	4.0	6.4	-2
Indonesia	214	378	77	0.9	1.3	3.4	1.2	1.7	2,271
France	364	373	3	1.6	1.3	0.9	6.4	6.0	-44
Brazil	210	332	58	0.9	1.1	2.6	1.4	1.8	1.111
Spain	212	330	56	0.9	1.1	0.7	5.5	7.6	-28
Ukraine	600	330	-45	2.6	1.1	0.7	11.5	7.0	-60
Australia	278	327	17	1.2	1.1	0.3	16.3	16.2	..
Saudi Arabia	255	308	21	1.1	1.1	0.4	15.9	13.6	(.)
Poland	348	307	-12	1.5	1.1	0.6	9.1	8.0	-44
Thailand	96	268	180	0.4	0.9	1.0	1.7	4.2	18
Turkey	146	226	55	0.6	0.8	1.1	2.6	3.2	-18
Kazakhstan	259	200	-23	1.1	0.7	0.2	15.7	13.3	(.)vv
Algeria	77	194	152	0.3	0.7	0.5	3.0	5.5	-6
Malaysia	55	177	221	0.2	0.6	0.4	3.0	7.5	3
Venezuela	117	173	47	0.5	0.6	0.4	6.0	6.6	..
Egypt	75	158	110	0.3	0.5	1.1	1.5	2.3	-1
UAE	55	149	173	0.2	0.5	0.1	27.2	34.1	-1
Netherlands	141	142	1	0.6	0.5	0.2	9.4	8.7	-1

Source: Human Development Report 2007/2008, Fighting Climate Change: Human Solidarity in A Divided World, The United Nations Development Programme, New York 2007.

Chart of CO2 emissions in GCC States



Source: United Nations Economic and Social Commission for Western Asia (ESCWA) Environment Statistics, New York, 2007.

Earthquakes, a dangerous outcome of oil drilling, were reported near oil fields. Irrational drilling, pumping, explosion and extraction activities reanimated seismic cracks that have been inactive for millions of years. The region was not known for seismic activities in the past due to its alluvial soil. Tremors were, however, reported in several areas. The most recent shocked Manakish, a border city between Saudi Arabia and Kuwait, at a magnitude of 4.0 degrees and depth of 7.3 km. Its oscillations survived for 90 seconds of which 30 seconds were felt. Two aftershocks, 3 and 2 degrees consecutively, were registered in the same place. Other Saudi areas such as Jafora desert and Aghwar oil field were also shut down.

In Qatar, a huge quake was reported in the north of the country. Gas and oil drilling along with seismic activities in Iran were the reason behind the 3.5 to 4.2 degrees quake. The eastern part was convulsed by a tremor of superficial depth that measured from 3.5 to 3.9 degrees and was primarily ascribed to local oil extraction. By the same token, western Qatar suffered a tremor measuring from 3.5 to 3.8 degrees at superficial depth, mainly due to oil drilling in Dhukhan, Qatar's largest and oldest oil field. Conclusive decisions and steps are required to rationalize upstream processes and avoid landslides, together with other negative consequences on underground water and industrial as well as urban projects in the region.

Available and easy to use, oil and gas are not likely to lose ground in the short term, and modern equipment and vehicles have been designed accordingly. Alternatives are still under experimentation and mostly unviable for commercial use. These alternatives are quite costly compared to oil prices even after the recent hike that saw oil exceeding $100 per barrel for the first time. The Gulf decision makers should however consider other energy alternatives to limit oil and gas drilling and consequently reduce related environmental dangers. These alternatives include the following:

1- Nuclear Power

Nuclear power is a key clean energy that depends on extremely safe reactors. Uranium and plutonium are used for power generation in massive quantities through nuclear fission. Nuclear power accounts for 16 per cent of global energy requirements, and makes up 77 per cent, 35 per cent and 30 percent in France, EU and Japan consecutively.

Compared to other sources of energy, smaller quantities of nuclear fuel are required to produce a sizable volume of electricity while nuclear wastes are less environmentally dangerous especially with well-functioning plants. Moreover, nuclear facilities do not need much space. The bad part of the story is the limited uranium reserves and the deadly environmental impacts on reactor surroundings if high safety precautions are not taken. The world has survived more than one accident, such as the 1979 leakage from Three Mile Island, a reactor near Pennsylvania and the Chernobyl disaster. Chernobyl claimed 31 lives with hundreds of thousands exposed to nuclear radiation. The catastrophe resulted in huge economic damages throughout Europe and Asia.

In 2006, the GCC heads of state unveiled their intentions to own nuclear capabilities and ordered studies on a possible common nuclear program. Meetings were held for the team assigned to supervise the peaceful use of nuclear energy and studies progress. IAEA, at the instructions of the GCC Secretariat General, prepared a study using nuclear energy

in electricity generation and water desalination according to international standards. Apart from confronting Iranian nuclear ambitions, the proposed project ushers a quantitative leap in the field of sustainable energy and is likely to reduce oil and gas consumption in GCC states. Barbara Thomas, the chairperson of UK Atomic Energy Authority, said Gulf countries could lead the nuclear development due to their cash liquidity and absence of political opposition that usually thwarts the process. According to US officials, US will assist its Gulf allies in developing their nuclear program for peaceful purposes in an attempt to reduce gas emissions causing global warming. The Russian president, Vladmir Putin, had made a similar offer to the GCC, which he unveiled on a visit to Saudi Arabia.

The GCC Secretariat General released a report recommending the following measures: establishing a Gulf nuclear program implementation authority; evaluating the cons and pros based on previous experiences; conducting pilot studies to determine the optimum waste storing and disposal sites to be easily connected to electric networks; determining whether all nuclear activities to be concentrated in one country or distributed among several countries; and reaching multilateral agreements governing related issues such as accountability, transport of fuel, waste disposal and cost sharing.

