Regional Action Programme (RAP): networking activities 1998-2000

Hamdy A., Lamaddalena N., Steduto P.

in

Hamdy A. (ed.).
Regional Action Programme (RAP): Water resources management and water saving in irrigated agriculture (WASIA PROJECT)

Bari : CIHEAM
Options Méditerranéennes : Série B. Etudes et Recherches; n. 44

2003
pages 55-74

REGIONAL ACTION PROGRAMME (RAP): NETWORKING ACTIVITIES 1998-2000

A. Hamdy[1], N. Lamaddalena[2] and P. Steduto[2]
[1]Director of Research, CIHEAM/MAIBari, Italy email: hamdy@iamb.it
[2]Research Scientists, CIHEAM/MAIBari, Italy email: lamaddalena@iamb.it; steduto@iamb.it

INTRODUCTION

In the Mediterranean Countries, particularly in the arid and semi-arid ones, we all recognize two opposing realities.

On one side, we know that for all practical purposes fresh water resources are finite and that most of the economically viable development of these resources has already been implemented. Thus, the potentiality to expand this resource base is marginal, in addition, water quality degradation resulting from pollution is shrinking the usable volume of fresh water.

On the other side, we are confronted with increasing population, fast urbanization and the associated expansion of economic activities, all of which require more water, putting strain on the already limited and fragile resources.

Traditionally, the response to water shortage in the Mediterranean region has been addressed trough developing more supplies. But today such approach is becoming extremely difficult. In this water crisis context, it is needed to shift from water policies based totally on water supply to new policies which rather privilege water demand.

There is no question on the central importance of demand management particularly in the agricultural sector.

Water saving in the region to satisfy increasing demand of the other user sectors and the future expansion in irrigated areas to fulfil the food gap in the region must come from agriculture knowing that more than 80% of the available water is allocated to irrigation and the water efficiently used by crops amount to 45% with losses as high as more than 50%!

In the region we need to elaborate the concept of demand management into implementation policies, programmes and actions in particular with irrigation as the main consumer, with major water losses, thus huge water saving could be realized.

This is the fundamental scope of EU/CIHEAM-MAI.B RAP Programme (1998-2002) which is mainly oriented to the sustainable use of water resources in irrigation sectors emphasizing the following major issues:

Non conventional water resources practices and management for sustainable use;

Water use efficiency;

Design, management and optimization through performance analysis of collective irrigation systems;

Participatory Irrigation Management (PIM);

