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BEST WATER CONSERVATION PRACTICES IN MOROCCO

By Mr LAHLOU Abdelhadi

Consultant

BEST WATER CONSERVATION PRACTICES IN MOROCCO

SUMMARY

- INTRODUCTION
- METHODOLOGY
- PROGRAMS
- CONCLUSION

INTRODUCTION

SOME MOROCCAN CHARACTERISTICS :

GEOGRAPHY :

Morocco has a total area of 712,500 km²

Morocco is divided into the following principal physographic units :

- The Coastal Plains
- The Northen 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

- 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 $150.10^9 m^3 year^{-1}$
- Total renewable water resources $30.10^9 m^3 year^{-1}$ (of which $6.10^9 m^3$ of groundwater).
- Renewable water resources by inhabitant : 1100 $m^3.year^{-1}$ (year : 1995).
- Total dam capacity 13.4 $10^9 m^3$.

b- Water withdrawal

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

In 1992 water withdrawal was 11. $10^9 m^3$ $year^{-1}$ of which 92 % for agricultural purposes : 7.5 $10^9 m^3$ was surface water and 3.5 $10^9 m^3$ groundwaer in the rural areas (92 % : wells, 8 % springs) 8 % of rural population receives water from water distribution network.

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

c- Wastewater - Non-conventional water sources :

- produced wastewater (1994) : $0,37 10^9 m^3 year^{-1}$

Dessalinated water (1992) 3.4 $10^6 m^3 year^{-1}$

Irrigation in Morocco

1- By large dams

Irrigation constitutes presently a strategic sector for the economic development in Morocco.

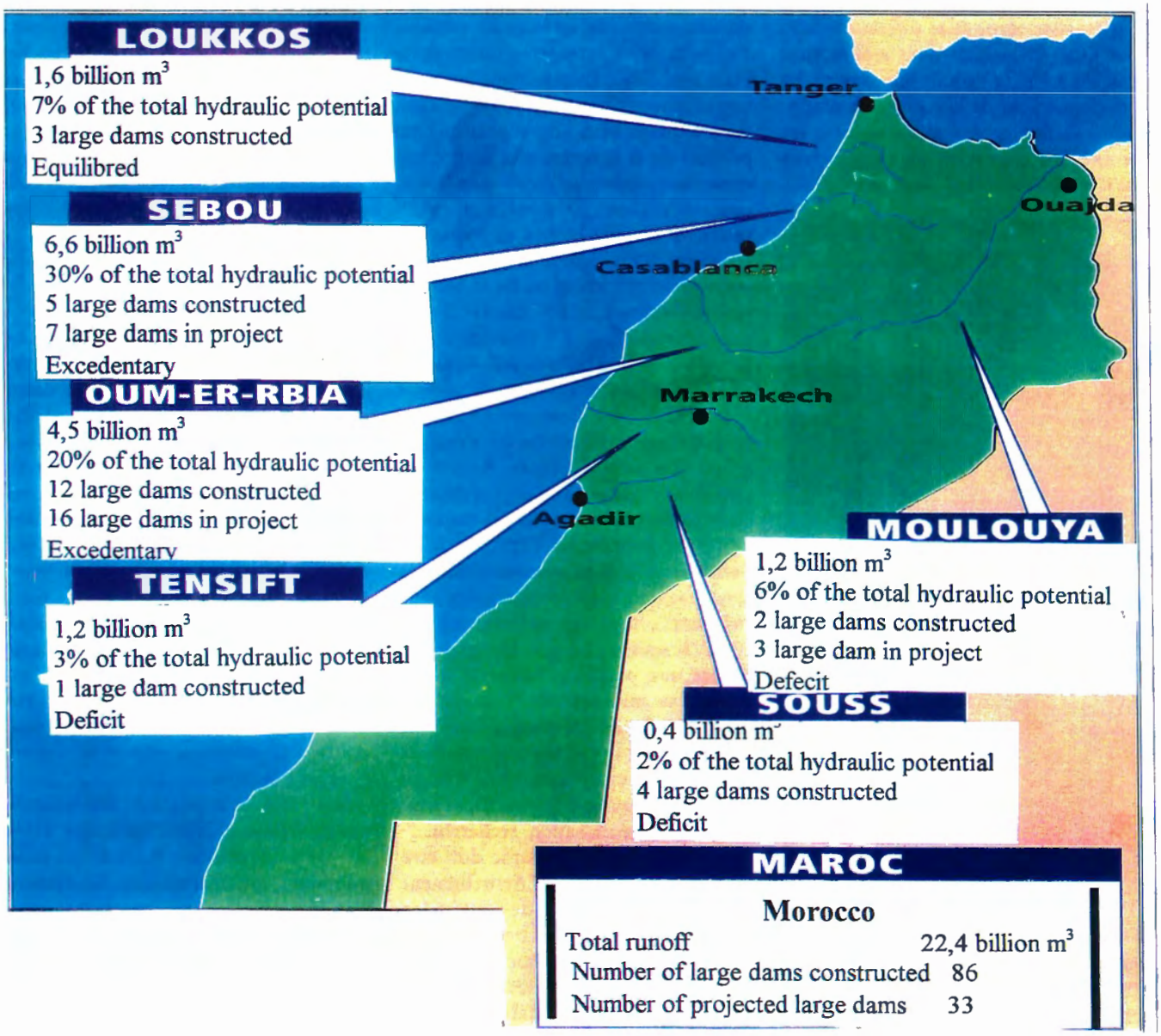
2- By medium and small dams

The 1969 agricultural investments code (now under revision) determines the contribution of farmers to the costs of equipment and maintenance works. This is an important contribution to water conservation in irrigation, which is by far the main water consumer.

2- Medium and smal dams

There are about 826 000 ha of medium and small dams including the spate irrigation area (out of this total area 416 000 ha are located within the zones managed by the ORMVA (regional farming development agencies) ; about 397 000 ha are irrigated by perennial water, 265 000 ha by seasonal water and 165 000 ha by spate water.

CARD N°: 1 LOCATION OF FLUVIAL BASINS IN MOROCCO



HYDRAULIC POTENTIAL: CHARACTERISTICS IN MOROCCO

1°) HYDRAULIC POTENTIAL

THE OVERALL WATER RESOURCES, IN MOROCCO ARE AS FOLLOWING :

- 16 BILLION CU.M FOR SURFACE WATER
- 5 BILLION CU.M FOR GROUNDWATER
- 9 BILLION CU.M ARE NO MOBILIZABLE.

SO, THE GLOBAL WATER RESOURCES, IN MOROCCO, ARE 30 BILLION CU.M.

TABLE N°4

2°) THE AMOUNT OF MOBILIZED WATER RESOURCES, UP TO MAY 1993

WATER NATURE TYPES	SURFACE WATER RESOURCES (10^9cu.m)	%	GROUNDWATER RESOURCES (10^9cu.m)	%
MOBILIZED WATER RESOURCES	**8.02**	**~ 50 %**	**3.68**	**73 %**
WATER RESOURCES WHICH IREMAINS TO BE MOBILIZED	**7.98**	**~ 50 %**	**1.32**	**26.4 %**

UP TO MAY 1993, 74 % OF SURFACE WATER ARE MOBILIZED AND 74 % OF GROUNDWATER. SO IT REMAINS 50 % OF SURFACE WATER AND 27 % OF GROUNDWATER TO BE MOBILIZED.

3°) WATER RESOURCES DISTRIBUTION IN RELATION WITH USES.

