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Biosalinity News

Newsletter of the International Center for Biosaline Agriculture

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FROM THE EDITOR

A great deal has happened at ICBA since our last issue of *Biosalinity News.*

One important result of the June meeting of the Islamic Development Bank, which featured in our July issue, was the decision to split the dual functions of Director General and Chairman of the Board of Directors. This decision has freed the Director General from the necessity of wearing two hats, leaving him more able to attend to the research agenda so vital to our stakeholders. Our new Chair is described in the cover story.

This issue contains a seminal paper on salinity written by Clive Malcolm, who analyzes a half century of research in farmers' fields in Western Australia.

Another article, written by our Salinity Management Scientist, Dr Shabbir A Shahid, concerns the efficacy of soil mapping and monitoring of saline soils.

We remind you that the Editor welcomes short contributions on research or projects that would be of interest to our readers.

Please send your submissions, including relevant photographs and figures, to:

The Editor
Biosalinity News, ICBA
PO Box 14660
Dubai, UAE
icba@biosaline.org.ae

Fawzi AlSultan is ICBA's new Board Chair

ICBA is proud to announce that the new Chairman of its Board of Directors is Mr Fawzi Hamad AlSultan, a Kuwaiti national.

The new Chair touring the ICBA campus with Director General Dr Mohammad Al-Attar.

In recent years, Mr Fawzi AlSultan has worked closely with the Government of Kuwait in its efforts to open up the economy by transforming the country into a trade and investment hub. As Senior Partner with F&N Consultancy, he had a leading role in Kuwait's free trade negotiations with the US and Singapore. From 2001 to 2004, he served as Secretary General of Kuwait's Higher Committee for Economic Development and Reform.

Mr Fawzi AlSultan was at the helm of the International Fund for Agricultural Development (IFAD) from 1993 to 2001. IFAD is now an important donor to ICBA.

Before joining IFAD, Mr Fawzi AlSultan served the World Bank as Executive Director for 10 years. During his tenure with the Bank, he was a member of the Joint Audit Committee for five years, and chaired that committee for four of those years. He also chaired the Committee of Administrative Matters and was a member of the Pension Finance Committee. From 1990 to 1993, when he left the World Bank to join IFAD, he held the prestigious position of Dean of the Executive Directors.

Mr Fawzi AlSultan has worked with the Kuwait Fund for Arab Economic Development, and has held senior positions in such prestigious financial institutions as the Bank of Kuwait and the Middle East, IFABANQUE SA Paris, and the United Bank of Kuwait in London. He has authored numerous publications on finance and development. Mr Fawzi AlSultan holds a Master's degree in economics from Yale University.

Mr Fawzi AlSultan chairing his first Board of Directors meeting at ICBA.

PROJECT NEWS

ICBA completes 1st phase of bilateral projects in Pakistan and Iran

ICBA recently completed two 3-year bilateral projects on *Use of low quality water for productive use of desert and salt-affected areas in Pakistan* and *Production of halophytes in Iran*.

The first project was undertaken in collaboration with PARC, the Pakistan Agricultural Research Council, at three highly saline and sodic wasteland sites. Various agronomic practices and irrigation management schemes were applied to convert wastelands into productive areas using forage and fruit trees. As a result, 3 ha of formerly useless land were extended to 13 ha of productive land by local farming communities.

Prof. Faisal Taha discussing the benefits of the project activities at Farmer's day in Bhalwal, Pakistan.

The second project was undertaken in collaboration with Iran's National Salinity Research Centre in Yazd, using five halophytic species. These species were evaluated using different types of irrigation systems and fertilizer applications of N and P. Growth and productivity were evaluated over repeated harvests to determine the feasibility of introducing the halophytes into production systems.

At the conclusion of each project, final farmers' days were held in participating institutions. The functions were attended by ICBA management and Dr Shoaib Ismail, ICBA coordinator for the two projects.

ICBA delegation and Iranian scientists at the seminar held in Yazd, Iran.

LETTERS TO THE EDITOR

Biosalinity News is pleased to introduce this section of the newsletter as a forum for sharing your thoughts with other subscribers. Please feel free to write to The Editor at icba@biosaline.org.ae on any subject relevant to biosaline agriculture.

