Harnessing salty water to enhance sustainable livelihoods of the rural poor in four countries in West Asia and North Africa: Egypt, Jordan, Syria and Tunisia

Report of the Project Workshop

28-29 June, 2004
ICBA, Dubai, U.A.E

Introduction:

Early in 2004, the International Water Management Institute (IWMI), headquartered in Colombo, Sri Lanka, awarded ICBA a grant of US$75,000 to implement the above project under the aegis of the Comprehensive Assessment on Water (CA), which is supported by funds from the Governments of the Netherlands and Switzerland. The project aims to assess the potential impact of the use of saline groundwater resources for agricultural production on the livelihoods of rural people and on poverty in the study countries.

Between April and June 2004, national experts identified by ICBA collated and interpreted information on the current status and trends in saline water resources in the four study countries. Their analysis included an assessment of the quantity and quality of saline groundwater, poverty distribution, potential agricultural systems that could be based on the available water, and their likely impact on poverty and the livelihoods of the rural poor. The aim of the project was to identify areas in the four study countries where availability of saline groundwater, poverty and suitable farming systems coincided; and where the potential for use of saline groundwater in agricultural production to contribute to poverty alleviation could then be evaluated. The four sets of national experts submitted draft country reports to ICBA in June 2004.

As per the project proposal, a workshop involving the participation of the consultants and relevant ICBA staff was conducted at ICBA in the last week of June 2004.

The objectives of the workshop were:

1. *Review draft national reports submitted to ICBA by national consultants from four countries.*
2. *Request national consultants to provide missing information, if required.*
3. *Discuss mechanisms and targets for dissemination of the information contained in the country reports.*

Program of the workshop:

The program for the 2-day event is provided in Annex 1. Part of the first day of the meeting was taken up by presentations of the background to the current project with the aim of clarifying its objectives and outputs. This was followed by presentations from the national consultants of salient features of the their national reports (see Annexes 2a, 2b, 2c and 2d). The final part of the first day comprised further discussion of the aims of the project and the information that was required in the reports to establish the potential of the use of saline groundwater in agriculture to alleviate poverty.

The second day was initiated by each of the national consultants identifying the geographical areas of their countries that, in their view, had the highest potential for alleviating poverty through the use of biosaline agriculture and the criteria that were used to establish this. This was followed by general discussion of the criteria to be used to identify and prioritize potential target areas for biosaline agriculture and to assess how this might contribute to improving the livelihoods of poor farmers in rural areas.

The four national consultants who attended and presented the national reports on behalf of the national teams were Dr Fatma Attia (Egypt), Dr Abdel Nabi Fardous (Jordan), Dr Awadis Arsalan (Syria) and Dr Kamel Zouari (Tunisia). In addition, ICBA staff members made presentations on ICBA's research programs, the overall aims of the project, and an earlier saline water resources assessment on which the current project builds.

An international consultant, Dr Jacob Kijne (former Director of Research at IWMI) interacted with ICBA staff and the national consultants prior to the Workshop and actively led the discussions in several sessions of the project workshop. Dr Kijne also presented a summary of the aims and objectives of the Comprehensive Assessment on behalf of Dr David Molden who was unable to attend the workshop.

Project outputs

To set the scene for the discussions, participants were reminded of the outputs anticipated from the project, the form that they would take and the projected time frame. These were:

- *Reports on the quantity, quality and location of saline groundwater resources and the potential impact of their use in agriculture on the livelihoods of the rural poor.*

  National reports for each of the four participating countries were envisaged. These would be concise – 15-20 pages in length – and summarize the national situation. The reports would be well illustrated, in color and would provide a resource that would be useful for each country.

  In addition to the national reports, a synthesis report assessing the potential to use saline groundwater for agricultural production at the regional level would be produced. This would also be a glossy publication, similar in length to the national reports, aimed to provide a technical resource for researchers and policy makers.

- *Bibliography of publications on saline groundwater resources*

  A bibliography of documents and other sources of information on saline groundwater resources would be produced. Much of the available information is scattered and hidden in documents and reports on other subjects. A bibliography would help to overcome difficulties of access to information of this type.

- *Policy brief on the use of brackish and saline water resources to improve agricultural productivity*

A two-page summary of the synthesis regional report would be produced as a policy brief for decision makers. This document would present the salient findings on potential use of saline groundwater in agriculture and their policy implications.

All the outputs were envisaged as being produced at least in draft form by the end of 2004. In addition to being produced in hard copy, all would be made available through Internet and other forms of electronic publication.

Summary of the discussions:

The discussions were wide ranging and touched on many aspects of water resources, poverty, technology transfer, and related areas. The following paragraphs highlight some of the main points raised

Data requirements for the reports: The guidelines for the national reports were revisited. The basic requirements were to identify the quantity and quality of the saline water available in different aquifers. Having done this the reports had to identify the proximity of these locations to poor farm households. The locations with available saline groundwater, limited other water resources and poor farmers would represent the best options for agriculture using the available saline water resources to improve the livelihoods of the rural poor.

The question of integration of the different types of data required for the study was raised as a problem. Comprehensive databases are not available and local and regional socioeconomic information is scarce.

The importance of soil type and texture for management of salinity was raised and discussed. It was also pointed out that naturally saline soils used in conjunction with less saline water could also contribute to prospects for biosaline agriculture. While both of these were acknowledged as significant, detailed consideration of soil salinity was agreed to be beyond the scope of the current study, which focused on groundwater. Soil texture was, however, agreed to be a factor that should be considered in identifying areas with greatest scope for using saline water for agriculture.

Water resource assessment: Should agriculture drainage water or recycled water from domestic and industrial sources be added to the data? Such non-fresh water is important in quantity and is often used/reused in irrigation, by resorts and cattle. It was agreed, however, that these sources of water would not be included in the current study as they present particular problems of pollution and contamination that by and large are absent with groundwater and therefore require separate consideration. Furthermore, large quantities of agricultural drainage water tended to be associated with large irrigation schemes where are usually not the most poor. Similarly, domestic and industrial effluents tend to be found in areas distant from the rural poor.

The dynamics of saline groundwater were discussed at length. The origin of much of the salinity problem for groundwater was acknowledged to be over-pumping and lack of control of wells. The sustainability of continued over-extraction was considered highly questionable. Priority should therefore be given to areas where there was natural recharge either through rainfall or other mechanisms, such as intrusion of seawater in coastal areas.

The country reports clearly indicated that comprehensive and reliable quantitative, spatial and temporal data for non-fresh water in the four countries is generally not available and most probably would not become available in the near future. Given this situation, the issue then became how to identify potential areas for biosaline agriculture in the absence of such data. Firstly, do we need the data at this stage? Would the country representatives, from their personal knowledge and their understanding of the data in their reports, be able to identify target areas for biosaline agriculture in each country with some confidence? Is the concept of 'safe yield' of groundwater relevant when there are no alternative sources of water?

Farming systems: Although regional-scale maps of farming systems have been compiled by agencies such as FAO and the World Bank, the region does not yet have maps at the country scale which would help identify farming systems likely to benefit from biosaline agriculture. The regional-scale maps, in addition to mapping the farming systems, indicate the most likely strategies to alleviate poverty for each system. Such strategies include leaving farming altogether. Questions arising included whether costs-benefit analyses of biosaline agriculture were relevant in all cases or whether in some cases, for example where the benefits of permanent biosaline crops could prevent soil erosion or growing fodder locally rather than importing it, need to be considered? Is data available from other development programs in the four countries that might shed light on some of these questions? The lack of up-to-date data on agricultural trends and production, particularly in livestock farming where growth in most countries has been strong, was also a concern. Where possible it would be helpful to include more recent data in the country reports.

Non-irrigated or supplementary irrigation systems for using saline soils were also mentioned as candidates for biosaline agriculture. Water harvesting or use of limited fresh or saline water irrigation, when combined with appropriate plant species, could provide the basis for novel agricultural systems. This could be particularly important in restoring productivity to degraded environments.

Poverty: It was pointed out that unless the project specifically targets the poor it may not have the anticipated impact. Questions to be asked include: Who are the poor? What are the specific criteria in each country? Are there different 'kinds' of poverty and if so what particular poverty will be targeted? The criteria for determining poverty may be different in the four countries, for example income level, calories per day, access to water. Data in the public domain from different agencies may not be consistent and the source and variation in data should be noted.

Resistance to changes in lifestyle was raised as an issue in persuading the rural poor to adopt biosaline agriculture. The example of the difficulty in persuading Bedouin to accept a settled lifestyle and farming was quoted as an example. It was agreed that the limitations of the socio-economic circumstances could not always be overcome but that communities which had shown a willingness to adopt new practices or move to new areas probably represented better targets for innovative new agricultural systems and this could be integrated into choice of target areas. Areas where there were no existing communities were considered poor targets for introducing biosaline agriculture, in the absence of declared policies to resettle people or indications that they were willing to move.

Biosaline agriculture systems: The country reports indicated the difficulties inherent in identifying the specific areas where there are opportunities and the greatest need for biosaline agriculture based on the quantitative data available. Nevertheless, country representatives, from their personal knowledge and experience have clearly identified priority areas in each country. Discussion focused on a methodology for developing a set of criteria to identify areas where there are opportunities and the greatest need for biosaline agriculture. Developing these criteria would help in prioritizing areas for development of biosaline agriculture.

Fish farming was pointed out as an option for situations where the soil is not suitable for agriculture, where returns from agriculture might be low, or where other factors mitigated against cultivation of plants (for example, upward seepage of groundwater leading to rapid salinization of the upper soil layers). It was also pointed out that fish farming could sometimes be combined with crop production and should be actively considered as one of the most profitable uses of saline groundwater.

It was pointed out that in Jordan farmers were using desalination of groundwater to provide fresh water for production of high value crops such as bananas and strawberries. The cost of desalination was approximately US$0.35 per cubic meter, at which rate production of export crops was economically attractive. Consideration should also be given to indirect use of saline groundwater along these same lines.

