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in the Water Sector in the ESCWA Region
5-8 June 1989
Amman, Jordan

Working paper:

PRELUDE TO

THE ESTABLISHMENT OF
A REGIONAL WATER TRAINING NETWORK
IN THE ESCWA REGION

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Introduction

A. Need for trained manpower in the water sector

Water resources continue to form an important component of national development in today's world. In the Economic and Social Commission for Western Asia (ESCWA) region, water resources projects constitute a significant part of development activities, drawing on unilateral, bilateral and international financing which is mainly employed to promote the water sector by introducing sophisticated technologies. In this region, the growth of population and, in parallel, agricultural and industrial development, impose greater demands on limited renewable water resources. Conventional water supplies are being exploited to the point of exhaustion and new sources are being explored in an effort to meet the excessive water needs of the people of the region. Hence, efficient management, planning and the conservation aspects of water resources development activities are needed to develop national systems operated by trained manpower at different levels. The shortage of professional and technical manpower in the region constitutes a drawback to the successful development of water resources and therefore, places a constraint on the development of modern water resources institutions.

The manpower situation, where some countries with a surplus of manpower export this surplus to other countries of the region which suffer from a lack of skilled manpower, is the result of many problems. The ESCWA region suffers from a variety of problems owing to its heterogeneous structure and resources. Though all ESCWA member States fall within the category of developing countries, per capita income in these countries ranges from the highest to the lowest in the world. As far as population is concerned, some member countries are densely populated, while others are underpopulated.

All ESCWA member States, however, share the common problem of a shortage of personnel at the technical level. The salaries of technicians are considerably less than these of professionals. Consequently, there is an imbalance between professionals and technicians. This affects the essential task of manpower planning, which aims at having various kinds of qualified skilled or trained personnel at the right time and in the right numbers in order to avoid both surpluses and shortages.

Since the situation of trained manpower is critical, the planning of water resources development becomes a complex operation requiring a wide range of expertise owing to the interdisciplinary character of water use and management problems. This dictates that the services of various professionals, with their corresponding assistants or middle-level technicians (hydrologists, hydrogeologists, engineers-civil, hydraulic, hydropower, irrigation, agricultural and sanitary-geographers, catographers, geophysists, chemists, biologists and water resources planners) must be available. This interdisciplinary character is further amplified at the development state where experts in economies, law, health and administration are required.

Consequently, ESCWA countries must strengthen their existing manpower resources and establish new network situation for the purpose of developing trained, qualified personnel exchanging information and expertise between

themselves and other countries. Therefore, continuous efforts must be directed towards training manpower in the water sector, which is the key to improving water resources development, conservation and management.

B. Background

A major problem of water resources development faced by ESCWA countries is the lack of trained manpower at all levels. This was recognized by the United Nations Administrative Committee on Co-ordination Inter secretariat Group for Water Resources at its first session, when the need for systematic programmes of manpower training in water resources development and management was stressed. Also, the United Nations Water Conference held at Mar del Plata from 14 to 25 March 1977, called upon countries to implement training and research programmes to give water management planners an understanding and appreciation of the various disciplines involved in water resources development and utilization; to provide professional, technical and skilled manpower in conventional and non-conventional water resources techniques and to provide managers for water resources projects, operators for water distribution and for treatment plants and monitors for water quality installation.

As in the case of most developing countries, ESCWA member States need to be provided with the know-how, and financial means to develop their own resources to enable them to reach the level of the developed, industrialized nations. In order for ESCWA countries to catch up with the advanced nations in the field of water resources, in addition to developing co-operation amongst themselves, they need to develop trained manpower at all levels.

The ESCWA secretariat, in its efforts to assist the provision of trained manpower in the water sector, decided that its contribution to the qualitative and quantitative improvement of manpower, education and training facilities in this field should be given high priority. This has been reflected in all its water resources programmes, especially the action proposals submitted to the United Nations Water Conference in 1977, where the Mar del Plata Action Plan was drawn up1/. One important aspect included in the Action Plan is proper planning to establish a trained cadre in different aspects of the water sector at all levels.

Also, during the Second Regional Water Meeting held at Riyadh on 30 December 1978 to 3 January 1979, the ESCWA secretariat presented a study on the manpower situation and requirements in the water sector, which revealed the need for a regional training institute. Several delegates stressed the need for such an institute and the Jordanian Government expressed its willingness to act on host. However, a number of delegates stressed that there was no need for a new regional water institute and that the use of existing national training facilities in the different disciplines of water resources, appropriately strengthened, might be preferable at this stage.

1/ Report of the United Nations Water Conference, Mar del Plata, 14-25 March 1977 (United Nations publication, Sales No. #.77. II.A.12).

The Economic and Social Council (ECOSOC) in section III of its resolution 1981/80 of 24 July 1981 on water resources development, requested the Secretary-General "to develop integrated and comprehensive approaches and programmes with regard to education and training in the field of water resources in developing countries". It also requested the regional commissions and the organizations concerned "to consider the establishment and upgrading of regional and subregional water training programmes and networks, taking into account existing arrangements".

C. Objectives

The importance of well-trained manpower in handling exploration, development, conservation and management of water resources must be emphasized, especially in view of the following: the absence of a water strategy and plans of action at the country and regional level, the lack of regional and subregional co-operation on vital issues, the limited use of modern technologies such as remote-sensing in the exploration and possible optimization of water resources in the region, the lack of co-operation in formulating centres and institutions for water resources activities that are capable of handing the above-mentioned issues on training, research activities, the proper use of available facilities in the region and full exploitation of international assistance.

It is clear that success in increasing the quantitative and qualitative utility of water hinges to a great extent on the ability to find new and improved methods and technologies. It should be noted, however, that technology alone is not the pancea for all of the water problems in the region; local applications of advanced technology call for support from local institutions to establish technical cadres to deal with this technology.

After taking into consideration the recommendations made by the Second Regional Water Meeting in its detailed study of 1987[1/], and as a follow-up to these activities, ESCWA included a programe element entitled "Manpower training in ESCWA region" in the programme of work and priorities for the biennium 1988-1989 (E/ESCWA/C.1/14/8).[2/] The Expert Group Meeting on manpower Training Needs in the Water Sector in the ESCWA Region will be held at Amman on 5-8 June 1989 to discuss different issues relating to manpower training needs in the water sector, and to make recommendations on future co-operation among ESCWA countries in this field.

Accordingly, the present study presents a proposal on the kind of co-ordination that could be developed among ESCWA countries, including the establishment of a co-ordinating body for training, upgrading and expanding regional training capabilities in water resources in the ESCWA region, together with the establishment of a regional network for training in water resources development.

1/ See Economic and Social Commission for Western Asia, Study on Manpower Training Needs and Problems in the Field of the Water Resources Development in the ECWA Region, Preliminary report presented to the Second Regional Water Meeting (E/ECWA/NR/CONF.3/9), (Beirut, 4 December 1978).

2/ See "Natural resources in Western Asia", subprogramme 1, programme element 1.5.

I. CRITERIA FOR ESTABLISHING THE NETWORK

A. General

The present study will discuss the criteria for establishing a regional network for training in water resources development. In order to ascertain the need for the establishment of the proposed network, the ESCWA secretariat will seek the views of the experts who attend the Meeting.

The criteria for establishing the regional network on training in water resources in the ESCWA region are as follows:

1. To ascertain the need for the establishment of the regional network;
2. To determine the order of magnitude of training requirements;
3. To assess the regional capability of providing training;
4. To identify fields in which training is most needed;
5. To point out the appropriate functional organization and structure of the network which would meet the needs of the region.

B. Training capabilities and requirements in the ESCWA region

The ESCWA study Development of Manpower Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) presented a survey on the training capabilities and requirements on the basis of data furnished by most ESCWA countries for each major field of the water sector during the period 1984 to 1985. The study was an output of subprogramme 3 on water resources development and management, programme element 3.1, entitled the "Promotion of manpower training and education programmes in the water sector within the region", of the ESCWA programme of work and priorities for 1984-1985 (E/ECWA/167), which complied with ECOSOC resolution 1981/80.

The study included an assessment of the manpower situation and of education and training in the water sector, as well as detailed recommendations for the development of manpower education and training facilities in this field.

The study concluded that:

1. There were an estimated 4,650-5,150 professionals in the water sector in Western Asia in 1985, whereas the required number was in the order of 5,250, which indicated a deficit of between 600-900 professionals (see table 1). Furthermore, some of the professionals were not water or civil engineers, which meant that they had to undergo extensive training before they were able to do the tasks assigned to them.

2. From the estimates in the study, it was concluded that about 800 additional professionals were needed annually in the region to meet the increase in economic development activities and turnover of personnel in the water sector.

3. According to the available (incomplete) information, the number of technicians in the water sector in Western Asia was estimated to be between 16,750 and 18,350, which indicated that there was a serious deficit of 4,300-5,400 technicians. The above comments on the specialization in other branches also applied to technicians.

