Water Authority of Jordan

Agence de l'Eau Rhin-Meuse

Monitoring networks assessment

Mission report
Marc BABUT
(24-30/11/1996)

Summary

1- Context

There have been previously a lot of reports, calculations etc related to the water and wastewater subject in Jordan ; so my aim in this section isn't to repeat their contents, but only to remind some few elements, as far as they are useful to understand the organization and orientations of the monitoring system(s) in Jordan.

There have always been a chronic shortage of water resources ; more than one half of the exploited resources are groundwater, the rest coming from surface water originated different basins in the country.

Most of the surface water « network » is managed by the Jordan Valley Authority (JVA), mainly for irrigation purposes ; a part of the water which is coming from the Yarmouk River through the King Abdullah Canal (KAC) is then pumped to Zai treatment plant, and then pumped to Amman governorate for drinking water supply. The effluents of several treatment plants such as As Samra, Jerash and Salt are dumped into major wadis, and the water used for irrigation purposes, after storage into dams.

Drinking water production and distribution, and wastewater collection and treatment, are placed under responsibility of the Water Authority of Jordan (WAJ). WAJ and JVA are part of the Ministry of Water and Irrigation (MWI).

Annual effluent discharge equals to 60 millions m^3, 90 % being reused for irrigation purposes (more or less directly).

2. *Objectives of the mission*

The objectives which were primarily proposed for this mission were as follows :

1. assessment of existing monitoring system (surface water) : networks, data and technical means
2. assessment of the needs, according to the uses and potentialities of the rivers and canals
3. optimization proposals

However, it was clear even before the beginning of the mission that these objectives could be adapted during the mission, according to the most urgent needs expressed by the representatives of the Water Authority of Jordan.

According to the objectives of the mission and to the conclusions of the first meeting with Dr R. GEDEON, and MM. TUFFAHA and AMRO, the main focus of this mission was put on *network design*[1] and on *data management* and *data processing* in the Laboratory Directorate (also called Central Laboratories), because some improvements are already done or planned for the laboratories - new building, training of staff, QA/QC development program to comply with ISO 9001 -. *Reporting* cannot be examined before the previous steps are assessed, and *information utilization* is more or less beyond the scope of the mission, because it depends first on decision makers. So the remaining stages to assess are *network design* and *data management / data processing.* Considering the current organization of the Central Laboratories, it seemed preferable to assess its monitoring activity as a whole rather than only a specific part of it.

So the adjusted scope of the mission was :

1. assessment of network design, data management and data processing in the Central Laboratories, including drinking water, effluents and surface water, but excluding groundwater
2. optimization proposals

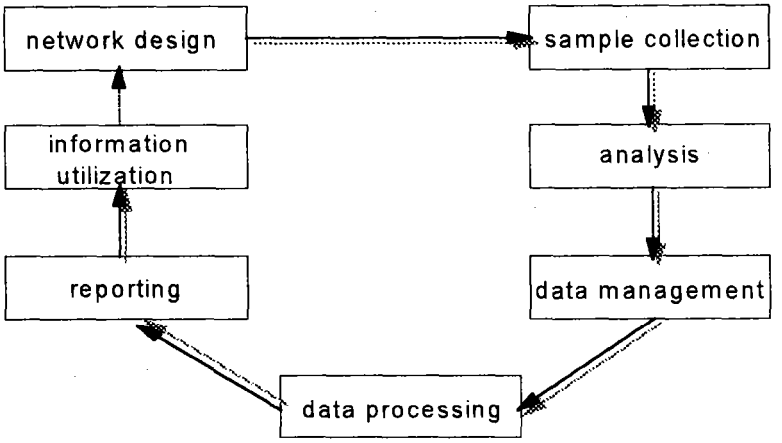
[1] terms in italic are explained in the next section

3- Problem analysis

3.1 Introduction

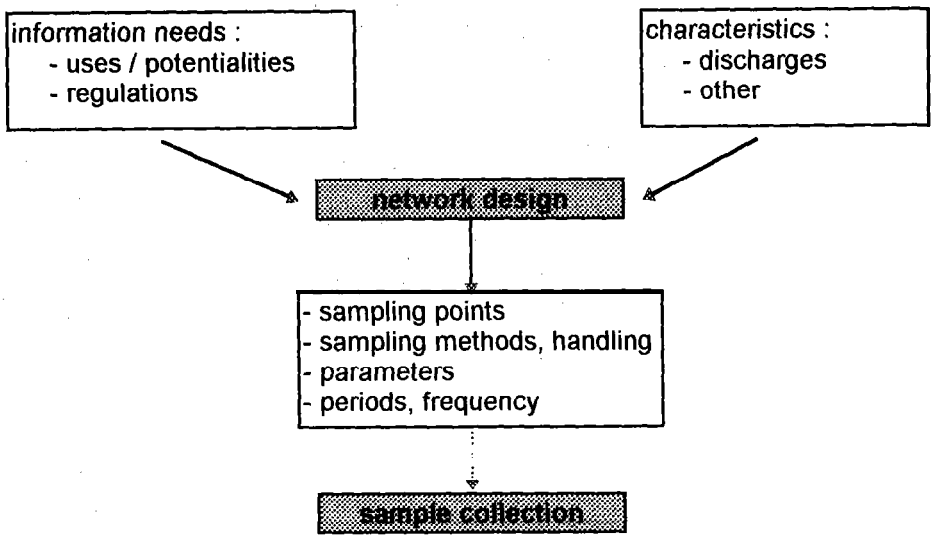
Any monitoring system can probably be represented as a cycle, like that one in figure 1 ; each step in this figure covers several items, and can ultimately be described through different protocols or so-called methodologies. Every step is essential - if one step is missing or incorrect, the whole process is biased and inefficient -, but some are probably more crucial than others. « Network design » is one of them, because the choices made at this stage induce choices at the following ones.