- IN MAY 1993, IRRIGATION USES ACTUALY :10.10^9 CU.M
- AND DRINKABLE WATER : $1.58.10^9$ CU.M

TABLE N°5 TOTAL : $11.71\ 10^9$ CU.M

THE SHARE OF SURFACE WATER AND GROUNDWATER FOR VARIOUS USES IS AS FOLLOW :

WATER NATURE / USE	MOBILIZED WATER VOLUME IN MAI 1993 IN 10^9cu.m	SURFACE WATER 10^9cu.m	%	GROUNDWATER 10^9cu.m	%
IRRIGATION	**10.13**	**6.95**	**59**	**3.18**	**27**
DRINKABLE WATER	**1.58**	**1.07**	**9.1**	**0.51**	**4.9**
TOTAL	**11.71**	**8.02**		**3.69**	

SO, ACTUALLY, DAMS SHARE IN 86 % OF MOBILIZED SURFACE WATER FOR AGRICULTURE, AND IN 14 % FOR DRINKABLE WATER.

CARD N°2

LOCATION OF SOME MOROCCAN LARGE DAMS

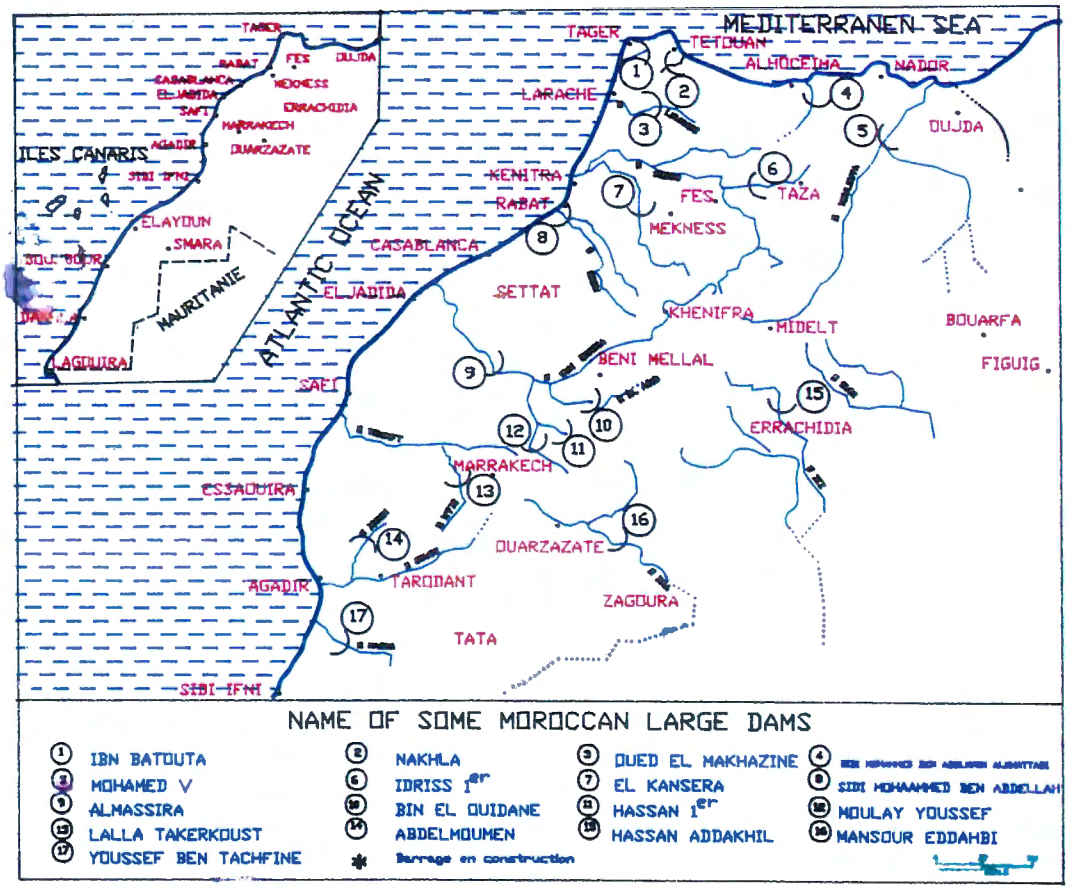
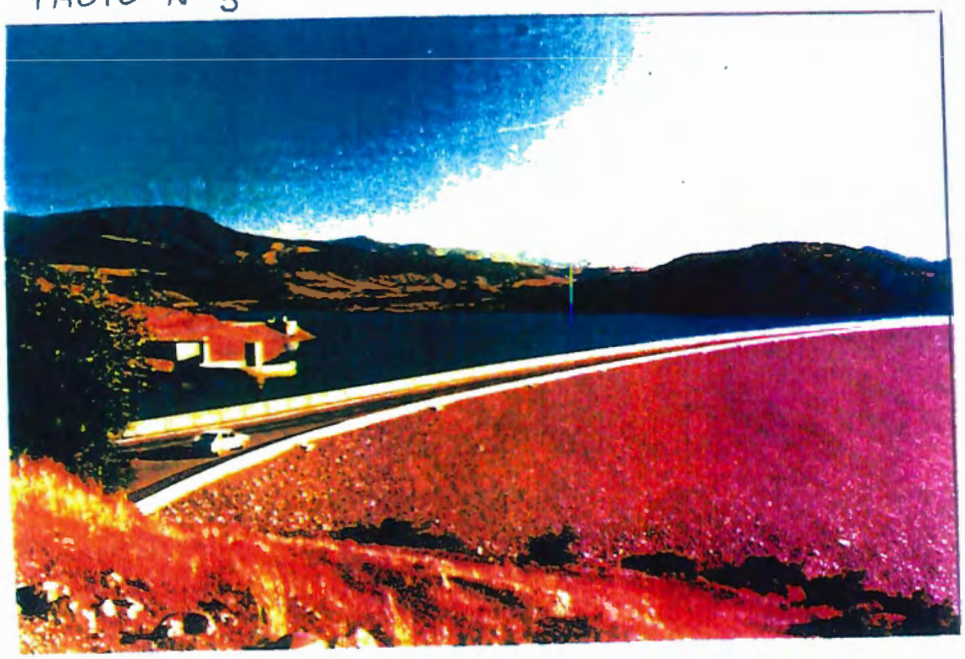