Assessment of impact on livelihoods: Indications of the numbers of people who might potentially benefit from the introduction of biosaline agriculture would strengthen the final reports. Such data might be available from other development project reports. The synthesis report would also indicate the chances of extending the impact of the project to other countries in North Africa or regions, such as Central Asia.

Conclusions: Many uncertainties and lack of data limit knowledge on: non-fresh water resources (quantity and quality of water); farming systems, poverty (distribution, target communities); biosaline agriculture systems (plant systems); and the potential impact of biosaline agriculture on the livelihoods of the poor.

Criteria for identifying the areas in each country with best potential for biosaline agriculture to improve the livelihoods of the poor

To move forward, the group looked for a common understanding of the minimum set of information for the project reports given the variability of data across the four countries. Useful information would include: where the non-fresh water occurs; where the poor people live or areas to where they might be relocated according to national government policies for settlement, and the attitude of communities to adopting new systems.

The group agreed on a methodology for establishing these criteria:

1. Each country representative would identify priority areas in their country and list the criteria they used to determine these areas.
2. An overall list of criteria would be compiled.
3. The list of criteria would form the basis of the information to be included in the final country reports.

Based on this discussion country, representatives identified the potential areas for biosaline agriculture and the reasons why they had selected these areas. The criteria for selection were then compiled into an overall list of criteria, which will be addressed in each of the final country reports. The areas identified and the criteria used in selecting them are indicated in Annex 3.

Feedback on national reports

Individual meetings were scheduled with the consultants from the four countries to discuss water information and farming system information separately. The linkages between water data, poverty information and farming systems – current and projected biosaline systems – were discussed in both sessions. The aim of the meetings was to give specific feedback on redundant information and gaps and to discuss how these could be addressed. All the country representatives had a good understanding of what was required by this stage and were highly receptive to suggestions, in many cases already having worked out themselves the changes that would be required in their reports.

Action plan

The final session of the meeting was devoted to discussion of the follow-up actions required after the workshop. An action plan, specifying the actions to be taken, the actors and the deadlines, was agreed (Annex 4).

Session V

10:30-12:30 Feedback on national reports – individual meetings with Dr Jacob Kijne and ICBA team

Lunch break

Session VI Chairperson: Jacob Kijne
Co-chair: John W Stenhouse
Rapporteur: Sandra Child

14:00 - 16:15 Discussion and Action Plan
16:15 - 16:30 Closing remarks

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Project Workshop

Harnessing salty water to enhance sustainable livelihoods of the rural poor in four countries in West Asia and North Africa: Egypt, Jordan, Syria and Tunisia

28 – 29 June 2004
Dubai, United Arab Emirates

Program

International Center for Biosaline Agriculture

International Water Management Institute

Monday 28th June 2004

Arrival and registration

Opening Session Chairperson: Jugu J Abraham

09:00 - 09:10 Welcome and opening remarks
Dr Mohammad H Al-Attar, Director General of ICBA
09:10 - 09:30 Introduction to ICBA
Dr Abdullah Dakheel, Acting Director of Technical Programs, ICBA
09:30 - 09:50 Introduction to the Comprehensive Assessment
Dr Jacob Kijne, International Consultant
09:50 - 10:00 Overview of the project
Dr John Stenhouse

Tea break

Session II Chairperson: John W Stenhouse
Rapporteur: Jugu J Abraham

10:30 - 10:50 IFAD Assessment
Dr Bassam Hasbini
10:50 - 11:20 Outline of national reports
Dr Jacob Kijne, International Consultant

National Reports -- Process

11:20 - 11:50 Egypt - Dr Fatma Attia
11:50 - 12:20 Jordan - Dr Abdel Nabi Fardous
12:20 - 12:50 Syria - Dr Awadis Arsalan

Lunch break

Cont/…

Session III Chairperson: Abdullah J Dakheel
Rapporteur: Sandra Child

14:00 - 14:30 Tunisia - Dr Kamel Zouari
14:30 - 15:00 Feedback on draft national reports - Dr Jacob Kijne
15:00 - 16:30 Identification of issues arising from national reports by topic
Water resources assessment
Farming systems
Poverty
Biosaline agriculture systems
Assessment of impact on livelihoods

Dinner hosted by ICBA

Tuesday 29th June 2004

Session IV Chairperson: Jacob Kijne
Rapporteur: Bassam A Hasbini

National Reports -- Highlights

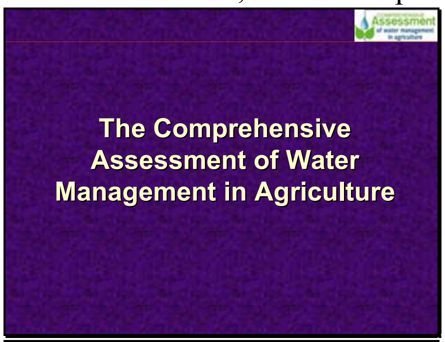
08:30 - 09:00 Tunisia - Dr Kamel Zouari
09:00 - 09:30 Syria - Dr Awadis Arsalan
09:30 - 10:00 Jordan - Dr Abdel Nabi Fardous
10:00 - 10:30 Egypt - Dr Fatma Attia

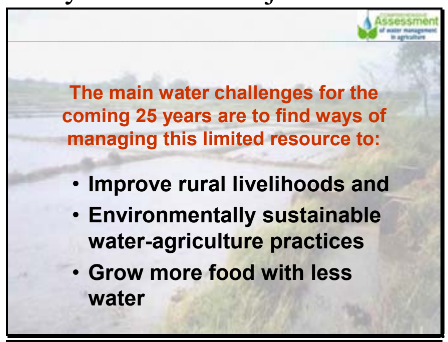
Tea break

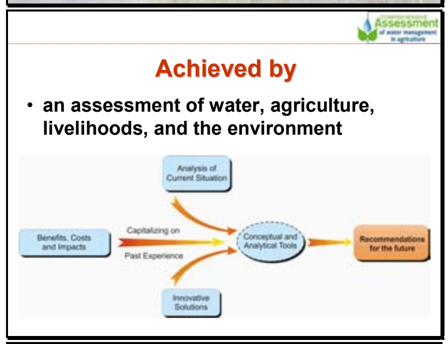
Cont/….

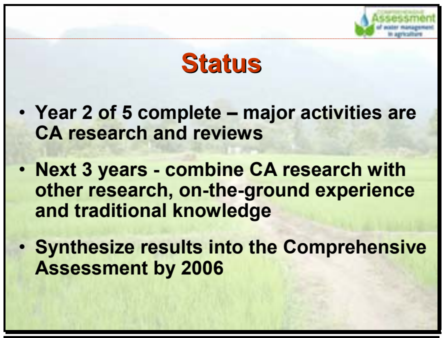
Annex 2. Workshop presentations

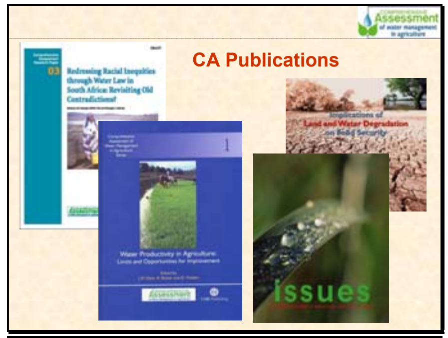
1. Presentation on the Comprehensive Assessment of Water in Agriculture prepared by Dr. David Molden, IWMI and presented by Dr. Jacob Kinje

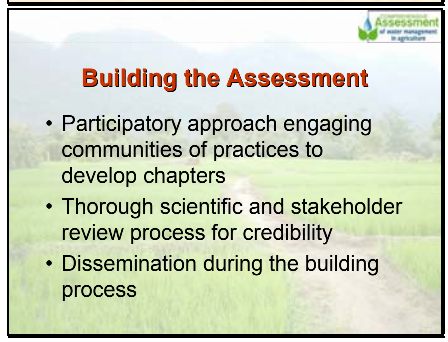




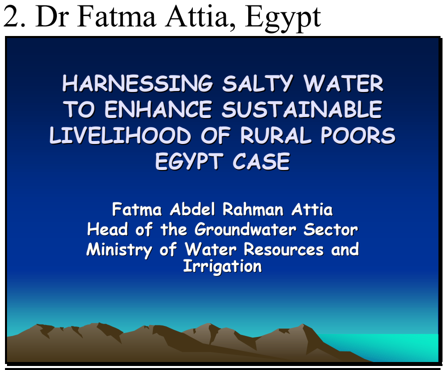


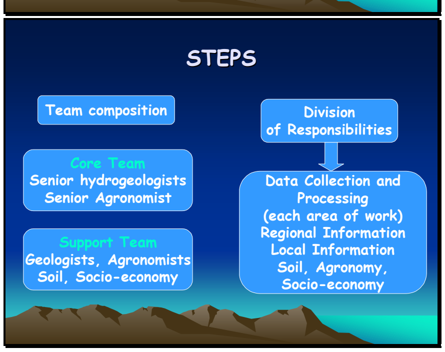


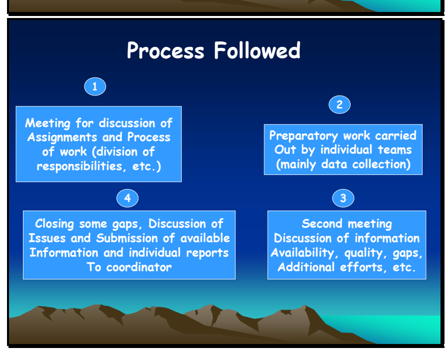




2. Dr Fatma Attia, Egypt







SOME REMARKS/ISSUES

- Some difficulties are encountered in putting the team together due to their separate physical presence and lack of understanding of integration.
- An integral data base for non-fresh water resources is not available at any institution. This may be due to the low concern given to non-fresh water resources in the past, especially groundwater.
- Local/regional socio-economic information is very scarce.

SUMMARY OF CURRENT STATUS OF THE REPORT AND PRELIMINARY CONCLUSIONS

NON-FRESH GROUNDWATER ASSESSMENT

- Assessment satisfactory on the high level scale (e.g. national and aquifer).
- On local scales, lack of data made it very difficult (approximate).
- The term *Safe Yield* does not apply to the majority of locations.
- The major problem encountered for the initial assessment is the distribution of salinity (with depth and areal).

