

RAP-Programme: WASIA Project is a realistic step towards a soft path water management approach

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REGIONAL ACTION PROGRAMME (RAP)-WATER RESOURCES MANAGEMENT:

INTRODUCTORY PAPER ON: WATER SAVING IN IRRIGATED AGRICULTURE (WASIA PROJECT)

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1. 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, which means that there is no more room to increase the supply, inevitable following to amplified conflicts among sectorial water users;

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

In the Mediterranean region, 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. Therefore, we need to elaborate the concept of demand management into implementation policies, programmes and actions in particular with irrigation as the main consumer (about 80%), where inefficiencies lead to major water losses (more than 50%), so that huge water saving could be achieved.

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 sector emphasizing the following major technical 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;

and the aid to decision making through the themes of:

Participatory Irrigation Management (PIM); and

Economic aspects of water mobilization and use.

For the last 10 years, the Collaborative Irrigation Network has focused its activities on research related to the use of non-conventional water resources in irrigation, Eco-physiology and modelling for water use efficiency and assessment and improvement of hydraulics performances of collective irrigation systems. In these fields, great efforts have been carried out locally and at the regional, Mediterranean scale, resulted in numerous publications, organization of several conferences and workshops as well as realization of several research projects.

Nowadays, we believe that is essential to translate the ideas, conclusions and recommendations developed through these researches to actions on the ground in the Mediterranean region.

2. PROBLEMS TO BE ADDRESSED

With a view on the general aspects of water crisis in the Mediterranean Region, the following problems need to be addressed:

Inefficient use of water on farm scale due to inadequate cropping pattern and irrigation scheduling, considering hydrological, eco-physiological and economical aspects;

Poor performances and huge water losses of irrigation distribution systems due to scarce design, operation and maintenance;

Increased use of non-conventional water resources (wastewater, saline water and drainage water) in irrigation which may have adverse impacts on both the environment and the public health.

Therefore, selection of cropping pattern, irrigation method and scheduling criteria, use and recycling of non-conventional water resources in irrigation, operation and maintenance of irrigation systems and impact of such activities on crop eco-physiological parameters and production, on soil characteristics and surface and groundwater quantity and quality are essential components of the system for water saving in agriculture.

A proposal that considers all aspects of the above problems comprehensively would be possible only within the frame of a long-term research programme and would require significant resources. This is not possible in the frame of the RAP Programme at this stage. However it is important to start building up a deep insight of the issues.

3. OBJECTIVES

Bearing in mind the aforementioned problems and considerations, the main objective of the presented research project is to develop a conceptual framework for **water saving in irrigated agriculture**, through the *integration* of the activities which represent major topics of the three Collaborative Irrigation Networks and aim to:

Improve water use efficiency in irrigation practices,
Improve performances of irrigation distribution systems, and
Promote safe and sustainable use of non-conventional water resources,

Specific objectives of the project are addressed to the development of 8 (eight) research themes to be carried out at eight different locations in the Mediterranean Region:

1. Regulated Deficit Irrigation of orchards with low quality water, (Tunis, Tunisia)
2. Regulated Deficit Irrigation with low quality water by partial root drying of pistachio (Southeast Anatolian Region, Turkey)
3. Hydraulics performances of irrigation systems under different irrigation practices (Ghezala, Tunisia)
4. Energy saving in irrigation by means of improved irrigation practices (Souss Massa, Morocco)
5. Reuse of treated wastewater for irrigation of cereals, forage and vegetables by means of different irrigation methods (Agadir, Morocco)
6. Re-cycling of drainage water for sustainable irrigated agriculture (Nile Delta, Egypt)
7. Use of artesian highly saline water for irrigation of cereals and vegetable crops (Tarsus, Turkey)
8. Development of screening legumes and forage nursery for salinity tolerance (Aleppo, Syria)

The realization of each research theme at different pilot area - experimental site in the Southern Mediterranean countries will give an additional value to the Project through the possibility to exchange research experiences in different fields and under different climatic, soil and management conditions.

