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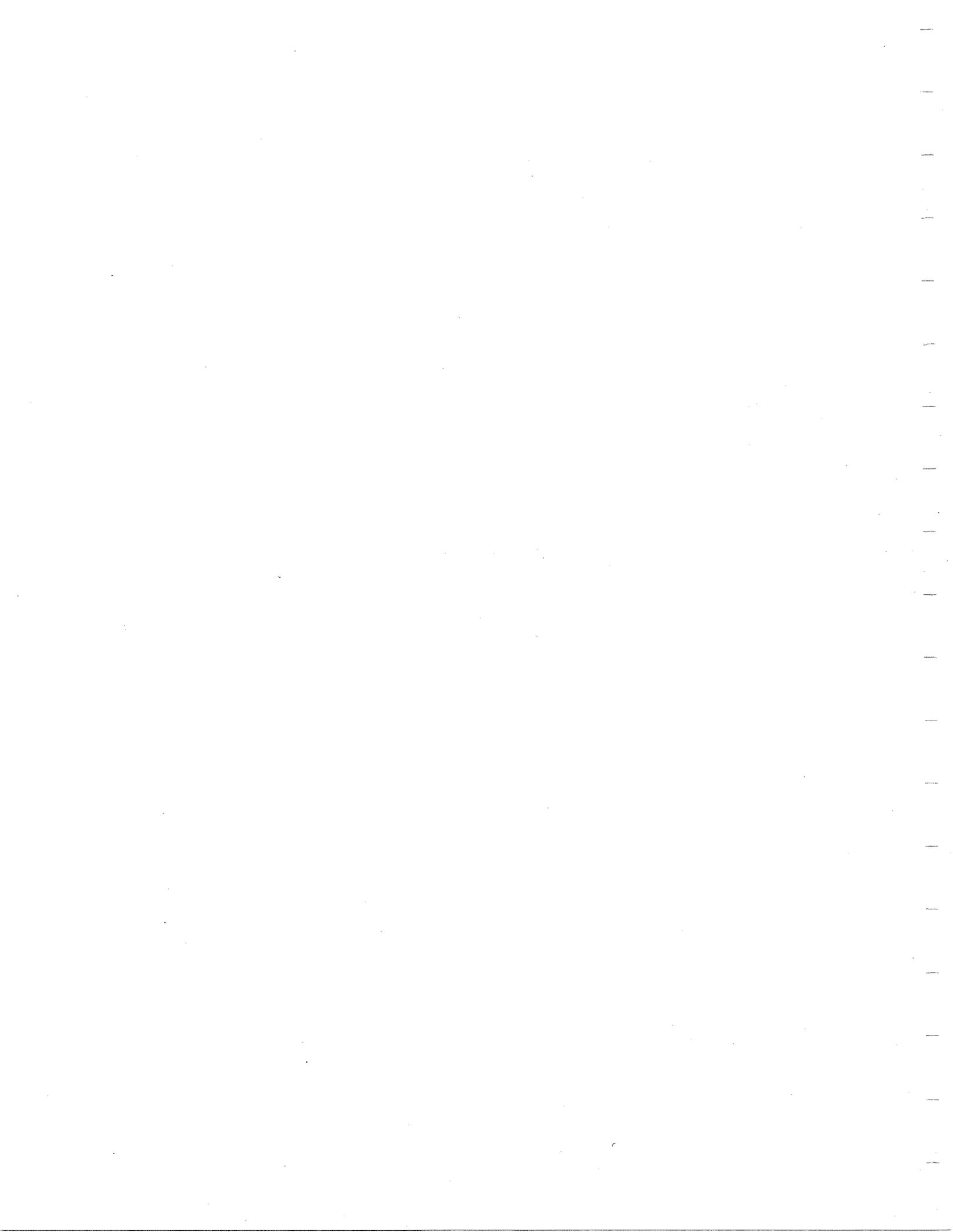
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Environmental Education and Communication Project

**BEST WATER
CONSERVATION PRACTICES
IN MOROCCO**

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BEST WATER CONSERVATION PRACTICES IN MOROCCO

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PREFACE

Successive droughts which have plagued Morocco since 1980, have prompted policy-makers and the public at large to develop and implement different actions in an attempt to cope with the adverse effects of this hazardous phenomenon on the availability of groundwater and surface resources, both in urban and in rural areas. Ad-hoc committees were set up in the various districts and provinces, with the participation of partners having in common their keen interest in water conservation and protection issues.

During five successive years of acute drought in Morocco (1980-1985), I had, in my capacity as head of Dam Operation and Supervision Department, full responsibility of all the country's water dammings in terms of allocation of water resources to meet drinking, farming and industrial needs. I also had a mandate to determine the size of cuts in water supply for irrigation purposes in times of drought. Decisions on this aspect and also on the reduction of the size of lands to be irrigated under such circumstances, were made in agreement with officials in charge of regional agricultural development boards. I thus had an opportunity to see how precarious it was to ensure the conservation of water resources. Everybody seems to have suddenly awoken to the dangers of the dwindling water resources, especially the government, local authorities, policy-makers, scholars, educationists, the media as well as NG'Os (see Appendix N°7) and the Moroccan associations for the protection of the environment, women's associations, youth associations and trade associations. Diplomatic and International Organizations missions also grasped the magnitude of the problems related to the scarcity of water in Morocco (UNDP, WHO, UNEP ...). Natural disasters such as droughts and floods, and man-made ones, such as chemical pollutions, have enhanced the need and strengthened the determination to improve knowledge and analysis of these phenomena which have such an adverse impact on the quality as well as the quantity of water from the collecting stage, to the damming, then flowing into the sea or the desert.

The artificial rain system which was applied successfully in the Oum Er Rbia catchment basin, near Bin El Ouidane large dam, and in which it was possible to use heavy duty equipment under an American-Moroccan cooperation program, is one of many options available for the conservation of water.

Interaction between surface water and groundwater resources to ensure optimal conservation of water has been improved with the adoption of a combined type of management. Several studies have been conducted on quantity/quality relationship. A survey on eutrophication of water in dams located in high temperatures led to the development in 1982 of sophisticated systems for medium-term projections about water level changes in dams. These methods were used, for example, to determine the degree of eutrophication in Sidi Mohamed Ben Abdellah dam which supplies drinking water to the capital Rabat and the neighbouring coastal zone, and which has the largest drinking water supply station in the country.

Having conducted a study under a U.N.D.P. project on artificial recharge in Djibouti, in December 1995, I considered that it may be useful to describe the method used there as a significant full-fledged hydraulic system for the conservation of surface water in aquifers and its use when needed, especially in periods of drought or low hydraulicity. The aim is to prevent loss of water through evaporation or flow into the sea or the desert. This method which has been used in Morocco since 1925 consisted in infiltrating and injecting water in the Charf Al Akab water sheet and subsequently supplying drinking water to the city of Tangier. The same approach was adopted with respect to river N'Fis, near the city of Marrakech. Artificial recharge techniques were also being considered with regard to the river Zat. A comprehensive program in this connection is detailed in the study, showing the location of various aquifers where such artificial recharge methods are being applied to protect water, in terms of quality and quantity, from the adverse effects of such hydrological phenomena.

Another way of conserving water is to treat wastewater with a view to using it for agricultural purposes. This approach was applied particularly in the case of the Ourzazate region. Other water treatment techniques, including lagooning, distribution and infiltration are described in this study.

Another water conservation device consists in building small debris dams, a method which also helps curbing erosion. In fact, the latter phenomenon has a considerable impact on the environment and deserves special attention in Morocco. In this connection, as a representative of ICCE (International Commission of Continental Erosion), I came to realize that some of the highest erosion rates in the world, were actually recorded in Morocco, with an average of 6,000 t/km²/year recorded at Nekor catchment basin in the North Eastern part of the country.

Details are also given in this study about the relationship between erosion, silting-up and the reduction of drinking, irrigation and industrial water. As a matter of fact it has been recorded that the overall silting volume has reached 800 million m³ or 7 % of total capacity of all the country's dams. Each year some 60 million m³ of sediment are deposited in the Moroccan large dams (including Al Wahda large dam which is also the second largest dam in Africa). Sediments take the space reserved for water; therefore, to ensure conservation of water it is necessary to fight erosion and hence sedimentation. The following steps are recommended to this effect :

- Large-scale afforestation of catchment basins above the dam. This approach, called biological anti-erosive action has a long term positive impact,
- Mechanical actions consisting in building sedimentation debris dams.

Farming methods as well as the type of farm machinery used may have a considerable impact on the extent of erosion, on silting-up and on the conservation of water. However the essential factor, in my opinion, lies in the efficient management of irrigated lands and of the water resources allocated to agriculture. Indeed it is in this particular field that the highest level of water saving can be achieved.

A wide range of water conservation projects have been carried out in Morocco as part of bilateral, sub-regional, regional and international cooperation programs or through international organizations such as UNDP, UNEP, WHO, the World Bank and African Development Bank ...

On the other hand, the number of NGOs operating in Morocco is increasing rapidly and I think that they deserve support and encouragement. It is also my opinion that their efforts so far have been confined to convening conferences and seminars. To enhance their performance and output, other financing sources should be explored, both in the private sector and through the relevant government agencies.

On the other hand, solar and wind renewable energies constitute other significant alternatives which deserve careful consideration in Morocco. I presented papers on this subject at the 3rd and 4th editions of the International Congress of Renewable Energy (Reading, England, 1995 and Denver Colorado, USA, 1996). I believe that the use of solar energy for pumping groundwater should be encouraged, just as wind energy production should be promoted.

Another possibility to improve water conservation is through desalinization of water, especially in the South of Morocco (see relevant program).

The following pages include an introduction, a methodology description and a set of programs describing best water conservation techniques and awareness raising efforts to be conducted according to specific target audiences, in Morocco.

METHODOLOGY

Water efficiency (water conservation programs have been implemented in Morocco since 1972 by ONEP, the country's largest agency responsible for drinking water supply.

The present study is an update and reappraisal of previous surveys on drinking water protection and conservation efforts in Morocco. It also covers water-related issues addressed by the country's experts, educationists and media specialists as well as by NGO^s and regional and international fora and conferences.

Despite 30 years of personal involvement in the design and implementation of the country's hydraulic policies I can by no means claim this to be an exhaustive study. Through it is incomplete, mainly because of time constraints, it does raise a score of questions which call for a relevant and prompt response.

One of the major steps taken in preparation for this study was the program of visits to ONEP sites and facilities and interviews with the agency's top management.

Other information and data collection activities included :

- Visits to rural zones (near Fes city).
- Visits to urban zones (Fes, Casablanca and Rabat).
- Calls on education officials (Director General of Educational Affairs (Ministry of Education, Rabat) : Contacts with the director of primary and secondary education.
- Calls on industrial leaders (in Casa, Fes, Rabat).
- Call on the Director of the Agency for the decongestion of the city of Fes.

To collect maximum data on awareness raising efforts for drinking water conservation, and on prospective projects and activities, as well as on target audiences, the cases of success in solving water-related problems, the socio-economic and environmental impact, interviews were arranged with ONEP officials.

Notwithstanding the time constraints, it was still possible to consult multiple sources and to collect a wide range of documents, and subsequently to cross - validate the information gathered.

Those interviewed include : Policy makers, Implementors, Water delivery services, Personnels, and some beneficiaries of water supply services.

