

Mission Report

TUNISIA:

INSTITUTIONAL ASPECTS OF WASTEWATER REUSE

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UNDP-World Bank Water and Sanitation Program
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INTRODUCTION

The Program Mission to Tunisia was conducted by Dr. Takashi Asano (USA) and Dr. Rafael Mujeriego (Spain) from 26 October to 3 November 1991 at the request of the UNDP-World Bank Water and Sanitation Program in Washington D.C., USA, with funds provided through UNDP Project RAB/88/009. The authors of this Mission Report conducted field visits to inspect several wastewater treatment plants and wastewater reuse sites in and around Tunisian cities. In addition, they participated in a Colloquium in Tunis with two main objectives: 1) to evaluate the present system of wastewater reuse monitoring and control in Tunisia, and 2) to recommend improvement measures that would ensure the safety of wastewater reuse now and in the future.

The Mission followed the detailed program prepared by Dr. Akissa Bahri, Centre de Recherche du Génie Rural (CRGR), in close collaboration with officials from the Ministry of Agriculture, the Ministry of Public Health, the Ministry of Public Works, the Office National de l'Assainissement (ONAS), l'Institut Pasteur of Tunis, the Agence Nationale de Protection de l'Environnement (ANPE), and other agencies involved in wastewater reuse for agricultural irrigation and groundwater recharge.

The detailed program of official meetings and field visits is included in Annex A of this Mission Report. In addition to the activities indicated, a meeting was held in the evening of Monday 28 October with Mr. Taieb Belhay, General Director of Agriculture Production, and with Mr. M. Mouelhi and Mr. M. Marzouk, Société Nationale d'Exploitation et de Distribution des Eaux (SONEDE). The proposed meeting with Mr. M.M. Mlika, Director of the Institut Pasteur, did not take place due to unexpected extensions of meetings held in the morning of 28 October.

The last two days of the Mission were devoted to the Colloquium on the Institutional and Organizational Aspects of Reclaimed Wastewater Reuse, jointly organized by the Ministry of Agriculture, the United Nations Development Programme (UNDP), and the World Bank. The program for the Colloquium is included in Annex B of this Mission Report.

The authors of this Mission Report would like to express their sincere gratitude to all Tunisian government officials, all agency representatives, and, particularly, to Mr. M.A. Horchani, Secrétaire d'Etat auprès du Ministre de l'Agriculture, and Mr. M.F. Fokaladeh, UNDP permanent representative, for their warm welcome and fruitful discussions. Our special thanks to Dr. Akissa Bahri for her efforts in organizing an excellent Mission program, introducing us to the many officials and agency representatives, offering us extensive information on the subject of the Mission, and translating into English the numerous discussions held during our visit to Tunisia.

OFFICIAL MEETINGS

The discussions held with government officials, at all levels, clearly indicated a general consensus on the interest and benefits of wastewater reuse as an essential component of water resources management in Tunisia. Current laws and regulations are viewed by all government officials as appropriate and clearly conducive to wastewater reuse, particularly through agricultural irrigation. Various agencies have been established to collect and treat municipal wastewater; to transport, store and distribute reclaimed wastewater to farmers; to control industrial discharges and promote water recycling within industries; to study the effects of irrigation with reclaimed wastewater on plants, soils and aquifers; and to advise farmers on adequate irrigation and farming practices. In addition, the Ministry of Public Health also conducts epidemiological surveillance of the population affected by the use of reclaimed wastewater for irrigation.

Public health officials expressed their strong concern about the manner in which wastewater regulations are currently applied. They expressed their need to get involved in irrigation projects in the early planning phase, instead of being confronted with projects already completed. The officials are also hampered by obvious deficiencies such as inadequate public health education for farmers using reclaimed wastewater, and insufficient resources to monitor and control reclaimed wastewater effluents. These deficiencies represent a potential public health problem for the population exposed to the reclaimed wastewater and that consuming the food crops irrigated with reclaimed water.