Figure 1 . Simplified flow-chart of a monitoring system



Basically, *network design* can be represented by an input/output diagram, with *inputs* being related to information needs and characteristics of the domain to monitor, and *outputs* being the design by itself . location of sampling points, sampling methods, parameters to measure, frequencies and periods, if appropriate - (figure 2). Information needs proceed from water uses and existing regulations, and may be expressed as objectives of the monitoring : examples of such objectives could be to establish the actual quality, to assess trends, to provide early warning, or to check the compliance with standards, either for effluents and for surface or groundwaters.

Figure 2 - Network design : input / output diagram



Sample collection and *analysis* are technical tasks, which are directly derived from network design ; that means in fact that a written protocol should be available for the design as a whole (general description, including the objectives), and also for each step of the sample collection and analysis. In the latter case, this requirement is consistent with general quality assurance requirements.

Data managementand data processing are also technical tasks, which are more and more carried out with computer systems. This kind of tool can be ver-y helpful, but it may also induce several biases and difficulties, if programs aren't well designed, or if the capacities of the system are insufficient. Data processing should also be strongly related to the objectives of the monitoring, which means the statistics, graphs and other indicators used should be chosen according to these objectives.

Reporting is essentially a communication task, and less a technical one. It consists in making the data available for the users in a comprehensive form, so it means various efforts of presentation of the results of data processing. For example, there could be a rather rough form for presenting simple analysis results, and some more elaborate reports including annual synthesis for the headquarters of the WAJ.

Information utilization is more or less beyond the scope of this approach, because it is essentially the duty of decision makers. But this stage is obviously very important for the whole monitoring process : if the utilization of information is poor, money invested in this activity is wasted, people involved in monitoring are less motivated, and finally the results are less credible. Anyway, in such cases, the monitoring process should be reviewed and improved.

This flow-chart also provides a sound basis for the organization of the monitoring system : permanent tasks belonging to different stages should be carried out by different units of the organization chart. The design of the whole system, and its control, must be placed under the responsibility of people making data processing and reporting, because they are the real « customer » of the system. So sample collection, analysis, and data management and

processing functions have to be distributed among different services. Even data management and data processing could be effected by different services,

3.2 Network design

a) The first look at the monitoring system as it is worked out in the Central Lab. (Annex c) reveals some heterogeneity in the objectives : for drinking water, the objectives are those of the quality control of a product . drinking water -, and the regulatory control is assumed by a section of the Ministty of Health. For effluent, the objectives are oriented to a compliance control, and to efficiency assessments. In other words, the Departement proceeds on one hand to an *interna/* control, and on the other hand to an *externa/* one.

b) Regarding surface water, the situation seems less clear : three different objectives are displayed, according to the different actors in this field :

- assessment of effluents discharges (compliance with Jordanian standards, treatment efficiency, impacts on water resources)
- suitability for drinking water production
- suitability for irrigation purposes

Two different sections of the Central Lab. (WAJ) are dealing with the first two objectives, and JVA is dealing with the third one. So there are various sampling programs, with some overlapping in the Northern part of the country ; on the other hand, it seems that coverage of other areas is insufficient.

According to the flow-chart described in Fig. 1 and to its operational consequences, the various objectives of surface monitoring could be assumed through a single design, provided that objectives were clear and technical tasks well designed. It is the only way to use the financial and human resources allocated for monitoring without waste.

A much more detailed assessment of the monitoring programmes has been done under WQIC[2] project, which is funded by US-Aid and supported by a consultancy group (DAI, Development Alternatives Inc.). The overall objective of this project is to have a comprehensive unified monitoring program for Jordan, in order to avoid any duplication of efforts. This detailed assessment is described in several reports (cf Annex b) ; regarding the aspects mentioned here, the report entitled « Water Monitoring System Adequacy report » includes a proposal of re-organization of the monitoring activities effected by MWI.

According to this proposal, the MWI's monitoring activities should be carried out by a single and unified organization. Two models are then discussed, a centralized and a decentralized one.

[2] Water Quality Improvement and Conservation Project

In fact, some intermediary models are also possible (for example, sampling could be decentralized, and also a part of analysis, and more sophisticated analysis, data management and data processing would be centralized). Both models separate the sampling function, which is accomplished by a technical department, and design and data processing functions, which are carried out by several « thematic » (meteorological, surface water, groundwater, drinking water, waste water) departments. This approach is more or less the one adopted by Rhine Meuse Water Agency for its monitoring activity[3].

Monitoring upgrade plans are being implemented for each basin in Jordan under the WQIC project. Although neither these plans, nor the other aspects of the project, have been assessed in detail, WQIC project doesn't seem criticizable as a global approach, because :

- it includes all the various aspects of monitoring (see Fig. 1),
- it includes short and long-term developments,
- it is undertaken with Jordanian staff, who will have then to implement it,
- the same approach is applied in each basin.

c) Monitoring of effluents is focused on compliance with standards, impacts on receiving waters and treatment efficiency assessment (Annex *c).* As part as an *external* control, these goals are logic and complete; however, it seems that the operation monitoring (interna1 control of works functioning) is not currently implemented by any part (service) of the WAJ.

d) Monitoring of drinking water is focused on compliance with standards ; among the problems mentioned, a few seem more critical, like coliforms contamination of Springs, and trihalomethanes (THM) precursors (organic matter) in summer. These problems, unless actual, are beyond the scope of this assessment, in that they are properly detected by the current monitoring eff ort.

The coliforms' problem arise two different questions : (1) are the standards relevant in the particular context (is it possible to use better resources, is it possible to treat the contaminated water, and to ensure the efficiency of the treatment) ? (2) is it conceivable to protect the concerned Springs from fecal contamination (perhaps unrealistic, according to the karstic nature of the aquifers).