Each of the above categories expressed their views from a different perspective.

Pictures and audio-visuals are provided to supplement the report. Information sources are footnoted.

FACTS ABOUT MOROCCO

GEOGRAPHY :

Morocco has a total area of 712,500 km²

Morocco is divided into the following principal physographic units :

- The Coastal Plains
- The Northern Hills (Rif mountains with maximum peak level of 2500 m).
- The Central Hills (Central, Upper and Lower Atlas with a maximum peak level of 4200 m)
- The Desert Hills.

CLIMATE

The average annual rainfall is 340 mm/year⁻¹ (less than 150 mm in the South - East). Half of the precipitation is concentrated on 15 % of the territory.

TABLE N° 1 : MOROCCAN POPULATION

| | | |
|--------------------|---------------------------------|-------------|
| Total Population | 27 028 000 inhabitants | Year : 1995 |
| Population density | 61 inhabitant. km ⁻² | Year : 1995 |
| Rural population | 52 % of the total | Year : 1995 |

AGRICULTURE

- The cultivable area is estimated at 8 million hectares (18 % of the territory).
- In 1993, the total cultivated area was 7.23 million ha (6.57 million of annual crops and 0.66 million ha of permanent crops).
- Irrigated areas represent 17 % of the cultivated lands but contribute about 45 % to agricultural earnings.
- In 1993 agriculture including fisheries accounted for 14.3 % of GDP and employed about 47 % of the labour force.

TABLE N° 2 : CULTIVATED AREA

| | |
|---|-------------|
| - Area of Morocco 712,500 Km ² | |
| - Cultivable area 8 000 000 ha | Year : 1992 |
| - Cultivated area 7 232 700 ha | Year : 1993 |
| * annual crops : 6 568 300 ha | Year : 1993 |
| * permanent crops : 664 400 ha | Year : 1993 |

TABLE N° 3 : WATER CHARACTERISTICS

a- Renewable water resources

- Average national precipitations : 340 mm year^{-1} or $150.10^9 \text{ m}^3 \text{ year}^{-1}$
- Total renewable water resources $30.10^9 \text{ m}^3 \text{ year}^{-1}$ (of which 6.10^9 m^3 of groundwater).
- Renewable water resources by inhabitant : $1100 \text{ m}^3 \cdot \text{year}^{-1}$ (year : 1995).
- Total dam capacity $13.4 \cdot 10^9 \text{ m}^3$.

b- Water withdrawal

- Agricultural (1991) : $10.10^9 \text{ m}^3 \text{ year}^{-1}$
- Domestic (1992) : $0.54 \cdot 10^9 \text{ m}^3 \text{ year}^{-1}$
- Industrial (1992) : $0.32 \cdot 10^9 \text{ m}^3 \text{ year}^{-1}$

In 1992 water withdrawal was $11.10^9 \text{ m}^3 \text{ year}^{-1}$ of which 92 % for agricultural purposes : $7.5 \cdot 10^9 \text{ m}^3$ was surface water and $3.5 \cdot 10^9 \text{ m}^3$ groundwater in the rural areas (92 % : wells, 8 % springs) 8 % of rural population receives water from water distribution network.

- Total water withdrawal per inhabitant : $440 \text{ m}^3 \text{ year}^{-1}$, representing 37 % of current total renewable water resources.
- Other water withdrawal (1990) : $0,38 \cdot 10^9 \text{ m}^3 \text{ year}^{-1}$

c- Wastewater - Non-conventional water sources :

- produced wastewater (1994) : $0,3710^9 \text{ m}^3 \text{ year}^{-1}$
- Dessalinated water (1992) $3.4 \cdot 10^6 \text{ m}^3 \text{ year}^{-1}$

(See Appendix N° 1).

STUDY OF PRE-CAMPAIGN AWARENESS RAISING EFFORTS ON WATER CONSERVATION

The following study contains the results of direct contacts and interviews concerning water conservation awareness raising efforts, in rural and urban cities and with industrial leaders.

Because the pre-study undertaken by ONEP on this subject (TOP PUBLICITE INTERNATIONAL) concerns a large population base I prefer to give the following statistics in connection with the questions put to many consumer categories (See in APPENDIX n° : List of questionnaires sent by another to industrial executives).

Three types of groups are considered :

- Real particular consumers who have drinking water.
- Non particular consumers who get drinking water from other sources than ONEP.
- Real industrial consumers (industries using potable water).

1- Analysis of the first group : real consumer of drinking water

For this group, 100 consumers have been selected as follows :

- Class A/B : 25 males and 25 females, with an income $>2,500$ Dirhams/month, location : Casablanca, 4 quarters : Gauthier, Oasis, Anfa, C.I.L.
- Class C/D : 25 males and 25 females with $500 < I < 2,500$ dh/month, location : Casablanca, quarters : Maarif, Hay Hassani, Derb Sultan.

2- Non consumers who get drinking water from other sources than ONEP

- 25 persons using public fountains, location : Derb Hjjama, Old medina (city).
- 25 water porters (old medina, Derb Ghallef).
- 25 users of springs and rivers (El Malah river).

3- Real industrial consumers

Questions were put to leaders of 100 industrial plants operating in the following fields : food (22), lighting (1), canning factories (2), construction and installation (8), detergents (2), energy (3), electro-mechanics (3), sponge (1), steel making (9), dairies (3), marble-working (3), metal (4), paper-making (2), glass-making (4), plastic (6), leather works (3), painting (5), chemicals and drugs (9), textile (8), Morocco-leather (2).

General conclusions

Five problems mentioned in this study which was conducted in 1984, have to be resolved.

(a)- Is an advertizing campaign achievable and desirable, even if water is not available everywhere ?

(b)- How to promote an image of water as a scarce and precious commodity ?

(c)- How to raise awareness about water value ?

(d)- How to avoid the loss of water ?

(e)- How to preserve the positive effects of drinking water on the public health ?

The results obtained for each consumer category are summed up in the table below :

TABLE N° 4 : SUMMARY OF RESULTS OF THE INQUIRY

| Questionnaires number | Questions | Replays |
|--|--|--|
| 1 | Q1 : Do you think that we ought to save drinking water ? | - Real consumers (A) : 84 % - Non consumers (B) : 79 % - Real industrial (C) : 100 % |
| YES FOR SAVING WATER : AVERAGE 87,67 % | | |
| 2 | Q2 : Is an advertizing campaign feasible for saving water ? If yes, how ? | Acceptability of the campaign A → 83 % B → 88 % C → 98 % |
| YES FOR A CAMPAIGN FOR WATER CONSERVATION : AVERAGE 89,6 % | | |
| 3 | Q3 : Do you think that this campaign is useful ? | A → 78 % B → 88 % C → 88 % |
| YES THIS CAMPAIGN IS USEFUL : AVERAGE : 86,33 % | | |
| 4 | Q4 : Do you think that this campaign will encourage the population to save water ? | A → 80 % B → 86 % C → 70 % |
| YES THIS CAMPAIGN WILL ENCOURAGE FOR WATER CONSERVATION : AVERAGE 78 % | | |

TABLE N° 5 : SUMMARY OF RESULTS OF THE INQUIRY

| | Saving factors, yes | Acceptability of the campaign | Adaptation to reality | Positive action on population |
|---|---------------------|-------------------------------|-----------------------|-------------------------------|
| Real particular consumers | 84 % | 83 % | 78 % | 80 % |
| Non real consumers | 79 % | 88 % | 88 % | 86 % |
| Real industrial consumers | 100 % | 98 % | 93 % | 70 % |
| - Yes for saving drinking water | | | | : 87,7 % |
| - Yes for a campaign in support for drinking water saving | | | | : 89,6 % |
| - Yes, this campaign will have an impact on the public | | | | : 78 % |

(See Appendices N°2 and N°3).

(b)- How to promote an image of water as a scarce and precious commodity

TALBE N° 6 : RESULTS OF QUESTIONNAIRES

| | Real consumers | Real non consumers | Industrials | Average |
|---|----------------|--------------------|-------------|---------|
| - To save for the future | 43 % | 1 % | 41 % | 28 % |
| - Because drinking water is fundamental, precious and exhaustible | 30 % | 23 % | 33 % | 28 % |
| - Because water squandering is wrong | 12 % | 23 % | - | 11 % |
| - Because saving drinking water constitutes an act of solidarity | 11 % | 3 % | 9 % | 7 % |
| - To save money | 8 % | 47 % | 17 % | 24 % |
| - To insure drinking water allocation for all Moroccans | - | 6 % | - | 2 % |
| - To help population save water | - | 4 % | - | 1 % |
| - Drinking water saving resolves structural problems | - | - | 9 % | 3 % |
| - Because it contributes to protecting hygien | - | - | 3 % | 1 % |

(c)- How to raise awareness about water value

TALBE N° 7 : RESULTS OF THE QUESTIONNAIRES

| | Real consumers | Real non consumers | Industrials | Average |
|--|----------------|--------------------|-------------|---------|
| - Use water without squandering it | 35 % | 3 % | 11 % | 16 % |
| - To use only the necessary quantity of water | 20 % | - | - | 7 % |
| - You ought to save water | 13 % | - | 7 % | 7 % |
| - Water can run out | 7 % | 13 % | - | 7 % |
| - Saving drinking water is duty for each citizen | 4 % | 3 % | 8 % | 5 % |
| - Advice on saving water | 3 % | 13 % | 23 % | 13 % |
| - Permits to redistribute water | - | 13 % | - | 4 % |
| - Efforts to motivate population | - | 57 % | - | 19 % |
| - Education | - | 13 % | 16 % | 10 % |
| - To save water = to save money | - | - | 40 % | 13 % |

(d)- How to avoid loss of water

To urge citizens to stop squandering water, we must show them examples of excessive uses of drinking water and lead them to identify squandering factors (as leaks, inadequate installations ...). Squandering is :

- To allow depletion of an indispensable resource.
- To waste water by : letting the cock flowing, using inconsiderably water.
- To keep pipe and tube in bad condition.

(e)- How to preserve the positive effects of drinking water on the public health of the population ?

- Knows the relationship between the saving concept and squandering.
- Thinks the campaign is justified.
- Is aware that drinking water is scarce, precious and depletable.

Displaying of signboards and posters at place of work acts as a reminder which can be used on campaign site and constitutes a continuation of Television campaigns.

Written material (brochure, folding album, documents ...) more widely used by industrial leaders for information purposes.

For industrial leaders, it is recommended to have an awareness raising campaign organized by expert engineers who can propose relevant technical solutions to reduce drinking water consumption in light of the industrial plant concerned, and of the means used.

Following are statistical data developed by ONEP in the light of interviews conducted with industrial executives :

- 35 % of industrial officials interviewed by the (ONEP) answered that there are no substitution systems of technical equipments.
- 20 % of industrial officials think that they use only sufficient water.
- 4 % of industrial officials think that water cost is not a trump.

In conclusion, it is necessary to organize technical information operations for industrial officials.

- 100 % consider that water economy may induce treatment economy, employment limitation and money savings.
- 8 % consider that water economy can improve the productivity. Nevertheless, modern techniques are very costly.
- 85 % consider that informative documentation can induce water economy.