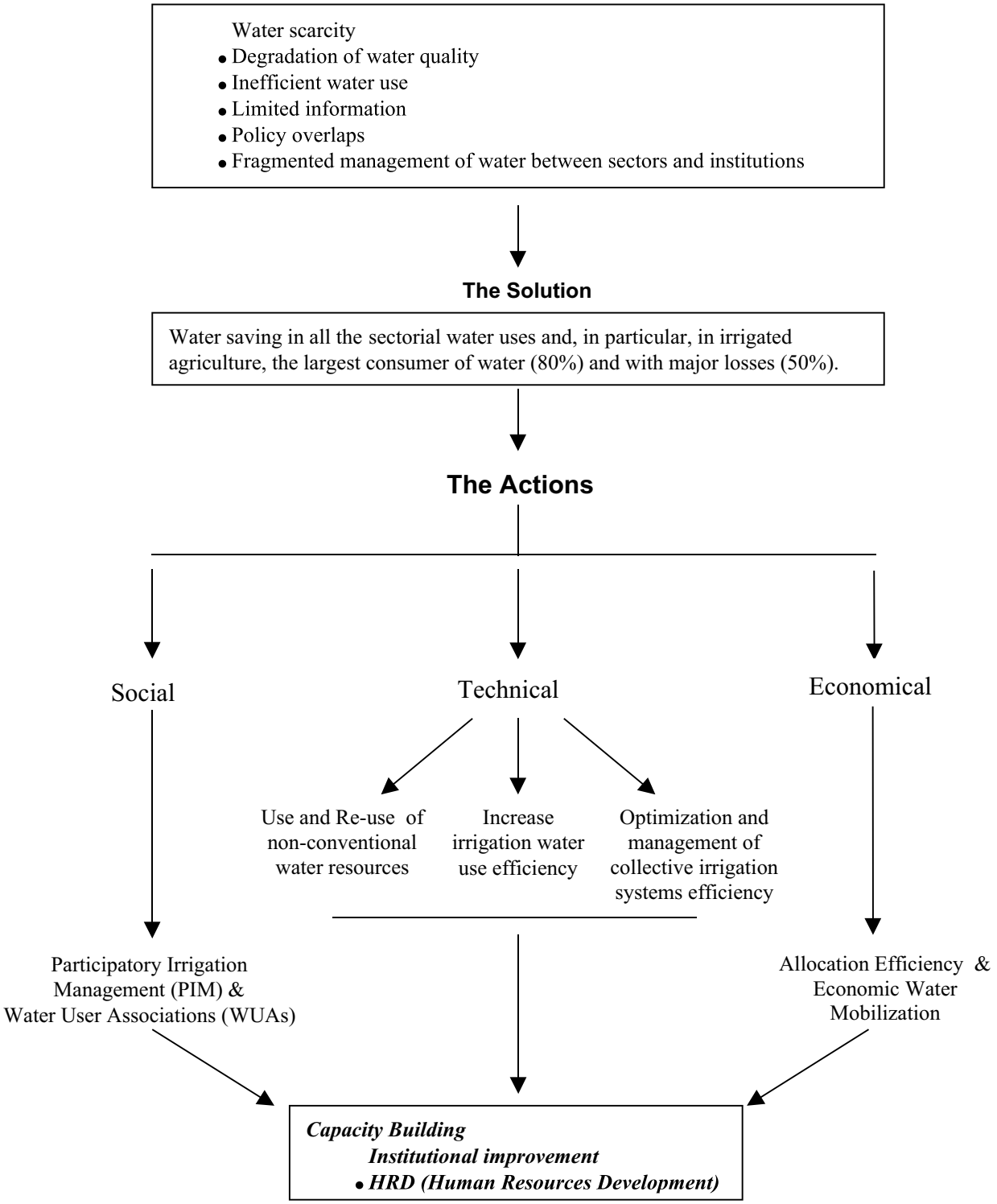
Economic aspects of water mobilization and use.

The programme objectives are to improve the institutional capacities, the development of human resources strengthening regional cooperation, the technology transfer and exchange of experiences between the Southern and Northern part of the Mediterranean through training, promotion of research, networks and communication of scientific and technical information in the field of water resources and irrigation based on the concept of “centers without walls”.

Programme EU/CIHEAM-MAI.B
RAP (1998-2002)

Programme: "*Water Resources Management*" - Formulation Synthesis

Water Resources in Arid and Semi-Arid Regions:
Major Problems and Constraints



COOPERATIVE RESEARCH ACTIVITIES

SUB-PROGRAMME “NONCONVENTIONAL WATER RESOURCES MANAGEMENT”

SUB-PROGRAMME “WATER USE EFFICIENCY”

SUB-PROGRAMME “COLLECTIVE IRRIGATION SYSTEMS”

SUB-PROGRAMME

"*Non-Conventional Water Resources Practices and Management for Sustainable Use*"

INTRODUCTION

In the developing countries of the Mediterranean, the major challenge facing water planners and managers is that while physical availability of water is fixed, its demand will continue to increase steadily in the foreseeable future.

The limited water resources in these countries, on one hand, and the population growth with relatively high rate, on the other hand, will be the major constraint for further agricultural and socio-economic development water demand are fast approaching the limit of resources which will impose their significant effect on water sectorial use, creating notable competition and conflicts among users in the various sectors and on the irrigation and domestic sectors, in particular.

The problems aside from massive population growth rate, continuing urbanization and rapid development of the urban and water domestic supplies, water supply shortage and wastewater disposal regulations aimed at protecting environment and public health, all are pushing towards a realistic re-use of the enormous quantities of the non-conventional water resources which have not been effectively used so far.

Therefore, the use of other water resources than freshwater is now a must.

The use of such non-conventional water resources will certainly result in greater amounts of water for irrigation but of lower quality. In the long run this could seriously affect crop production, deteriorate the soil productivity as well as creating serious environmental problems.

In the situation of limited supply of good quality water, efforts should be directed towards reducing its demand, particularly in the irrigation where more than 80% of the freshwater is allocated to this sector, and as a solution, more marginal quality water should be used for irrigation substituting the good quality one. The implementation and practicability of such solution, we have to provide the decision-maker and the users a concrete and very clear answer on how agriculture can make use of non-conventional water resources in a way that is technically sound, economically viable and environmentally non-degrading. Those are the major issues our NWRM Sub-Network is focussing on.