4. No estimates were made of the number of semi-skilled and skilled workers, largely owing to lack of data. In any case, it was easier to produce workers at these levels, and the necessary training could be provided as required without any major capital expenditure once the professionals and senior technicians were available to train them.

5. In a global study undertaken by the United Nations Educational, Scientific and Cultural Organization (UNESCO) which included the Arab States a relationship between the demand for professionals and technicians in water sector and the country's population was derived for different economic and hydrological characteristics and water-use practices. In another UNESCO study, the need for engineers and technicians in the Arab region up to the year 2000 were studied. Combining the results of these two studies, a methodology was derived for obtaining order-of-magnitude estimates of requirements for professionals and technicians in the water sector in Western Asia. These estimates are presented in table 2 for different time horizons.

6. The deficit in the number of professionals and technicians in the water sector was estimated for each member country and is presented in tables 3 and 4. In these same tables, order-of-magnitude estimates for the annual additional numbers needed to meet the requirements of additional activities and to replace losses due to retirement, resignation, etc., as well as expatriates who are to be replaced, are also presented.

Table 1. Estimates of the manpower situation in the water sector in Western Asia in 1985

Country	Professionals	Technicians
Bahrain	40-60	200-250
Egypt	1,600-1,800	6,500-7,000
Iraq	(750-800)a/	(2,500-2,800)a/
Jordan	150-200	600-800
Kuwait	220-260	900-1100
Lebanon	(100-140)a/	(500-600)a/
Oman	40-50	60-80
Qatar	(60-100)a/	(250-300)a/
Saudi Arabia	755	3,367
Syrian Arab Republic	72	1,215
United Arab Emirates	55-70	100-130
Yemen Arab Republic	100-120	400-500
Democratic Yemen	60	180-220
Total	4,658-5,143	16,772-18,362

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia, (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 8.

a/ Not based on data.

Table 2. Order-of-magnitude estimates of requirements for professionals and technicians in the water sector in the ESCWA region

	Estimates for corresponding years											
	1985			1990			1995			2000		
Country	Population	Prof.	Tech.	Population	Prof.	Tech.	Population	Prof.	Tech.	Population	Prof.	Tech.
Bahrain*	360,000	60	240	410,000	78	274	463,000	94	304	515,000	110	330
Kuwait	1,721,000	103	413	2,101,000	164	576	2,524,000	237	767	2,936,000	323	969
Oman	1,041,000	62	250	1,218,000	95	334	1,423,000	134	433	1,651,000	182	545
Qatar*	285,000	60	240	330,000	78	274	377,000	94	304	425,000	110	330
S.Arabia	10,823,000	649	2,598	12,908,000	1,007	3,537	15,247,000	1,433	3,635	17,804,000	1,958	5,875
UAE*	883,000	60	240	1,025,000	80	281	1,146,000	108	348	1,286,000	141	424
Iraq	15,475,000	836	3,343	18,136,000	1,270	4,480	21,054,000	1,790	5,748	24,198,000	2,396	7,187
Syria	10,903,000	589	2,355	13,227,000	926	3,267	15,866,000	1,349	4,331	18,677,000	1,849	5,547
Jordan	3,888,000	175	700	4,657,000	270	959	5,448,000	381	1,242	6,510,000	534	1,608
Egypt	47,240,000	2,126	8,503	52,709,000	3,057	10,858	58,908,000	4,124	13,431	64,421,000	5,283	15,912
Yemen	6,536,000	294	1,176	7,447,000	432	1,534	8,565,000	600	1,953	9,828,000	806	2,428
PDRY	2,124,000	96	382	2,459,000	143	507	2,863,000	200	653	3,312,000	383	818
Lebanon	2,963,000	133	533	3,301,000	191	680	3,653,000	256	833	3,992,000	327	986
TOTAL		5,243	20,973		7,791	27,561		10,800	34,982		14,291	42,959

* For countries with less than one million population, the requirements for one million are taken.

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 11.

Table 3. Deficit in the number of professionals in the water sector in 1985 and annual additional requirements between 1985-1990

	Deficit in 1985	Annual additional required		
		For additional activities	For turnover and Expat. replacement	Total
Bahrain	0-20	4	4	8
Egypt	326-526	186	84	271
Iraq	36-86	87	40	127
Jordan	0-25	19	10	29
Kuwait	-	-	26	26
Lebanon	0-8	12	7	19
Oman	12-22	7	5	12
Qatar	-	4	8	12
Saudi Arabia	-	72	76	148
Syria	-	68	36	104
UAE	0-5	4	6	10
YAR	174-194	28	12	40
PDRY	36	9	3	12
Region	584-921	500	318	818

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) Baghdad, 16 August 1987), table 21.

Table 4. Deficit in the number of technicians in the water sector in 1985 and annual additional requirements between 1985-1990

	Deficit in 1985	Annual additional required		
		For additional activities	For turnover and Expat. replacement	Total
Bahrain	0-40	7	23	30
Egypt	1,503-2,003	471	337	789
Iraq	543-843	227	133	360
Jordan	0-100	52	35	87
Kuwait	-	33	100	133
Lebanon	0-33	29	27	56
Oman	170-190	17	7	24
Qatar	-	7	27	34
Saudi Arabia	-	188	337	525
Syria	1,240	182	60	242
UAE	-	8	12	20
YAR	676-776	72	45	117
PDRY	162-202.	25	10	35
Region	4,294-5,427	1,318	1,153	2,452

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) Baghdad, 16 August 1987), table 22.

C. Assessment of education and training in the ESCWA region

1. Education of professionals

At the undergraduate level in the region, specialization in water engineering is somewhat limited. Some universities produce irrigation and drainage engineers in their faculties of agriculture, but the output in other aspects of water engineering is very limited. The number of graduates with a Bachelor of Science (B.Sc.) degree in civil engineering exceeded 5,000 in the region, but of this number, only a little over 200 specialized in hydraulics/water engineering (see table 5).

The data on the education and training facilities in universities, technical institutes and training courses in water-related subjects are listed in annex table A-I.

According to the ESCWA study, civil engineering faculties usually offer 3-6 water-related subjects as basic and optional courses at the B.Sc. level. In the faculties where specialization forms part of undergraduate studies, it is possible to concentrate on water-related subjects in the last two years of engineering school.

A review of the curricula of the civil engineering faculties reveals that they are quite adequate but require consolidation. If the member countries decide to introduce specialization at the undergraduate level, then new curricula must be considered, including a number of additional special topics as compulsory and optional courses. Sample curricula for basic undergraduate work (B.Sc. degree) in civil engineering and for specialization in a water field are presented in table 6. These curricula are available for students following a four year B.Sc. degree course, since this is the normal period required to obtain the degree. In many universities in the region, five years is the normal period required to complete a B.Sc. degree, but this is usually owing to the relative unpreparedness of secondary school graduates who require a preparatory year of study at the beginning.

Currently, graduate-level studies in the region are very recent in origin and the output of graduates is limited. The total number of M.Sc. graduates was less than 100, and there were very few with a Ph.D., as can be seen from table 6. At the M.Sc. level, civil engineering graduates with a B.Sc. degree begin specialized programmes in water resources, hydraulic engineering or in other related fields. It usually takes a minimum of two years to obtain an M.Sc. degree in this field in the ESCWA region. Some universities have updated their curricula and others are planning to do so. Table 7 presents guidelines for typical curricula for graduate work at the M.Sc. level in branches related to water science and engineering.

Table 5. Number of annual graduates in civil engineering and water-related fields in Western Asia

	BS degree		MS degree water-related	Ph.D. degree water-related	Remarks
	Total: civil + water-related	Water-related			Remarks
Bahrain	-	-	-	-	
Egypt	2,560	79	8	2	1983 graduates
Iraq	(1,000)	200*	(18)	(2)	Estimated
Jordan	120	35	9	-	1984//1985
Kuwait	80	-	-	-	New MS programme starting 1985/1986
Lebanon	(100)	(25)	(10)	-	No conclusive info. available estimated
Oman	-	-	-	-	University will soon start
Qatar	(20-25)	(4-6)	-	-	
Saudi Arabia	170	40	30	2	
Syria	1,000	25*	20	-	First MS graduates in 1986
UAE	21	6	-	-	
YAR	30	-	-	-	First graduates in 1986
PDRY	36	-	-	-	
Total	5,137	214	95	6	

* All in irrigation and drainage.

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 23.

Table 6. Typical curricula for undergraduate work (B.Sc. degree) in civil engineering and specialization in a water field

Undergraduate studies: basic requirements

Mathematics, physics, chemistry, technical drawing, surveying, social subjects (humanities/arts, etc), economics, geology, statistics, dynamics, fluid mechanics, strength of materials, electrical and mechanical engineering, computers, systems' engineering, etc.