Program

SENSITIZING CAMPAIGN TOWARDS DRINKING WATER SAVING, BY TELEVISION (ONEP)

Goals and objectives

Following contacts and enquiries with ONEP management including the Communication Director, conclusion was reached that public mobilization through relevant television programs was the best approach for water conservation

Following a picture study and the consideration of the specificities of drinking water as well as the reaction of different groups of people to the idea of launching a campaign in favour of drinking water saving while preserving all the benefits linked with its uses, the campaign has mostly focused on the audio-visual support (Television).

Implementor

ONEP (National Drinking Water Office).

Context (Urban / rural)

Both.

Target Audience (socio-demographics)

The target of the campaign is to carry on sensitizing the population to the issues of pollution and its consequence on the water liable to be used for human consumption.

Television allows for :

- a through cover of the targeted population (there were presumably 12,000,000 TV viewers in Morocco in 1990)
- very strong memorisation of the target.

Description of Activities

The campaign has been made up in the first stage of a 10 large - audience targeted commercials, in addition a written support is undertaken (which is an appropriate supplement towards the advertisements).

The 10 commercial headings are as follows :

TABLE N° 8 : LIST OF FILMS

| N° | Designation | Duration |
|----|----------------------------------|----------|
| 1 | Introducing the logo | 15" |
| 2 | Water is a rare commodity | 45" |
| 3 | Car cleaning | 30" |
| 4 | Washing up | 30" |
| 5 | Households installations repairs | 30" |
| 6 | Pricing | 40" |
| 7 | Social connections | 40" |
| 8 | Daily use | 50" |
| 9 | Treatment techniques | 55" |
| 10 | Scientific control means | 60" |

1- The film "INTRODUCING THE LOGO" has helped situate the concept of drinking water.

The message has been both simplified and clarified : "Drinkin water is essential to good health : use it sparely".

2- The film "WATER IS A RARE COMMODITY", is the explanation of concept of drinking water, reminds that water is difficult to treat (showing that all these treatment processes are time consuming and costly) ...

3-4-5- The 3 films : "CAR CLEANING", "WASHING UP", "HOUSEHOLDS INSTALLATIONS REPAIRS" are advisory films : they contrast the right and the wrong approaches to the most common cases of water wastcage due to lack of information through amusing cartoon sequences.

6- The film "PRICING" advices to the consumers the issues of cost and wastcage through drinking water pricing.

7- The film "SOCIAL CONNECTIONS" This campaign had two objectives : to highlight the quality of life achieved through the availability home water facilities.

8- The film "DAILY USE", highlights the importance of drinking water and the daily uses while stressing the qualitative aspects inherent to the water as delivered to the consumer.

9- The film "TREATMENT TECHNIQUES" highlights in a simple way through cartoons and real life shots the treatment and the quality control processes undertaken throughout the process.

10- The film "SCIENTIFIC CONTROL MEANS" shows the means in use at the level of ONEP.

Gender Impact

Male and female alike.

Record of Success in Solving Problems

The television campaign is the best practice for water sensitization comparatively to other used methods as caravaning, advertising in Radio, in overall cover Morocco.

List of Contacts

ONEP.

Program

WATER CONSERVATION ADVOCACY PROGRAMS FOR YOUNG PEOPLE (1997)

Goals and objectives

Through a participative and motivating approach young students are encouraged to get an understanding and an insight of their environment, with special emphasis on water - related issues.

The program is part of a large-scale campaign launched by ONEP to raise awareness among young people about water issues, in conjunction with other government agencies and with the support of international organisations.

Implementor

ONEP and the Ministry of Education, with the support of the International Development Society.

Context (Urban / rural)

Both.

Target Audience (socio-demographics)

This educational and training program was designed for young students under 18.

Description of Activities

This educational program was implemented in the form of specific projects on water and its environment, which were designed for the students under the supervision of their teachers.

The program addresses such subjects as drinking water: production, distribution, treatment, water pollution, water and modern life, erosion, water, storage, water through history in Morocco, drinking water and school enrolment, drinking water and the environment, the cost of water, the cultural aspects of water ... etc.

The program was implemented over a period of 3 months by 60 Education Ministry branches in the country's 8 economic districts. Each branch has 3 class-rooms and 2 teachers. The total student population covered by the program is 6,000 pupils.

Teachers were selected and trained for this specific project. Student groups were set up along subject lines. Achievements were assessed and prizes awarded by provincial and national boards of examiners.

Gender Impact

The same for female and male population alike.

Record of Success in Solving Problems

The aim of the program is to encourage young people to develop positive attitudes about the projection of the environment in general and of water in particular.

List of Contacts

Ministry of Education : General director of pedagogic affairs.

Program

GOVERNMENT EDUCATION EFFORTS AND WATER CONSERVATION

Goals and objectives

To use the Ministry of Education's huge resources in terms of facilities, staff, programs and network, in order to reach the largest possible audience and familiarize it with water conservation problems and possible solutions.

Implementor

Ministry of education.

Context (Urban / rural)

Both.

Target Audience (socio-demographics)

Teachers, families, pupils and students.

Description of Activities

The following publications concerning water conservation were issued by the Ministry of Education :

1- "L'enfant et l'eau" (children and water", Proceeding of a panel organized on 11-12 April 1991 in conjunction with the Moroccan Association for UNICEF (Association Marocaine de Soutien à l'UNICEF). The meeting focused on drinking water and sanitation issues : papers were presented by : the Ministry of Public Works, ONEP, the Ministry of Interior, the Ministry of Health, the Ministry of planning, the Ministry of Agriculture, the Ministry of Energy and Mines, the Ministry of Education, the Ministry of Handicraft and Social Affairs and the Ministry of Youth and sports.

2- "Becoming the importance of water as a basic element for life"

The above is part of a course offered by the Natural Sciences Department of the University of Kenitra. Issues addressed include water pollution, water losses, sanitation, wastewater problems, the various types of aquifers, ... water supply, the physical and chemical characteristics of drinking water.

3- Document n°152, issued by the Ministry of Education (General Secretariate) on 26 september 1994 and sent to :

- The directors of district academies
- The general inspectors
- The Ministry of Education local representatives

- The inspectors of basic and secondary education
- The directors of basic and secondary education
- Basic and secondary education teachers.

This paper was disseminated on a large scale on the occasion of the International Food Day.

4- Document n°112 of the Ministry of Education sent by the General Secretariat.

It was published following a meeting held on this occasion of the International Day for environment (5 June).

5- Letter n°199 of the Ministry of Education addressed to its regional representatives concerning a contest on raising awareness about water conservation, letter dated 29 December 1994.

6- Circular memo n°120204, concerning the organization of a 7 - day cultural event on : "Human security and environmental security", and sent by the Ministry of Education to its regional representatives sent. Many papers were presented on this occasion, particularly on water and health ...

Gender Impact

Male and female alike.

Record of Success in Solving Problems

The experience has had a direct and positive impact on the targeted populations in many areas, where concrete results, as evidenced by comparative data, have been recorded.

Relevance to the Region

Applicable nation - wide.

List of Contacts

Ministry of Education (General director of pedagogic affairs).

(See APPENDICES N°5 and N°6).

Program

BENSLIMANE USED WATER TREATMENT PLANT

Goals and objectives

- Protection of public health
- Protection of water resources
- Protection of environment
- Obtaining additional water resources, saving drinking water through reutilisation of treated water for irrigation purposes in green areas and the golf course of Benslimane city.

Implementor

- Ministry of Interior, Benslimane city council.
- ONEP - MILD Company
- Sub - contractors ADS (Canada), MATIMEX (Morocco) and SRGM (Morocco)

Context (Urban / rural)

Both.

Target Audience (socio-demographics)

Population of Benslimane city and more specifically those dwelling on the banks of rivers which receive used waters as well as Bouznika beach.

Description of Activities

* Feasibility study and construction of a used water treatment plant in Benslimane. The station is of the open lagunage type with an average discharge of 5,600 m³/day. It covers 35 hectares. The system includes the following facilities :

- a water admission pipe, diameter : 600 mm, length : 2400 m,
- a mechanical pretreatment system,
- 5 treatment basins of 3,500 m³ each (total : 17,500 m³),
- 4 aerated basins of 500 m³ each (total : 2,000 m³),
- 4 optional treatment basins of 17,000 m³ each (total : 68,000 m³)
- 4 deep reservoirs (height h = 5 m) for tertiary treatment and storage. The capacity of each one is 75,000 m³ (total 300,000 m³),
- pumping station with a discharge of 150 m³/hour and a delivery conduct (length : 4,500 m, diameter : 250 mm) to the green area of golf,
- one laboratory,
- the overall cost of the plant is : 94,7 million DHS (survey : 15 million DHS).

Gender Impact

To improve sanitary conditions for populations neighbouring Aïn Sultan and Al Ghbar rivers and for swimmers at Bouznika beach.

Explanation of How Environmentally Friendly

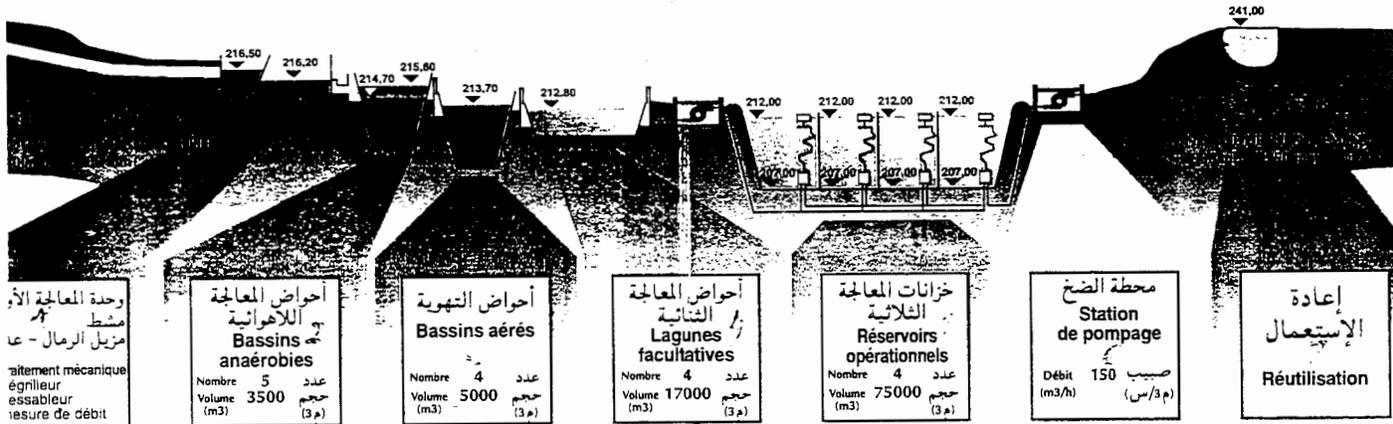
- Cleaning rivers from used water pollution.
- Development of green areas.
- Protection of water resources.
- Protection of sea-resort.

List of Contacts

- Ministry of Interior (General Direction of local collectivities, Direction of water and sanitation).
- ONEP.
- Mild company.

Photographs of Program

PHOTO N°1 : OVERVIEW OF PLANT



LEGEND : (1) : mechanical pretreatment basin, (2) : anaerobic basin, (3) : aerated basin, (4) : optional lagoon basin, (5) : 4 deep reservoirs for tertiary treatment, (6) : pumping plant, (7) : re-use.