2- Renewable Energy

Before the discovery of oil, many countries relied on renewable natural energy, mainly water and wind power. Due to the hike in oil prices in the 1970s, imminent depletion of oil reserves and climate change concerns, new alternatives such as solar and wave energy were seriously sought. These alternatives, though promising, are still under experimentation and not likely to be used on a wide scale in the foreseeable future. The GCC states made use of these natural resources primarily to generate electricity and desalinate sea water. The mounting demand and limited supply however hampered the expansion of this energy investment. As many as 114 energy generation projects of more than $160 billion are currently operational in the GCC states. Solar energy is used to desalinate 580 cubic meters daily in the UAE, 500 cubic meters daily in Saudi Arabia, 77 cubic meters daily in Kuwait and 44 cubic meters daily in Qatar. The UAE has the edge over other GCC states in renewable energy investments. A study to build a 500 megawatt solar energy plant of about $500 million is underway in the UAE. Another UAE study to set up a hydrogenic power plant of $100 million and a third to build a wave energy complex of about one billion dollars are also under preparation. Saudi Arabia is planning to set up waste-based power plants for electricity generation and water desalination. In view of their sizable natural and financial resources, GCC states can make ahead through encouraging the scientific research in this industry.

3- Biofuel

Bio fuel is made from wood, plants and animals. Thanks to modern experiments, fluids can be extracted from these sources and used in combustion engines instead of oil. Bio fuel has different forms: solid such as wood and plants, liquid such as ethanol and oilseeds, along with gaseous bio fuel which is extracted from decomposed plants and animals. Bio fuel demand soared recently due to increased oil prices. In 2006, world supply of bio ethanol was 40 billion liters against 6.5 billion liters of bio diesel. Brazil is viewed as most competitive, with half of its sugarcane allocated for ethanol production. Bio fuel investment was not restricted to developed countries; sugarcane, among other crops such as palm oil and Indian beech, was turned into bio fuel in a number of developing countries.

Bio fuel is renewable and environment-friendly energy due to its neutrality to CO2 and fast dissolution in water. However, it is very costly, compared to fossil fuel, because it produces only two-thirds of oil energy. Expansion in bio fuel investment will result in higher land prices and fiercer competition for agriculture lands and water resources. Agriculture wastes are expected to leave adverse impacts on the environment, in view of increased use of fertilizers and deforestation.

In a nutshell, oil and gas have been the prime movers behind GCC development and are likely to remain the key source of energy and income for a long time in spite of their unsustainable nature and their adverse impacts on green environment. Unlike gas and oil, alternative energy sources are not available in large quantities while raw materials of some, mainly bio fuel, are scare in the GCC states. An instant action should be taken; GCC countries should seriously encourage scientific research which can push sustainable clean alternatives, mostly solar energy, to the fore.

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Effective Microorganisms Applications in a Sustainable Agriculture Crop Growth

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Abstract

The concept of organic vegetable production is designed to support the old philosophy of "feed the soil to feed the plant." This basic precept is implemented through a series of approved practices designed to increase soil organic matter, biological activity, and nutrient availability. Over time, adding organic materials such as green manure, crop residues and composts to cultivated soils builds levels of soil organic matter. As soil organic matter increases, the ability of the soil to supply nutrients to crops also increases. Agricultural residues and wastes may have an adverse effect on the environment if they were not properly treated. Therefore successful treatment processes should be applied to mitigate their harmful impact on the environment, and achieve the best use of these effluents.

Plant and microorganisms have been in continuous interaction throughout the history of ecosystems. The majority of those organisms are beneficial to the plant's welfare and are known as effective microorganisms (EM). Such EM may help in the production of antioxidant substances such as Inositol, Ubiquinone, Saponin, low molecular polysaccharides, polyphenols and chelates of minerals. Therefore, the significance of those organisms is well recognized encouraging the efforts to explore the indigenous environment for its predominant microorganisms associated with naturally composted organic material and plant root systems. A consortium of such organisms may give EM a significant role in sustainable agriculture and the production of superior plant growth.

Effective Microorganisms

Professor Dr. Teruo Higa, of the University of Ryukyus, Okinawa, Japan, produced the first batch of effective microorganisms, which he eventually called EM in 1980. EM is a liquid concentrate and a combination of various beneficial naturally occurring microorganisms mostly used for or found in food. It is produced in vats from cultivations of over 80 varieties of microorganisms. The microorganisms are drawn from ten genera belonging to five different families. The most outstanding characteristic of EM is that it includes both aerobic and anaerobic species coexisting symbiotically in a most beneficially productive manner. EM contains beneficial tiny anabiotic microorganisms from three main genera phototrophic bacteria, photosynthetic bacteria, lactic acid bacteria, yeast, fungi and effective actinomycetes. A positive feature of effective microorganisms is that they secrete large amounts of nutrients such as amino acids, organic acids, chelated minerals, antioxidants, polysaccharides and vitamins when in contact with organic matter. This natural and organic biotechnology has since been successfully commercialized throughout world markets in human health, agriculture, livestock and industrial waste treatment. Thousands of research and efficacy studies have been conducted and documented in projects, conferences and books around the world. (http://www.scdworld.com/deliver.cfm?page=emtech). EM is a fermented mixed culture of beneficial microorganisms. These are lactic acid bacteria, phototropic bacteria and yeast. The culture of EM contains these species, in an acidic medium. This solution does not contain any genetically modified microorganisms. Research and field studies in all continents have shown that the inoculation of EM culture to the soil/plant ecosystem can

improve soil quality, soil health, and the growth, yield, and quality of crops. Similar benefits have also been reported when EM is used in animal production systems. EM can significantly enhance the beneficial effects of soil and crop management practices, especially in organic farming systems. (Higa.T.1994)
Optimum Crop Production The idea of controlling and manipulating the soil microorganisms through the use of inoculants, organic amendments, and cultural and management practices, to create a more favorable soil microbiological environment for optimum crop production and protection, is not new. For at least five decades, microbiologists have known that organic wastes and residues, including animal manures, crop residues, green manures, and municipal wastes (both raw and composted) contain their own indigenous populations of microorganisms, and that these often have broad physiological capabilities. It is also known that when such organic wastes and residues are applied to soil, many of these introduced microorganisms can function as biocontrol agents by controlling or suppressing soil borne plant pathogens through their competitive and antagonistic activities. While this has been the theoretical basis for controlling the soil microorganisms, in actual practice the results have been unpredictable and inconsistent, and the role of specific microorganisms has not been well-defined (Baker 1968, Papavizas and Lumsden 1980, Kloepper et al. 1989).