4. RESEARCH ACTIVITIES AND METHODOLOGY

Four Work Packages are established for the realization of the Projects. Three of them are tightly related to the three Collaborative Irrigation Networks with the task to coordinate and carried out the major activities under specific research themes:

Work-Package 1 Water Use Efficiency, WUE, guiding the activities under two themes:

- Research theme 1, in Turkey (Gaziantep, Southeast Anatolian Region) and
- Research theme 2, in Tunisia (Tunis, experimental field of INAT);

Work-Package 2 Irrigation System Performance, ISP, guiding the activities under two themes:

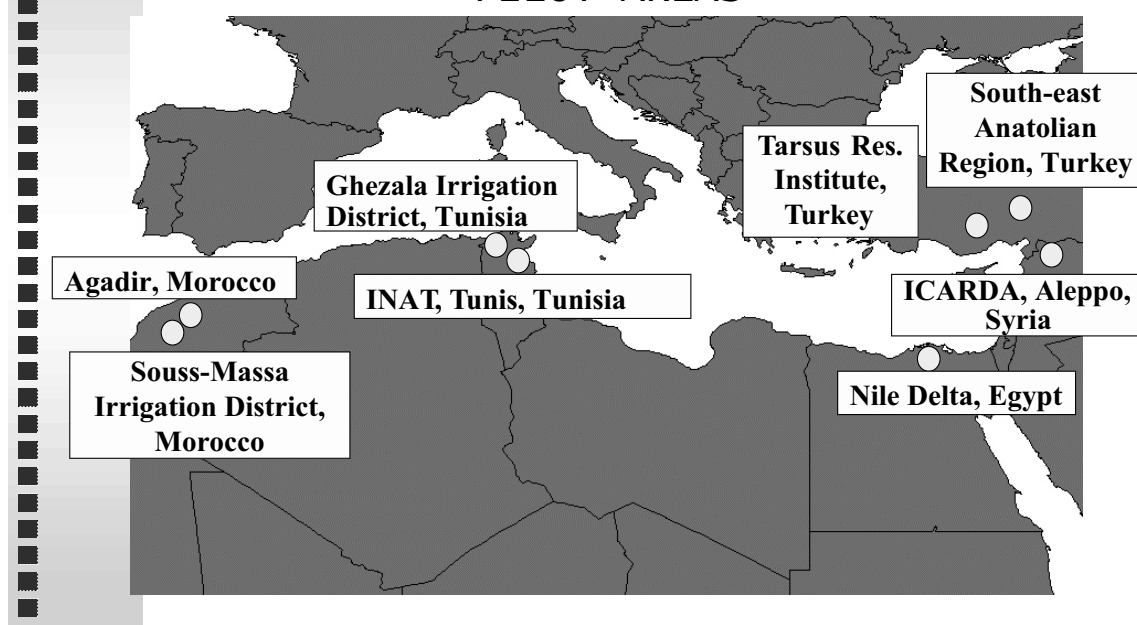
- Research theme 3, in Tunisia (Ghezala Irrigation District), and
- Research theme 4, in Morocco (Souss-Mossa Irrigation District);

Work-Package 3, Non-conventional Water Resources, NWR, guiding the activities under four themes:

- Research theme 5, in Morocco (Agadir),
- Research theme 6, in Egypt (Nile Delta),
- Research theme 7, in Turkey (Tarsus), and
- Research theme 8, in Syria (ICARDA, Aleppo).

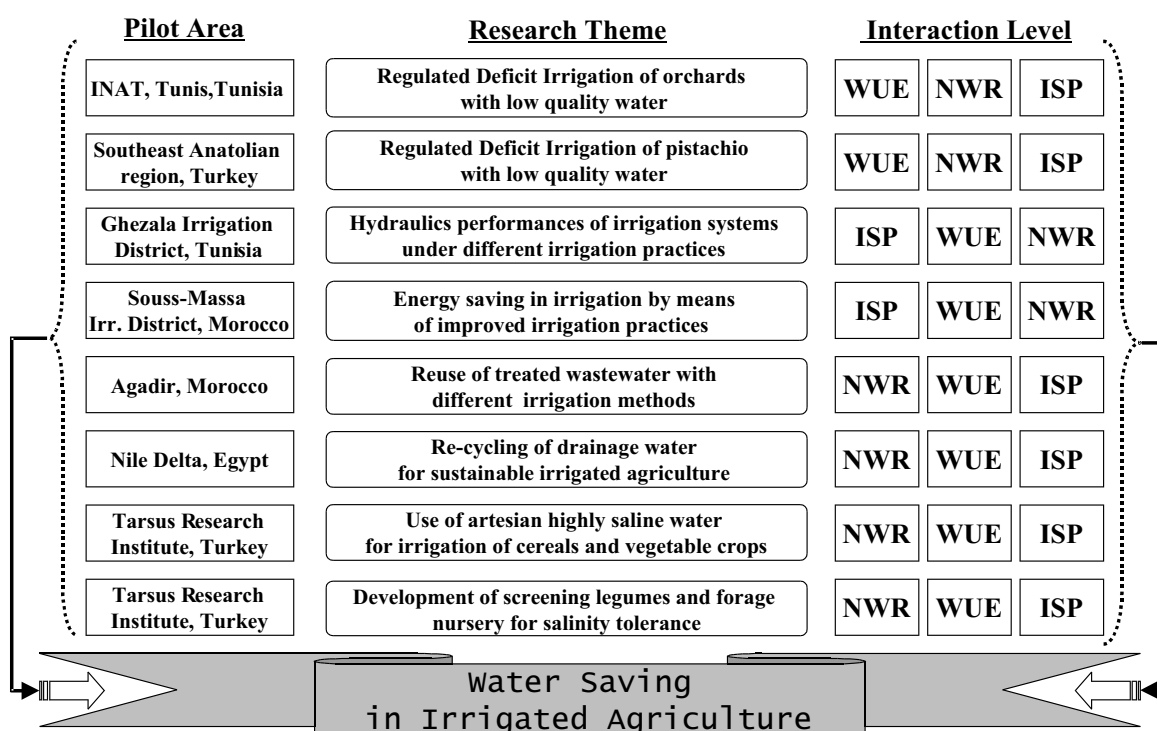
"Water Saving in Irrigated Agriculture (WASIA)"