PHOTO N° 1 IBN BATOUTA LARGE DAM

PHOTO N°2 BARRAGE AL MASSIRA

BARRAGE MOULAY YOUSSEF

PHOTO N° 3



BARRAGE MOHAMED

PHOTO N°4 BEN ABDELKRIM EL KHATTABI

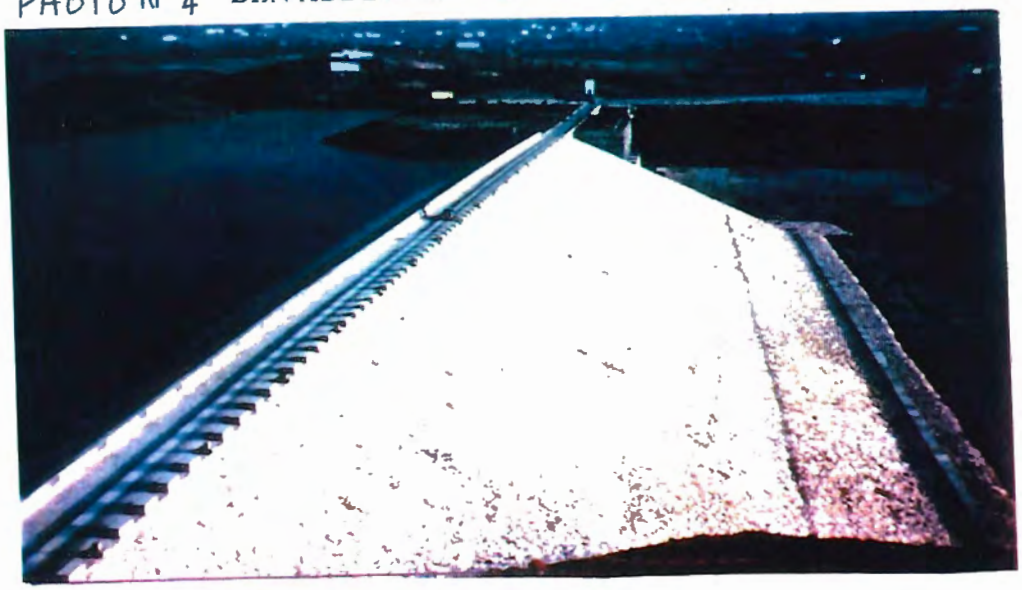


PHOTO N°5 MOHAMED V LARGE DAM

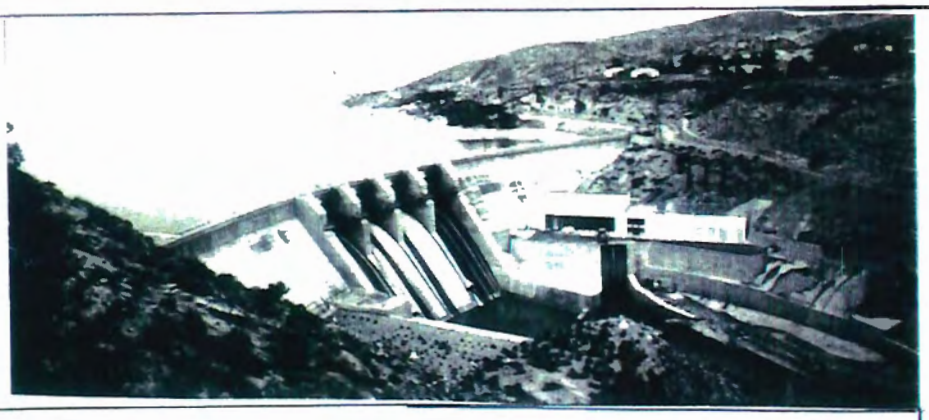


PHOTO N°6 MANSOUR AD DAHBI LARGE DAM

PHOTO N°7 SMALL DAM

In 1994, drinking water production in urban zones reached 778 million cubic meters; an increase of about 1.6 % over 1993. This is lower than the 4 % rate observed between 1982 and 1991. On the other hand, ONEP (National Drinking Water Supply Office) drinking production went up 6 % (from 560 Mm^3 in 1993, to 594 Mm^3 in 1994). This rate is higher than the national average ; this is due to ONEP production in some major cities such as Beni Mellal, Tangier, Tetouan, Oujda and Meknes where water production increased successively by 55,44,22,69 and 26 %.

The connection highly volatile and too difficult to ansers with some measure of occurency.

However the rate of this connection in urban areas reached 80 % in 1994 against 79 % in 1993. Daily consumption of water, especially among connected population, declined in 1994 in comperison with the previous years. This is due to the introduction of a new pricing system involving classification of consumers into three categories according to their monthly consumption average. The system encourages big consumers to curb their consumption while it provides some protection for low-income users. An additional "water cleansing tax" is now being charged to consumers in their monthly bills, expecially in major towns where the relevant services are provided by water supply offices. This, too, led to an overall decline in water consumption ; 164 centers out of a total of 203, are operated by the National Drinking Water Supply Office.

In 1994, ONEP achieved the following results :

- In 124 centers (where ONEP intervenes ; 78 % of the total), the global efficiency was up to 65 %.

- In 65 centers (among them 43 are run by ONEP, the global efficiency varies from 50 % to 65 %).

- In 14 centers (12 of them depending on ONEP), present an efficiency lower than 50 %.

Production Distribution

For a total population of 13.4 million inhabitants, the total water production in 1994 was 778 Mm^3 (of which 593.8 Mm^3 were produced by ONEP).

Total output of drinking water in 1994 reached 778 Mm^3

Production by ONEP	76 %
Production by water supply offices	15 %
Production by other operators	9 %

Characteristic ratios

- Net ratio : 100 l / inhabitant / day
- Gross ratio : 154 l / inh / day

Rate of connection : 80 %

Consumption by subscriber : 792 l / inhabitant / day

CONSUMPTION BY TYPE OF USER

Rates of domestic consumption

- Connected	64 %
- Not connected	3 %

Rate of administration by Government buildings	**18 %**
Rate of industrial consumption	**15 %**

CONSUMPTION BY TYPE OF USER

Domestic :	
- Connected	83 l / inhab / day
- Not connected	16 l / inhab / day
Consumption by Government building :	19 l / person / day
Industrial	9 l / person / day

DISTRIBUTION OF DRINKING WATER ACCORDING TO SIZE OF TOWNS

- Major cities : 79 %
- Medium size towns : 15 %
- Small towns : 6 %

TABLE N° 6

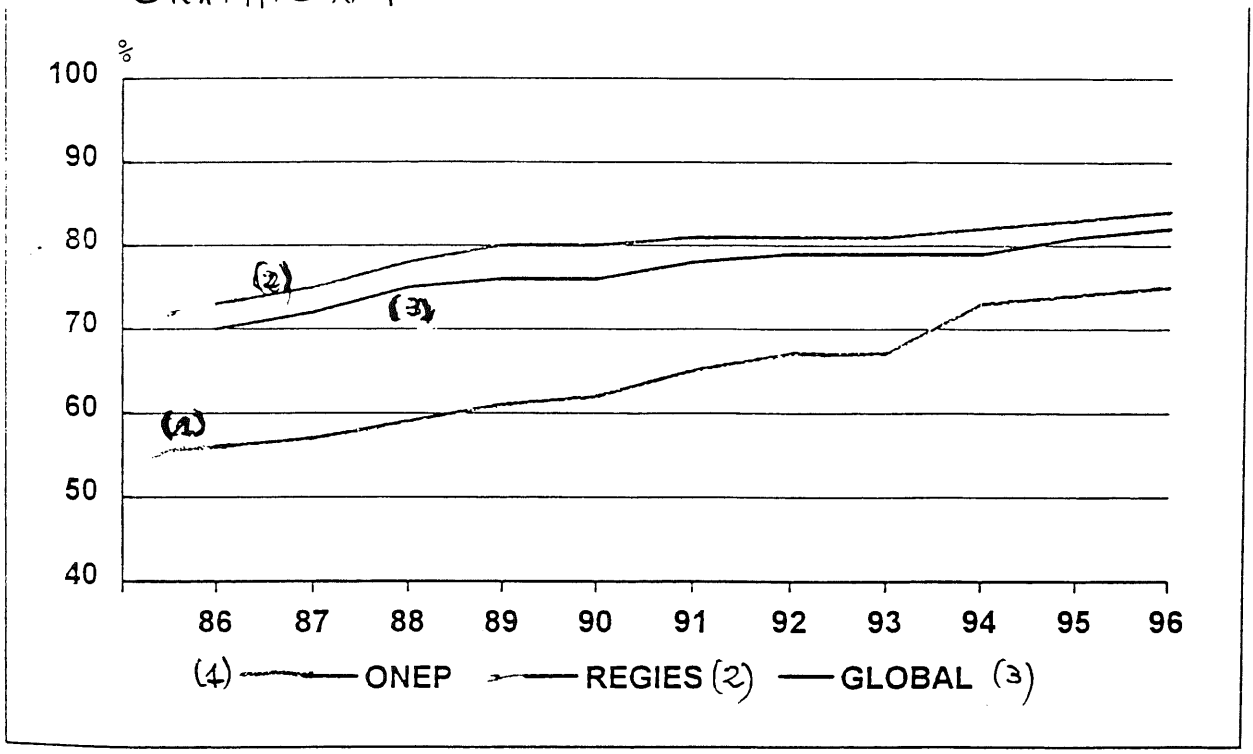
CONNECTION RATES IN URBAN ZONES

(%)

Years	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Agencies	73	75	78	80	80	81	81	81	82	83*	84*
ONEP	56	57	59	61	62	65	67	67	73	74	75*
Total	70	72	75	76	76	78	79	79	79	81*	82*

* Estimated values

GRAPHIC N°1



SPECIFIC CONSUMPTIONS FOR VARIOUS USERS (ONEP AND AGENCIES)
In liters/inhabitant/day