GENERAL OBJECTIVES

Increase the potentiality and sustainability use of non-conventional, water resources in irrigation, particularly the saline and the sewage treated effluents.

Improvement of the institutional capacities and the development of human resources for the programme implementation in the region.

SPECIFIC OBJECTIVES

The establishment of new strategies for the use of non-conventional water resources (saline and treated sewage effluents) technically and scientifically based on a proper integrated approach for soil, crop and water management.

Setting the new guidelines and criteria for the re-use of the non-conventional water resources that promotes and facilitates their use on a large scale without environmental and health hazard effects.

Setting the crop salinity tolerance index for major crops in the region to attain flexibility choices of crop rotation with relatively higher economic returns.

Development of a documentation and information exchange systems through the development of data-base on the use of non-conventional water resources.

COORDINATOR

Prof. Atef Hamdy, Director of Research, CIHEAM/MAI-Bari (Italy)

PARTNERS

Algeria

Prof. A. Macklouf (Ministry of Agriculture, Alger)

Cyprus

Dr. I. Papadopoulos (Agricultural Research Institute, Nicosia)

Egypt

Dr. S. Abdel-Dayem (NWRC, Cairo)
Dr. H. Kandil (DER, Cairo)

France

Prof. N. Katerji (INRA, Thiverval-Grignon)
Dr. D. Zimmer (CEMAGREF, Montpellier)

Italy

Dr. M. Mastrorilli (ISA, Bari)
Dr. A. Castrignanò (ISA, Bari)
Prof. M. Tarantini (University of Basilicata, Potenza)
Prof. V. Sardo (University of Catania)

Jordan

Prof. M. Shatanawi (Faculty of Agriculture, WERSC, Amman)

Lebanon

Dr. M. Maroun (Université Saint-Esprit de Kaslik, Beirut)

Morocco

Prof. Redouane Choukr-Allah (IAV Hassan II, Agadir)

The Netherlands

Prof. W. van Hoorn (Faculty of Agriculture, Wageningen)
Dr. Cecilia Stanghellini (Institute of Agricultural and Environmental Engineering - IMAG, Wageningen)

Tunisia

Prof. N. Ben Mechlia (INAT, Tunis)
Mrs. Akissa Bahri (Centre Recherches du Génie Rural, Tunis)

Turkey

Prof. A. Yazar (Cukurova University, Adana)
Prof. O. Tekinel (Karahmanmaras University)

Cooperative Research Activities

Under the NWRM Sub-Network the following research programmes are coordinated by the Institute and carried out in cooperation with other scientific Mediterranean Institutions members in the Sub-Network with the participation of researchers from the Mediterranean region.

ACTIVITIES 1st PHASE, 1998-2000

During this period the major research activities of the NWRM-Net can be summarised as follows:

A Saline irrigation practices and management

This programme is focussing on testing different approaches for saline water management including:
- Irrigation methods
- Irrigation scheduling (amounts and intervals)
- Leaching scheduling (amount and timing)
- Management of multi-source irrigation water of different qualities.

Several major crops in the region had been experimented (wheat, bean, tomato, sunflower, sugarbeet, potato, lentils, check-peas). The experiments were conducted in the lysimeter stations and the greenhouses in Bari Institute, and the demonstration experimental field at IAV Hassan II, Agadir. This experimental field is well equipped (tanks, pumps, monitoring equipment, etc.) and a drip irrigation system including all the accessories needed for water application control. A great part of the field equipments were provided through the logistic support.

Several members from the Sub-Network working group, professionals and experts from different Mediterranean Institutions and Universities, and several candidates from various Mediterranean countries under the M.Sc programme participated in realizing this programme.

The experimental work was mainly dictated to elucidate the following:
- plant response to salt concentration level in irrigation water to propose the one to be safely used to set the proper crop rotation;

- identifying the most critical growth stages to salinity and the management practices should be followed;
- Climatic and soil pedological conditions and their impose on the sustainability of variable crops to salinity in relation to the management practices to be adapted.
- Irrigation practices and the mode of water application where water of different qualities are available.