PHOTO N°2 : VIEW OF BASIN



PHOTO N°3 : VIEW OF AERATOR IN SERVICE



Program

SEAWATER DESALINATION : CURRENT SITUATION AND PROSPECTS

Goals and objectives

Despite studies of Master Plans, some hydrographic basins would remain deficient by the year 2020, such as Oum Er Rbia (240 million m³), Tensift (60 Mm³) and Souss-Massa (140 Mm³) basins. For these reasons and in order to improve water preservation (in terms of mobilization), it appears reasonable to include the use of non conventional water resources in the general water management policy.

In order to improve the existing conditions and fulfill the needs in the medium and the long term, some units for producing drinking water by means of seawater desalination are implemented in Laayoune (7000 m³/day) and Boujdour (800 m³/day). In the future, essentially in the coastal zones, whenever the mobilization of non conventional water resources is found to be impossible, or very costly, desalination could be considered as the saving solution from now on. Seawater desalination stations will be needed in the cities of Agadir, Tan-Tan, Sidi Ifni and Essaouira, in the medium or long terms.

This program describes the current status of the desalination techniques known to be particularly efficient. It also refers to the experience conducted by ONEP in this field and to the future prospects of desalination in Morocco.

Implementor

ONEP.

Context (Urban / rural)

Both.

Target Audience (socio-demographics)

- Population supplied with desalinated water in Boujdour 15,000 inhabitants.
- Population supplied with desalinated water in Laayoune : 132,000 inhabitants

Gender Impact

For female and male population alike.

Record of Success in Solving Problems

The two plants of seawater desalination in Boujdour and Laayoune cities supply 7800 m³/day of desalinated water to the population.

To mitigate the shortage, desalination turned out to be a competitive solution (compared to the water carriage option) for cities located in the coastal zone. The advantage of availability of mobile plants makes desalination an interesting relief solution.

Relevance to the Region

To improve knowledge of and adjustment to new technology, in this field, ONEP sets up a technical committee which has visited countries known for their experience (Middle East, Canary Islands ...). The five North African countries (Morocco, Algeria, Tunisia, Libya and Egypt) requested technical assistance from the International Agency of Atomic Energy (IAEA) in 1989 to undertake a feasibility study of desalination of seawater by means of nuclear power. Such a study in which ONEP took part, began in 1991 and was completed in 1995. The conclusion was that the use of nuclear power for seawater desalination purposes is technically feasible for capacities exceeding 60000 m³/day of desalinated water.

Description of Activities

1- Description of current plants of seawater desalination implemented in Boujdour and Laayoune cities

TABLE N° 9 : PLANTS OF SEAWATER DESALINATION

| PLANTS | BOUJDOUR | LAAYOUNE |
|--|----------------------------|----------------------------|
| CHARACTERISTICS | | |
| - Population supplied by desalination seawater | 15,000 inhabitants | 132,000 inhabitants |
| - Production capacity | 800 m ³ / day | 7000 m ³ / day |
| - Percentage of use | 100% for human consumption | 100% for human consumption |
| - Desalination technique | Reverse Osmosis (RO) | Reverse Osmosis (RO) |
| - Cost of the plant "keys 6 in hands" | 60,000,000 DHS ATI 1992 | 223,000,000 DHS ATI 1992 |
| - Date of launching | October 1995 | October 1995 |
| - Cost of production per year | 5.86 DH / m ³ | 6.056 DH / m ³ |
| . Energy (including the energy of row water pumping) | 4.13 DH / m ³ | 3.696 DH / m ³ |
| - Specific consumption (in kw(e)/m ³ of desalinated water | 5.11 DH / m ³ | 5.07 DH / m ³ |
| - Cost of m ³ of desalinated water production | 42 DH / m ³ | 21 DH / m ³ |
| - Conversion rate | 40 % | 45 % |
| - IDS of water produced | 500 mg/l | 500 mg/l |

1- For a voluntary program in zones with high competitiveness

Future locations suitable for the implementation of seawater desalination units are to be sought in cities located within deficient hydrographic basins such as Agadir, Sidi Ifni, Tan-Tan and Essaouira in the Atlantic coastal zones.

TABLE N° 10 : SUMMARY OF DATA RELATED TO POTENTIAL SITES FOR SEAWATER DESALINATION

| N° | CITY | PRESENT TIME | | FUTURE | | OBSERVATION |
|----|----------------------|---------------------------------|--------------------|---------------------------------|--------------------|---|
| | | CAPACITY m ³ /day | SATURATION Year | CAPACITY m ³ /day | SATURATION Year | |
| 1 | Laayoune | 7000 | 2000 | 14000 | 2020 | Extension of current units to permit fulfillment of water needs of the city in the medium and long terms |
| 2 | Boujdour | 800 | 2020 | | | The current unit will permit fulfilling water needs of the city in the long term. |
| 3 | Agadir | | | 45000 | 2030 | Taking into account its high costs, the desalination solution at the present stage is not competitive with the mobilization of surface water resources (costs are 65 DH/m ³). The idea of using nuclear power might be interesting. |
| 4* | Tiznit and Sidi Ifni | | | 3500 | 2020 | Resorting to desalination may be considered from 2008 |
| 5* | Tan-Tan | | | 7000 | 2020 | Seawater desalination not to be envisaged from the year 2000 |
| 6* | Essaouira | | | 13000 | 2020 | Resorting to desalination may be considered from 2006 |

* Beyond 2020 water demand will be fulfilled through the extension of desalination units.

The various methods used for desalination are : MSF (multi-stage - flashing), MED (multi-effects distillation, and RO (reverse osmosis)).

Explanation of How Environmentally Friendly

The population supplied with dessalinated seawater is estimated at 147,000 inhabitants for Boujdour and Laayoune cities.

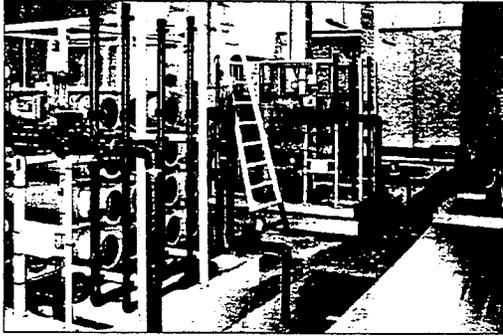
Drinking water, sanitation and other positive environmental impacts, are obtained through these water conservation practices.

List of Contacts

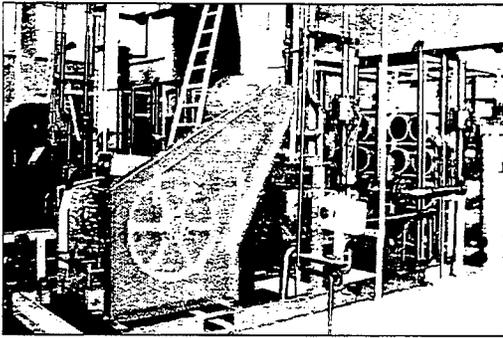
ONEP.

Photographs of program

Dessalination plant of Boujdour
(800 m³/day)



Modules used in reverse osmosis

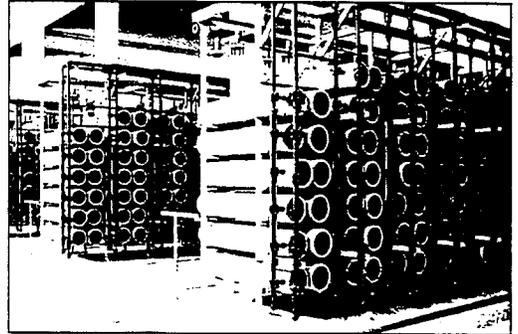


High pressure pumps

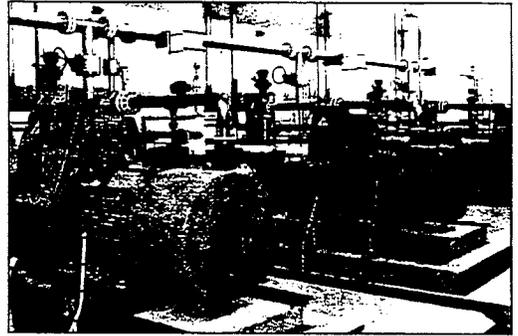


Reagent metering

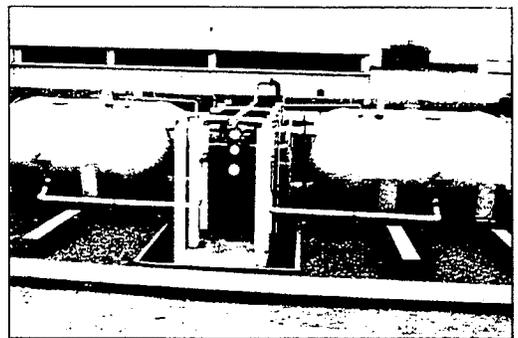
Dessalination plant of Laayoune
(7,000 m³/day)



Modules used in reverse osmosis



High pressure pumps



Sand filters

Program

HIGHTENING OF LALLA TAKERKOUST LARGE DAM ON N'FIS RIVER : BEST CURATIVE METHOD (SEE APPENDIX N°11)

Goals and objectives

When the technical requirement for heightening the dam are met, this method constitutes the best practice to make up for loss of water as a result of previous silting-up. Following are some features of Lalla Takerkoust large dam.

Implementor

Department of Hydraulics (Ministry of Public Works).

Context (Urban / rural)

Both urban and rural.

Target Audience (socio-demographics)

All populations, agricultural areas and industrial plants located downstream of the dam, benefit from this operation.

Description of Activities

Heightening of Lalla Takerkoust large dam involved :

- Raising Lalla Takerkoust large dam by an additional 9 meters.
- Increasing the dam's capacity by an additional 44 million m³.

