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Biosalinity News

Newsletter of the International Center for Biosaline Agriculture

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FROM THE EDITOR

This current issue of *Biosalinity News* introduces the new members of ICBA Board of Directors to our readers. The Board held their inaugural meeting in February at ICBA headquarters in Dubai.

As well we are pleased to share with you the great news that during the last few months, ICBA received not only one but two awards in recognition of its scientific endeavors – the *H2O Award* and the *Khalifa Date Palm Award*.

ICBA researchers have been recently working on the research and formulation of the *United Arab Emirates Water Conservation Strategy* and we include a summary of our findings.

Mohammed Shahid of the ICBA's Plant Genetics Resources Unit introduces *Salicornia bigelovii* as a versatile crop for the seawater agriculture.

News on meetings, capacity building and new staff is also included.

Contributions on research or projects of interest to our readers are always welcome, as are letters to the Editor. Please send your submissions, including relevant photographs and figures, to:

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INAUGURAL MEETING OF NEW BOARD OF DIRECTORS

As a outcome of the revised and extended agreement regarding the financial support of the Center, which was signed in 2010 by the Government of the United Arab Emirates represented by His Excellency Dr Rashid Ahmad Bin Fahad, the Minister of Environment and Water, and His Excellency Dr Ahmad Mohamed Ali, the President of the Islamic Development Bank, new members were appointed to the ICBA Board of Directors.

From left to rightt (front): Mr Abdelrahim Mohammad Alhammadi, Mr Fawzi AlSultan, Mr Mohammad Jamal Al-Saati and Her Excellency Razan Khalifa Al Mubarak; (back): Dr David J Molden, Dr William Sutton, Mr Adel Abdulla Alhosani, Dr Mahmoud Solh and Dr Shawki Barghouti

The prestigious new lineup of members comprise:

- **Mr Fawzi AlSultan**, Chairman of the Board;
- **Mr Abdelrahim Mohammad Alhammadi**, Ministry of Environment and Water;
- **Her Excellency Razan Khalifa Al Mubarak**, Secretary General, Environment Agency-Abu Dhabi;
- **Mr Mohammad Jamal Al-Saati**, Director, Operations Policy and Services, Islamic Development Bank;
- **Mr Adel Abdulla Alhosani**, Director, Projects Department, Abu Dhabi Fund for Development;
- **Dr Mahmoud Solh**, Director General, International Center for Agricultural Research in the Dry Areas;
- **Dr William Sutton**, The World Bank;
- **Dr Nadim Khouri**, Director, Near East & North Africa Division, Programme Management Department, International Fund for Agricultural Development;
- **Dr David J Molden**, Deputy Director General – Research, International Water Management Institute; and
- **Dr Shawki Barghouti**, ICBA Director General (*ex officio*).

The new Board of Directors held their inaugural meeting from 2nd to 3rd February at ICBA headquarters in Dubai. Scientists welcomed the opportunity to meet with the new Board members during their visit to ICBA's Research Station.

Board members visit ICBA's Research Station and meet with scientists

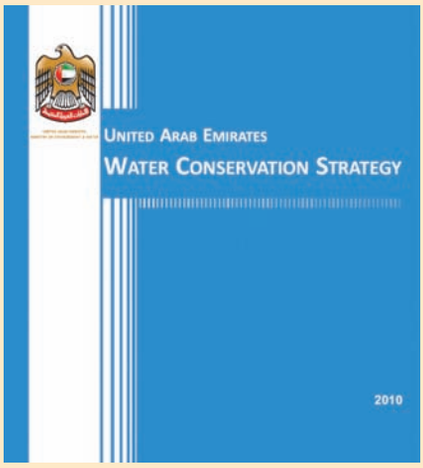
United Arab Emirates Water Conservation Strategy

The United Arab Emirates Ministry of Environment and Water in collaboration with the International Center for Biosaline Agriculture developed the United Arab Emirates Water Conservation Strategy*. Highlights of the water resources and use in the UAE as well as the key initiatives of the strategy are summarized below.*