The main conclusions achieved under this research programme could be outlined in:

- plant response to salinity differ greatly from one crop to other and this holds true by changing varieties for the same crop.
- Crop response to salinity and its tolerance degree is mainly dependent on the degree of salt accumulation in the soil, which is highly related to soil characteristics, the prevailing climatic conditions and the irrigation systems.
- For the majority of tested crop salinity up to 3 dS/m could be used safely without significant losses in the yield.
- The salt concentration level the (Ec_i) to be used should be chosen considering not only the salt tolerance degree, but of equally importance the soil characteristics, the climatic conditions, the irrigation method and the irrigation scheduling (volumes and intervals).
- For all tested crops, generally the germination, seedling establishment, flowering and crop formation stages are very sensitive to salinity with respect to the vegetative and crop maturity ones. As the latter stages (vegetative and maturity) are relatively of longer periods with respect to the former ones and as more than 60% of irrigation water for a certain crop is delivered within the vegetative period, this will lead to the following advantages:
  - saving the freshwater and its substitution with the saline one
  - slightly reduction in the vegetative growth, less transpiration. i.e. less consumptive use and earlier flowering and maturity
  - under saline irrigation practices leaching is the key management factor. Therefore, identifying the critical growth stages is crucial in setting a proper leaching scheduling, *i.e. when to leach and what is the leaching fraction?* This will give the opportunity of using more and more salty water in irrigation even those of salt concentration level exceeding the one the plant could tolerate and achieving a satisfactory crop production hence the proper leaching management is practiced.

B Soil-water-plant interrelationships under saline irrigation practices

The research under this programme is mainly devoted to characterize the changes in plant physiological parameters, in relation to those taking place in the soil chemical properties and their impact on the water status in the plant and the yield production.

This programme is realized in cooperation with INRA-France and Wageningen University, Holland.

In the last two years (1999-2000), the I Phase of RAP Programme the activities under this programme were extended with the participation of ICARDA to evaluate the salt tolerance degree to some of the most important legumes and cereals crops in the arid Mediterranean and Middle East regions (Broad Beans, Lentils, Chick-peas, Wheat, Barly).

In the year 1999 studies were carried on six lentil varieties. In the year 2000 the different varieties of the chick-peas crop are under studies.

The wide information and the results obtained in the previous years, the time initiated the activities in the Sub-Network and those recently achieved under the RAP-Programme are now under complete analysis to set new strategies on the use of saline water in the arid countries of the Mediterranean that provide acceptable yield production economically viable and non-environmentally degrading.

This was one of the main subjects discussed during the Annual Meeting of NWRM Sub-Network held in Rabat, Morocco on October 28, 1999.

The members of NWRM fully agreed on organizing the work for analysing all the published data as well as those still under research with respect to the variable aspects (agronomic, hydraulic, economic and the prevailing environmental conditions).

The results and experience gained during the first phase of RAP Programme are all presented in several publications already issued or under print in scientific journals (see the list of publications).

C Municipal wastewater re-use

The other major component of the non-conventional water resources is the treated sewage water.

The use of this water resource in the region is nowadays a must. The reasons are not only of being as additional source to compensate the water shortage and scarcity, but, due to the advantages it provides by its use as a source for nutrients and there by reducing the excessive use of fertilizers as well as diminishing the pollution of both surface and underground water, particularly with the NO_3 ions.

In addition and above all if such water is not treated and reused in irrigation, it could result in serious environmentally problems of dangerous health hazards.

Aware of this, in the first phase of RAP Programme a part of the activities of the Sub-Network was oriented to this subject by the aim of:

- An evaluation of the wastewater treatment methods already used in the region, technically, economically in relation to the quality of the effluent.
- Setting a guidelines for re-use according to the prevailing local conditions.
- The possibilities of introducing simple technologies (gravel hydroponic system and constructed wetlands) for effluent sewage treatment in small communities and villages.

The research programme was conducted using the facilities of the municipal wastewater treatment station O.R.M.V.A. of Sousse-Massa-Benserago situated 5 km South-West of Agadir.

The research programme was focussing on: the impact of irrigation with sewage water treated by infiltration-percolation and treated by epuvalisation comparable to irrigation with freshwater enriched with fertilizers on both the quantity and quality of several horticulture crops and some flowers and ornamental cash crops to set new strategies for the use and management of treated municipal wastewater in irrigation and its adaptation in the region.

