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EFFICIENT MANAGEMENT OF WASTEWATER, ITS TREATMENT AND REUSE IN THE MEDITERRANEAN COUNTRIES: THE EMWATER PROJECT

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SUMMARY – Water shortage is currently one of the biggest concerns of human being worldwide and it becomes a global problem that affects seriously the lives of high numbers of the world population. According to the Kyoto summit in 2003 two billion people will not have access to safe drinking water supplies in the year 2015. The Mediterranean region belongs to the most affected countries in the world. The EMWATER Project (Efficient Management of Wastewater, its Treatment and Reuse in the Mediterranean Countries) aims to increase the security and safety of water supply in the MEDA countries thus providing core conditions for social, economic and political stability within the region. The beneficiary countries of this project are Jordan, Lebanon, Palestine and Turkey. The project started on May 2003 and has a 4 years total duration. It has been founded by the EC under the EU-MEDA "Regional Program for Local Water Management" and is co-funded by the German Ministry for Economic Co-operation and Development (BMZ), with about € 4 million total budget. The project consortium is composed by EU partners: InWEnt (project coordinator, Germany), TUHH-Hamburg (Germany), Adelphi Research (Germany) and ENEA (Italy) – with a role of support and technology transfer – and MEDA partners: Al al-Bayt University (Jordan, Al Mafraq), Birzeit University (Palestine, Birzeit), University of Balamand (Lebanon, Tripoli) and Yildiz Technical University of Istanbul (Turkey, Istanbul). Furthermore, experts from the field, decision-makers, civil organisation and interested citizens have been involved in order to reduce the water shortages in the Mediterranean Region. EMWATER project aims to highlight suitable solutions in wastewater treatment and reuse supporting the installation of proper technologies for wastewater management. Specific tasks being implemented consist in the elaboration of regional policy guidelines for wastewater treatment and reuse, the design and the construction of pilot plants applying appropriate and low cost techniques for demonstration and training purposes, the definition of an adapted training and capacity building programs (local, regional and web-based) for technicians, engineers and employees of authorities and non-government organizations in the field of wastewater treatment and reuse (local stakeholders and professionals). Such activities will allow to achieve general objectives as: promoting transfer of suitable wastewater treatment technologies and improving current technologies used in rural areas; strengthening of regional co-operation through the creation of co-operative networks aimed to improve the efficiency and effectiveness in integrated water resource management; strengthening of local capacity building; developing regional policy guidelines for wastewater treatment and reuse in the region; enhancing public awareness of the insufficient respectively wrong wastewater treatment and reuse and for the necessity of an improved hygienically safe disposal. The paper describes the state-of-the-art in the project implementation after the 1st year, mentioning the progresses towards achieving objectives and listing the main aspects in the implementation of a fruitful co-operation between EU and MEDA countries.

Keywords: Wastewater treatment and reuse, integrated water management

1. INTRODUCTION

Water shortage is currently one of the biggest concerns of human being worldwide and it becomes a global problem that affects seriously the lives of high numbers of the world population. Water is an essential element for the economic development and political stability and limited water resources are recognised as the most important obstacle to the development of the agricultural sector.

According to the Kyoto summit in 2003 two billion people will not have access to safe drinking water supplies in the year 2015. The Mediterranean region belongs to the most affected countries in

the world.

In 1995 the European Union has started the MEDA Programme (Euro-Mediterranean Partnership). The Programme shall improve the infrastructure in the so called MEDA Countries, aiming to the establishment of the Euro-Mediterranean Free-Trade Area in 2010. Important milestone in this process has been the establishment of the Euro-Mediterranean Water Network in 1999 in order to strengthen the regional cooperation between the MEDA Countries in the field of water supply and wastewater management.

In such a framework is inserted the EMWATER - Efficient Management of Wastewater, its Treatment and Reuse - project, whose primary aim is to highlight innovative solutions in the management of wastewater, its treatment and reuse in the Middle East Region.

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The project consortium is composed by European Partners (InWEnt, ENEA, TUHH-Hamburg, Adelphi Research) and Local Partners (Al al-Bayt University, Institute of Earth, Environment and Space - Al Mafraq/Jordan; University of Balamand, Dept. of Civil Engineering – Tripoli/Lebanon; Birzeit University, Institute of Water Studies - Birzeit/Palestine and Yildiz Technical University of Istanbul, Faculty of Science & Art, Chemistry Dept., Istanbul/Turkey).