Despite these difficulties, Public Health officials emphasized their positive attitude toward wastewater reuse, their commitment to increase wastewater reuse beyond the current 20% level, and their satisfaction with the reclaimed water quality limits established by the current regulations. However, they expressed strong concern for potential infection problems due to the inappropriate use of reclaimed wastewater, and the lack of personnel and material resources to carry out their monitoring and control duties.

The discussions held with officials from various agencies, particularly those of ONAS, ANPE and SONEDE, clearly revealed their extensive experience with all practical aspects of wastewater reclamation and reuse, and the existence of a considerable number of reports and studies on the subject, although scattered among different agencies and seldom sufficiently evaluated and interrelated. Most government officials particularly emphasized their willingness to reach the goal of 100% reclamation and reuse of wastewater, in spite of the lack of sound economic studies establishing the feasibility of such a goal. At the same time, most officials were well aware of the limitations currently imposed by seasonal demands of reclaimed wastewater and the few and limited storage facilities available for reclaimed wastewater. Although practical information is available at the CRGR, at the wastewater treatment agencies, and at the public health agencies, the overall evaluation and assessment of technical information, as well as technology transfer activities, are still limited.

WASTEWATER TREATMENT AND REUSE OPERATIONS

The field visits confirmed the information made available by World Bank officials and through the WHO report prepared by M. Strauss and U. Blumenthal on the number and capacity of wastewater treatment facilities, their high treatment efficiency, and their excellent level of operation and maintenance.

The wastewater treatment facilities visited by the Mission have an excellent overall appearance, which extends to both the treatment processes and buildings as well as the surrounding landscape within the plant properties. Treatment facilities and mechanical equipment are well maintained and operated. The effluents are generally of good quality, in spite of the highly concentrated influents (BOD values close to 700 mg/l, strong odor, and dark color due to warm weather and the long residence time in sewer lines) reaching the plants. The facilities have an excellent monitoring and operation program conducted by knowledgeable personnel both at the plants and their adjoining laboratories. The plant managers are competent and knowledgeable about the processes employed at the treatment plants. We believe the experience gained by the ONAS personnel on the maintenance and operation of wastewater treatment plants should be taken into account by many Mediterranean countries when designing future wastewater treatment facilities.

The adoption of an extended aeration activated sludge process or an oxidation ditch with long sludge detention time has resulted in frequent episodes of water quality deterioration due to suspended solids in the effluents. This problem has been compounded, particularly during the rainy season, by the insufficient surface area available for sludge drying beds. Thus, the inability to dispose of the waste activated sludge in drying beds has made it necessary to retain the sludge in the aeration basins with the resultant consumption of energy and the deterioration of the effluent quality. By providing additional sludge drying beds or appropriate mechanical sludge dewatering facilities the operation of the biological processes could be optimized, and the constraints currently imposed by waste sludge discharges could be overcome, thereby improving the performance and reliability of the biological treatment processes.

The anaerobic digestion of waste activated sludge as it is installed in some of the ONAS wastewater treatment plants could provide an additional source of energy in the form of methane gas and it could also achieve a better disinfection of the pathogens present in the sludge. Energy recovery from anaerobic digestion should be a clear alternative from an economic point of view. It is evident that the ONAS staff is capable of operating the anaerobic digestion process. Again, providing adequate of sludge drying beds, and mechanical dewatering of digested sludge should be considered a priority for the future expansion and remodeling of wastewater treatment plants in Tunisia.

The facilities for conveyance and distribution of reclaimed wastewater to irrigation fields are the responsibility of the Ministry of Agriculture and are operated and maintained well. Water distribution channels, pumping stations, and discharge metering devices are operated and monitored by the Ministry of

Agriculture field staff and provide reasonable control of the irrigation conditions and the water flows being used. Furthermore, the Ministry of Agriculture staff supervises the types of crops irrigated with reclaimed water and together with the Ministry of Public Health staff supervise the observance of regulations concerning the types of crops allowed and enforce precautionary measures prior to harvesting.

Legal and regulatory efforts are under way to implement agricultural land reforms: 1) to ensure that the individual irrigated plots reach their optimum size - especially when private properties within the irrigation area are too small to achieve a productive and suitable agricultural operation, and 2) to allow for effective control of irrigation practices with reclaimed wastewater.

