WASTEWATER REUSE PRACTICES IN MEDITERRANEAN AND MIDDLE EASTERN REGIONS

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INTRODUCTION

During the last decade within the framework of International Drinking Water Supply and Sanitation Decade (IDWSSD), numerous non-conventional water resources management activities have been promoted in order to meet the ever increasing water supply demand, and water reuse is one of them. Even though the concept of wastewater reuse is not a new technological breakthrough for the mankind, its interest is quite new, and lately it is increasing in popularity in the semi-arid and arid countries. In this part of the world, reclaimed domestic wastewater, specially for irrigation has been considered as an economically as well as environmentally sound method of water resources management.

In general wastewater reuse can be classified into two broad categories, namely : indirect and direct reuse.

Indirect Reuse: This mode is practiced in many countries for centuries, even for millennia in some others. Here the used wastewater is discharged with or without treatment into the fresh surface water courses or into the underground aquifers and withdrawn at downstream in its diluted form. In this unplanned reuse method, health and environmental effects are not given adequate attention, which eventually result in frequent outbreak of health hazards.

Direct Use: Here the end use of the wastewater is always distinctly defined, and it serves for beneficial purposes. In contrast to unplanned reuse, in this method the health and environmental effects are given predominant role and wastewater is applied only to the controlled and monitored environment.

Accelerated urbanization and industrialization among the Mediterranean and Middle Eastern nations have manifested extreme pressure on existing limited and venerable water resources. Meanwhile agricultural activities are also geared to feed the ever increasing population. These ambitious development activities tend to siphon off more and more water. Thus, often water demand exceeds reliable and exploitable water resources. This situation is the root cause to spur special interest in effluent reuse.

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In parallel with these development programmes, lately many nations began to paying more emphasis on environmental protection, thus resulting in the establishment of stringent effluent standards. Therefore polluters recently have made substantial investments on new waste treatment technologies to meet the necessary high quality effluent. The availability of this constant volume of high quality effluent, throughout the year further boosts the effluent reuse, which is the situation in many of the oil rich Middle Eastern nations.

The context of reclaimed water use encompasses a wide spectrum of activities such as agriculture, industry, groundwater recharge, potable water supply, etc. Each of this method is associated with different health and environmental risks, and they are summarized in Table 1. Now in most of the semi-arid and arid countries, wastewater reuse activities are predominantly concentrated on the agricultural sector.

Until beginning of the last decade, many countries have been using either untreated or partially treated domestic wastewater for agricultural activities. Today, these nations were very well aware of the possible health risks and the environmental degradations associated with such uncontrolled water reuse practices. Meanwhile it is interesting to note that, in these regions being conscious of the financial gains of the wastewater reuse projects, greater number of controlled projects are being implemented as an alternative to exploration of new water resources.

In spite of the fact that wastewater is widely practiced in these regions, at this moment no nation has mastered this technique which denoted great potential.

STATUS AND PROSPECTS OF WASTEWATER REUSE ACTIVITIES AMONG THE MEDITERRANEAN AND MIDDLE EASTERN NATIONS

MOROCCO

The major part of Morocco is influenced by arid or semi-arid climatic conditions. Being geographically situated in between Atlantic ocean and the Saharan desert, it experiences very fable and irregular rainfall.

In spite of the nation's increasing interest in mineral industries and tourism, today agricultural remains as the primary national activity, and it keeps progressing. This top geared agricultural development invariably augments water demand. However, like many other North African countries, Morocco's natural water resources are confined mainly to groundwater.