TABLE n°7

Years	Domestic connected and non connected population		Connected population		Non conncected popualtion		Gov. build Goverment buildings		Industrial	
	ONEP	AGENCY	ONEP	AGENCY	ONEP	AGENCY	ONEP	AGENCY	ONEP	AGENCY
1986	41	74	62	94	13	21	14	22	8	17
1987	41	79	63	99	11	22	19	23	7	15
1988	42	81	63	97	11	23	17	23	8	15
1989	45	90	66	106	10	26	15	21	8	15
1990	46	92	67	109	11	23	16	22	8	14
1991	42	88	60	102	8	25	14	22	8	14
1992	45	85	62	98	11	26	15	23	9	13
1993	42	83	56	97	9	24	11	22	9	12
1994	44	82	57	92	9	20	10	22	7	10
1995	45	80*	54	90*	13	20*	10	20*	7	10*
1996	45	80*	54	90*	13	20*	10	20*	7	10*

*** Estimated values**

$$\text{- Domestic allocation} = \frac{\text{Consumption of connected and non connected population}}{\text{Total popualtion}}$$

$$\text{- Allocation of connected population} = \frac{\text{Consumption of connected households}}{\text{Connected population}}$$

$$\text{- Allocation of non connected population} = \frac{\text{Consumption of non connected population}}{\text{Non connected population}}$$

$$\text{- Gov. build allocation} = \frac{\text{Gov. buildings}}{\text{Total population}}$$

$$\text{- Industrial allocation} = \frac{\text{Consumption of connected industrial units}}{\text{Total population}}$$

TARIFFS OF DRINKING WATER IN MOROCCO FOR THE FIRST CATEGORY OF WATER CONSUMERS (VAT and national solidarity duties included)

TABLE N°8

Agencies	TARIFF AT THE DISTRIBUTION (DH/m^3) DOMESTIC USE (0 to 24 m^3 by quarter)
MEKNES	0.77
TAZA	1.00
MARRAKECH	1.37
TETOUAN	1.55
FES	1.62
NADOR	1.70
OUJDA	1.72
KENITRA	1.83
SETTAT	1.90
RABAT	2.03
B. MELLAL	2.21
MIDDLE TOWNS AND SMALL ONEP CENTERS	2.30
CASABLANCA	2.43
AGADIR	2.62
TANGIER	2.65
EL JADIDA	2.74
SAFI	3.10
MEAN	2.10

N.B : These tariffs have been applied since 1st October 1995 with no increase observed in 1996.

TABLE N° 9

NUMBER OF PUBLIC FOUNTAINS

(ONEP AND AGENCIES)

Years / Number	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Agencies	2116	2064	1942	1962	1913	1893	1858	2062	1993	197	1900*
ONEP	741	703	737	854	1007	1107	1396	1461	1598	1774	1890
Total B.F*	2857	2767	2679	2816	2920	3000	3254	3331	3591	3711	3790

* B.F : Public Fountains.

TABLE N° 10

PUBLIC FOUNTAINS IN 1996

Total number of public fountains In urban zones In rural zones	1890 688 1202
Number of renovated public fountains	233
Number of public fountains with keepers	952
Total of employment wated	1500
Dealy allocation l / inh / day	14
Preferential Tariff furnished to keeper Dh/m^3	563

TABLE N° 11

EVOLUTION OF VOLUMES OF DRINKING WATER DISTRIBUTED BY ONEP AND AGENCIES IN MOROCCO

In thousand m^3

Years	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
ONEP	175	192	208	230	272	305	343	414	453	507
RAD	316	346	344	347	371	397	408	410	420	430*
RED	135	143	151	159	165	172	179	187	192	197*
RADEEF	56	65	70	70	81	88	91	100	111	122*
RADEEMA	64	68	74	77	81	86	89	89	96	103*
RAID	52	55	58	63	63	65	67	72	77	82*
RADEEM	34	37	40	44	47	50	53	57	62	67*
RDE	58	61	64	74	70	73	76	82	57	64*
RAMSA	34	39	42	46	49	53	56	58	60*	63*
RADEEO	39	42	45	47	50	53	56	56	59	62*
RAK	30	33	35	36	39	42	42	42	47	52*
RADEEJ	25	26	28	29	32	34	37	37	40	43*
RADEES	36	41	44	47	50	53	43	44	37	41
RADEET	19	21	22	26	27	31	31	31	35	39*
RADEEL									25*	26*
RADEEC	15	15	19	16	17	18	20	20	22	24*
RADEETA	10	10	12	13	14	15	16	17	17	18*
RADEEN	7	8	8	9	9	11	11	11	12	13*
TOT.	1105	1202	1264	1333	1436	1546	1618	1727	1822	1953*

* Estimated values.

TABLE N°12

GLOBAL WATER PRODUCTION BY ONEP IN URBAN ZONES

Years	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Mean variation between 1995 and 1996
Overall production in million m^3	539	579	636	666	714	762	781	760	778	747*	780*	4.4
ONEP Share %	70	72	73	72	74	75	76	74	76	78	79	

GRAPHIC N° 2 and N°3 ONEP GLOBAL PRODUCTION

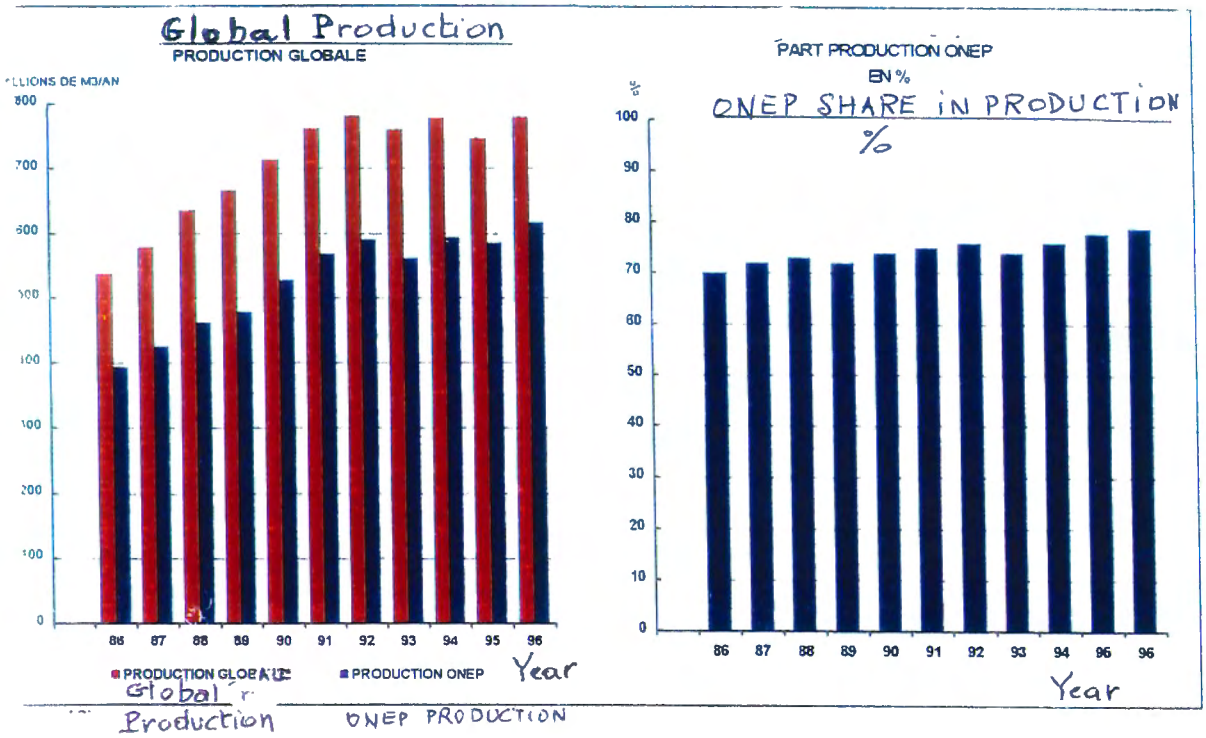


TABLE N°13

TOTAL PRODUCTION OF DRINKING WATER

(million m^3)

Years	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	Variation in % between 1995 and 1996
Total production	394	426	463	479	528	568	590	561	593	585	617	+5.5
Groundwater	164	163	179	189	202	214	223	216	227	228	225	-1,3
Surface water	230	263	284	290	325	353	367	345	366	357	390	-1,3
Disalined	0,05	0,07	0,07	0,1	0,11	0,15	0,17	0,14	0,09	0,36	2 (1)	-

(1) Start of disalination stations in Laayoune and Boujdour.

