



## EXISTING SITUATION, PLANS AND POLICIES FOR THE WASTEWATER REUSE IN AGRICULTURE IN CYPRUS, JORDAN AND PALESTINE

**D. Fatta<sup>1</sup>, I. Skoula<sup>2</sup>, C. Moustakas<sup>2</sup>, A. Mentzis<sup>2</sup>, A. Papadopoulos<sup>2</sup>, M. Loizidou<sup>2</sup>, Z. Salem<sup>3</sup>, K. Hameed<sup>4</sup>**

<sup>1</sup>Πανεπιστήμιο Κύπρου, Τμήμα Πολιτικών Μηχανικών και Μηχανικών Περιβάλλοντος, Καλλιπόλεως 75, 1678 Λευκωσία, Κύπρος, Email: [dfatta@ucy.ac.cy](mailto:dfatta@ucy.ac.cy), <sup>2</sup>Εθνικό Μετσόβιο Πολυτεχνείο, Σχολή Χημικών Μηχανικών, <sup>3</sup>Jordan University of Science and Technology, Department of Applied Biological Sciences, <sup>4</sup>The Palestinian Environmental Quality Authority

### ABSTRACT

The North African and Middle East Countries are characterized by the lowest per capita amount of water supply in the world, unequally distributed in space and time. Demands for water are high. Two-thirds of Mediterranean countries currently use over 500 m<sup>3</sup> per year per inhabitant – mainly because of heavy water use of irrigation. In many situations, especially in arid and semi-arid areas, wastewater is simply too valuable to waste. It can be profitably reused to grow crops. But first the wastewater should be treated to acceptable levels in order not to threaten environment and human health. In this paper the existing situation, in relation to water resources availability, wastewater treatment and reuse, in three Med countries, is analysed.

## ΥΦΙΣΤΑΜΕΝΗ ΚΑΤΑΣΤΑΣΗ ΚΑΙ ΠΟΛΙΤΙΚΕΣ ΓΙΑ ΤΗΝ ΕΠΑΝΑΧΡΗΣΙΜΟΠΟΙΗΣΗ ΤΩΝ ΛΥΜΑΤΩΝ ΣΤΗ ΓΕΩΡΓΙΑ ΣΤΗΝ ΚΥΠΡΟ, ΤΗΝ ΙΟΡΔΑΝΙΑ ΚΑΙ ΤΗΝ ΠΑΛΑΙΣΤΙΝΗ

**Δ. Φάττα<sup>1</sup>, Ε. Σκουλά<sup>2</sup>, Κ. Μουστάκας<sup>2</sup>, Α. Μέντζης<sup>2</sup>, Α. Παπαδόπουλος<sup>2</sup>, Μ. Λοϊζίδου<sup>2</sup>, Ζ. Σαλέμ<sup>3</sup>, Κ. Χάμεντ<sup>4</sup>**

<sup>1</sup>Πανεπιστήμιο Κύπρου, Τμήμα Πολιτικών Μηχανικών και Μηχανικών Περιβάλλοντος, Καλλιπόλεως 75, 1678 Λευκωσία, Κύπρος, Email: [dfatta@ucy.ac.cy](mailto:dfatta@ucy.ac.cy), <sup>2</sup>Εθνικό Μετσόβιο Πολυτεχνείο, Σχολή Χημικών Μηχανικών, <sup>3</sup>Jordan University of Science and Technology, Department of Applied Biological Sciences, <sup>4</sup>The Palestinian Environmental Quality Authority

### ΠΕΡΙΛΗΨΗ

Οι χώρες της Βορείου Αφρικής και Μέσης Ανατολής χαρακτηρίζονται από τη χαμηλότερη κατά κεφαλήν ποσότητα διαθέσιμου νερού παγκοσμίως, άνισα κατανομημένο χωρικά και χρονικά. Η ζήτηση του νερού είναι μεγάλη. Τα δύο τρίτα των Μεσογειακών χωρών καταναλώνουν 500 m<sup>3</sup> κατά κεφαλήν και ανά χρόνο- κυρίως λόγω της χρήσης στη γεωργία. Σε πολλές περιπτώσεις, ειδικά στις περιοχές με μεγάλη ξηρασία, τα λύματα είναι πολύ πολύτιμα για να θεωρούνται απόβλητα. Μπορούν να επαναχρησιμοποιηθούν στη γεωργία με αποτέλεσμα την εξοικονόμηση νερού. Προϋπόθεση αποτελεί η επεξεργασία τους ούτως ώστε να μην απειλείται η ανθρώπινη υγεία και το περιβάλλον. Η εργασία αυτή παρουσιάζει την υφιστάμενη κατάσταση αναφορικά με τη διαχείριση του νερού και των λυμάτων σε τρεις Μεσογειακές Χώρες.