Background

The challenge of balancing water demand against supply is enormous for a country such as the UAE which is located within the hyper-arid and arid climate zones of the Arabian Peninsula. The demand for fresh water has increased with the remarkable economic development of the last thirty years, and concomitant accelerating population growth, higher living standards, and expansion of the agricultural, forestry and industrial sectors. The per capita water consumption is among the highest in the world, creating an enormous strain on the water budget. The burgeoning demand was initially met through pumping fresh but non-renewable groundwater; consequently many of the country's aquifers have now been depleted to great depths and deterioration in water quality has resulted in many places. To bridge the resulting supply gap there has been an enormous expansion of non-conventional water resources, particularly desalinated water. However, this has important implications for both energy supplies and environmental protection.

In reviewing the current water management situation in the UAE, it is important to start with the country's constitution. Under Article 23 of the UAE Constitution it is stated that natural resources are the property of the individual Emirates and so the principal institutions, laws, regulations and day-to-day management are predominantly found at this governance level. Yet water is in effect a national shared resource with the sea, groundwater and atmosphere acting as a common source and sink for the water production and discharge activities. The actions of one have implications for all Emirates and there is thus a need for a comprehensive strategic framework for water policy, planning and management to overcome some of the problems found from the current fragmentation and the disparities that exist between them.



Objectives of the strategy

1. Provide an updated and integrated assessment of UAE's water resources and their use;
2. Provide an understanding of what governs water demand, allocation and use;
3. Identify the options to improve the efficiency of

***H.E. Dr Rashid Ahmed Bin Fahad**, the UAE Minister of Environment and Water, introduced the strategy with the following words:*

The remarkable achievements in the United Arab Emirates' water sector over the last three decades have allowed the country to sustain water services for the growing population, thus sustaining high standards of living, and meeting the needs of agricultural activities and forestry and the growing industrial sector. However, the future growth of the water sector is increasingly constrained by the rapidly dwindling renewable water resources, the increasingly high costs of new water infrastructure investment and concerns about environmental sustainability. In response to the United Arab Emirates' government vision for the sustainable development of natural resources and achievment of water security, the Ministry of Environment and Water has taken the initiative to develop a strategic framework for the sustainable management of all water resources in the United Arab Emirates (UAE). This framework has been developed based on the scientific analysis of the main factors affecting the supply and demand for water in the UAE. A challenging feature of this strategy is to ensure that the water sector is responsive to the dynamic growth path that has been charted for the country while taking into account that renewable water resources in the UAE are among the lowest in the world.

The water conservation strategy is based on an integrated approach that considers meeting future water demand from a mix of investment in new water infrastructure and efficiency improvements of existing water supplies. The strategy embraces all water supplies - natural resources, desalination and reclaimed water - and all water uses. The strategy has been adopted based on careful studies of the available water resources and water use, and critical analysis of water institutions and policies in the country. To implement the strategy, the Ministry of Environment and Water has adopted its eight important outcome initiatives to guide the comprehensive management of water as an integrated resource. These initiatives provide important steps toward achieving water security in UAE. The outcomes are expected to be responsible national policies, rules, and regulations that will be designed to improve the management of the nation's precious water resources and enhance their contribution to the economic growth of the country.

This Strategy for Water Conservation represents a major achievement in the realization of the Government's vision to secure sustainable water resource development for future generations, and will be implemented, monitored and sustained through close coordination with all water sector related partners in the UAE.

Special appreciation goes to the International Center for Biosaline Agriculture (ICBA) for undertaking this study in partnership with the Ministry of Environment and Water and to all water and environmental authorities and organizations in UAE for their contributions in the workshops and provision of data and information for the development of this Water Conservation Strategy.

water allocation and use, reduce costs and improve the environment;

4. Make recommendations to strengthen Federal policy, laws and capacity to comprehensively oversee sound water resources management and use; and
5. Enhance water security and protect surface water and groundwater resources, marine, and the environment.