There have been many reports on the possible mechanisms that can shift the soil microbiological equilibrium, following the addition of microbial inoculants and organic amendments. A brief mention of these is relevant to the subject:

- Antibiosis – production of antibiotics by non-pathogenic microorganisms that can induce biostasis and biocidal effects on others.
- Competition – competition by microorganisms for substrates, space and growth.
- Parasitism – direct parasitic attack on soil borne plant pathogens by nonpathogens.
- Detoxification – metabolism of toxic substances by specific microorganisms.
- Inhibition – production of compounds by microorganisms that can inhibit specific metabolic pathways in others.

For many years, microbiologists have tried to culture beneficial microorganisms for use as soil inoculants, to overcome the harmful effects of phytopathogenic organisms, including bacteria, fungi, and nematodes. Such attempts have often involved single applications of pure cultures of microorganisms, and have been largely unsuccessful for several reasons. Firstly, we did not thoroughly understand the individual growth and survival characteristics of each particular beneficial microorganism, including its nutritional and environmental requirements. Secondly, our knowledge of their ecological relationships and interactions with other microorganisms was lacking. And thirdly, the pure culture inoculant was often not at a sufficiently high inoculum density to enhance the probability of its growth, survival and adaptation in a soil environment (Higa.T 1994).

Higa and Wididana (1991) and Higa (1994) reported a unique approach in maximizing the beneficial effects of microbial inoculants. Through repeated applications of the organic amendment, or mixed culture inoculant, while the level of microbial growth and activity is still high, they can maintain a high inoculum density of the inoculated microorganisms for an extended period. This approach can help to ensure that the numbers of beneficial microbial cultures that promote plant growth and protection will remain high during the first three to four weeks after planting a crop. This is the period when young seedlings and plants are so vulnerable to environmental stresses (e.g., drought, heat, weeds, insects, and diseases).

There are some problems and constraints that have been major obstacles to controlling the microorganisms of agricultural soils. First and foremost is the large number of types of microorganisms that are present at any one time, their wide range of physiological capabilities, and the dramatic fluctuations in their populations that can result from man's cultural and management practices applied

to a particular farming system. The diversity of the total soil microorganisms depends on the nature of the soil environment and those factors which affect the growth and activity of each individual organism including temperature, light, aeration, nutrients, organic matter, pH and water. While there are many microorganisms that respond positively to these factors, or a combination thereof, there are many that do not. Microbiologists have actually studied relatively few of the microorganisms that exist in most agricultural soil, mainly because we don't know how to culture them; i.e., we know very little about their growth, nutritional, and ecological requirements (Higa, 1994).

The diversity and population factors associated with the soil microorganisms have discouraged scientists from conducting research to develop control strategies. Many believe that, even when beneficial microorganisms are cultured and inoculated into soils, their number is relatively small compared with the indigenous soil inhabitants, and they would likely be rapidly overwhelmed by the established soil microorganisms. Consequently, many would argue that even if the application of beneficial microorganisms is successful under limited conditions (e.g., in the laboratory) it would be virtually impossible to achieve the same success under actual field conditions. Such thinking still exists today, and serves as a principle constraint to the concept of controlling the soil microorganisms (Higa, 1994).

Chemical-based conventional farming methods are not unlike symptomatic therapy. Examples of this are applying fertilizers when crops show symptoms of nutrient-deficiencies, and applying pesticides whenever crops are attacked by insects and diseases. In efforts to control the soil microorganisms some scientists feel that the introduction of beneficial microorganisms should follow a symptomatic approach. However, we do not agree. The actual soil conditions that prevail at any point in time may be most unfavorable to the growth and establishment of laboratory-cultured, beneficial microorganisms. To facilitate their establishment, it may require that the farmer make certain changes in his cultural and management practices to induce conditions that will (a) allow the growth and survival of the inoculated microorganisms and (b) suppress the growth and activity of the indigenous plant pathogenic microorganisms (Higa, 1994; Parr et al., 1994).

EM improves the growth and the yield of crops increasing the beneficial microorganisms' populations in soil and nutrient uptake by plant. Plant and microorganisms have been continuously developed in interaction with the proper symbiosis and co-exist by themselves. Therefore, maintaining ecological stability of microbes in soil and increasing of maximum action are important ways for conservation of soil and safety of crop production. At present, EM technology is important for providing sustainable and safe agricultural production. EM is a mixed culture of various bacteria, Actinomyces, yeast and fungi; it has been proved to be very useful and effective in agriculture. It is important to display the property of EM as a living entity and to clarify the mechanism of physiological action, to apply it reasonably (Sustainable Community Development.2000).

Plant Growth-Promoting Rhizobacteria

A group of bacteria are now referred to as plant growth-promoting rhizobacteria (PGPR), which participate in many key ecosystem processes such as those involved in the biological control of plant pathogens, nutrient cycling and seedling establishment, and therefore deserve particular attention for agricultural or forestry purposes (Elo et al., 2000). Moreover, some strains have multiple functions for plant growth. The beneficial effect of Azospirillum may derive both from its nitrogen fixation and stimulating effect on root development Phosphate (P) - and potassium (K)- solubilizing bacteria may enhance mineral uptake by plants through solubilizing insoluble P and releasing K from silicate in soil (Goldstein and Liu, 1987). Some successful examples of inoculation with PGPR have been achieved both in laboratory and field trials; strains of Pseudomonas putida and Pseudomonas fluorescens could increase root and shoot elongation in canola, lettuce and tomato (Glick et al., 1997) and wheat yield increased up to 30 percent with Azotobacter inoculation and up to 43 percent with Bacillus inoculation (Kloepper et al., 1991). Mycorrhizal colonization of roots results in an increase in root surface area for nutrient acquisition. The extrametrical fungal hyphae can extend several centimeters into the soil and absorb large amounts of nutrients for the host root (Khan et al., 2000).

Mehnaz and George Lazarovits (2006) found that three bacterial strains isolated from corn rhizosphere were characterized as Azospirillum lipoferum (N7), A. brasilense (N8), and Pseudomonas putida CQ179. Significantly increased root and shoot weight of corn I. A. lipoferum strain N7 showed significant increase in root and shoot weight of corn. IAA production was considered as the major mechanism responsible for the growth promotion by these three strains.

Diazotrophic heterocystous cyanobacteria are known to possess the ability to form associations with vascular/non-vascular plants and produce growth-promoting substances. Most of the work on cyanobacterial inoculants has been focused on rice while other crops have received little attention. Field level evaluation of these strains and testing under different agro-climatic conditions will help to further evaluate their agronomic efficiency and utility in integrated nutrient management of wheat crops (Nanjappan Karthikeyan.2007).