Record of Success in Solving Problems

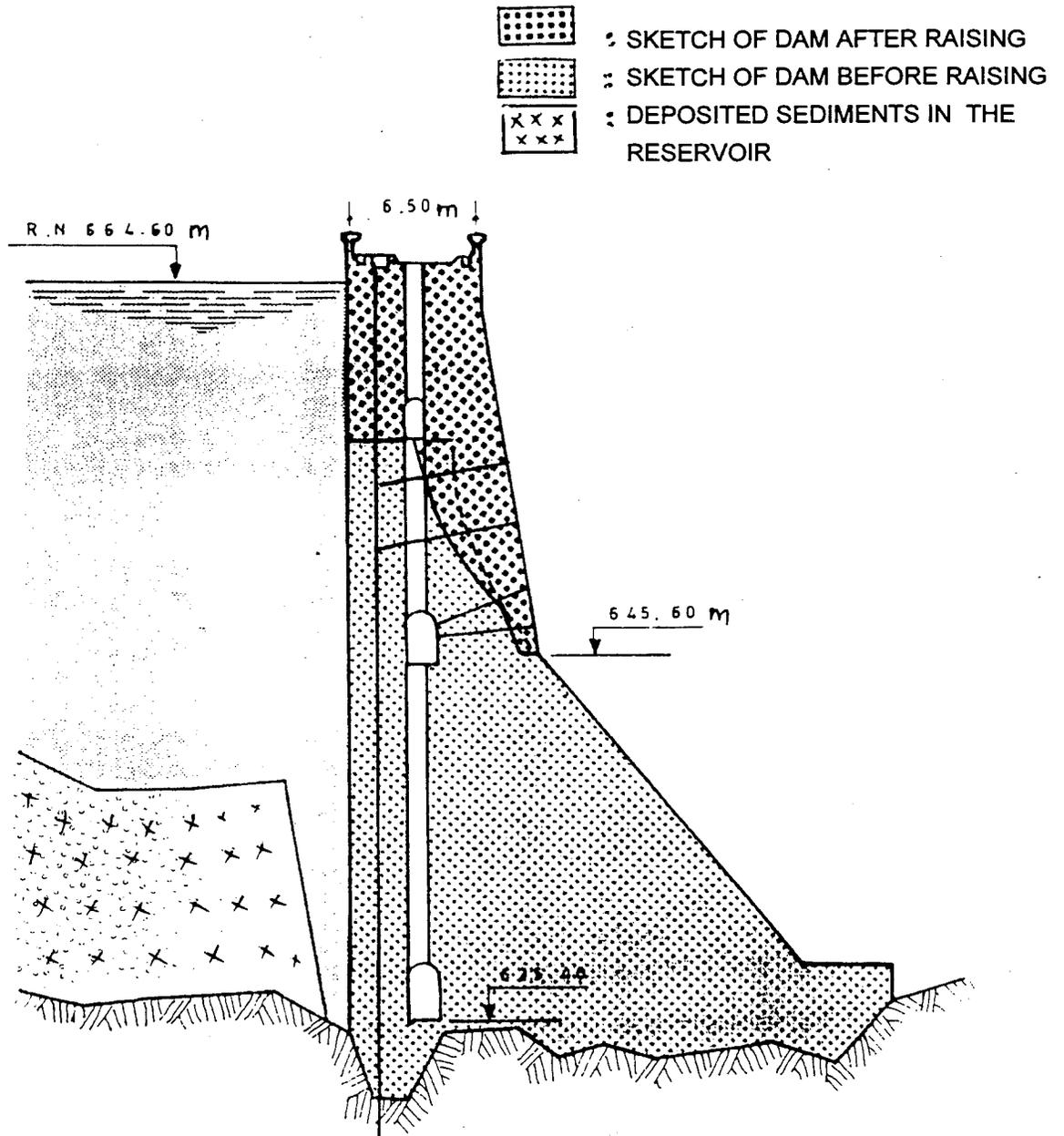
Allocation of water for various uses from this dam was made possible by this successful operation which was carried out in 1980 at a cost of 130 million dirhams.

List of Contacts

- Department of Hydraulics (Ministry of Public Works).

Photographs of program

SCHEME N° 1 : CHARACTERIS OF HEIGHTENING



Program

ARTIFICIAL RECHARGE OF CHARF AL AKAB GROUNDWATER

Goals and objectives

With a view to catering for the drinking water needs for the city of Tangier this practice has turned out to be a determining factor in stocking surface water particularly during the winter season for future use in periods of water shortage. We demonstrate that this artificial recharge operation becomes competitive comparatively with a great hydraulic management.

Implementor

- ONEP : Office National d'Eau Potable (National Drinking Water Office) : it is responsible for management of water treatment (processing stations).
- Department of Hydraulics : it is responsible for groundwater exploitation.

Context (Urban / rural)

Urban : to supply drinking water to the city of Tangier and subsequently to the city of Asilah.

Target Audience (socio-demographics)

All the population of Tangier benefits from the program.

We have demonstrate that this economic practice consisting on the built of 2 dams combined with artificial recharge, constitutes a best operation for water conservation.

Description of Activities

When the water is released from Ibn Batouta dam (built in 1978) it is processed at Bougdour water treatment station, then injected into the groundwater at a rate of 80,000 m³ per day. The aquifer is also injected with an additional 120,000 m³ of water released from the second large dam Hachef (Built in 1989) and processed subsequently.

Record of Success in Solving Problems

In the field of water conservation, artificial recharge has many advantages :

- To raise the piezometric level of aquifer through overexploitation.
- To monitor and regulate surface water and groundwater simultaneously.
- To reduce the shortage water impact.
- To avoid multiannual water scarcity which occurred in large dams (interannual regulation).

The success of this comprehensive program can be assessed in light of the volume of water drawn from the groundwater (7 million m³ between 1975 and 1989). In 1984, 384,000 m³ of water were injected each day into fault n°12 and pits 1 through 9.

(See APPENDICES N°9 and N°10).

WATER CONSERVATION AND LEGAL FRAMEWORK IN MOROCCO

A- SECTION 3 OF ACT 10 -1995. CONSERVATION AND PROTECTION OF PUBLIC HYDRAULIC PROPERTY (PHP)

1- Targets

This section sets forth the steps needed to deal with activities which may adversely affect public hydraulic property (PHP), whether quantitatively or in terms of quality (regulating extraction of building material, protecting public streams, irrigation ditches and hydraulic facilities and ensuring unhampered flow of water).

It should be recalled in this connection that under the relevant legislation (Act 10-95), a special section is devoted to the protection of water resources from pollution hazards. The ultimate purpose of these legal provisions is to provide for the protection of PHP as a whole.

2- Activities

In addition to identifying activities which have a bearing on PHP, this section deals also with the physical protection of PHP through the removal of obstacles which hinder the flow of water as well as the prevention of the destruction of hydraulic facilities (public irrigation and cattle watering installations).

Under this section a distinction is made between activities which require approval in advance and those which are banned outright.

a- Activities subject to approval include :

- dredging, widening, deepening and straightening out of streams. Clearance is required to ensure that such activities are truly in the public interest,
- diverting water from public canals and dams and from streams,
- extracting building material from sites which are less than 10 meters away from the free-boards of streams or from state - acquired lands on the banks of canals and streams.

b- Fully banned activities include :

- Encroaching on PHP, as this may :
 - threaten constructions built on PHP sites to deal with possible floods,
 - endanger population and property downstream, as flood risks may be heightened by installations built on PHP upstream,
 - hinder proper management and exploitation of PHP.
- Erecting obstacles or dumping waste and rejects within PHP boundaries.

The aim of such legal provisions is to ward off any impediment which may hinder the flow of water or the circulation on free - boards such as dykes and enclosures, or occasion landfall (rocks, sediments).

- Crossing by vehicles or animals of "seghias" or closed - in culverts or aqueducts :

- the ban concerns only open superficial constructions,
- the ban is meant to protect constructions from any damage or deterioration resulting from lack of control,
- as for cattle watering it is up to the Administration to determine the relevant ponds and provide for their protection and maintenance.

On the other hand, it should be noted that temporary occupation of PHP sites is still governed by the 1918 Dahir (Royal Decree). Occupation of such sites may involve readjusting free - boards on dam reservoirs or rivers by installing tourism and leisure amenities and equipment (for swimming, fishing and similar activities).

B- SECTION 6 : FIGHTING POLLUTION

1- Targets

This section spells out specific legal provisions to provide for efficient protection of water resources.

2- Definitions (Article 51)

- Waste water : water which has undergone some alteration as a result of its use ;

- Polluted water : water which, as a result of man made activity, can no longer be used.

Permits for discharging activities on Public Hydraulic Property (PHP)

Water quality standards are set by the Government according to intended use.

- Any dumping, discharging or pouring of material (whether directly or otherwise) into surface water or underground water, shall be subject to authorization to be issued by the regional water authority, following a public enquiry (Article 52).

- Beneficiaries of the above authorization shall pay a fee according to the amount of pollutants dumped on PHP (Article 52).

- Authorization may, if necessary, be issued for a single water extraction or injection activity (Article 52).

- The water authority shall set time - limits for regulating spill - overs, discharges, evacuations and depositions (Article 53).

- Authorization shall be granted to any person who provides a commitment in writing to take regulating measures in accordance with the relevant legal provisions (Article 53).

Polluting activities banned under the latest legislation

Under Article 54 there shall be a ban on all activities which consist in :

- dumping solid waste or waste water in PHP sites (public watering ponds, boreholes, wells), with the exception of pouring house - bold waste water into filtration wells preceded by septic tanks ;
- scattering household or industrial waste which might pollute underground water through infiltration or surface water through rain wash ;
- activities such as washing and bathing which are likely to pollute water supplies bound for towns and other centers ;
- dumping waste water or any material detrimental to public health, outside the sites designed for this purpose within town boundaries.

Water quality status (Article 56)

- The Regional Water Authority shall :
 - assess the quality of underground and surface water, prepare a report thereon and make it available to users and to the public at large ;
 - prepare charts showing degree of vulnerability of threatened underground water.
- The above documentary material shall be reviewed and updated by the relevant water authority periodically and whenever the situation warrants so.
- These activities are meant to :
 - set the technical specifications and norms (physical, chemical, biological, bacteriological ...) which must be met by surface water supplies bound for the population ;
 - Set deadlines for improving the quality of water recipients (lakes, rivers, underground water ...).

Utilization of waste water

Utilization of waste water is subject to authorization issued by the relevant water authority according to the requirements set by the government. These concern :

- The quality of waste water
- Water treatment methods.

The government can provide financial support (subsidies, fiscal incentives ...). As for the regional water authority, it may extend its technical assistance in cases where reutilization of waste water is likely to lead to a reduction in water consumption and to the protection of water resources from pollution.

In case of accidental pollution, the government shall take the necessary steps to eliminate any hazards to public health, sanitation and security. It reserves the right to take legal action against those responsible for provoking such hazards (Article 55).

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APPENDICES

APPENDIX N°1

MAIN MOROCCAN DRINKING WATER SUPPLY AGENCIES AND DEPARTMENTS

- The (Direction Générale de l'Hydraulique) DGH, which is part of the Ministry of Public Works. It is in charge of water supply at basin level and is responsible for research and exploitation of water resources ;
- The National Drinking Water Supply Office (ONEP or Office National de l'Eau Potable), which is under the responsibility of the Ministry of Public Works. It is in charge of water distribution control in urban areas and in some rural municipalities. It plans, builds and operates installations for treatment and transport from the primary sources, i.e. reservoirs and primary canals ;
- 16 autonomous, inter-communal state-owned water supply companies, which are under the responsibility of Ministry of Interior and run by the Directorate for state-owned companies and services leased by this ministry. They are in charge of water distribution in the municipalities ;
- The Ministry of Public Health (MSP or Ministère de la Santé Publique) which, together with ONEP, is in charge of quality control with respect to water resources and drinking water supply networks.

MAIN ORGANIZATIONS INVOLVED IN THE IRRIGATED

AGRICULTURE SECTOR :

- The Ministry of Agriculture and Agricultural Development (MAMVA or Ministère de l'Agriculture et de la Mise en Valeur Agricole), which is in charge of supervising of new investments, in particular for the extension, rehabilitation and maintenance of all the large and medium schemes ;
- The DGH, which is in charge of providing irrigation water for large schemes. It constructs and maintains large hydraulic structures like dams, river diversion structures and projects for the exploitation of groundwater ;
- The Agricultural Engineering Service (AGR or Administration du Génie Rural), which is responsible for the management of irrigation schemes :
 - The ORMVAS, which are state owned but financially autonomous entities placed under the MAMVA, and which are responsible for the planning and management of water resources for agriculture purposes and the design, construction and management of the large schemes. They are also responsible for the small and medium schemes within their geographical jurisdiction ;
 - Outside the areas controlled by the ORMVA, the provincial Directorates for Agriculture are in charge of the promotion and management of the small and medium irrigation schemes, in reality mainly limited to extension activities.