Water Resources

Water is supplied from three main sources:

1. Groundwater supply which supplies about 51%, mostly for irrigation uses, but some limited quantities are used for potable uses particularly in the Northern Emirates;
2. Desalinated water supply, which supplies about 37%, mainly for potable water uses, and in some places are also used for irrigation; and
3. Reclaimed water supply (also known as treated sewage effluent), which accounts for 12%, and mainly used for irrigating amenity areas.

UAE organizations operate around 70 desalination plants, representing about 14% of the total global capacity. The majority of these installations are in the Emirate of Abu Dhabi (about 67%) whilst Dubai has around 18%, and Sharjah (10%) and the Northern Emirates (about 5%) having limited capacity. As with most aspects of water management in the UAE, the planning and managing of desalination projects is carried out at the Emirate level with little coordination either between them or with Federal institutions. The current cost for producing this water is about AED 7.16 (USD 1.95) per m^3, with annual production costs reaching about AED 11.8 billion (USD 3.22 billion) for the year 2008. There is an argument that with coordinated planning, regulations and management, economic savings could be made particularly in capital expenditure where future plants could be designed to the same or better standards.

Reclaimed desalinated water is becoming increasingly viewed as an important resource for certain areas of usage. More than 60 wastewater treatment plant exists in the UAE. While there is universal access to sewerage systems and septic tanks, wastewater can only be reclaimed from those connected to the sewerage systems. The percentage of people served with sewerage networks varies among the Emirates ranging from 0 to 95%. Currently, about 0.56 km^3 of reclaimed water are available in UAE, with two-thirds of this used for irrigating amenity and landscaping, and a third is lost to the sea or the desert.

The possibilities for the use of reclaimed water are controlled by a number of factors particularly with regards to its quality. As far as controls on the inputs to the sewerage network are concerned, between the Emirates there are currently different rules for connecting and discharging industrial and domestic wastewater to the system and concomitant variations in the sets of standards for the quality of effluent accepted. Further variables that can affect the reclaimed water quantity and quality include leakages of brackish groundwater into the network, which limits its subsequent use in growing vegetation.

Water Use

The increase in total water consumption is a growing problem in UAE, reaching about 4.6 km^3 in 2008. The agricultural water sector remains the largest consumer using about 34% of total water, whilst domestic and industrial water sector (32%), forestry sector (15%), and amenity (11%) are the other key areas, where losses accounts for the remaining 8%. These values highlight that in the overall water consumption, over 60%, is used to grow vegetation of one form or another (agricultural, forestry and amenity water uses). Given the importance of agriculture and recent rates of economic expansion it comes as no surprise to find that most water is consumed in Abu Dhabi Emirate (61% of the total water use), followed by Dubai Emirate (18%), whilst the Emirate of Sharjah and the Northern Emirates use about 21% of total.

Looking in more detail at domestic consumption, the average daily usage of 364 litres per capita per day (lpcpd) is much higher when compared with other developed countries such as the United States of America (295 lpcpd), Spain (270 lpcpd) and Greece (180 lpcpd). Urban water consumption rates continue to increase in the UAE. An increasing amount of this is used outside the actual home. A study undertaken by Abu Dhabi's Regulation and Supervision Bureau (RSB) indicated that the share of per capita water consumption in villas was about 3-9 times the water consumption in apartments where the water consumption is close to the global average of 200 lpcpd. That study showed that the increase in water consumption in villas was due to using desalinated water for irrigating the gardens and washing cars, which can obviously be replaced by using water of a lower quality.

It is little wonder that with predicted increases in population and economic development, the total consumption value is expected to double to about 10 km^3 by 2030, assuming current patterns and rates continue. The area of predicted greatest increase is in urban demand (household, industrial, commercial, institutions and public facilities) resulting from population and industrial/commercial growth under current economic development policies. Conversely, the demand for agricultural and forestry water is expected to decrease relative to today's values as a result of depleting groundwater resources, unless reclaimed or desalinated water resources are used as substitutes.