## 1. INTRODUCTION

In many North African and Middle East countries, it has become ever more difficult to meet the water demand. The frequent years of drought and the constant increase of water demand for the civil sector have made irrigation supply more problematic. Wastewater reuse could represent a viable solution to meet water demand.

The total population of the Mediterranean countries in 2000 reached 427 million people. It was 285 million in 1970, presenting an increase of 142 million, or 50%, in thirty years. The latest projected demographic figures, estimated in the Blue Plan, estimate the population at 523.5 million by 2025, which demonstrates a certain decrease in the population growth rate with a little under 97 million (or 22,5% increase) additional inhabitants in 25 years, [1]. Presently the average rate of urbanisation is at 64.3 per cent, while it is expected to reach 72.4 per cent by 2025. This rise is mostly due to the urban growth in the southern and eastern countries. In absolute terms the urban population of all Mediterranean countries - 274.5 million in 2000 - will reach 379 million by 2025. In the same period, there will be 104.5 million additional urban dwellers, of which more than 98 million will reside in the South and East.

In general, Mediterranean countries are currently undergoing intensive demographic, social, cultural, economic and environmental changes and hence the resources consumption and the consequent environmental effects are constantly changing.

## 2. THE WATER PROFILE OF CYPRUS, JORDAN AND PALESTINE

Table 1 provides information on the water resources available and the water demand for the countries under examination. From this information it is clear that in some countries like for example Cyprus, Palestine and Jordan water shortage is already a fact. More information on the status in each of the countries examined is provided below.

**TABLE 1: Water Resources Available and Water Demand, [2]**

<b>Country</b>	<b>Water resources available (surface, groundwater) MCM<sup>1</sup>/yr</b>	<b>Water demand MCM/yr</b>	<b>Water Demand / Water Resources Available<sup>2</sup></b>
Cyprus	300	265.9	0.89
Jordan	780	810	1.04
Palestine	295	354	1.2

<sup>1</sup>MCM: million of cubic meters, <sup>2</sup>Surface plus groundwater resources

### 2.1 Cyprus

Cyprus is the largest island in the Eastern Mediterranean with an area of 9 251 km<sup>2</sup>. The area of the country currently under governmental control, to which this country profile and the accompanying information refer, is about 5807 km<sup>2</sup>. The total population is 689 565 (Census 2001), with an annual growth of 1.45 %, [3]. The share of agriculture accounts for around 3.7 % of the GDP for 2001 and varies according to the weather conditions, ie. rainfall. For the area under control of the government with a tourist inflow of around 2.4 millions a year and population around 700 000 the domestic, industrial and commercial consumption of water is estimated at 67 MCM per year, where the irrigation water is around 175 MCM per year, [4]. The first large sewage treatment plant, in the Government controlled areas, started its operation in Lemesos in the summer of 1995. The total number of the main UWTPs currently in operation in Cyprus is 25. Apart from these treatment plants, which serve the big cities some municipalities and rural communities, there are also some smaller UWTPs, (around 175) located in hotels, military bases and hospitals. Table 2 shows the quantities of the wastewater that are treated and the quantities that are being reuse. It is estimated

that by the year 2012 an amount of approx. 30 million m<sup>3</sup>/yr of treated sewage effluent will be available for agriculture and landscape irrigation, [2]. Some problems concerning the reuse of water are the following:

- The demand for water exists only during the summer, thus the Sewerage Boards face problems with the storage and disposal of water during winter.
- There is no systematic monitoring of the water use: as a result in some cases the recycled water irrespective of its analysis, is used for irrigation of crops including leafy vegetables.
- There is a problem of disposal of treated water at the smaller UWTPs of villages. The farmers in these areas refuse to irrigate with the recycled water their cultivations, due mainly to physiological reasons. The problem is aggravated due to the fact that these treatment plants are located in the mountain area of the island.