APPENDIX N° 2

LIST OF QUESTIONNAIRES SENT TO INDUSTRIAL EXECUTIVES

QUESTIONS N°1 : WATER USE IN YOUR COMPANY

- What is the monthly quantity of water used in your company to meet the needs of staff, facilities and production equipment ... ?
- What type of water you use : treated water, groundwater or sea water ... ?
- In acute drought, what type of water do you use ? what restrictions do you introduce during these periods ?
- How much water goes for example to washing, vaporization, cooling, manufacturing, energy production, crushing, cutting, straightening, polishing operations ... ?
- Are raw material processing machines considered to be the largest consumers of water ?
- In your company, can water be saved by modern techniques such as : closed circuit, water recycling, water re-use, compression faucet, water treatment, refrigerating, non drinking water use, new manufacturing methods, heat-insulation tube, basin use, monitoring means, use of sea-water, demineralisation ?
- Can you undertake new investments needed to obtain a certain level of water saving through substitution systems ? and at what cost ?
- Do you think that campaigns organized by specialized engineers and technicians suggesting adequate technical solutions for reducing water consumption are more desirable ?
- Do you agree that it is necessary to set up a center to affect the recommendations on implementation of adapted water saving devices in the light of production, needs and the resources available ?
- Does water saving depend on water tariff policies ?

QUESTIONS N°2 : SENSITIZATION TO WATER CONSERVATION

- Do you support campaigns for drinking water saving in industrial plants ? Do you think that these campaigns will have any impact ?
- What are the best means, in your opinion, to achieve this result ?
- Are such Media as television, advertising in radio, caravanning, cinema, mailing ..., able to make the public aware of the need to save water ?
- Do you think that wall notices in your company will have any positive impact with respect to water saving ?
- Do you think that education and training can have impact on water saving ?

APPENDIX N° 3

**TABLE N° 1 : LIST OF INDUSTRIAL EXECUTIVES CONTACTED IN CASABLANCA CITY
BY FAX, TELEPHONE OR DIRECTLY ON WATER (CONSERVATION) PROBLEMS**

| N° | Company | Company Executive (Name) | Products | Fax number (212) | Telephone number (212) |
|----|---|--|--|------------------|------------------------|
| 1 | ALCOMAR (A.S.) | M. Mohamed Benarab | Canning factory | 2 31 18 69 | 2 31 10 92 |
| 2 | ALF DOUKKALA | Technical director : M. Akran Makki Hassan | Cattle alimentary | 2 29 89 80 | 2 29 89 47 |
| 3 | AIGUEBELLE - MAROC | General director : M. Taïeb Benchekroun | Chocolate Banania Caobel ... | 2 24 89 37 | 2 24 12 31 |
| 4 | ALIF MARBRES | General director : M. Saïd Majnoun | Marble - working | Telex : 24789 | 2 33 20 76 |
| 5 | COSUMAR | General director : M. Benmakhlout | Sugar | 2 40 12 42 | 2 24 10 71 |
| 6 | CENTRALE LAITIERE (in Sale town) (1) | Commercial director : M. Ali Bakkari | Cheese | 7 78 19 86 | 7 78 21 18 |
| 7 | CENTRALE LAITIERE (2) (Casa) | | Cream cheese fresh cream milk products | 2 24 99 71 | 2 40 12 55 |
| 8 | CHIMICOLOR | General director : M. Mustapha Hanine | Paint manufacturing | 2 30 15 51 | 2 30 64 80 |
| 9 | LESIEUR AFRIQUE UNIGRAL CRISTAL | Director : Mohamed Hamdouch | Table, Oil-works, soap- works | 2 35 46 36 | 2 35 43 31 |
| 10 | PRODUITS SESTA | Administration - Director Gaëtar, stable | Canning factory | 2 35 58 28 | 2 35 49 98 |
| 11 | SAMIR | Director : M. Manjour Abderrafih | Oil refinery | 3 32 74 89 | 3 32 74 80 |
| 12 | SANDOZ MAROC | Financial Administrator : M. Albert Abitbol | Chemical products : Sandoz representative | 2 30 65 28 | 2 35 26 53 |
| 13 | AFOMA | President of Administration Council : M. Abdelhaï Laalj | Foundry | 2 35 06 32 | 2 35 48 83 / 84 |
| 14 | TANNERY DELECLUSE | Director : M. Moulay Brahim Agouzzal | Tannery | 3 32 47 22 | 3 30 00 32 |

APPENDIX N° 4

ONEP EDUCATIONAL EFFORT AND WATER CONSERVATION

As part of the job training programs, the ONEP training department has been offering multi-level courses at its center in Rabat, over the last 20 years, with special emphasis on drinking water, sanitation, maintenance, management and computer science.

The center contributes to enhancing the skills and capabilities of staff and technicians. It also develops teaching support material and offers courses in training center's management.

In addition it hosts and participates in local and international conferences and seminars.

In 1994 the ONEP training center was selected by WHO as a partner in the field of drinking water.

In 1995, the center hosted 400 training sessions, with 3,000 trainees and 20,000 training days. It also hosted 100 local and international academic meetings attended by some 3,000 participants.

The choice of relevant curricula and teaching aid as well as the use of efficient equipment have contributed to the reputation of the center as a provider of first quality training.

Training sessions lasting between one week and one month were held in 1997. The major objective is to update and improve the skills of the staff involved in different stages of water conservation and supply.

More specifically, courses cover drinking water conservation, sanitation and environment, quality control, electro-mechanics and automation, computer science and human resource management.

Other sessions provide for on-the-site adjustment problem solving and self-training.

APPENDIX N° 5

**TABLE N° 2 : (HIGHER EDUCATION) FACULTIES OF SCIENCE : LIST OF DEANS CONTACTED
BY FAX, TELEPHONE OR DIRECTLY, ON WATER (CONSERVATION) PUBLICATIONS**

| N° | Faculty of Science | Director | Direct telephone (212) | Secretariat telephone (212) | Fax number (212) | Home telephone (212) | Address |
|----|-------------------------|-----------------------------------|------------------------|-----------------------------|------------------|----------------------|---|
| 1 | Agadir | M. Mohamed EL MOHTADI | (8) 22 02 64 | (8) 22 02 67/68 | (8) 22 01 00 | ██████████ | Quartier Dakhla, BP : 28/S - Agadir |
| 2 | Ain Chock / Casablanca | M. Driss EL KHYARI | (2) 23 06 78 | (2) 23 06 72 | (2) 23 06 74 | ██████████ | Km 9, Route El Jadida, BP : 5366, Maarif - Casa |
| 3 | Ben M'Sick / Casablanca | M. Mohamed BERRADA | (2) 70 46 74 | (2) 70 46 73 | (2) 70 46 75 | ██████████ | BP : 6621, Sidi Otmane - Casablanca |
| 4 | El Jadida | M. Abderrahim SADEL | (3) 34 35 56 | (3) 34 23 25 | (3) 34 21 87 | ██████████ | Km 1, Route Ibn Maachou, BP : 20 - El Jadida |
| 5 | Dhar El Mahraz / Fes | Mme BENZAKOUR et M. Mohamed SAGHI | (5) 64 23 94 | (5) 64 23 89 | (5) 54 25 00 | ██████████ | Dhar El Mehraz, BP : 1796, Atlas - Fes |
| 6 | Fes - Saiss | M. Abdelilah HALLAOUI | (5) 60 80 14 | (5) 60 29 53 | (5) 50 82 14 | ██████████ | Route Imouzer, BP : 2359 - Fes |
| 7 | Kenitra | M. Ali BENBACHIR | (7) 37 16 45 | (7) 37 22 01 | (7) 37 27 70 | ██████████ | BP : 133 - Kenitra |
| 8 | Essamlalia / Marrakech | M. Abdelkader MOKHLISS | (4) 43 74 13 | (4) 43 20 76 | (4) 43 67 69 | ██████████ | Av. le Prince My Abdellah, BP : 15 S- Marrakech |
| 9 | Meknes | M. Larbi EL ASSAL | (5) 53 88 69 | (5) 53 78 96 | (5) 53 88 69 | ██████████ | Azaitoun, Route El Hajeb, Beni M'hamed, BP : 4010 |
| 10 | Oujda | M. Benaissa ANSIRI | (6) 74 47 46 | (6) 74 47 47 | (6) 74 47 49 | | Route Sidi Maafa, BP : 524 - Oujda |
| 11 | Rabat | M. Mahjoub LAMSOUGUER | (7) 77 18 76 | (7) 77 18 76 | (7) 77 42 61 | ██████████ | Av. Ibnou Batouta, BP : 1040 - Rabat |
| 12 | Tetouan | M. El Ayachi EL YAMLAHI | (9) 97 23 44 | (9) 97 24 23 | (9) 99 45 00 | ██████████ | BP : 2121, M'HANECH II, Tetouan |

ANNEXE N°6

GOVERNMENT EDUCATIONAL EFFORTS :

TABLE N° 3 : LIST OF SOME THESES AND DISSERTATIONS ON WATER ISSUES :
FACULTY OF SCIENCES : EL JADIDA

1- STATE THESES

Author : MOUNTADAR Mohammed
Date : 5 Juillet 1995.
Title : Etude de la qualité des eaux souterraines en zone littorale de la province d'El Jadida et dénitrification biologique.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

2- THESES OF THIRD CYCLE

Author : YOUNSI Abdelkader
Date : 20 Juillet 1994.
Title : Etude des mécanismes des intrusions marines vers le système aquifère compris entre Oued Oum-er-Rbia et Bir Jdid (Province d'El Jadida - Maroc).
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

Author : EL KRATI Mohammed
Date : 30 Mai 1995.
Title : Epuration des eaux boueuses et étude physico-chimique des rejets des sucreries de DOUKKALA et de TADLA (Maroc).
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

Author : GUESSIR Hakima
Date : 2 Décembre 1995.
Title : Etude de l'impact de l'irrigation par les eaux usées brutes sur la qualité physico-chimique du sol et de la nappe phréatique dans la région de Sidi Bennour.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

Author : ABABOU Bouchra
Date : 9 Décembre 1995.
Title : Elaboration d'un modèle bicouche d'eutrophisation de lacs et réservoirs.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

Author : AIT YACINE Zehor
Date : 13 Décembre 1995.
Title : Irrigation d'appoint du blé : gestion de l'eau et techniques culturales adaptées.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

Author : DAMNATI-ADIB Nezha
Date : 9 Janvier 1995.
Title : La réutilisation des eaux usées brutes en irrigation dans la région de Sidi Bennour : "expérimentations agro-pédologiques et étude socio-économique".
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

ANNEXE N°6 (CONTINUATION)

- Author : FETHI Fatima
Date : 22 Mars 1996.
Title : Etude de la viabilité des oeufs de parascaris équorum dans les boues résiduaires et dans le sol.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : JEMALI Boumehdi
Date : 16 Mai 1996.
Title : Etude du compostage et des possibilités de valorisation agricole du compost de l'U.T.O.M. de la wilaya de Rabat-Salé.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : FDIL Fatiha
Date : 7 Décembre 1996.
Title : Irrigation des cultures à risques sanitaires par les eaux usées : suivis microbiologique et physico-chimique.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : TAMOH Saphia
Date : 31 Mai 1997.
Title : Fermentation du citron : connaissance et maîtrise.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

3- MEMORIES DEA "TRAITEMENT AND IMPROVE OF WASTE WATERS"

- Author : CHENNAOUI Mohammed
Date : 27 Octobre 1995.
Title : Caractérisation physico-chimique des rejets de la ville d'El Jadida et évaluation de la contribution de certaines industries dans le flux global de pollution.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : HAMDANI Ahmed
Date : 27 Octobre 1995.
Title : Caractérisation physico-chimique et étude d'impact des rejets de la ville de Sidi Bennour sur l'environnement.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : AYLAJ Mina
Date : 27 Octobre 1995.
Title : Etude physico-chimique des eaux usées de la ville de Zémamra et évaluation de la performance des bassins de stockage.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : ABOUZAIID Amina
Date : 21 Novembre 1996.
Title : Caractérisation et essais de traitements physico-chimiques des rejets de la Société de Confection Industrielle Marocaine d'El Jadida.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.
- Author : BOURAJI Amina
Date : 28 Novembre 1996.
Title : Elimination des ions Fe^{2+} et Cu^{2+} par adsorption sur une smectite.
Institution : Faculté des Sciences de l'Université Chouaib Doukkali, El Jadida - Maroc.