PILOT AREAS



An exchange of information and interaction of three Work Packages has to be established at different phases of Project realization and it is the major tasks of **Work Package 4**. Moreover, Work Package 4 is related to the overall scientific and administrative coordination of the Project.

RESEARCH LAYOUT and LEVEL of WORK PACKAGES INTERACTION



The scientific coordination of the Project is assigned to the Chairperson of the National Water Research Center (NWRC), Cairo (Egypt), in cooperation with the CIHEAM-MAI.B Network coordinators included in the Programme and local coordinators of different pilot areas cited here below. The Project will be financially administrated, along the whole duration, by the Administration Division of the CIHEAM-MAIB in cooperation with the person nominated by the NWRC, Cairo (Egypt).

The research activities and methodology are described for each selected pilot area in each Work-Package.

4.1 WORK-PACKAGE 1 - WATER USE EFFICIENCY

4.1.1 PILOT AREA: EXPERIMENTAL FIELD OF INAT, TUNIS

SPECIFIC PROBLEM

Fruit trees cover about 40% of the irrigated lands and represent an important component of the productive farming system in the country. However productivity is usually low and irrigation with waters having more than 1.5 g/l total dissolved solids is commonly practiced without provision of drainage and consequent high salination hazard in irrigated orchards. Any strategy that may help to save water and control salinity, while producing more fruits, is needed. In the absence of a drainage system, techniques based on irrigation restrictions seem to be reasonably appropriate. The Regulated Deficit Irrigation (RDI) can be used. RDI is based on the concept that water supply can be reduced to control vegetation growth during specific periods of the season, while fruit growth remains little or not affected.

Research work will be conducted mainly in the INAT experimental station located 15 km south-east of Tunis, in the middle of the plain of Mornag, where important cash crops are grown under irrigation with different water qualities (canal, deep wells and shallow wells). Because drainage systems are not implemented in the area, salinization and ground water contamination are major threats for this important horticultural area.

Participatory experimental work will also be conducted in the areas with motivated farmers for rapid integration of experimental findings.

The experimental site has:

- 1) 10 ha of irrigated fields comprising different water delivery systems
- 2) one automatic weather station
- 3) two water source qualities

Laboratory facilities at INAT are made of:

- 1) one soil characterization unit (texture, F.C., W. P., moisture content)
- 2) equipment for measuring water flow
- 3) computers GIS system
- 4) one weather station with two batteries of "concrete lysimeters"

Soils of Mornag are essentially alluvial soils (mostly heavy) and irrigation waters have an EC_i of about 1.5 ds/m (deep wells) and 2.5 ds/m (canal).

Research work will benefit from an ongoing collaborative action that's conducted with the support of a private company and concerning "water requirement of peach trees".

ACTIVITIES

- A.1.1)** Data collection of available meteorological data and characterisation of the regional climate: rainfall frequency distribution, ten-days T°C averages and ETo
- A.1.2)** Characterisation of the soil of the selected region: sampling of typical soil, determination of Field Capacity, Permanent Wilting Point (PWP), Soil Moisture Release Curve
- A.1.3)** Surveys on irrigation practices in representative orchards
- A.1.4)** Development of phenological calendars on the basis of available data and set periods of growth stages suitable for deficit irrigation
- A.1.5)** Implementation of demonstration plots (amount of water usually delivered by the farmer will be

used for reference). Restrictive treatments will consist in irrigation water cuts of 10%-50% at selected growth stages