Table 1 : Health and Environmental Risks Associated with Different Modes of Wastewater Reuse

Wastewater Reuse for : / Health Risks through :	MICROBIAL CONTAMINANTS							CHEMICAL CONTAMINANTS			MINIMUM TREATMENT REQUIREMENTS
	Microbes (viruses, bacteria) & possible body contact	Aerosols	Flies and mosquitoes	Parasitic eggs (Schistomiasis)	Wrong connection of mains (due to dual pipe systems)	Odour problems to the neighbourhood	Microbial Pollution aquifers	Chemical Pollution of aquifers, soil & plants	Accumulation of heavy metals in soil & food cycle	Formation of toxic gases (H_2S, SO_2)	
AGRICULTURE											Crops :
. DRIP	x			x				x	x		. not for direct consumption (A + E)
. Surface	x		x			x	x	x	x		. eaten cooked (B + E)
. Spray	x	x	x			x	x	x	x		. eaten raw (D + E)
GROUNDWATER RECHARGE											
Surface Infiltration	x		x	x		x	x	x	x		A or B
Injection Wells							x	x	x		D
INDUSTRIAL											
Cooling	x				x					x	B or C
Steam Production	x				x					x	B or C
Washing/Transport of material	x		x		x	x				x	(B + E) or (C + E)
Dust Suppression	x				x	x				x	B
AQUACULTURE	x		x	x		x	x	x	x		A or B
IGATION FOR LANDSCAPE	x	ⓧ	x		x	x	x	x	x		(B + E) or (C + E)
SILVICULTURE	x	ⓧ	x		x	x	x	x	x		A or B
RECREATIONAL WATER REUSE											
. No body contact			x	x		x	x	x	x		A or B
. Body contact	x		x	x		x	x	x	x		(B + E) or (C + E)
FIRE PROTECTION/ STREET WASHING	x	x			x	x				x	A or B
TOILET FLUSHING	x				x					x	A or B

A = Removal of suspended solids & significant removal of parasite eggs (Primary treatment)
B = A + Significant removal of bacteria (Primary + Secondary treatment)
C = B + more effective removal of bacteria & virus (Primary + Secondary + Sand filter or effluent Polishing methods)

D = C + advanced treatment
E = Disinfection
ⓧ = in case of spray irrigation methods

Presently, wastewater reuse operations are focused only to agricultural activities. The reuse agricultural sites are located primarily in the outskirts of the urban areas, which are equipped with wastewater treatment systems. The treated water is used for irrigation using simple gravity surface irrigation systems.

Currently, out of the 350 MCM of treated wastewater, only 60 MCM is used for irrigation 6000 ha (Refer Table 2). By the year 2000, it is expected that, this amount will rise to 500 MCM, which can be applied approximately to 50,000 ha of potential cultivation land.

Table 2 : Present Wastewater Reuse Projects in Morocco.

Town	Population (Thousands)	Volume of the Wastewater Used (MCM)	Surface Area (ha)
Marrakesh	437	15	3000
Meknes	352	14	1500
Fes	530	21	800
Fquih B. Salah	55	1	100
Beni - Mellal	110	3	300
Khouribga	145	4	360
Total	1665	58	6060

TUNISIA

Based on the climatic situation, Tunisia can be classified into three zones, namely : The Northern Mediterranean part, which represents 23% of the total surface area with humid and semi-arid climate with an annual rainfall between 400-1000 mm. The arid central part, with 31% of the total surface area, with an annual rainfall of 300 mm. The Southern, dry and arid pre-Saharan area, which encompasses 46% of the total surface area, but with an annual rainfall less than 200 mm.

The Tunisian economy largely depends on three sectors: agriculture, and it plays a vital role because 31% of the population is involved in this sector. Then the industrial sector (minerals and petroleum) and the tourism.

The above mentioned climatic plight clearly explains the importance of water conservation for agricultural developments. Therefore, for the past two decades, the government has financed considerable hydrological projects such as dams, deep wells, shallow wells, diversion canals etc., which permit to mobilize 60% of the national water resource potential.

Meantime, use of reclaimed domestic wastewater is presently considered as a potential water resources, which can assist to bridge the existing gap between demand and supply. In Tunisia, the first application of wastewater dates back to early 1960. At present there exist 26 sewage treatment plants, which treat approximately 100 MCM/year, and 10% of it is used for irrigation. The treatment plants adopt only primary and secondary treatment. By end of this decade, 30 more treatment plants will be constructed and it is planned to use 95% of the treated wastewater for irrigating 20,000 hectares. Table 3 presents the present and future wastewater reuse projects in Tunisia.

