UNITED NATIONS

E

Distr.:
LIMITED:
E/ESCWA/ENR/1999/WG.2/18
27 September 1999
ORIGINAL: ENGLISH

Economic and Social Commission for Western Asia

Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States

Eighth Biennial Meeting of the Arab National Committees of the International Hydrological Programme of UNESCO

Beirut, 28 September – 1 October 1999

Laws, Policy measures, Effluent Standards & Regulations in the Water Sector in Lebanon

Note: This document has been reproduced in the form in which it was received, without formal editing. The opinions expressed are those of the author and do not necessarily reflect the views of ESCWA.

99-0869

LAWS, POLICY MEASURES, EFFLUENT STANDARDS & REGULATIONS IN THE WATER SECTOR IN LEBANON

By

Jean Georges CHATILA, Ph.D

Assistant Professor
Civil Engineering Department
Lebanese American University
P.O.Box 36, Byblos, Lebanon
jchatila@byblos.lau.edu.lb

ABSTRACT

Water is a vital source of life and fundamental to the environment. It plays an instrumental role in agricultural, industrial, and economic development. It is a commodity of considerable value specifically in Arab countries where supply is inadequate to meet the needs of potential users. The Arab World faces water quality as well as quantity problems since it lies in an arid region. Lebanon is increasingly suffering from shortage and mismanagement of water. Efficient solutions for water-related problems necessitate the adoption of well-planned policies. These should concentrate on improving water management, rationalizing water consumption, and augmenting and protecting water supplies. A system of laws has been developed to determine who has the right to use water when shortages occur. Water rights play an important role in determining the availability of water in some regions. In general, governments have framed comprehensive codes of health regulations. Strict water policy and wastewater treatment and disposal criteria should be in effect in order to avoid contamination and achieve proper management of water resources systems. This paper describes the different aspects of the water laws and applicable policies to water resources as well as the disposal of treated wastewater and the potential use for irrigation in Lebanon. A set of proposed regulations and recommendations have been cited.

INTRODUCTION

Water is a vital source of life and fundamental to the environment. It plays an instrumental role in agricultural, industrial, and economic development. Water has considerable significance in Arab lands since most Arab World lies in an arid region. Rivers, estuaries, and other waterways have long served many important uses for mankind although they have been subjected to stresses by diverse human activities. Such uses and stresses have made it necessary for hydrologists and hydraulicians to research and understand the complicated behaviour of water movement and interaction with its environment; by means of computer simulation and/or experimental verification. Water resources engineers strive to predict the inter-relationships between rainfall, runoff, floods, droughts, and stream water quality. In a surface water system, runoff, floods, droughts, and stream water quality interact very closely. Excessive rainfall from extreme storms results in flooding along rivers whereas shortage of rainfall due to drought causes minimal stream flows, reduced water supply, restricted navigation and poor water quality. Many Arab countries are facing water quality as well as quantity problems. Efficient solutions for water-related problems necessitate the adoption of well-planned policies. These should concentrate on improving water management, rationalizing water consumption, and augmenting and protecting water supplies.

In the Middle East region, water security, like food security, is a matter of survival. The availability of fresh water is very unevenly distributed. Relative availability of internal renewable water resources ranges from an extremely low level to a high level. More disturbing are the uncertainties surrounding the potential impacts of climatic change and global warming on the rain patterns and hence on water resources. Against all this, total water use has increased nearly tenfold over the last 100 years. New sources of water have become scarcer and more expensive to develop, while competition amongst the various users has increased. Pollution from industry, urban wastewater and agricultural run-off reduces the fitness of fresh water sources in this region. Where groundwater is used as the source of irrigation water, a steady decline in groundwater levels has often followed. Inappropriate irrigation practices result in the development of salinity. Irrigation and overgrazing by livestock significantly increases soil erosion. Much of the eroded soil contributes to higher sediment loads in watercourses. When industrial wastewater, which is very heterogeneous and uneven in composition, is discharged into surface water, or mixed with municipal wastewater for irrigation, it creates serious environmental problems. There is a whole range of diseases associated with water that are prevalent in the region.

BACKGROUND

Lebanon, like most of the Middle East countries, is increasingly suffering from shortage and mismanagement of water. The potential consequences of such situation are well expressed in a book entitled "***The Politics of Water in the Middle East***" published by the Center for Strategic and International Studies in Washington, D.C. The author states that "***before the twenty first century the struggle over limited and threatened water resources could sunder***

already fragile ties among regional states and lead to unprecedented upheaval within the area".

In addition, a very extensive review and analysis of wastewater management needs and procedures was presented in the 1982 National Waste Management Plan (NWMP82). As a part of a number of urgent rehabilitation works, it recommended new or extended sewerage systems to 524 communities, and construction of ***74 wastewater treatment plants, including 9 coastal sites with sea outfalls*** which would each serve multiple communities. After the end of the war, the Lebanese government through the Council for Development and Reconstruction (CDR) and concerned ministries had started the planning and design of wastewater treatment plants. The only operational one is a preliminary wastewater treatment plant located at Ghadir near Beirut International Airport. Only preliminary treatment of the sewage is performed and the effluent is disposed of through a sea outfall located 2.5 km away from the coast at a depth of about 60 m below the water surface. The main concern of such process is the inefficiency of the treatment plant. In this instance, different types of nutrients and toxic materials will reach the coastal waters and they will have a detrimental effect on water quality, fish and aquatic habitats, to mention a few effects.