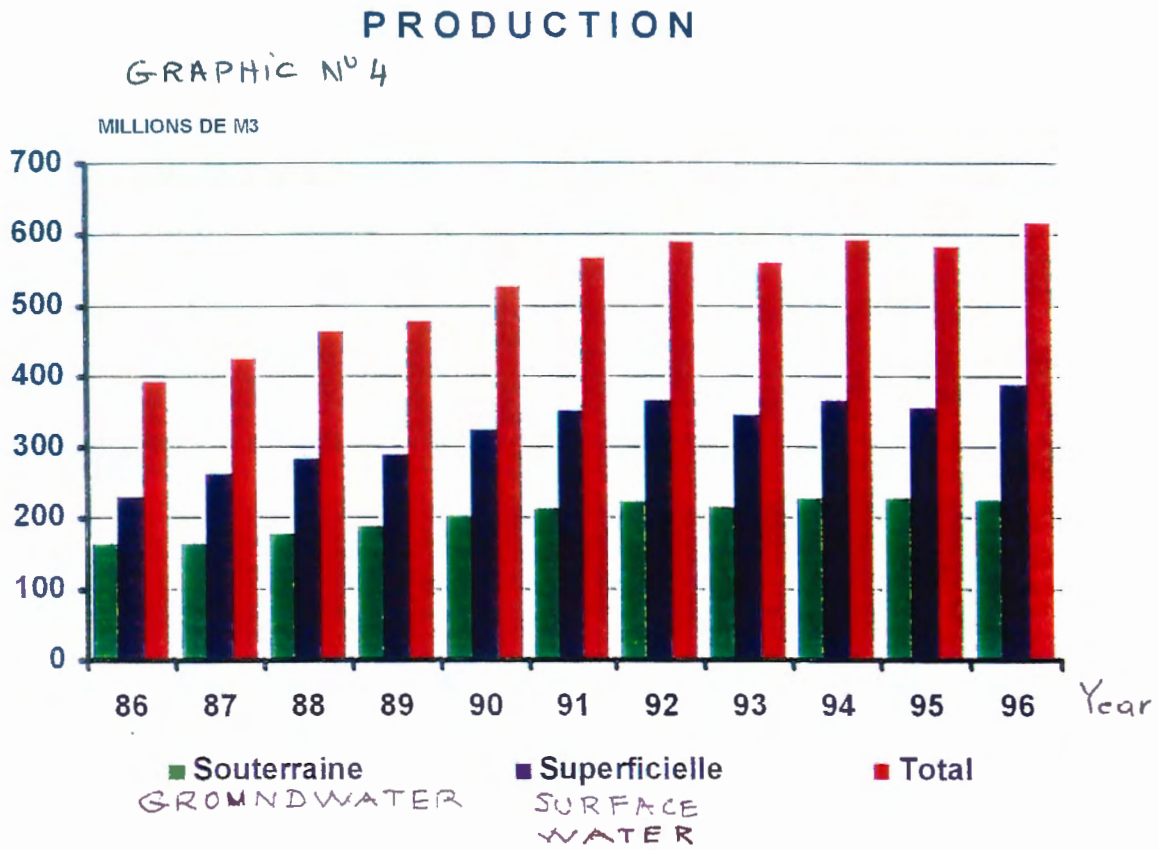


TABLE N°14

EFFICIENCY OF NETWORKS

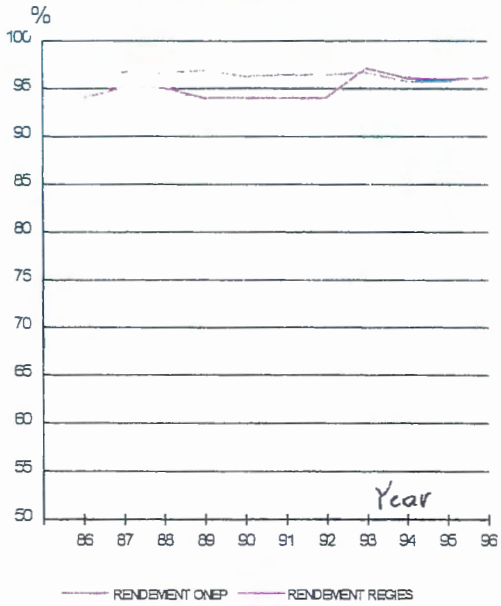
(DISTRIBUTION AND ADDUCTION BY ONEP AND AGENCIES in %)

Years	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
- ONEP	95.4	96.7	96.6	96.8	96.2	96.4	96.4	96.6	95.7	95.8	96.1
. Adduction efficiency											
. Distribution efficiency	65	66	66	65	65	65	65	65,5	66,6	65,6	65,6
- AGENCIES											
. Adduction efficiency	94	95	95	94	94	94	94	97	96	96*	96*
. Distribution efficiency	69	69	69	73	71	69	67	69	67	66*	67*

EFFICIENCY EVOLUTION OF ADDUCTION

GRAPHIC N°5

EFFICIENCY EVOLUTION IN ADDUCTION



GRAPHIC N°6

DISTRIBUTION EFFICIENCY

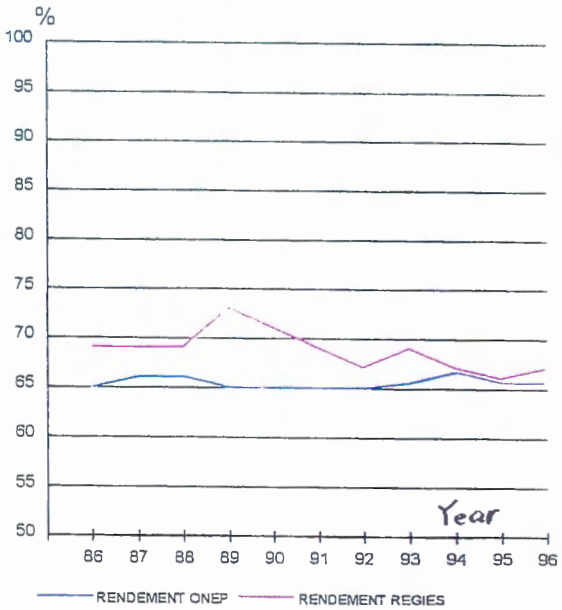


TABLE N°15

TARIFFS OF CARRIED WATER

LOCALITIES	TARIFFS DH / m^3
Taroudant	125
Al hoceima	50 to 60
Dakhla	50
Tarfaya	50
Beni Nsar	20 to 40
Tiznit	32
Laayoune	30
Boujdour	30
Targuist	30
Selouane	25
Guelmim	20

TABLE N°16

FOR COMPARISON PURPOSES THE FOLLOWING TABLE INDICATES SOME TARIFFS BEING APPLIED TO THE FIRST CATEGORY OF CONSUMERS (4 p TO 24 m^3 / quarter)

LOCATION	TARIFFS DH / m^3
- Medium size and small towns	2,30
ONEP Centres	
- Meknes	0,77
- Nador	1,70
- Safi	3,10