Biofertilizer

Biofertilizer has been identified as an alternative to chemical fertilizer to increase soil fertility and crop production in sustainable farming. Wu, S.C. et al (2005) used four biofertilizers containing an arbuscular mycorrhizal fungus (Glomus mosseae or Glomus intraradices) with or without N-fixer (Azotobacter chroococcum), P solubilizer (Bacillus megaterium) and K solubilizer (Bacillus mucilaginous) on soil properties and the growth of Zea mays. The use of biofertilizer (G. mosseae and three bacterial species) resulted in the highest biomass and seedling height. Microbial inoculum not only increased the nutritional assimilation of plant (total N, P and K), but also improved soil properties, such as organic matter content and total N in soil.

Organic farming is becoming a major tool for sustaining the soil quality degraded by intensive use of synthetic chemicals for increasing crop production and therefore, use of bio-agents as biofertilizers or biopesticides is an integral part of organic farming especially in vegetable cultivation. An effort was, therefore, made to see the effect of arbuscular mycorrhizal fungi (AMF) and pseudomonads as the microbial inoculants in vegetable based cropping systems under organic farming practices. Three crops taken in rotation were okra, pea and cowpea in a year. The inoculants used were Glomus intraradices, an arbuscular mycorrhizal fungus, and four isolates of Pseudomonas fluorescens singly and in combinations. No chemical/organic fertilizer was added during two rotations of chosen vegetables except the crop residues, which were chopped and distributed equally onto each plot after fruit harvest. A significant increase in yield was observed in the inoculated plots. Culturable microbial diversity was increased compared with the start of the experiment. Functional diversity assessed in terms of cellulase, xylanase, amylase, protease producers and P-solubilizers showed that the inoculants worked beneficially for maintaining soil health. The mycorrhizal inoculation followed by combination of AMF and pseudomonads proved to be better. Under organic farming management practices, inoculated bioagents and crop residues increased the yield of vegetables (Rashmi Srivastava.2007).
Conclusion Many microbiologists believe that the total number of soil microorganisms can be increased by applying organic amendments to the soil. This is generally true because most soil microorganisms are heterotrophic, i.e., they require complex organic molecules of carbon and nitrogen for metabolism and biosynthesis. Whether the regular addition of organic wastes and residues will greatly increase the number of beneficial soil microorganisms in a short period of time is questionable. However, we do know that heavy applications of organic materials, such as seaweed, fish meal, and chitin from crushed crab shells, not only helps to balance the micronutrient content of a soil but also increases the population of beneficial antibiotic-producing actinomycetes. This changes the soil to a disease-suppressive condition within a relatively short period.

This information then emphasizes the need to develop methods for isolating and selecting different microorganisms for their beneficial effects on soils and plants. The ultimate goal is to select microorganisms that are physiologically and ecologically compatible with each other and that can be introduced as mixed cultures into soil where their beneficial effects can be realized (Higa, 1994).

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Effect of bacterial isolates on root weight of four corn varieties after 30 days' growth in sterilized sand

Treatments	39D82 (mg/ plant	39H84 (mg/ plant)	39M27 (mg/ plant)	39T68 (mg/ plant)
Control	260 T 40 bc	210 T 56 a	270 T 50 a	220 T 60 c
A. lipoferum N7	300 T 42 a	220 T 36 a	270 T 47 a	255 T 52 abc
A. brasilense N8	290 T 41 ab	200 T 59 a	265 T 63 a	270 T 64 ab
P. putida CQ179	250 T 34 c	215 T 39 a	250 T 46 a	270 T 64 ab
G. azotocaptans DS1	250 T 32 c	220 T 65 a	260 T 41 a	280 T 90 a
G. diazotrophicus Wt	260 T 33 bc	210 T 57 a	290 T 42 a	230 T 49 bc
G. diazotrophicus nifD	250 T 40 c	200 T 42 a	250 T 42 a	240 T 50 abc

Values are averages of 12 replicates. Letters indicate a statistically significant difference between treatments according to Duncan's multiple range test at P =0.05. Mean separation within a column followed by the same letters do not differ significantly(Mehnaz and George Lazarovits.2006)

Bacteria currently used as agricultural inoculants in the field and new bacteria developed by genetic modification for improved performance. (NRCS)

Wild-Type Bacteria	Crop Inoculated	Usage
Anabaena-Azolla **Azospirillum brasilense and A. lipoferum**	Rice Cereals	Biofertilizer Biofertilizer
Bradyrhizobium japonicum **Rhizobium spp.**	Forage and grain legumes	Biofertilizer Biofertilizer
Frankia spp.	Non-leguminous trees (Alnus)	Biofertilizer
Bacillus subtilis and B. thuringiensis **Psuedomonas fluorescens** **Pseudomonas spp.**	Different crops	Biopesticide Biopesticide
Improved bacteria	Modified trait	Goal of modification
Agrobacterium radiobacter	Deletion of transfer genes	Safe use for biological control of crown gall
Clavibacter spp.	Addition of endotoxin from Bacillus thuringiensis	Biological control of insect damage to crops
Bradyrhizobium japonicum	Additional copies of nif gene	Increased nitrogen fixation
Pseudomonas syringae	Deletion of ice nucleation gene	Control of frost damage to crops
Rhizobium meliloti	Additional copies of nif and/or dct genes	Increased nitrogen fixation

Bacteria currently used as agricultural inoculants in the field and new bacteria developed by genetic modification for improved performance. (NRCS)

Effect of EM on the Yield of Chinese Cabbage			
Treatment	Yield (tons/ha)	Increase yield (tons/ha)	Increase rate (%)
Control	61.51	-	100
EM-1	66.46	4.95	108.0
EM-3	67.92	6.41	110.4

Effect of EM Application Time on the Growth of Rice Seedlings					
Application time	Height (cm)	Root length (cm)	Number of roots	Dry matter (g/100 plants)	
				shoot	root
1st day before sowing	15.67	11.58	4.8	0.740	0.390
15th day before sowing	16.46	12.67	5.8	0.748	0.400

Effect of EM on Mobilization of Nitrogen in Soil			
Treatment	Mobile -N (mg/100g soil)	Increase content	Increase rate (%)
control	2.67	-	100
EM-1	3.04	0.37	113.8
EM-3	2.83	0.16	105.9
EM-4	2.84	0.17	106.4

Source (Sustainable Community Development.2000)

SOS From Planet Earth

Rahul Singh
Former Editor of Reader's Digest, Indian Express and Khaleej Times

Our planet earth is going into a tailspin, thanks to an unprecedented environmental crisis. A number of factors are responsible for this and they all interact with each other: water and food shortages, global warming and climate change, and a continuing population growth. There was a time, not so long ago, when many scoffed at the doomsayers, claiming that they were being unnecessarily alarmist and that scientific progress and human ingenuity would take care of everything. No longer. There is now a widespread acceptance that the world is at a tipping point and unless we do something fast, some of the changes that are taking place will be irreversible.