Furthermore, the presence of non-sanitary and un-engineered landfills located across the coast, namely in Normandie, Ouzai'i, and lately Bourj Hammoud had caused tremendous problems of water and fish quality along the coast. Thus, it is important to study and understand the water quality and perform the necessary remedial actions.

The disposal of human wastes and other organic refuse without creating a nuisance has been a problem since the immemorial. Moses was one of the foremost early sanitarians who framed a very striking and comprehensive code of health regulations for the ancient Israelites. At that time, the difficulty in disposal of human waste products was surmounted by resorting to burying the wastes rather than dumping them in rivers and water bodies. This is shown in the Old Testament in Duet xxiii, 12-13 as follows:

Thou shalt have a place also without the camp,
wither thou shalt go forth abroad:
And thou shalt have a paddle upon thy weapon:
and it shall be, when thou wilt ease thyself
abroad, thou shalt dig therewith, and shalt turn
back and cover that which cometh from thee.

Water pollution problems existed hundreds and even thousands of years ago. Wright (1960) reported that some of London's water courses, such as Fleet River, was grossly polluted as early as the fourteenth century due to discharges from latrines, privies, ...etc. Pollution had affected the public opinion from the beginning of the nineteenth century. An angry manufacturer wrote a memorandum which was included in the third report of the 1868 Royal Commission report. This letter contained a very convincing evidence of the shocking state of the Yorkshire River Calder. It was not written in ink but with *river water taken this day from the point of*

junction between the River Calder and the town sewer. The writer added: *Could the odour only accompany this sheet, it would add much to the interest of this memorandum.* In his *Les Miserables*, Victor Hugo (1802-85) described the picture of ocean pollution as such: *It is the very substance of the people which is carried away, here drop by drop, there in floods, by the wretched vomiting of our sewers into the rivers, and the gigantic collection of our rivers into the ocean.... From this two results: the land impoverished and the water infected.* This shows that water pollution problems have reached unacceptable limits in some places. Remedies to the problem would start by knowing the source of pollution, studying the pollutant transport and spreading, trying to eliminate any future pollution, and recovering the existing water. In his *Petite Palace*, George Pettie (1576) stated: *The cause taken away, the effect vanisheth.* Also, Ralph Waldo Emerson (1803-82) stated that: *Cause and effect, means and ends, seed and fruit, cannot be severed; for the effect already blooms in the cause, the end pre-exists in the means, the fruit in the seed.*

Given the above, a strict water policy and wastewater treatment and disposal criteria should be in effect in order to avoid contamination and achieve proper management of water resources systems. In this instance, this paper aims at describing the different aspects of the water laws in natural resources as well as the disposal of treated wastewater and the potential use for irrigation as it may apply in Lebanon.

WATER LAWS

Water is a commodity of considerable value specifically in Arab countries where water supply is inadequate to meet the needs of potential users. A system of laws has been developed to determine who has the right to use water when shortages occur. Water rights play an important role in determining the availability of water in some regions. These rights can be of different types such as the Riparian or Appropriative.

Riparian Rights

Riparian Rights started with the French civil law and were accepted by two American jurists. In early nineteenth century, English courts adopted the doctrine as part of their common law. Subsequently, American jurisdictions that adopted the English common law also accepted the riparian doctrine. Under the concept of riparian rights the owner of land adjacent to a stream (riparian land) is entitled to receive the full natural flow of the stream without change in quality or quantity. The riparian owner is protected against the diversion of waters upstream from the property or from the diversion of excess floodwaters toward the property. In other words, no upstream owner may materially lessen or increase the actual flow of a stream to the disadvantage of a downstream owner. The main drawback of this concept is that it does not provide water usage for irrigation or other purposes. In this instance, this concept has been modified to accommodate reasonable use of water. Thus, it permitted to divert and use streamflow in reasonable amounts for beneficial purposes.

However, in instances of insufficient flows, the available water is divided on some equitable basis, although upstream owners may always use as much water as they need for domestic use and for watering domestic stock. Such use is considered ordinary or natural. Irrigation or watering of commercial herds of stock is an artificial use and not entitled to preference. Reasonableness of use is usually determined by such factors as area, character of the land, importance of the use, and possible injury to other riparian owners. No priority of right can exist between riparian owners. Thus, all riparian owners have equal rights to their reasonable share of water, and no owner can exercise rights to the detriment of other owners. It is worth mentioning that riparian rights are not affected by use or lack of use and are transferable. The new owner must adhere to the conditions governing the original owner. If riparian land is divided, any section not adjacent to the stream loses its riparian status unless the right is specifically preserved in the conveyance and is not recoverable. Riparian rights do not inhere in artificial channels. Riparian rights are not expressed in specific quantities unless they have been apportioned by a court decree. This decree is based on conditions existing at the time of the hearing and is subject to change by the court if the conditions change. Since the government was riparian owner of the land prior to the issuance of patents, the new owners generally claimed riparian rights on any streams adjacent to it.