TABLE N° 17

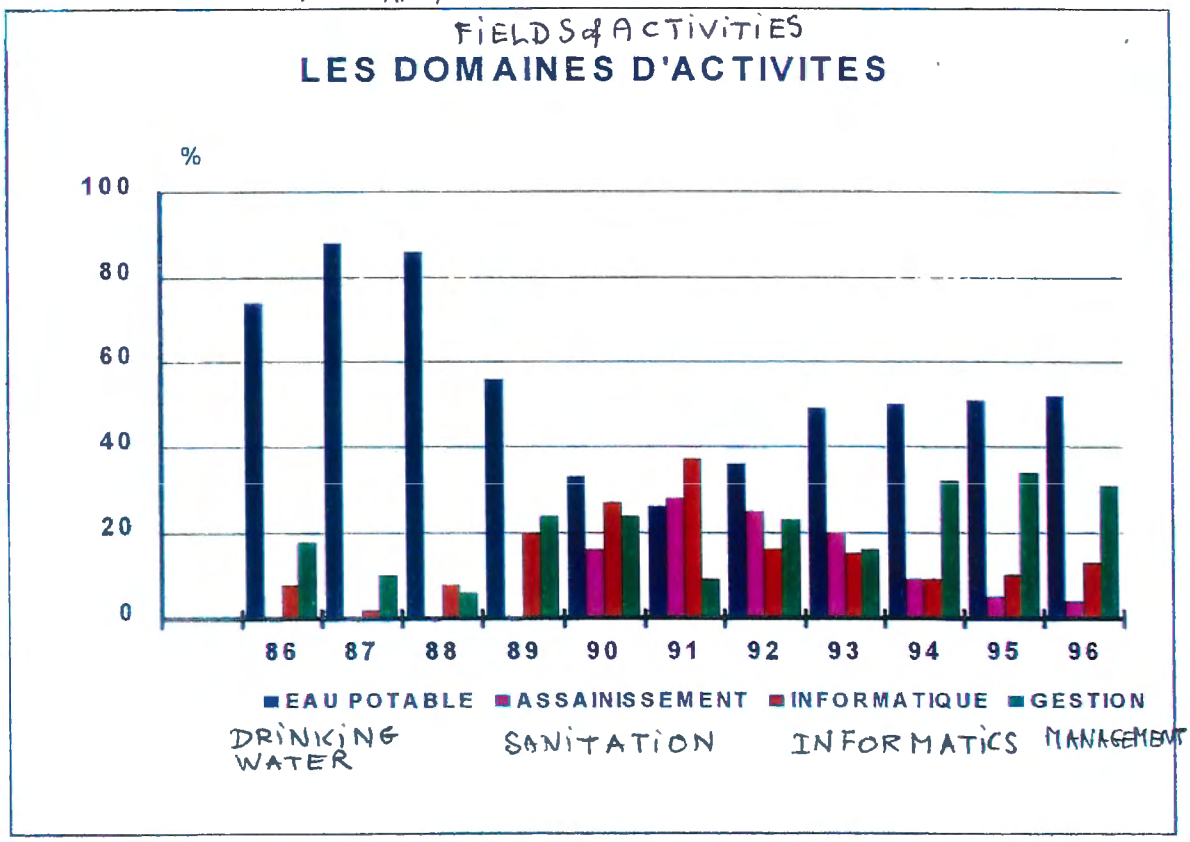
INDICATORS CONCERNING LEAKAGE LOCATION

Number of centers	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Programs	4	20	21	5	5	5	10	76	85	93	116
Totals	4	24	45	50	55	60	70	146	231	324	440
Works Finished Preparatory works											
Programs	4	16	13	4	9	8	10	38	14	17	15
Total	4	20	33	37	46	54	64	102	116	133	148
Losse researchs											
Programs	4	8	8	9	6	3	6	43	31	50	73
Total	4	12	20	29	35	38	44	87	118	168	241

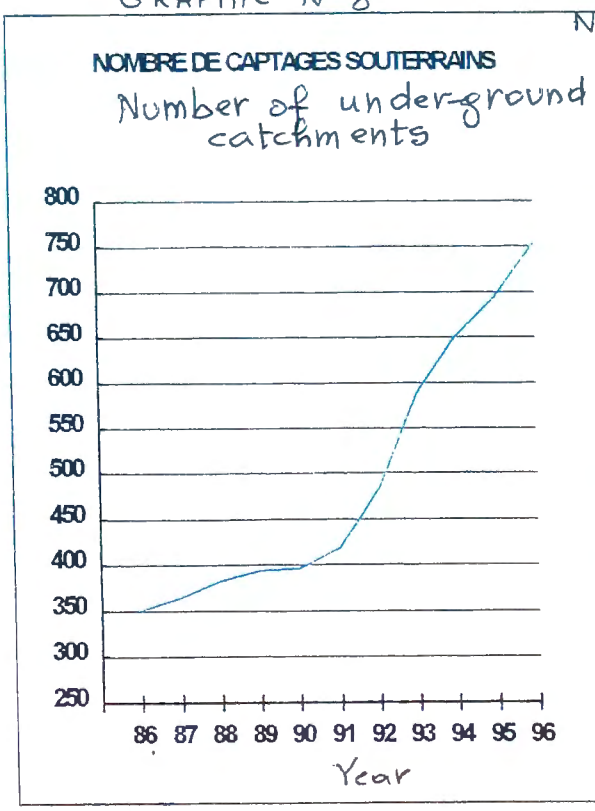
Control Network linear kms	197	270	399	519	462	542	931	2794	2642	2665	3547
Total	197	467	866	1384	1847	2389	3320	6114	8756	11421	14968
Inspected Network linear km	35	82	73	167	115	172	270	894	734	1254	1401
Total	35	117	190	357	472	644	914	1808	2542	3796	5197
Loss Discharge Recupereted l/s/year	49	52	33	79	38	35	149	289	233	307	269

The search for leaks is a fondamental factor to improve efficiency. This should be an on-going process in order to monitor network performances by taking into account external agressive factors and particularly the works undertaken by populations.