Let us start with population. In the past 50 years, the number of people in the world has more than doubled, from three billion to 6.5 billion. At current growth rates, global population will total over nine billion by 2050, when it may start stabilizing. The urban increase in population has been even more drastic. In 1900, there were just 200 million people living in towns and cities; by 2000, there were 2.9 billion, almost 15 times as much. In 1900, there were only 19 cities with a population of one million or more; by 2000, there were 388. Worldwide, there are now almost as many people living in urban areas as in the countryside.

The population increase has taken place almost entirely in the developing world, in other words among the poorest and least developed countries. In fact, in the developed world, population is either static or declining. India's population is going up by 20 million a year, which is the entire population of Australia. In Yemen (more about that country later), it is going up by three percent a year, one of the highest increases in the world and if it continues at that rate, Yemen's population of 22 million will double in a little over two decades. This is also the case with several other countries in the Middle East.

Greater numbers means higher consumption in virtually every area of human activity: more vehicles, power plants, factories – and, of course, more food and accommodation. Land has to be cleared to house and feed the extra numbers. In the 20th century, half the world's original forest area was cleared for such purposes. Population pressures in Brazil have led to the destruction of much of the Amazon rain forest. Flora and fauna have been destroyed in the process, some for ever, others severely endangered. The magnificent tiger, the king of the jungle, now found in the wild in just a few countries, may be confined to zoos in a few years' time.

Let us now turn to global warming and climate change, which was the subject of a recent Oscar-winning documentary film

that has been shown all over the world to tens of millions of people, An Inconvenient Truth, by former US Vice President, Al Gore. As the film dramatically shows, the earth is getting warmer, leading to climate change of the kind that we have not experienced in living memory.

Freakish and disastrous phenomena have occurred in the past few years. Nature seems to have gone berserk: there was Hurricane Katrina in New Orleans, USA; the skies over much of Indonesia turned orange as a result of fires sweeping over the country; and a downpour in Mumbai, the like of which the Indian city had never seen, took several hundred lives. I am writing this from Kasauli, a small town 6,000 feet high in the Indian Himalayas. It is June, normally the hottest and driest month in the year. Instead, there has been chilly, heavy rain in the region, the coldest and wettest June that the older residents of the town can recall. The monsoon normally hits this part of India in mid-July. This time, however, it is over a month early. So, climate change is not just about global warming; it also about strange weather conditions and how it is getting unusually cold and wet in certain parts of the world.

Yes, there can be no doubt about it. Something very strange is happening to our planet earth, and it has a lot to do with one particular gas – carbon dioxide. The amounts of this gas in the atmosphere effectively controls the climate. The earth went into the ice age when carbon dioxide levels were very low. They have been constant in the modern, largely human era, with the ice retreating into the polar caps. However, in the last 150 years, the carbon dioxide levels have gone up perceptibly, raising the temperature of the earth, not by very much, but enough to make a huge difference.

The global average surface temperature has increased over the 20th century by about 0.6 percent. This may seem minuscule but the United Nations Environment Programme (UNEP) says it is probably the largest rise in temperature for any one century during the past 1,000 years. If the trend continues, the global average surface temperature will go up by 1.4 to 5.8 degrees C by the end of this century. We should be alarmed. A study by an international team of scientists has found that the Arctic is warming nearly twice as fast as the rest of the world, snow cover declining, and permafrost (frozen ground, like that commonly found in Siberia and Canada) increasing in temperature at a rapid rate. Land ice, all over the world, including glaciers, is vanishing due to global warming.

Why are carbon dioxide levels going up? Largely because of increasing fossil fuel consumption and deforestation. The cutting down and burning of trees releases carbon dioxide into the air, while fossil fuel consumption means using up coal, oil and methane that has lain for eons under the surface of the earth and is now being released into the atmosphere. These released gases are also referred to as “greenhouse gases”. The world’s energy needs – petrol for cars and coal for electricity, for instance – are increasing the greenhouse gases in the air. And these energy needs are growing, as large countries like China, India and Brazil develop faster.

The USA, with only five percent of the world’s population, presently produces 25 percent of all greenhouse gases. But in just another 12 years, China is likely to overtake the US in greenhouse gas emissions, so huge is China’s hunger for fossil fuels, to feed its galloping energy needs, with its economy growing at around 10 percent a year. Mention has been made of how the world’s population has exploded, quadrupling in the last century, but the emission of greenhouse gases has gone up 12 times in the same period.

One of the inevitable consequences of global warming and the melting of glaciers and the ice-caps, is a rise in ocean levels. It has been estimated that a one-meter rise in sea levels would cause coastlines all over the world to retreat by some 1,500 meters. When you consider that one-third of the world’s population live along coastlines, the consequences are bound to be absolutely catastrophic: the rice-lands of Bangladesh, a largely low-lying country, would be reduced by half; more than half of Shanghai would be inundated; many islands, like the Maldives and Seychelles, would be either completely wiped out or devastated. Most of the Gulf nations would also be affected.

Though there is going to be more water in the seas as a result of global warming, yet, paradoxically, there will be less water to go around for essential purposes. This could perhaps be

the worst short-term consequence of climate change and may reach crisis proportions very quickly. Only 2.5 percent of the world's water is not salty. Of this 2.5 percent, two-thirds of it is locked up in ice-caps and glaciers. Of what is left, 20 percent is in remote areas. What is actually available to us is 0.08 percent of the world's fresh water. Yet, in the next two decades, water use is expected to go up by 40 percent.