Appropriative Rights

Appropriative rights concept was also adapted from the Roman Civil law. The outstanding feature of this doctrine is the concept of "first in time, first in right." The right of the earliest appropriator is superior to any other claim, and further appropriation is possible only if water in excess of earlier claims is available. During water shortages the available supply is not apportioned among all users. Earliest priority claimants are entitled to their full share, and those with later priorities may have to do without. Under an exclusive system of appropriative rights, all water in natural watercourses is subject to appropriation. An appropriator may store water in reservoirs for use during periods of shortage, but the amount stored is limited by the terms of the storage appropriation. Reservoir releases intended for downstream use belong to the person storing the water or those to whom it is consigned and may not be appropriated. Minimum flow requirements for public water use had been established. This is important to provide adequate water in the stream for fish and wildlife, recreation, and to protect the aesthetics of the stream. But these vary along the stream and with different parts of the year.

The appropriation doctrine provides for acquiring rights to use of water by diverting it and putting it to beneficial use in accord with procedures set forth in municipal statutes or acknowledged by the courts. Appropriated water may be used on lands away from the stream as well as on lands adjoining the stream. The earliest appropriator in point of time has the exclusive right to use of water to the extent of appropriation without diminution of quantity or deterioration of quality whenever the water is naturally available. Each subsequent appropriator has like priority over all appropriations later in time. Appropriations are for a definite quantity of water and are valid only as long as the right is exercised. Appropriations may he made only for beneficial and reasonable uses. Considerable confusion is to be expected where both doctrines are jointly recognized.

Permit Systems

A permit confers a right to use a specified quantity of water at a specific location and at specific times. The issuing agency may include any reasonable conditions in the permit. Permits are usually for a limited term subject to renewal. Priority of issue does not control priority of right. All permittees usually have equal status all deficiencies must be shared on equitable basis. Permit systems combine characteristics from the riparian law (no priority) and the appropriation law (use may be permitted on non-riparian land. An exclusive feature of the permit system is the fixed time limit that permits the water to be transferred to higher use at the expiration or a permit.

Water Codes

A typical complete water code consists of three parts: appropriation of water, adjudication of water rights, and administration of water rights and distribution of water. Water codes differ in content and extent of coverage but they contain similar provisions on fundamental matters. Some of the items with respect to appropriation of water are as follows:

- Method of appropriation: the intending appropriator is usually required to file an application for a permit. This is advertised, and if any interested parties object, a hearing is held before a permit is issued.

- Conditions of fulfillment and forfeiture: a time limit is set within which constriction of works must be completed and the water put to use (often 6 months or a year). This limit is subject to extension for good cause. Nonuse of water for a specified period (usually 3 to 5 years) constitutes forfeiture of the right.

- Preference of use: domestic and municipal uses have the first preference of water. Then would be for irrigation, power and milling, wildlife, and recreation...etc. These preferences are exercised in several ways. Applications for appropriation are filed at the same time and approval is given to the one having the highest preference.

- Water shortage: highest preferences are entitled to water. But prior rights cannot be taken by the holders of junior rights without just compensation. Water rights may also be condemned in favor of a higher preference use. Some water codes usually give the city engineer or water board authority to grant or deny applications for water rights. If the water is available and the application fulfills the statutory requirements a permit must be issued. In case a question as to the availability of water arises, the decision can be appealed in court and it is the responsibility of the claimant to demonstrate and prove the sufficient availability of water to satisfy the needs without detriment to the prior rights.

- Permit systems require similar codes and organization and are generally similar to appropriation systems, except for the greater restrictions that can be placed on permits. It has been suggested in areas where water is in short supply that all water rights ought to be

reviewed once every 10 years to see that each right to water is being used in a proper and reasonable manner. If not, then some modification of the right may be appropriate so that the available water is used to maximum advantage.

Groundwater Law

Under common laws, rights to groundwater are inherent in the overlying property, and the owner of this property is free to remove and use the water. However, if the groundwater is inadequate to meet all needs, difficulties may be expected. Under the common law, early court decisions held diversion of water from under a neighbor's property or lowering of the water level by excessive pumping was not a proper cause for court action. For some time the trend of court decisions respecting groundwater in arid areas has been toward a doctrine of reasonable use. Under this doctrine overlying landowners retain their rights to water under their property, but they are not permitted to use more than they really need or to export the water to points distant from the source. The use of water must be reasonable and priorities of all landowners are equal and if the supply is not sufficient for all demands, each owner is entitled to no more than an equitable portion of the available water.

Water law with respect to groundwater is notably less advanced than for surface water due to the fact that it is harder to understand and detect the movement. Generally speaking, groundwater is divided into groundwater streams and percolating waters. Groundwater streams are governed by similar rules as the surface streams. The proof as to the nature of that stream falls on the claimant who asserts the existence of such a stream. Percolating waters have been described as wandering drops moved by gravity along the line of least resistance. Such waters are further supposed not to contribute to the flow of any definite stream. In some places, percolating water is subject to appropriation in the same manner as for surface water. Some others concentrate on reasonable use. As groundwater may contribute to a stream or is recharged by streamflow, this interrelation constitutes a legal problem. It may be presumed that future statutory action will be in the direction of correlating all sources of water.

Cross Boundary Rivers

With many streams crossing country boundaries and others serving as country boundary, it is inevitable that disputes over water rights will arise between neighbors, mainly about getting the fair share.