D - Supplementary irrigation of cereal crops with treated sewage water

Very promising data are already obtained indicating the high potentiality of using such source for irrigation as its use led to a better improvement of the crop production quantitatively and qualitatively. In addition, this water can meet the nutritional requirements and thereby reducing the production costs. Moreover, the use of such water irrigation providing an accurate irrigation scheduling, it is possible to avoid the risk of groundwater contamination caused by nitrates.

The results obtained in this programme are under preparation for publication.

OTHER RESEARCH PROJECTS SUPPORTING THE RAP-PROGRAMME RESEARCH ACTIVITIES

1 - EU Concerted Action Project:

"SUSTAINABLE HALOPHYTE UTILIZATION IN THE MEDITERRANEAN AND SUBTROPICAL DRY REGIONS"

The subject of the Project is of a special interest and is one of the main research activities carried out by the Institute. In addition, this subject is of vital importance for tackling the salinity problems in the Mediterranean region.

The project aims at the selection of the best species and cultivars for each region, climate as well as soil type and design for those species requiring the best irrigation system in order to minimize cost and optimize the profit gained for the general application of the new production system in each environment where it will be established.

The "Halophyte Network" was involved in this Project which was established under the co-sponsorship of the CEC as well as some research groups from relevant countries.

Countries participating:

Algeria	(I.N.R.F., Cheaga)
Brazil	(UFRPE, Recife-PE)
Egypt	(Desert Research Center, El Mataria-Cairo and Faculty of Sciences, Cairo)
Germany	(Botanical Institute, Hannove; University of Osnabruck)
Morocco	(IAV Hassan II, Agadir)
India	(Central Soil Salinity Research Institute, Karnal)
Italy	(CIHEAM/MAIBari and -Studio Sardo, Catania)
Pakistan	(University of Karachi)
Spain	(Public University of Navarra, Pamplona)
Sultanate of Oman	(Ministry of Agriculture and Fisheries)
Tunisia	(Inst. Nation. Scientif., Hamman)
U.A.E.	(Faculty of Agriculture, Al Ain)

Bari Institute is coordinating the activities with the projects in the Mediterranean region. The works started on the beginning of the year 1997.

Expectations from the CA project

Through the experimental demonstration fields realized in Morocco and in Italy-Catania and the experimental work carried by Bari Institute, major information has been possible to obtain on the sustainable use of halophytes under heavy saline conditions. In addition, the carried out research program concerning the germination and seedling establishment of different varieties and species beside the research related to the physiological parameters has increased the knowledge in different points till now not yet clear.

Our contribution will increase more and more the exchange of experience in this relevant subject and it will promote the creation of national and regional networks on the subject concerning the scarcity of available freshwater resources in arid and semiarid regions and the rapid deterioration in soil productivity due to salinity problems. Biological reclamation using Halophytes could bring such abonded soils again to its productivity.

MAI-B activity for the CA Project

Major activities were devoted to establish a well defined cooperation and coordination between Bari Institute and the Mediterranean countries participating in the Project as well as to develop a regional network for halophyte utilization under saline irrigation to be included under NWRM Network.

Workshops were organised and conducted:

- *Florence INTECOL Symposium with a Seminar on "Sustainable Halophyte Problems" (19-22 July, 1998). This Institute prepared the compilation of all CA INTECOL Seminar papers for publication in a new journal "Journal of Mediterranean Ecology";*
- an advanced short courses was organised by NWRM Sub-Network including separate sections to teach this specific subject: *the cultivation of "halophytes*" the Institute plans to include in the future saline irrigation techniques and the use of halophytes as regular parts in its scientific activities.

"*Halophytes adaptation to high salty environment "*

The programme was carried in the greenhouse of the Institute, using some of Halophyte varieties and included the following major parts:

- crop growth of different varieties irrigated with saline water of different salt
- concentrations;
- crop physiological parameters;
- salt accumulation and its distribution in the soil under successive irrigation with saline water.

Contributing in this research a specialist from Lebanon, Ms. Zeina Mezher Master Student of MAIB for Academic Year 1998/1999.

The thesis of Ms. Mezher deals with the performance of the two halophytic species Aster tripolium and Kosteletzkya virginica under saline irrigation treatments up to 50 dS/m and using different substrates. In cooperation with the University of Osnabrueck, Germany the candidate will continue her career on this subject for the Ph.D degree.