The THM-precursors problem is rather a tehnological one : it seems possible to solve it through a specific treatment sequence, and a proper elimination of the organic matter.

e) Some of the parameters monitored are summarized in the table below ; this list seems quite classical, and more or less complete. Some more concern could be put on micropollutants, specially pesticides, according to the current uses (industrial and domestic uses for solvents and other organic micropollutants, agricultural uses for pesticides).

[3] The model is similar, but there are some differences, either in terms of scope and of organization : for example, a part of the sampling activity is subcontracted with independent companies ; analysis activity is almost entirely subcontracted with independent companies

Parameter	Drinking water monitoring	Effluent monitoring
pH	xxx	xxx
BOD (5d)	xxx	xxx
COD	xxx	xxx
colour	xxx	xxx
TSS (total suspended solids)	xxx	xxx
NO_3, NH_4, N-tot	xxx	xxx
PO_4, SO_4, Cl, HCO_3	xxx	xxx
Na, K	xxx	xxx
Ca, Mg,	xxx	
Fe, Mn	xxx	xxx
As, Cd, Cr, Cu, Hg, Ni, Pb, Zn	xxx	xxx
CN	xxx	xxx
total coliforms	xxx	
fecal coliforms	xxx	xxx
pesticides (cf Annex c)	xxx	

3.3 Data management

The most critical point in the domain of data management in Central Lab. is the fact that there are several gaps in information flux :

- the first gap happens between registry of the samples, at the entrance of the Information section, and analyses ; obviously, registry is essential in any information system, but the existing system forces to copy several times each information ; this imply a risk of transcription errors, and a waste of human potential ;
- the second gap is symmetrical to the first ; although there are several computers in the laboratories, the results are written on the note and then checked and seized in the database; the only advantage in this procedure is the way through a check-point (validation), but this figure is not critical. In modern information systems, it is possible to install some checking gateways before including a new data set in the database.
- the third gap is due to the inaptitude of the database to provide neither retrospective series, nor exchange formats allowing to realize statistics or other calculations with spreadsheets. Nevertheless, extracting data from the database with a spreadsheet like Excel 4.0 is possible, but ignored by the staff at the moment.

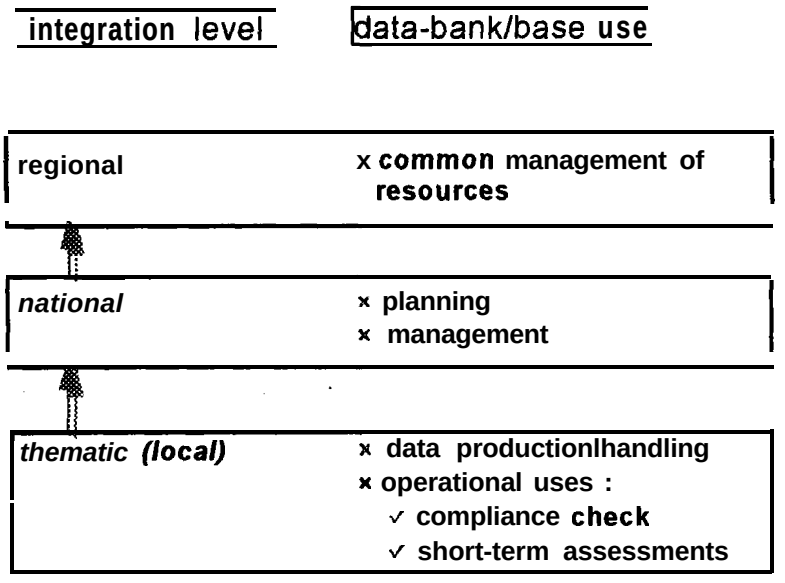
The staff of the department has well addressed this problem, and identified a way to improve the situation, which is to install a network, and a server (mainframe) hosting the database. The place for this computer is already reserved in the new building, which will be directly equipped with the cables for the network. But at the moment it seems that there is no further perspective to complete the equipment of the department with a set-ver.

If a project of such an equipment was designed, it should be necessary to discuss about the connection priorities : from my point of view, the first step should be the installation of the database and the connection of the computers dedicated to data processing rather than the connection of computers in the laboratories, which should be connected in several further steps.

Another important problem is the inaccessability of data gathered before 1995, because of the change in the database language. The integration of these data in the actual database would allow a better comprehension of pollution patterns, if these long term series are then exploited ; at the moment, such retrospective analysis seems nearly impossible.

There should be no confusion about this project of database : data management, inside the Ministry of Water and Irrigation of Jordan and even in the region, should be considered as an integrated process, with several levels of management and use of information, These levels appear to be related to each other in a logical way (figure 3).

Figure 3 - Data management



3.4 Data processing

This step of the process doesn't need any particular comment for the domain of drinking water, because the main purpose is to check compliance with standards on a case by case basis.

Data processing of effluent monitoring results appears to be relatively well structured: data are used mainly to check compliance with standards, nearly on a case by case basis (in fact, several results are taken into account in these reports, which is a sound approach, but each effluent is considered by itself). On the other hand, there are monthly (brief) reports, and detailed annual reports.

The inlet/outlet data for treatment plants are processed, mainly in annual reports, in the way to assess treatment efficiency. Various types of treatments are compared in these reports.

Nevertheless, it is surely difficult to infer from these interpretations that there is no impact on the receiving waters, which is an important objective of the monitoring of effluents. This is due to the sampling frequencies, perhaps to the standards (not assessed in details), and to the mode of interpretation : the impact on receiving water depends on the characteristics of the discharge (quality and quanti) and those of the receiving water (idem). Such calculations are quite simple with the data available. The use of mean values appears also questionable, because it allows to discharge pollutants nearly half of the time above the standard.

Further stages of the monitoring process of effluents (reporting and information utilization) might therefore be poorly efficient (cf Annex c, § 2), but weren't assessed during the mission.

Concerning surface water, data processing seems quite poor : statistics are limited to min/max and average values. Except for irrigation (JVA), the interpretation criteria used are unclear. This domain however is going to be improved through the WQIC project.