Considering the possible health hazard associated with the agricultural reuse, the authorities are currently involved with preparing standards for wastewater reuse and guidelines for crop selection and irrigation techniques. In order to eradicate any possible health risk, the state adopts a stringent authorization procedure for wastewater irrigation farms. Each project designed to use treated effluent has to get an approval from three different national authorities, namely : Ministry of Agriculture, Ministry of Health and National Environmental Protection Agency.

Table 3 : Reclaimed Water Reuse Projects in Tunisia

PROJECT SITE	Surface Area (ha)	Sewage Treatment Plant			Type of Cultivation
		Name	System	Capacity m³/day	
Completed Project					
1. Tunis - Soukra	600	Cherguia	AS	60,000	Citrus Fruit
2. Nabul Oued Souhil	250	SE-4	AS	14,400	Citrus Fruit
3. Sousse					
Sousse Nord	43	Sousse N	AS	13,000	Golf Course
Sousse Sud	205	Sousse S	TF	18,700	Fodder Crop
4. Monastir	-	Monastir	TF	2,600	Alfalfa
Sub Total	1098				
On Going Projects					
1. Tunis					
Soukra	200	Cherguia	AS	60,000	Citrus Fruit
Cebala	2670	Choutrana	OP	43,000	Fodder Crop
		Cotiere N	L	15,800	"
Morang	940	Meliane S	OP	37,500	"
2. Nabul	330	SE-2	AS	3,500	Citrus Fruit
		SE-4	AS	14,400	"
		SE-3	OP	3,500	"
3. Hammet	140	SE-1	AS	6,600	Golf Course
4. Sousse					
Sousse Nord	120	Sousse N	AS	13,000	Cirtus Fruit +
Sousse Sub	200	Sousse S	TF	18,700	Fodder Crop
5. Sfax	270	Sfax	L	24,000	"
6. Kairouan	240	Kairouan	AS	12,000	Fodder Crop
7. Gafsa	157	Gafsa	L	4,500	Citrus Fruit + Fodder Crop
Sub Total	5267				
Planned Projects					
Moknine	100	Moknine	L	2,400	
Sfax	130	Sfax	L	24,000	
Tunis	15,000	Sed joumi			
Sub Total	15,230				
Total	21,595				

AS : Activated Sludge Process
TF : Trickling Filter
OP : Oxidation Ponds
L : Waste Stabilization Pond

KUWAIT

Kuwait being located in the desert region of the Middle East, it has dry and hot climate, which is very prevalent in this region. The average annual rainfall is around 106 mm, and there exist no rivers or streams. The groundwater is considered to be the only natural water resource and its exploitation capacity is very limited in comparison to the nation's water demand for industrial, agricultural and domestic activities.

Within a period of two decades, this nation has seen a rapid modernization, from small fishing community to very high technological one. Today desalinated fresh water is the predominant water source, for all these development activities. Present desalination capacity is around 164.6 million gallons per day. Even though this water is used for different development activities, its use for agricultural sector is not considered as an economically accepted solution.

This constraint is the most important factor in future development of agriculture sector. Therefore the government of Kuwait has planned to make use of modern techniques for treating sewage, so as to utilize the effluent for agricultural purposes.

Currently there exist three major treatment plants, namely : Aridiya plant, Costal Village plant and Jahra plant, with respective capacity of 150,000 m^3/d, 96,000 m^3/d, 65,000 m^3/d. All these treatment plants are equipped with tertiary treatment system consisting of chlorination, rapid sand filtration and final chlorination, with the objective to obtain a BOD level less than 1.9 mg/l and SS 1.0 mg/l.