2 - EU projects:

A SYSTEM APPROACH TO WASTEWATER BIOTREATMENT FOR THE PROTECTION OF MEDITERRANEAN COASTAL AREAS ("BIOWATSYST")

Coordinator: MAI-Bari, Italy

Partners:
- Suez Canal University, Ismailia-Egypt
- CIEMAT, Spain
- NTUA, Greece
- IAV Hassan II, Rabat-Morocco and
- WERSC, University of Amman, Jordan

The principal objectives of the Project are the following:
- to monitor, prevent and remediate coastal pollution due to wastewater disposal through the use of multipurpose subsurface-flow constructed wetlands (SFW), inserting them into the productive system of rural societies and, in a more general way, into the surrounding environment;
- to gain information useful to help in the optimisation of the design and management of constructed wetlands;
- to assess the effectiveness of SFW as a low-tech, low-cost solution to domestic wastewaters treatment;
- to demonstrate the possibility of reusing treated waters for irrigation purposes and aquifer recharging;
- to conduct an economic-social-environmental analysis to evaluate the global impact of wetland construction and management.

The project is based on the construction of biodepurating systems in 5 representative places: - Egypt, Suez Canal; Spain, Madrid; Morocco, Rabat; Jordan, Amman; Greece, Athens.

Phytodepuration efficiency will be evaluated comparing physical, chemical and microbiological characters of inflowing and treated waters.

The results of system monitoring in the technical, economic and environmental aspects will be analysed to issue recommendations and guidelines and a decision support tool will be released.

The main expected outcome is a set of information and recommendations addressing operators and decision-makers, explaining and demonstrating how to take advantage of domestic wastewaters instead of polluting watercourses and seacoasts.

Further outcomes are methods for optimising the design and management of constructed wetlands.

Aspects of interest are also: the biomass production and use as an organic compost or to generate biopower; the observation of effects of treated wastewaters used for irrigation purposes and aquifer recharging; the demonstration action addressing extensionists and operators at large.

MAI-Bari Research Activities

This project provided the opportunities of many researchers to visit the depuration stations constructed in both the Southern and Northern countries involved in the programme. Exchange of experience among the researchers in this field led to optimum results in facilitating the research working programme.

Training candidates from the Mediterranean countries: in the depuration station constructed in Catania in cooperation with Bari Institute, three candidates (from Palestine, Turkey and Yemen) were fully involved in all operation steps regarding the construction of the system. The three candidates carried out their Master thesis on the spot and the research programe included the following:
- “an evolution of the system and its validity in treating the municipal wastewater to the international standards”;
- response of some horticulture crops to treated municipal water in comparison with freshwater enriched with nutrients on both quantity and quality of the production;
- permanent irrigation with treated sewage water and its impact on the physical and chemical characteristics of different soil types (clays calcareous, sandy) as well as evaluation of the pollution risks on the groundwater.

3 - Research project:

"CEREALS AND LEGUMINEOUS SALT TOLERANCE DEGREE"

The aim of the project is evaluating the salt tolerance degree of some important legumineous and cereals crops in the arid regions of the Mediterranean and Middle East.

The programme will include the crops (Broad beans, lentils, check-peas, barley, wheat).

The programme is coordinated by Bari Institute and realized in cooperation with ICARDA, Syria, INRA, France, Wageningen University, Holland.

The programme will last for 5 years. The activities started in the year 1998-1999 on six varieties of lentils already produced through the genetic-breeding techniques and evaluated according to their resistance to water stress and drought conditions. Three candidates (2 from Tunisia and 1 from Egypt) were involved in the lentils studies and obtained their M.Sc.

Three scientific papers were prepared including the scientific findings, one had been accepted in "water management journal" and is under press, and the other two papers were accepted as oral papers to be presented in Antalya, Turkey on the occasion of the International Symposium on "Techniques to Control Salinization for Horticulture Productivity", (November 7-10, 2000) which is sponsored by CIHEAM/MAI-Bari.

In the year 2000, the programme is continued and studies are carried on six varieties of check-peas with the involvement of three candidates from the Mediterranean (Egypt, Lebanon and Tunisia).

RAP PROGRAMME ACTIVITIES AND ITS IMPACT ON LOCAL, REGIONAL AND GLOBAL LEVEL

The elevated number of scientific publications, the special publications (proceedings of international seminars, workshops, round tables, short courses) and the participation on international, regional and national scientific events all led to wide dissemination of the running and developed activities carried under the Sub-Network "Non-Conventional Water Resources Management (NWRM).