Treated effluents are not disinfected in Tunisia, apart from the natural inactivation process taking place at stabilization ponds available at a few treatment plants. Microbiological quality of reclaimed wastewater is generally monitored in terms of the presence or absence of specific pathogenic organisms and helminths. Analyses for faecal indicator organisms, such as the coliform group of bacteria, are occasionally conducted. In general, the microbiological quality of reclaimed wastewater is not systematically checked and, thus, does not provide a sound basis for assessing either the microbial inactivation taking place during conventional wastewater treatment or the potential public health hazard of using reclaimed wastewater through irrigation. The limited number of field personnel and laboratory facilities, as expressed by officials from the Ministry of Public Health, accounts for the limited scope of microbiological monitoring of reclaimed wastewater. However, for prudent public health practice, an adequate disinfection step, such as that achieved by maturation ponds, is a necessary precaution prior to irrigation.

The field visits included several agricultural irrigation areas, where the efforts and expertise of the Ministry of Agriculture officials operating and maintaining the reclaimed wastewater reuse project were quite evident. Our visit included two golf courses irrigated exclusively with reclaimed wastewater; the golf course of El Kantaoui, in Sousse, was particularly impressive for the excellent condition of its greens and tees, after more than 10 years of irrigation with reclaimed wastewater. This golf course enjoys a large clientele of foreign visitors who apparently have become regular customers over the years. No public health incident has been reported among its players or visitors. The golf course is spray irrigated at night, once it is closed to the public. However, the presence of nearby home construction projects, some already completed and others being built, could become a potential public health problem in the near future. On-site disinfection facilities, such as chlorination systems, may become necessary for these situations.

Irrigation of restricted garden areas at nearby hotels has been considerably restricted in the last few years to minimize potential public health problems. Public health and agriculture officials felt that current irrigation procedures, even without disinfection, should pose no practical public health hazards to the tourist population in nearby hotels.

Finally, a visit was made to the experimental site of a soil-aquifer treatment project. The detailed discussions held with the project engineer indicated the extensive knowledge and experience gained through the project, including the practical difficulties encountered when setting quality priorities for current aquifer water and defining the treatment strategies best suited for the effective recharge and extraction of groundwater.

CONTROL OF WASTEWATER REUSE OPERATIONS

The current regulations governing acceptable uses of reclaimed wastewater for agricultural irrigation (Décret no. 89-1047 du 28 Juillet 1989, fixant les conditions d'utilisation des eaux usées traitées à des fins agricoles), the physico-chemical and microbiological standards for agriculture irrigation with reclaimed water (Norme Tunisienne 106.03, 1989), and the standards for wastewater disposal into receiving waters (Norme Tunisienne 106.002, 1989) provide an adequate framework for the operation and control of wastewater reclamation and reuse.

As emphasized by various officials, particularly those from the Ministry of Public Health, there is a need for better coordination among agencies and Ministries when implementing these regulatory provisions. It appears that a more collaborative approach, within the overall consensus of the benefits of irrigation with reclaimed wastewater, should greatly improve the planning, implementation and follow-up of wastewater reuse projects. Considering the different priorities of the various Ministries concerned, it seems necessary that one of the parties directly involved with agricultural irrigation should take a leading role in coordinating and enforcing regulatory compliance, while ensuring that other government agencies get due recognition for their efforts and contributions.

Wastewater reclamation and reuse is considered by Tunisian institutions to be an essential component of water resources management. Laws and regulations have been established to guide wastewater reuse implementation by agricultural irrigation. There is a positive and collaborative attitude among officials in the Ministries of Agriculture, Public Health, and Public Works. Such a commitment places Tunisia in an admirable position compared to other, more developed, countries in the Mediterranean region, where such a consensus is not generally reached, and no such level of institutional collaboration exists. However, as it has been indicated, there is still a need for better coordination among responsible agencies, particularly from the public health point of view.

