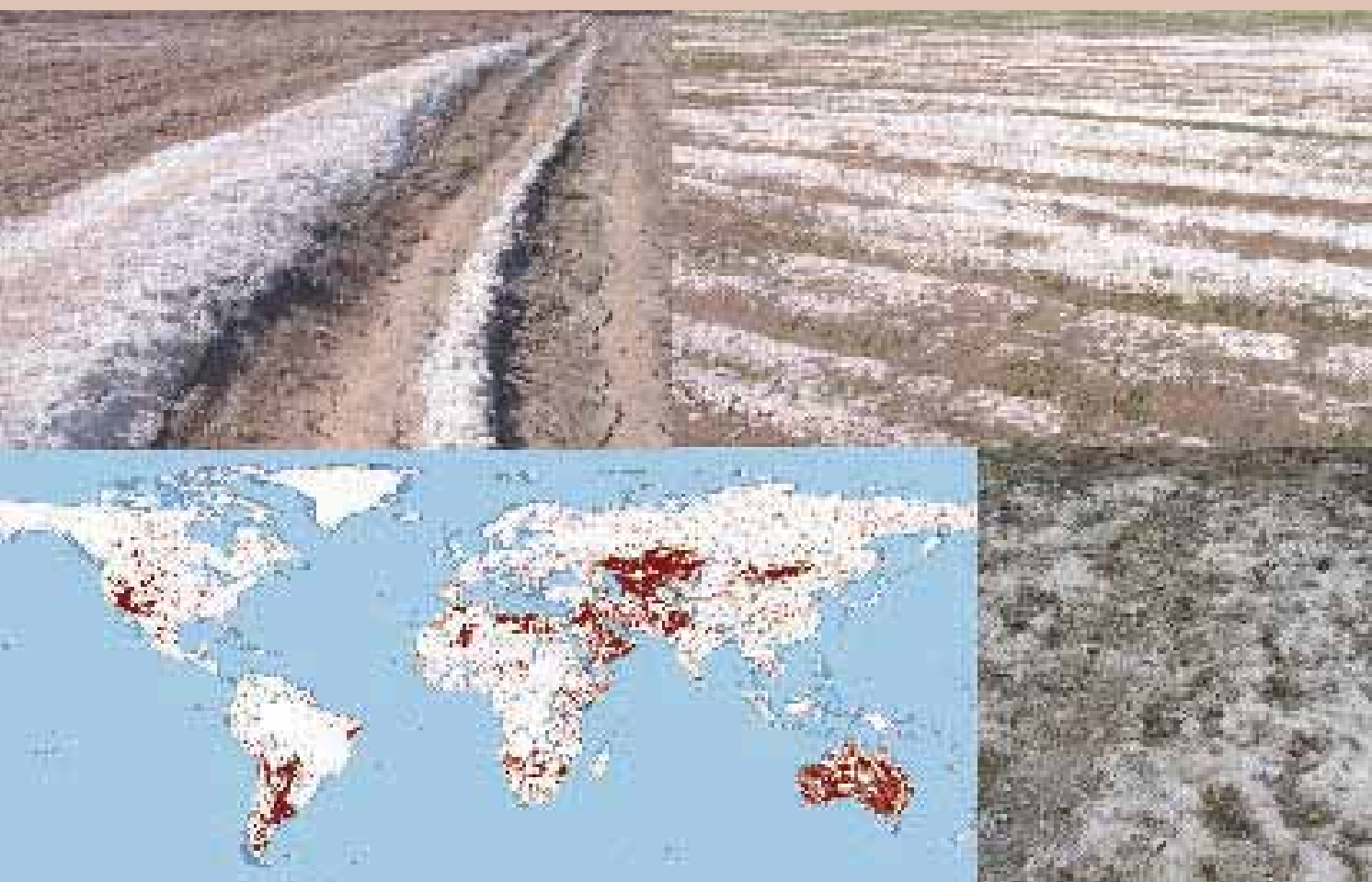


Advances in the assessment and monitoring of salinization and status of biosaline agriculture

Report of an expert consultation held in Dubai,
United Arab Emirates, 26–29 November 2007



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Salt-affected soils in Uzbekistan.