The resulting water supply-demand balance is expected to be in deficit in the mid-term, rising up to an average of 30% of total water demand by 2030. Whilst this demand varies across the Emirates with Abu Dhabi and Dubai expected to suffer shortages by 2017 and 2018 respectively, others, such as Sharjah, are better provisioned until 2024. The situation, however, is a little more complex between the Emirates, with Sharjah and the Northern Emirates already relying on imported desalinated water from Abu Dhabi Water and Electricity Authority (ADWEA) to meet the current water deficit. This is expected to continue until the currently-constructed desalination projects come online in the near future. Thus, it is expected that the future shortfall for the Northern Emirates will be about 10% of the total UAE water deficit.

Water Governance

The governance, and legal and regulatory systems are the foundations on which policy and management decisions are made and implemented. They determine the authority and roles and responsibilities of the various organizations involved and are the framework within which further ideas are developed. It is therefore important to understand the current systems in place in the UAE.

The starting point for any analysis of the governance system in the UAE is its Constitution and the division of powers between the Federal and the Emirate levels of authority is clearly demarcated within. Whilst water is not mentioned explicitly in the Constitution, by implication of some of its provisions (Articles 23, 120, 121, 122) water resources and their regulation fall within the remit of the individual Emirates. As a result, legislation and regulations governing the management, development, protection, conservation and use of natural water resources engage mostly the Emirate level of legislative, executive and judicial authority, with the Federal-level Ministry of Environment and Water (MOEW) retaining a national policy/strategy, coordination and standard-setting authority.

The legal status of non-conventional water resources like desalinated water and reclaimed water is not explicitly defined in the Constitution (unlike electricity). It is assumed therefore, that they are the property of the relevant producer, and are for him/it to dispose of and allocate for further use. The role of the Federal legislature and executive is therefore more indirect and is given in various Federal laws, agreements and bi-laws which are centred on the protection of marine environments, the air and biodiversity and health of those involved. The actual implementation of these though is again given to the competent authority in each Emirate.

There is no clear indication as to responsibilities for water demand management from the Constitution except in Article 23, which states that the Federal government is '…responsible for the protection and proper exploitation of such natural resources and wealth for the benefit of the national economy'. Thus, there is an onus on the Federal legislature and executive to protect water resources and to ensure sustainable use of groundwater. However, the introduction of practical measures has to date emanated from Emirate-level organizations.

The result of the constitutional emphasis on devolution to the Emirate level for most of water management roles and responsibilities has led to the development of various legal and regulatory systems overseen by their competent authorities. In the area of natural water resources each Emirate has its own organization and various laws have been enacted primarily to control the use of groundwater. The extent of implementation, and monitoring and enforcement, varies between the Emirates and all have found a certain resistance.

Possibilities for future water management

To date, water policies have been predominantly supply-side based. If this were to continue, to meet these projected shortfalls there would be a need to increase capital investment in both water desalination plants and distribution infrastructure, estimated at around AED 117 billion (USD 32 billion) over the period 2009 - 2030. The incremental annual operation and maintenance costs over this period would average about AED 202 billion (USD 55 billion) and the total bill for desalinating water could top AED 319 billion (USD 87 billion) over the same period.

There is a role for reclaimed water which could be increasingly substituted for expensive desalinated water in a number of areas. The recent advances in technology, regulations and public acceptance of this resource could relieve the deficit in certain sectors of usage.

Policies associated with water demand management have not played a large part in the current water strategies of the UAE, but if properly researched and formulated could achieve a significant reduction in both total consumption and related future investments in production capacity and infrastructure. A major area of consideration is the use of large volumes of water in agriculture. This sector has cultural and social importance, but it has been in decline recently in terms of contributions to GDP falling from 3.5% in 2002 to 1.3% in the year 2008. Only 2% of the farmers depend on agriculture as an essential income with the majority of the workers being unskilled non-national labor. Various possibilities exist to try to balance the needs for food and water security including increasing the efficiency of water use or to move its use to crops of higher economic return.