THE COLLOQUIUM

Although our participation at the Colloquium was initially planned as moderators, our actual role was more as resource persons to guide and contribute to the discussions held by the participants. The presentations made by the different agency representatives clearly indicated the considerable experience they have gained on wastewater treatment, effects of irrigation on

plants and soils, soil-aquifer treatment, and monitoring and control of public health effects.

Dr. Takashi Asano made a comprehensive presentation on the planning and implementation of wastewater reuse projects, based upon the considerable experience gained in California and other states and countries. Dr. Rafael Mujeriego presented the major findings and preliminary recommendations derived from the official meetings and the field visits.

The discussions were well coordinated by government officials who had to limit the numerous and interesting discussions, due to time restrictions. The opening and closing addresses presented by the Ministers of Agriculture and Public Health respectively, were very relevant and in accord with all our observations throughout the official contacts held during the Mission.

The Colloquium produced a long series of specific conclusions and recommendations whose final text will be made available by the Tunisian Organizing Committee to all participants in the near future. The main conclusions and recommendations were: 1) to follow more closely applicable regulations, particularly those concerning the advisory role of public health officials, both during the planning phases and the operation of the irrigation projects, 2) to ensure better coordination and communication among responsible agencies, 3) to pursue current efforts in monitoring the quality of reclaimed water as well as the possible impact on the persons working and/or living within the irrigation areas, and 4) to implement quality control programs of physico-chemical and microbiological analyses to ensure that results obtained by different laboratories are reliable and comparable.

Concern was expressed about the potential damage that wastewater reuse may have on plants and soils due to accumulation of heavy metals, dissolved salts, refractory organic compounds and toxic substances. Frequent complaints were addressed to ONAS concerning reclaimed water quality at the irrigation sites, particularly due to the suspended solids concentration that impairs the operation of water pumps and water filtration equipment of drip irrigation systems. Transport of treated effluent through open channels results in a noticeable increase in suspended matter due to natural vegetation and the impact of surrounding fields. Obviously, an adequate maintenance of the water conveyance channels and the adoption of water pumps suitable for reclaimed water should minimize current difficulties. The fine screens currently installed ahead of the pumping wells have been effective in removing suspended materials, although they require frequent cleaning and periodic maintenance.

Public Health officials clearly pointed out their need for additional personnel and laboratory equipment to carry out the monitoring and control program necessary to protect public health. Although some officials described ambitious proposals for epidemiological studies among the populations exposed to reclaimed water within the irrigation area, the authors of this Mission Report believe that an effective disinfection of the effluents being used for irrigation, by using maturation ponds or high-rate ponds, could significantly improve the hygienic conditions of the population concerned. An effective disinfection of the effluents could also

eliminate the need for farmers to wear protection boots, that are quite cumbersome and inconvenient in the Tunisian climate and thus often ignored, and could simplify the factors to be considered in future epidemiological studies.

The discussions held during the Colloquium also pointed out the need to clarify some pertinent issues that seem to create conflicts between government agencies, farmers, political groups, and the public at large. One important issue was the perception that ONAS should be responsible for the particulate matter (suspended solids) present in reclaimed wastewater at the point of use for irrigation. The particulate matter gets into the water during its transport through open dirt channels and apparently has nothing to do with the good effluent quality provided by ONAS wastewater treatment plants, particularly in those with conventional activated sludge systems.

Another concern, perceived by some participants, was the potential damage that could be caused to crops and soils by the toxic substances and refractory organic compounds present in reclaimed wastewater. The effective source control program of industrial wastewater effluents implemented by ONAS, ANPE and other government agencies has resulted in municipal wastewater effluents with less than a 10% contribution of industrial flows. This source control program together with the effective secondary treatment levels provided by ONAS results in a reclaimed water quality that should pose no special danger to agricultural soils or the crops grown on them. A systematic follow-up study such as those conducted by the CRGR of the Ministry of Agriculture on salinity, nutrients, and other wastewater constituents should provide the necessary information to establish any corrective measures if they are needed.

Concern was also expressed about the results of and experience gained by the large scale application of soil-aquifer treatment. Although considerable experience was gained by project engineers on how to evaluate underground water quality improvement, during its migration through aquifers, discrepancies were expressed in the microbiological quality of the water extracted from the wells and the ultimate quality of the aquifers, after years of artificial recharge with reclaimed wastewater.