Drainage Law

Two basic rules of law are applied in drainage problems:

- Owners of high land are entitled to the advantage that this elevation gives them and may discharge their drainage water onto lower land through normal depression without obstruction by lower owners. A dominant owner may accelerate the flow of surface water by

constructing ditches or by improving natural channels on his or her property and may install tile drains.

- Water is a common enemy of all, and land owners may protect themselves from water flowing onto their land from a higher elevation. Under this rule, the dominant land owner cannot construct drainage works that result in damage to the property of a servient owner without first securing an easement.

Both doctrines of drainage law place the responsibility for damages on any person or organization that alters the natural stream pattern of an area or creates an obstacle which blocks the flow of a natural stream. Common law confers no rights to control of navigable streams under state jurisdiction except by the construction of levees to keep the stream from overflowing one's land. The trend in drainage law is toward reasonableness: reasonable use of land, reasonable modification of the drainage pattern, and reasonable care to see that neither the dominant nor the servient landowner suffers unreasonable injury. This approach provides flexibility, but its ambiguity often leads to lawsuits between and among parties.

WATER POLICIES IN LEBANON

Current Practice

A standard practice document has been prepared and aims at providing guidance to engineers and other interested parties in achieving satisfactory design and operational standards appropriate to the conditions in the country. It contains the requirements for the design of transmission and distributions system to international standards based on the perceived policies and strategies for water supply within Lebanon and the requirements of the concerned ministry. The standard practice document contributes to achieving the long term objectives while meeting the short term levels of service aims. At present supplies are intermittent with seasonal rationing and consequently there is a suppressed demand.

Although not formally documented, the ministry and supply authorities have a number of technical and operational policies and objectives that are applicable both to the current situation and to future operations. These include policies for the levels of service of the supply to the customer, including quality of water delivered, system and customer metering and preferred standards and current practices for materials and construction. The policies can be summarized as follows:

- Within the availability of existing resources, provide restricted and rationed supply equitably distributed to all consumers through the combination of the sequential area allocations and the use of orifice plates in the service connections.

- Restrict flows in distribution through the use of small diameter distribution pipes.

- Improve level of service before charging for water.
- Supply a quality of water that complies with World Health Organization (WHO) guidelines.
- Perform passive leak detection.
- Provide an unrestricted supply to customers and improve level of service standards.
- Having improved line of service, charge for water consumed through water metering.
- Improve monitoring of system flows and pressures.
- Implement loss reduction policy using comprehensive flow monitoring to analyze changes in demand patterns into discrete supply zones.
- Improve the quality of water supplied (raise to higher standard than WHO standards).
- Stop the use of private pumps to draw water from the mains. Storage on the consumer's premises however is encouraged provided that the pipe discharging into the tank is fitted with a control valve.

Regulations and Standards

In the absence of any relevant Lebanese National Acts of Parliament, or Government regulations and/or standards, it is recommended to comply with the current International Standards (ISO) for design, materials and workmanship. However where no such International Standard is available, appropriate European or other national standard may be adapted.

Policies

In general, it is appropriate to adopt a more rigorous approach or standard that is considered an enhanced design. However, any proposal to reduce a standard will not be acceptable unless justified.

- ***Level of service:*** minimum pressure measured at the consumer's stop tap shall be more than 10 meters at a flow of 10 l/min at the first tap within the property. Accounting for losses in the service pipe between the tapping in the main and the stop tap at the edge of the property boundary, this is equivalent to a pressure in the main of 15 meters. For urban areas where the predominant housing stock comprises multi-storey buildings over 5 floors high, the minimum pressure shall be not less than 35 meters in the main. Except for emergencies, the supply shall not be interrupted without prior warning to consumers. Alternative supply arrangements shall be implemented where a planned interruption is programmed to last for a period greater than 24 hours. The level of service shall be monitored by pressure and flow

monitoring equipment permanently installed in the system. The locations of monitoring points and frequency of measurements are well defined.

- ***Quality of water delivered:*** shall be better than the maximum acceptable guide levels given in the WHO guidelines for Drinking Water Quality", 1993. Systematic and random sampling programs shall be set up to monitor the variations in water quality throughout the distribution system from source to consumers tap. The frequency of sampling shall be sufficient to obtain statistically meaningful information and to cover systematically all discrete zones within the supply zone. Conservative substances (i.e. substances that are unlikely to vary in concentration in the network) need only be sampled and analyzed at the point of going into supply. Non-conservative substances (ie substances whose concentration changes with time or as consequence of other pipe-work related characteristics) and conservative substances which change concentration through blending of different quality source waters, shall be sampled at key points in the system and at the consumer's taps. Continuous water quality monitoring is required at all sites where water is taken directly from a surface source for immediate treatment and where a risk assessment indicates that there is a significant risk of producing water after treatment that shall not comply with WHO Guidelines with a consequent risk to public health.

- ***Monitoring system performance:*** through a programme of selective and random measurements of pressure, flow and determination of water quality parameters. Flows shall be continuously monitored at the outlets from all sources, into all discrete supply zones and within distribution at leakage control/district boundaries. The meters of large industrial, commercial and institutional consumers shall be monitored periodically and compared with the billing records. Pressures shall be continuously monitored at all sources feeding a supply zone, leakage control meters and within distribution at selected locations for level of service.