In Kuwait, the use of sewage water for irrigation was practiced for many years, but mostly in uncontrolled manner. Whereas, from late 1970 and early 1980, the state has drafted a more systematic high priority plan to promote this activity. According to this plan wastewater reuse is applied only in intensive controlled cultivation in enclosed farm complexes and development of low water demand plantations in large areas of low population density areas. Now there exist nine such effluent reuse sites.

The ultimate project objective was to develop 2700 hectares of intensive agriculture in enclosed farms and 9000 hectares of forestry.

BAHRAIN

The state of Bahrain constitutes of archipelago of 33 low lying islands, with a total area of 622 sq.km. The underground spring fed from the Damman aquifer in Saudi Arabia is considered as the predominant water resource of the island. Until 1960's, the island's urban and agricultural activities had plentiful access to this water resource. Therefore the scarcity of island's rainfall, which has a mean annual value of 72 mm, had no significant influence on the development activities.

However, later, with rapid rise in population, industrial and agricultural activities, the water table fell, due to increased abstraction. Meanwhile salt water intrusion into certain sections of the aquifer has prevented any further developments. Currently, the salinity level across the island varies from 2000-9000 mg/l.

Whereas the gap in demand and availability of water resources was progressively bridged with the utilization of desalinated water, which is mainly used for domestic purposes. The total annual water consumption is around 168 MCM, of which 95 MCM is for domestic consumption. The prevailing government policy is to replace two third of the domestic water consumption by desalinated water. In addition, by using treated sewage effluent for irrigation, further cut down of groundwater abstraction could be implemented. With this objective, the state has launched the wastewater reuse scheme in 1984.

At this moment, 50% of the population is connected to the country's main sewerage system and treated at the centralized treatment plant at Tubli Water Pollution Control Center. A major portion of this treated effluent is discharged into the sea and the rest (85,000 m^3/d) undergoes tertiary purification composing of filtration and ozone treatment. Then this tertiary effluent is used for irrigation. Presently, the treated sewage effluent is restricted only to controlled state farms, which prevents any possible health effects. Nevertheless, because of the difficulties encountered in developing agricultural land, at present only a part of this effluent is used.

Table 4 presents envisaged three phase plan for wastewater reuse. By end of the third phase, 3,7000 ha will be cultivated using this effluent.

Table 4 : Three Phase Development of Bahrain Wastewater Reuse Schemes

Description	Initial (85) m^3/day	Phase I 1990 m^3/day	Phase II 1995 m^3/day	Phase III 2010 m^3/day
Landscaping	9,000	12,000	16,000	28,000
Agriculture	31,000	43,000	54,000	100,000
Industrial	5,000	8,000	17,000	22,000
Groundwater Each	6,000	6,000	8,000	16,000
Total	51,000	69,000	95,000	166,000

Here, it is noteworthy to observe that due to excessive use of desalinated water and improved drainage facilities, the salinity content of treated water is expected to decrease, which will be beneficial for irrigation purposes.

JORDAN

Jordan's 81% land area experiences arid-desertic climate with an annual rainfall less than 100 mm. Only 9% of the land receives more than 200 mm per year. Such unfavorable climatic scenario compels careful development and exploitation of its existing water resources. The nation's total annual available water resources amounts to 1110 MCM, of which 880 MCM is surface water resources and the remaining is groundwater.

Table 5 presents the present and the future water demand for Jordan. Here, even though currently, 70% of the total water is used for irrigation activities, due to population growth and commercial activities, water demand for such endeavors tends to augment faster than the agricultural need. Meanwhile, right now, due to water scarcity, only 60% of the total estimated 47,000 ha land is cultivated. Therefore the water authorities have realized that reuse of wastewater will be the best alternative to meet the additional water demand and increase the cultivation land area.