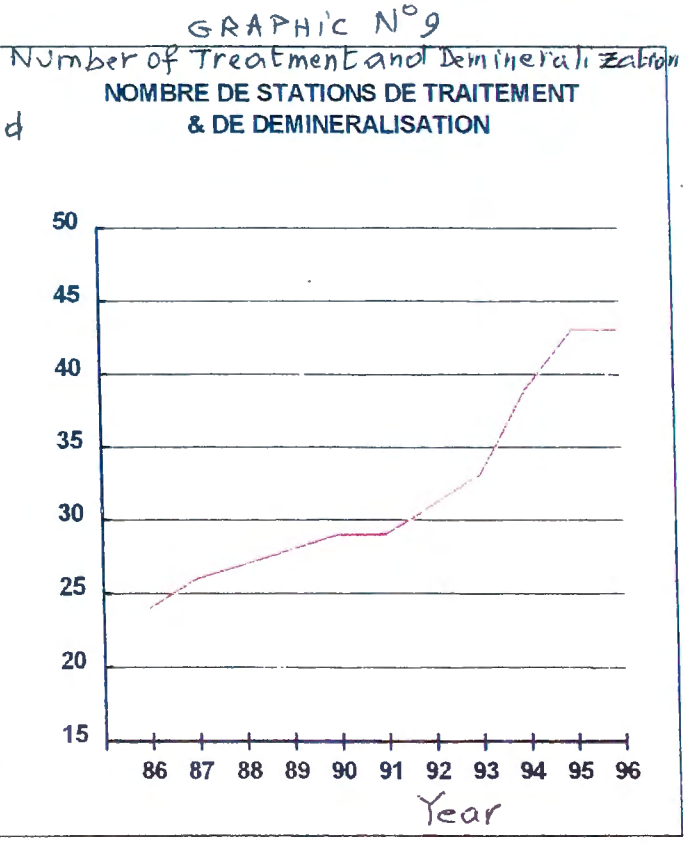
GRAPHIC N°7



GRAPHIC N°8

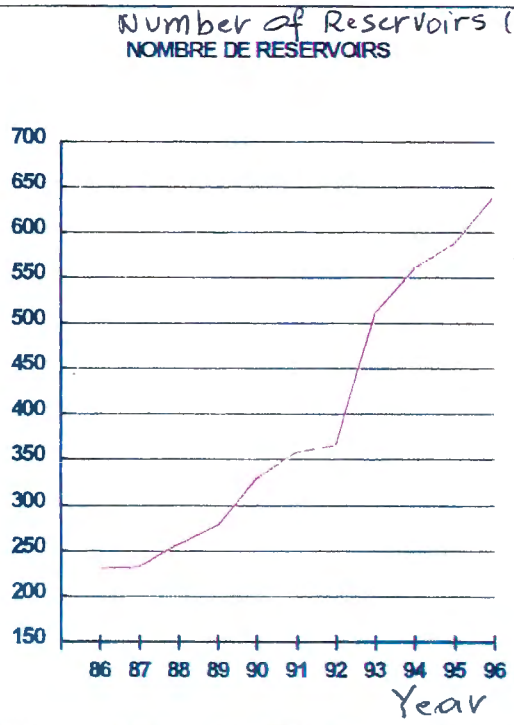


GRAPHIC N°9



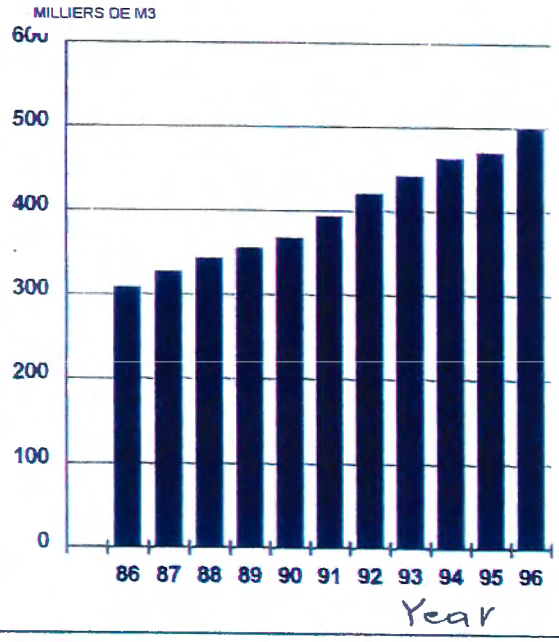
GRAPHIC N°10

Number of Reservoirs (ONEP)



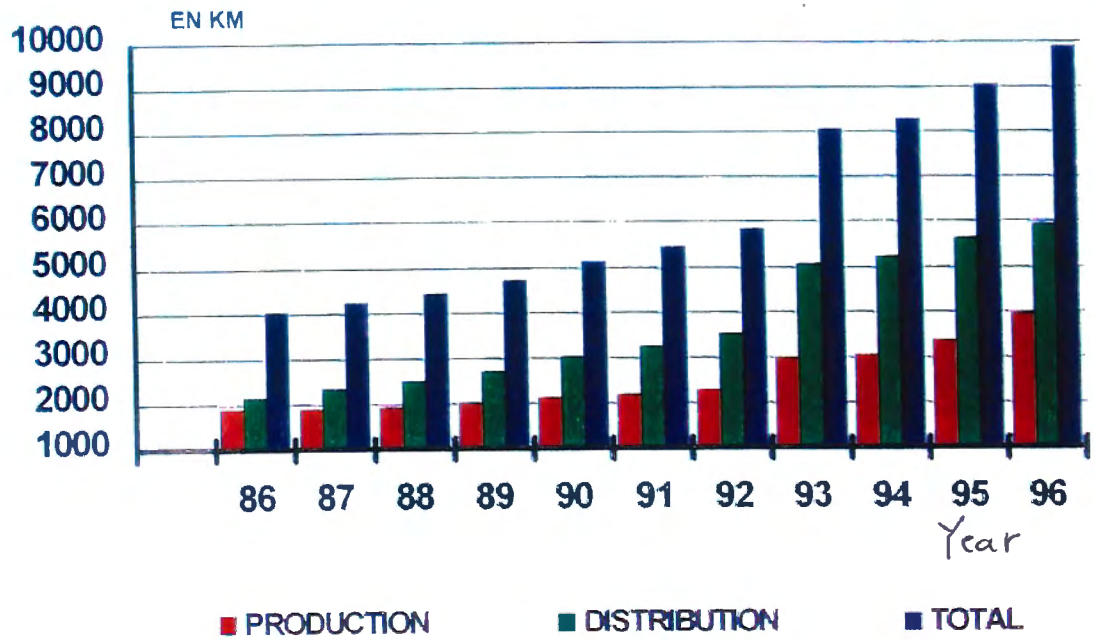
GRAPHIC N°11

RESERVOIR CAPACITY



GRAPHIC N°12

LENGTH OF NETWORKS



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 Drinkin 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 alpurposes 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.

AWARENESS RAISING CAMPAIGNS ABOUT WATER CONSERVATION IN MOROCCO

This operation was prompted in 1980 by the following factors :

- Limited water resources available nation - wide,

- Rapidly expanding needs,

- Successive drought periods since the early 80^{S},

- Steady increase in the cost of water resource exploitation (uneven distribution of water resources over the national territory and water pollution problems ...).

Morocco had no alternative but to develop a sound and coherent strategy to improve water resources management and exploitation.

As far as the drinking water component is concerned, ONEP has taken steps to curb the wasting of water and keep it within minimum levels both institutionally (by establishing watchdog units in provinces), technically (by locating leaks and enhancing efficiency of ONEP facilities and equipment) and in terms of pricing (by applying gradual rates according to level of consumption) as well as in terms of education (by initiating campaigns to stimulate public interest in water - related issues).

I- ONEP STRATEGY FOR PUBLIC MOBILIZATION

Informing the public plays a key role in the fight against the wasting of water resources. Campaigns aimed at making the population more sensitive to the need to save water were initiated over 10 years ago. They are designed for two types of audiences :

A- Campaign for the general public

Before the start of the campaign, a feasibility study carried out by a specialized firm in 1982 - 1984, issued the following recommendations :

- To use Television as a key element to boost the campaign ; and to mobilize, at a later stage, other media such as the radio and the press.

- To make the relevant choice of the messages to be relayed and disseminated by the above media.

B- Multi - audience approach

The campaign which was launched in 1984, was backed up, as from 1990, by a set of initiatives designed for specific audiences, including :

a- Children and young people

Considering the key role that can be played by children in reducing the waste of water, and given the fact that young people under 20 account for half the population of Morocco, ONEP developed in 1993 a significant program aimed at making young people aware of the need to save water.

The main targets of the program which is due to last a few years, include schools, summer camps, children's fairs and exhibitions. It also provides for the organisation and participation in cultural activities and sporting events as well as commemoration of International Days of Water, of the Environment, of Food ...).

Support for the program is provided by government agencies including the Ministry of Education and the Ministry of Youth and Sports. The local authorities also extend their assistance. Financial support - (mainly to cover the costs of publishing documents and purchasing prizes and rewards) comes occasionally from foreign countries (Switzerland, Belgium, France and Canada). UNDP also made a financial contribution for the launch of the youth - oriented awareness raising program in october 1993.

b- Subscribers

The population connected to the water supply network is considered as a priority target audience to be reached through brochures recommending easily applicable measures to rationalize water use and consumption.

c- The Press

The national media representatives constitute another significant target audience. They are regularly invited to press gatherings and conferences to discuss topical water - related issues.

d- Other target audiences

Teachers, students and associations are invited to attend relevant seminars and to visit the sites of water treatment and supply facilities and equipment.

e- Other activities

Commemoration of the International Days of Water, of Food and of the Environment.

II- EVALUATION

Combined, the various measures taken as part of the campaign against the wasting of water resources have resulted in curbing signifcantly the increasing demand for water which declined from an annual 8 % increase to merely 4 %. This positive development has made it possible to cancel part of the investments which were initially planned to face an excessive increase in the demand and to reallocate the funds to expanding water supply projects in small and remote communities.

The overall outcome of these activities is two-fold : improved water supply services and expansion of the water distirbution network.

Furthermore, it should be pointed out, that a study is being conducted to determine the impact of the above public information and mobilisation campaigns.