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Map:

Salt-affected soils around the world.

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Part 1

Executive summary

RATIONALE FOR AN EXPERT CONSULTATION

Soil salinization and sodication have been identified as major processes of land degradation and loss of agricultural production. The high costs of measuring salinization and sodication, as well as inconsistencies in data collection and reporting methods, have resulted in incomplete – and often contradictory – information on the extent and distribution of salt-affected soils at country, regional and global levels. Nevertheless, scientists and government authorities consider that the problem is extensive and growing.

The causes of salinity/sodicity, which vary between countries and regions, need to be identified, assessed and monitored carefully so that they can be managed and controlled. The few maps that show the extent of salt-affected soils are often based on old data and do not give a picture of the current extent of salinity, as data to determine the rate of change of salinization need to be updated regularly. Therefore, there is a need for practical and cost-effective methodologies for assessing, monitoring and mapping the extent and distribution of salt-affected soils; for assessing the causes and sources of the problem; and for choosing management options and evaluating the effectiveness of those options.

In order to collect up-to-date information on the methods for assessment and monitoring of salinization and sodication, the Food and Agriculture Organization of the United Nations (FAO), through the Global Network on Salinization Prevention and Productive Use of Salt-affected Habitats (SPUSH), along with the Center for Biosaline Agriculture (ICBA) and the Inter-Islamic Network on Biosaline Agriculture (INBA), organized the SPUSH Expert Consultation on *Advances in Assessment and Monitoring of Salinization for Managing Salt-affected Habitats*. This was held in Dubai from 26 to 29 November 2007. (More information on SPUSH and INBA Networks is included in Annex I.)

Holding the Expert Consultation in ICBA constituted an opportunity to learn about its work, as well as that of the INBA Network. Therefore, the organizers decided to allocate an additional day for holding the Meeting on *Status and Progress of Biosaline Agriculture of the Inter-Islamic Network on Biosaline Agriculture* (INBA), in order to promote further exchange of information between the Networks and explore areas for collaboration.

OBJECTIVES

The objectives of the SPUSH Consultation and the INBA Meeting were to:

- exchange experiences with data collection and analysis for the assessment and monitoring of salinity and sodicity, with particular emphasis on practical applications at local, national, regional and global levels;
- collect up-to-date official country statistics on the extent of different types of salt-affected soils;
- reactivate the SPUSH Network, introduce new topics and identify priorities for action;

- present the work of the host institution and that of INBA members in order to explore points of convergence, strengthen information exchange and explore potential areas of collaboration.

The SPUSH Expert Consultation and the INBA Meeting were a step towards collaboration between two international institutions to bring experts together for the purpose of developing a consensus on various aspects of the problem of soil salinity and, in particular, its assessment and monitoring. Another objective of this meeting was to provide a common perspective to various players engaged in research and development efforts in the cross cutting areas, to tackle this important problem.

FORMAT OF THE SPUSH CONSULTATION AND INBA MEETING

The Expert Consultation consisted of presentations by participants, group discussions and a field visit to ICBA facilities. The topics covered were:

- assessment and monitoring of salt-affected soils (at field, landscape and irrigation district levels);
- assessment and monitoring of salt-affected soils at national and regional levels;
- modelling for salinity-sodic development;
- mapping and interpretation of spatial data;
- reactivation of the SPUSH Network and future work;
- status and progress of biosaline agriculture with examples of work carried out by INBA members.

The detailed programme is included in Annex II. Abstracts of papers presented are included in Part 2; the findings and recommendations of working groups are included in Part 3; and full papers are included in the CD-ROM accompanying this publication.

ATTENDANCE

The Expert Consultation and the INBA Meeting were attended by senior soil and water scientists and authorities representing national institutes, members of the SPUSH and INBA Networks from different regions:

- Africa: Kenya, South Africa and Tanzania;
- Asia: China, India, Pakistan, Thailand;
- Europe: Italy, Romania, Spain, Tajikistan and Uzbekistan;
- Near East: Egypt, Iran, Jordan, Morocco, Oman, Saudi Arabia, Sudan, United Arab Emirates and United States of America.