Our first letter to appear in *Biosalinity News* is from Dr Dinesh Joshi of the Central Arid Zone Research Institute (CAZRI) in Jodhpur, Rajasthan, India.

Dear Sir,

I am very grateful for your courtesy for regularly sending Biosalinity News, the newsletter of ICBA. It is of great interest for me because I had the opportunity of working on salinity problems for many years and published papers in international journals on the subject. The newsletter has very good coverage on the activities of ICBA.

ICBA has embarked in a big way on utilisation of saline water by screening salt-tolerant genotypes and propagation of halophytes. The research findings will be useful for Rajasthan Desert (India) because groundwater in 80% situations is saline sodic besides vast coastal salinity. I request you to kindly continue to send the newsletter and related publications.

I extend my full support and am prepared to share my experiences.

With regards and best wishes for New Year,

DC Joshi
(ex) Principal Scientist (Soils)
CAZRI, Jodhpur

Board of Directors meeting

The second meeting of ICBA's Board of Directors during 2005 took place on 13 November. As mentioned in our lead article, this was the first meeting of the Board to be chaired by the new Chairman, Mr Fawzi AlSultan.

The Board took note of ICBA's achievements during the past year, and examined proposals for the coming year. After a lively discussion about the present and future of the Center, the Board unanimously approved both the Work Plan and the Budget for 2006.

ICBA's consists of nine members: Mr Fawzi AlSultan (Chair), Director General Dr Mohammad Al-Attar, Eng Mohamed Sager Al-Assam, Eng Essa Al Maidoor, Dr Fareed Husain Al Darwish, Dr Ismaeil Ali l Hosani, Mr Abdelmajid Slama, Dr Mohammad H Roozitaleb and Dr Mohammed Al-Suwaiyel.

Above: DG Dr Al-Attar welcoming Dr Mohammad H Roozitaleb and Mr Abdelmajid Slama. Left: Dr Ismaeil Ali Al Hosani. Lower left: ICBA's Dr Shoaib Ismail with Eng Mohamad Sager Al-Assam. Lower right: Dr Fareed Husain Al-Darwish.

New staff

Two members of the ICBA team joined recently. Zaynal Thannon Younis replaced Ghassan Sarris as Administration and Finance Director (Acting), and Eric McGaw succeeded Sandra Child as Communications Specialist.

Mr Younis, an American of Middle Eastern descent, comes from San Diego, California. He was most recently employed by a large real estate developer in Dubai. His extensive background with the US government will prove useful to ICBA in dealing with administration and finance issues both internally and externally.

Mr McGaw, who is also American, has been living and working in Asia for 25 years, most recently in India where he worked for ICBA's partner center ICRISAT for 11 years before heading his own consultancy firm. Prior to moving to India, he worked for a variety of institutions in the Philippines, including IRRI and the Asian Development Bank.

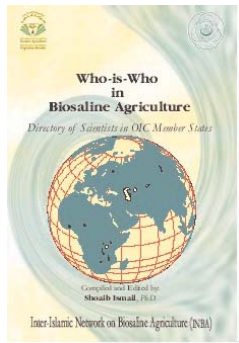
Farewell to departing staff

Ghassan Sarris, Administration and Finance Officer, joined ICBA in 2001. Mr Sarris, who holds a Canadian passport, is Palestinian by birth. In October, he left Dubai with his family to take up a new post in the private sector in Abu Dhabi. He will be sorely missed by ICBA.

Inter-Islamic network on Biosaline Agriculture (INBA)

INBA co-sponsored a special session on *Food Security and Unconventional Water Resources* in an international conference on *Water, land and food security in arid and semi-arid regions* held in Bari, Italy, 6-11 September. INBA also sponsored Saud Ali Farsi from Oman, an INBA member country, to participate in this conference and present a paper on Food *Security and Use of Non-Conventional Water Resources in Sultanate of Oman*.

INBA prepared a directory entitled *Who-is-Who in Biosaline Agriculture*. It also prepared the database of this directory in Microsoft Access. Complimentary copies are available. Just send an email to inba@biosaline.org.ae. Scientists are encouraged to update their personal and scientific profiles by sending a message to Dr Shoaib Ismail, Coordinator INBA. An update of the directory will be published soon.