Key initiatives

This Strategy provides a framework to sustainably manage the UAE's water resources over the period to 2021. As such it highlights the challenges and opportunities to better manage scarce and expensive water resources and provides a range of options to do so. Some of the options will be easy to implement, others less so. It also

has to be recognized that because water management is devolved among the seven Emirates the type and quality of information about water resources and use varies widely – this is particularly so for the agricultural sector – and the availability of better information may favour some policy options more than others. Institutions to monitor and regulate water resources management will also evolve over time and may require policy responses different to those suggested in the Strategy. Consequently the findings in this Strategy should be reviewed every five years to keep it relevant and up-to-date.

In order to implement the Strategy, the following eight initiatives should be implemented:

Initiative 1: Develop legislation, standards and Federal mechanisms for integrated water resources management

- Coordinate the development of common regulations, standards, and specifications for economic, technical and environmental controls;
- Support stakeholder coordination and understanding;
- Integrate anticipated consequences of climate and environmental change;
- Monitor and evaluate progress towards achievement of national objectives;
- Ban water export; and
- Establish a national council to coordinate water and a forum for dialogue and coordination among stakeholders on water resources.

Initiative 2: Better manage natural water resources and enhance strategic reserve

- Introduce water budgeting at the national, regional and local levels that takes account of all water supplies and uses;
- Facilitate formation of a national water quantity and quality monitoring system;
- Guide and oversee the creation of a national water database;
- Improve the design and operation of dams in the Northern Emirates to improve retention of floodwater and groundwater recharge; and
- Promote zoning and artificial groundwater recharge.

Initiative 3: Develop national agricultural policy aimed at water conservation and increasing value to the economy

- Promote a new agricultural development model that is water conservative, environmentally benign, and commercially viable;
- Initiate research to deepen knowledge on UAE's agricultural economy and its use of water;
- Conduct a study with farmers to agree which parts of UAE's traditional agriculture should be retained as part of its cultural heritage;
- Agriculture and forestry compete for the same scarce water resources – a plan to assess the trade-offs and where they should be applied should be prepared; and
- Build on this knowledge to initiate an agricultural plan to better conserve scarce water resources.

Initiative 4: Manage efficiently desalinated water from a comprehensive and national perspective

- Introduce and apply economic optimization principles to design future desalination capacity;
- Reduce losses in water distribution and main lines;
- Create a national water grid system to enhance water security and cost efficiencies; and
- Further develop Aquifer Storage and Recovery (ASR) using surplus desalinated water where economically feasible.

Initiative 5: Rationalize water consumption to be within the global daily per capita water consumption rate

- Develop strategies to reduce the daily per capita consumption of water to the global average of 200 litres per capita per day (lpcpd);
- Review and adopt as suitable water efficient systems and technologies;
- Develop strategies to match water quality and different uses; and
- Design awareness programs and campaigns.

Initiative 6: Review and develop clear water pricing and subsidy policies

- Review and adjust water tariffs of all water sources for all customers to reflect more the water production and distribution costs; and
- Review and adjust government subsidies for all water resources and uses.

Initiative 7: Better manage effluent and reclaimed water

- Develop wastewater effluent discharge standards for UAE's marine and terrestrial environments and monitor their enforcement by the Emirate level authorities;
- Coordinate the development of common standards for wastewater collection, treatment, and reuse in different sectors;
- Monitor the enforcement of environmental standards by the individual Emirates;
- Assess network integrity to minimize leakage and inflows;
- Coordinate measures to increase use of reclaimed water; and
- Coordinate awareness raising campaigns to overcome public fears.