Civil engineering:

Structural engineering
Reinforced concrete
Water resources engineering
Sanitary engineering
Soils and foundations

Water science and engineering (to be elected from the following courses):

Advanced fluid mechanics
Hydraulics
Sanitary engineering
Hydraulic engineering
Water resources planning, development and management
Basic hydrology
Hydrological measurements
Hydrological analysis
Open channel flow and sediment transport
Irrigation and drainage engineering

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia, (E/ESCWA/NR/85/14) (Baghdad 16 August 1987), p.97.

Table 7. Typical curricula for graduate work (M.Sc. degree) in branches related to water science and engineering

Subject	Hydrology	Hydro-geology	Water resources	Hydraulic engineering	Sanitary engineering	Irrigation and drainage
Advanced fluid mechanics		X		X	X	X
Hydraulics		X		X	X	X
Sanitary engineering					X	
Hydraulic engineering				X	X	X
Water resources plan. develop. and management	X	X	X	X		
Water resources systems and analysis			X			X
Water resources economics			X	X		X
Water legislation and administration				X		
Basic hydrology	X	X	X	X	X	X
Hydrological measurements	X					
Hydrological analysis	X	X	X			X
Statistical hydrology	X					
Hydrological forecasting	X		X	X		X
Urban hydrology	X				X	
Hydrology of agricultural lands	X					X
Hydrological services	X					
Stochastic and parametric hydrology	X					
Nuclear and tracer techniques in hydrology	X					
Photohydrology	X					
Hydrology of lakes, swamps and wastral areas	X					

continued

Table 7 (continued)

Subject	Hydrology	Hydro-geology	Water resources	Hydraulic engineering	Sanitary engineering	Irrigation and drainage
Hydrogeology and ground water	X	X	X	X	X	X
Ground water hydrology and hydraulic		X				
Geophysics, geohydrology and geomorphology		X				
Open channel flow and sediment transport				X	X	X
Hydraulics structures				X	X	X
Hydropower development			X	X		
Estuarine and coastal hydraulics				X	X	X
Irrigation and drainage eng.				X	X	X
Water supply and sewerage					X	
Water quality and pollution control					X	
Physical and mathematical models		X		X		
Remote sensing	X	X				X
Desalination			X		X	
Waste water reuse			X		X	
Basic requirements (for all branches, advanced mathematics, computer thesis, and other school requirements)						
Elective courses from other subjects in civil engineering						

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 26.

Graduate work at the Ph.D. level is not covered in this study since the present number of students enrolled for this degree in the region is extremely limited (see table 5).

In order to produce good quality engineers, universities of the region should have adequate numbers of well qualified professors and instructors, as well as adequate laboratory equipment. A considerable number of universities lack good staff, space, laboratories and equipment and finance, as well as good quality high school graduates. These are the major factors that limit the consolidation and expansion of civil engineering departments. The non-oil-producing countries need assistance from the United Nations or regional assistance in order to overcome these problems.

The funds required to establish adequate laboratories and the facilities for practical training are in reality small compared to the benefits that would be derived from producing professionals with the right knowledge of their fields, well-balanced in theory and application.

A civil engineer with a basic B.Sc. degree is suitable for most jobs within the water field. However, he would require training in water subjects related to his job before becoming competent enough to undertake the tasks assigned to him. Some universities, for example Qatar and Yarmuk in Jordan, have started offering specialized education at the undergraduate level. In this way specialization starts within this field. At the moment specialization starts during the first degree, relatively more competent graduates can be produced within their field of work. Specialization is not currently favoured within the region, perhaps owing to the fact that it limits the civil engineer to his special line of work and reduces the opportunities for moving out of that sector. Weighing the advantages of specialization against a classical civil engineering education, a number of universities are considering changing their systems. Others maintain the position that specialization should start after the B.Sc. degree, although it takes two more years to obtain a master's degree.

Member countries should take a policy decision on whether to introduce specialization at the undergraduate level or at the graduate level and then the plans for emphasis and support could be made accordingly.

It should be mentioned here that available resources need to be concentrated in education below the Ph.D. level, as the universities in the region have to be firmly established at the basic levels first. Naturally, after some years, the region may be capable of producing high quality graduates with doctoral degrees.

In ESCWA member countries considerable efforts are being made to establish new universities and to offer a professional level of education within the region to replace education abroad. It would be gratifying to see each country possess its own university complexes, but where the population is not large enough to support various faculties, it may be wiser to concentrate on fewer subjects.

Curricula and syllabuses must be reviewed periodically and upgraded according to the needs of the society and new developments and techniques in the field. When preparing to launch a new curriculum adequate preparation must be made to provide the required number and quality of professors and to meet laboratory and practical equipment requirements. The development of teachers for engineering schools takes a long time, and it is preferable to have persons with practical experience, as well as academic qualifications.

2. Education of technicians

The education of technicians usually takes place at technical schools offering a two year course (exceptionally three years), usually in civil engineering technology. General information on technical institutes that offer education in water-related subjects (and civil engineering) is presented in annex table A.2. Some schools offer specialized courses in water related-branches such as water system operation, irrigation and drainage and land reclamation, as well as civil engineering (building and construction).

It should be mentioned here that the manpower situation in the region is more critical at the technical level than at the professional level. Unfortunately, technical institutes in Western Asia are few in number, producing only a limited number of graduates. Generally inadequate numbers of students enrol in these institutes. Normally, the engineer to technician ratio should be about 1:3, but owing to the abnormal situation, when the number of engineering faculty and technical institute graduates are compared, this ratio is the other way around.

The gains would be twofold: the quality of engineering school entrees will be higher and there would be more candidates for the technical institutes. Also, the intake of general secondary schools should be limited in order to increase the number of students enrolling in secondary technical schools that produce junior-level technicians.

Generally, the curricula of technical institutes in the region appears to be adequate. Table 8 provides a checklist of typical curricula of two-year programmes for various water-related fields.

Unfortunately the curricula cannot be put into practice, largely because of the lack of teaching staff or in some cases, more seriously, owing to the lack of laboratory and practical training facilities. For example, the hydrology section had to be abandoned at the Amman Marka Polytechnic Institute because of lack of equipment.

3. Training in the water sector

In ESCWA member countries training activities are conducted either in vocational training centres or through special training courses arranged by the concerned ministries on an ad hoc basis. In vocational training centres the trades and crafts applied in industry are generally taught. The plumbing course is perhaps the the closest to the water sector as far as skilled workers go. For special training courses ministries prepare the curricula acccording to their needs and the trainees are usually trained by professional or higher sub-professional staff from the concerned ministries.

Table 8. Typical curricula for various two-year courses at technical institutes

8 ∝ · Typical curricula for 2-year technical institute course for hydrology and water resources

Institute requirements:

Mathematics
General physics
Surveying
Fluid mechanics
Hydrology and hydrometry
Hydrologic equipment
Air photo survey/mapping
General geology
Hydrology and ground water
Soil mechanics
Hydraulic Hydraulic structures
Water resources topics
Industrial management
Water measurements and flood control
Irrigation and drainage
Concrete structures
Project and practical training

Table 8 (continued)

Table 8b. Typical curricula for 2-year technical institute course for irrigation and drainage

Institute requirements

Mathematics
Engineering drawing
Surveying
Air photo survey/mapping
Soil and irrigation
Fluid mechanics
Hydraulics
Irrigation and drainage
Hydrology and hydrometeorology
Geology
Hydraulic structures
Quantity estimates and specification
Ground water
Water measurements and flood control
Earthworks and construction materials
Irrigation structures
Field irrigation and land levelling
Soil survey and land classification
Project and practical training

Table 8c. Typical curricula for 2-year technical institute course for water plant operation

Institute requirements:

Mathematics
Engineering drawing
Surveying
General physics
General chemistry
Sanitary chemistry
Chemical analysis
Water bacteriology
Sanitary drawing
Fluid mechanics
Hydraulics
Water purification for cities
Water distribution and disposal
Industrial water and waste water
Mechanical technology
Electrical technology
Mechanical equipment in treatment units
Electrical works in treatment units
Municipal sewage system
Industrial management
Project and practical training

Table 8 (continued)

Table 8 d. Typical curricula for 2-year technical institute course for drilling

Institute requirements:

Mathematics
Engineering drawing
Surveying
General physics
Applied mechanics
Fluid mechanics
Hydrology
Water resources topics
General geology
Hydrogeology and ground water
Mineral science
Soil mechanics
Rock mechanics
Drilling equipment
Drilling liquids
Engines and other equipment
Sample collecting and recording
Project and practical training

Table 8 e. Typical curricula for 2-year technical institute course for land reclamation

Institute requirements

Mathematics
Engineering drawing
Surveying
General physics
Air photo survey/mapping
Applied mechanics
Fluid mechanics
Hydrology
Irrigation and drainage
General geology
Soil mechanics
Land reclamation topics
Reclamation of swamps
Reclamation of deserts
Earth-moving machinery
Industrial management
Quality estimating and specifications
Project and practical training

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), tables 27 a-e.