Along with the newsletter, INBA is sending a Database Registration Form for *Biosalinity News* readers who would like to subscribe for thedatabase. The form is also available on our web page.

Other news

Arab Fund official visits ICBA

On 11 December, Mr Habeeb Behbehani, a senior official with the Arab Fund for Economic and Social Development (AFESD), Kuwait, visited ICBA and met with senior staff. AFESD is a founding sponsor of ICBA and a major donor to the ongoing multi-million dollar, multi-country forage project.

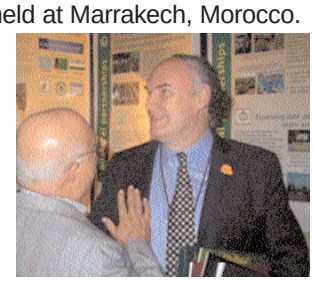
Director General Dr Mohammad Al-Attar welcomed him to the Center, where Prof Dr Faisal Taha and Dr Abdullah Dakheel briefed him on the progress of the project. He had interactions with Mr Jugu Abraham concerning the administrative aspects of the project. Later, he visited ICBA field experiments, many of which are relevant to the forage project.

Mr Behbehani said that AFESD is delighted to support the important work ICBA is doing for the Arabian region.

Mr Behbehani in the field with Jugu Abraham and Abdullah Dakheel.

ICBA attends donor meeting in Morocco

For the fifth straight year, ICBA was represented at the Annual General Meeting of the Consultative Group on International Agricultural Research (CGIAR), a gathering of all the important stakeholders in agricultural research. ICBA's booth, which we happily shared with our valued donor the OPEC Fund, was quite popular. ICBA management and staff members met with an array of donor and partner institute representatives and various collaboration ideas were explored. A highlight was Director General Dr Al-Attar's speech at a ceremony commemorating the retirement of Prof Dr Adel El-Beltagy, Director General of our partner center ICARDA. The meeting was held at Marrakech, Morocco.



Above left: ICBA Board member Abdelmajid Slama, who is from Morocco, accepting a scroll from CGIAR representative Manny Lantin. Above: CGIAR Chairman Ian Johnson at the ICBA booth. Left: Mr Suleiman J Al-Herbish, Director General of the OPEC Fund, at the booth.

Salinity Mapping and Monitoring - An approach to improve yields from saline soils

Dr Shabbir A Shahid, Salinity Management Scientist, ICBA

Saline soils form a significant part of the earth's ecosystem. These soils are affected by high concentrations of soluble salts, resulting in crop production with little economic value. Many plants either fail to grow in saline soils or their growth is retarded significantly. However, a few plants actually grow well in saline soils. Soil salinity therefore restricts cropping options in a given area.

Salinity mapping helps to clarify the subtle differences in soil salinity across agricultural fields, and allows precise management of zones through selection of salt-tolerant varieties. Salinity mapping is a simple, inexpensive measurement tool that can be accomplished by using either routine equipment (EC meter, salinity bridge through salinity sensors) or modern equipment (EC Probe, EM38 and automated salinity measurement though salinity sensors). However, for many reasons, laboratory analysis of soil saturation extract is still the most common technique for assessing soil salinity and other potential hazards. The choice of the technique depends upon the purpose, size of the area, soil depth, frequency of measurement, accuracy required and the available resources.

Salinity mapping prior to seeding/plantation can provide general guidance concerning yields from a salinized area relative to an area without salinity. Using the salinity values in a salinity yield model developed by Maas and Hoffman in 1977, expected yield loss can be predicted. Typically, plant growth is suppressed when a threshold value of salinity is exceeded. Maas and Hoffman expressed salt tolerance of many crops by this relationship: $Yr = 100\text{-}b(EC_e\text{-}a)$, where Yr = percentage of the yield of crop grown in saline conditions relative to that obtained on non-saline conditions; where a = the threshold salinity level at which yield decreases begin, and b = the percent yield loss per increase of EC_e (dS/m) in excess of a. In this model, it is assumed that crops respond primarily to the osmotic potential of soil solution. Specific ion effects are of secondary importance.

