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THE ROLE OF NON-CONVENTIONAL WATER RESOURCES OF AUGMENT CONVENTIONAL ONES IN ESCWA COUNTRIES

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1. Introduction

The region of ESCWA countries is about 4.75 million square kilometers and 97.7% of this area is desert. Water is a valuable and limited resource and its development and management require considerable investment. Climatic conditions, availability of water resources, socio-economic conditions, national borders, conflict of interest and politics play an important role in hindering the development in many countries of the ESCWA region. Water resources issues are probably more significant in this region than in any other part of the World.

The member countries of Economic and Social Commission of Western Asia (ESCWA) are Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine (the West Bank and Gaza Strip), Qatar, Saudi Arabia, Syria, the Yemens and the United Arab Emirates (UAE). All these member countries are situated in either the arid zone, relatively arid or semi-arid and thus can be group accordingly.

The population of ESCWA region in 1990 was estimated to be over 124 million and it is expected to reach 266 million by the year 2015. Table (1) shows the population and water supply situation in all ESCWA countries. This region is also characterized by high population growth rates due to economic growth, improved health and social services, and increased oil revenues in the early seventies for some of the countries in this region. With population growth and increased development and efficient utilization of the regions water resources has become a major challenge[1].

Population increase and urbanization require extra quantities of water for domestic, industrial and agricultural uses. Improvement in living standards increases demand for domestic water and sanitary services. As any society becomes more effluent it will generate more per capita waste.

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1 Fakhrudin A. Daghestani and Arafat R. Altamemi, "Science and Technology Issues For Development in The Islamic World". Published in Amman, Jordanby by The Islamic Foundation for Science, Technology and Development, 1991.

It is possible to group ESCWA countries in to 3 groups. Group I countries are situated in arid zone and they lack sufficient natural water resources, fertile soil, and suffer from adverse climatic conditions[2]. They have to desalinate sea water to obtain most of their fresh water needs and to reuse sewage effluents to meet the needs of their high rate of population growth and rapid development. All group I countries share the western coast line of the Arabian Gulf. Oman, UAE, and Saudi Arabia have long coast lines on the Arabian Sea.

Group II are situated in relatively arid zone and include Jordan, Patestine, and Yemen. These countries have a better natural water potential than group I, yet water shortage is eminent in many of these countries.

Group III countries are situated in semi-arid zone and include Egypt, Iraq, Lebanon, and Syria. The most important water resource problem of this group is that they share among themselves and with neighboring countries a substantial percentage of their surface water. The water resources of group III are adequate only for the coming decade and if they conserve, develop and manage these resources.

Most of ESCWA countries have developed almost all of their naturally available fresh water resources. Some of these countries are extracting water from non renewable water resources such as fossil water. Other countries are over pumping from exploited aquifers and causing water quality deterioration. One has to remember that the global fresh water supply is limited and may never be increased, but the existing quantity could be developed and managed to supply man's needs for a longer time to come.

Non of ESCWA countries is self sufficient in food production. Countries like Saudi Arabia, Iraq, Qatar, and others in the region import large quantities of food. In 1989 the ESCWA countries imported $ 12.5 billion in food. Turkey is the main source of food and fresh vegetables to the ESCWA countries (F. Daghestani, 1991).

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2 United Nations, Economic and Social Commission for Western Asia, "Development of Manpower, Education and Training in the Water Sector in Western Asia", Document No. E/ESCWA/NR/85/14/1987.

Industry must be encouraged to invest in better water efficiency, more recycling, and resource conservation. Water use standards can be set for each industry and factories could be allocated only as much water as necessary to achieve their production targets. As new technologies are developed, the standards become more stringent. This is equivalent to an effluent fee which is a type of environmental tax to be paid by the industry in order to minimize the costs of pollution damage and pollution abatement.

Government policies regarding management of industrial effluents in some ESCWA countries are not adequate and are not suitable for local conditions. Some countries have introduced standards for discharge of wastewater but these standards tend to be stringent and difficult to comply with. A discharge standard that is difficult to achieve will make the industry more reluctant to cooperate with the regulatory agencies in any country. Wastewater discharge standards should be site or location specific and should take into consideration the effect of pollutants on the receiving environment. The treated effluents from industry can be significant contribution to non-conventional water sources.