Globally, the use of spreadsheets by the Central Lab.'s staff might be improved ; some useful functions (e.g. import of data under other formats) are ignored, and use of graphs and calculation functions seem limited.

Network design

a) The different monitoring activities should be more clearly separated in 3 different domains: drinking water, effluent monitoring, resources (surface + ground-waters). This can be done without changing the current objectives in these domains. Also various technical tasks (sampling, analysis, etc) should be carried out by various units, with clear responsibilities.

b) Concerning resources monitoring, the upgrade plan carried out by MWI and USAID (DAI) is obviously well designed ; the French party could possibly help to achieve this plan, if needed, but under the coordination of MWI/DAI team, and on well defined items.

c) One of these items might be the selection of relevant pesticides to be included in the monitoring programs.

d) Another one, in a longer term, could be the improvment of quality criteria for surface water, or even of « quality objectives ». This latter issue depends on political premisses.

e) About effluent monitoring, one of the major issue should be the increase of data production, which could allow sounder interpretation. Another important issue would be to use composite samples, which give a more accurate assessment of pollution levels and loads. However, both issues imply an increase in operating costs.

f) This problem might be resolved by implying industries in monitoring : they could at least be involved in financing the system, allowing the department to use its own financial resources in a better way (unexpected controls, studies). Such a procedure makes industries more responsible, but implies that some incentive to do so is given back to them. For example, self-control could be used to assess compliance with standards ; in case of exceedance, a penalty could be applied ; self control can also be implemented through regulation. Obviously, it-would be unwise to apply this approach to all industries immediately ; it would rather be implemented through a step by step process, with at first pilot experiments.

g) Effluent sampling has to be shared between decentralized and central staff on a firm basis (geographical) ; in each subdivision in charge of sampling, an annual program of sampling should be drawn, with the possibility of doing some spot-check (unexpected) samples.

Data management :

a) The Central Lab. should be fitted with a computerized network ; it would be better to gradually build up this equipment, beginning with the Information section and Drinking Water and Effluent Monitoring sections, and then completed with labs (from that representing the more important volume of data to that representing the less ; see also links between labs sections i.e. parameters analysed systematically . ..). The server will be dedicated to database and administration of the network ; the programs (mainly spreadsheets) will be available on a local basis.

b) Data from 1987 to 1994 should be included in the database.

Data processing

a) Treatment efficiency should be assessed not only per se but also with consideration to the receiving water. This can be achieved quite simply with the existing means, and training of staff.

Among these suggestions, at least three might be carried out with a support from Rhine-Meuse Water Agency :

- selection of relevant pesticides for monitoring of resources and drinking water
- implementation of a network for the Central laboratories
- effluent monitoring improvement

These aspects will be developped in the next section of the report ; other issues may also be included in the future cooperation between WAJ and Water Agency, if necessaty, but it would need more discussion, As mentioned in § 3.2 (section d), there are also specific needs for drinking water production ; these needs could also be met through the cooperation agreement between WAJ and Rhine-Meuse Water Agency, but they weren't assessed in details during the present mission,

5- Detailed proposals

5.1- Selection of pesticides

The selection of pesticides to measure must be take into account the actual uses for agriculture or other purposes, and by the physicochemical properties of the substances. Second, one should take into account the analytical aspects.

A selection method was developed by a working group at a national level in France, and is currently being applied at regional level. One expert of Rhine-Meuse Water Agency was involved in the implementation of this method in France, and helped to apply it in Rhine-Meuse Basin.

Basically, the method consists in a rough estimate of the risk of negative impacts of pesticides in waters. If we consider risk as a two-dimension function, exposure and effects, *exposure* could be represented by the amounts of pesticides applied on land and by the physico-chemical properties of the substances. These physico-chemical properties determine if the pesticide has a potential to move to groundwater (leaching) or to surface water (runoff). *Effects* may be represented either by the MPC (maximum permissible concentration) or by any other parameter characterizing toxicity.

The method developed in France is based on ranking of the substances, according to their use and properties (K_{oc}, DT50, solubility etc). There is no need to allow a weight to the different parameters considered, it is only necessaty to determine the order in which to take them into account. The complete description of the method has been published in France, and a database including physicochemical properties for about 280 substances is available.

Application of such a method seems possible in Jordan ; the project should include in a first step collection of qualitative and quantitative data about the uses of pesticides (concerned crops,

doses applied, surfaces), and possibly a comprehensive analysis and summary of available studies on losses of pesticides from crops and existing data about contamination of waters in Jordan. In a second step, these data should be recorded, and the original method adapted to the Jordanian situation. In a third step, the adapted method would be applied to the pesticides identified during the first and the second steps. An evaluation should be envisaged some time later, when a sufficient amount of monitoring data would have been yielded.

The resources needed to achieve this process might include mainly work either in Jordan and in Fratice, and one mission (2 men-weeks) for the third step, as described in the table below.

Step	Content	Possible period	Resp. Party	Duration(*)
1	Collection of data (land use, crops, pesticides used ...) Comprehensive analysis of literature and existing data	03-05/97	WAJ with support of Agr. Mission[4] WAJ with support of RMWA[5]	3
2	Adaptation of the method	06/97	RMWA	3
3	Application of the method	06/97	RMWA (mission in Jordan)	10
	Collection of monitoring data		WAJ	
	Evaluation	?	WAJ with support of RMWA	4

(*) working days ; estimation of RMWA involvement

5.2- Netwot-k and database implementation

The working hypothesis consists in a network deserved by a data server; spreadsheets and other specific programs are available on customer computers. This approach allows to reuse a part of the existing resources of the Department, and minimize the investments.