ICBA, in most of the experiments, conducts a strong salinity-monitoring program with the major objective to determine periodic salinity changes in the root zone and beyond to assess the performance of experiments. In 2005, more than 2,500 soil samples were analyzed as a part of a salinity monitoring program. At ICBA, salinity is assessed using a salinity bridge through salinity sensors, electromagnetic induction equipment (EM38), and through intensive periodic soil sampling and analyses in the laboratory throughout the cropping seasons, as appropriate.

Initial salinity mapping/monitoring plans and selection of salt-tolerant varieties are good agricultural practices. These practices are technically sound, economically attractive, environmentally safe, socially acceptable and feasible in practice. By following this course of action, the national agricultural research systems and agricultural extension departments of countries typified by saline conditions can contribute significantly to improving crop yields from saline soils in resource-poor farmers' fields.

Sample collection from a barley field.

Salinity monitoring by EM38.

In-situ salinity measurement by salinity bridge.

Sustainable plant communities on saline land

Clive V Malcolm

Return visits to old saltland agronomy research sites on Australian farms reveals that in many cases the plants established up to 50 years ago have formed long-term sustainable stands. Sustainability depends on ability to survive either by longevity or recruitment, establishing a long-term salt and water balance, exercising ecological dominance, being of strategic economic value and recovering after use.

Over the last 50 years, research and demonstration plots have been established on about 270 sites scattered through the farming areas in southwestern Australia as a part of the saltland agronomy research programme of the Western Australian Department of Agriculture. Most of the work was done on private farms.

The Co-operative Research Centre for Plant-based Management of Dryland Salinity arranged for the author to visit old sites and note their current condition, assess the changes and take photographs to compare with earlier images.

In a report on sites in the northern, northeastern and central wheatbelt (Malcolm 2003), sites were assessed to determine their sustainability status. The following definitions were used.

Remedial. Sites where capability has changed from the species originally planted to species of less salt and/or waterlogging tolerance.

Sustainable. Sites on which the original species still survive and may be recruiting, and where other species of comparable salt and/or waterlogging tolerance have invaded.

*Reversionary. S*ites where capability has changed to plants of higher salt and/or waterlogging tolerance than the originally planted species.

Of the 81 sites assessed, 52 met the sustainable criterion, 18 were reversionary and 6 were assessed as remedial. The other 5 sites had been cultivated and were thus impossible to assess. Overall, 76% of the assessable sites were sustainable or remedial. During 2005, an additional 21 sites were assessed in the Great Southern and 17 (80%) were either remedial or sustainable. These results indicate that it is possible to revegetate saltland in many situations and expect the revegetation to be sustainable.

Sustainable halophyte shrub communities

All the sites were originally established on land in the transition zone between totally bare land and land typified by barley grass; ie, moderately affected saltland. The sites discussed below were selected because they illustrate the characteristics of long-term sustainable halophyte shrub communities.

Germplasm conservation plots of *Atriplex amnicola* were established in 1976 at Korbelka, Wongan Hills and Tammin. It was arranged that the farmers could graze the plants but would protect them in the long term. The Korbelka plot was grazed by sheep and cattle, and in 2003 was surviving well with a vigorous understorey of annual grasses and legumes. By 2002, the Wongan Hills plot had been extended to cover the whole of a paddock, was healthy and had been used each year for grazing. By 2003, the Tammin plot had been grazed by sheep every autumn and all bushes survived. There was little understorey.

At a site established in 1970 at Pintharuka, a local ecotype of *A. bunburyana* had formed a dense stand in the paddock adjacent to the trial plot 32 years later in 2002. The leaves of the bushes tasted very bitter, possibly due to saponins, and there was a complete absence of understorey. By contrast, on a site north of Nangeenan, a wind-eroded site was stabilised by iceplant (*Mesembryanthemum nodiflorum*), enabling forage shrubs to colonise the area. Samphire was acting as a pioneer on another site and *A. stipitata* was colonising the samphire bushes. Depending on the site, plant associations can assist or hinder the establishment of a good grazing resource.

In a grazing experiment conducted at Kondut from 1980 to 1985 (Malcolm and Pol 1986), plots of four forage shrub species were grazed hard each autumn for six years. *A. amnicola* had 94% survival and was providing as much grazing at the end as at the beginning. *A. paludosa* was eliminated and replaced with samphire. Samphire failed to replace the *A. amnicola*. From 1986 to 2002, grazing was very low and samphire encroached on the whole site. The site was rated as reversionary but lack of grazing may have allowed the samphire to invade.