Initiative 8: Capacity building and strengthening of local expertise on the concepts of integrated water resources management

- Develop a body of expert knowledge and training to support national capacity in water resources technologies and management, particularly in non-conventional water resources; and
- Encourage greater participation of private water sector organizations in capacity building.

Salicornia bigelovii: A versatile crop for the seawater agriculture

Mohammad Shahid[1] and NK Rao

Plant Genetic Resources Unit, International Center for Biosaline Agriculture

More than 97% water found on earth is saline in nature which cannot be used in agriculture. The amount of fresh water available for agriculture is limited and it is getting scarcer as the demand for food rises with the increase in population of the world. To meet the ever increasing need of agriculture products such crops have to be found that can be irrigated with saline or seawater. *Salicornia bigelovii*, a halophyte (salt-loving plant), may prove to be a strong candidate for such exigencies. It has a great potential to be a part of both human and animal diet and it can also be used in the production of bio-fuel.

Young tender shoots of S. bigelovii *are used as a vegetable*

The genus *Salicornia* belongs to family Chenopodiaceae and subfamily Salicornioideae which includes some of the most salt-tolerant terrestrial plants that grow in coastal marshes and on seashore. One of its species, *Salicornia bigelovii,* can even be grown in hyper-saline drainage water. Arguably it is considered to be the most salt-tolerant vascular plant in the world. *S. bigelovii* is an annual plant, with erect, succulent, photosynthetic stems. Its jointed spikes are terminal on each stem. Its flowers are bisexual, consisting of merged sepals that encircle the stigma and stamens. Pollination occurs through wind. It has small thin seeds which are brown in color. The species is found in coastal areas of Mexico and the United States of America.

S. bigelovii, which is commonly known as samphire or saltwort, can be eaten either cooked or raw forms. Uncooked samphire, with its sea flavor, is ideal as a side dish with fish and other seafood, while its pickle is served as an appetizer. For cooking, samphire is usually steamed or micro-waved followed by coating either in olive oil or butter. After cooking, its flesh color is like seaweed while its texture and flavor resemble asparagus; that is why sometime it is called as sea asparagus. Different experiments show that its foliage can also be used as a fodder to replace crops like alfalfa and Rhodes grass for domestic animals including cattle, sheep and goats. It can either be given to the animals directly following desalinization or after mixing with other fodders like wheat straw and Rhodes grass.

Agriculture researches have found that the halophyte species has an immense potential to be used as an oilseed crop. In the coastal areas of deserts and wastelands, *Salicornia bigelovii* can successfully be grown using seawater for irrigation. In the desert shoreline of Mexico it has already been evaluated as an oilseed crop. Trials show that its yield is better than fresh water grown oilseed crops such as sunflower and soybean. The desert areas that line Indian Ocean, Gulf of California, Red Sea, Arabian Gulf and other similar regions can be used to cultivate it as an oilseed crop.

S. bigelovii *seed contains good quality edible oil*

High contents of oil (30%) and lower concentration of salt (less than 3%) in its seed make *S. bigelovii* a most promising oilseed halophyte crop for the future. It has high quality edible oil as its seeds contain 75% of linoleic acid, an unsaturated fatty acid essential for human diet and linolenic acid (2%), an omega 3-fatty acid, which reduces the cholesterol level of the blood. By transesterification the salicornia oil can also be converted into bio-diesel, an environment friendly fuel. According to one estimate, one hectare of salicornia can produce 225-250 gallons of bio-diesel. After the extraction of oil its meal that has high protein contents (42-45%) can be used to feed livestock and fish.

In recent years, *Salicornia bigelovii* has gotten so much attention that different breeding programs have been started in Eritrea, the USA and Saudi Arabia for the improvement of its various desirable characteristics. The emphasis in those programs is to evolve better oilseed salicornia varieties which are suitable for their respective conditions.