Minimum required configuration

a) Server : Pentium processor, with 16 Mo RAM, hard disk 2 Go, Ethernet communication card

Operating system : Windows NT 4.0 (one license for the server, and one license per customer computer)

b) Customer computers : processor 386 and above, with at least 8 Mo RAM, hard disk of minimum capacity of 80 Mo, and Ethernet communication card

Operating system : DOS 6.22 + Windows 3.11

c) Network : active « HUB » elements for interconnections of ethernet strands

Such a configuration, which seems a minimum, implies some upgrading of several existing computers, for hardware or operating systems ; 2 among existing computers are impossible to connect to any network of this type. So there is a need to make a complete inventory of the equipments to buy for the upgrading of local computers, and a detailed estimation of the budget.

[4] Agricultural Mission. French Embassy
[5] Rhine-Meuse Water Agency

Implementation

In parallel, the data produced before 1995 should be integrated to the database, which suppose a reorientation of the planned development of LOIS (Lab Online Information System). The priorities should be the integration of the data stored under LIMS (Lab Information Management System, used before implementation of LOIS), which would allow to make statistics, trends analysis and other desired calculations in available spreadsheets.

According to the new building project, the implementation of the network and the database could be realized within two years (time schedule hereafter). If necessary, two technical missions could happen at different stages of the project :

1 : detailed assessment of equipment needs, programme planning
2 : implementation of the network, with a limited number of connected computers, tests, training for further connections

A third mission might be necessary after a few months, in order to adjust the functioning of the network, and to train some people to maintenance aspects,

Proposed work schedule for the network implementation

Step	Content	Possible period	Resp. Party
1	Mission : detailed specifications, planning	06/97	RMWA
2	Purchase of equipment and software	10/97	WAJ with support of RMWA
3	Implementation of the network	11/97 to 02/98	WAJ with support of RMWA
4	Mission : start of the implementation	11/97	RMWA
5	Implementation of the network (II) connexion of labs'computers	04 to 07/98	WAJ
6	Mission : training to maintenance aspects	?	RMWA

Primary assessment of costs

This assessment was made on the basis of hard- and software average costs in France, so the cost in Jordan may be slightly different. Anyway, it should be accurate enough to determine the purchase budget.

Equipment		Description	Unit cost (HT)*
Server	(a)	AST Bravo[6] MS T Pro 200 ns (32 Mo RAM, hard disk 2 Go)	20 900
		AST 15 " Monitor	2 500
		Ethernet card (32 bits)	690
		Sub-total	*24 090*
	(b)	COMPAQ Proliant 2500 (32 Mo RAM)	49 200
		hard disk 2 Go	5 980
		SCSI controler	2 080
		AST 15 " Monitor	2 500
		Ethernet card (32 bits)	690
		Sub-total	*60 450*
		Windows NT 4.0	
		System MGM server v 1.2	3 866
		User's license	331
		*Sub-total (14 users**)*	*8 500*
Customers' computers		8 Mo RAM strap	200
		Ethernet card (32 bits)	690
		DOS upgrade (DOS 6.22)	382
		Windows upgrade (3.11 from 3.1)	535
HUB elements		8 ports	1 010
		16 ports	2 840

* in French currency

** based on the existing equipment, and the minimum requirements (386 PC)

The (a) solution seems sufficient, in order to answer current needs of the Central Labs. The (b) solution is more flexible, and allows further evolution of needs.

According to these unit costs, the total cost can be estimated between 60 000 FF (HT) and 100 000 F (HT). It would be wise to provide an additional amount, in order to cover unexpected expenses.

5.3 Effluent monitoring improvement

This proposal is related to the « f » suggestion in the conclusions. Basically, it could be achieved through two missions, one from France to Jordan, and one from Jordan to France.

a) Mission in Jordan :

- **inventory of industrial effluents ; classification in terms of organic load, toxicity, destination (sewage system, surface water, irrigation ...)**
- **assessment of the feasibility of self control**

b) Mission in France :

[6] Trademarks and models are pointed out as examples, but should not be considered as definite suggestions ; however, there are strong differences in terms of quality and performance between different equipments with similar specifications for RAM or hard disk capacity.

- assessment of the self-control design in France : organizational aspects, financial aspects, results
- visits to industries

6- Acknowledgements

This rapid overview of the monitoring activities supported by the Central Lab. wouldn't have been realizable without the kind reception of all the people met, and their patience to explain their job and its organization, and to make relevant documents available. I would like to thank them all, and more particularly Dr Raja GEDEON, Hassan AMRO, Muhammad Al'LAFI and Ahmed ULIMAT, Ayman TUFFAHA, and Edwin STAINS. I sincerely hope this report will have some usefulness for them and for the improvement of water management in Jordan. I also would like to thank people from the Aaricultural Mission of the French Embassy for their logistic support and their kindness.

Annex a

Time schedule & people met

NAME, First name	Date/hour	Title	Organism, Department
	24/11/96		
Akram JUNEIDI	9.00	Adviser of the General Secretary	WAJ
Ayman TUFFAHA			WAJ, Central Operation Dept
Raja GEDEON	10.30	Director	WAJ, Labs & Water Quality Dept
Hassan AMRO		Head of Isotope Laboratory	WAJ, Labs & Water Quality Dept
Visit of the offices and laboratories of the Labs & Water Quality Dept			
	25/11/96		
Muhammad Al'LAFI	9.00	Head of Environmental Monitoring Division, & Information and Documentation section	WAJ, Labs & Water Quality Dept
Information and documentation section : data storage, data processing			
	26/11/96		
Raja GEDEON, Hassan AMRO	9.00	(see above)	(see above)
Evaluation of data management needs			
	27/11/96		
Ahmed A. ULIMAT	9.00	Head of Drinking Water Monitoring Division	WAJ, Labs & Water Quality Dept
Geneviève VAN ROSSUM	16.00	Attaché Culturel	French Embassy
Denis FOURMEAU	17.00	Attaché Infrastructures, Poste d'expansion économique	French Embassy
	28/11/96		
Mamoon KHADER	9.00	Computer Engineer	WAJ
Edwin D. STAINS	10.00	D Chief of Party (WQIC project) A	I
Muhammad HANBALI	12.00	Adviser of the General Secretary	JVA
C.J. CRACKNEL	14.30	Development Adviser	European Commission Delegation
	30/11/96		
Ahmed A. ULIMAT	9.00	(see above)	(see above)
Edwin D. STAINS	10.30	(see above)	(see above)
H.E. Koussai QUTEISHAT	12.00	General Secretary	WAJ
Akram JUNEIDI			
Ayman TUFFAHA			
J.M. HOFFMANN		Expert Hydraulique Régional	French Embassy
Gilles MARTIN		Mission Agricole	
J.M. DESCOMBES		Mission Agricole	