Those are frightening statistics. Even more scary is the rate of depletion of underground water. Scores of countries are over-pumping their aquifers, resulting in a catastrophic drop in the underground water table. Worse, what are categorized as "fossil aquifers," which have been there for thousands of years and which cannot be replenished, are drying up. One of them is in Saudi Arabia. This fossil aquifer is being used to irrigate the country's wheat crop. But the cost of bringing the water up from such great depths – often, over a kilometer – and then get it to the fields is so great that the wheat grown in Saudi Arabia is five times the world price. Hence, it has to be heavily subsidized. The Saudi government has belatedly realized the shortsightedness of such a policy and is phasing out wheat production. But it may be too late to save its fossil aquifer. In eastern Iran, villages are being abandoned as wells are drying up due to over-pumping of underground water. This has created what is becoming known as "water refugees."

Desalination provides most of the water needs of the Gulf but it is an expensive process and the Middle East remains the most concentrated water scarcity region in the world. Nine out of 14 countries there are facing acute water shortages, while the population in six of them will double in the next 25 years. Yemen's water table is falling by two meters a year. In the next two years, the water basin below the national capital, Sana'a, home to two million people, is expected to run dry. Which is why Yemen is being described by water experts as a hydrological basket case: grain production has declined by two-thirds over the last 20 years and the nation has to import four-fifths of its food needs, mainly because of the shortage of water. Not without reason has it been said that the Gulf region may be oil-rich but it is exceedingly water-poor. Oil has been referred to as the "liquid gold" of the past few decades. Water could soon become just as precious and valuable in the decades to come.

So, what can be done to avert the catastrophe that lies ahead, or at least to lessen its impact?

One, there needs to be a sustained drive to stabilize population growth, since extra numbers are at the heart of the environmental crisis. Two, there must be less wastage and greater efficiency in the use of water, such as drip-irrigation, rainwater harvesting, and the setting up of more desalination plants. A corollary is that there should be less pumping out of underground water, especially from fossil aquifers, so that the underground water table rises higher. Three, the use of other sources of energy – other than fossil fuels – has to be intensified and the trend of growing grain for ethanol, as the US is doing, arrested, since this has led to a spurt in food prices, even to food riots in some countries. Lastly, but perhaps most importantly, all of us, in the developed and developing world need to realize that the health of our planet earth is in serious decline, endangering the lives of millions, thanks to our greed and our folly. Grave mistakes have been made in the past. We should learn from them, not repeat them.

"My grandfather rode a camel, my father rode a camel, I drive a Mercedes, my son drives a Land Rover, his son will drive a Land Rover, but his son will ride a camel."

Sheikh Rashid bin Saeed Al Maktoum

Although said in the context of concern for Dubai's diminishing oil reserves, this quote from the late Sheikh, taken in the environmental context, poignantly reflects a warning for the nation if air pollution continues to be uncontrolled.

While we are still able to enjoy a semblance of the natural environment through desert tours and scenic spots like the Hajjar mountain ranges, these places are giving way to accelerating urbanization. Maintaining basic greenery and combating desertification has become an uphill task and is taxing on water resources; albeit impressive, the cosmopolitan skyline of Dubai cannot reveal its full splendor under the cloak of air pollution.

If air pollution remains unabated, the prospect of riding camels instead of driving may not be such a farfetched notion.

The photos were contributed by GRC's summer interns Chan Jingzhong and Faith Hu. Faith and Jingzhong are 3rd-year undergraduates from Singapore Management University.

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

State of Qatar

Qatar, a tiny Gulf emirate, is located on a peninsula that heads out almost due north from the eastern side of Saudi Arabia into the central Persian Gulf. Other neighbors include Bahrain to the south-west and the United Arab Emirates to the south-east. It only has one land border, which is with Saudi Arabia - the border runs across the neck of the Arabian Peninsula. This strategically placed country is mostly low lying, rising from sea level along the Gulf to the modest 103-metre-high Qurayn Abu al-Bawl. A large part of the country is a dry and barren desert, composed mainly of sand and gravel. Climatic conditions in the State of Qatar are hot, arid, with scanty rainfall, hot dry summer winds and high relative humidity as usually experienced for the greater part of the year. Average annual rainfall and temperature are 31.3 mm and 27.5oC, respectively, for the capital Doha.

Environmental Resources

Water resources: The primary source of fresh water in the country is ground water (2500 millions of cubic meters). About 98 percent of ground water withdrawal (amounts to 244 million cubic meters in 1997) is for agricultural purposes creating an imbalance between sustainable supply and demand, and which has also resulted in both an annual deficit (39 million cubic meters) and an accumulated deficit in the range of 1000 million cubic meters. The annual recharge by the seasonal rains was also estimated at 54 million cubic meters in the same year (1995). Wastewater reuse was estimated at 25 million cubic meters. The country consistently depends on desalinization of sea water (92 million cubic meters) to meet all of its domestic and industrial demands for water. Hence, the total estimation of water resources was estimated at 2618.35 million cubic meters. Surface fresh water is scarce and if ever any, consists only of short-period rainfall poundings in depressions, wadis or runnels.

Natural Resources: petroleum, natural gas, fish

Environmental Challenges: The very poor ecosystem mainly suffers from:

- Scarcity in fresh ground water resources, their depletion due to very high imbalance withdrawals and the consequent deterioration in quality (high salinity);
- Harsh climate which leads to over-irrigation and its coincidence with other in-efficient irrigation, poor production management practices, consistently in use; and the resultant land degradation (farm abandonment).
- The high toll of socio-economic developments on the delicate and sparse vegetation coupled with the very relative effects of overgrazing and changes in nomadic pasturalism and weed-cutting traditions;
- Wind desertification mainly in the sand dunes area of the south and adjacent pasture and agricultural lands (170,000 ha). Also shallow profile soils (approximately 136,000 ha) are said to be susceptible to water erosion due to the occurrence of erratic rainstorms.

Environment Agreements

The agencies concerned in Qatar support regional and international conventions for the protection of the environment, and participate with the international communities. Qatar is party to conventions on biodiversity, climate change, desertification, endangered species, hazardous wastes, and ozone layer protection.

Environmental Authorities (Local & Regional)

- Ministry of Regional Municipalities, Environment, and Water Resources

Regional Agencies:

- Regional Organization for Protection of Marine Environment (ROPME)
- The Red Sea and Gulf of Aden Environment Program (PERSGA).