To see the performance of *Salicornia bigelovii* in the United Arab Emirates, the International Center for Biosaline Agriculture (ICBA) conducted experiments in its vicinity. The seed of different *S. bigelovii* lines was provided by BEHAR (Arabian Saline Water Technology Company Limited) Saudi Arabia that had been working on this halophyte species for some years. The experiment was carried out on sandy soil and pure seawater was used for irrigation. The results were quite encouraging. The performance of the six prominent salicornia lines tested at ICBA showed that it can be adopted in the UAE as a vegetable, fodder and oilseed crop.

The Masdar Institute of Science and Technology, UAE with the support of Boeing, Etihad Airways and UOP Honeywell has embarked on a project to cultivate salicornia in Abu Dhabi to produce bio-fuel for aviation industry. For this salicornia project only seawater will be used for irrigation. ICBA is also lending its expertise to the project.

1. For more information, contact **m.shahid@biosaline.org.ae**

ICBA News

And the winner is … ICBA!

The International Centre for Biosaline Agriculture won the *Best Water Consultancy* category at the inaugural *H20 Water Awards* for its consultancy work culminating in the *Abu Dhabi Water Resources Master Plan*. ICBA was commissioned by the Abu Dhabi Executive Council, through the Environment Agency-Abu Dhabi (EAD), to undertake a comprehensive strategic environmental assessment of the role of water in the Emirate, identify what needed to be done in the water sector to improve the sustainability of the environment and strengthen the structure of water and environmental management.

The H2O Water Awards celebrated the outstanding achievements of individuals and organizations who contributed during the year to the advancement of the Middle East and North Africa (MENA) region's water industry. The "H2O Awards" are organized and presented by H2O Middle East - a monthly magazine for the Water Industry in the MENA Region, published by CPI Industry. Winning projects and programmes are expected to demonstrate a high standard of excellence and quality as well as processes and innovations that promote sustainability.

ICBA DG (right) receives the H2O Award

And ICBA wins again .....

The Khalifa International Date Palm Award was established in 2008 by President His Higness Shaikh Khalifa bin Zayed Al Nahyan to highlight the role of the date palm and its importance in the culture and heritage of the United Arab Emirates.

The importance of ICBA's scientific research findings on date palms was recognized during the prestigious *Khalifa Date Palm Awards*. ICBA was one of the eight winners chosen out of 131 regional and international participants with its research on the *Potential of Arbuscular Mycorrhizal Technology for Date Palms* which was awarded second place in the first category of *Distinguished Research and Studies*. A certificate, trophy and cash sum was awarded at the official ceremony held on 15 March 2011.

Known as the Blessed Tree (Shajrat-ul-Mubaraka) in Arabic, the date palm is also referred to as the Tree of Life given its high nutritional value, productivity and long-yield life. Most of the world's date production is concentrated in a few countries with the top ten date-producing countries (Egypt, Iran, Saudi Arabia, Pakistan, Iraq, Algeria, United Arab Emirates, Sudan, Oman and Morocco) accounting for 90% of the total world date production.

Date palms grow mainly in the desert oases which provide marginal conditions including high temperature, low rainfall, and poor quality soil and water. Although the date palm is highly salt-tolerant and able to withstand longish periods of drought, large quantities of water are required to ensure vigorous growth, higher yield and fruit quality. This is a problem when the main water supply is brackish groundwater. As well, palms are susceptible to nutrient deficiencies. The constant fertilizer applications to address this problem are negated by leaching into the groundwater. These challenges mean that it is critical to find alternative ways to mitigate these challenges affecting date palm production systems, hence the research into Arbuscular Mycorrhizae (AM).

Arbuscular Mycorrhizae is a symbiotic association between the roots of higher plants and about 200 fungal species belonging to the phylum Glomeromycota. AM promote plant growth by various mechanisms such as enhanced water and nutrient absorption, improvement of soil conditions, and alterations in physiological and bio-chemical processes in their host. AM-fungi are ubiquitous and have the potential to enhance salinity and drought tolerance of plants.