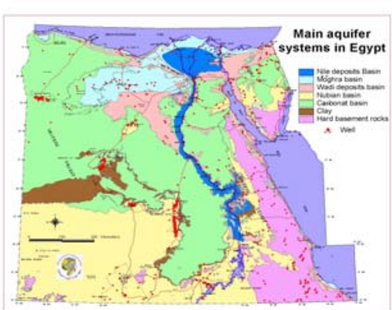
POTENTIAL PRODUCTION SYSTEMS

- The diversity of locations and rural population may dictate specific production systems.
- Agriculture may not be the most suitable production system everywhere.
- We cannot change people's culture in a short time. This may need either adaptation to people's expertise or discussion and scoping sessions (or may be piloting) to introduce different production systems.

IMPACT ON LIVELIHOOD AND POVERTY

- Not yet

PRELIMINARY CONCLUSIONS



- The only aquifer systems experiencing recharge, although very little, are the coastal aquifer systems (rain and sea water intrusion) and the Pleistocene (sea water intrusion).
- Non-fresh groundwater is found at depths ranging from 0 (north coast in the Nile alluvium, carbonates and coastal aquifers) to more than 3,000 m (the Nubian sandstone).

- The safe yield has been estimated at about 1,744 million cubic meters per year from all aquifer systems.
- The salinity of groundwater is estimated to range from 2 to 20 dS/m, at the beginning of development, and is expected to increase with time, especially for the Nile alluvium and the coastal aquifer systems.

- The major present utilization of non-fresh groundwater is mainly by resorts and hotels after desalination (South Sinai and the northern part of the Eastern Desert).
- Agriculture dependence is very limited; while use for cattle is still confined to the southern portion of the Eastern Desert.
- The total utilization is estimated at about 60 million cubic meters per year, mainly from the upper ranges of salinity (2-15 dS/m).

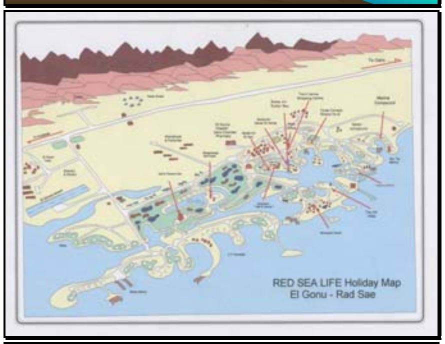
OTHER NON-FRESH WATER RESOURCES

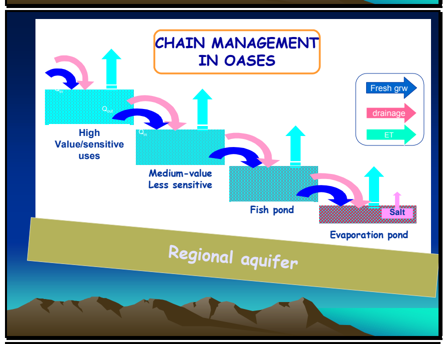
- Agricultural drainage…very widely utilized in the Nile valley and delta, but may not continue with the progress of irrigation improvement and IWRM.
- Domestic sewage…very limited

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

- Assessment of non-fresh groundwater, as presented in this report, is very tentative both in terms of initial salinity and the future changes in salinity and potential. *More investigations should take place in priority regions.*
- In the future, and parallel to the application of IWRM, a matching between supply and demand should take high priority. Also Regional aspects (water resources, poverty, activities, etc.) should be considered.

- An important factor in water resources allocation is the impact of upstream users on downstream users of the resource.
- Preparation of people in regions suffering from water shortages to switch to activities that depend on lower quality water is highly important.
- *It is recommended to investigate the possible multi-use of fresh water, especially in closed basins.*





DIFFICULTIES AND CONSTRAINTS

DATA ACCESS AND AVAILABILITY

DATA ANALYSIS AND INTERPRETATION

3. Dr. Abdel Nabi Fardous, Jordan

The Hashemite Kingdom of Jordan

National Center For Agricultural Research & Technology Transfer *(NCARTT)*

Harnessing salty water to enhance sustainable livelihoods of the rural poor in four countries in West Asia and North Africa

ICBA Workshop
Dubai, 28-29 June 2004

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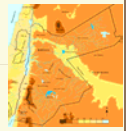
-Jordan National Report-

CONTENT:

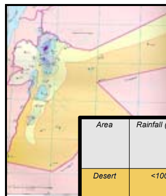
- *Introduction:*
- *Background Information:*
  - *Water Resources in Jordan*
  - *Agricultural Resources*
- *Availability of Brackish and Saline Water:*
- *Rural Poverty:*
- *Conclusions and Recommendations:*

PRESENTED BY:
Dr. AbedAl-Nabi Fardous,
Director General of NCARTT
(www.NCARTT.GOV.JO)

INTRODUCTION



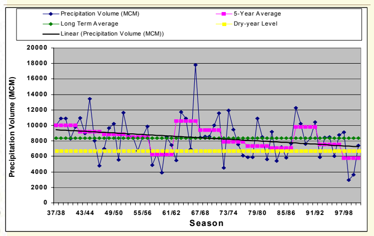
- Jordan is a country with scarce water resources.
- The most important critical factors are low and erratic rainfall.
- The total land area of Jordan is about 90,000 square kilometers, which receives on the average an estimated 8.4 billion cubic meter of water.
- Most of the area (about 90%) receives less than 200 mm of annual rainfall.



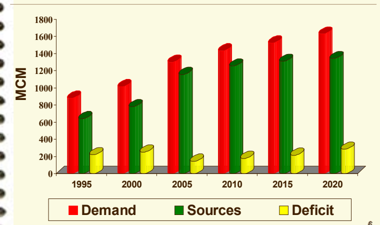
The average rainfall over Jordan's agro-climatic zones

Area	Rainfall (mm)	Area (km^2)	Percent of Total	Average Weighted Rainfall (mm/yr)	Rainfall Volume (MCM)
Desert	<100	633849	71.5	53.05	3,414
Arid	100-200	19,914	22.3	147.00	2,947
Marginal	200-300	l,965	2.2	250.24	513
Semi Arid	300-500	2,947	3.3	393.22	1,160
Humid	>500	625	0.7	650.00	390
Total		89,300	100%	93.60	8,424

The average annual precipitation volumes in Jordan since 1937.



Total Demand , Available Sources and Deficit in MCM



Background Information

- According to water experts and UN classification, Jordan is a country, which is under the poverty water line.
- Agricultural development in the country have concentrated on the highland rainfed areas and irrigated area in the Jordan Valley and the highland. The irrigated area amounts to 2% of the total area.
- With population increase at a high rate of 3.6%, and unexpected immigration, Jordan has no choice but to utilize any available source of land and water.

Land utilization in Jordan:*

Utilization Pattern	Area (Million dunum)	% Total Area
Rangelands	80.7	90.4
Buildings & Public Utilities	1.7	1.9
Land used for Forestry	0.7	0.8
Land registered as Afforested	0.6	0.7
Water Area	0.5	0.5
Agriculture Land	5.1	5.7
TOTAL	**89.3**	**100.0**

The area of production in the rainfed areas and irrigated lands as well as the major crops grown on them are shown in next Table.

**Source: MOA, Dept. of Economics and Statistics.*

Area of crops grown in Jordan under rainfed and irrigated conditions. (1000 dunums)

Commodity	1984-1986	1987-1989	1990-1992
Rainfed	**1587.8**	**2519.5**	**2011.3**
Field crops (winter)	905.7	1734.8	1170.8
Field crops (summer)	75.1	65.3	74.0
Vegetables	78.6	75.2	64.7
Fruit trees (bearing & non-bearing)	528.4	644.2	701.8
Irrigated	**538.2**	**549.2**	**716.5**
Field crops	33.3	76.8	81.0
Vegetables	347.7	260.7	339.7
Fruit trees (bearing & non-bearing)	157.2	211.7	295.8
TOTAL	**2126.0**	**3068.7**	**2727.8**

**** This table gives some indication of the variability of land use for the periods 1984-1986, 1987-1989, and 1990-1992***

Contribution of the agricultural sector to the gross domestic product at current prices, 1980-1992,

(Million JD)

Year	GDP	Agriculture	%
1980	984.3	69.4	7.05
1981	1164.2	75.1	6.45
1982	1321.2	81.8	6.19
1983	1422.7	110.0	7.73
1984	1490.0	95.8	6.43
1985	1275.3	83.2	6.52
1986	2114.6	97.2	4.60
1987	2162.7	121.8	5.63
1988	2218.4	120.2	5.42
1989	2329.9	143.5	6.16
1990	2611.4	179.6	6.88
1991	2778.4	174.3	6.27
1992	3257.0	204.0	6.26

Availability of Brackish and Saline Water:

Water natural resources:

- ***Quantitatively*:***
  - Surface waters (millions m^3/year)= *505 MCM/Year*
  - Underground waters (millions m^3/an)= *418 MCM/Year*
  - Deep water tables (renewable resources)= *275 MCM/Year*
  - Water tables *(non-renewable)= 143 MCM/Year*
  - Other (treated wastewater)= *65 MCM/Year*

**Details are presented in the National Report*

Availability of Brackish and Saline Water:

Water natural resources:

- ***Qualitatively:***

1- Salinity rate:

- ***< 1 g/l = 89% of Total***
- ***1-2 g/l = 6.56% of Total***
- ***> 2 g/l = 4.44% of Total***

Availability of Brackish and Saline Water:
Water natural resources:

2- Other criteria :

Water in Jordan is classified as follows according to its quality:

Class A water:

According to FAO standards, with a salinity less than 0.45g/l. It includes water of Yarmouk River, King Abdullah Canal, Wadi-Arab Dam, Shurahbiel Bin Hasna Dam, Shuaib Dam, Alkafrein Dam, as well as water from the wadis of the southern Ghore.

Class B water:

According to FAO standards, it includes water discharged from King Talal Dam. Its salinity range is 0.45-2g/l.