The scarcity of water in the region calls for a shift in the way water is valued, used and reused. If food production is to keep pace with expanding food needs, attention must turn to increasing water productivity in agriculture. Sustaining economic growth and supplying growing cities with food and water will require recycling, reusing, and conserving water to get more production out of existing supplies. Only by building water efficiency into farms, factories, and growing urban areas can many ESCWA countries prevent the constraints to economic growth.

2. Non-conventional water sources

The terminology for non-conventional water is not accurately defined and may mean different water sources. Water sources that are not indigenous or that are not readily available and suitable for direct beneficial use can be considered non-conventional. The most obvious and relevant non-conventional water sources in the ESCWA region are those obtained from desalination, sewage effluents , imported water, cloud seeding and possibly water obtained from non renewable and very deep aquifers.

a) Desalination

Water desalination is a well established and proven technology. It is technically possible to produce large amounts of water of adequate quality by the process of desalination of brackish or sea water. Raw water delivered to a desalination plant may be divided into the following broad categories:

- Sea-water, which generally has a constant composition ranging from 35,000 to 45,000 mg/l of dissolved solids;
- Brakish water, which is defined as having no more than 10,000 mg/l of dissolved solids;
- Waste water, which is available from a variety of sources and has a wide range of both types of dissolved impurities and their concentrations.

The world installed desalination capacity since the introduction of this technology is in excess of 11.48 MM3/day. Plants of up to one million M3 per day have performed reliably. The greatest number of desalination plants are built in group I ESCWA countries. More than 60 % of world desalination capacity is located in the Arabian Peninsula. Saudi Arabia has (30.2 %), Kuwait (11.5 %), and UAE (11 %) of world desalination capacity[3].

Worldwide desalting plants inventory shows that 64.5 per cent desalting plants operate on the multistage flash (MSF) principle and that the RO process accounts for 23.4 per cent and some operate on the principle of multi-effect and vapor compression.

New technologies are coming into the desalination market place such as membrane distillation. It is claimed that membrane distillation can produce permeate of 0.2 to 0.6 µS/cm regardless of the feed water quality [4]. Ceramic RO membranes are said to tolerate very high amounts of suspended solids in the feed water. These technologies are very promising

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3 Leon Awertbuch, "Desalination technology, An overview", Water Technology International 1992, pp 227, Century Press, Holford Mews, Cruikshank Street, London WC1X (HD. 1991.

4 Aapo Saak, "Desalination technology, An overview", Water Technology International 1992, pp 237, Century Press, Holford Mews, Cruikshank Street, London WC1X (HD. 1991.

and can widen the application of desalination to include waste water and raw sewage.

Water obtained by desalination of sea is considered a net addition to the water budget of a country or a region. Therefore, it is prudent to take this important factor into consideration when making financial evaluation of the cost of water desalination. Any quantity of high purity fresh water that is added by desalination to a water-use system can be considered to have a multiplied reuse effects.

Desalination of brakish water is less costly and more flexible especially with regard to removal of dissolved salts. This means better management of the product water and can permit multiple reuse cycles in industry and then for irrigation. Even more than two reuse cycles are possible; namely, first as potable water then treated sewage for industrial cooling and other uses and finally for irrigation.

The salt content of water is the most important single parameter that affect the cost of water desalination and limit its reuse cycles. This is especially true in arid and dry countries. The soils in arid climate is considerably more saline than soils in humid countries. The impact of all this is when is reused. Therefore, the salinity and alkalinity of non-conventional water in relation to agricultural reuse is most important factor.

Desalination, specially by RO, is always accompanied by a disposal of a reject concentrated saline stream. This is not a serious problem when a desalination plant is located at sea shore. Inland desalination of brackish water can create brine disposal limitations and if the brine or reject stream is not managed properly can affect nearby shallow aquifers. This is a typical problem faced by power generation plants and petroleum refineries in Jordan and similar countries.

Desalinated water is considered the main source of non-conventional water in group I ESCWA countries. It will be the only source fresh water source in Bahrain, Qatar, and UAE. Jordan will soon have to desalinate brackish ground water on an ever increasing scale in order to supply drinking water.

b) Effluents reuse

The construction of sewer net works and sewage treatment plants is increasing in the ESCWA countries. This will result in increasing amount of reclaimed sewage effluents. Table (2) shows estimates of effluents in ESCWA region[5]. Effluent reuse provides some temporary relief to water and resource scarce countries like Jordan.