**TABLE 2: Treated Urban Wastewater Produced and Reused, [2]**

<b>Country</b>	<b>Treated wastewater produced MCM/yr</b>	<b>Wastewater reused MCM/yr</b>	<b>Treated Wastewater Reused / Treated Wastewater Produced</b>
Cyprus	20	5	0.25
Jordan	73	73	1
Palestine	30	5.44	0.18

The Water Development Department is responsible for implementing the water policy of the Ministry of Agricultural, Natural Resources and Environment with primary objective to develop the national management scheme for the water resources of Cyprus. As treated wastewater is part of the water resources, the Government appointed the Water Development Department as the responsible body for the tertiary wastewater treatment, as well as the allocation and distribution of the treated wastewater to agriculture. The Department of Agriculture, which also belongs to Ministry of Agriculture, Natural Resources and Environment, is responsible for the education of farmers in all matters related to agricultural production, including the use of treated wastewater. The selection of crop and the irrigation system to be used, as well as the preparation of irrigation schedules are amongst the responsibilities of the Department. The follow up of the guidelines and the code of practice is also responsibility of the Department of Agriculture. The sewerage boards are public sector organizations, which have the responsibility of the concentration, operation and maintenance of the main sewers system including the pipes, the pumping stations and the treatment plants. Its main target is to produce treated effluent, which can be used for irrigation purposes. The sewerage boards treat the wastewater up to secondary level and the tertiary treatment is undertaken by the Government. The boards are under the control of the Ministry of the Interior and their president is the Mayor of the city. The Ministry of the Interior and the Water Boards are responsible for the administration at the consumers' level and the distribution of domestic water. At present there are plans by the Government to reorganize the institutional set-ups of the water sector through the establishment of a water entity to undertake full responsibility of the management of all water resources responsible for all the water cycle.

## **2.2 Jordan**

Jordan with a total area of approximately 89 210 km<sup>2</sup>, lies to the east of the Jordan River. The total population is around 5 million of which 29% is rural. The population growth is estimated at 3.45%. Over 90% of the country receives less than 200 mm of rainfall per year, [5]. Agriculture fluctuates around 2 % of Jordan's GDP. The level of Dead Sea falls each year by 85 centimeters due to extensive water use in the Jordan basin. Irrigated soils along the Jordan valley show signs of salinization since natural floods are no longer available to flush the irrigated land and leach salts. One of the water resources, which need to be made available for irrigation purposes, is recycled water from municipal wastewater treatment plants. The total quantity of reused treated wastewater

was around 50 million m<sup>3</sup> in the 90s, 73 million m<sup>3</sup> in 2000 and is expected to grow up to 237 million m<sup>3</sup> in 2020, [6, 7]. Table 2 gives information on the wastewater produced and reused. Treated wastewater will be a main water supply resource to agricultural sector in coming years in Jordan. Jordan already uses some quantities of the wastewater generated in the country for agricultural purposes, but there are plans to further expand it, since demand for fresh water in cities is increasing in relation with the growing urban sector. Improper treatment of wastewater not only prevents efficient use in agriculture, but actually endangers the health of people. Therefore, the need for efficient control and monitoring of wastewater treatment and reuse is of vital importance. Wastewater collection, transportation, treatment, disposal and reuse receive the greatest concern by the health authorities in the Ministry of Health (MOH). The MOH realizes that the protection and promotion of human health cannot be guaranteed and safeguarded without monitoring wastewater treatment and controlling its use. Other responsible bodies are the Water Authority of Jordan, the Ministry of Environment, The Ministry of Agriculture and the National Center of Agricultural Research and Technology Transfer, the Ministry of Industry, and the Jordan Institution of Standards and Metrology.

### **2.3 Palestine**

Palestine is located in the transitional zone between the arid desert climate of the Sinai Peninsula and the temperate and the semi humid Mediterranean climate and occupies an area of 6 020 km<sup>2</sup>. The broad population characteristics of Palestine are strongly influenced by political developments, which have played a significant role in the growth and distribution of population in the Governorates. Until recently, the available demographic statistics about the Palestinian Territory have been characterized by the multiplicity and variation of its sources. After succeeding in executing the first Palestinian Census, highly accurate demographic data about the Palestinian Territory became available. According to the Palestinian Central Bureau of Statistics (PCBS) in 2002, Palestine had a total population of 3 549 524 living in the two geographical areas, 64% in the West Bank including Jerusalem and 36% in Gaza Strip, [8]. This level is expected to reach 4,938,264 by the year 2010 assuming an average growth rate of (4.83-3.5) percent for the years (2000-2010), which is high above the world average of 1.5 percent. The growing population strains natural resources and the assimilative capacity of the environment. The situation of the sewerage system is extremely critical. Both the West Bank and Gaza are facing a series of wastewater and sanitation related problems. These are: large scale discharge of untreated wastewater, leaking of collected wastewater from sewer systems and cesspits, water treatment plants that are badly functioning and uncontrolled reuse of untreated wastewater by the irrigation sector. The total annual wastewater production in the area is estimated to be about 30 MCM, [9]. There is a strong need for appropriate management, for establishing sanitation infrastructures in rural communities and effective wastewater treatment plants and for promotion of sustainable practices for the protection of environment and public health. The institutes/organizations that are active in the field under examination are The Palestinian Water Authority, the Ministry of Planning, the Environmental Quality Authority, the Ministry of Agriculture, the Ministry of Local Government, the The Municipalities and the Village Councils, the Ministry of Health and the Coastal Municipal Water Utility.