Vocational and special training aims at providing the participants with the adequate skills needed to undertake manual work, which also requires some specialized knowledge, such as gauge observing, pipe-fitting, pump and engine maintenance and operation, current meter surveying, etc. The skills required at this level are diverse and a common curricula for training in each subject is quite usual. However, for training at the semi-skilled, skilled, junior and senior technician levels, the subjects that need to be covered are presented in table 9 for various activities and banches in the water sector. It should be noted here that the courses for semi-skilled personnel may be offered to people with no official education, but who are literate or who have had some basic schooling. The training of skilled personnel should usually be offered to people who have completed at least primary education. Courses for junior and senior technicians should be taken by people with at least eight years of formal education.

It is necessary to re-emphasize the need for adequate laboratory facilities and practical work equipment. Instructors may be drawn from university and technical institute staff and practising engineers.

Table 9. Typical curricula for training at different sub-professional levels for various activities in the water sector

Subjects	Semi-skilled worker (observer)	Skilled worker (senior observer)	Junior technician	Senior technician
Basic subjects (applicable to all)				
Mathematics	Reading and writing numbers with decimal points (T+P)	Review of arithmetic (T+P)	Review of elementary mathematics (T+P)	Review of secondary mathematics (T+P)
Units of measurements	Length, area, volume, flow rate, weight units (T+P)	length, area, volume, flow rate, weight, concentration units (T+P)	all units of measurement used in water sector (T+P)	all units of measurement used in water sector (T+P)
Physics	-	)	)	)
Chemistry	-	)	)	)
Mechanics	-	) Review of basic	) Review of basic	) Review of secondary level
		) principals	) principles at	)
Hydraulics	-	)	) elementary level	)
		)(T+P+L)	) (T+P+L)	) (T+P+L)
Surveying	Use and maintenance of tapes and rods (P)	Measure horizontal distances (P)	Operate the level and take rod readings (P)	Operate all survey equipment readings in survey notes. Establish benchmarks (T+P)
Engineering drawing		Sketching	Simple engineering drawings	Detailed eng. drawings
HYDROLOGY				
Hydrologic cycle	-	Identify the basic elements (T)	Qualitative and quantitative study of the cycle (T+P)	Qualitative and and quantitative study of the cycle in depth (T+P)
Streamflow gauging	Identify type of gauge, assist in installation of equipment. Observers to be trained in reading the gauges and keeping the record (T+P)	Install and maintain all the equipment in the network, record all changes and collect measurements (T+P)	Inspect and service the gauging stations, and collect all data (T+P)	Locate gauging station sites, and process data coming from gauges and automatic records (T+P)

Table 9. (continued)

Subjects	Semi-skilled worker (observer)	Skilled worker (senior observer)	Junior technician	Senior technician
Hydrometeorology				
General concepts	Identification of various equipment, purpose for data (T+P)	Same as semi-skilled plus basic terminology (T+P)	Same as skilled plus relation to water resources (T+P)	Same as junior technicians (T+P)
Precipitation	Operation of daily rain gauge, measurement of daily and long-term rainfall, recording data (T+P)	Same as semi-skilled plus maintenance of instruments, changing charts on automatic recorders (T+P)	Reviewing and processing all rain gauge data in addition to same as skilled worker training (T+P)	Locating and installing rainfall stations. Analysis of strip charts. Interpolating missing records. Processing radar precipitation data (T+P)
Hydrometeorological stations (temperature), radiation sunshine, wind, relative humidity, installation-evaporation, etc.	Identify equipment. Reading of instruments and recording data (T+P)	Same as semi-skilled plus review of field data. Maintenance of equipment (T+P)	Site survey and installation of equipment in addition to same training as skilled worker (T+P)	Reconnaissance survey for sites. Supervise construction of site and installation of equipment. Processing data (T+P)
Irrigation and drainage				
Soil - plan - water relationship	Identify main crops in agriculture (P)	Identify major soil groups and main crops in agriculture (P)	Basic agricultural soils, crops, crop-water requirements (T+P)	Basic agricultural soils, crop, crop-water requirements, cropping pattern and irrigation intensities (T+P)
Irrigation methods	Identify main irrigation methods. Maintenance of field canals (P)	Same as semi-skilled plus maintenance of primary, secondary and tertiary canals (P)	Same as skilled plus operation and maintenance of automated systems (P)	Same as junior technician, plus training others on various irrigation methods (T+P)
Drainage	Maintenance of drains and control of vegetation (P)	Same as semi-skilled worker (P)	Control of vegetation growth, water logging and salinization (T+P)	Control of vegetation growth, water logging and salinization. Various drainage methods (T+P)
Water diversion and intake structures	Identify main structures. Maintenance of simple structures (P)	Same as semi-skilled plus operation of some structures tures (P)	Operation and maintenance of water diversion and intake structure- (P)	Same as junior technician (P)

Table 9 (continued)

Subjects	Semi-skilled worker (observer)	Skilled worker (senior observer)	Junior technician	Senior technician
Discharge measurements		Maintain current meters, undertake velocity measurements (P)	Calibrate current meters, process current meter data. Undertake survey for indirect flow measurement (T+P)	Calculate flow rates establish rating curves, convert gauge height data to flow data indirect flow measurement (T)
Runoff, base flow, flood flow		Identify different sources of runoff and flows (T)	Runoff theory and and estimating mean annual runoff. Methods of calculating minimum, mean and maximum flows, constructing hydrographs (T)	Same as junior technician plus compiling data on base flows and flood flows (T)
River basins and river systems		Define river basins and river systems (T)	Designate river basin on maps, identify classes of tributaries (T)	Same as junior technician plus estimating basin area, length and slope of tributaries (T)
Sediment discharge		Collect water and river bed samples for analysis (T+P)	Same as skilled worker plus laboratory analysis of samples (T+P+L)	Same as junior technician plus processing of sediment and chemical data (T+P+L)
Hydrology and drilling				
Identification and classification of rocks	Identification of different types of rocks (T+P+L)	Identification of different types of rocks (T+P+L)	Physical and chemical properties of rocks. Locating water bearing formations (T+P+L)	Same as junior technicians (T+P+L)
Ground water: origin, properties, exploration, measurement	Basic information on physical and chemical properties of ground-water. Observation of water depths in wells and boreholes (T+P)	Same as semi-skilled plus ground-water sampling. Flow measurements of springs (T+P)	Processing ground water and spring data. Chemical analysis of samples (T+P+L)	Same as junior technician plus hydrogeological surveys, methods of ground-water exploration, pump-testing of wells and boreholes, filing of data (T+P+L)
Drilling of boreholes and wells		Review of drilling methods, equipment and liquids (T+P)	Same as skilled worker (T+P)	Operating drilling equipment, collecting samples, development of wells (T+P)

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia (E/ESCWA/NR/85/14) (Baghdad, 1987), table 29.

Key: T: Theoretical; P: practical; L: laboratory

D. Fields of training

The fields of training will cover all the major aspects of the water sector. Specialized fields will be suggested by the countries. Determination of the fields in which training is most needed will be carried out on the basis of the total number of trainers who will need to be trained in each field. The experience of ESCWA indicates that priority should be given to the following major fields of the water sector.

1. Conventional water resources

The technical aspects of water resources development conservation and management that need to be considered when establishing a regional water network are as follows.

(a) Assessment of water resources

The objectives of the assessment of water resources are: to determine the sources, quantity and quality, the dependability of water supplies and the parameters within which an evaluation of water supplies can be based. The evaluation of the available and potential water resources of a basin is a continuing activity through which the assessment process is refined.

It is evident that the water resources assessment programme is a continuing activity that should form an integral part of all national development plans. It is supposed to deal with all aspects that have an impact on the development of water resources. The following are important items that need to be considered when implementing assessment programmes.

(i) Basic data collection, processing, storage and retrieval and related services

a. Observational networks and data collection. With regard to the observation of water data, the following factors should be considered: the inventory of networks, their adequacy, reliability and distribution, plans for future improvements, modification and expansion and the adequacy of manpower to operate and maintain existing and future networks and the quantity and quality of instruments.

Regarding the collection of data, the basic elements that should be considered are precipitation, infiltration, soil moisture, surface run-off, sediment, river stages, ground-water levels, well logs, aquifer parameters, water quality and pollution. Time length of intervals to observe and collect water data should also be considered.

b. Data processing, storage and retrieval. With regard to the availability and adequacy of data processing facilities and software, the following elements should be considered: the availability of trained manpower, water data banks, the availability of computers, plans for the future expansion of facilities and the improvement of software and the dissemination of information.

c. Workshops, laboratories and related services. The following elements should be considered: the quality of laboratories, the facilities and staff of maintenance and repair workshops for hydrological and hydrogeological equipment and instruments and plans for the future expansion of facilities and the training of personnel.