APPENDIX N° 7

NGOs EFFORTS

LIST OF SOME NGOs DIRECTLY OR INDIRECTLY INVOLVED IN WATER CONSERVATION ACTIVITIES (BASED ON USAID SOURCES)

(Asso = Association)

TABLE N° 4

| Type and Activities | Number | Association | President | Address | Fax | Telephone |
|---|--------|--|----------------------------|---|----------|---------------|
| A: REGIONAL DEVELOP- MENT ASSOCIA- TIONS | 1 | - Ribat Al Fath | Abdelfettah Frej | Rabat, BP 1390 | | 76 61 06 / 08 |
| | 2 | - Asso. Iligh pour le développement et la coopération | Bouftas | Agadir, BP 663 | 26 96 34 | 84 10 13 |
| | 3 | - Asso. Bou Regreg | Mohamed Aouad | Salé Zankat oued Dahab, Al Manzah, Battana BP 172 | 78 09 25 | |
| | 4 | - Asso. du Grand Atlas | Taïb Chkili | Marrakech, BP 550 | | 44 61 14 |
| | 5 | Asso. du Bassin Méditerranéen | Mansouri Benali | Nador, 37 Rue de Ait Ba Amrane | | |
| | 6 | Asso. Angad du Maroc Oriental | Ahmed Osman | Oujda, 301 Av. Med Derfoufi BP 214 | 68 09 96 | 68 09 96 |
| | 7 | Asso. Fes-Saïss pour le développement culturel, social et économique | Mohamed El Kabbaj | Fes, Sidi Khayat, Batha | 63 45 69 | 63 54 00 |
| | 8 | Asso. du Bassin du Sebou | | Souk El Arbaa, 36 Charia Mansour Eddahbi | | 90 23 93 |
| | 9 | Asso. Haoud Safi | Aziz Hasbi | Rabat, Agdal 1, Rue Abou Marouan-Saadi | 77 56 90 | 77 57 21 |
| | 10 | Asso. Casablanca Carrières Centrales | Haj Belouit Bouchentouf | Casa, willaya Grand Casa | | 24 86 25 |
| | 11 | Asso. Al Boughaz | Hamza El Ouazzani | 1616 Rue Kalimanso Casa | | |
| | 12 | Asso. Ismailia | Ahmed Snoussi | Meknes, 115 Av. El Haboul BP 2070 | | 53 36 50 |
| | 13 | Asso. Jbel Ayachi pour le Développement Culturel, Social, Economique l'Environnement | Saïd Ihraï | Midelt BP 113 | | 58 26 89 |
| | 14 | Asso. Sidi Mohamed Ben Abdellah | Haj Miloud Chaabi | Essaouira, Av. Lalla Aïcha | | 47 37 55 |
| | 15 | Asso. Doukkalas | | El Jadida, Av. Hammane Fatouaki | 44 76 51 | 35 05 82 |
| | 16 | Asso. Chaouia | Ferhat Sidi Anas | Settat près gare fenoriaire | | 40 05 74 |
| | 17 | Association pour l'Intégration des Femmes dans le Développement au Nord du Maroc (AIFD, Med) | Président Tourya Tamsamani | Rue n°13 N°7, Boie de Tanger | 94 31 94 | |

APPENDIX N° 7 (CONTINUATION)

TABLE N°4 (CONTINUATION)

| Type and Activities | Number | Association | President | Address | Fax | Telephone |
|--|--------|---|--|---|------------------------|---------------------------------|
| B : ENVIRON- MENTAL ASSOCIA- TIONS | 1 | Comité de Coordination Inter-Associations Regionales et Spécialisées pour l'Environnement (CCIRSE) | Abdallah Laouina | Rabat, Rue Al Madani Bel Housni BP 1390 Rabat | 75 64 09 | 75 62 06 |
| | 2 | Asso. Marocaine pour la Protection de l'Environnement (ASMAPE) | Abdelhadi Bennis | BP 6331 Rabat Instituts | 76 11 78 / 79 91 31 | 76 11 54 / 77 44 86 |
| | 3 | Mouvement National des Ecologistes du Maroc | Présidente Mme Skalli Adj : M. LAHLOU Abdelhadi Vice-Président | Ecole Nationale d'Administration Rabat Zankat Rhamna Rabat | | 77 87 86 65 16 26 |
| | 4 | Asso. Marocaine pour la mer (ASMER) | Miloud Loukili | BP 4438 Rabat | | 72 19 35 74 76 10 |
| | 5 | Mouvement National des Ecologistes au Maroc | Zahia Ahmed Khaless | Rabat, Rue Abdelmoumen El Marrakchi | | 23 07 27 76 41 50 |
| | 6 | Asso. Homme et Environnement | Mme Benzekri | Fes, BP 2165 | 62 02 92 | 62 02 92 65 48 25 |
| | 7 | Asso. Marocaine pour l'Environnement et le Développement | | Mohammadia Quartier Eucalyptus n°50 | | |
| | 8 | Al Majal | M. Pegurier | Rue Imam Ali, Marrakech | | |
| | 9 | Groupe d'Etudes et de Recherche sur les Energies Renouvelables et l'Environnement (GERERE) | | Faculté des sciences Rabat | | |
| | 10 | Forum Maghrebin pour l'Environnement et le Développement | Fatima Alaoui | Rabat, 2 Rue Zahla BP 403 | 72 21 27 | 72 74 06 |
| | 11 | Asso. Marocaine des Ingénieurs Paysagistes | | Complexe d'Agadir BP 438 Agadir | | |
| | 12 | Asso. Marocaine pour la Qualité de l'Architecture, de l'Urbanisme, de l'Environnement et le Respect du Patrimoine | Charal Eddine Berrada | 45, Av. Hassan II, Anfa Casa | | 27 28 34 |
| | 13 | Société Marocaine pour le Droit de l'Environnement (SOMADE) | Ali Mekouar | Faculté de Droit, Route d'El Jadida km8 BP 8110 Oasis Casa | | 22 33 97 26 11 15 |
| | 14 | Asso. des Amis de l'Arganier | Brahim Adardour | Municipalité de Tamanar Province d'Essaouira | | 77 68 12 D 69 19 11 Rabat |

APPENDIX N° 7 (CONTINUATION)

TABLE N°4 (CONTINUATION)

| Type and Activities | Number | Association | President | Address | Fax | Telephone |
|---------------------|--------|--|-----------------------|--|----------|-----------------------------------|
| | 15 | Asso. Ecologique Marocaine | Abdelhakim Badih | 6, Rue du Laos Rabat | 27 72 56 | 92 27 27 69 01 47 |
| | 16 | Club Marocain pour l'Education en Matière de Population et d'Environnement | Mohamed Ftouhi | BP 1072 Rabat Instituts | 77 42 80 | 77 27 41 67 11 84 |
| | 17 | Asso. des Habitants d'Anfa pour la Conservation de l'Environnement | Mustapha Kheir Eddine | 10, Rue Mustapha Choukri Apt. 4 Anfa Casa | | |
| | 18 | Asso. Chantiers et Environnement | Miloud Rahmouni | Bloc 68 n°38 Al Bernoussi Casa | | |
| | 19 | Asso. Marocaine pour la Protection de l'Environnement et de la Nature | Said Benjelloun | 13, Rue Madani Ben El Housni Rabat | | |
| | 20 | Asso. de la Protection de l'Environnement | Mustapha Deda | BP 55 Tetouan | | |
| | 21 | Asso. pour la sauvegarde de l'Environnement | Abdelkader Essafi | Wilaya de Meknes | | |
| | 22 | Asso. "Je recycle" | Janan Benabud | 54, Rue de Tensift Agdal Rabat | 77 56 90 | 77 12 09 / 08 |
| | 23 | Office Marocain de la Jeunesse et de l'Environnement | Abdelhakim Ibnu Sina | 25, Rue 630 El Jadida | 35 09 98 | 35 38 43 (Khalil Berrazouk) |
| | 24 | Centre d'Etudes et de Recherches Appliquées aux Sciences de l'Eau et de l'Environnement (CERASE) | Djouaï | Ecole Nationale Supérieure de Takkadoum Rabat | | 75 20 29 |
| | 25 | Asso. Marocaine pour la Protection de l'Environnement khemisset (ASMAPEK) | Lahcen Baadi | BP 624 Azhar Khemisset | | |
| | 26 | Asso. Dey pour le Développement et la Protection de l'Environnement | Mohamed Kettani | 140, Av. Tamagnount Beni Mellal | | 48 10 23 |
| | 27 | Asso. de sauvegarde du Patrimoine Architectural | | 185, Bd. Zerktoni Résidence Zerktoni Casa | | |
| | 28 | Asso. Al Massira des Usagers de l'Eau d'Irrigation | Mohamed Ryad | ORMVAT Fquih Ben Salah Cité Administrative | | |

APPENDIX N° 8

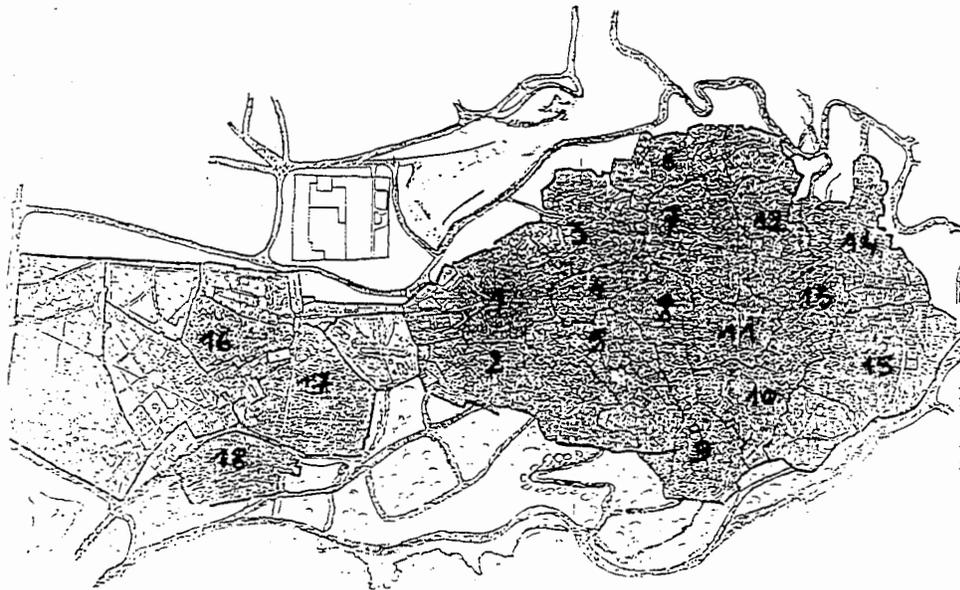
PARTICIPATOR EFFORTS WITH RESIDENTS IN THE MEDINA OF FE PRIOR TO INSTALLING WATER, SANITATION SYSTEMS AND REHABILITATION :

LIST OF 17 DISTRICTS RESIDENT ASSOCIATIONS IN FES MEDINA

To develop interaction between the department and the population with a view to rehabilitating the city and fighting pollution hazards, the department for the decongestion of the city of Fes has established 17 district residents associations, located (see this Scheme N° 1). These are : Bouinania (3), Batha Ziat (2), Ain Azliten (3), Talaa Sghira (4), Belle demeure (5), Bab Guissa (6), Quaraouyine (7), Guerniz (8), Bab Jdid (8), Mokhfa (9), R'Cif (10), Bilmdoun (11), Andalous (12), Sidi Boujida (13), Bab Ftouh, Moulay Abdellah (15), Fes Jdid (16), Mellah (17).