- A.1.6)** Quantification of saved water volumes
- A.1.7)** Monitoring salt accumulation in the soil and developing strategy to prevent salinization
- A.1.8)** Alternate during the drought period using saline water to compare it to normal dry condition
- A.1.9)** Development of “Regulated Deficit Irrigation Guides” to be used by surveyed farmers for feed back and improvements
- A.1.10)** Dissemination of results

DELIVERABLES

- D.1.1)** Regulated deficit irrigation guides for fruit growers to save water
- D.1.2)** Regulated deficit irrigation criteria to control excessive vegetative growth and to produce fruits of a better quality
- D.1.3)** Salination hazards minimised on orchards

4.1.2 Pilot area: Southeast Anatolian Region (Turkey)

SPECIFIC PROBLEM

Many efforts have already been done by the central government to bring water in the Southern Anatolian Region, particularly through the realisation of reservoirs for multiple uses with the capacity of more than 5 billions m³ / y. Pistachio is the most important crop in the area (Turkey is the third biggest producer and exporter of pistachio in the world), however field crops are also extensively present. The current crop water demand of the area is satisfied by water available in current reservoirs.

Nevertheless, the main future trend of the area will be characterised by an increase (horizontal and in varieties) of field crops together with an increase of the most traditional crop “pistachio” over the whole region. As a consequence, the total crop water demand will increase to a critical level in a region (Southern Anatolia) that experiences water shortages. Future total demand will unlikely be met with calculated existing freshwater yields with consequent negative impact on agriculture production, socio-economic setting and freshwaters. All this could lead to water conflicts. Intervention of deficit irrigation management is needed today to prevent envisaged impacts.

Experiments have proved that the most appropriate programme of irrigation can be obtained for some major crops in an area under Deficit Irrigation conditions. In particular, Deficit Irrigation can be improved by the increased crop water use efficiency under Regulated Deficit Irrigation (RDI) and/or Partial Root Drying (PRD). Since pistachio is the most important crop of the area, the RDI and PRD techniques are thought to be experimented on this type of orchard with the aim of saving water and possibly re-use the saved water to reduce future deficit irrigation and mitigate pressure on freshwater, without influencing crop yield and quality.

ACTIVITIES

- A.1.11)** DATA COLLECTION OF AVAILABLE METEOROLOGICAL DATA AND CHARACTERISATION OF THE REGIONAL CLIMATE
- A.1.12)** Characterisation of the soil of the selected region
- A.1.13)** Assessment of water quality in function of the type of crop water quality requirement. Data will be used from available water quality analysis and some new sampled water
- A.1.14)** Geomorphological analysis over the region to select the most appropriate experiment site. Available satellite images will be used. The size of the experimental site will be about 1 hectare
- A.1.15)** Experiments will be carried out in the selected site on pistachio with restrictive irrigation treatments having water cuts of 20-50% or more
- A.1.16)** Monitoring of plant root zone soil water status with, plant growth and gas exchange will be carried out
- A.1.17)** Quantification of saved water volumes
- A.1.18)** Development of “Deficit Irrigation Guides”
- A.1.19)** Dissemination of results

DELIVERABLES

- D.1.4)** An appropriate deficit irrigation is adopted by PRD on pistachio orchards to save water.
- D.1.5)** Regulated deficit irrigation is used to control excessive vegetative growth and to produce pistachio of a better quality.

4.2 WORK-PACKAGE 2 - IRRIGATION SYSTEM PERFORMANCE

4.2.1 Pilot area: Ghezala Irrigation District (Tunisia)

SPECIFIC PROBLEM

Existing large-scale pressurized irrigation systems in the selected area operate at low performance level, with consequent high water losses and wastages. At the same time, the areas suffer of high water shortage and freshwaters are overexploited. Moreover, the low performance of distribution systems induces farmers to withdraw water through uncontrolled wells with consequent overexploitation of groundwater causing salination hazard. With this outlook on the existing irrigation systems, the main need is the development of criteria improving irrigation system performance and management activities to save fresh water from agriculture. The research will be carried out at district scale considering meteorology, hydrology, cropping system and physical characteristics of the network to calculate the saved water yield in relation to the net water balance of the irrigation scheme in the frame of different climatic, hydrological and cropping scenarios.

A research program concerning the analysis of large scale distribution systems already started in Italy, at the Consorzio di Bonifica of Capitanata. The experiences and the results carried out in this area will be taken into account for a better assessment of the Tunisian pilot area.