(b) Administration and management of assessment programmes

(i) Institutional arrangements: the identification, description and evaluation of existing and planned agencies and institutions responsible for water-related activities, the budgetary situation and the rate of expenditure on ongoing water-related projects, together with future expenditure.

(ii) Water legislation and management: the identification of water regulations, legislation, ordinances, decrees, etc., national water policies, strategies and planning for the development of water resources, any bilateral and/or multilateral co-operation in water resources activities, including research, manpower training, operational services and the dissemination of information.

(c) Aerial assessment of water resources

The following items need to be considered when making an aerial assessment of water resources.

(i) Surface water: topographical maps and aerial photographs, previous hydrological and hydrometeorological investigations, the availability of thematic maps, the application of remote sensing and modelling, the execution of water projects by national and/or foreign consultants, plans for the future assessment of water resources and the status of assessment programmes.

(ii) Groundwater: hydrogeological, geological and topographical maps, previous investigations, the application of remote sensing, geophysical techniques and modelling, the availability of thematic maps, use of national or foreign consulting firms for geohydrogeological aerial assessments and test drilling and plans for future assessments.

2. Regional review and appraisal

Many countries of the ESCWA region have recognized the urgent need to develop, conserve and manage their vital water resources. Water assessment and planning to determine the most appropriate allocation of resources to the various water users, as well as the formulation of medium and long-term water policies and guidelines for the exploitation, utilization and subsequent conservation and management of water resources, were among the objectives and targets of some member countries of the ESCWA region in the last decade.

The progress made in the prime areas of specific concern to water resources assessment activities in the region may be described briefly as follows.

(a) Adequacy and reliability of basic data and networks

In general, in many countries of the region, there are serious inadequacies in the availability of the basic hydrological, hydrogeological and hydrometeorological data. The data are scanty and widely distributed in space and time; even if they are available, the records are often too short, particularly in Democratic Yemen, Yemen and the United Arab Emirates. In Iraq, Lebanon and the Syrian Arab Republic the hydrological-hydrogeological data and information are adequate.

Programmes pertaining to the measurement of basic water data from meteorological, hydrological and hydrogeological stations and networks and the collection, processing, storage and publication of basic data have been undertaken in recent years in most of the countries of the region, while plans to strengthen and modify existing networks are being reviewed in a number of other countries.

Countries with adequate networks are Bahrain, Kuwait, Qatar, Lebanon, Jordan, Oman and Saudi Arabia. Poor networks exist in Democratic Yemen and Yemen. Iraq, the Syrian Arab Republic and United Arab Emirates have fairly well designed networks.

The latest techniques have been employed in some countries in the region to analyse water data and assess their water resources. Isotope analysis, ground-water modelling (analogue and digital), geophysical prospecting and remote sensing have been applied in investigations of water resources in a number of basins in Jordan, the Syrian Arab Republic, Iraq and Saudi Arabia.

(b) Progress in organizing the management of water resources in the region

(i) Institutional arrangements

At the national level efforts have been made in some countries to administer and draw up inventories of the available and potential water resources. However, in spite of the work already carried out, most ESCWA countries are still in the process of achieving the integrated management of their total water resources.

In a number of countries in the ESCWA region such as Jordan, Oman, Yemen and the Syrian Arab Republic, measures are being taken to unify and centralize national water institutional arrangements. In others there are a number of water-related institutions.

National committees dealing with other regional and international programmes have been formed in some countries such as Jordan, Iraq and the Syrian Arab Republic in response to the UNESCO hydrological programmes.

(ii) Water legislation

Water legislation in the region is in most cases complex and outdated when compared with modern water management practices and techniques, and this

perpetuates the undesirable fragmentation of administrative responsibilities. Provisions for the regulation of the development and management of water resources are often contained in different laws and regulations.

Many countries in the region are making a critical examination of the legislation, rules, regulations, customs, decrees, ordinances and other measures of control in the water field.

(iii) Water planning and policies

A few countries in the ESCWA region such as Jordan, Qatar, Oman and Saudi Arabia have established an overall national water master plan. The plan aims at making the best use of available resources (water, funds, manpower and other relevant means), finding the most suitable methods and operations and, wherever practicable, the reuse and renewal of resources. Kuwait, too now has a national water policy. In Oman a statement on a national water policy has been prepared, while other countries such as Iraq and the Syrian Arab Republic are considering the matter. These national water policies are expected to cover many other aspects in the field of water resources with the aim of improving the management, conservation and development of this vital resource.

(c) Subregional and regional technical aspects

Some of the major surface and ground-water basins in the region extend beyond national boundaries. Current knowledge of national water resources, including shared resources, varies from country to country. On the other hand, investment and efforts could be undertaken more effectively through mutual co-operation for the development of these shared resources. The findings of studies carried out at the national level on common surface and/or ground-water basins have often proved to be incomplete or misleading in view of the unilateral hydrological and hydrogeological data used in them. Moreover, the unilateral development of the resources of one member country may have a serious impact on resources of neighbouring States.

Co-ordination in the application of modern techniques such as remote-sensing, desalination and the dissemination of information in relation to water resources at the regional or subregional level would help to give a multidisciplinary orientation to shared basin management and would provide the basis for integrated surveys of land, surface and ground-water resources.

Hydrogeological and hydrological investigations carried out in the region at the national level have confirmed the existence of major shared water basins. Their development may require co-operative efforts at the subregional, regional and international level. The major basins are as follows:

(i) Ground-water basins

The primary objectives of investigating shared aquifers are:

a. To delineate the actual extent, potentiality, storage capacity and dependability in space, time and quality of the aquifers.

b. To study the possibility of trapping or capturing the wasted underflows from some of these aquifers. The Dammam Um-er-Rhaduma aquifer is subject to heavy losses and deterioration in the quality of its water as a result of underflow into the Gulf area in Bahrain, Qatar, the United Arab Emirates and the eastern coast of Saudi Arabia. The paleozoic-mesozoic sandstone aquifers are also believed to be subject to sub-surface flows into the Gulf. The jurassic-cretaceous karstified carbonate aquifers are subject to similar submarine waste flows into the Mediterranean in Lebanon and the Syrian Arab Republic. This same aquifer is suffering from a deterioration of water quality and/or drainage owing to a sub-surface flow into the brackish ground-water reservoir in the Jordan valley depression.

c. To formulate and execute plans of action to develop the potential water resources of shared aquifers from which more than one member country can benefit through joint projects.

d. To harmonize the status of the hydrogeological investigations carried out on these aquifers and to fill the gaps in these studies.

e. To initiate plans and programmes for future joint monitoring, data updating and development of these aquifers.

(ii) Surface water basins

The following surface water basins are located in the region:

The Euphrates river basin;

The Yarmouk river basin;

The Al-Asi and South Al-Kabir River Basins;

The Wadi Tuban, Wadi Bana and Wadi Beihan water-sheds;

Needless to say, the unilateral development of shared water resources will never reach its full potential unless full knowledge can be gained of the main parameters of shared watersheds. These include geomorphology, hydrology, hydrogeology, hydrometeorology, agrometeorology, climate, soil, vegetation and the socio-economic conditions prevailing in the whole watershed area. Full knowledge of these parameters will allow the realistic development of these basins on a long-term basis. Moreover, unilateral development will inevitably be guided in the main by the interest of the country taking the action, with little regard being shown for the other countries involved. This may create intractable and undesirable political problems that could bring a halt to all forms of joint action. Donors would then be reluctant to finance unilateral projects that could lead to conflict.

In order to agree upon joint action for the development of shared basins, it will be necessary to conduct negotiations. In these negotiations, the upstream country might appear to hold the upper hand, but the whole field of relations between the countries involved will have to be considered if hostility between these countries is to be avoided.

3. Non-conventional water resources

The expected shortage in conventional water resources in the ESCWA region has focused the attention of some member countries such as Saudi Arabia and the Gulf States on non-conventional sources. The production and use of desalinated water has progressed rapidly in the region during the last two decades. At present, Kuwait and Saudi Arabia are world leaders in this aspect. In order to make use of non-conventional water resources, techniques have to be devised for countries subject to financial constraints which have limited water resources. The following topics should be considered:

(a) The exploration of non-conventional sources of energy for use in desalination plants, especially in non-oil-producing countries.

(b) Continued research to reduce the cost of tertiary and advanced waste-water treatment processes.

(c) Continued research to develop new techniques to reduce the cost of current desalination techniques, with particular reference to the treatment of brackish groundwater.

Countries subject to financial constraints should receive international aid for the introduction of schemes to develop non-conventional water resources, possibly from internaional organizations.