The final point of discussion was the degree of wastewater treatment required for wastewater reuse. Although the role of natural treatment systems, conventional treatment processes, and high-technology alternatives were clearly perceived within the national program of wastewater reclamation and reuse, there was an apparent misunderstanding among participants about the concept that each potential use of wastewater requires a specific set of water quality standards. As an illustration, the presence of algae in a pond effluent was of equal concern whether the effluent was going to be discharged into coastal waters or reused in agricultural irrigation. In fact, the presence of algae could be highly detrimental in a coastal water environment, but it could be beneficial when reusing the effluent for irrigation because algae become an additional source of natural fertilizer.

The potential public health impact associated with the use of reclaimed wastewater is essentially approached from the identification and enumeration of

pathogenic organisms. Monitoring of water quality is based on the detection of pathogenic microorganisms such as *Salmonella*, *Vibrio cholera*, and helminths. The results of those analyses are commonly expressed in terms of presence or absence of microorganisms. Considering the limitations of current laboratory methods for detecting helminths, and the qualitative nature of the results obtained, the information currently available is of little use in evaluating wastewater treatment efficiency or the public health implications of using such effluents for irrigation. The Mission repeatedly recommended to public health officials and ONAS wastewater treatment officials to conduct systematic analyses of total coliforms, faecal coliforms, and faecal streptococci in wastewater effluents as a means to evaluate the treatment efficiency; these analyses in combination with helminths analyses should be used to assess the potential public health consequences of using reclaimed wastewater for irrigation.

Implementation of effective disinfection for reclaimed wastewater effluents, such as maturation ponds or high-rate ponds, could reduce the public health risks of wastewater reuse. This would eliminate the need for extensive and complex epidemiological studies to assess the health status of populations using reclaimed wastewater for irrigation or living within the irrigation areas.

Both ONAS wastewater treatment plant operators and Ministry of Agriculture officials have considerable expertise and capabilities for monitoring the quality of reclaimed wastewater from the point of view of receiving water quality and irrigation water quality. Reports made available to us by ONAS clearly show the detailed evaluation they have conducted over the years on the treatment efficiency and the operation and maintenance requirements of their wastewater treatment plants. Furthermore, collaborative efforts with Tunisian universities have resulted in a basic treatment alternative for small municipalities that is based on a stabilization pond system as a first stage, and a conventional activated sludge process when higher flows are reached in the future.

As discussed with ONAS officials during the field visits, the parameters used for evaluating treatment efficiency should include those specific to the design and operation of wastewater reclamation facilities, in addition to those conventionally used for evaluating pollution loads. Furthermore, the list of physical and chemical parameters should be progressively extended to include those of specific interest when reusing wastewater for irrigation.

CONCLUSIONS AND RECOMMENDATIONS

From the official meetings and field visits conducted during this Program Mission, the following conclusions and recommendations are made:

1. There is a consensus among Tunisian institutions to consider wastewater reclamation and reuse as an essential component of water resources management. All administration officials are committed to a near 100% water reuse goal, although they are well aware of the limitations imposed by seasonal demands of irrigation water and the lack of storage facilities for reclaimed wastewater to meet peak demands. The economic

implications of wastewater reuse should be evaluated to ascertain the extent to which this alternative water resource would be affordable. In other words, it is necessary to define the economic optimum point for wastewater reuse in comparison to the development of other water resources.