- ***Leakage management monitoring:*** water samples shall be taken from permanent sampling points installed at key locations within the distribution on the trunk mains. Pressures shall be monitored periodically within the distribution system and on trunk mains. Data from the continuous monitoring of flows, pressures and water quality parameters shall be assembled to create data files of the long term performance of the area. The results of the random sampling and monitoring shall be added to the data.

- ***Demand management:*** comprises three interrelated policies for reducing leakage, reducing excessive system pressure in relation to the designed levels of service and controlling the flow in service connections.

- ***Leakage Policy:*** calculations of leakage will be based on the net night flow method determined from the flows recorded through the distribution meters. Night flows into each supply zone shall be established from flow meters installed at all supply points into distribution areas. Reservoir drop tests shall be carried out annually and, where practical, at 5 yearly intervals, the drop tests shall be preceded by reservoir water tightness tests. They are

intended to carry out meter calibrations at about 5 yearly intervals. Where meters have been installed in sufficient quantities, surveys of trial areas covering a cross section of groups of domestic properties shall be carried out to monitor night usage. The results of these surveys may be used to revise the legitimate night use allowance. The surveys may include consumer questionnaires. The consumption pattern of those consumers having a significant demand in an area can affect the leakage calculation. Based on the results of the reservoir drop tests and leakage assessment, the supply authority will define a target level of leakage for the supply zone as a whole and a programme for achieving the target. The supply authority will periodically review both the target and the programme and may revise either to take account of leakage detection performance. The overall target will be made up of individual target levels of leakage for each distribution area and these will take account of the characteristics of the zone. It is recognized that leakage may be higher in some areas than the supply authority-wide target but lower in others. The introduction of district metering will allow a more detailed assessment of the variation of leakage within each supply zone and will highlight any rapid or gradual rise in leakage levels. Monitoring of district meter night flows will allow comparison of leakage detection performance against the preset targets. Once the targets are achieved, leakage thresholds will be set so that if they are exceeded leakage detection action will be triggered. Leakage will be detected using visual identification, step testing, sounding, and through surveys.

- ***Pressure Reduction:*** when designing both network extensions and district metering, consideration will be given to opportunities for full time pressure reduction where it can be demonstrated to be economic. Consideration will also be given to schemes offering part time pressure reductions either over part of a day or over a season.

- ***Consumption Control:*** realistic water charges will be reinstated when it is considered that an acceptable level of service has been achieved. Metering of individual consumers, which is a long term objective, is one possible method of assessing charges. Other methods include charges based on condition of housing stock, restricting the supply and local taxation. Currently supplies are controlled through the introduction of a throttle into the service pipe that is installed immediately upstream of the stop valve and is sized to take account of the characteristics of the supply zone and the consumers' pipe work arrangement and relative elevation. Each consumer will be permitted to request a different quantity per day subject to operational constraints and the serviceability of his plumbing. A range of charges will reflect the different demand requirements of consumers.

- ***Reservoir storage:*** the quantity of storage provided will be assessed for the supply zone as a whole and will take into account limitations and constraints within the existing distribution system. Provision of additional storage to optimize pumping requirements with respect to reliability of power supplies and tariffs.

- ***Network Parameters:*** design of new distribution systems, extensions to and rehabilitation of existing systems shall take into account both the long term objectives for the improvement of levels of service and the need to design for growth. Distribution systems shall be designed to

ensure that the minimum pressures are available at the peak hour demand consistent with levels of service requirements. They shall also be checked against minimum demand conditions to assess possibilities for pressure reduction. In practice there will be locations/service connections close to service reservoirs, at local high point and at the extremities of the network where pressures may be lower and where the engineering solution required to raise pressures will be uneconomic. The causes of the lower pressures shall be investigated and provided the local supply arrangements and physical constraints are unlikely to result in failing to meet level of service criteria, the minimum design pressure may be reduced locally to 15 meters. However the pressure shall not fall below 15 meters at any point in the distribution system where there are consumer connections. In urban areas where the existing or proposed buildings are predominantly high rise, the supply authority may require the minimum supply pressure to be 35 meters. Identified specific fire fighting pressure and flow requirements associated sprinkler systems (supply authority agreements with or obligations to specific consumers).

- ***Wastewater Effluent Criteria:*** general guidelines for quality of wastewater discharges to streams and other water bodies are established by the government and concerned organizations. These controls aim at preventing the spread of disease and avoid nuisance through careless discharge of wastes. The distinction between environmental and human risks for different water uses should lead to the formulation of "standards", expressed in maximum receiving capacity of the sea water for specific categories of pollutants most frequently discharged into the marine environment along with the sewage. It is evident that schemes for wastewater disposal into the marine environment should be designed primarily taking into account the beneficial uses to be protected in the area affected by the discharge. Among the different acceptable alternatives for the disposal of urban sewage in coastal localities, reuse and discharge into the sea of complete or partially treated effluents are the two more commonly used for small and medium size towns, while septic tanks and infiltration are applied in hotels and individual dwellings. The general absence of strong tidal currents and the subsequent lack of dispersion in the Mediterranean give great importance to attaining the maximum possible initial dilution and distance between the point of discharge and the predicted impacted areas. Because of these reasons, for most situations in the Mediterranean, sewage outfalls remain a better option and a necessity for domestic wastes under the condition that multiple discharges in the same area do not affect the background levels. Industrial discharges should always be considered for treatment. In order to remain below the receiving capacity of coastal waters, for most Mediterranean situations and for medium to small submarine outfall it will be normally sufficient that the conditions mentioned earlier are maintained when considering all discharges in the affected area. As a further guarantee that the discharge will not exceed the receiving capacity of the marine environment, some basic effluent standards can be applied on medium and large submarine outfalls of cities of more than 50,000 inhabitants. Effluent standards are expressed in a statistical form to allow their control by the corresponding authority.
- ***Environmental protection:*** countries differ in their water requirements and endowments, poverty profiles, institutional capacities, and the problems they face from environmental degradation. Thus, the design of relevant reforms, and the time frame for implementation,