Industry can be considered as a source of considerable amounts of reusable effluents. The beverage industry for instance, which is growing at very high rate, is a big fresh water user. But this industry is also a big consumer of salt for water softening. This results in addition of significant amounts of sodium and chloride ions to the waste water. Potassium chloride can substitute for normal table salt in softening and will result in reducing the sodicity of the product effluents.

Industries desalinate water for different purposes then all waste water and the brine that result from desalination are discharged into a combined sewer. This means spending a great deal of energy in separating the salts then simply mixing them again at the discharge point. Brine streams must be kept separate from waste water and must be disposed of by a suitable method such as solar evaporation or deep well injection.

Water scarcity in ESCWA countries must have its impact on many water-using technologies, especially those used in the home which are not designed or intended for water scarce countries.

The largest use of water is for irrigation. Many ESCWA countries still subsidize water to the agricultural sector. The policy of subsidy did not result in improving the productivity and efficiency of the agricultural sector. Subsides encourage consumption. One can see farms spreading across deserts in the Gulf countries, Jordan and Egypt. As a result of this is thaty aquifers started to deplete, water tables started to drop, and stream flows diminished.

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5 Saqar S. Al Salem, "Potential and Existing Treated Wastewater Reuse in the ESCWA Countries, 1993.

c) Imported water

Importation of water is under active consideration in the Middle East. Water transport by large conduits is considered in many other parts of the world. The idea of conveying water through conduits: either canals, pipelines or tunnels requires huge investment and regional cooperation.

The technical considerations involved in canal, overland pipeline and tunnel construction are generally well understood. In order to estimate costs for water conveyance schemes, specific project information is needed. Preliminary cost estimates have been made for a number of the large-scale water transfer projects proposed for the Middle East. The largest of these is the Turkish Peace Pipeline proposed in 1987. The total project would cost $21 billion and provide 2,200 MM3 per year. A more modest Mini-Peace Pipeline was proposed to convey 600 MM3 per year with a project cost of $3 or $4 billion [6]. Water transport project will only become possible when there is peace and prosperity and regional cooperation.

Apart from short-term and small-scale deliveries by tanker truck, the two options most relevant to ESCWA involve transportation by pipeline from Turkey in the north or from the Nile in the south. countries that are located on the sea are considering water transportation using medusa bags, each of which carries about 1,5 MM3. The medusa bags are a Canadian invention and are made of thick nylon coated with vinyl and reinforced with nylon straps [7](Stehen and Brooks).

But the idea of water importation means in commercial terms that water is then treated like any other commodity. If we have to accept this now then it is necessary to understand how we will price water for the biggest users. It is going to affect first the agricultural sector and this will start the debate of how to provide jobs to the will be unemployed.

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6 Wachtel Boaz. "The Peace Canal Project on the Golans", Abstarct published in a report on Enhancement of Middle East Water Supply, A literature survey, 1992.

7 Stephen C. Lonergan and David B. Brooks, " The Economic, Ecological and Geopolitical Dimentions of Water in Israel", Published by Centre for Sustainable Regional Development, University of Victoria, Canada, 1992.

Water security for ESCWA countries is as important as food security. Therefore, one can consider the possibility of importing water to the region instead of importing food (fresh food and vegetables consist of more than 90 % water). This means that we look into the gains that are likely to result from conveying water to some of these countries in order to conserve local water resources and specially groundwater and also in order to create more jobs for the unemployed.

d) Conclusion

All ESCWA member countries have put large investments in developing their water sector. Some countries like Jordan and Egypt borrowed from foreign banks large sums of money to provide domestic water and sanitary services. It is important for these countries to maintain and operate their water supply and treatment systems at an optimum level and to price water to the consumers such that it reflects the real cost involved in order to be able to repay their creditors.

The boundaries of water supply sources, both surface and subsurface are shared within many ESCWA countries as well as with countries from outside this region. Up stream riparian could affect the quantity and quality of surface water. The same is true for shared groundwater resources. Cooperation and information sharing will improve water use efficiency in this region.

Over pumping of shallow aquifers leads to a fall in the water table and drying up of wells. Abstraction on one side of the boundary may seriously affect supplies on the other. Such a situation can lead to competition where a vital commodity is scarce and it is directly or indirectly shared.