2. Considerable knowledge and experience exists in Tunisia on wastewater reclamation and reuse, particularly for agricultural irrigation. The long time experience in some reuse projects, such as the 12 years of irrigation at a golf course in Sousse, and the considerable land surface being irrigated with reclaimed wastewater (reaching several thousand hectares) place Tunisia in a prominent and leading role in the field of wastewater reclamation and reuse among Mediterranean countries. The extensive studies carried out by the CRGR of the Ministry of Agriculture on the agricultural aspects of irrigation with reclaimed wastewater and fertilization with municipal sludge have also provided a sound basis for implementing large-scale irrigation projects with reclaimed wastewater. The knowledge and experience gained by the CRGR should provide excellent guidance in defining the different irrigation uses for reclaimed wastewater, the different quality requirements for different uses, the treatment levels best suited to each use, and the most adequate management options available for implementing current and proposed reuse projects.
3. The results and experience gained in Tunisia on wastewater reclamation and reuse still remain scattered among agencies and have not undergone a process of critical evaluation or wide publication. As a result, the information has had limited impact, particularly outside the country. Meetings like the Colloquium organized during this Mission should play a major role in integrating the different administrative points of view, identifying the practical difficulties encountered when implementing reuse projects, defining future research needs, and developing the necessary consensus among scientists, engineers, managers, and administrators on the necessity and the benefits of wastewater reclamation and reuse. Regular publication and distribution of information both nationally and internationally of the results obtained in wastewater reclamation and reuse projects would considerably increase the self-esteem of the Tunisian people involved and gain international recognition for the excellent progress achieved in this field in Tunisia.
4. Wastewater treatment facilities are operated efficiently and are well maintained. Similarly, agricultural irrigation projects using reclaimed wastewater have been well defined and implemented because of the considerable experience gathered by the CRGR and other agencies. However, successful implementation of reclaimed wastewater reuse projects requires a slightly different approach in the design, operation and management of wastewater treatment plants. For example, agricultural irrigation frequently requires water quality parameters different than those conventionally used for discharge into natural waters. Similarly, treatment reliability and flow regulation become important when providing an effluent to be used for agriculture production rather than for land disposal. In particular, disinfection of reclaimed wastewater by stabilization ponds or

high-rate ponds should be considered a clear alternative to: 1) current and proposed programs for monitoring and controlling of public health incidence among exposed populations, 2) public health education for farmers, and 3) promotion of environmental health. The systematic determination of total coliforms, faecal coliforms, and faecal streptococci, in conjunction with helminths and specific pathogenic microorganisms, could provide an excellent basis for evaluating both the treatment efficiencies and the potential public health impact of using reclaimed wastewater.

5. The considerable knowledge acquired in Tunisia through extensive research studies and varied field experiences is crucial to their own country as well as to North African and other Mediterranean countries because of the considerable progress that could be made on water resources management in arid and semi-arid zones. The Tunisian experiences in wastewater reuse in agriculture and landscape irrigation as well as in groundwater recharge are worthy of note and their excellent findings should be disseminated through seminars and publications to other countries.

Furthermore, to promote interagency coordination and to stimulate the research and development efforts and the implementation of wastewater reuse projects, the Mission strongly recommends the establishment of a *Center for Excellence on Wastewater Reuse* in Tunisia under UNDP-World Bank assistance for the Maghreb region and other Mediterranean countries based on the extensive experience Tunisia has gathered in wastewater treatment and wastewater reuse.

The specific objectives of the *Center for Excellence on Wastewater Reuse* would include: 1) the effective coordination of current and future wastewater reclamation and reuse projects, 2) the identification and promotion of new research studies, 3) the systematic analysis, discussion, publication, and distribution of the scientific knowledge and technical experience gained from those projects through the implementation of a comprehensive technology transfer program and 4) the publication of wastewater reclamation and reuse guidelines encompassing land use planning, agricultural aspects, irrigation methods, management of irrigation areas and protection of public health as applicable to the Maghreb region as well as other Mediterranean countries.

The proposed *Center* could be placed under the sponsorship of one of the leading institutions on wastewater reuse, such as the Ministry of Agriculture, or be set up as an independent body with strong central government control for coordination. Attention should be paid to keep the *Center* closely interrelated with all the agencies and institutions active in the field, so that the *Center* is viewed not as a competitor but as a means of coordinating and promoting all wastewater reuse activities. It is recommended that the *Center* be adequately funded with U.S. \$ 100000 per year for five years.