will need to be developed and evaluated case by case. Developing countries have generally paid too little attention to water quality and pollution control. Many of these countries do not have standards to control water pollution adequately or the capacity to enforce existing legislation. Preservation of the environment and the resource base are essential for sustainable development, The protection, enhancement, and restoration of water quality and the abatement of water pollution will therefore be a focus of operations, particularly since providing safe drinking water is so critical to maintain and improve health. It is important to support efforts to improve and expand sanitation and the collection and treatment of wastewater. Efficiency pricing and "the-polluter-pays" principle through the imposition of pollution charges should be applied to encourage water conservation and reduce polluting industrial waste, mining runoff, and wastewater discharges. A balanced strategy involving economic incentives, effective legislation and regulatory systems, and guidelines for levels of pollution control will be used to reduce effluents at the source especially toxic substances. For pollution originating from agricultural activities, initiatives to restore and protect surface and subsurface waters degraded by agricultural pollutants and that minimize soil erosion should be supported. Strategies and cost-effective mechanisms for the ecologically sustainable management, protection, and restoration of recharge areas and water-dependent ecosystems, such as wetlands, floodplain areas, and coastal zones should be encouraged. Based on the increasing importance of groundwater, it is critical to establish linkages between ground and surface water in managing river basins and establish programs and policies, including land use policies that restore and protect the quality of groundwater and preserve groundwater recharge areas. Reducing water pollution in urban areas requires coordinated policies and steps to lower municipal and industrial discharges of wastewater. To reduce the cost of waste treatment, both industries and municipalities should be given incentives to reduce their waste loads based on the principle that the polluter pays. Municipal sewer and sewage treatment surcharges can be applied to water supply fees, preferably on the basis of volume. The industrial use of municipal sewerage systems should be based on clearly established standards for pretreatment and on user charges based on the volume and pollution load of industrial effluents. Best-practice guidelines for minimum levels of pollution control for both municipal and industrial sources can be developed. Establishing the appropriate standards requires careful analysis of the costs and benefits, given the very large price tag associated with cleanup operations and monitoring of enforcement. The cost of sewage treatment can be reduced by using innovative systems, water conservation and demand management, isolation of toxic pollutants, and reuse for irrigation water. Community participation can enhance official enforcement. A recent study in Bangladesh found that downstream villages pressured upstream polluters to install first-stage effluent treatment systems. With better information and legal support, such local participation could provide a cost-effective way to identify enforcement problems. The key is the public disclosure of information on the discharge of industrial and municipal pollution. Disclosure improves compliance by supplementing the limited monitoring resources of public agencies in cooperation with affected communities. It strengthens enforcement efforts by focusing the attention of public officials on health and environmental problems associated with noncompliance. Wasteful use of water should be eliminated, and mining activities that seriously damage water resources should be regulated and controlled. Environmental

considerations need to be built into water projects. For water investments, consideration should be given to protecting natural ecosystems and to directing development to less sensitive or already altered watersheds.

REUSE OF WASETWATER

Agricultural developments have concentrated on the rain-fed areas. In order to develop economical agriculture production in some areas an intervention based on integrated system approach is necessary. Such an approach must take into consideration all technical, socio-environmental factors, though its most critical constraint is water. Also, the development of ***new water resources such as treated wastewater is one of the highest priorities of development in Lebanon***. It will improve the national agricultural production which will have a definite positive impact on the socio-economical conditions of the population in Lebanon and the Middle East region.

The accumulated shortages of water resources as well as the environmental issues represent, in long term, a serious threat to the future development of Lebanon and many countries in the Middle East. Water demands for agricultural purposes are fast approaching the limits of available resources. The solution to the problem of water depletion must be sought in optimum utilization of the available water, in which ***reuse*** plays a vital part. Conservation measures include the recycling of wastewater, along with nutrient recovery. However, uncontrolled wastewater irrigation practices may have major detrimental effects on the health of people who consume the irrigated edible crops, or to farmers who are directly exposed to wastewater irrigation process. Also, soil properties such as salinity might be gravely affected if the concentration of salts in the wastewater exceeds certain limits and guidelines. It is generally accepted that wastewater used in irrigation should not include industrial wastewater which may contain elevated concentrations of trace elements and heavy metals. If treated wastewater is used in irrigation then the major threat to human health comes from microbiological contamination of such water. The trend towards the use of reclaimed municipal wastewater for purposes such as food crop irrigation and groundwater recharge often requires tertiary or advanced wastewater treatment. These reuse applications result in exposing the public to reclaimed wastewater, thus assurance of microbiological and, particularly, virological safely is of utmost importance. Thus, removal or inactivation of viruses from wastewater depends on the level of wastewater treatment, residual solids concentration, and disinfection.