II. PROPOSED REGIONAL TRAINING NETWORK

A. Concept of the network

The concept of the regional network for training in water resources development, conservation and management involves the co-ordination of a number of training institutes in the region (both national and regional) as a means of upgrading and expanding at a minimum cost the regional capability to meet the training needs of the ESCWA region in the field of water resources. The primary objective of co-ordination is to provide links between the participants in the network in order to facilitate the quick exchange of information, skills and technology. This concept is illustrated in figure I below.

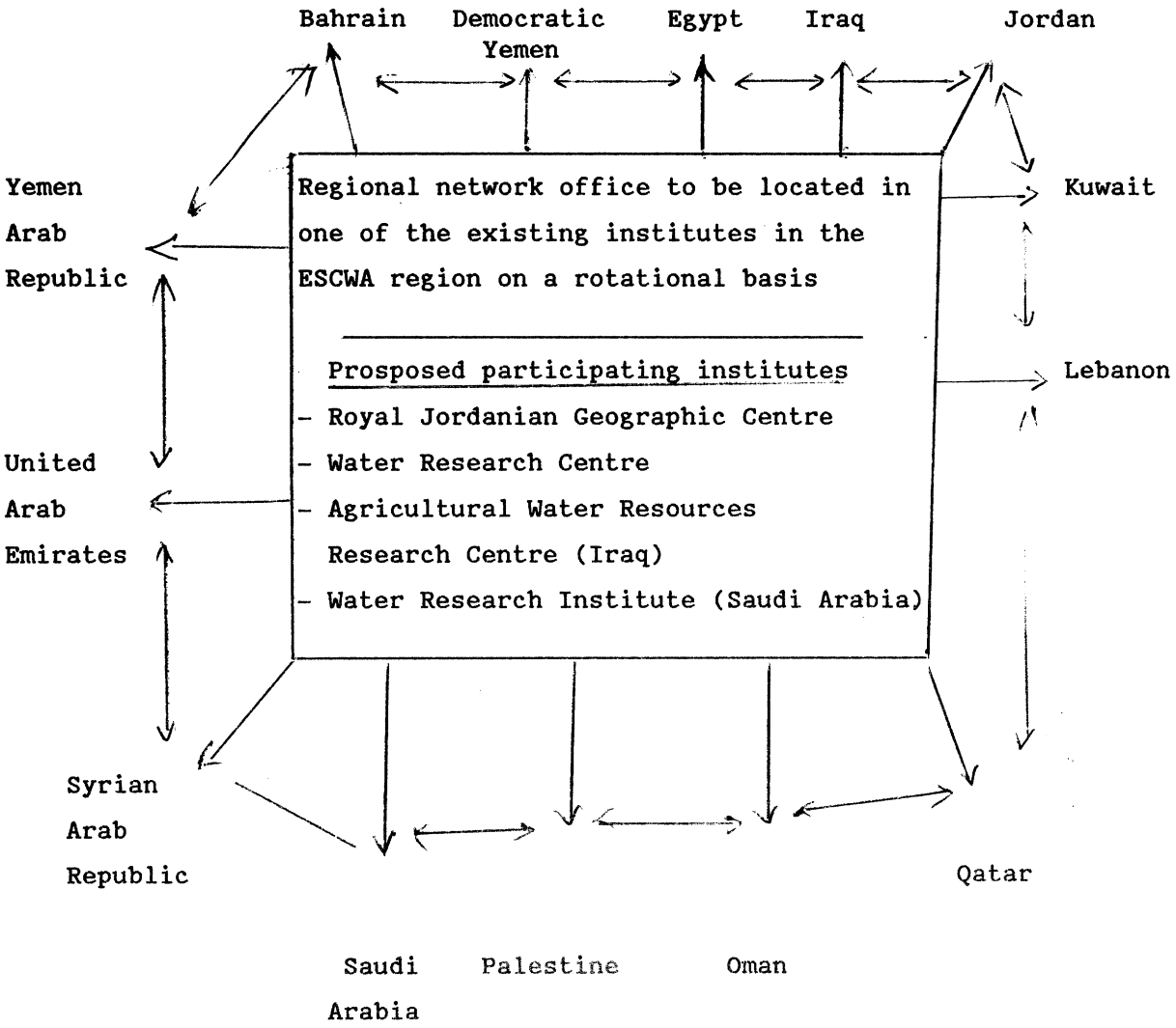

Figure I. Concept of the network

Vertical concept:

1. Strengthening of training capabilities
2. Strengthening of training facilities
3. Dissemination of information

Horizontal concept:

1. Training and fellowships;
2. Visits of ESCWA advisory staff;
3. Visit of network experts;
4. Annual workshop/seminar;
5. Advisory missions from other United Nations agencies.

The proposed elements of the work programme of the regional network office include the following:

1. Training in water resources development, conservation and management in terms of:

(a) Organization of regional seminars on selected topics of major interest to ESCWA countries;

(b) Organization of workshops and training courses;

(c) Arrangement of individual fellowships for post-graduate work in selected fields of specialization;

(d) Engagement of experts from outside and inside the ESCWA region to provide training in the fields of specialization.

2. Strengthening of regional training capabilities by:

(a) The launching of fact-finding missions to assess the capabilities of the participating institutes and what they need to make improvements;

(b) Improvement of the participating institutes;

(c) Arrangement of exchange visits of instructors/national experts among the participating institutes;

(d) Organization of advisory and co-ordinating missions to participating institutes by the experts/staff of concerned United Nations agencies to advise on the detailed modalities for the operation of the network;

(e) Organization of seminars for instructors of the participating institutes in the region to update their knowledge and exchange experience.

3. Information dissemination through:

(a) The periodic publication of a network newsletter (to disseminate information on training in water resources, as well as on the activities and achievements of the network);

(b) Publication of the proceedings at its annual sessions of the governing body;

(c) Publication of selected proceedings/reports of regional seminars/workshops/training courses.

B. Structure of the network

The network would have the status of an independent intergovernmental body and would establish its own rules of procedure. In view of the fact that most regional institutions suffer from weak financial support, which in some cases threatens their continued existence, it would appear that one of the basic principles that should govern the establishment of the regional network is institutional self-sufficiency.

The function of the network will be to provide training and to upgrade and expand the regional capability to meet the training needs of the ESCWA region in the different fields of water resources. Therefore, a possible set-up for the network would be as follows:

(a) The highest authoritative body of the network would be the Governing Body, which would be composed of representatives nominated by member Governments. The governing body would also deal with policy decisions and financial matters. Substantive matters would be dealt with by the Technical Advisory Committee. Meetings of the Govering Body would be serviced by the Network Office;

(b) The Technical Advisory Committee would be composed of a group of experts such as professional engineers holding senior positions in the national institutes participating in the network, or experts connected directly with the technical aspects of these institutes. The number of members of this Committee would be decided by the Governing Body, which would also make the appointments to the Committee. The Committee would deal with the technical matters of the network;

(c) The Network Office would carry out the functions of the network. It would consist of a co-ordinator, an assistant co-ordinator, a secretary and one typist. It could be located in one of the host countries and rotated every two years;

(d) The participating institutes, which could be national or regional training institutes, would comprise the supporting bodies of the network. They would provide training in different fields of water resources.

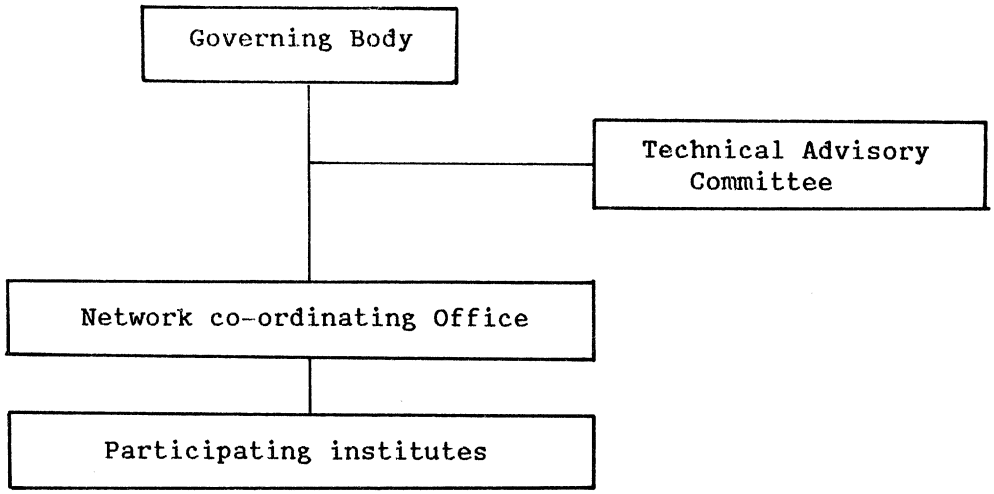

Figure II. Structure of the network

C. Network support

The type of support required by the regional network for training in water resources development may be classified as follows:

(a) Institutional support. This comprises the resources required for the establishment and operation of the Network Office. These would include office space, the cost of supplying office stationery and equipment and the salaries of the network co-ordinator and his staff. The office could be situated in an established participating institute and could be rotated on a biennial basis.