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Availability of Brackish and Saline Water:
Water natural resources:

- ***The most important supply of surface water is the Yarmouk and Zarqa rivers.***
- ***The Yarmouk River is suitable for irrigation (TDS=600ppm).***
- ***The water quality of Zarqa River is deteriorated due to Kherbet Al- samra wastewater effluent (13500M³/DAY).***
- ***The water quality of the aquifers is declining due to unorganized over pumping.***

14

Availability of Brackish and Saline Water:
Water natural resources:

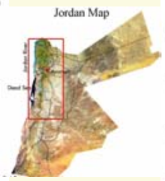
Water salinity for different resources

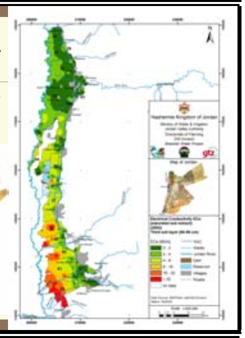
Water resources	Water salinity TDS (PPM)
Yarmouk Aquifer	240-800
Yarmouk River	300-400
Jordan Valley Aquifer	450-3000
Wadi Araba	800-2500
Jafer and Disi	250-2246
Azraq	300-815
Al- Khalidiah	2000-5300
Zarka River	930-1230

15

Availability of Brackish and Saline Water:

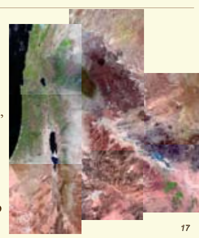
Soil Salinity in the Jordan Valley





Availability of Brackish and Saline Water:
Water natural resources:

- Sixty seven saline water springs have been identified:
  - 23 in the Jordan River Basin,
  - 33 in the Dead Sea Basin,
  - 8 in the Wadi Araba Basin,
  - 1 in the Azraq Basin,
  - and 2 in the Al- Jafer basin.
- The total average discharge was estimated to be approximately 46 MCM/year.

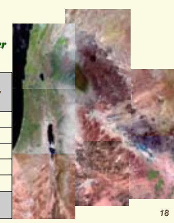


17

Availability of Brackish and Saline Water:
Water natural resources:

Total average discharge (MCM/year) and water salinity (mg/l) of saline water springs in Jordan.

Basin	Average Discharge (MCM/year)	Average Salinity (mg/l)
Jordan River	21.03	1010-3860
Dead Sea	24.06	1020-7841
Wadi Araba	0.09	1110-1410
Azraq	0.74	1043
Al-Jafer	0.10	1100
Total	46.00	



18

Availability of Brackish and Saline Water:
Water natural resources:

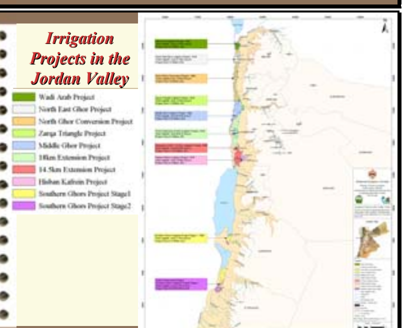
- ***Regardless of the adopted measures, the amounts of fresh water resources that could be made available will not exceed 1000MCM, whereas the demand in the year 2000 has exceeded this number.***
- ***As a result, the Ministry of Water and Irrigation (MWI) conducted a program to:***

1. ***study the deep-water aquifers to utilize its waters for drinking purposes in various areas in Jordan.***
2. ***Enhancing the treated wastewater quality, to obtain better qualities, MWI is formulating plans to improve the performance and elevate the efficiency of some of the existing treatment plants*.***

****example: Khirbet As-samra, Ramtha, Mafraq, and Madaba treatment plants, with an estimated cost of 170 million US $***

19

Irrigation Projects in the Jordan Valley



Socio-Economic

Human Resources:

- Agriculture currently is the main source of livelihood for about 6% of the population, a percentage that has been shrinking due to out-migration from rural areas.
- The number of employees in agriculture has declined from around 100,000 in 1969-71 to 44,400 in 1992.
- The labor force is about equally divided between the Jordan Valley and the Uplands.

21

Socio-Economic

Human Resources:

- The number of foreign laborers engaged in agriculture is increasing and is estimated to be approximately 60,000 in 1994.
- The average age of Jordanians engaged in agriculture is 54 years indicating that the younger generation is not engaged in agriculture.
- The average age of herders in the Badia is 56 years and the average illiteracy rate is more than 32%.

22

Rural poverty

- Only 30 percent of Jordan's cultivated land-base are irrigated with low crop yields.
- Jordan's rural population does not press for access to land because the attractive economic rates of return are found in the non-farm sector.
- Rural Jordan's rich earn less than 10 percent of their total per capita income from agriculture and more than 55 percent of it from non-farm sources.
- However, many pilot programs and projects were implemented in Jordan and including different aspects of alleviation poverty and employment creation.
- About 6433 households with US$ million 17.2 were benefited from Diversification of Income Sources Project (1994-2001).

23

Rural poverty

- A recent report prepared by the United Nation Development Program (UNDP) 2001 indicated that the Gross Domestic Product (GDP) per capita is $ 1490, and the current population growth rate amounted to 2.6%.
- Furthermore, Jordan indicator of human development, as indicated by the Human Development Index (HDI) is medium (89 out of a list of 174 countries).
- The level of livelihoods of rural family in Jordan became increasingly dependent upon the availability of food subsidies and any reduction in these subsidies will represent a real decline in their standard of living.
- A significant portion of rural income is spent on food.

24

Rural poverty

- Furthermore, the combining effects of privatization and other ingredient of Structural Adjustment Program (SAP) could lead to deterioration of the rural economy.
- On the other hand, agricultural reforms under privatization and SAP usually favor large and efficient farmers.
- This could lead to further deterioration in the small and poor farmer's position, increase rural inequality, land concentration and deepen poverty.

25

Rural poverty

- The Ministry of Social Development in partnership with the Department of International Development (UK) and UNDP estimated the absolute poverty line in Jordan in 1997 to be USD 55 per capita monthly (Measurements and Analysis of Poverty in Jordan, 1997).
- Absolute poverty incidence is estimated to be 33% in terms of population and 25% in terms of households.
- The Zarqa and Mafraq area have the second highest absolute poverty lines, while Amman ranks first and Balqa and Madaba provinces has the lowest absolute poverty in Jordan.

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Rural poverty

- However, in terms of the number of poor, Zarqa and Mafraq rank third after Amman and Irbid areas, the distribution of the absolutely poor is 18% in the Zarqa and Mafraq area.
- Using severe poverty line instead of absolute poverty line, the Zarqa and Mafraq area has the second rank in the highest severe poverty incidence (3.3%) and number of severely poor (21%).

27

Conclusions

- Jordan is among the world's countries least well endowed with water resources.
- Its nearly 5.039 million inhabitants have far less water at their disposal than an arid country needs.
- This includes the water required for self-sufficient food production in irrigated agriculture, along with municipal and industrial requirements.
- As the volume of saline water is increasing by time as a result of over-exploiting groundwater or due to pollution.

28

Conclusions

- There is evidence that ground water resources are being stressed (increasing salinity in the Wadi Duhleil and Azraq basins).
- This could have a negative effect on highland irrigated production in the future.
- The share of treated wastewater is increasing and currently accounts for about 52 MCM and is expected to increase to about 85 MCM in the year 2000 and 150 MCM in 2010.
- Ground water is considered to be the major water resource of many areas, and the only water resource in other areas in Jordan.
- At the present conditions and as over pumping continues, the estimated usable time for the ground water resources is around 40 years only.

29

Recommendations:

- There is a growing need to come out with an environmentally safe package to:
  1. allow the use of such water qualities to both increase the planted area.
  2. And increase the production of strategic crops that are badly needed on the national level.
- Future planning should aim to meet country's water demands.
- As conventional resources are inadequate, many studies stress the need for some new and non-conventional water resources to be developed for the long term.

30

Recommendations:

- Principal; among new and non-conventional water resources are:

1= Desalination:

****(R.O. In the Jordan Valley =BANANA CROP)***

Recommendations:

2 = Water imports:

4. Dr. Awadis Arsalan, Syria

Harnessing salty water to enhance sustainable livelihoods of the rural poor in Syria

GCSAR-MAAR

Syria

The total area 18518000 ha

The population 18 866 000

51% male

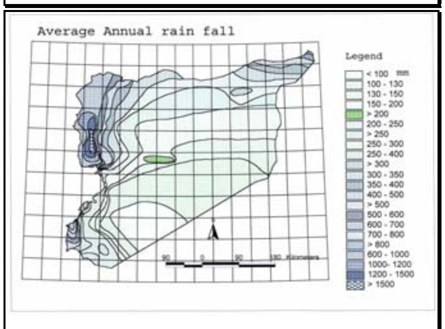
49% female

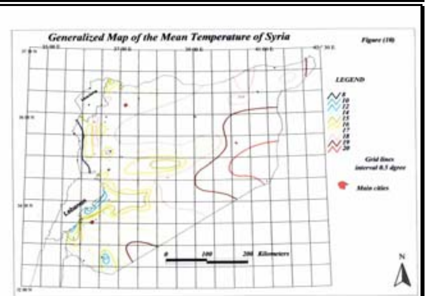
Rural population is 9 395 000

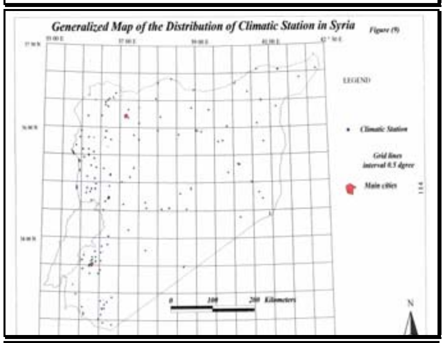
working population is 4 821 000

81.6% males

18.4% female.