An experiment to measure the effect of plant spacing and soil conditions on the growth of *Atriplex* spp stands was planted north of Kellerberrin in 1976 (Malcolm et al. 1988). Soil and water table sampling

after two years showed that there had been an increase in root zone salinity. When the site was revisited in 2005, it was carrying a dense stand of *A. bunburyana*. No plants of *A. undulata* or *A. vesicaria* were found, but *A. paludosa* and *A. amnicola* plants were observed. The survival of a dense stand of *Atriplex* spp on the site indicates that a long-term salt and water balance has been established.

In 1976 and 1977, *A. amnicola* was sown in establishment experiments on a property north of Bencubbin. The site was visited several years later when it was found that in one experiment the original bushes were surviving but had not recruited any seedlings. Nearby, in the second experiment, the original bushes had recruited numerous seedlings. Seeds from these bushes were collected and shown to have superior ability to establish (Malcolm et al. 2003) compared with seeds from the accession 573 from the Wongan Hills site. The survival strategies of the two ecotypes differed greatly.

In 1976, an area of saltland north of Tammin was fenced and *Maireana brevifolia* was allowed to spread. A small amount of *A. amnicola* was sown. In 1985, the farmer obtained 2,510 sheep grazing days per ha from the 24-ha site. By 2003, the area was still being grazed every autumn and the density of the *M. brevifolia* had increased. The farmer regarded the area so successful that he now has eight similar areas on his farm.

In about 1950, the late Bevan Parker fenced off a section of land, sowed some *A. nummularia* and encouraged *M. brevifolia* to spread. Once the shrubs were established, he allowed his sheep to graze them in the autumn. The author sampled the soil to 2.7m beneath the *M. brevifolia* stand and the adjacent paddock in September 1960 and again in February 1961 (Malcolm 1963). Soil chloride was much higher beneath the *M. brevifolia* than the grass from 1-2m depth. Total soil moisture stress levels were higher in February from the surface to 2.7m under *M. brevifolia* than under grass. A photograph of the site taken in 1960 showed an understorey of annual grass and burr medic (*Medicago polymorpha*). In 2003, the site was revisited. The stand had changed. The *M. brevifolia* bushes were smaller but the stand was denser. *A. nummularia* had not survived. The understorey of annual grass and burr medic was still present. On another site on the same property, yields of grazeable biomass from *M. brevifolia* were measured each year for five years. The yields were found to be strongly correlated (r=0.9) with the total rainfall for the two years prior to the measurement. The conclusion is that *M. brevifolia* is efficient at extracting all available water to a substantial depth and can provide a long-term sustainable grazing resource.

At a test site at Booralaming, the farmer collected seeds from bushes of *A. nummularia* and sowed them nearby. The resulting plants included some that were hybrids between *A. nummularia* and *A. amnicola*, both of which were in the test plot. Cuttings of hybrid material were struck and planted at a site at Cunderdin Agricultural College about 1983. On each side of the rows of the hybrid rows of *A. amnicola* and *A. nummularia* were planted with the hope that backcrossing would occur. When the site was visited in 2003, the hybid and *A. amnicola* bushes were surviving, but all of the *A. nummularia* bushes had died. There had been no grazing.

Criteria associated with long-term sustainability

Assessment of the performance of the sites has identifed eight criteria that contribute to sustainability.

1. *Longevity. A. amnicola* exhibited the ability to survive on a wide variety of sites for periods of up to 29 years. It survived on sites where *A. nummularia* did not.

2. *Recruitment. M. brevifolia* and *A. bunburyana* survived by recruiting new plants. A stand of *M. brevifolia* survived for up to 50 years but, the density and size of the bushes changed over time as old bushes were replaced by new ones.

3. *Grazing recovery. M. brevifolia* and *A. amnicola* both survived over extended periods with annual autumn grazing and *A. amnicola* for 15 years with spring grazing. By contrast, *A. paludosa* was eliminated over six years, despite having a year's rest from annual autumn grazing. *A. undulata* and *A. vesicaria*

Before: in 1957, this badly degraded saline land was photographed near Corke, Yealering.

After: in 2003, revegetation had occurred due to changed management, leading to major environmental benefits.

disappeared from the spacing trial site which had relatively light grazing.