Annex b

Reference documents

1. List of measured parameters (drinking water)
2. Jordanian guideline 202/91 for disposal of industrial effluents
3. Jordanian guideline 286 : quality standards for drinking water
4. Jordanian guidelines for discharge of industrial and commercial wastewaters into the sanitary sewer system
5. Water Quality Improvement & Conservation Project : Water Monitoring System Adequacy Report (MWI, April 1995)
6. Water Quality Improvement & Conservation Project : Water Monitoring Upgrade Plan, vol. 1 (MWI, August 1995)
7. Water Quality Improvement & Conservation Project : Water Monitoring Long-Term Plan (MWI, December 1995)
8. Water Quality Improvement & Conservation Project : Assessment and Evaluation of the Central Laboratories (MWI, September 1994)
9. Water Quality Improvement & Conservation Project : National Laboratory Management Assessment Report (MWI, December 1995)
10. Water Quality Improvement & Conservation Project : Upgrade Plan - Appendix A, vol. 2 : Monitoring System Procedure (MWI, August 1995)
11. Water Quality Improvement & Conservation Project : Upgrade Plan . Appendix B to E : Monitoring Programmes for Surface and Ground-waters in Zarqa River Basin (MWI, August & October 1995)

Annex c

Summary of meetings

1- Dr Raja GEDEON, Hassan AMRO, Ayman TUFFAHA (24/11/96)

The Department of Laboratories & Water Monitoring has to cover 3 main fields :

- **drinking water monitoring**
- **wastewater monitoring**
- **measurements**

According to these duties, the Department includes 2 Sections . *Drinking water quality, Environmental quality* . and 7 laboratories - *inorganic chemistry, organic carbon and nitrogen, heavy metals, organic micropollutants, microbiology, biochemistry, isotopic measurements* -.

These laboratories are equipped with rather modern apparatus (ICP/MS, GC/MS, AAS - flame and furnace, etc), and use still a lot of manual techniques (DOC, NKj etc). The building seems too small at the moment, and it appears difficult to improve the organization and functioning in this context, but a new 3000 m^2 building is planned, which construction should begin in Dec 1996. The laboratories collaborate with several foreign or international organizations for interlaboratories assays (WHO, EPA), and is by now involved in a QA/QC improvment program with a British organism (Aquacheck, UK) ; the final objective of this program is the compliance with ISO 9001 standard. The isotopic laboratory ccoperates with IAEA and other agencies in the same field, and is used as a regional reference (Lebanon, Syria, Saudi Ar., etc).

The drinking water monitoring program is focussed on reservoirs (each collecting several wells) and the distribution networks ; the sampling program is designed according to WHO recommendations (relationships between population and sampling frequencies). The wells by themselves are usually not included in the monitoring program, but are controlled by the Water Resources Department (WAJ) when they are put in operation, or if this department suspect any problem. Data are interpreted according to Jordanian Guidelines 286, if necessary completed by WHO recommendations and other international guidelines (EPA, Canada, European Union etc).

The wastewater monitoring programme deals with two types of effluent :

- **effluents disposed of on land or discharged in the rivers, either domestic and industrial,**
- **discharge of industrial effluents in the sewage system, and inlet of the treatment plant**

There are different guidelines for industrial effluents : Jordanian Guidelines 202 for effluents disposed of on land or discharged in the rivers, and specific requirements and instructions for effluents connected to the sewage system. Reporting takes several forms : memoranda,

addressed to the factory under signature of the General Secretary of the WAJ, and to the governor, and monthly and annual reports. The main statistics indicator used in these documents is the mean value.

According to Mr GEDEON, this organization doesn't avoid redundancy, and provide more work to the laboratories and to the Environmental quality Division than they can assume. From a more general point of view, he suggests that at least a part of the monitoring activity should be decentralized. For example, parameters like residual chlorine or microbiology should be measured, and managed at a local level, under responsibility of governorates. The central level should in this case supervise the decentralized activity, mainly under QA aspects,

At the end of the meeting, two items were identified :

1. network design, from a broad approach, including the different types of monitoring, their objectives, the gaps and difficuties encountered, and the improvements which should be proposed ;
2. data management and data processing.

Human resources of the Department

section	3 yrs + graduate (engineers, biologists, chemists)	technicians, secondary graduate	administrative (graduate)	other (storekeeper, drivers)
Env. Monit.	2	2		
Drink. Wat. Monit.	3	5		
organic & inorganic chemistry	4	6		
isotope	4	3		
microbiology	2	2		
Info-Doc.		5		
Administration		5	1	1
Logistics				10

Production of the Department (sampling and analysis)

year	samples	analysis
1990	25,300	123,000
1991	24,000	113,000
1992	22,000	104,000
1993	23,000	112,000
1994	26,000	128,000
1995	23,000	104,000

2- Muhammad Al'LAFI (25/11/1996)

The Environmental Monitoring Section is responsible for the monitoring of wastewater - industrial and domestic -, *wadis* and dams, and treatment plant effluents. Occasionally, people of the Section may be involved in research activities. Basically, monitoring of wadis and dams should be considered as an extension of the monitoring of effluents : the objective is to check if there is an impact of effluents on river or underground water quality, so sampling points are located up- and downstream of the effluent discharge point. Observation wells are also surveyed downstream (see for example the As-Samra Waste stabilization ponds monitoring programme).