Annex A

Program of official meetings and field visits
conducted during this Mission

prepared by Dr. Akissa Bahri
Centre de Recherche du Génie Rural (CRGR)
Ministry of Agriculture of Tunisia

PROGRAMME DE LA MISSION DES EXPERTS

28 octobre - 2 novembre 1991

ASPECTS INSTITUTIONNELS ET ORGANISATIONNELS DE LA
REUTILISATION DES EAUX USEES TRAITEES

Première journée: le 28 octobre

8h30 : Entretien avec M. A. Horchani, Secrétaire d'Etat auprès du Minsitre de l'Agriculture, chargé des Ressources Hydrauliques, Ministère de l'Agriculture.

9h30 : Entretien avec M. F. Fokaladeh, Représentant Resident du PNUD.

10h30 : Entretien avec M. S. Cheniti, Directeur de l'Hygiène du Milieu et de la Protection de l'Environnement, Ministère de la Santé Publique.

11h30 : Entretien avec M. M. Mlika, Président Directeur Général de l'Office National de l'Assainissement.

12h30 : Entretien avec M. K. Dellagi, Directeur de l'Institut Pasteur et visite des laboratoires de bactériologie (M. Ben Aissa) et de parasitologie (Mme Kanou).

15h : Entretien avec M. A. Bouzaïdi, Directeur du Centre de Recherche du Génie Rural, visite des laboratoires du CRGR et entretien avec les chercheurs.

Deuxième journée: le 29 octobre

8h30 : Entretien avec M. A. Baouandi, Président Directeur Général de l'Agence Nationale de Protection de l'Environnement

10h : Point de rencontre ONAS-CRDA-SRHMA : station d'épuration de Choutrana

1. Présentation des stations d'épuration de Cherguia, de Choutrana et de la Côtère Nord par l'ONAS;

2. Présentation des périmètres de la Soukra et de la Cébala par le CRDA de l'Ariana;

3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu de l'Ariana.

11h : Tournée dans les périmètres de Soukra et de Cébala

13h30 : Déjeuner à Tunis

15h : Point de rencontre ONAS-CRDA-SRHMA : station d'épuration de Sud Méliane

1. Présentation de la station d'épuration de Sud Méliane par l'ONAS;
2. Présentation du périmètre de Mornag par le CRDA de Ben Arous;
3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu et de l'Assainissement de Ben Arous.

16h : Tournée dans le périmètre de Mornag.

Troisième journée: le 30 octobre

9h : Point de rencontre ONAS-CRDA-SRHMA : Golf de Hammamet

1. Présentation des stations d'épuration de SE1 et SE4 par l'ONAS
2. Présentation des périmètres irrigués avec les eaux usées traitées (golf, oued Souhil....) par le CRDA de Nabeul;
3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu et de l'Assainissement de Nabeul.

10h : Visite du golf, du périmètre de Oued Souhil, des bassins de recharge artificielle de la nappe avec les eaux usées traitées et de la station d'épuration SE4;

12h: Déjeuner

15h30 : Point de rencontre ONAS-CRDA-SRHMA : station d'épuration de Sousse Nord

1. Présentation de la station d'épuration de Sousse Nord par l'ONAS;
2. Présentation des périmètres irrigués avec les eaux usées traitées (golf, ...) par le CRDA de Sousse;
3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu et de l'Assainissement de Sousse.

16h30 : Visite du terrain de golf

Quatrième journée: le 31 octobre

9h : Point de rencontre ONAS-CRDA-SRHMA : station d'épuration de Sousse Sud

1. Présentation de la station d'épuration de Sousse Sud par l'ONAS;
2. Présentation du périmètre irrigué avec les eaux usées traitées de Zaouiet Sousse par le CRDA de Sousse;

3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu et de l'Assainissement de Sousse.

10h : Visite du périmètre irrigué de Zaouiet Sousse

13h: Déjeuner à Monastir

15h: Point de rencontre ONAS-CRDA-SRHMA : station d'épuration de Monastir

1. Présentation de la station d'épuration de Monastir par l'ONAS:

2. Présentation des périmètres irrigués avec les eaux usées traitées par le CRDA de Sousse (Société d'Élevage de Monastir....):

3. Présentation des contrôles effectués par le Service Régional de l'Hygiène du Milieu et de l'Assainissement de Monastir.