In all the beneficiary countries (Turkey, Jordan, Lebanon and Palestine) wastewater treatment is not sufficient: high water losses in the drinking water supply (average between 30%-50%), rural and peri-urban areas are mostly neglected from water and wastewater facilities (average between 20-30% coverage while in cities 50-90%). Jordan and Palestine belong to the countries which are most affected by water scarcity worldwide. Availability of renewable water resources are below 500m³ per capita and year.

More in the details, the project's target areas are the following rural or peri-urban areas:
- Turkey, Peri-urban area of Istanbul.
- Jordan, Mafraq area.
- Lebanon, Koura area - Jbeil (Byblos).
- Palestine, Birzeit / Albiereh.

2. OBJECTIVES

Though the project is limited in time to 48 months, starting in 2003 and ending in 2007, the measures it aims to implement are designed to create long-term positive effects in the region.

Given the fact of water shortage crisis in the Mediterranean countries, the EMWATER project aims to create awareness of innovative solutions in wastewater treatment and its reuse and to support the installation of sustainable technologies for wastewater management. The improvement of the security and safety of water supply in the Mediterranean countries is indeed the best recipe for social, economic and political stability in the region and is, thus, the foremost goal of the project. With these goals in mind experts from the field, decision-makers, interested citizens and civil organizations have been sensitized to these issues.

More in the detail, the following general objectives can be enlightened:
- Strengthening long-term regional co-operation and sustainable development in the Mediterranean countries, through the creation of networks among the experts as well as through cross-border knowledge transfer.
- Improving efficiency and effectiveness in integrated water resource management, taken into consideration decentralisation concepts.
- Promoting transfer of innovative wastewater treatment technologies and improving current technologies used in rural areas.
- Encouraging reuse-oriented wastewater management.

- Enhancing public awareness of the insufficient respectively wrong wastewater treatment and reuse and for the necessity of an improved hygienically safe disposal.
- Providing decision-makers with up-to-date, relevant information in order to help them choosing the most suitable technology.
- Exchange of experiences and know-how between the European and Mediterranean partner countries and among the Mediterranean partner countries.

The general objectives will be complemented by the following specific tasks:
- Elaboration of regional policy Guidelines for wastewater treatment and reuse.
- Adapted training and capacity building programs for technicians, engineers and employees of authorities and non-government organizations in the field of wastewater treatment and reuse.
- Design and construction of pilot plants for demonstration and training purposes.

3. PROJECT CONSORTIUM

The project consortium is composed by European Partners (InWEnt, ENEA, TUHH-Hamburg, Adelphi Research) and Local Partners (Al al-Bayt University, University of Balamand, Birzeit University, Yildiz Technical University of Istanbul).

The responsibilities of the European partners are to work jointly with the Mediterranean partners to achieve the objectives of this project. This know-how transfer related to wastewater treatment and reuse shall be aimed to strengthen the capacity building and to assist the partner countries in the design and the construction of pilot plants for research and demonstration purposes and in the elaboration of policy guidelines.

InWEnt as an international foundation for training and human resources development is the leading institution and contributes with its experience in human resources development by designing and implementing training programs throughout the world, with a special focus on computer based training programs. Additionally InWEnt is responsible for the overall management of the project.

ENEA, the Italian National Agency for New Technologies, Energy and the Environment, is assisting the Al al-Bayt University in Jordan and the Birzeit University in Palestine in implementing the project.

The Technical University Hamburg-Harburg, a young applied science university highly regarded in Germany for the inter-disciplinary and industrial orientation of its research, is working closely together with the Yildiz Technical University of Istanbul in Turkey.

Adelphi Research, a non profit research organisation in environmental policy and technology transfer, acts as adviser for the Mediterranean partner countries, especially for the University of Balamand in Lebanon.

All partners in the Mediterranean partner countries are well established scientific institutions with experience in water related issues. Their responsibilities within their own countries will be the collection and evaluation of relevant data on water topics and the implementation of the results of the project and the transfer into actions as part of their water policies and strategies. The dialogue with the local authorities and other stakeholders, the organization of the implementation of planned measures and the general dissemination will be other relevant activities to be followed up.

To fulfil their responsibilities the partners have set up the following groups for this project:
- Project management team (located in each partner country) whose main tasks are to plan, to build up, to implement and to monitor all local actions, which include the installation of local management and steering teams in each of the Mediterranean partner countries. The Lead office is located in Al Mafraq, Jordan.
- Local steering committees (in each Mediterranean partner country) composed of representatives of stakeholders from local institutions, NGOs, users and consumer associations, women and environmental protection organisations and water authorities assists the local project co-ordinator in all aspects of the project to achieve the optimal results.
- Regional steering committee composed of representatives from the local steering committees will assist the Project Director by monitoring the entire project at a regional level (representatives of European and Mediterranean partner countries). This committee, meeting twice a year, guides and monitors the project and the evaluation process. Detached from the

day-to-day details of the project, the committee can ask evaluative questions about project direction and methods, review operational data collected by the participants, suggest modifications to project direction and provide an evaluative commentary on the final report.