4. *Understorey friendly.* It is an advantage for shrubs to form a good association with annual understorey. There appear to be major differences in the understorey friendliness of halophyte shrubs. One ecotype of *A. bunburyana* is very unfriendly while *M. brevifolia* and *A. amnicola* are very friendly.

5. *Ecological succession / dominance.* Some species are very aggressive. *A. bunburyana* has formed a dense cover on the spacing experiment sites at Kellerberrin and Pintharuka. But at Kellerberrin it has invaded strongly in the bushes of *A. amnicola*. At Kondut, as soon as *A. paludosa* declined, samphire invaded; while in the *A. amnicola* plots, samphire failed to invade until the experiment was stopped and grazing ceased. On severe sites such as Nangeenan and East Narembeen, pioneer species provided an opportunity for other species to colonise. This criterion provides a basis for designing management methods to maintain the desirable species.

6. *Water and salt balance.* The fact that stands of shrubs have survived as long as 50 years on land too saline for profitable crop production indicates that those sites are in salt and water balance. At both *M. brevifolia* and *A. amnicola* sites, there is evidence of high levels of salt in the root zone and of all available water having been used. The presence of vigorous understorey in 2003 with both species of shrubs due to good rains indicates that whatever salt is present does not prevent plants of low tolerance from growing well in the surface soil. It can be hypothesised that the water that caused the water table to rise on these sites had infiltrated on site. The water is used by the shrubs and the balance established. Whatever salt and water arrives from elsewhere is not in sufficient quantity to disturb the long-term balance.

7. *Economic sustainability.* The only site for which there is an assessment of grazing value is the stand of *M. brevifolia* at Tammin. The farmer regards it as economically worthwhile. Use of an *A. amnicola* stand in spring at Wongan Hills is an example of a novel economic strategy that turned out to be sustainable.

8. *Environmental sustainability.* Many environmental benefits of saltland revegetation have not yet been measured. Potential benefits include reduced run-off of nutrients, silt and salt to streams. Colonisation by plants, ants, spiders and lichens is common. Birds were observed on some sites. The changes resulting from revegetation, even when grazing is allowed, include a wide range of environmental benefits.

The most outstanding examples of long-term sustainable forage shrub communities are stands of *M. brevifolia* and *A. amnicola*. Table 1 is an assessment of these species in relation to the eight criteria. In all cases, the assessment assumes that the species is growing on a site to which it is well adapted.

Table 1. Assessment of *M. brevifolia* and *A. amnicola* for establishing sustainable grazing resources.

Criterion	*M. brevifolia*	*A. amnicola*
1. Longevity	<41 years	>27 years
2. Recruitment	Excellent	Depends on ecotype
3. Grazing recovery	Excellent	Excellent
4. Understorey friendly	Excellent	Excellent
5. Ecological succession/dominance	High	High
6. Water & salt balance	Yes	Yes
7. Economic sustainability	Yes	Yes
8. Environmental sustainability	Yes	Yes

M. brevifolia is an excellent species for establishing long-term sustainable grazing. It has the ability to grow on non-saline land and is deep rooting, making it a good plant to reduce infiltration to groundwater.

A. amnicola proved to be a long-lived species with excellent ability to recover from heavy grazing. It is very understorey friendly and establishes a salt and water balance resulting in long-term sustainability. It has the ability to survive droughts, floods and intense heat. A wide range of ecotypes has been collected and is represented in germplasm conservation plots throughout the farming areas.

Appreciation

Special appreciation is expressed to the many farmers who for over 50 years have allowed these sites to remain intact and permitted the re-examination of their condition.

Mr Malcolm, an internationally renowned consultant in land rehabilitation, lives in Denmark, Western Australia. In 2004, Mr Malcolm won the Great Southern Development Commission Natural Resource Management Medal. For more information about this paper, including details of cited references, contact:

cmalcolm@denmarkwa.net.au

Partner Survey

ICBA has created a Partner Survey to elicit suggestions concerning our future research priorities. A copy of the survey is appended to this issue. Your suggestions are of vital importance to us. Please take a few minutes to fill out the survey form. If you would prefer an electronic version, send a request to Ms Loubna Baya at l.baya@biosaline.org.ae

Many thanks!