Several studies dealing with wastewater reuse have been performed in different countries; however, more specific research is needed for the application of wastewater reuse in Lebanon, as there is a great diversity in the country's social and cultural activities, topography and geography, climate, ...etc. Until recently, the sole wastewater disposal method in Lebanon was the use of septic tanks, which posed a threat to drinking water supplied by the groundwater resources underlying the inhabited area of any city or village. The Lebanese government therefore started to connect houses through a network of sewers that are ultimately connected to the conventional treatment plants that started to exist in some areas and are under design in other areas. Examples of estimated quantities of treated wastewater in different areas of Lebanon are as follows:

Ghalboun in Jbeil, 1027 m^3/day; Chloumas in Jbeil, 938 m^3/day; Qartaba in Jbeil, 1077 m^3/day; Yanouh in Jbeil, 824 m^3/day; Jouret Arsoun in Metn, 1108 m^3/day; Btebiat in Metn, 4117 m^3/day; Nahr Beirut in Metn, 2124 m^3/day; Qannabe in Metn, 2479 m^3/day; Qortada in Metn, 1337 m^3/day. These are only a few examples of plants under design in Lebanon. In addition, there is the major wastewater treatment plant in Dora serving greater Beirut region with an estimated ultimate flow of 2.33 m^3/sec. From Line A, 4.17 m^3/sec. From Line E with a total of 6.50 m^3/sec. From Line AE to the treatment plant. This is equivalent to 561600 m^3/day lost in the Mediterranean.

Given the above, it is important to deal specifically with the issues of monitoring environmental changes resulting from the reuse of wastewater for agricultural practices, and the establishment of technically feasible and cost-effective wastewater reclamation methods for tertiary treatment. This can be achieved as follows:

- Identify the characteristics of the wastewater treatment plants proposed by the Ministry of Hydraulic and Electric Resources (MHER) and the Council for Development and Reconstruction (CDR) in order to determine its potential use as a source for irrigation;

- Find ways to upgrade the treated wastewater quality by (i) performing a comprehensive search and summary evaluation of the tertiary treatment processes; (ii) optimizing the process of direct filtration processes by determining an optimal combination/polymer dosages, energy inputs, and flocculation time; and (iii) developing technically feasible and cost effective system (conceptual) to convert secondary municipal effluent to a quality suitable for agriculture use.

- Investigate health hazards posed by the use of wastewater for irrigation;

- Evaluate the effects of irrigating selected crops in terms of the changes of accumulations of heavy metals in their tissues.

- Analyze the raw wastewater to identify its components; irrigate a controlled field bounded by appropriate ditches; analyze the collected water from the ditches; analyze the soil properties before and after irrigation takes place over designed period of time; collect field data needed for testing and calibration of the model. Field data includes wastewater effluent quality which concerns with the type of pollutants, its concentration before its use, and its concentrations in the soil based on a designed drainage system; implement the model to determine the effects of varying wastewater effluent conditions on the soil and water resources system.

- Conduct studies and research on the development and management of water resources, and protection of the environment from pollution and degradation;

- Provide services to the public and private sectors in the area of water engineering design,

environmental impact assessment, management of sustainable development, and laboratory and field analysis; identify solutions and propose alternatives for water and environmental problems;

- Create official and public awareness to water, environmental, and development issues; and cooperate with national and international institutions as well as governmental agencies.

SUSTAINABLE WATER USE

Typical Water Use

The overall trends in water use are related to key socio-economic indicators in which the per capita consumption remains high in most developed countries. Industrial, commercial, institutional facilities can benefit from technical 3R programs. Often, seasonal and peak use offers potential for cost effective capital savings. But, system losses remain high in many regions.

Technical Initiatives

In order to preserve water, many water saving technologies have to be applied although they may be simple but yet effective. Pilot programs and campaigns are good implementation devices and public education programs have a vital role to play. Also, leakage reduction technologies need to be promoted widely where repair and rehabilitation technologies offer cost-effective solutions. Finally, process improvements are needed.

Financial Initiatives

The cost of service assessment is crucial to efficient operations. Rate setting and increase need to promote sustainable systems and enhance increased billings and collections as well as inventory control. In addition, reduced litigation & penalties are effective as well as debt analysis and restructuring.

Operations &Maintenance Initiatives

These may include: privatization and outsourcing, competitiveness and performance, operational audits and evaluations, restructuring & organizational design, incentive pay schemes, and training & development.

Supplemental Sources

These include: recycled wastewater, water harvesting, rainwater catchment systems, captured flood runoff, brackish water, submarine springs, crop substitution, cloud seeding, and desalination.

SUMMARY & RECOMMENDATIONS

The challenge is to design options which governments in the Middle East can choose from or adapt. However, to do this, most countries in the region need to remove the major constraints on efficient water management. The adoption of a comprehensive framework for analyzing policies and options would help guide decisions about managing water resources in countries where significant problems exist, or are emerging, concerning the scarcity of water, the efficiency of service, the allocation of water, or environmental damage. The complexity of the analysis would vary according to the country's capacity and circumstances, but relatively simple frameworks can often clarify priority issues. The analysis should take into account any social, environmental, and economic objectives, and should evaluate the status of water resources as far as the level and composition of projected demand. Special attention should be given to the views of all stakeholders.