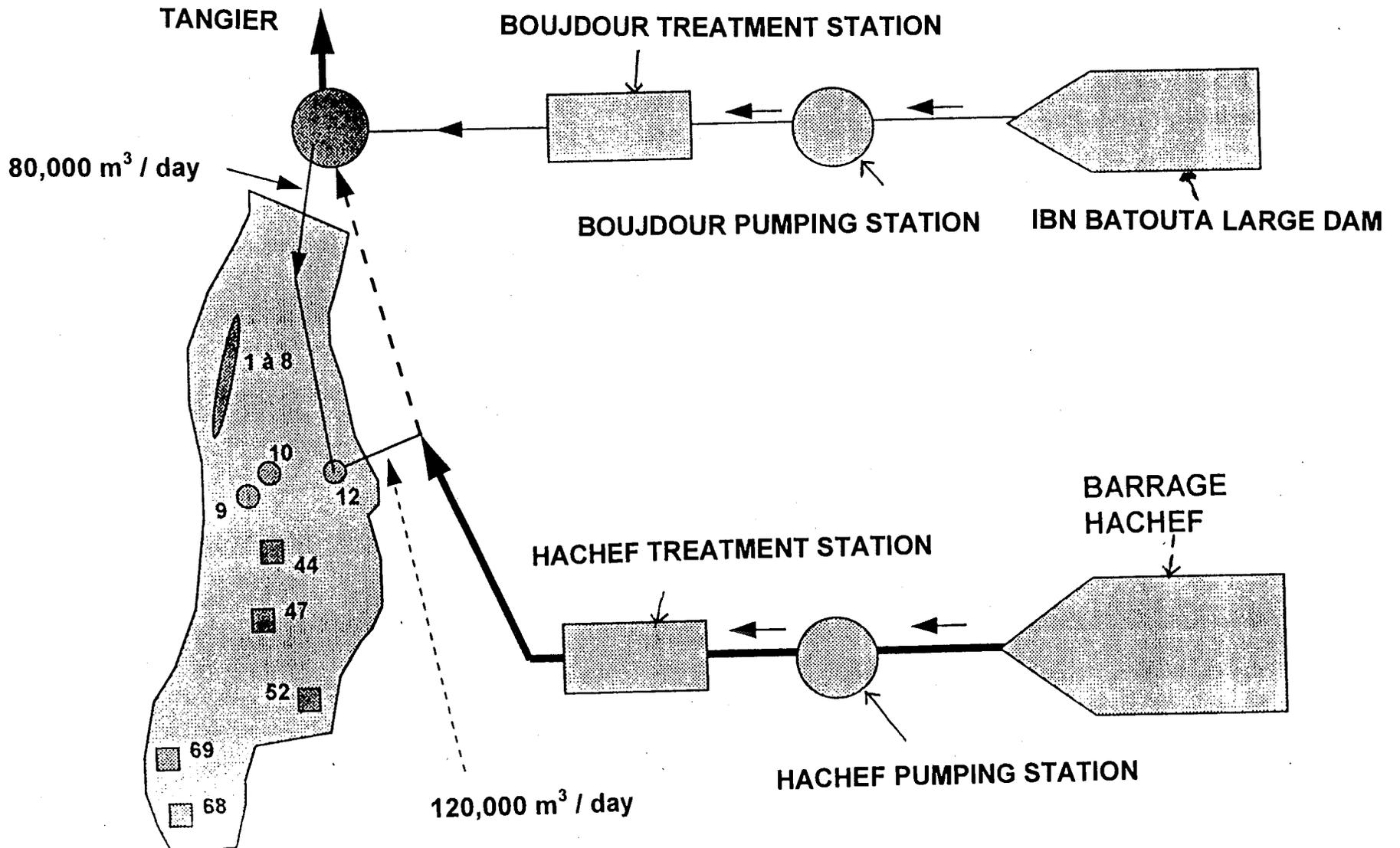
During investigations with the city decongestionning department, I discovered that a study had been carried out by a World Bank expert on the population's ability to participate in the old medina rehabilitation effort. Unfortunately the survey was not available.

SCHEME N° 1 : LOCATION OF DISTRICT ASSOCIAIONS IN FES MEDINA



APPENDIX N° 9

SCHEME N° 2 CHARF AL AKAB ARTIFICIAL RECHARGE : LOCATION OF THE TWO TREATMENT STATIONS OF FLUSHED FROM IBN BATOUTA LARGE DAM AND FROM HACHEF LARGE DAM



APPENDIX N° 10

PHOTO N°1 AND N°2 CONSTRUCTION OF DECANTATION AND INFILTRATION BASINS ON OUED N'FIS RIVER (INJECTION OF WATER : 1.2 MILLION m³)



APPENDIX N° 11

TABLE N° 5 : SILTING - UP OF MOROCCAN LARGE DAMS

| N° | Dams | Watershed (km ²) | Initial Capacity (10 ⁶ m ³) | Last bathymetric survey date | Total sedimentation since the construction of the dam (10 ⁶ m ³) | Average annual silting-up | "Dead zone (10 ⁶ m ³)" | Lost capacity in % | Actual capacity (10 ⁶ m ³) |
|----|-------------------|------------------------------|--|------------------------------|---|---------------------------|---|--------------------|---|
| 1 | Nakhla | 107 | 13 | 1987 | 6.08 | 0.23 | 1.5 | 46.80 | 6.92 |
| 2 | Mohamed V | 49 920 | 725 | 1990 | 256.91 | 11.17 | 60.0 | 35.44 | 468.09 |
| 3 | Lalla Takerkoust | 1 710 | 96 | 1988 | 26.50 | 0.50 | 4.0 | 33.97 | 51.50 |
| 4 | El Kansera | 4 540 | 330 | 1989 | 64.66 | 1.22 | 21.5 | 22.30 | 225.34 |
| 5 | M.B.E.A Khattabi | 780 | 45 | 1989 | 6.96 | 0.87 | 4.5 | 16.19 | 36.04 |
| 6 | Ibn Batouta | 178 | 43.6 | 1989 | 5.60 | 0.56 | 2.51 | 12.84 | 38.00 |
| 7 | My Youssef | 1 440 | 198 | 1990 | 22.00 | 1.10 | 24.0 | 11.11 | 176.00 |
| 8 | Mansour Eddahbi | 15 000 | 592 | 1988 | 62.88 | 3.93 | 24.0 | 11.09 | 504.12 |
| 9 | Bin El Ouidane | 6 400 | 1 484 | - | 99.82 | 3.22 | 324.0 | 6.73 | 1384.18 |
| 10 | Hassan Edakhil | 4 570 | 396 | 1990 | 20.96 | 1.31 | 20.0 | 5.68 | 384.04 |
| 11 | Y.B. Tachfine | 3 780 | 320 | 1989 | 16.49 | 0.97 | 20.0 | 5.15 | 303.51 |
| 12 | S.M. Ben Abdellah | 9 800 | 509 | 1985 | 22.97 | 1.77 | 100.0 | 4.51 | 486.03 |
| 13 | Oued el Makhazine | 1 820 | 807 | 1990 | 33.99 | 3.09 | 20.0 | 4.21 | 773.01 |
| 14 | Hassan I | 1 670 | 272 | 1990 | 10.00 | 3.33 | 40.0 | 3.70 | 260.01 |
| 15 | Al Massira | 28 500 | 2 724 | 1987 | 82.94 | 7.54 | 480.0 | 3.04 | 2641.06 |
| 16 | Idriss I | 3 680 | 1 217 | 1986 | 30.94 | 2.21 | 180.0 | 2.54 | 1186.06 |
| 17 | Abdelmoumen | 1 300 | 216 | 1987 | 1.38 | 0.23 | 10.0 | 0.64 | 214.62 |

- The regression obtained between mean annual silting-up E (10⁶ m³ year⁻¹), the watershed areas S (Km²) and the ratio [reservoir capacity C / [inflow (A)]] is as follows : $E = 10^{-2.228} \cdot S^{0.699} \cdot (C/A)^{-0.259}$. The regression coefficient is 0.758.

- The "dead zone" of following large dams : Mohamed ben Abdelkrim El Khattabi, Ibn Batouta, Hassan Eddakhil, Mansour Eddahbi, El Kansera and Mohamed V, is already full of sediments.

TABLE N° 6 : PREDICTION OF THE SILTING-UP OF THE TOTAL LARGE DAMS IN MOROCCO AND SOCIO-ECONOMICAL AND ENVIRONMENTAL IMPACTS ON LONG-TERM

| Country | Yearly sedimentation of 17 principal large dams (10 ⁶ m ³ year ⁻¹) | Yearly sedimentation of large dam in 2030 (10 ⁶ m ³ year ⁻¹) | Yearly reduction of hydroelectric production due to sedimentation (10 ⁶ Kwh year ⁻¹)** | | Impact of sedimentation on annual reduction of drinking water supply (10 ⁶ m ³ year ⁻¹) | | Annual reduction of irrigated area due to sedimentation (ha year ⁻¹) (based on an irrigation requirement of (10000 m ³ ha ⁻¹ year ⁻¹) | Annual economic loss in 2030 due to sedimentation (10 ⁶ Dh year ⁻¹) | Yearly reduction of employment due to sedimentation | |
|---------|--|--|---|---------|---|---------|---|--|---|---------|
| | | | In 2000 | In 2030 | In 2000 | In 2030 | | | In 2000 | In 2030 |
| Morocco | 50 | 150 | 60 | 80* | 50 | 120* | 5 000 | 800* | 10 000* | 30 000* |

Study Principle : Capacity Reduction --> Reduction of Regularized Volume --> Reduction of Hydroelectric Production.

* Estimated Values

** In 1991 Hydroelectric production was : 1246 x 10⁶ KWh in MOROCCO.