Agriculture in economy

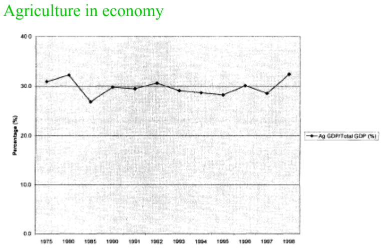


Fig 1. Contribution of agricultural GDP to total GDP:1975-1998. Adapted from Report No. 22602-SYR, 2001.

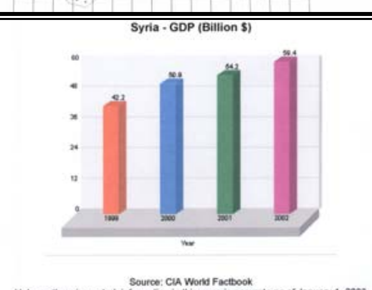


Fig 2. Syrian GDP (Billion $).

Agriculture employing nearly 25 percent of the workforce

with another 50 percent of the manufacturing workforce dependent on it for employment

Agriculture also employs the majority of the female workforce

The cultivated land area in Syria was estimated at *5.5* million ha,

or about 30% of the total country area in 1998 ,

of which about 20 percent (1.2 million ha) was irrigated

Rural population is 40%,

agriculture, and irrigated agriculture in particular,

have strong impact on poverty alleviation and income distribution

Water rights

The right to use surface or groundwater is acquired through the issuance of water use license by the MOI.

Whoever installs a pump on public surface without having a license is subject to a nominal fine.

The license can be withdrawn if the user does not comply with license conditions *or if they use the water for purposes other than those authorized.*

At present, licenses specify discharge, well numbers and a maximum depth of 150m.

Water rights

According to MOI officials, over 140 laws have been passed since 1924 that address water.

Drinking water has the top priority followed by agricultural water and industrial water.

According to MOI officials, disputes over water rights and other water management issues are currently resolved through the normal court system.

This often involves a committee chaired by a judge and containing representatives from the MOI, local authorities and the Farmers' Union.

Water rights

Given their highly fragmented nature, the MOI has drafted a new bill to supersede and replace existing water laws.

This law is currently being considered by the Parliament

The Syrian farmers are operating under an area-based administered water pricing system and are not charged for the actual use of water.

Currently, irrigators use large volumes of water well above what will be considered the optimal crop irrigation requirements without any penalty.

Water Resources

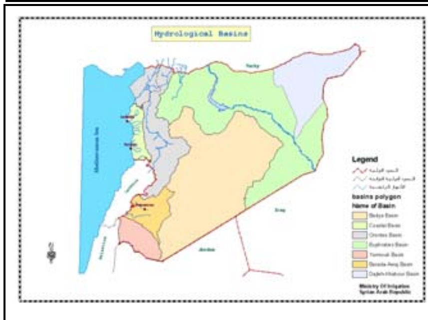
The water resources in the Syrian Arab Republic consist of the rainwater, the permanent and temporary rivers, the runoff and the ground water.

The annual average rainfall is about (46.76 milliards m^3/year)

Annual evaporating is about 36.43 milliards m^3

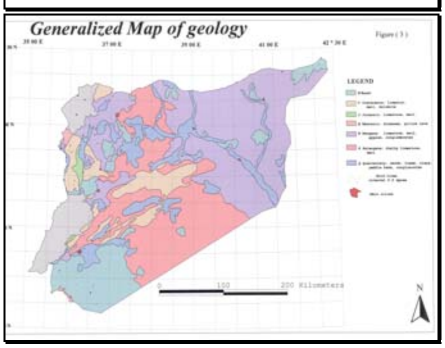
about 78% of rainfall

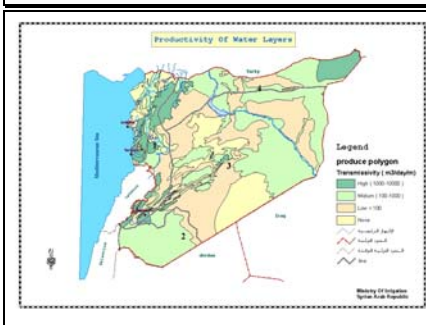
The amount of the average surface and ground incoming water is estimated to be about 16.559 milliards m3/year, distributed into 7 water basins.

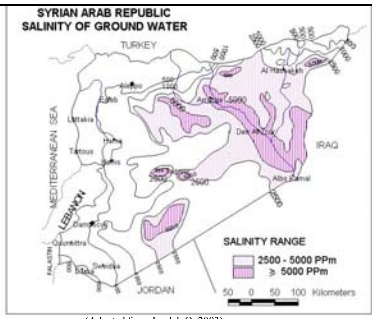


The water resources in the Syrian Arab Republic.

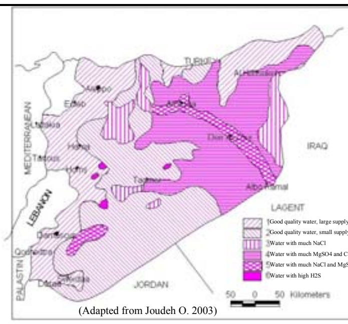
Basin Name	Basin area	The annual average of rainfall		Evaporation	The average of the annual resources / million m^3		
		Rainfall average	Rainfall amount		Surface	Ground	Total
Al– Yarmuk	6721	290	1949090	1502	180	267	447
Barada and Awaj	8596	267	2295132	1445	12	838	850
Coastal	5086	960	4882560	2547	1557	778	2335
Orontes	21624	403	8714472	5997	1110	1607	2717
Al-Badeih	70786	138	9768468	9422	163	183	346
Euphrates &Aleppo	51238	208	10657504	9408	7105	371	7476
Tigris &Al-Khabur	21129	402	8493858	6106	788	1600	2388
Total	185180	252.5	46761084	36430	10915	5644	16559







(Adapted from Joudeh O. 2003)

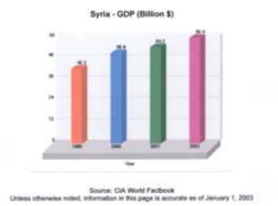


(Adapted from Joudeh O. 2003)

Rural poverty

The GDP of Syria increased from 42.2 to 59.4 Billion $ during the period 1999 to 2002 (CIA world Factbook 2003).

The per capita GDP is 3609.78$ per person.



Rural poverty

The population below national poverty line is 4 500 000 people,

3 500 000 of them live in the rural areas.

The literacy between females is about 64% according to 2003 estimate

and between males is about 89.7%.

The number of people who are working is 1 462 000,

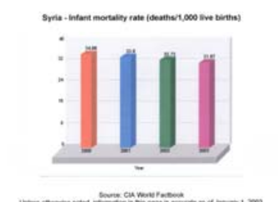
946 000 males

and 516 000 females.

Rural poverty

The agricultural sector provides about 29% of the natural income.

Infant mortality rate ranks 90th in the world and is decreasing with time



Rural poverty

Syrian population with access to piped water:

98% in the urban areas

38% of the rural areas.

The socio economic survey studies of the nomad families in the Syrian Badia showed that:

The percentage of nomads capable of working constitute 55% of the total Badia's population (Cheap herding).

Rural poverty

The ownership of the nomads families of sheep fall in one of these categories:

33.5% own less then 50 sheep

43% own between 51 and 200 sheep

17.5% own between 201 and 500 sheep

6% own more than 500 sheep

Rural poverty

The 1.5 million people nomads who live in the Syrian Badia have 3 types of living:

1 - 50 000 who are stable and connected to agricultural production

- 750 000 semi stable

-500 000 non stable

Prospect for biosaline agriculture

Since agriculture uses around 80% of water resources, there is an urgent need to use non-conventional water resources to meet the present and future needs.

By reusing the saline brackish and agricultural drainage water in biosaline agriculture production system that is sustainable, environmentally sound.

It is wise to combine scientific and practical expertise to tackle challenges for sustainable production in the country.

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The EC values of 8 sectors of vertical drainage wells in the lower Euphrates basin during 2003.

Sector	# of wells	Average EC dS/m	
		May 2003	November 2003
1	3	6.82	5.52
2	5	4.00	3.03
3	43	16.76	15.79
4	5	8.4	7.5
5	47	11.35	15.46
6	10	8.19	5.34
7	72	15.55	15.00
8	19	12.84	10.22

Prospect for biosaline agriculture

It can be achieved directly and indirectly fulfils several objectives:

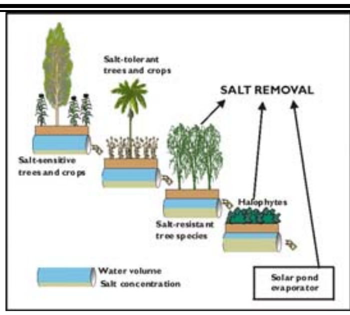
•determination of the area having saline water that can be used for biosaline agriculture.

•International and regional Cooperation.

•Scientific approach

•Selecting the most appropriate salt tolerant plant species

The overall goal is to contribute towards the sustainable use of saline water resources in the region where conflicting demand for water is combined with a wide range of hydrological, social and economic conditions.



Regional drainage water or saline ground water reuse plan

Conclusions :

•New map for ground water quality

•New map of saline agricultural drainage water

→

selecting pilot areas for executing a project of using such water in biosaline agriculture for further dissemination to promising areas.

Conclusions :

The proper use of saline water could help:

- The establishment of nomads,
- Reduce the poverty in the country especially in the Syrian Badea and rural areas,
- Increase the Syrian GDP through increasing fodder for the existing sheep and goat herds in the country,
- Reduce the need for governmental support of animal feed during the dry season,
- Improve the establishment of nomads in the areas producing fodder for animals will increase literacy, education women in the rural areas and Syrian Badea,

Thank you

5. Dr. Kamel Zouari, Tunisia

National Research Institute for Rural Engineering Water and Forestry (I.N.R.G.R.E.F)

National school of Engineering (E.N.I.S)

Harnessing Salty Water to Enhance Sustainable Livelihoods of the Rural Poor in Tunisia

International Center for Biosaline Agriculture (I.C.B.A)

Total surface area is 164 150 km².

Tunisia, situated in the north of Africa. Tunisia extends from the Mediterranean Sea coast in the north to the Sahara desert in the south.