Table 5 : Water Demand for Jordan

Year	Population Million (x)	Industrial and domestic Million m^3	Irrigation Million m^3	Total Million m^3
1986	2.5	160	518	678
1990	3.2	200	540	740
1995	3.7	245	574	819
2000	4.3	290	575	865
2005	5.4	353	576	929
2015	7.5	448	595	1093

In Jordan, all major cities have wastewater collection network and treatment plants. In 1989, 75% of the urban population (52% of total population) was connected to sewage system, and this figure is expected to rise to 86% by the year 2005. The total volume of water available from the treatment plant is around 35 MCM per year, which will augment to 61 MCM/year by 1995.

Even though the quality of the treated effluent meets the irrigation water quality, presently water reuse is practiced mainly in indirect form, such as discharging the effluent into the wadis and reusing at the downstream for irrigation. Aquifer recharge through wadis bed is quite common, and in many wadis during dry season treated effluent is the only base flow.

In regard to direct use of wastewater, the national policy requests that it be practiced at the vicinity of the treatment plants. Such practice is advocated only to the cultivation of silviculture, fruit trees, fodder crops and vegetables which are cooked before consumption. Concurrently, it is imperative for all new treatment plants to incorporate a on-site reuse component.

By the year 2000, it is expected that approximately 30,000 ha of land will be irrigated using treated wastewater.

EGYPT

Egypt's 96% of the total area is represented by desertic land, which accommodates a population less than 1 million, out of its total 53 million inhabitants. It is a very dry country, with an average rainfall of 150 mm at Northern part near Mediterranean cost and it decreases rapidly until it reaches 25 mm only at 35 km from the seashore. Due to this rainfall pattern, for centuries Egypt's water resources are predominantly based on Nile water.

The Egyptian economy depends mainly on agriculture with the participation of 58% of its population. Considering the rapid boost in population, which will reach 70 million by end of this decade, further expansion of its agricultural sector is inevitable. In order to cope with this agricultural dilatation, there exist ample land, but the main development constraint is the water.

Table 6 shows available water resources by the year 2010 and the water uses. These data reveal that, there will be water shortage of 2.4 BCM in 1992 and 3.8 BCM in 2010. This breach can be bridged by adopting the following alternatives :

- Exploration of groundwater in the Nile valley and its delta :

- Reuse of agricultural drainage water. In Nile basin, due to poor irrigation methods,, currently farmers use almost twice as much of water needed for irrigation. The estimates indicate that the availability of irrigation drainage water is to be between 14 to 16 BCM/year, of which only 5 BCM/year is used for irrigation;

- Reuse of treated sewage water;

Table 6 : Available water resources by the year 2010 for Egypt

Source	Available Water Resources (BCM)		
	1987	by 1992	by 2010
- Nile water quota	55.5	55.5	57.5
- Underground water (in desert & Sinai)	0.5	1.0	3.0
- Rainfall harvesting	0.1	0.2	0.5

Water uses (BCM)

	1987	by 1992	by 2010
- Agriculture (in Delta and Valley)	46.2	45.0	43.0
- Agriculture (Newlands)	0.5	4.5	12.0
- Drinking, commercial & Industry	6.9	7.8	9.5
- Navigation and power generation	2.4	1.8	0.3
Total	56.0	59.1	64.8

1) Including reclamation of 0.6 million feddans.
2) " " " 2.5 " "

In spite of the fact that wastewater reuse represents a strategical water resource, currently it is not fully utilized. Greater Cairo and Alexandria are the two major cities equipped with seawater treatment plants. A project is planned to irrigate approximately 80,000 ha based on the Greater Cairo treated sewage. Meanwhile, as a national policy all new treatment plants with capacity ranging between 200 l/s to 1200 l/s will be designed to reuse each drop of its effluent.

By the year 2000, the total capacity of treatment plant may reach 3 BCM, and out of which 2 BCM could be used for agriculture.

CYPRUS

The Mediterranean island state of Cyprus, has a total population of 690,000. Its climate is characterized by hot dry summer and rainy winters, with an average annual rainfall of 600 mm. Even though Cyprus's economy is predominantly based on agriculture, lately due to the island 's touristic attraction, this sector starts to play an important role.