ICBA's research is the first long-term applied level investigation that demonstrated clearly the significant growth responses of date palms to mycorrhizal inoculation under nursery conditions. Research findings demonstrated that AM-fungi can enhance the growth of date palms (*Phoenix dactylifera* L.) under low nutrient and saline conditions, that is, AM-inoculated date palms grow better than non-inoculated palms. Since date palms, which possess a coarse and limited root system, are often grown under nutrient-poor soil and saline water conditions where salinity is a major concern for plant growth, the research clearly finds that AM-technology will enable sustainable date palm production in marginal conditions.

Effect of AM-fungi on the growth of date palm trees

ICBA News

Collaborations

Director General Dr Shawki Barghouti met in January with Dr Faleh Bin Nasser Al Thani Director of the Research and Agricultural Development of the Ministry of Environment in Qatar. Discussions emphasized the cooperation between ICBA and the Ministry of Environment in developing a pilot demonstration farm on biosaline agriculture technologies and capacity building.

Food Security in the Arab World

Dr Faisal Taha, Director Technical Programs, participated in the *First Arab Development Symposium* co-organized by the Arab Fund for Economic and Social Development and the World Bank, which was held at the Arab Fund Headquarters in Kuwait during 14-15 March 2011. The Symposium focused on proposed solutions to improve food security in the Arab region.

Dr Taha contributed to the Symposium by addressing the topic *Harnessing Research and Innovation for Arab Food Security*.

Capacity Building

ICBA, in collaboration with the Farmers' Service Center (FSC) of Abu Dhabi, organized a training course on *Technologies Advances in Biosaline Agriculture* in Liwa, Abu Dhabi from 4 to 6 April 2011. The course was attended by 25 extension staff of the FSC.

Participants of the course practise assessment of soil salinity in the field

World Water Forum 2012

The 6th World Water Forum, which attracts over 25,000 participants from across the world, will be held in France in 2012. ICBA has been honoured to be selected to coordinate the session *The safe use of non-conventional waters for agriculture*, which will be presented as part of the theme *Contribution to Food Security through Optimal Use of Water*. ICBA is most appreciative of organisations such as FAO, ICID and others who supported its candidacy for the role.

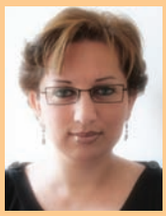
Adaptation to climate change

ICBA, in collaboration with the Desert Research Center (DRC) in Egypt, organized the annual coordination meeting of the technical committee of the project *Adaptation to climate change in WANA marginal environments through sustainable crop and livestock diversification*. Attended by Technical Committee members from Egypt, Jordan, Oman and Syria, the meeting was held from 12 to 14 April 2011 in Cairo, Egypt. A visit to DRC Research Station in Ras Sidar in Sinai was organized on 14 April.

The project is funded by the International Fund for Agricultural Development, the Arab Fund for Economic and Social Development, the OPEC Fund for International Development, the Islamic Development Bank and the national agricultural research centers of Egypt, Jordan, Oman, Palestine, Syria and Tunisia.

Participants visited DRC Research Station in Ras Sider, Sinai

Staffing Update



Dr Adla Khalaf, who holds a PhD from the University of Durham, UK, joined ICBA in January 2011 as a researcher in the MENA-LDAS Program. Dr Khalaf has specialized in remote sensing and GIS applications in water resources and land management. She has worked for the Palestinian Ministry of Planning for the last 9 years and had also been appointed for a short term consultancy by the Negotiations Support Unit and the Palestinian Water Authority as a remote sensing and GIS consultant.

Eng Rami Moustafa El Soufy joined ICBA in January 2011 as an Agricultural Engineer (Soil) in the Central Analytical Lab of the Technical Programs.

Mr Velmurugan Arumugam joined ICBA in March 2011 as Irrigation Assistant to the Technical Programs.

For more information on ICBA and its latest news, please visit www.biosaline.org