Officers from the following international institutions also participated in the SPUSH Consultation and INBA Meeting: the Food and Agriculture Organization of the United Nations (FAO); the International Center for Agricultural Research in the Dry Areas/ International Water Management Institute (ICARDA/IWMI), the International Center for Biosaline Agriculture (ICBA), the International Union of Soil Sciences (IUSS) Working Group of Salt-affected Soils, the Islamic Development Bank (IDB), the OIC Standing Committee on Scientific and Technological Cooperation (COMSTECH) and the United Nations Educational, Scientific and Cultural Organization (UNESCO).

A total of 40 participants attended the events (the list of participants is included in Annex III). The organizers also received abstracts from member countries and international institutions that could not participate, either due to unforeseen circumstances or lack of funds. As the organizers had a limited amount of funds available, they received more abstracts than could be funded.

CONCLUSIONS

The following conclusions include the ideas and concepts presented in papers as well as the results of group discussions:

- Soil salinity/sodicity, waterlogging and low soil fertility are serious problems at the global level and are present in the countries participating in the Consultation to varying extent and severity. Due to the high cost of measurements, the lack of data and the inconsistencies between data provided by various sources, there is incomplete information on the extent, distribution, rate and degree of salinity development for most of participating countries. In some countries, the existence of these soils was discovered only because of the pressing demand for agricultural utilization in specific areas. Few countries have up-to-date data on the extent of salt-affected soils.
- Researchers and field technicians often lack funds, other resources and government support to enable them to work on issues related to salt-affected soils including assessment, monitoring and mapping.
- Human resources required to assess, monitor and map salt-affected soils are limited in most participating countries.
- Many countries lack systematic national procedures to monitor secondary salinization and sodication. Studies are done on an *ad hoc* basis. Reliable data to establish baseline conditions are also lacking.
- Depending on the scale, the different methods required for assessing and monitoring salt-affected soils in participating countries varied from simple field surveys, sampling and laboratory measurements, including electrical conductivity (EC) and exchangeable sodium percentage (ESP), to the use of expert assessment, salinity sensors, electromagnetic sensors, remote sensing, Geographic Information Systems (GIS) and modelling.
- Models require a very intensive effort for data collection and are not commonly used in most participating countries. However, some countries do have standardized assessments, modelling and mapping methodologies and procedures that could be shared with other SPUSH members to improve classification and mapping of their salt-affected soils.
- Policies that relate to the management of salt-affected soils in the participating countries are often not effective. Most countries do not have a strategy or policy at national level for assessing and monitoring salt-affected soils.
- The available maps on the extent, severity and rate of salinization/sodication and waterlogging in participating countries need to be updated as they are based on old data. In this regard, SPUSH may develop guidelines and a database on resource surveys and land use planning. This database must be maintained and updated regularly.
- The Expert Consultation participants acknowledged the efforts made by the Organizing Committee to make possible the SPUSH Consultation and INBA meetings and to bring together different experts to discuss common problems. Participants also hoped that the efforts made will lead to further strengthening and development of cooperation between members of the two Networks.

GENERAL RECOMMENDATIONS

The following is a summary of the recommendations from the SPUSH Expert Consultation and the INBA Meeting; many of them relate to the future activities of the SPUSH Network. Detailed recommendations for each topic covered are included in Part 3:

- There is a need to strengthen research and implementation of assessment, monitoring, mapping and modelling of salt-affected soils in participating countries. The SPUSH Network could be fundamental for the promotion of collaboration between different interested national and international organizations.
- Efforts to explore possible financial support from other agencies or national programmes to strengthen the Network activities should be intensified. The SPUSH secretariat should explore funding possibilities with FAO, ICBA, UNESCO, EU, UNEP, ICARDA and Gulf Cooperation Countries (GCC) to keep the Network active.
- The SPUSH Network should be expanded to other countries having problems with salt-affected soils. In this context, further collaboration should continue between the SPUSH and INBA Networks and other relevant networks.
- An expert group needs to be constituted within the SPUSH Network to address technical issues such as improving remote sensing methods, standardizing definitions, considering the assessment of waterlogged saline soils; studying the cost-effectiveness of microwave and thermal lines for the assessment of salt-affected soils.
- SPUSH Network countries are encouraged to establish benchmark sites for periodic monitoring of salinity, sodicity, water quality; develop and use early warning mechanisms to undertake preventive measures; develop farmer-friendly salinity assessment and monitoring systems.
- Countries that have standardized assessment, modelling and mapping methodologies are encouraged to share expertise with other SPUSH members in order to assist them to update existing data on the extent and distribution of salt-affected soils. Improving the data of SPUSH members will facilitate not only management at national level but also the preparation of a new global salinity map, to increase awareness of the problem and potentially to obtain funding to combat problems.
- Several countries have identified promising germplasm of trees, shrubs, grasses and crops (as well as fish) that can contribute to the management of salt-affected soils. Network members are encouraged to share, as far as possible, their knowledge in this area with other members of the SPUSH and INBA Networks.
- Members should seek to formulate joint network project/programmes related to assessment, mapping, monitoring and modelling of salt-affected soils, to benefit from members' expertise and undertake more effective fund raising.
- The SPUSH Network should serve as a focal point to create national and international awareness, to exchange information on sustainable and environmentally-sound use of salt-affected soils and related issues such as assessment, mapping, monitoring, modelling, and impacts of climate change. It is recommended that the Network considers coordinated field experiments, education, advisory services, publications for different audiences and through different information media.
- The Network will promote the development of kits on assessment and monitoring for field technicians and farmers. This material should be available free of charge. China offered the technical facilities to develop such kits and ICARDA, Iran, Jordan and Tanzania showed interest in contributing.

- The SPUSH member countries should be encouraged to publish good quality papers. The Network should also distribute guidelines for different publics. Papers and presentations in the Expert Consultation should be published as proceedings after editing.
- The secretariat of SPUSH should continue to maintain the Network website which should be modified to allow direct contribution and regular updates from members. Quality publications, maps and available data should be included in the website.
- A task force to ensure the continuity of the Network was established. The initial appointed members were India, Iran, Italy, Pakistan, ICARDA and FAO.
- Participants recommended that the next Expert Consultation should be organized as soon as funds are available. Hungary and Spain offered to host the next meeting, while Iran offered to be the host after Hungary or Spain. It is suggested that the topic of the next Consultation could be “Impacts of climate change on salinity development”. However, many of the member countries may not have enough related information in their countries, as climate change is a complex issue. The topic suggested as an alternative is “Sustainable management of salt-affected soils under changing climatic conditions”, which could include biosaline agriculture, in which case INBA could participate. In all cases, the national institutes are the focal points to participate in the Expert Consultation and not individuals.

RECOMMENDATIONS FOR FURTHER APPLIED RESEARCH

- There is a need to design appropriate monitoring networks. Monitoring of irrigation schemes is critical.
- There is also a need for developing methodologies for assessing different kinds of salinity and crop damage based on integrated use of remote sensing and plant physiology.
- The development of salt-tolerant crop varieties will become fundamental (breeding with the application of gene-surgery, selection, production of salt-tolerant plants). The use of biosaline agriculture could also be further advocated; e.g. the use of *Salicornia*, *Atriplex*, *Salvadora* and *Prosopis* has been identified as a good alternative in salt-affected areas.
- The classification of salt-affected soils should be harmonized and it should consider their potential land use and include soils rich in magnesium.
- Land use classification and decision support systems need to be further developed.
- There is a need for research on the implementation of sustainable irrigation technologies using low quality water, including saline water and wastewater, considering different impacts to human and ecosystem health.
- Unfavourable changes in groundwater quality due to over-exploitation need to be further studied.
- More effort should be made on investigating the impact of climate change and salt dynamics in soils.
- There is a need to devise early warning systems that use simple indicators.
- Researchers should contribute to the development of simple kits for farmers to assess and monitor salinity in the field.
- Assessment and monitoring of salinity should include associated salts/metals, such as like boron, iron, aluminium, manganese, arsenic, selenium, nitrates, etc.
- More studies are needed to show if salt-affected soils and poor quality waters may also be an asset for seaweed cultivation for biomass/hormone production and growing halophytes for energy or salt production.

- There is a need for advice on assessment and management technologies that incorporate socio-economic and environmental factors.
- There is a need for models that better represent field conditions. For this reason, further parameters should be considered.