Facts	
Official Name	State of Qatar
Capital	Doha
Population	628,000 (UN, 2005)
Location	Middle East, peninsula bordering the Persian Gulf and Saudi Arabia
Total Area	11,437 km2
Length of Coastline	563 km
Climate	arid; mild, pleasant winters; very hot, humid summers
Terrain	mostly flat and barren desert covered with loose sand and gravel
Land Use	arable land: 1.27% permanent crops: 0.27% other: 98.46%

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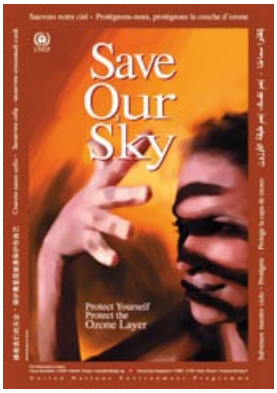
Ozone Layer Protection Day

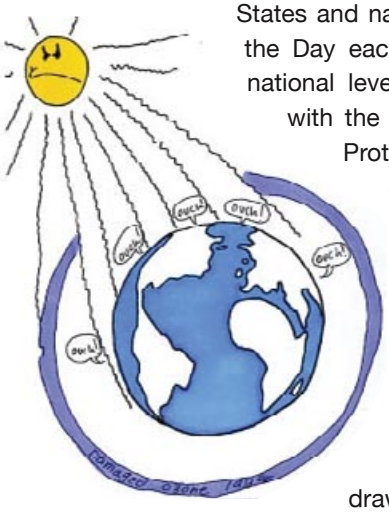
What and When is the International Day for the Preservation of the Ozone Layer?



International Day for the Preservation of the Ozone Layer commemorates the day in 1987 on which the Montreal Protocol on Substances that Deplete the Ozone Layer was signed - 16 September. The main objective of the Montreal Protocol is to protect the thin layer of ozone in the stratosphere, located between 10 and 50 kilometers above the Earth, which absorbs all but a small fraction of the harmful ultraviolet radiation (UV-B) emanating from the Sun and protects all life on Earth.

This special day was initally celebrated in 1995 and each 16 September we continue to pause to indicate the International Day for the Preservation of the Ozone Layer, which provides us with an opportunity to reflect on the health of the Earth's ozone layer and to mark Australia's achievements to reduce our impacts on the ozone layer. This commemoration around the world also offers an opportunity to focus attention and action at the global, regional and national levels on the protection of the ozone layer.

What happens on Ozone Layer Protection Day?



States and nations are invited to devote the Day each year to promote, at the national level, activities in accordance with the objectives of the Montreal Protocol and its amendments. Some of the activities conducted by parties for the International Day for the Preservation of the Ozone Layer are as follows:

- Round table discussions
- Competitions for children's drawings
- Speeches by Minister for Environment, Natural Resources and Wildlife, and representatives from the Ozone Secretariat, UNEP, UNIDO and UNDP
- Workshops to raise people's awareness
- Press conferences and video cassette shows on the Ozone layer
- Poster distribution to the public
- Public address by the local ministers and UN representatives

Main Ozone Protection Themes and Events in Previous Years

2007	"Celebrating 20 years of progress in 2007": Commemoration of the 20th anniversary of the Montreal Protocol, including a publication recognizing some of the exemplary projects undertaken.
2006	Protect the Ozone Layer: Save Life on Earth: Forum on the preservation of the marine ecosystem through the protection of the ozone layer.
2005	Act ozone friendly-Stay Sun Safe: Workshop of "Evaluation of the retrofit done on refrigerant and air conditioning equipment."
2004	Save O_3ur Sky: Ozone Friendly Planet, Our Target: Roundtable Meeting on Compliance Challenges in West Asia.
2003	Save Our Sky: There is a Hole Lot More to Do for Our Children: Environmental Effects Assessment Panel (EEAP).
2002	Energy Efficiency and Saving For Climate and Ozone Protection in Vietnam.
2001	UNEP/UNESCO Exhibition of children's paintings from developing countries on the protection of the ozone layer.
2000	Selected Issues on CO2 as Working Fluid in Compression Systems.
1999	IIR/IIF Refrigeration into the Third Millenium: Twentieth International Congress of Refrigeration.
1998	Implementation of the Refrigerant Management Plan: Training of Trainers for Good Refrigeration Servicing Practices.
1997	Ninth Meeting of the Parties of the Montréal Protocol 10th Anniversary of the Montréal Protocol
1996	2nd International Ozone Day Celebration (various countries)

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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.

August 2008	Project is Launched: First meeting of Steering Committee
September 2008	First Workshop
December 2008	Second Workshop and Second meeting of Steering Committee
March 2009	Third Workshop and Third meeting of Steering Committee
July 2009	Fourth Workshop and Fourth meeting of Steering Committee
December 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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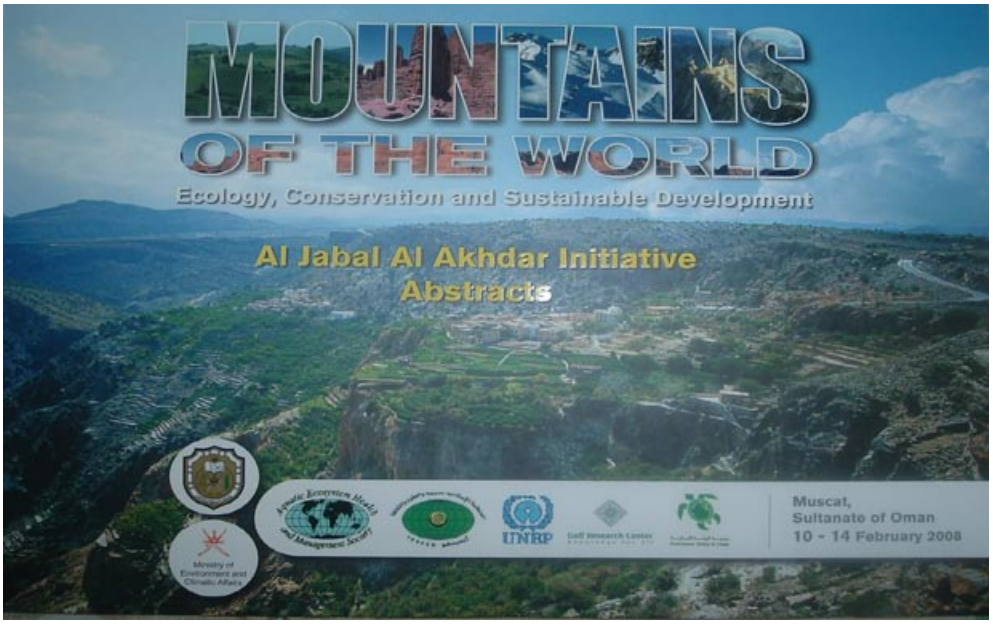
Water Policy and Associated Technological Challenges in Arid Dynamic Environments