The agricultural land is only 28% of the total area,I.e.,about 4.5 million ha.

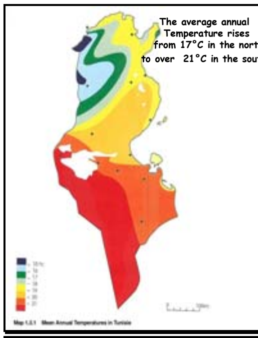
The climate varies from Mediterranean to semi-arid and arid;it is characterized by hot and dry summers and mild winters .

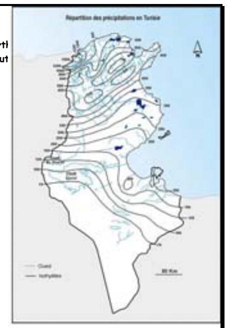
Climate:

The location of Tunisia and its topography are responsible for its limited water resources.

Total rainfall and distribution is highly variable from year to year and from North to South.

Average annual rainfall is around 594 mm in the North, 289 mm in the Center, and 156 mm in the South; it is ranging from 1 500 mm in the extreme North to less than 100 mm in the extreme South.

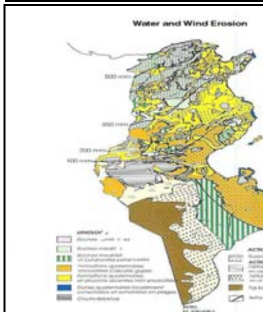




Soil resource:

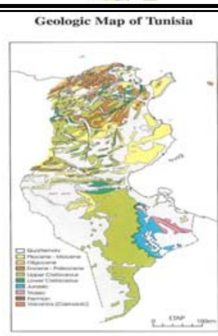
The total area of irrigated perimeters in Tunisia is about 350.000 hectares, in which 30.000 hectares are affected by salinity (12%).

The salinity is found in particularly in the North and in the South of the country.



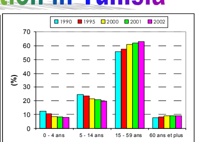
Map 5.1.1 Erosion map

Mean annual rainfall values can be exceeded by factors of two to twelve during short and intensive rainfall events producing runoff and causing soil erosion (695 to 6050 tons per Km²and year)



Demographic condition in Tunisia

Governorate	No. of Delega.	No. of Imada	Total Area (Km2)	Population (1994) Male	Female	Total	Pop. 2003	Growth Rate(%) (1984-94)	Pop. Density (per Km2)	No. of Family	Family Size
Tunis	21	159	288	453092	434711	887803	935800	1.4	3082.6	195557	4.54
Ariana	12	83	1592	291855	277439	569294	392200	4.3	357.6	110622	5.15
Manouba							478400				
Ben Arous	12	75	687	189757	181988	371745	332500	4.2	541.1	76947	4.83
Nabeul	16	98	2837	296563	282055	578618	659400	2.3	204.0	118041	4.90
Zaghouan	6	48	2833	71456	71580	143036	159000	1.9	50.5	26888	5.32
Bizerte	14	102	3751	245812	237274	483086	532500	2.0	128.8	97101	4.98
Beja	9	101	3887	153198	150655	303853	321800	1.0	78.2	59973	5.07
Jendouba	8	91	3075	202144	202639	404783	433300	1.2	131.6	78722	5.14
Le Kef	11	87	5081	135845	136507	272352	282800	1.0	53.6	54021	5.04
Siliana	10	86	4642	122672	122238	244910	259700	1.0	52.8	44196	5.54
Kairouan	11	114	6603	269161	263548	532709	574500	2.4	80.7	92973	5.73
Kasserine	13	106	8251	195063	191845	386908	428600	2.6	46.9	68498	5.65
Sidi Bouzid	12	111	7379	190440	186703	377143	406800	2.7	51.1	64101	5.88
Sousse	14	103	2669	220430	213279	433709	519100	3.0	162.5	88845	4.88
Monastir	13	77	1033	185382	178519	363901	437100	2.7	352.3	72564	5.01
Mahdia	11	99	2873	165082	170662	335744	381500	2.2	116.9	62918	5.34
Sfax	15	125	7008	374076	359611	733687	844700	2.4	104.7	150436	4.88
Gafsa	11	74	7360	155241	152272	307513	335900	2.7	41.8	54330	5.66
Tozeur	5	36	6159	44917	44138	89055	99500	2.7	14.5	16590	5.37
Kebili	5	40	22454	66381	65533	131914	145600	3.3	5.9	21316	6.19
Gabes	9	72	7505	156400	155313	311713	340400	2.6	41.5	56431	5.52
Medenine	9	93	9333	194263	191922	386185	436800	2.7	41.4	70443	5.48
Tataouine	7	64	38266	68111	67592	135703	151500	3.1	3.5	22672	5.99
Total	**254**	**2044**	**155566**	**4447341**	**4338023**	**8785364**	**8953600**	**2.3**	**56.5**	**1704185**	**5.16**



Structure population by ages

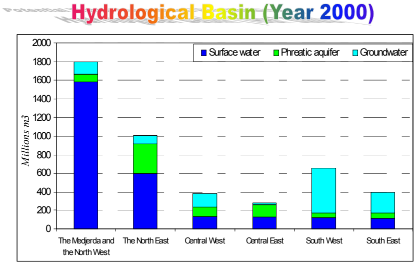
Years	1956		1966		1975		1984		1994
Population (x1000)	3,783.2		4,533.3		5,588.2		6,966.2		8,785.4
Annual growth rate (%)		1.8		2.3		2.5		2.3	
Overall fertility rate							4.64		2.87

Water resources distribution in Tunisia

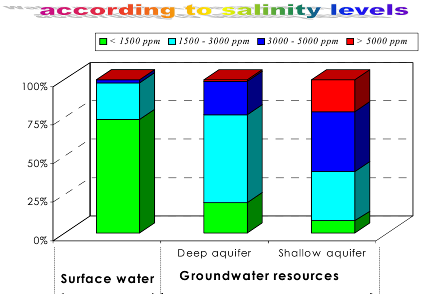
(billion m3)

	1970	1975	1980	1985	1990	1995	2000
Surface water	2.3	2.4	2.6	2.6	2.7	2.7	2.7
Groundwater							
Phreatic aquifers	0.2	0.3	0.5	0.56	0.69	0.74	0.74
Deep aquifers	0.6	0.9	1.0	1.1	1.1	1.2	1.2
Total	**3.1**	**3.7**	**4.1**	**4.3**	**4.5**	**4.6**	**4.6**

Potential Water Resources Allocation by Hydrological Basin (Year 2000)



Water resources classification according to salinity levels



Surface water

Natural Region	Hydrology Basin	Base flows Discharge (Mm^3/yr)	Base flows Salinity (ppm)	Floods Discharge (Mm^3/yr)	Floods Salinity (ppm)	TOTAL Discharge (Mm^3/yr)	TOTAL Salinity (ppm)
North	Extrême Nord	85	680	500	500	585	550
	Ichkeul	50	1680	325	480	375	630
	Medjerda	200	2250	800	1000	1000	1250
	Miliane	10	5500	40	2850	50	3400
	Cap-Bon	20	2200	160	830	180	1000
Total North		365		1825		2190	
Center	Sahel Nord	4	3400	16	1000	20	1500
	Nebhana	5	2000	20	700	25	960
	Region Alen			25	1000	25	1000
	Merguellil	7	3000	28	2000	35	2200
	Zéroud	15	4580	90	2100	105	2450
	Sahel	5	4500	55	1500	60	1770
	Centre Sud	5	3500	45	1600	50	1500
Total Center		41		279		320	
South	Chott Gharsa	1	2500	69	350	70	390
	Sud Est	8	4800	112	1410	120	1470
Total South		9		181		190	
Total of surface water in Tunisia		415		2285		2700	

Salinity class of surface water by region in Tunisia

Region	Rivers	Class of surface water < 1500 ppm	1500 to 3000 ppm	3000 to 5000 ppm	> 5000 ppm	Average Discharge Millions m³
Extreme Nord	O.Kebir	400 to 500 > 500				585
	O.Maaden	< 400				
	O.Melah	>300 to 1500	1500 to3000	> 2000		
Ichkeul	Sejnane	400 to 750				375
	Joumine	400 to 750				
	Ghezala		100 to 2400			
Medjerda	Medjerda to Ghardimaou	780				1000
	Bousalem	1040				
	Mejez El Bab	1210				
	Mellegue K13		1800			
	O.Bouheurtma	460				
	O.Tessa		1800			
	O.Beja	480				
	O.Siliana		1700			
Miliane	O.B. Aroda			2000 to 4000		
	O.Jerabia				5000 to 10000	50
Cap Bon	O.El Bey, Abida, Oudiane, El Abid	700 to 1430				160
Sahel Nord	Triba, R'mill, Khairat			2700 to 6400		20
Nebhana	O.Nebhana		910 to 2000			25
Marguellil	O.Marguellil		2000 to 3000			35
Zeroud	Zeroud (S. Saad)		1300 to 5500	2100 to 4500	4500 to 5500	105
Centre Sud	O.Leben					50
	O.Sellaz			1200 to 5000		
	O.Oudrane				5000 to 6250	
Chott Gharsa	O.Sidi Aich	300				70
	O.Kebir	300				
	O.Selja			2000 to 5000		
Sud	O.Akarit				4100 to 7900	120
	O.Hamma			2700 to 4500		
	O.Gabes			3000 to 4700		
	O.Akarit				[illegible]	

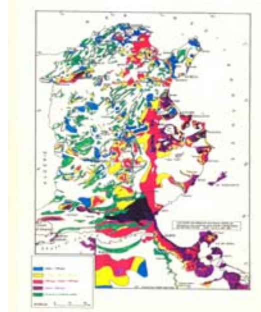
Evolution of exploitation of phreatic aquifers from 1980 to 2000