The water situation in the Middle East has become an overwhelming issue. Governments, international agencies, and planners are concerned with the growing deficit between supply and demand. Many factors work together in a manner that make water availability and distribution a dilemma.

The crisis of water is delayed in many countries with no real solution. Poor countries at the present deal with the water shortage problem by

attempts to improve water use efficiency, tapping non renewable sources, and reuse of effluents.

Some water intensive industries may be located near central sewage treatment plant in order to use sewage effluents for suitable industrial uses. Refineries, thermal power plants, metal industries can use treated sewage effluents and discharge it for further use for irrigation. The industrial use must minimize addition of minerals and salts into the content of the effluents.

Water productivity in ESCWA countries must be measured in terms of benefits gained from each cubic meter of water used. Industrial processes require large quantities of water and depending on the type of industry these processes generate different quantities of wastes.

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Table (1)*

Estimated water supply in ESCWA region

		population in millions			% population	Available surface	Available ground	Nonconventional	Nonconventional
		1990	2000	2015	growth rate	MM3 /1985	MM3 /1985	MM3 /1985	MM3 /2000
1	Bahrain	0.50	0.71	1.21	3.6	0	153	87	186
2	Egypt	52.54	65.95	92.76	2.3	55500	5850	1400	2200
3	Iraq	18.82	26.29	43.41	3.4	41500	2000		
4	Jordan	3.22	4.59	7.80	3.6	826	260	35	116
5	Kuwait	2.11	2.78	4.21	2.8	0	247	356	547
6	Lebanon	2.99	3.68	5.03	2.1	4300	3000		
7	Oman	1.51	2.21	3.93	3.9	1039	569	10	39
8	Palestine	1.71	2.30	3.58	3	50	228		
9	Qatar	0.44	0.65	1.15	3.9	0	100	198	274
10	Saudi Arabia	15.20	22.94	42.51	4.2	2712	20112	1534	1534
11	Syria	12.45	17.73	30.14	3.6	30285	5655		
12	UAE	1.57	1.97	2.77	2.3	264	387	225	225
13	Yemen	11.67	16.46	27.58	3.5	2900	1177	9	9
	Totals	124.73	168.27	266.08		139376	39738	3854	5130

* sources from : F. Daghestani, 1991 and S. Al Salem 1993

MM3 = million meters cube

Table (2)*
Estimated effluent supply in ESCWA region

		Population (in million)			% population	sewage, M3/cap/y			sewered			treated sewage MM3/y		
		1990	2000	2015	growth rate	1995	2000	2015**	1995	2000	2015**	1995	2000	2015**
1	Bahrain	0.50	0.71	1.21	3.60	151	157	164	0.58	0.65	0.85	44	73	169
2	Egypt	52.54	65.95	92.76	2.30	47	68	69	0.45	0.55	0.60	1,111	2,467	3,840
3	Iraq	18.82	26.29	43.41	3.40	40	42	44	0.40	0.50	0.70	301	552	1,337
4	Jordan	3.22	4.59	7.80	3.60	29	31	35	0.52	0.60	0.90	49	85	246
5	Kuwait	2.11	2.78	4.21	2.80	73	77	88	0.85	0.90	0.92	131	193	341
6	Lebanon	2.99	3.68	5.03	2.10	55	57	58	0.50	0.55	0.73	82	115	213
7	Oman	1.51	2.21	3.93	3.90	70	73	88	0.15	0.18	0.30	16	29	104
8	Palestine	1.71	2.30	3.58	3.00	44	46	55	0.45	0.75	0.80	34	79	158
9	Qatar	0.44	0.65	1.15	3.90	80	82	84	0.65	0.70	0.90	23	37	87
10	Saudi Arabia	15.20	22.94	42.51	4.20	73	82	84	0.70	0.72	0.80	777	1,354	2,857
11	Syria	12.45	17.73	30.14	3.60	55	57	58	0.55	0.65	0.75	377	657	1,311
12	UAE	1.57	1.97	2.77	2.30	73	77	80	0.70	0.85	0.88	80	129	195
13	Yemen	11.67	16.46	27.58	3.50	15	20	24	0.30	0.35	0.50	53	115	331
	Totals	124.73	168.27	266.08								3,077	5,886	11,188

* sources from :a- F. Daghestani, 1991, b- S. Al Salem 1993

** Estimated by interpolation from 2000 to 2015

MM3 = million meters cube