Such efforts resulted in recognizing the important role CIHEAM/Bari Institute is playing in the field of non-conventional water resources in the Mediterranean and to use its experience to be applied in other arid regions around the world. This has an impact at different levels.

ON THE LOCAL LEVEL:

- **in Egypt,** the total drainage water is around 16 milliard m^3/annually. The amount already used in Agriculture till the year 1996 did not exceed 4 milliard m^3 due to the uncertainty and non-availability of the re-use strategy for both decision makers and the responsible Institutions. The tight cooperation in this field between Bari Institute and NWRC/Ministry of Water Resources and Irrigation, Egypt in setting the strategies on the re-use of drainage water resulted in increasing the re-use of drainage water in irrigation to nearly six milliard m^3/year already used for irrigation. The re-use program is advancing and it is expected with the year 2005 the drainage water will be totally recycled and re-used for irrigation. This will lead to freshwater saving around 10 milliard m^3, those will be diverted to the irrigation of around 1 million acres in the Tuska project.

- **Tunisia**, is among the countries facing a great gap in its food production and, in particular, cereals, due to severe water scarcity. The experiences of Bari Institute on the use of non-conventional water resources as supplemental irrigation to increase the cereals production under rainfed agriculture and drought conditions were applied on Tunisian realities. This programme has been realized in tight cooperation with Tunisia experts under both controlled and open field conditions. The scientific findings implemented under rainfed agriculture resulted in a notable increase of cereals yield production and, particularly, the wheat. Through such approach annual wheat production was increased by nearly 80%. Nowadays, the use of non-conventional water resources as supplemental irrigation represents an important national programme to compete drought condition and overcome the food gab in the country.

- **Morocco,** nowadays is facing severe drought conditions. Leading to nearly 80% losses in the cereals production, particularly wheat which is resulting in serious socio-economic problems. To compete the

drought, the Moroccan authorities and decision makers are now setting a national plan based on the use of non-conventional water resources as supplementary irrigation to increase the cereals production under rainfed agriculture and to face the prevailing drought conditions. In cooperation with Bari Institute, discussions are taking place to organise an international conference on "supplementary irrigation under rainfed agriculture and drought conditions: the role of non-conventional water resources. This will be a follow-up of the international conference held in Bari Institute, 1992 to be acquainted with the progress achieved in this field and to exchange the experiences between the scientists in the Mediterranean region and others all over the world.

ON THE REGIONAL LEVEL

Bari Institute is a member of the "Technical Advisory Committee" of the Mediterranean (MEDTAC) which is in direct contact with the "Global Water Partnership-TAC (GWP-TAC).

The MEDTAC was involved in preparing the Water Vision of the Mediterranean. The work published by Bari Institute concerning the water resources development and management in the Mediterranean was taken as bases for the Water Vision presented in the 2nd World Water Forum, The Hague-Holland (November 17-22, 2000).

The part of the Vision - concerning the non-conventional water resource and how it can be integrally managed with freshwater - was prepared in tide cooperation with Bari Institute.

In the last meeting of MEDTAC with the participation of GWP/TAC (Athens, May 2000), Bari Institute was asked to prepare a working paper on the Action Plan needed for water resources development and management in the region to be discussed in Athens in November 2000 to set the water projects and programs for the region.

- Euro-Mediterranean Cooperation

The Institute was invited, as observer- in the Ministerial Conference on Water Resources of the Mediterranean to discuss policies and programmes to be implemented in the region.

The subject wastewater re-use and recycling achieved a primary priority. The presentation of Bari Institute in this field was essential, and, the sequence, European Commission has asked a representative of Bari Institute to attend the meeting on the 7th of June 2000 to discuss on the proposals to draw up a regional cooperation programme based on the Action Plan endorsed at Turin Conference.

- Bari Institute is coordinating the following two EU-Projects:

1. "SUSTAINABLE HALOPHYTE UTILIZATION IN THE MEDITERRANEAN AND SUBTROPICAL DRY REGIONS";
2. "A SYSTEM APPROACH TO WASTEWATER BIOTREATMENT FOR THE PROTECTION OF MEDITERRANEAN COASTAL AREAS (BIOWATSYST)";

both are highly related to the RAP Programme activities on Non-conventional water resources.

Such programmes are realized by both Northern and Southern Mediterranean Institutions.