Region	Resources (Million m³/year)					Exploitation resources (Million m³/year)				
	1980	1985	1990	1995	2000	1980	1985	1990	1995	2000
North	287	324.4	371.6	395.2	386.1	227	300	382.1	406.2	405.1
Center	162	194.1	199.6	220.8	235.4	137	202.5	225.2	226.5	260.8
South	27	67.2	97.4	102.2	115.2	31	60.3	91.2	112.4	111.8
Total	486	585.7	668.6	718.1	736.7	395	562.8	698.5	744.9	777.8

Characteristic of phreatic aquifer by governorate in Tunisia

Region	Governorate	Number of wells	Wells abandoned	Wells construction	Resources (Mm³/yr)	Exploitation resources (Mm³/yr)	Salinity (ppm)
North East	Tunis-Ariana	3669	979	0	12.6	38.1	1000 to 5000
	Ben Arous	2100	257	3	24.1	23.6	1000 to 6000
	Nabeul	27605	5935	577	228.4	171.6	1000 to 6000
	Zaghouan	1675	320	230	6.0	10.0	1000 to 6000
	Bizerte	7240	1690	0	52.3	52.3	500 to 4000
Total N.E		42289	9181	810	323.4	295.6	
North West	Beja	638	0	0	7.3	23.4	500 to 6000
	Jendouba	1333	106	0	8.7	14.0	1500 to 3000
	El Kef	3939	696	263	27.8	26.5	500 to 5000
	Siliana	1711	199	91	14.1	12.10	500 to> 7200
Total N.W		7621	1001	354	57.9	76.0	
Center East	Sousse	2699	934	0	11.0	13.2	1000 > 6900
	Monastir	3203	1369	0	7.4	7.6	1000 > 5600
	Mahdia	7170	2422	451	8.5	13.8	1000 > 5000
	Sfax	10958	2644	201	26.3	26.7	1000 > 5900
Total C.E		24030	7369	652	53.2	61.3	
Center West	Kairouan	7375	1052	12	56.4	56.1	500 to 6000
	Kasserine	2907	244	456	20.6	22.3	500 to 5000
	Sidi Bouzid	8827	360	452	95.0	59.9	1500 to 6100
Total C.W		19109	1656	920	172	138.3	
South	Gafsa	415	760	1267	29.5	24.7	
	Tozeur	872	91	12	24.3	19.6	
	Kebili	579	104	93	1.6	4.8	
	Gabes	2772	588	31	16.6	24.3	
	Mednine	4731	1812	0	14.3	12.5	
	Tataouine	745	295	143	4.9	11.5	
Total S		10114	3650	1546	91.2	97.4	
Total of Tunisia		103163	22857	4282	697.7	668.6	

Salinity of Phreatic Aquifers in Tunisia



Evolution of exploitation of deep aquifers from 1991 to 2001

(Millions m3/year)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
North	65	74.8	87.4	96.6	101.9	101.9	106.9	110.6	115.1	124.8	133.2
Center	169.5	169.8	169.1	189.9	200.9	177.6	175.4	187.9	191.8	215.8	230.8
South	599	616.7	625.6	632.2	624.8	717.8	722.8	715.2	723.7	737.8	754.6
Total	833.5	861.3	882.4	918.7	927.6	997.3	1005.1	1013.7	1030.6	1078.4	118.5

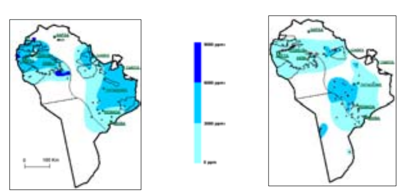
Annual exploitation of deep aquifers by class of salinity

Salinity (ppm)	<1500	1500 to 3000	3000 to 5000	5000 to 7500	>7500	Total
Drinking water	97.5	61.6	15.1	9.7	0.0	183.9
Irrigation	147.8	555.2	142.8	14.9	0.1	860.7
Industry	8.7	16.3	17.2	12.0	14.9	69.1
Tourism	0.2	0.7	0.5	2.6	0.8	4.8
Total exploitation *(million m³/yr)*	254.2 (22%)	633.8 (57%)	175.6 (16%)	39.2 (4%)	15.8 (1%)	1118.5 (100%)

Characteristic of deep aquifer by governorate in Tunisia

Region	Governorate	Wells exploited	Exploitation (Mm³/yr)	Exploitable Resources (Mm³/yr)	Salinity (ppm)
North East	Tunis	11	0.69	0.86	800 to 1300
	Ariana	82	8.17	5.62	3000 to 6000
	Ben Arous				1000 to 2000
	Nabeul	138	12.00	24.50	Variable
	Zaghouan	33	6.45	13.90	Variable
	Bizerte	56	13.67	28.70	1000 to 2000
Total	North East	320	40.98	73.58	
North West	Beja	14	1.76	24.80	1000
	Jendouba	33	14.40	44.39	3000 to 2000
	El Kef	47	8.56	28.64	500 to 2600
	Siliana	33	7.10	11.73	Good quality
Total	North West	127	31.82	109.56	
Center East	Sousse	45	10.79	8.13	1000 to > 5000
	Monastir	14	1.89	5.40	1000 to > 5000
	Mahdia	24	2.66	3.00	2000 to > 5000
	Sfax	25	19.69	22.07	2000 to > 5000
Total	Center East	108	35.03	38.6	
Center West	Kairouan	192	50.85	78.30	1500 to 3000
	Kasserine	135	53.17	68.96	1500 to 3000
	Sidi Bouzid	108	31.30	68.20	1500 to > 5000
Total	CenterWest	435	135.32	215.46	
South	Gafsa	127	68.65	81.24	1500 to > 3000
	Tozeur	144	154.65	178.59	1500 to >3000
	Kebili	191	232.45	237.46	1000 to 4000
	Gabes	154	103.36	155.46	2300 to 3700
	Medenine	54	22.97	41.45	1500 to > 3000
	Tataouine	41	10.91	39.36	1500 to > 3000
Total	South	711	592.99	733.56	
Total of	Tunisi a	1701	836	1171	

Distribution of salinity of the Complexe Terminal and the Continental Intercalaire in the South of Tunisia



1-Salinity of the Complexe Terminal aquifers in the south of Tunisia

2-Salinity of the Continental Intercalaire aquifers in the south of Tunisia

Potential drainage water discharge of oasis in the south of Tunisia

Governorate	Characteristics of oasis			Potential drainage discharge	
	Number of Oasis	Total surface (ha)	Irrigated are (ha)	Minimum (l/s)	Maximum (l/s
Gafsa	8	3 467	3 294	753	1056
Tozeur	30	5 622	5 622	1124	2248
Kebili	67	7 213	7 019	1442	2885
Gabes	48	7 133	6 752	1426	2853
Total	161	23 435	22 687	4745	9042

Chemical composition of drainage water in the south of Tunisia.

Governorates	Name of Oases	Chemical composition (ppm) Ca	Mg	Na	K	SO_4	Cl	HCO_3	R.Sec	T.Salty	CE (mmhos/cm)	pH
Gafsa												
Tozeur	Tozeur	294	668	1201	40	1003	1140	63	15000		18	19.5
	Chemsa	720		1035	56	2573	1775	317		6,914		7.40
	Ibn Chabbat	1001	216	1249	39	2486	2130	610	5300			7.8
Kebili	Smida Winter	374	432	2814	108	4266	3535	132	11462		14.2	7.7
	Summer	447	372	2347	81	3717	3162	130	10639		13.0	8.0
	Zarcine	400	672	989	46	3048	1775	189	7360		13.0	
	R Mtoug 182	430		500	50	2340	816	268		4,920		7.45
Gabes												

Evolution of the poor population and the poverty rate in Tunisia (1975 - 2000)

	1975	1980	1985	1990	1995	2000
Poor population (thousands)		823	554	544	559	399
Poverty rate (%)	22.0	12.9	7.7	6.7	6.2	4.2

Characteristics population and household in the South of Tunisia

Item	Gafsa	Tozeur	Kebili	Gabes	Total
Population, 1994 *(Person)*	307513	89055	131914	311713	840195
Household Number	54330	16590	21316	56431	148667
Family Size *(per household)*	5.66	5.37	6.19	5.52	5.65
Total Area *(Km^2)*	7360	6159	22454	7505	43478
Population Density *(per Km^2)*	41.8	14.5	5.9	41.5	19.3
Population Growth *(%)*	2.7	2.7	3.3	2.6	2.8
Farmer's number	5620	7060	9020	17900	39600
Person number	31000	37900	55800	98600	223300

Poor population and the rate poverty by region and by community environment in Tunisia

Region	Country		Community		No Community	
	Population Poverty *(Thousands)*	Rate Poverty *(%)*	Population Poverty *(Thousands)*	Rate Poverty *(%)*	Population Poverty *(Thousands)*	Rate Poverty *(%)*
Tunis District	58	2.8	58	3.0		
North East	52	4.0	41	5.3	11	2.2
North West	30	2.3	18	3.9	12	1.5
Center West	98	7.1	54	12.6	44	4.7
Center East	50	2.4	44	3.0	6	1.0
South West	50	8.7	40	10.5	10	5.1
South East	60	6.7	41	6.7	20	6.7
Total	**399**	**4.2**	**296**	**4.9**	**103**	**2.9**

Location of the fourth Rural zones in Tunisia

Kroumirie: mountainous and forest zone where threatens of the deforestation.

Bargou: in the High tell, is subjected to erosion of soils and to the deforestation.

Menzel El Habib: in the region of Gabes, knows the desertification problems.

El Faouar: oasis in edge of the Sahara, where the resources of water are starting to show signs of wearing out.