## **3. PLANS AND POLICIES FOR THE FUTURE**

### **3.1 Cyprus**

In Cyprus the water shortage problem was identified and dealt in time. The slogan, *Not a Drop of Water to the Sea*, determines the water policy of the Government. In Cyprus, demand for water is expected to increase in the forthcoming years, while at the same time the capabilities for developing new water resources will be lessened. Therefore, in order to satisfy the increasing water demand

and to eliminate the dependency of the towns and tourist centers on rainfall the Government has decided to proceed with the construction of seawater desalination plants. At the same time the Government has turned its attention to other non-conventional sources such as the use of recycled water for irrigation, recharge and amenity purposes, the desalting of brackish water, the changing of the cropping pattern to less water demanding crops, the introduction of new effective management procedures through the establishment of a Water Entity, the efficient use of available water including the better use of pricing and water conservation measures and the preservation of the water quality. Table 3 presents the guidelines for domestic treated effluents use for irrigation applied in Cyprus.

**TABLE 3:** Cyprus guidelines for domestic treated effluents use for irrigation, [2]

Irrigation of	BOD mg/L	SS mg/L	Faecal coli-forms/100ml	Infestinal worms/L
All crops (a)	(A) 10*	10*	5* 15**	Nil
Amenity areas of unlimited access and vegetables eaten cooked (b)	(A) 10* 15**	10* 15**	50* 100**	Nil
Crops for human consumption. Amenity areas of limited access.	(A) 20* 30*	30* 45**	200* 1000*	Nil
	(B)		200* 1000*	Nil
Fodder crops	(A) 20* 30**	30* 45**	1000* 5000**	Nil
	(B)		5000*	Nil
Industrial crops	(A) 50* 70**		3000* 10000**	Nil
	(B)		3000* 10000**	

A Mechanised methods of treatment (activated sludge e.t.c.)

B Stabilization ponds

\* These values must not be exceeded in 80% of samples per month (Min. number of samples = 5).

\*\* Maximum value allowed

(a) Irrigation of leafy vegetables, bulbs and corms eaten uncooked is not allowed

(b) Potatoes, beetroots, colocasia.

Note: No substances accumulating in the edible parts of crops and proved to be toxic to humans or animals are allowed in effluent.

However, the implementation of short or long term projects will not solve the water shortage problem of Cyprus, unless everybody realises that water is a scarce resource and that all people have the responsibility and obligation to manage it correctly and to make every possible effort for its correct use and conservation. Undoubtedly water scarcity is the biggest and most difficult problem Cyprus is facing besides the political problem. There is no recipe for a permanent solution of the water problem of Cyprus. However, the long-term rational policy that has been followed has alleviated the problem and created all the necessary conditions for facing any future periods of drought. This project falls within the overall approach of the Ministry of Agriculture, Natural Resources and Environment for the protection of water resources, the control and monitoring of treatment plants and the utilization of the treated effluent in irrigation. Various projects are now under development which concern the improvement of agricultural practices, research on the potential use of treated sewage in agriculture and establishment of criteria on water requirements in agriculture.

It is apparent, by a simple comparison of the supply and demand, that the current water situation is not sustainable. The recent droughts of 1989/91 and 1995/2000 demonstrate quite convincingly how critical the water situation may become. A new water policy is warranted that will bring about sustainability. The new water policy should include the following specific measures, which should be holistically applied.