April 28-29, 2008

GRC Participated in the first conference on "Water Policy and Associated Technological Challenges in Arid Dynamic Environments: the special case of Arabian Gulf countries, bridging the gap between water science and policy making" organized by The University of Texas Center for International Energy and Environmental Policy, in collaboration with Schlumberger Water Services and hosted by American University of Kuwait. The GRC delivered remarks in the panel "Water Policy and Cost Recovery Options". GRC will publish an event report.

Mountains of the World - Ecology, Conservation and Sustainable Development



February 10 -15, 2008

The GRC co-organized and participated in the conference "Mountains of the World - Ecology, Conservation and Sustainable Development," held from February 10-15, 2008, in Muscat, Sultanate of Oman. The event was organized by the Center for Environmental Studies and Research (CESAR) at Sultan Qaboos University in association with the Ministry of Regional Municipalities, Environment and Water Resources (MRMEWR). GRC will publish the conference proceedings.

Visitors

June 9, 2008

Dr. Andreas Schild, director general, International Center for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal, visited GRC to discuss possible cooperation in environmental issues.

April 24, 2008

As part of a Business Study Mission to the Gulf region, a group of 30-plus students from Singapore Management University (SMU) visited the GRC where they were briefed about the environmental, political, economic and security dimensions of the Gulf region. The delegation was led by Dr. Caroline Yeoh, Associate Professor of the Lee Kong Chian School of Business of SMU and was accompanied by two representatives from Raffles Junior College.

April 14, 2008

Dr. Adel M. Abdel Kader, regional coordinator, Division of Early Warning and Assessment, UNEP- West Asia office, visited GRC to discuss possible cooperation in environmental activities especially the UNEP potential GEO Gulf Region Environmental Assessment research project.

February 25, 2008

Muna Ahmad Ali, Environment Specialist in Dubai Aluminum Company (Dubal), visited GRC to discuses future cooperation between GRC and Dubal in environmental activities, training and research.

Participation

June 24-25, 2008

Dr. Mohamed A. Raouf, Senior Environment Research at GRC participated in the first Annual Meeting of the Global Humanitarian Forum (GHF) held in Geneva. Dr. Raouf took part in the discussion sessions of Climate Change and Water and International Food Crisis. The event was attended by various experts and scientists from around the world, as well as many politicians such as Javier Solana, High Representative for the Foreign and Security Policy, European Union; Secretary General, Council of the European Union. It is worth mentioning that the GHF is founded and chaired by Kofi A. Annan, the seventh Secretary-General of the United Nations.

May 26-27, 2008

Dr. Mohamed A. Raouf gave a presentation about "Water Policy in GCC Countries, Current Status and Recent Initiatives' as well as being a panelist on the discussion "Demonstrating a sustainable water management plan to address the water scarcity issue in the Middle East", during the Middle East Waste and Water Congress organized by Marcus Evan in Dubai.

May 6-7, 2008

Dr. Mohamed A Raouf Program Manager Environment at GRC participated and made a presentation "Assessment of the Media Role in Environmental Issues in the UAE" at the Environmental Thinking Forum organized by the Federal Environment Agency. The event was hosted by the Emirates Center for Strategic Studies and Research (ECSSR).

April 15, 2008

GRC Participated in "Carbon Emissions Trading in the Gulf Region" organized by Ecosecurities and held at the Dubai Creek Golf and Yacht club.

March 25, 2008

Dr. Mohamed A. Raouf delivered a lecture, "Environmental Accounting and Costing: concept and case study" at the American University of Sharjah and organized by the environment program of the School of Science for students from various schools.

February 26, 2008

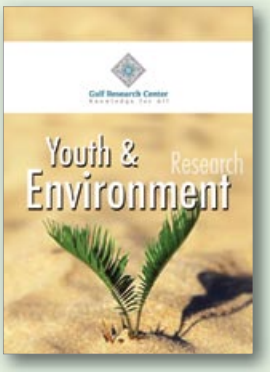
GRC Participated in "Climate Change and Clean Development Mechanism in the Gulf Region" at Environmental Day 2008 organized by the School of Science at the American University of Sharjah.

Internship

Faith Hu is a 2nd year student from Singapore Management University, studying business management with marketing as her major and a secondary degree in social science. Her strong interest in climate change and ecology prompted her to join GRC as an intern under Dr. Raouf, working on research projects relating to the environment at both regional and global levels. Faith believes that gaining a deeper understanding of environmental management will help further her efforts in business-related areas like corporate social responsibility as well as in shaping public sector environmental policies in future.

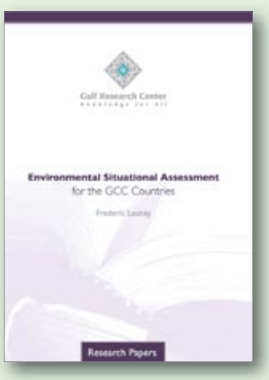
Green Gulf Report

GCC Environmental Action Origin, Challenges and Prospects (Arabic)

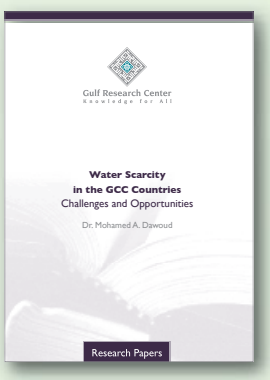


Youth and Environment Research

Economic Instruments as an Environmental Policy Tool: The Case of GCC Countries (English-Arabic)



Environmental Situational Assessment for the GCC Countries



Water Scarcity in the GCC Countries: Challenges and Opportunities

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