	Kroumirie	Bargou	Menzel Habib	El Faour
Distribution of the investigated women	619	708	933	810
Percentage of the women single (%)	58.6	52.8	45.8	48.3
Percentage of the women participating in the agricultural works according to the age (%)				
10 to 19 old year	24.8	18.4	18.3	33.2
20 to 29 old year	64.0	30.9	40.0	52.8
30 to 39 old year	65.7	33.8	43.4	64.4
40 to 49 old year	73.3	35.4	35.6	70.0
50 to 59 old year	66.1	42.3	35.2	64.9
60 old year and +	40.0	33.9	8.3	34.4
Percentage of household's disposing a water resource in the lodging, connecting to the network, by a tank or a well (%)	8.0	27.8	66.6	82.1
Number of households dot have water in the lodging	287	216	106	57
Percentage of women assuring chore water (%)	95	72	81	98
Total average time to assure the chore water (minutes)	59	82	52	38
Average number of chore water per week for the household.	12.4	10.7	24.1	20.9
Average number of persons by household assuring chore water	1.2	1.4	1.6	1.4
Average time weekly by household devote to chore water (hours).	12.3	14.6	21.0	13.3
Proportion of households where, chore water is assured by an alone person (%).	81.6	64.7	55.7	64.3

Degrees of restriction from Salinity and SAR for irrigation uses

	Potential Restriction		
	None	Slight/Moderate	Severe
Salinity			
Electrical Conductivity (dS/m)	<0.7	0.7 to 3.0	>3.0
Total Dissolved Solids (mg/l)	<450	450 to 2000	>2000
SAR			
0-3	Ec_w>0.7	Ec_w 0.7 to 0.2	Ec_w<0.2
3-6	Ec_w>1.2	Ec_w 1.2 to 0.3	Ec_w<0.3
6-12	Ec_w>1.9	Ec_w 1.9 to 0.5	Ec_w<0.5
12-20	Ec_w>2.9	Ec_w 2.9 to 1.3	Ec_w<1.3
20-40	Ec_w>5.0	Ec_w 5.0 to 2.9	Ec_w<2.9

Classification of saline waters

Water class	EC *(dS/m)*	Salt concentration *(mg/l)*	Type of water
Non-saline	<0.7	<500	Drinking and irrigation water
Slightly saline	0.7 - 2	500 - 1500	Irrigation water
Moderately saline	2 - 10	1500 - 7000	Primary drainage water and groundwater
Highly saline	10-25	7000 - 15000	Secondary drainage water and groundwater
Very highly saline	25 - 45	15000 - 35000	Very saline groundwater
Brine	>45	>45000	Seawater

Historical of use of saline waters for irrigation in Tunisia

Gover-norates	Name of Stations	Chemical composition *(mmolc/l)*										
		Ca	Mg	Na	K	SO_4	Cl	HCO_3	TDS *mg/l*	SAR *(mmolc/l)½*	E.C *ds/m*	pH
Sfax	Ksar Gheriss	18	15.5	29	0.6	37.9	20.9	3.2	4000	7.1	4.9	7.5
Tozeur	Tozeur	9	6.7	17.6	0.6	13.0	17.6	2.4	2100	6.3	3.1	7.7
Kairouan	Messaoudia	11.2	3.1	16.3	0.5	14.4	12.4	3.8	2000	6.1	2.8	7.6
Gabes	Nakta	13.5	7.5	37.8	0.5	20.8	36.7	3.0	3800	11.7	5.5	7.6
Medenine	Zarsis	14.8	6.2	81.3	0.8	32.6	70.2	2.1	6500	24.8	9.2	7.9

Photo 1. Drainage system in Tunisia

Photo 3. Irrigation system in the South of Tunisia

Photo 2. Rectification of water drainage in the North of Tunisia

Photo 4. Drainage water in the South of Tunisia

6. Dr. Jacob Kijne, Identification of issues arising from national reports

Issues arising from national reports

Monday 28 June '04, pm

1

Water resources assessment

- Data in general: reliability, age, spatial and temporal variability not captured
- Data: availability of brackish water and saline groundwater (IFAD report)
- Data for the target area(s): were these areas identified?
- Water rights and tariffs: do they apply to the use of drainage water or brackish groundwater?
- How relevant is the issue of 'safe yield' of the groundwater resource?

2

Farming systems

- What are the farming systems most likely to benefit from biosaline agriculture?
- What are the most suitable (salt-tolerant) crops and habitats for the identified farming system?
- Are there links with other regional development programs that could help to identify these farming systems? (e.g. Integrated crop/livestock production in the low rainfall areas of WANA Mashreq/Maghreb project; Regional initiative for dryland management – ICRISAT)

3

Poverty

- Poor people are usually on poor land with poor water resources
- Causes of resource poverty: land degradation (erosion and salt); scarcity and increasing salinity of water; development projects not focused on resource-poor farmers; and non-enforcement of rules and regulations
- What is the implication for the success of biosaline agriculture of the younger generation not entering into farming?

4

Biosaline agriculture systems

- Identify locations with the greatest need and opportunities for biosaline agriculture [criteria: availability of brackish unused water; knowledge of suitable crops; farmers willing to grow the crops because of economic advantage or filling a known need (cattle feed); market for products of biosaline agriculture; support for its adoption or adaptation]
- Where are the poor who could use brackish water; where is the brackish water and is anyone keen to use it?
- Choose one of these locations as target area; collection of relevant socio-economic data and information

5

Assessment of impact on livelihoods

- What are the present constraints on livelihood enhancement? (e.g. unpredictability of feed supplies and water; high risk associated with range degradation)
- How many people could potentially benefit from the introduction of biosaline agriculture?
- What are the tangible benefits from the introduction of biosaline agriculture?
- Could it be repeated elsewhere in the country or region?

6

Annex 3. Areas in Tunisia, Syria, Jordan and Egypt with potential for biosaline agriculture and the criteria used in selecting them.

Tunisia	
Areas	Coastal area between Mahdia and Gabes
	Central area around Kairouan
Criteria	Near wells
	Marginal soil
	Near communities
Syria	
Areas	Expanding the margins of the current irrigated area (200 x 12 kilometers) in the Lower Euphrates Basin Vertical well drainage system 150 cubic meters per year of non-fresh drainage water
	Jezira area Poor quality groundwater Working with farmers Switch system to biosaline fodder production
	Rasafa to establish biosaline agriculture and settle Beduoins The area has been mismanaged over 25 years. Originally prime steppe grazing land, the area was converted to a rainfed barley/wheat system and subsequently to irrigated cotton farming using groundwater. The use of saline groundwater on heavy soil led to abandonment of cotton farms after 3 years. Horizontal drainage system of groundwater. Biosaline agriculture could replace the current cotton/wheat system.
	Badya (lower priority) Palmyra and Dawa In this area there is no agreement on whether the use of saline groundwater would be sustainable except in small isolated oases.
Jordan	
Areas:	Azraq where there is saline groundwater
	Western Zarka
	Katar to the north of the Dead Sea where there are existing communities
Criteria	The community must be large enough
	Livestock farming system
	Data on the hydrology, population, crops and climate need to be available
Egypt	
Areas	Middle and NE Sinai (Al Arish, Sheikh Zouid, Rafa) has the greatest potential in Egypt for biosaline agriculture Brackish water, seawater intrusion, some rainfall Very poor Bedouins In the Center of Middle Sinai there are potential synergies with the Islamic Development Bank project ‘Settlement of Bedouins’ which is evaluating and designing water systems, including water harvesting NE Sinai. Here over pumping has led to seawater intrusion affecting the farming of dates, olives and livestock. There are potential synergies with the UDAID project to settle communities in the Wadi Al Arish, selected because

	of the very poor communities whose livelihoods have been affected by the decline of the Palestinian market for their produce. Here the water is insufficient for large-scale development but there is strong community sharing in development efforts.
	Red Sea 100 kilometers north of Hurgada. Landless poor have been relocated from the Eastern Desert to Wadi Dara where they grow jojoba in a project supported by the major investor, Sawaris. Wadi Dara is representative of the wadis of the Eastern Desert, where groundwater is over 5000 ppm and which have the potential for poor from the eastern Desert to make livelihoods based on non-fresh groundwater.
	North West coast to the borders of Libya (lower priority) In this area a project funded by the World Bank is developing rainwater harvesting and storage of flash floods techniques to supplement non-fresh groundwater.
	North Delta Although this area is not suitable for biosaline agriculture because of upward leakage brackish water is productively used for fish farming.
Criteria:	Non-fresh groundwater (excluding saline drainage water)
	The water may be a mixture from more than one aquifer or water source at the regional scale (including saline drainage water)
	Areas where the majority of people are poor
	Areas identified by the government for resettlement of poor
	Areas where the livelihoods of the poor have been affected by mismanagement of non-fresh water resources

Generic criteria

The group identified the following criteria for identifying areas with potential for biosaline agriculture that would be addressed in the individual country reports.

Water	Non-fresh surface water in depression
	Non-fresh surface water
	Non-fresh groundwater
Resource	No alternative
	Sustainability (amount, quantity)
	Quality
Where to use it	On location
	Transport to another location
Community	Poverty
	In situ vv movement of people
	Acceptance by farmers
National policies	Support for biosaline agriculture

	Support for well development
Farming systems	Livestock
Synergies	With other development projects
Alternatives	Allocation of non-fresh water to biosaline agriculture uses such as fish farming
Infrastructure	Existing wells
Management	Complications

Annex 4. Action Plan, June-December 2004

Date	*Action*	*Responsible*	*Input*
June	Workshop report	Mr Jugu Abraham	
July-August	Revise country reports	Dr Fatma Attia Dr Awadis Arsalan Dr Abdel Nabi Fardous Dr Kamel Zouari	
July-August	Draft synthesis report	Dr Jacob Kijne	
30 August	Submit revised country reports to ICBA	Dr Fatma Attia Dr Awadis Arsalan Dr Abdel Nabi Fardous Dr Kamel Zouari	
September	Review revised country reports	Dr John Stenhouse Dr Jacob Kijne	Dr. Abdullah Dakheel Dr Sandra Child Mr Jugu Abraham
October	Finalize country reports	Dr Fatma Attia Dr Awadis Arsalan Dr Abdel Nabi Fardous Dr Kamel Zouari	
October	Finalize synthesis report	Dr Jacob Kijne	
30 October	Submit final country reports to ICBA	Dr Fatma Attia Dr Awadis Arsalan Dr Abdel Nabi Fardous Dr Kamel Zouari	
November	Editing and preparation for printing	ICBA	
December	Publication of country reports Publication of synthesis report Publication of policy brief Final project report	Mr. Jugu Abraham	