- Secure additional sources of supply
- Ensure efficient use of available water
- Modify the current irrigation water allocation matrix
- Built up strategic water reserves
- Maintain and enhance the quality of the water
- Introduce new effective/efficient management procedures through the establishment of a Water Entity

### 3.2 Jordan

In Jordan treated wastewater from urban areas will play a key role in supplying the agricultural sector with water. This is one of the main research activities of the Water and Environment Research and Study Centre of Jordan. The urban sector is growing gradually and more wastewater is being generated. Numerous projects are undertaken concerning the construction and operation of wastewater treatment plants and sewer systems by the Ministry of Planning in various areas such as Zarqa, Qwaismeh, Yajooz/Jubaih wastewater project, the Yajooz/Alrashid wastewater project, Baqa, Irbid, Wadi Mussa, Wadi Hassan, etc. The tools and methodologies that will be developed in this project will help the authorities to have continuous control and monitoring of all these treatment plants. In order to increase the use of treated wastewater in Jordan, decentralised wastewater treatment plants are also needed. It is the aim of the country to intensify agriculture in the vicinity of the treatment plants. Nevertheless, no matter how the reclaimed water is allocated the interrelated actions needed to support the use of reclaimed water can be listed in approximate order of priority according to the Ministry of Water and Irrigation:

- Support the farmers to improve on-farm water management, especially to deal with water quality issues. This needs a major integrated extension and applied research effort
- Enhance management of information, especially in terms of water quality, and make it available to farmers. Regular monitoring and reporting of soil and crop health needs to be introduced
- Control secondary faecal contamination sources in the basin
- Enhance the Jordanian standards and guidelines for water reuse
- Control hazardous discharges to sewers and wadis more vigorously

According to the Jordanian standard, it is not allowed to:

- Discharge any raw sewage into the environment.
- Irrigate crops, which are eaten raw with treated effluent regardless of its quality.
- Irrigate crops that are eaten cooked unless the faecal coliforms are less than 1000 /100 ml and the nematode eggs count is less than 1/liter, [2].

An ongoing project that is currently taking place at national level is the evaluation of long term impacts of reclaimed effluent reuse for irrigation in the Jordan Valley.

### 3.3 Palestine

Depletion of water resources and deterioration of water quality in both West Bank and Gaza are very important environmental themes that require direct and urgent measures. The lack of sufficient wastewater management is one of the largest causes of these problems. Groundwater resources are rapidly deteriorating by infiltration of untreated wastewater, influencing directly the quality and availability of this scarce and essential resource. Moreover, lack of wastewater management has a direct impact on human health, marine pollution, and deterioration of nature and biodiversity as well as landscape and aesthetic distortion. The highest priority in the Environmental Strategy Plan is given to setting up an effective wastewater management system in both West Bank and Gaza. This includes:

- Maximization of collection of wastewater
- Upgrading the existing wastewater collection systems.
- Rehabilitation or upgrading of existing wastewater treatment plants or the construction of new treatment plants
- Establishment of proper standards for influent and effluent wastewater quality
- Establishment of a system in which the cost of investment and operation of the wastewater management systems are recovered.

Also, priority is given to the water resources management like for example reuse of treated wastewater for agricultural purposes, prevention of reuse of untreated wastewater, establishment of wastewater treatment standards in relation to allowed reuse by the irrigation sector. Table 4 presents the standards for restricted and unrestricted wastewater reuse in Palestine.

**TABLE 4:** Standards for wastewater reuse for restricted irrigation, [10]

Parameter	Unit	Max. Value	Parameter	Unit	Max. Value
Temperature	°C	25	Ammonium (NH <sub>4</sub> )	mg/ L	---
pH	pH units	6 - 9	Mercury	mg/ L	0,001
Colour		Absence	Lead	mg/ L	1
BOD <sub>5</sub>	mg O <sub>2</sub> / L	45	Cadmium	mg/ L	0,02
COD	mg/ L	150	Arsenic	mg/ L	0,02
Dissolved Oxygen	mg/ L	> 0.5	Total Chromium	mg/ L	0,5
Dry residues at 150°C	mg/ L	1800	Copper	mg/ L	0.2
Suspended solids	mg/ L	40	Nickel	mg/ L	0,2
Turbidity	NTU	50	Iron	mg/ L	5.0
Sulphates	mg/ L	1	Manganese	mg/ L	0.2
Oil & grease	mg/ L	5	Zinc	mg/ L	2
Petroleum hydrocarbons	mg/ L	0,5	Silver	mg/ L	0,1
Phosphates (PO <sub>4</sub> )	mg/ L	30	Barium	mg/ L	2
Nitrates (NO <sub>3</sub> )	mg/ L	50	Cobalt	mg/ L	1
Phenols	mg/ L	0.002	Total pesticides	mg/ L	0,2
Fluorides	mg/ L	1,5	Cyanides	mg/ L	0,05
Boron	mg/L	0.7	Pathogens		Absent
Aluminium	mg/ L	5	Total coliforms	colony/ 100 ml	1000