The main stakeholders to achieve the general and specific objectives by strong involvement, support and acceptance in the project will be the following target groups:

- Decision-makers in governmental/public authorities (i.e. ministries, municipalities) and other local institutions dealing with water and wastewater management problems in general (stakeholders).
- Non government organizations (NGO's) such as users, consumers and farmers associations, women and environmental protection organizations, health organizations.
- Universities and teaching institutions.

All these groups, as stakeholders, they are a part of the regional and local steering committees assisting the Mediterranean project management in the project.

4. PROJECT ACTIVITIES

In addition to the necessary starting activities (conduction of the first regional "kick off meeting" 19.- 23.5.2003 in Berlin and the local steering committee meetings in the Mediterranean partner countries) the milestones for the first two years are:

- conduction of 4 Country Studies (Turkey, Lebanon, Jordan, Palestine).
- conduction of 4 local and 1 regional Training Program.
- design and construction of 4 Pilot Plants (Turkey, Lebanon, Jordan, Palestine).
- elaboration of Regional Policy Guidelines.
- elaboration of Public Awareness Programs.
- development of a website.
- publications.

All the issues above are aimed to gain basic experiences to be amended or changed in order to achieve the optimum results in the following of the project.

4.1. Country Studies

Such studies, acting as baseline document of the project, have been finalised for each participating Mediterranean partner country. The main objective of the studies was to analyse the current state of water and wastewater management and reuse in each country. Therefore, the country studies required relevant data to be collected in different fields, such as:

- national institutions, policies, guidelines and standards in the water sector.
- situation of the water resources (quantity, quality, demand, consumption).
- rural and urban water distribution systems.
- wastewater quantity and composition, and disposal systems.
- status of wastewater treatment and reuse, existing wastewater treatment and reuse facilities.

The studies aimed to provide an insight into the situation of the water sector in the Mediterranean partner countries. The documents proceed through a first overview of the countries profiles (geography, politic, climate and environment, economics) and their legal and institutional frameworks. Then, an assessment about all possible partners and contact subjects/institutions active in the reference countries wastewater sector is provided, also by collecting information on similar projects that have been or are being implemented in the region. After such introduction and outline sections, a detailed water sector assessment is performed through the description of the water cycle (water resources, consumptions, management structures, water prices) focusing both on the drinking water sector and on the wastewater management. In this latter section, a detailed description of the most widespread technologies for the wastewater treatment and reuse is given, including the most important applications, even providing a technical, socio economic and cultural assessment. Finally, an overview about public awareness programmes for proper water and wastewater management is realised, through the assessment of all the existing institutional, political and international frameworks.

The finalisation and the comparison of the different country studies, especially related to the description of the applied techniques for wastewater treatment and its reuse, will allow to suggest suitable and reliable solutions for wastewater management (drainage, treatment and reuse), standards to comply with and human resources development based on the local experience. Information sharing, technology transfer and the regional exchange of best practices will be facilitated.

The results of the country studies will provide the basis for all further activities within the project, like the design and construction of pilot plants, the formulation of wastewater treatment and reuse guidelines and the implementation of different training programs.

4.2. Pilot Plants

Complementary to the objectives of developing policy guidelines and providing sustainable capacity building through training programs it is important to apply and to test appropriate techniques for wastewater treatment and reuse.

Thus, pilot plants have been designed in order to verify the suitability of low cost technologies. Both the executive design and the construction of such plants will take place according to the international open tender procedures to be applied also to all the other supplies. Pilot plants operation and results will constitute an optimal field of practice and application for all the participants to the training programs.

Within the EMWATER project, for wastewaters produced by rural areas, characterized by medium-high organic concentration in temperate fluctuating countries (like the Middle-East), a two-stage biological integrated system seem to be the most suitable and sustainable treatment scheme to be applied for almost all the expected installations.

The first stage will be represented by a high-rate anaerobic biological systems which guarantee a fairly good removal of carbonaceous matter (and which may even reach high efficiency levels in the case of readily biodegradable substrates). The full-scale systems that have found a wider application are those based on the Upflow Anaerobic Sludge Blanket (UASB), which is a suspended growth system. When anaerobic biological systems are arranged in series, they are called ABRs (Anaerobic Baffled Reactors).