As there exist no perennial rivers or lakes, water is a valuable commodity. It line with many nations of this region, the rapid urban and rural development ventures have resulted in over exploitation of conventional underground water resources.

Currently, numerous water resources development projects are being promoted to meet the nation's water demand. Considering the fact that 85% of the precipitation occurs between the month of November and March, substantial interest has been focused on construction of dams. At the termination of these projects, they can withhold approximately 350 MCM of water, and will cover Cyprus's water demand until the year 2015.

In parallel to the development of conventional water resources, adequate attention is being paid to other innovative approaches, and wastewater reuse is one of them. This practice is mainly concentrated on irrigation sector.

According to the present wastewater reuse potential, it could be used to cultivate approximately 6% (3350 ha) of the total area. Moreover, the state's interest on this sector is mainly due to the fact that this technique is considered as the best solution to the pressing problem of wastewater disposal and yet preserving natural environment. Such practice will further boost the tourism industry.

At present, the National Agricultural Research Institute is involved in an extensive research work to find out the soil-water-plant relation in wastewater irrigation. The information acquired through these studies will be used to draw-up national standards and guidelines. In regard to irrigation techniques, modern irrigation systems (drip and mini-sprinkler) are highly advocated. With such systems, higher level of salinity and Na content of the irrigation water could be accepted.

Table 7 presents the Cyprus's proposed provisional standards for wastewater reuse.

Table 7 Provisional quality standards for treated domestic sewage effluent used for irrigation

Crop	BOD_5 mg/L	SS mg/L	Faecal coliforms/ 100 ml	Intenstinal worms/L	Treatment required
Fruit trees amenity areas of unlimited access	10* 15**	10* 15**	50* 100*	Nil	Secondary+ tertiary+ disinfection
Amenity areas of limited access	20* 30**	30* 45**	200* 300**	Nil	Secondary storage for 1 week or tertiary + disinfection
Nuts and other similar fruits	20* 30**	30* 45**	200* 300**	—	Secondary+ disinfection
Fodder crops	20* 30**	30* 45**	1000* 5000**	Nil	Secondary+ storage for 1 week or tertiary+ disinfection
Industrial crops	50* 70**	— —	1000* 10000**	—	Secondary+ disinfection

* These values should not be exceeded in 80% of samples analysed in a month.
** Maximum value allowed.
Note 1. Irrigation of vegetables is not allowed.
Note 2. Irrigation of ornamentals for trade purposes is not allowed.
Note 3. No substances accumulated in the eatable parts of crops and proved to be toxic to humans or animals are allowed in effluents.

FRANCE

In contrast to other arid and semi-arid countries of this region, France has abundant water resources, and important man made canals such as "Canal du Bas-Rhone-Languedoc", "Canal de Provence" and numerous agricultural water reservoirs give access to many parts of the naturally semi-arid regions of the Southern Mediterranean coastal area. Due to the possibility of tapping fairly adequate quantity of water even in the most dried areas of the country, wastewater reuse was never considered as an important imperative alternative.

In spite of these situations, there exist numerous localized interesting projects on wastewater reuse. During the last decade, frequent occurrence of drought and excess migration of tourists has put excessive demand on groundwater in many parts of the Southern touristic coastal cities. In certain cases, profilicated exploitation of groundwater has lead to the salt water intrusion problems.

In such regions, lately, wastewater reuse was considered as a possible alternative to meet such seasonal demands (Ex. Island of Porquerolles). Here reutilization of wastewater is considered as a constant water source and it is mainly used for irrigation, thus limits excessive pumping from the conventional water resources during touristic and drought periods.

In certain touristic sites wastewater irrigation is used as a method of disposing and preserving the natural environment. The future potential of wastewater reuse in France lies mainly on this line, rather than on water resources management sector.

In the light of this fact, at national level water reutilization is practices in small scale. Currently there exist no national sanitary standards for irrigation. In many situations, as in many other European nations, the possible health and environmental risks are averted by implementing appropriate micro-irrigation techniques. At the same time, the Health Ministry Authorities are updating the recently published WHO wastewater reuse recommendations, in view to bring out national sanitary guidelines for the French context.