Ongoing projects concern the construction of sewer networks and wastewater treatment plants. The Palestinian Water Authority (PWA) has considered the following three principal objectives for sustainable water resources management:

- Provide quantity and quality of water for domestic purposes in compliance with WHO standards.
- Supply adequate quality and sufficient quantity of water that is required for the planned agricultural production in Gaza Strip.
- Managing the aquifer at its safe yield and preventing further deterioration of the aquifer water quality.

Successful implementation of those issues will allow the maintenance of the water balance and the prevention of further deterioration of the aquifer. In parallel, clear and precise legislation and strict water sector implementation policies are mandatory for successful implementation.

#### 4. CONCLUSIONS

In the Mediterranean countries, wastewater, at different level of treatment (raw, secondary or tertiary) is used alone or mixed with fresh water, mostly on forage and cereals but also sometimes on fruit trees and even vegetables, depending on national legislation and its enforcement. Concern for human health and the environment are the most important constraints in the reuse of wastewater. In several cases the wastewater is not properly treated due to the fact that the construction cost of efficient treatment systems is very high, especially for small and medium size communities. Of course many alternative solutions have been developed with the scientific and technological progress during the last years. However, the selection of the appropriate treatment technique that is tailored to the needs of each community means in several cases the involvement of qualified specialists. Moreover, in several cases the outflow of the wastewater treatment systems does not have a standard quality because either standard operating procedures are not followed, or there is no qualified personnel able to overcome usual problems and to control/monitor the whole treatment procedure. A serious problem that can create significant obstacles in the safe reuse of the treated wastewater in agriculture is the lack of information of all the involved actors.

The first step towards the improvement of lack of water is the recognition by local officials that water is a limited resource that has to be well managed. Integrate wastewater reuse practices is essential, the governments must plan and promote projects that involve non-conventional water resources, but also provide the necessary resources to make these projects possible. There is certain concern among population about safety and quality of treated water. To achieve public acceptance it is necessary to inform and educate them about the goodness and advantage of using reclaim water.

Therefore, the transfer of knowledge, experience and know-how in the Mediterranean countries will be mostly valuable. More work has to be carried out in relation to the aforementioned problems. Effective technologies and safe practices must be promoted while at the same time education and awareness campaigns must be launched.

#### REFERENCES

1. I. Attané and Y. Courbage, (2001) '**La démographie en Méditerranée. Situation et projections**', Plan Bleu, Paris.
2. MEDAWARE Report, (2003). **Development of tools and guidelines for the promotion of the sustainable urban wastewater treatment and reuse in the agricultural production in the Mediterranean basin**, Task 1: Determination of the Countries Profile. European Commission, Euro-Mediterranean Partnership, <http://147.102.83.100/projects/meda/current%20status/reports/reports-task1.htm>
3. Department of Statistics and Research (2001), 'Census of Population 2001', Ministry of Finance Report, [www.mof.gov.cy/cystat](http://www.mof.gov.cy/cystat).

4. “Re-Assessment of the Water Resources and Demand of the Island of Cyprus: The Assessment of water demand of Cyprus” Water Development Department and Food, Agriculture Organisation, TCP/CYP/8921, Nicosia, Cyprus, October 2001.
5. Aquastat, <http://www.fao.org/waicent/search/default.asp>
6. Ministry of Water and Irrigation (1998), ‘Irrigation Water Policy’.
7. Ministry of Water and Irrigation (1998), ‘Wastewater Water Management Policy’.
8. Palestinian Central Bureau of Statistic (2001), ‘Agricultural Statistics Various Data’.
9. Al-Sa`ed R. (2000), ‘Wastewater Management for Small Communities in Palestine’, Proceedings of the 1st Scientific Meeting at Hebron Polytechnic University, Hebron, West Bank, Palestine.
10. EQA (2001), **Environmental standards for drinking water, wastewater reuse and industrial wastewater discharged to the sewer System**, Environmental Quality Authority, Gaza, Palestine.