Site Description and Objectives

The selected irrigation district is located at about 60 km North-West of Tunis. The source of water is the Ghezala dam, having a capacity of about 6 Mm³. The irrigable area is 1000 ha, cultivated with vegetables (27%), tree crops (38%), wheat (16%) and forage (19%). The irrigation systems was designed for on-demand operation but, specially during the peak period, important pressure deficits occur at the hydrants, don't allowing farmers to irrigate in an appropriate way.

The objectives of this work are:

- understand the farmers behaviour by monitoring the irrigation system and by applying models able to simulate different scenarios;
- develop a tool aiming at identifying the failure areas in the system and the importance of such a failure;
- improve the capabilities of managers and responsables of irrigation systems in identifying the problems and related solutions for improving the irrigation system performance.

ACTIVITIES

- A.2.1)** Data collection on climate, hydrology and hydrogeology, irrigation systems, water demand, cropping pattern.
- A.2.2)** Analysis of data and realisation of relevant thematic maps.
- A.2.3)** Development of models for simulating alternative cropping scenarios and for evaluating the farmers' behaviour through the generation of the hydrographs of withdrawals.
- A.2.4)** Development of models for the performance analysis and rehabilitation-modernisation of the selected irrigation scheme.
- A.2.5)** Application of models for performance analysis of the irrigation scheme
- A.2.6)** Quantification of total water losses
- A.2.7)** Identification of possible solutions through implementation of new technologies
- A.2.8)** Quantification of potential water saving within pilot irrigation schemes
- A.2.9)** Development of criteria for management of irrigation system.
- A.2.10)** Dissemination of results.

DELIVERABLES

- D.2.1)** Quantified degree of efficiency of irrigation system.
- D.2.2)** Defined solution schemes and measures to save water.
- D.2.3)** Quantified volumes of water saved in irrigation.
- D.2.4)** Developed criteria for management of irrigation system efficiency.

4.2.2 - Pilot area: Souss-Massa Irrigation District, Agadir (Morocco)

SPECIFIC PROBLEMS

The Souss-Massa irrigation station in Morocco was designed for on-demand sprinkler irrigation during 1970. The design of the whole irrigation system (network and pumping station) was referred to the actual situation of the country but, after the crisis of petroleum (1974) the cost of the energy increased enormously, causing the increasing of the operating costs. In fact, actually, the cost of the energy represents about 60% of the total cost of the water. Therefore, all the actions aiming at reducing such energy cost represents a priority issue for the country.

Site Description and Objectives

The selected irrigation scheme, within the Souss-Massa region, is called “Ait Amira” and covers an irrigable area of around 3700 ha. It is managed by the ORMA-Souss Massa (Agadir). At the upstream and of the network a pumping station with a regulating water tower 90 m high was installed. It is able to guarantee a minimum pressure at the hydrants of 4 bars, for a maximum discharge in the network of about 1800 l/s.

The objectives of this work are: set up an innovative methodology for reducing energy cost for the operation of the system; quantify the energy saving; improve the social conditions of farmers by reducing the water price.

ACTIVITIES

- A.2.11)** Data collection on the demand hydrograph, on the energy consumption and on the physical characteristic of the network
- A.2.12)** Set up a data-base on the demand hydrograph, on the energy consumption and on the physical characteristic of the network
- A.2.13)** Development of a methodology (including a software package) for the energy saving in irrigation districts serving by pumping station
- A.2.14)** Application of such a methodology to the “Ait Amira” irrigation scheme
- A.2.15)** Quantification of the energy cost saving for the Ait Amira irrigation scheme
- A.2.16)** Dissemination of results.

DELIVERABLES

- D.2.5)** A software package
- D.2.6)** Data-base on energy consumption and on the physical characteristic of the network
- D.2.7)** Quantification of energy saving

4.3 WORK-PACKAGE 3 NON-CONVENTIONAL WATER RESOURCES

4.3.1 Pilot area: perimeter located in Agadir region (Morocco)

Re-use of treated wastewater

Specific problem

South of Morocco has low rainfall, mostly seasonal and with erratic distribution. Moreover, due to the

rapid development of urban and rural domestic water supplies, conventional water resources have been seriously depleted and wastewater reclamation and reuse for irrigation gained increasing role in the planning and development of additional water supplies.

However, the re-use of wastewater may have potential adverse impacts on the environment, soil and groundwater. During last six years of collaboration with IAM-Bari, field experiments have demonstrated the benefit of using treated wastewater to irrigate cash crops (vegetable and flowers) and cereal crop (barley, wheat, maize). The use of drip irrigation increased water use efficiency in this cropping system and eliminated the health risk for labour and on the products.