(b) Programme support. This comprises the resources required for the implementation of various activities under the programme of work to be adopted by the Governing Body. These activities would include the provision of advisory and consultancy services, the organization of seminars, workshops and training courses, the acquisition of training equipment, teaching aids, textbooks and reference material and the dissemination of relevant information on training in water resources development.

Should the proposed network be established on the basis of institutional self-sufficiency, it would not be necessary to seek institutional support from external sources. However, arrangements would have to be made to effect the sharing of costs by the member countries.

Some of the ways in which the institutional costs of the network could be shared are as follows:

(i) The total (annual) institutional costs could be shared equally or on the basis of an agreed formula among the countries that nominate the participating institutes;

(ii) In-kind contribution by the host country of the network office space and the salaries of the network co-ordinator and supporting staff; the remaining (annual) institutional costs could be shared equally or on the basis of an agreed formula among the countries nominating the participating institutes;

(iii) Voluntary contributions from all ESCWA member countries meet the institutional costs;

(iv) Assessment of the country contributions of ESCWA member countries on the basis of an agreed formula.

Programme support for the implementation of the work programme of the network could be sought from the United Nations Development Programme and from other agencies in the United Nations system involved in water resources development. Programme support could also be obtained from interested donor countries or organizations.

IV. CONCLUSIONS AND RECOMMENDATIONS

Over the last two decades, the region has experienced a rapid increase in the improvement and modernization of various aspects of the development and management of water resources. This increase has created an unexpected demand for trained manpower at all levels (professional and technical) which must be provided by the countries involved. Recent studies have shown that in all ESCWA countries there is a serious shortage of skilled manpower in water resources development, conservation, planning and management. This shortage of scientific and technical personnel is one of the major constraints on progress in this field.

In order to strengthen and expand facilities and existing institutions, universities, colleges, polytechnics and training centres so that the quantity and quality of their output can be increased, the present study recommends the establishment of a regional training network for water resources. The proposed major components of the work programme of the network are as follows:

1. Training in various fields of water resources, both at the professional and technical level.

2. The strengthening of regional training capabilities.

3. The dissemination of relevant information on training in water sector.

4. The introduction of other components that ESCWA member countries consider to be important.

Annex

PROPOSED REGIONAL TRAINING NETWORK IN WATER RESOURCES: FUNCTIONS AND STRUCTURE

A. Functions

The functions of the network will be to:

1. Co-ordinate with the participating institutes (both national and regional) in the region.

2. Plan and implement the work programme of the network, including the following:

(a) Organization of seminars, workshops and training courses;
(b) Arrangement of fellowships for post-graduate work;
(c) Dissemination of relevant information on training in water resources development;
(d) Arrangement of exchange visits of instructors, exchange of experience, expertise and teaching materials;
(e) Provision of advisory services to the participating institutes.

3. Seek possible financial and technical support from external sources for the implementaiton of its work programme.

4. Arrange for the preparation of requests for technical, financial and other assistance from donor countries, United Nations bodies and other international organizations.

5. Provide information and maintain contact to meet the financal and specific needs of member countries in the field of training in water resources development.

6. Regularly review the progress made with regard to upgrading and expanding the regional capability to meet training requirements.

B. Structure

The network will have a governing body which will be assisted by a Technical Advisory Committee, Network Office and the participating institutes. They will have the following functions:

1. Governing Body

(a) Will decide on matters regarding financial and non-financial contributions from member Governments;

(b) Will seek and receive external assistance;

(c) Will decide on policy matters regarding inter-country co-operation and complementary and reciprocal arrangements for the implementation of specific activities;

(d) Will formulate policies and guidelines regarding financial management;

(e) Will approve the work programme of the network;

(f) If necessary, will review and amend the terms of reference of the network;

(g) Will appoint the network co-ordinator and members of the Technical Advisory Committee;

(h) Will consider and approve the annual report of the network co-ordinator.

2. Technical Advisory Committee

(a) Will advise the Governing Body on all technical matters pertaining to the network;

(b) Will formulate the work programme of the network;

(c) Will review the work of the network for the consideration and adoption of the Governing Body.

3. Office of the Network Co-ordinator

(a) Will serve as the executive co-ordinating centre for the co-ordination of the network;

(b) Will support and interlink regional and national training institutes in order to deal effectively with regional and country requirements;

(c) Will serve as a clearing-house for the interchange of information, experience and expertise among the participating institutes;

(d) Will disseminate relevant information on training in water resources development;

(e) Will organize seminars, workshops and training courses in various aspects of water resources development;

(f) Will arrange fellowships for post-graduate work;

(g) Will arrange exchange visits of instructors;

(h) Will assist the participating institutes to improve their in-house capabilities;

(i) Will prepare annual reports to be submitted to the Governing Body;

(j) Will implement the work programme adopted by the Governing Body;

(k) Will conduct advisory and co-ordinating missions to the participating institutes whenever necessary.

4. Participating institutes

(a) National institutes

(i) Will participate in the implementation of the work programme of the network;

(ii) Will assess their need for improvement to meet the training requirements of their respective countries;

(ii) Will accept students or trainees from other countries of the region within the limits of their capacities;

(iv) Will provide the network co-ordinator with information on their capabilities and development needs;

(v) Will strengthen linkages and co-operate with other water resources development agencies in their respective countries in the assessment of training requirements and the upgrading of training capabilities.

(b) Regional institutes

Will provide technical assistance within their fields of specialization, including the furnishing of literature on expert services, training material and equipment.

Annex table A.I. Directory of universities and equivalent technical institutions offering education in water-related subjects in the ESCWA region

Institution/address	Faculty/department	Degrees/duration BS (yrs)	MS (yrs)	Ph.D (yrs)	Admission requirements for BS	Languages of instruction	Academic year	Status	Remarks
EGYPT									
Ain Shams University 1 Sarayat St., Abbasiya, Cairo Tel: 820111, 820198 821749	Faculty of Engineering Civil Engineering 1. Irrigation branch 2. Public works branch	5	2	2	General Secondary School Certificate (GSSC) or equivalent	Arabic English	October to June year system	State control	There is also a Structural Engineering branch
Alexandria University 22 El Geish Eve, El Shatby, Alexandria Tel: 71675/8 Telex: 54467 UNIVY UN	Faculty of Engineering Civil Engineering Dept.	5	2	-	GSSC	Arabic English	September to May year system	State control	Presently no doctorate level studies
Al Azhar University Madinat Nasr, Cairo Tel: 833722, 8243433	Faculty of Engineering Civil Engineering Dept.	6	-	-	GSSC	Arabic (and some English	October to June year system	State control	Presently no courses are offered at graduate levels
Assuit University Assuit Tel: 3000-3040	Faculty of Engineering Civil Engineering Dept.(2)	5	-	-	GSSC, major in mathematics	Arabic English	September to June year system	State control	Presently no courses are offered at graduate levels
Cairo University Orman,Giza, Cairo Tel: 840665, 840176	Faculty of Engineering Civil Engineering Dept.(1)	5	2	2	GSSC	Arabic English	October to June year system	State control	Hydraulics and irrigation and Sanitary Engineering branches at graduate levels
Mansoura University Sharia El Gamhoria Mansoura Tel: 7054/5	Faculty of Engineering Civil Engineering	5	2	-	GSSC	Arabic (and some English	October to June year system	State control	Presently no doctorate level studies
Suez-canal University Suez Tel: 3875	Faculty of Engineering and Technology (in Port Said) Civil Engineering Dept.	5	2	-	GSSC	English	October to May year system	State control	Presently no doctorate level studies

All the above universities and Menia University, Menufia University and Tanta University each have a Faculty of Agriculture where some courses are offered on irrigation and drainage and some other water-related subjects.

Note: The universities are listed in alphabetical order.
The numbers in parentheses after the concerned Faculty/Department of some of the universities indicate their reference number in tables 13 and 14,, for example, Civil Engineering Dept. of Assuit University is described in column (2) under Egypt in both tables 13 and 14.

Similarly, the numbers in parentheses apply to MS level education presented in tables 15 and 16 as well.