SPAIN

The majority of Spain's 38.5 million inhabitants are concentrated in the coast and in the valley of rivers Ebro and Guadalquivir. Its main economic activities are industry, agriculture and tourism. Based on climatic conditions and availability of water resources, the nation can be divided into three zones :

Zone I : Humid and oceanic climate with plenty of good quality water, in the Atlantic and Oceanic parts of the country.

Zone II : Continental climate with moderately sufficient water resources, which lies in the inner areas of the peninsula.

Zone III : Areas located on the border of the Mediterranean and the South Atlantic Ocean, which experiences Mediterranean climate, with scarce and badly distributed water resources.

These zonings beyond doubt indicate that major water scarcity occurs only in the Zone III. The present water forecast studies reveal that possible water shortage occurs in the year 2010 for the region located in this zone namely : Catalonia, the Southwest Mediterranean regions and the Canary islands.

Due to lack of national level interest and fewer number of treatment plants (current total is 48), till late eighties wastewater reuse activities were not really considered as an viable alternative. However with Spain's entry into the European community, it is exposed to stringent wastewater disposal requirement, which will result in construction of more sewage treatment plants. Along with these environmental protection measures, recently the idea of effluent reuse is being considered as an interesting alternative, and its potential in the zone III is highly promising.

At present, most of the sewage treatment plants dispose of their effluent into the rivers or streams and later use at downstream for irrigation. There exist handful numbers of controlled wastewater reuse projects and most of them are in the irrigation sector. Major part of these projects are developed either by private sector or research institutes. Meanwhile, wastewater is also used for greenspace irrigation such as golf courses and public parks in Canary Islands and Palma of Majorca Island.

In parallel to the above mentioned activities, in many parts of the country wastewater reuse is performed illegally, where they are used either treated or untreated form in agriculture and without any legal sanitary control. Lately, being aware of the possible health risks associated with such practice, the government is planning to establish national standards for wastewater reuse.

Table 8, presents the summarized version of the wastewater reuse activities of the other nations of this region.

Table 8 : Wastewater Reuse Activities and Potentials

COUNTRY	STATUS OF PRESENT WASTEWATER REUSE ACTIVITIES	FUTURE POTENTIAL	PRESENCE OF NATIONAL SANITARY STANDARDS	ROLE OF WWR IN NATIONAL WATER RESOURCES PLANNING	OBJECTIVE OF WASTEWATER REUSE
ISRAEL	. Highly Developed/Direct use . Controlled Irrigation >10,000 ha for Cotton & Citrus Cultivation	. Agriculture . Groundwater Recharge	Yes	Very Important	Water Resource Management / Development
SAUDI ARABIA	. Moderatly Developed/Direct use . Controlled Irrigation Present Irrigation land 3000 ha Total planned irrigation land by 2000 will be 7000 - 8000 ha	. Agriculture . Groundwater Recharge . Green-Space Irrigation . Industrial Reuse	Yes	Very Important	Water Resource Management / Development
SYRIA	. Under Developed/Indirect use . Mostly uncontrolled reuse for Agriculture	. Agriculture . Groundwater Recharge	No	Very Important	Water Resource Management / Development

QATAR	. Moderatly Developed/Direct use . Localized Irrigation . Watering municipal gardens	. Agriculture . Green-Space Irrigation	Under preparation	Important	Water Resource Management / Development
UNITED ARAB EMIRATES	. Moderatly Developed/Direct use . Extensive interest and experience in non-potable municipal water use . Controlled Small Scale Irrigation	. Non potable Municiple Water Use . Green-space Irrigation	Yes	Important	Water Resource Management / Development
ALGERIA	. Under Developed/Indirect use . Controlled Irrigation only at Pilot study level (7.5 ha)	. Agriculture . Groundwater Recharge . Green-space Irrigation	No	Important	Water Resource Management / Development
ITALY	. Moderately Developed/Indirect use . Lack of national level interest . Localized Agricultural uses Ex: Naples, Sicily, Motlola, Emilia-Romgna	. Agriculture	Yes	Relatively Important Specially in the Southern Coastal Regions	Environmental Protection