The second stage shall be fed by the effluent from the first and it shall consist of an aerobic reactor, where the oxidation of the residual carbonaceous fraction, ammonia nitrogen and sulphides occurs. Denitrification, if requested, shall take place in the anoxic section to be realized within the ABR reactor. According to Bovenduer *et al*. (1990) a Rotating Biological Contactor (RBC) system represents an excellent option for post aerobic treatment of UASB reactors effluents at low operational temperature.

A tertiary treatment, aimed to allow the compliance with the in-force standards (especially microbiological ones) for wastewater agricultural reuse, will be foreseen. It will consist in a low technology step to be realised with a sand filtration or a constructed wetland, according to the footprint availability on the sites and the local expertise.

4.3. Training

Different kinds of training programs have been foreseen:

- Regional training program "train the trainers".
- Local training program for professionals in Jordan, Lebanon, Palestine, Turkey.
- E-learning program.

The participants will be trained to build up a functioning wastewater treatment management and to promote appropriate technologies in the Mediterranean partner countries.

The trainers as well as the participants will be conveyors of the project topics and enhance the regional cooperation.

4.3.1. Regional training programs

The participants of the regional training programs have been trained on how to transfer technical knowledge of efficient management of wastewater collection and treatment to the technicians and administrative staff of the stakeholders with advanced experience in the field.

The first Regional training program has been implemented in October 2004 in Jordan at Al al Bayt University. Such training program has been designed as a "train-the-trainer" program to improve the training capacity of local experts and institutions (water and agricultural sector, agricultural and water engineers, university staff). Local experts will be able to act as multipliers in order to transfer their know-how to professionals and stakeholders in their countries.

"Train-the-trainer" courses have been focused on topics like “Wastewater management in rural and suburban areas” (5 days) and “Reuse of reclaimed wastewater” (5 days), taking into account all the aspects related to the choice of the best sustainable technology and to the most common operational problems to be overcome.

A 3-day workshop on the “Development of regional guidelines for wastewater treatment and reuse” for decision-makers has been held on October 2004.

4.3.2. Local training programs

The participants of the local stakeholders, who are responsible for the local water and wastewater management, will be trained in all the aspects of practical management of water and wastewater such as operation and maintenance of wastewater treatment plants, treatment technologies, their cost recovery, environmental impact assessment etc.

Such courses have been implemented from June - July in all the Mediterranean partner countries.

4.4. E-Learning program

An e-learning program has been implemented as an advanced course for professional engineers in the efficient management of wastewater treatment. The participants will improve their knowledge in wastewater engineering about the construction and design of wastewater treatment plants, solutions for trouble shooting on existing WWTPs, appropriate treatments and technologies for the sustainability and water reuse in rural areas, cost recovery planning, quality standards, environmental aspects, etc.

The first Web-Based Training module has been structured as a web intensive course with mainly asynchronous work, online forum and online moderated expert chats. It has been running in 2004 for 40 hours total duration.

This e-learning training program offers an advanced course for planning and operating engineers and other professionals in wastewater management, treatment and reuse from Jordan, Lebanon, Palestine and Turkey. Further courses will take place in 2005 and 2006.

4.5. Public Awareness Program

The project will be successful when the people in the Mediterranean partner countries will get accustomed to the efficient use of water and disposals, taking into account the aspects related to the protection of drinking water and to the best wastewater reuse option, and will accept these approaches as part of their everyday life.

Therefore public awareness programs will be implemented throughout the duration of the project by newspaper activities, video, radio, publication in international journals, dissemination through website (www.emwater.org)

4.6. Publications

One Publication has been done in September 04 in the Arab Water World Journal and project results have bee presented in the International Dead Sea conference on Water Demand Management held in June 04 in Jordan

5. CONCLUSIONS

EMWATER project's main objectives consist in improving the efficiency of integrated wastewater management in the Mediterranean countries through the transfer of suitable and sustainable solutions, enhancing public awareness for wastewater treatment and reuse.

After the first project year several results have been achieved, including country studies finalisation, steering committees (stakeholders) establishment, regional and coordination meetings, training modules for the local, regional and e-learning courses development and website development. Furthermore, many efforts have been making for the pilot plants design and installation.

The first project year experiences show that programmes aimed to enhance Euro-Mediterranean partnership – like the MEDA Water Program – represent an effective and powerful tool for the strengthening of the cooperation between the MEDA Countries, especially in the field of water supply and wastewater management.

Next project years will allow to realise further steps in this direction, aiming to enhance technology transfer to local experts and to increase public awareness for wastewater management and reuse in each one of the beneficiary countries.

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