Site description and objectives

Lately a wastewater treatment was developed by the rural Commune of Drarga about 4 km south of Agadir. The treated effluent will be used by 12 farmers in a perimeter of 6 ha. Our objective is to implement the finding developed under experimental conditions into on-farm level.

Three types of crops will be tested (cereals, forage and vegetables) and 3 systems of irrigation (sub-irrigation, drip irrigation and micro-sprinkler) will be tested.

The soil of this perimeter is sandy-loam and two irrigations will be used (well water, and treated effluent).

This research will benefit from the Master Programme developed between IAV Hassan II and IAMBari. The students will undertake their research thesis on this pilot to monitor crop development, eco-physiological data on the crop grown as well as the performance of the different irrigation systems at their impact on the soil characteristics and on the groundwater pollution.

ACTIVITIES

- A.3.1)** Data collection of available meteorological data (rainfall, temperature, ETo)
- A.3.2)** Plant productivity and product quality
- A.3.3)** Physiological data related to photosynthesis evapotranspiration, water potential and osmotic potential under the different treatments.
- A.3.4)** Evaluation on the performance of the different irrigation systems (water distribution efficiency, clogging, etc.)
- A.3.5)** Impact on soil characteristics, soil aggregate stability using "Henin" method.
- A.3.6)** Quantification of water and nutrient saved for each cropping system.
- A.3.7)** Evaluation of alternating freshwater with Non-conventional water during the sensitive stage.
- A.3.8)** Development of guideline on the use of purified water for different cropping systems.
- A.3.9)** Dissemination of results

DELIVERABLES

- D.3.1)** Guidelines for optimal use of non-conventional water resources in irrigation
- D.3.2)** Setting strategies for the recycling and re-use without any environmental and health hazards
- D.3.3)** Water saving potentiality through reuse of Non-conventional water resources
- D.3.4)** End-Users participation and creation of water user association for Non-conventional water resources
- D.3.5)** Cost benefit analysis for the use of Non-conventional water resources

4.3.2 Pilot area: Nile Delta (Egypt)

Re-use of Drainage Water

SPECIFIC PROBLEM

The irrigated agriculture of Egypt is sustained through provision of adequate land drainage systems. The drainage water in Upper Egypt is pumped and flows by gravity back to the River Nile. This drainage water flowing through the main drains, is rapidly available for farmers who suffer shortage in fresh water

supplying. This involves the risk of using saline water that may be harmful to crops, or they cause salinization of soils on a long turn. Since the early seventies, Egypt adopted a long term plan to reuse drainage water for irrigation on a more sustainable basis. The officially reused drainage water increased from 2.6 billion cubic meters per year in the eighties to almost 4.2 billion cubic meters per year in the nineties. Nowadays about 7.0 billion cubic meters are used for irrigation and according to the Egyptian Water Master Plan, a full use of drainage water will be achieved by the year 2017.

SITE DESCRIPTION AND OBJECTIVES

National Water Research Centre of Egypt initiated a long term management programme on a small scale perimeter located in the central delta with 30 farmers in an area of 26 ha. The aim of this research is to overcome factors that threaten the sustainability of agricultural production in Egypt. Trials (with such variables as water quality and quantity, inputs, irrigation systems and crop rotation) are conducted on the farm level and we will be testing different management practices and monitoring their impact on the soil, crop yield, and groundwater pollution. On a long term we will be proposing more efficient ways for the use of drainage water to maintain higher levels of productivity, while minimising adverse effects on the environment.

ACTIVITIES

- A.3.10)** Data collection of available meteorological data (rainfall, temperature, ET_o)
- A.3.11)** Plant productivity and product quality
- A.3.12)** Physiological data related to photosynthesis, evapotranspiration, water potential and osmotic potential under the different treatments.
- A.3.13)** Evaluation on the performance of the different irrigation systems (water distribution efficiency, clogging, etc.)
- A.3.14)** Impact on soil characteristics, soil aggregate stability using "Henin" method.
- A.3.15)** Quantification of water and nutrient saved for each cropping system.
- A.3.16)** Evaluation of alternating freshwater with Non-conventional water during the sensitive stage.
- A.3.17)** Development of guideline on the use of drainage water for different cropping systems.
- A.3.18)** Dissemination of results

DELIVERABLES

- D.3.6)** Guidelines for optimal use of drainage water resources in irrigation
- D.3.7)** Setting strategies for the recycling and re-use without any environmental and health hazards
- D.3.8)** Water saving potentiality through reuse of drainage water resources
- D.3.8)** End-Users participation and creation of water user association for drainage water resources
- D.3.10)** Cost benefit analysis for the use of drainage water resources

4.3.3. Pilot area: Tarsus Village Affair Research Institute, Tarsus (Turkey)

Re-use of Artesian Saline Water

SPECIFIC PROBLEM

Salinity is one of the most serious problems facing the world irrigated agriculture. Conservation and enhancement of quality of natural resources particularly of land and water are basic to ensuring food security of the growing population. Increasing of these two primary resources is a major constraint on our ability to ensure food security. To prevent the productive lands from being salinized as well as to utilize the existing salty land and water, it is essential to correct the deleterious conditions through application of appropriate technology.