The Sections duties include samples collection and handling, and prescription of the parameters to measure, and at the end of the monitoring process, interpretation of the results, and writing of the reports. Sampling is done by the 2 technicians of the Section, and represents a volume of about 200-250 samples per months. Other samples are collected by people belonging to governorates' staffs. The activity of the Section represents about 30 - 40 % of the total production of the department (table above).

The criteria for designing the sampling programm are discharge quantity, effluent quality, and performance of the industry during previous times.

One can wonder about the efficiency of the system in urging the industries to comply with the standards : the only way to obtain this compliance, if an industry exceeding the standards doesn't try by itself to improve its (pre-)treatment, is to undertake a suit under Public Health Code and Water Authority Law.

The main problems encountered by the Environmental Monitoring Division are as follows :

- lack of transportation means, or at least overload of the existing means
- overload of work,
- lack of technical means,
- which both means difficulties to assess trends, or to make some retrospective and global assessments
- overlapping with governorates'staff (redundancy of sampling programs)
- representativity of samples (grab samples, at present)

In the *Information and Documentation section,* most of the work is done by hand : at the inlet, the characteristics of the samples are written on a request form, which is then completed with codes (location, lab n") ; these data are also copied in a register, and recorded in the information system. Coming back from the labs, the request form is checked (completness of the desired results), and then results are recorded and the report edited after validation,

The section is equipped with 2 personal computers (see table of hardware and operating systems hereafter).

Since 1995, data are stored and edited through a program called LOIS (Lab Online Information System) developped by WAJ-computer section, on the basis of a database system (FOXPRO ®, DOS version). By now, this program only allow storage and edition of the results. The « Retrospective search module » isn't functional yet, and the « Statistics and status » module isn't developped either.

Before 1995 (since 1987), data were managed under another program, called LIMS (Lab Information Management System), and stored on diskettes, There are about 250 diskettes available ; according to people working in the section, there is no compatibility between LIMS and LOIS.

Some diagrams and assessments are done in the section with spreadsheet programs (Quattro Pro ®, DOS version, and Excel ® 4.0, Windows ™ version). In practice, data are recorded again for these calculations, because there is no export procedure in the LOIS database, and no sufficient training in the use of spreadsheets (Excel ® can read and import *.dbf* files directly).

3- Dr Raja GEDEON, Hassan AMRO (26/11/96)

The objectives of the discussion were to precise several points of the organization of monitoring, to deepen the analysis of certain items, and to gather some supplementary information on the data management system.

a) Monitoring design

It appears a difference in nature between the two sectors of monitoring, i.e. *drinking water* and *effluent*. The drinking water monitoring is designed as a control of the production and distribution process by the producer ; in parallel, there is a control on a regulatory basis by the services of the Ministry of Health. In case of critical events, there is a cooperation between the Environmental Health section of the Ministry of Health and the WAJ (Central Labs.). So the drinking water monitoring carried out by the WAJ appears to be an *interna/* control, with an *external* control under operation of the Ministry of Health.

The monitoring of effluents is designed as a regulatory and/or efficiency control. Checking the compliance of effluents with standards seems to be the main duty of the section - at least according to the volume of samples analysed -. A second duty is the determination of treatment efficiency of the treatment plants. Anyway, these two duties are designed as an *external* control, with customers located outside of the Department (industries, or other services of the WAJ).

b) Data management system : rough inwentoty of resources

Data processing resources of the Department

Section	Nb	Processor	Operating system	Function, (program)
Env.Monit.	1	386120	**D O S 6 . 2**	**Data processing (Quattro Pro)**
Drink. Wat. Monit.	2	386/? (16) **Pentium**	DOS 7.77 (?) DOS 6.20, Win. **3.11**	Data processing Data processing **(MS Office)**
organic & inorganic chemistry	4	Pentium 286 **Pentium** **Pentium**	DOS **6.20, Win. 3.11** **IBM-DOS 4.0** **DOS** 6.? (non installed yet)	**Data production (analyzer)** **Data production (analyzer)** **Data production (analyzer)** **Data production (analyzer)**
isotope	4	**Pentium** 386/33 286 **Apple** II/GS	**DOS 6.22** **DOS 6.20, Win 3.1** **DOS 3**	**Data production (analyzer)** **Data production (analyzer)** **Data production (analyzer)**
microbiolow	1	586 /DX4 **or Pentium**	**DOS 6.22, Win** 311	**Data** production
biochemistry	1	386/?	**DOS 5.0, Win 3.1**	**Data production**
Info-Doc.	2	486	**DOS 6, Win 3.1**	**Data** storage, **processing**
Administration	1	486/DX4 **or Pentium**	**DO**S 6.20, Win **3.1**	**Report,** letter, management
Total	*16*			

« Data production (analyzer) » means that the computer is connected to an analyzer, pilot it and treat the signal of the analyzer, and ultimately express the result in terms of concentration or activity.

4- Ahmed Ali ULIMAT (27/11/96) 1

The Drinking Water Monitoring Division has to ensure drinking water control nationwide ; samples are collected along the production and distribution pathway by the staff of the Division - about 4 trips each day, more than 1000 samples collected each month -.