16h: Visite de la Société d'Élevage de Monastir

17h: Retour sur Tunis

Cinquième et sixième journées: le 1 et 2 novembre: Colloque

Annex B

Program for the Colloquium on
the Institutional and Organizational Aspects
of Reclaimed Wastewater Reuse

held in Tunis, 1 and 2 November 1991

REPUBLIQUE TUNISIENNE
MINISTERE DE L'AGRICULTURE

PNUD - BANQUE MONDIALE



COLLOQUE



LES ASPECTS INSTITUTIONNELS ET ORGANISATIONNELS DE LA REUTILISATION DES EAUX USEES TRAITÉES

Le 1^{er} et 2 Novembre 1991

PREMIERE JOURNEE : 1er Novembre 1991

- 8h30 - 9h00 : Inscriptions
- 9h00 : **Ouverture du colloque par Monsieur Mouldi Zouaoui, Ministre de l'Agriculture**
 Allocution de M. F. FOKALADEH, Représentant Résident du PNUD
- 10h00 - 10h30 : Pause café
- 10h30 - 10h45 : Orientations et stratégie de l'ONAS en matière de réutilisation des eaux usées,
 par M. M. MLIKA, Président Directeur Général de l'ONAS.
- 10h45 - 11h00 : Orientations et stratégie de l'ANPE en matière de réutilisation des eaux usées,
 par M. A. BAOUENDI, Président Directeur Général de l'ANPE.
- 11h00 - 11h15 : Orientations et stratégie de la Direction de l'Hygiène du Milieu et de la Protection de l'Environnement en matière de réutilisation des eaux usées,
 par M. S. CHENITI, Directeur de la DHMPE.

Première séance :

- Président : M. A. HAMDANE, DGGR
 Rapporteur : Mme F. MEZHOUD, ANPE
 Thème : **Aspects liés à la normalisation.**

- 11h15 - 11h45 : Contribution de l'ONAS, Ministère de l'Equipement,
 par M. E. EL BECH
- 11h45 - 12h15 : Contribution de CRGR, Ministère de l'Agriculture,
 par Mme A. BAHRI
- 12h15 - 12h45 : Contribution de la DGRE, Ministère de l'Agriculture,
 par M. M. REKAYA
- 13h00 - 14h30 : Déjeuner

Deuxième séance :

- Président : M. A. BAOUENDI, ANPE
 Rapporteur : Mme M. TRAD - RAIS, CRGR
 Thème : **Aspects de contrôle et d'évaluation.**
- 14h30 - 15h00 : Contribution de l'ANPE, Ministère de l'Environnement et de l'Aménagement du Territoire,
 par M. A. HENTATI
- 15h00 - 15h30 : Contribution de la DHMPE, Ministère de la Santé Publique
 par M. S. CHENITI
- 15h30 - 16h00 : Pause café
- 16h00 - 17h00 : Débat

DEUXIEME JOURNEE : 2 Novembre 1991**Troisième séance :**

Président : M. S. CHENITI, DHMPE
Rapporteur : Mme R. BOUTITI, DGGR
Thème : **Application des textes en vigueur.**

9h00 - 11h00 : Rapports régionaux
CRDA - SRHMA Ariana
CRDA - SRHMA Nabeul
CRDA - SRHMA Sousse
CRDA Sfax
CRDA Ben Arous

11h00 - 11h15 : Vulgarisation, AVFA, Ministère de l'Agriculture,
par M. H. LAHMARI

11h15 - 11h45 : Pause café

Thème : Expérience internationale

11h45 - 13h00 : Contribution de M. T. ASANO et R. MUJERIEGO,
PNUD / Banque Mondiale
Discussion

13h00 - 14h00 : Déjeuner

Quatrième séance :

Président : M. E. BECH, ONAS
Rapporteur : M. KETAT, DHMPE

14h30 - 16h00 : Lecture et mise en forme des recommandations
Pause café

16h00 : **Clôture du colloque par Monsieur Dali Jazi,
Ministre de la Santé Publique**