Salinity is reported to affect about 1 billion hectares, mostly located in arid and semi arid regions. It is estimated that 20 million hectares of land deteriorate to zero or negative productivity each year in addition to that already affected. Saline soils of various natures and degree occupy over 80 million hectares in the Mediterranean basin.

This situation is not only being made worse by further land deterioration but also by population increase, urbanisation and industrialisation, all of which require more water and thus impose a tremendous strain on the already limited and fragile fresh water source in the region. In the arid and semi arid regions of the Mediterranean supplied of good water quality are expected to decrease. The development of the available water resources is questionable; most of the available water resources have been mobilised.

The decreasing availability of fresh water for agriculture use, while the need for production of food and fuel from plants is increasing in Turkey, which is nowadays a problem common to many countries in the Mediterranean region. Under such condition of fresh water scarcity, agriculture is forced to use more and more waters of poorer quality or saline ones. Fortunately, there are abundant sources of those water sources that could be used successfully in irrigation, but they are still marginally used. Water availability for irrigation in Turkey could be enhanced through proper use and management of saline water.

In arid and semi arid countries of the Mediterranean, cereal, vegetable/fruit and fibre productions are of vital important to overcome the gap in food and fibre productions and to reduce the relatively high rate of these importations.

SITE DESCRIPTION AND OBJECTIVES

The experiments will be conducted in the greenhouse in of the Çukurova University and open air in the Tarsus Village Affair Research Institute (TVARI). In the greenhouse experiment, 0.08-1.0 cubic meter cylindrical pipes (named lysimeter or pots) and soil plots in the TVARI are going to use for the experiments. The major soil series will be considered to use in the researches (generally, the soils in the Cukurova region are heavy or medium-heavy texture).

Sea water and drainage water from Lower Seyhan Irrigation System will be used as irrigation water. Irrigation water will be mixed with fresh water, and mixing ratio and leaching fractions will be changed as plants variety and irrigation programs to be used. Dilutions, on the other hand, will be changed with respect to varieties and different growing periods of the plant to be considered. employed and irrigation programs. According to irrigation programs, saline and fresh water will be consecutively used in the growing periods of the plants.

In the proposed experiments, maize, wheat and tomato plants which are the grown wide spread in the Çukurova Region will be used as the experimental crops.

The main objectives of this study are:

- (1) to investigate the possibility of using saline water for crop production;
- (2) to obtain the characterizing the plant growing parameters of investigated varies as a function of irrigation with saline water of different salt concentration levels;
- (3) to evaluate the yield production and yield loss in relation to the salt concentration level of irrigation water;
- (4) to assess the salt balance under different irrigation programmes;
- (5) to classify the investigated crops with respect to their salt tolerance degree;
- (6) to obtain the suitable leaching fractions for getting high yield from investigated plants and unsalinisation of soils to be irrigated with saline water.

ACTIVITIES

- A.3.19)** Data collection of available meteorological data (rainfall, temperature, ET_o)
- A.3.20)** Plant productivity and product quality
- A.3.21)** Physiological data related to photosynthesis evapotranspiration, water potential and osmotic potential under the different treatments
- A.3.22)** Evaluation on the performance of the different irrigation systems (water distribution efficiency, clogging, etc.)
- A.3.23)** Impact on soil characteristics, soil aggregate stability using "Henin" method.
- A.3.24)** Quantification of water and nutrient saved for each cropping system
- A.3.25)** Evaluation of alternating freshwater with Non-conventional water during the sensitive stage
- A.3.26)** Development of guideline on the use of epurated water for different cropping systems
- A.3.27)** Dissemination of results

DELIVERABLES

- D.3.11)** Guidelines for optimal use of artesian saline water resources in irrigation
- D.3.12)** Setting strategies for the recycling and re-use without any environmental and health hazards
- D.3.13)** Water saving potentiality through reuse of artesian saline water resources
- D.3.14)** End-Users participation and creation of water user association for Non-conventional water resources
- D.3.15)** Cost benefit analyze for the use of artesian saline water resources

4.3.4 Pilot area: ICARDA, Aleppo (Syria)

Development of Screening Legumes and Forage Nursery for Salinity Tolerance

SPECIFIC PROBLEMS

Water is a scarce resource and has great strategic importance for most Mediterranean countries of West Asia and North Africa (WANA). At present, over half the region's crops are grown under irrigation, and agriculture accounts for around 85% of the total consumption of water. However, with rapidly growing industrialization, urbanization and population increase, economic realities seem certain that farmers have to look for crop varieties that could produce using saline water for irrigation. Moreover, opportunities for large captures of new water are now very few. Depletion of the flow to downstream users will become increasingly difficult to avoid and the quality of irrigation water is becoming a way of live require some agronomic adjustment at the farm level.