Annex table A.I (continued)

Institution/address	Faculty/department	Degrees/duration BS (yrs)	MS (yrs)	Ph.D (yrs)	Admission requirements for BS	Languages of instruction	Academic year	Status	Remarks
University of Jordan P.O.Box 1682, Amman Tel: 65111-65130 64101-64105 Telex: 21629 UNIV JO.	Faculty of Engineering Civil Engineering (2) Faculty of Agriculture Soils and Irrigation (3)	5 5	2 2	- -	SSC	English	October to June(two semesters) July-August summer session	National and autonomous control	Specialization is mainly at graduate level in bot faculties
University of Yarmouk P.O.Box 566, Irbid Tel: 71100-71115 Telex: 51533 YARMUK JO	Faculty of Engineering Civil Engineering (1)	5	2	-	SSC	Arabic and English	October to June(two semesters) July-August summer session	National and autonomous control	
KUWAIT									
Kuwait University P.O.Box 5969, Kuwait Tel: 811198,816495 Telex: 22616 KUNIVER	Faculty of Petroleum and Engineering, Dept. of Civil Engineering (1) Dept. of chemical Engineering (2)	5	-	-	SSC	English	September to June(two semesters)	State control	Master degree courses ar planned to be initiated September 1985. Covered only to indicate some special water-related subjects
LEBANON									
American University of Beirut, P.O.Box 236, Beirut Tel: 348740 Telex: 20801 AMUNOB LE	Faculty of Engineering and Architecture Dept. Dept of Civil Engineering (3)	4	2	-	Baccalaureate or equivalent	English	October to June (three semesters)	Autonomous	
	Faculty of Agriculture and Food Science				(same)	English	(same)	(same)	Concentration on irrigation and drainage in MS level
	Irrigation Section (1) Faculty of Health Sciences Dept. of Environmental Health(2)	4	2	-					
Beirut Arab University Tarik El-Jadide, P.O.Box 5020 Beirut, Tel: 300110	Faculty of Engineering Dept. of Civil Engineering (4)	5	-	-	Baccalaureate or equivalent	Arabic and English	October to June	Private control	
Lebanese University Place Musee, Beirut Tel: 386817, 386818	Faculty of Engineering Dept. of Public Works Engineering (4)	5	-	-	Baccalaureate or equivalent	French, Arabic and English	October to June	State control	

Institution/address	Faculty/department	Degrees/duration BS (yrs)	MS (yrs)	Ph.D (yrs)	Admission requirements for BS	Languages of instruction	Academic year	Status	Remarks
Teshreen University Lattakia, Tel: 12104	Faculty of Civil Engineering (3)	5	-	-	Baccalaureate (science major)	Arabic	October to June (year system)	State control	
University of Aleppo Aleppo, Tel: 24660,24661,25902 Telex: ALUNIV 31018 SY	Faculty of Engineering Civil Engineering Dept. (2)	5	-	-	Baccalaureate (science major)	Arabic	September to May(year system)	State control	
University of Damascus Damascus, Tel: 115103-5, 2286232	Faculty of Engineering (Civil Engineering) (1)	5	2	-	Baccalaureate (science major)	Arabic	September to June (year system)	State control	MS programme has recentl been initiated in water field
UNITED ARAB EMIRATES									
United Arab Emirates University P.O.Box 15551, Al Ain	Faculty of Engineering Civil Engineering Dept. (1)	5	-	-	Secondary school certificate	Arabic	(Two semesters)	State control	
YEMEN ARAB REPUBLIC									
Sana'a University P.O.Box 1247, Sana'a Tel: 200514, 200515, 200516 Telex: 2468 UNISAN YE	Faculty of Engineering Civil Engineering Dept. (1)	5	-	-	Secondary school certificate	Arabic and English	(Two semesters)	State control	
PDRY									
University of Aden P.O.Box 7039 Al Mansura	College of Technology Civil Engineering Dept. (1)	5	-	-	Secondary school certificate	English		State control	

Source: 1. Replies to ECWA questionnaire, 1984/1985.
2. The World of Learning 1983-1984, Europa Publications Limited.
3. Universities Directory, Islamic Foundation for Science - Technology and Development, No. 1, 1983.
4. Directory of Engineering Education Institutions, 2and edition, The UNESCO Press, 1981.

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education and Training in the Water Sector in Western Asia, (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 12.

Annex table A.II. Technical institutes offering education in water-related subjects (and civil engineering in the ESCWA region.

Institution/address	Department/ specialization	Durat- ion yrs	Qualifications awarded	Admission requirements	Languages of institution	Tuition	Status	Remarks
BAHRAIN								
Gulf Polytechnic College Isa Town, Bahrain Tel. 681644	Engineering/ civil	3	Full technician certificate	Secondary school	English	Free of charge	State control	General civil engineering subjects are offered.
EGYPT								
Assiut Polytechnic Institute Assiut	Engineering/ civil	2	Technician certificate	Secondary school	Arabic English	Free of charge	State control	)The technical institutes at)Assiut and Cairo are the onl)out of a total of 33 institu)in the country having civil)engineering departments.
Cairo Polytechnic Institute Cairo	Engineering/ civil	2	Technician certificate	Secondary school	Arabic English	Free of charge	State control	))
IRAQ								
Institute of technology Zaafaraniya, Baghdad Tel. 7731491-7	Civil engineering	2	Technician diploma	Secondary school	Arabic English	Free of charge	State control	The civil engineering departm includes irrigation and drain and water purification branch
The Technical Institute/Basrah Basrah Telex 5600	Civil engineering	2	Technician diploma	Secondary school	Arabic English	Free of charge	State control	Building and construction bra
The Technical Institute/Mosul Naynawa, Mosul	Civil engineering	2	Technician diploma	Secondary school	Arabic English	Free of charge	State control	Building and construction bra
University of Technology Technicians Programme Baghdad	Civil engineering	2	Technician diploma	Secondary school	Arabic English	Free of charge	State control	Building and construction bra
JORDAN								
Amman Polytechnic Amman	Civil engineering	2-3	Technician certificate diploma	Secondary school	English Arabic	Not free	State control	Building and construction, we drilling, hydrology, water su and sewage branches
Arab College Amman	Civil engineering	2	Technician certificate	Secondary school	Arabic (English)	Not free	Private	Building and construction bra
Arab Community College Amman	Civil engineering	2	Technician certificate	Secondary school	Arabic (English)	Not free	Private	

Annex table A.II. (continued)

Institution/address	Department/ specialization	Duration yrs	Qualifications awarded	Admission requirements	Languages of institution	Tuition	Status	Remarks
JORDAN (cont'd)								
Ibn Khaldun College Amman	Civil engineering	2	Technician certificate	Secondary school	Arabic English	Not free	Private	Building and construc
Intermediate Amman University College Amman	Civil engineering	2	Technician certificate	Secondary school	English Arabic	Not free	Private	
Jordan Community College Amman	Civil engineering	2	Technician certificate	Secondary school	English Arabic	Not free	Private	
National Zarqa College Zarqa	Civil engineering	2	Technician certificate	Secondary school	English Arabic	Not free	Private	
Al-Quds College Amman	Civil engineering	2	Technician certificate	Secondary school	English Arabic	Not free	Private	
KUWAIT								
Kuwait Institute of Technology Jamal Abdul Nasser Street Shuwaikh, Kuwait Tel 816122	Construction engineering technology	2.5	Technician diploma	Secondary or vocational school	English	Free	State control	Some civil engineerin related courses are c
LEBANON								
No information available on present or recent status of technical institutes								
OMAN								
Technical institute is in formation								
QATAR								
Technical institute is planned for								

Annex table A.II. (continued)

Institution/address	Department/ specialization	Duration yrs	Qualifications awarded	Admission requirements	Languages of institution	Tuition	Status	Remarks
SAUDI ARABIA								
Saudi Arabian Institute for Higher Education Mecca	Engineering	2	Technician certificate	Secondary school	Arabic English	Free	State control	
Technical Institute Riyadh	Engineering	2	Technician certificate	Secondary school	Arabic English	Free	State control	
SYRIA								
Intermediate Engineering Institutes (four)	Engineering	2	Technician diploma	Secondary school	Arabic	Free	State control	Multidisciplinary en syllabus is followed
School of Technical Supervisors (one each in eight Governorates)	Engineering	2	Technician diploma	Secondary school	Arabic	Free	State control	includes courses on and ground-water hyd drainage, flood cont sanitary engineering
UNITED ARAB EMIRATES								
Technical Institute is being planned								
YEMEN ARAB REPUBLIC								
Technical Institute Sana'a	Engineering	3	Technician certificate	Intermediate school(9 yrs)	Arabic	Free	State control	Overall technical edu
Technical Institute Taiz	Engineering	3	Technician certificate	Intermediate school	Arabic	Free	State control	Overall technical edu There is a civil engi section
PDRY								
Irrigation Engineering Institute. Dept, of Irrigation and Mechanical Engineering Ministry of Agriculture and Agrarian Reform Aden.	Engineering	2	Technician diploma	Secondary school	English Arabic	Free	State control	The institute is atta the Ministry of Agric and Agrarian Reform a under its control.

Source: Economic and Social Commission for Western Asia, Development of Manpower, Education, and Training in the Water Sector in Western Asia, (E/ESCWA/NR/85/14) (Baghdad, 16 August 1987), table 17.

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