ON THE INTERNATIONAL LEVEL

The World Water Council decided to have its Regional Office for the Mediterranean region at Bari Institute. This ultimately confirms the important role Bari Institute is playing in the water resources development and management in the Mediterranean.

In the 2nd World Water Forum held in the Hague, Holland (March 17-22, 2000) with the participation of nearly 4500 scientists all over the world, the organizing and scientific committee of the World Water Council (WWC) asked Bari Institute to organize a special session on "Non-conventional water resources practices and management in arid regions" representing the activities of the NWRM Sub-Network including the research programme, scientific findings and proposed strategies for the re-use and recycling could be implemented.

The special session was held on 19 March, 2000 where NWRM activities were presented in details by the members of the sub-network. Attended the special session more than 300 scientists from several international and national institutions working in this field. In this event more than 1000 copies of special session proceedings was distributed.

The event in itself was a real success in bringing the activities of the NWRM from the regional level to the global one, in increasing the area of the dissemination of the information through distributing more than one thousand copies of the proceedings, the elevated number of scientists attending the session, the fruitful discussions backed with each presentation and the great interest showed by many scientists to be updated with the further progress in Sub-Network activities.

SUB-PROGRAMME

"Water Use Efficiency"

INTRODUCTION

The Regional Action Plan (RAP) on *Water Resource Management* was developed on three major considerations:

Water scarcity is one of the major limiting factors of agricultural, economic and social development in the arid and semi-arid regions of the Mediterranean

An increasing number of developing Countries of the Mediterranean are approaching full utilization of their available water resources

The quantity of fresh water resources available to agriculture is diminishing while lower quality water is increasing

The agricultural sector is the principal consumer of water resources in the Mediterranean Region (about 80%), half of which is lost due to inefficiencies throughout the whole traveling path, going from its source (reservoir or rainfall) to the root-zone of the cropped field. Furthermore, the trade of the water transpired by the crop in exchange for the carbon assimilated can be made more efficient if eco-physiological analysis are introduced along with the hydrological ones of water transport and field application. An overview of the whole water use efficiency framework is shown in Fig. 1.

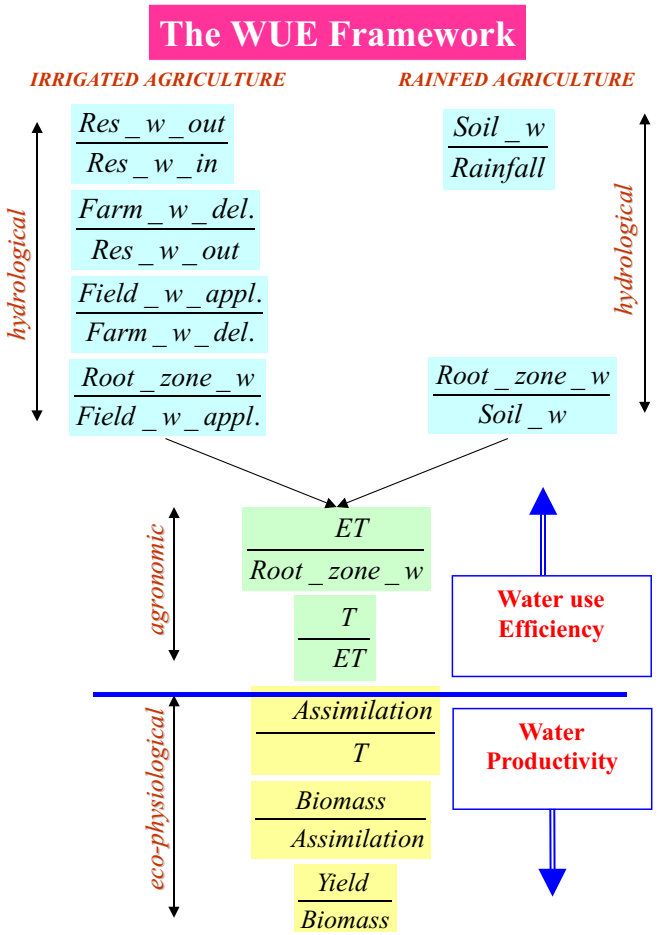


Fig. 1. Suggested framework for analyzing components of the *water use efficiency* and *water productivity* in agricultural crop production. The overall path "traveled" by water is split into different segments where appropriate analysis can be implemented.