Sustainability of agriculture system requires balanced crop rotations. This means introduction of some legumes varieties to the existing wheat-based and cotton-based crop rotations. Given that large areas of irrigated land in the WANA area suffer from salinity problems or the use of irrigation waters that have level of salinity, testing and introduction of legumes that tolerate salinity become a necessity. Around the world it has been numerous research efforts attempted to identify varieties that tolerate salinity and still economically produce yield. Legumes however, did not get the same attention as cotton or cereals. In dry areas of WANA legumes varieties such as lentil and chickpeas are important protein sources in the diet of the poor inhibitors of many communities in the region, particularly the ones that live in areas of salinity and or water quality problems and constraints respectively. Also, livestock industry is an important agriculture operation in the region of concern despite the shortages of healthy rangeland and enough winter forage and feed.

Therefore, the International Center for Agriculture Research in the Dry Areas (ICARDA) who has a worldwide mandate of these two crops is proposing to establish screening legumes and forage nursery for salinity tolerance that will be available serve not only the Mediterranean countries but also other places elsewhere interested in this field of study. Whereby, this nursery shall screen all varieties of lentil, chickpeas, and selected forage legumes in three-step system.

This programme is a completion of the project "Salt tolerance degree for cereals and leguminous crops dominant in the Mediterranean region lasting for 4 years.

This programme started 2 years ago, coordinated by ICARDA and Bari Institute in cooperation with INRA France, ISA Bari and Wageningen University.

SITE DESCRIPTION AND OBJECTIVES

This project to be conducted at ICARDA facilities, capitalizing on the infra structure the Center have. Field test to be conducted at the farmers field with different irrigation water salinity levels farmers are using for irrigation to verify plant phenology and yield in comparison to the green house results. The objectives of this work will be: screen lentil and chickpeas varieties available at ICARDA and National Programs for salinity tolerance; test 10 to 20 varieties of each under greenhouse condition for plant characterization and yield quantity and quality; test varieties at the farmer fields.

ACTIVITIES

- A.3.28)** Bench screening, available varieties of lentil, chickpeas, and at least one selected forage

legumes will be test for three salinity levels 3, 4-5, 8 dS/m. This test will be conducted with three treatments:

Dry seed with three salinity levels and control

Pr-soaked seed with fresh water and then with three salinity levels and control

X-rated seed to study the impact of x-ray on plant salinity tolerance as dry seed and pre-soaked seed with three salinity levels and control.

A.3.29) Greenhouse screening study: top 10 to 20 (upon availability of varieties) varieties will be tested with the same above treatments under greenhouse (controlled condition).

A.3.30) Top 3-5 varieties to move for field-testing at the farmers field

A.3.31) Dissemination of results

DELIVERABLES

D.3.16) Identification of lintel, chickpeas and some forage crops salt tolerant varieties.

D.3.17) Tested varieties of lintel, chickpeas and some forage crops salt tolerant varieties and their appropriate agronomic practices in cotton- and wheat-based rotations.

D.3.18) Provide degree- and/or non degree-training opportunities in the field of crop and water salinity management.

4.4 WORK-PACKAGE 4 PROJECT CO-ORDINATION

The whole project will be scientifically coordinated by the Chairperson of the National Water Research Center (NWRC, Cairo, Egypt) in cooperation with the IAMB (Istituto Agronomico Mediterraneo of Bari). The co-ordination will be carried out along the whole duration of the project.

The project will be financially administrated, along the whole duration, by the Administration Division of CIHEAM-IAMB (Istituto Agronomico Mediterraneo of Bari) in cooperation with the person nominated by the NWRC, Cairo (Egypt).

ACTIVITIES

A.4.1) contractual matter and project administration

A.4.2) maintenance of links among partners

A.4.3) maintenance of links with funding agency

A.4.4) scientific co-ordination and interaction of the Work Packages 1, 2 and 3

A.4.5) organization of projects and bilateral meetings

A.4.6) organization of seminars / workshops