YUGOSALVIA	. Under Developed/Indirect use . Uncontrolled Irrigation	. Agriculture . Groundwater Recharge	No	Important Specially in the Coastal regions	Water Resource Management / Environmental Protection
TURKEY	. Under Developed/Indirect use . Localized Agricultural use	. Agriculture	No	Less Important due to relatively abundant water resources	Environmental Protection
IRAQ	. Under Developed/Indirect reuse	. Agriculture	No	Less Important	Environmental Protection

CONCLUSION

Wastewater reuse is always being an integral part of human life. In the old times, it is practiced in small scale level, thus all adverse effects were considered as localized phenomenon. But today, it is beyond doubt effluent reuse is going to grow in much faster rate and scale than what we expected a decade ago. In view of this, all water reuse practices have to be viewed and analyzed in long term and in the global context.

Lately reclaimed water use activities have been intensified. Unfortunately these developments are not kept breast with creation of adequate sanitary regulations and effective enforcement agencies. This dichotomy has in turn created a spate of environmental and health hazards.

Even though water reuse appears like a simple and appropriate technology, in reality it is a complex one. It has multidisciplinary inter-linkage with different sectors such as : environment, health, industry, agriculture, water resources etc. In addition, due to these complex interlinkages in many countries the administrative responsibility of reuse activities is not well defined. Often it falls with the Ministries dealing with health, water supply and sanitation, agriculture, industry, water resources management etc., which further complicates creation of regulations and its promulgation.

In respect to establishment of sanitary standards, many nations tend to duplicate the stringent standards adopted in the Western World. This situation has to be overcome, and there is an immediate need to refine these norms in accordance with local technical, economical and social context.

In the agricultural sector, the attention should be focused on drawing-up national or regional level code of practices emphasizing the relation between soil-water-plant and irrigation techniques.

It is beyond doubt that the nations of this region does not possess adequate manpower resources for effective planning and implementation of wastewater reuse projects. Therefore, paramount importance has to be paid to the personnel training, because this sector will be the pivotal component of all future projects.

Routine monitoring plays a vital role in any development sector. However, it is one aspect of water resource that many developing countries are paying less attention. Hence, these nations have to focus more on this field, and mainly on health and environmental aspects.

Till today wastewater reuse is considered as a subject of academic research. This approach has resulted in publications of numerous scientific documents and papers. Furthermore the information is circulated mostly among the privileged scientific community. The national authorities fail to disseminate these scientific informations to real work force. There exist only handful number of documents on this field, which explains the techniques and associated possible hazards in simple layman language. Due to this situation, the farmers are still very much dubious of the real value of any water reuse project.

At the same time, researchers and academicians involved in this field, in their enthusiasm and eagerness, while playing down all associated adverse effects, tend to advocate that wastewater reuse is the solution to all water resources problem. Which is not the real case in many situations.

Finally, in most circumstances, water reuse projects are planned and implemented only with the technical and financial feasibility studies. Planners have the tendency to discard the people's belief and values on this issue. For example, the Hindu and Muslim community, due to religious beliefs, consider wastewater as an untouchable water source. In such situation there is a need to convince the community in terms of importance of water reuse before implementing the projects. Not the vice versa. A properly planned campaign and creation of awareness at the political and cultural levels, will increases the eventual chances of success of water reuse projects. Another stumbling block in the implementation of a reuse project is that politicians due to cultural reasons and eventual vested interest regard this technique with suspicion, and dare not to venture into this new field. Thus, today in spite of the fact that wastewater reuse is a scientifically and environmentally proven technology, there is a long way to go, before it is genuinely accepted by the society.

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