In order to achieve harmonization of water standards and policies among Arab countries, several steps have to be taken including a well prepared set of regulations that can be agreed upon and serve the interest of most countries of the region as most of the countries are suffering from similar water problems. It can be argued that each country has different conditions and this means that some of the policies cannot be applied to all but we are talking about harmonization and not unification of policies. Below is a set of recommendations for harmonization of standards in the water sector of the ESCWA member states. As far as environmental standards are concerned, many international standards such as the EPA, WHO, Canadian water quality criteria, Environment Canada, ...etc. Although these codes are not unified but they share common grounds as far as concentrations for better quality water. A general understanding of the different water laws as well as policies related to water management and wastewater treatment process, one can suggest the following:

- Understand the hydrology of surface water and groundwater and attempt to apply remote sensing and GIS as important tools for planning water resources projects.

- Put much emphasis on hydro-meteorological conditions in the Near East Countries for the preparation of applying the modern techniques

- Water conservation techniques are necessary to aid in relieving expected water stresses.

- Groundwater recharge should be integrated into a comprehensive water basin planning and management.

- Need to harvest and conserve water by small projects which have multiple purposes using various techniques such as agroforestry and fish farming.

- The benefit of using multiobjective planning methodologies is that it focuses the issue of costs, to achieve the desired national objectives.

- Water quality data and other information need to be obtained on excess water supply, receiving water, and soils geo-hydraulic setting before construction of management schemes.

- Proper treatment of wastewater is needed prior to disposal. It is important to be careful in applying the reclaimed wastewater for artificial recharge so as to avoid contamination of the aquifer systems. Reuse of wastewater should be integral part of water planning.

- Issue legal and environmental regulations in planning projects.

- Adopt an integrated watershed management approach for elaborating policies and strategies of water resources development, management and conservation.

- Selectivity of the appropriate technology to fit with the socioeconomic capabilities in each country and also the tradition followed in these countries.

- Integrated regional databank should be established for geological, hydrogeological, chemical and biological information obtained using standardized international methods.

- Training should be an integral part of the whole process.

- Establish a coordination mechanism between concerned countries in order to avoid fragmentation between agencies in the same country and between neighboring countries.

- Prepare a Coastal Zone Management Plan is suggested and it will serve the following purposes:

1- Prepare a regional environmental assessment which will identify the cumulative pressures and impacts of the coastal zone development under different investment scenarios,

2- Establish a GIS system for physical planning and water quality monitoring of the coastal zone development for use by the Municipalities and/or governmental and non-governmental agencies,

3- Prepare a coastal zone management plan that will hopefully be approved and to be legally binding on all future developments on the coast,

4- Initiate the implementation of emergency actions to protect and/or rehabilitate coastal resources.

5- Develop impact monitoring indicators to present an overview of criteria to measure the

progress in project implementation and progress towards meeting the major project objectives. The indicators are presented for each of the project's main components and are intended to guide supervision missions on major milestones and targets to be chronologically achieved in meeting the major project objectives. Monitoring indicators will have to be continuously updated during project implementation.

6- Eliminate unsanitary and improper dumping of solid-waste and the proper treatment and disposal of liquid wastes,

7- Improve methods of solid and liquid waste collection and disposal near the coast,

8- Improve cost recovery and modernize municipal management and finance systems,

9- Improve the quality of effluent, through the introduction of a proper operation and maintenance program,

10- Increase the involvement of the private sector in liquid and solid waste management,

11- Create instruments for the more orderly planning and development of the Lebanese coastal zone,

12- Clean up and rehabilitate the coastal zone.

- Adopt an integrated watershed management approach for elaborating policies and strategies of water resources development, management and conservation. The objectives of the water policies are to achieve the following improvements:

1- *For industry:* extensive water conservation and protection of groundwater sources. Experience in industrial countries suggests that controlling pollution will also substantially reduce the quantity of water used per unit of industrial output.

2- *For water supply and sanitation:* more efficient and accessible delivery of water services and sewage collection, treatment, and disposal, with the ultimate goal of providing universal coverage. This will be achieved by extending existing supplies through water conservation and reuse and by using other sustainable methods. Greater involvement of the private sector, non-governmental organizations, and user groups will be required, as will cost recovery to ensure financial viability while applying graduated fees to assist the poor.

3- *For irrigation and hydropower:* modernized irrigation practices, greater attention to cost recovery, drainage and salinity control, measures to reduce pollution from agricultural activities, improvements in operation and maintenance of existing systems, and investments in small-scale irrigation and various water-harvesting methods.

4- *For the environment and poverty alleviation:* more rigorous attention to minimizing resettlement, maintaining biodiversity, and protecting ecosystems in the design and implementation of water projects. Water and energy supplies gained through conservation and improved efficiency can be used instead of developing new supplies to extend service to the poor and maintain water-dependent ecosystems. Low-cost and environmentally sound methods of developing new water supplies for agriculture, rural drinking water, and industry will be pursued.