If any of the analytical results exceed the standards, a brief report is sent to the WAJ's General Secretary, which then asks for corrective actions to the concerned governorate staff. If there is no violation of the standards, the results are kept and included in the monthly report. This monthly report is designed as follows :

- **Number of samples collected and analyzed for microbiology, chemistry, biochemistry (BOD, etc) and proportion of chlorinated resources consistent with the standards ;**
- **table of microbiological aggregated results : for each part of the production and distribution pathway (pumping stations, reservoirs, networks, chlorinated wells, no chlorinated wells, springs, wadis), number of samples, number of samples exceeding the standards, percentage of violation ;**
- **table showing the distribution of chemical analysis, between inorganic chemistry, THM, among the 11 governorates ;**
- **table showing the percentage of exceedance of the microbiological standards among governorates, for chlorinated resources and networks only ;**
- **general comments.**

None of these indicators are obtained from the database at the moment ; they are calculated with spreadsheets within the Section. Monthly reports are sent to the governorates and to the Ministry of Health. There is a cooperation between WAJ and the Ministry of Health in case of exceedance of the standards, but it seems that this could be improved by a better definition of the respective duties : operational tasks by WAJ, supervision and ex-post control by Ministry of Health.

Beside this generic program, which applies to the drinking water supply system nationwide, there is a specific monitoring program designed for the King Abdullah Canal (KAC), upstream the location of the abstraction of water for supplying the city of Amman. This specific programme includes 7 sampling stations along the KAC, visited each month. At the beginning, there were 4 samples taken each month. The measured parameters include conductivity, pH, major ions, TOC, COD, turbidity, PO_4, NH_4, total and fecal coliforms, iron, manganese, 7 heavy metals, boron, bromide, BOD, and odor. The results are transmitted to the General Secretary in a semestrial report with a « comprehensive analysis ». This point wasn't examined in detail.

According to Mr ULIMAT, several difficulties or needs are identified :

- human - and probably financial . resources are insufficient in respect to WHO guidelines for drinking water monitoring : there should be about 5,000 samples each month according to these guidelines, instead of about 1,000 at the moment. Most of this discrepancy is concerning rural areas.
- QA/QC should be developped also about sampling and samples handling ;
- mainly for springs, it appears sometimes exceedance of WHO guidelines for raw water, and there is a debate with Ministry of Health about that subject, whether or not drinking water should be produced with such water ; so there is a need of arguments in the way to take the right decisions in such cases, and also a need for defining a strategy (springs protection or . ..) ;
- there could be also a need in idenfying the pesticides to be monitored : at the moment, the monitoring is focussed on endrin, lindane, methoxychlor, toxaphen, 2,4D and 2,4,5 TCPA, and also simazin, but several of them are forbidden.

Mr ULIMAT also mentioned a cooperation project funded by US-Aid, called « Water Quality Conservation and Improvement Project », which aims to define an appropriate monitoring program for underground and drinking waters in Jordan. Several reports covering different basins have already be edited.

5- Denis FOURMEAU (27/11/96)

Financial support provided by this protocol is basically designed for non profitable projects, with important budgets (pipes works, wastewater treatment plants etc). So the first impression is that this kind of funding is not appropriate for modest projects, like database and network implementation in Central Labs. Dep.. Nevertheless, further contacts could be useful, when more accurate assessments of the costs will be available.

6- Mamoon KHADER (28/11/96)

About LIMS (database program used before LOIS), Mr KHADER thinks that it was developped under an old Basic version, by a German company ; this program couldn't handle more than 3 months data, and each file corresponds to a single sample. If the internal structure of the database was known, the convergence with LOIS database could be achieved.

Mr KHADER considers that LOIS is quite completely achieved ; the missing modules (Comprehensive search, Statistics & status) could be realized in 3 to 4 months. From his point of view, there is no need to develop an export module, because Excel can read *.dbf* files directly.

The version of FOXPRO® used to develop LOIS database is compatible with a shared use of the database, through a network, bur this would need some specific developments, which could be done in about 2 months.

7- Edwin D. STAINS (28/11/96, 30/11/96)

Development Alternatives Inc. has a mandate through US-AID funding to prepare a monitoring plan throughout the country. The plan covers both ground- and surface waters, and includes also laboratory and data management aspects, purchasing of equipments etc.

The work started about 3 years ago, with a complete inventory of the existing monitoring programs, and recommended that these various programs be combined into a single unified comprehensive system.

Then, monitoring plans were prepared for each basin, and some equipments were purchased under this global plan, It should be completed in 18 months, but at the moment it seems unsure that the plan will actually cover all the needs, for example the data management aspects at the Central Labs. Dep. level.

8- Muhammad T. HANBALI (28/11/96)

The Jordan Valley Authority (JVA) is dealing with irrigation. Monitoring programs running under its responsibility has to ensure that the water abstracted from the King Abdullah Canal (KAC) complies with irrigation standards and cannot injure the irrigated crops.

The monitoring network managed by the JVA includes 60 sampling stations from the Yarmouk river to Wadi Araba, which are are sampled each month, and 3 sampling stations in the area of Zarqa river and KAC, which receives the effluent of the As-Samra waste water treatment plant. These latter stations are sampled each day.

The monitored parameters are conductivity, pH, major ions, boron, and coliforms. Monthly and annual reports are sent to the JVA's General Secretary. For annual reports, the interpretation is based on seasonal(6 months) averages, and on FAO and WHO[1] standards.

In order to check the quality of the measurements, 6 sampling sites are double-sampled, and the second series is analyzed by the Royal Scientific Society laboratories.

Mr HANBALI admits that there is some overlapping between JVA and WAJ in their monitoring programmes. The fact that objectives are different doesn't hinder to have a common sampling and measurement program, with two different uses of the data, since the different objectives mainly imply that the interpretation criteria are different.

8- C.J. CRACKNELL (28/11/96)

After a period of bilateral financial protocols between Jordan and the European Commission (EC), a new approach will be carried out starting from 1997, due to the Peace Process. Funds will be made available at a regional level, with no budget specifically reserved for each country of the region. Three axes have been primarily retained for Jordan - structural adjustment, human resources development, privatization -, and the projects for 1997 are considered as complete. Nevertheless, the mode of intervention and the priorities could evolve rapidly.

[1] Health guidelines for the use of wastewater in agriculture