III- SETTING UP THE COMMUNICATION UNIT

The mission assigned to the proposed communication unit will consist mainly in :

- highlighting ONEP's achievements and enhancing its image in the public opinion,

- informing and mobilizing the public about the different problems related to water in Morocco.

The unit shall include :

1- An Information Material Design Service, which will be responsible for designing and developing documents and other information aids (lay - outs and models, signbords, slides and pictures ...) ;

2- A Press Service, which shall establish or strengthen relations with media representatives and prepare newspaper articles for publication in the press.

3- A Planning Service, which shall prepare, schedule and supervise activities with a view to mobilizing public opinion about water - related issues.

PRE-CAMPAIGN AWARENESS STUDY ON WATER CONSERVATION

The following study contains the entire results of personal contacts and interviews concerning water conservation awareness raising efforts, in rural and urbain cities and with industrials leaders.

Because the pre-study undertaken by ONEP and relative to 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.

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- Anlysis 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 I>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 Hjajma, 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).

Global 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 ?

To resolve these five problems, the results obtained for each consumer category are summed up in the table below :

TABLE N°18

Questionnaires number	Questionnaires	Replays
1	Q1 : Do you think that we ought to economize drinking water ?	- Real consumers (A) : 84 % - Non consumers (B) : 79 % - Real industrial (C) : 100 %
YES FOR WATER ECONOMY : MEAN 87,67 %		
2	Q2 : We can do a publicitary campaign for water economy. What do you think about ?	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 poushs the population to economize water ?	A --> 80 % B --> 86 % C --> 70 %
YES THIS CAMPAIGN WILL PUSHS FOR WATER CONSERVATION : MEAN 78 %		

TABLE N° 19

SUMMARY OF RESULTS OF THE INQUIRY

	Economy Factoryes	Campaign Acceptability	Adaptation to the reality	Predictive positive action on population
Real particular constumers	84 %	83 %	78 %	80 %
Non real consumers	79 %	88 %	88 %	86 %
Real industrial consumers	100 %	98 %	93 %	70 %
- Yes for water drinkin water			: 87,7 %	
- Yes for a campaign favourable for watr drinkin water			: 89,6 %	
- Yes, this campaign which have an impact on the public			: 78 %	

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

TALBE N° 20

Results of questionnaires on this point :

	Real consumers	Real non consumers	Industrials	Mean
- To insure the future	43 %	1 %	41 %	28 %
- Because of drinking water is fondamental, precious and exhaustible	30 %	23 %	33 %	28 %
- Because of water squandering is bad thing	12 %	23 %	-	11 %
- Because of drinking water economy constitutes an national solidarity element	11 %	3 %	9 %	7 %
- To economize money	8 %	47 %	17 %	24 %
- To insure the drinking water allocation for all Morocco	-	6 %	-	2 %
- To help population for water economy	-	4 %	-	1 %
- Drinking water economy resolves structural problems	-	-	9 %	3 %
- Because of it insures hygiene	-	-	3 %	1 %

(c)- How to raise awareness about water value

TABLE N°. 21

Results of the questionnaires on this point :

	Real consumers	Real non consumers	Industrials	Mean
- Use water without squandering it	35 %	3 %	11 %	16 %
- To preserve the necessary water	20 %	-	-	7 %
- You ought to economize water	13 %	-	7 %	7 %
- Water can disappears	7 %	13 %	-	7 %
- The drinking water economy is an duty for each citizen	4 %	3 %	8 %	5 %
- Councils of economic uses	3 %	13 %	23 %	13 %
- Permits to redistribute water	-	13 %	-	4 %
- To stimulate population	-	57 %	-	19 %
-Education	-	13 %	16 %	10 %
- To speak on money	-	-	40 %	13 %

(d)- How to avoid the loss of water

To push citizen to stop the squandering concept, we have to present the excessive uses of drinking water and to oriente them to squandering factors (as leak, bad installations ...) Squandering is :

- To permit exhausting of indispensable resource.
- To spend abusively water :
  * To let the cock flowing
  * To use water for all curant operations with exagered quantity ...
- To have pipe and tube works in bad conditions :
  * Classic leak
  * Leak in pipes located in wall's interior
  * Cock out of order.

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

The population :

- Knows the relationship between the economy concept and squandering.

- Justifies the campaign.

- Is aware that drinking water is scarce, precious and depletable.

The more use drinking water easier to economise are :

- It is sufficient to economize water without exhausting it : 12 %

It is sufficient to shut a cock after each use (6 %)

* Household lenen	10 %
* Housekeeping	8 %
* Gardens	5 %
* Bathroom	3 %
* Roads cleaning	1 %
* Other domestic uses	1 %

Displaying of signboards and posters at place of work 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 industrials leaders, it is recommended to organize an awareness raising campaign by expert engineers who can propose adapted technical solutions to reduce drinking water consumption in light of the industrial plant concerned, and of the means used.

Program

FEASIBILITY STUDY FOR A SENSITIZATION CAMPAIGN

Goals and objectives

Initial targets are :

- To identify public images linked with water and its saving.
- To assess the necessity (and the feasibility) of a campaign for water saving.
- To identify incentives likely to prompt non consumers to get connected to the network (social connections).

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

The main information derived from the pre-study entrusted to the advertizer and relating to the feasibility (at the level of the city of Casablanca) of a sensibilization campaign for water saving, shows the following.

Three categories :

a- Particular real consumers (those who have drinking water at home).
b- Non particular real consumers (those who have other supply means).
c- Industrial real consumers (industrialists using drinking water).

Description of Activities

The working method was different for each of the three categories :

- With the first category, meetings were held with groups of 100 consumers divided according to sex and to the level of income.

- With the second category, meetings were held with groups of 100 people using public fountains, wells, springs and rivers or buying water from roving carrier.

Information was compiled by investigation through questionnaires.

For industrial consumers, questions were put to 100 technical managers of industrial plants from various branches using drinking water.

Gender Impact

Record of Success in Solving Problems

The results of the survey conducted with the three consumer categories about the necessity, acceptability, relevance and efficiences of an sensibilization campaign, are summarized in the table below.

TABLE N° 22

Description	Saving factors	Acceptability of the campaign	Relevance	Positive impact on population
Real Particular consumers	85 %	93 %	73 %	80 %
Non real consumers	79 %	88 %	88 %	86 %
Real industrial consumers	100 %	98 %	93 %	70 %

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

COMPAIGN FOR PUBLIC INFORMATION ON HOW TO SAVE WATER

Goals and objectives

This program is aiming at defining the methodology to be used in launching education and awareness raising campaigns through various means (TV, radio, public notices, mailing, etc ...).

The information consists in stimulating public interest in this topic through :

- T.V and radio programs.
- Feature stories in national newspapers.
- Natural sciences lessons on the matter, in primary and secondary schools and also in higher education (scientific research and applied researchs ...).
- Notices.

Implementor

Ministry of Education

Ministry of Higher Education and Scientific Research

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

Drought which has affected Morocco since 1980, has prompted awareness of public authorities to the need of defining a strategy for a

rational use of water and to set forth a comprehensive action plan ment to save water in all its uses :

- At the level of dams management.

- At the level of underground water where it is necessary to have a better understanding of the existing sheets and to conduct simulation studies.

- At the agricultural level (Irrigation system, management of water conveyance facilities in rural areas ...).

- At the level of drinking water : action to be undertaken with regard to producer, distributor and consumer. In the UNDP - financed project RAB 80/011 relating to water resources in North African countries, the issue of saving drinking water which encompasses all sectors of use, is adressed at length. As far as drinking water is concerned ONEP has taken several steps to reduce waste of water as much as possible. In Morocco, during the 1980-1985, drought consumption of agricultural water was largely reduced (up to 50 % in some regions) sometimes, with no significant loss for farmers, in areas irrigated by large schemes.

It seems that it is more difficult to explain to water consumers (for various uses), that they should save water in periods of good hydraulicity, than in drought periods : it is thus necessary to convince people in normal time that drinking water is a scarce and precious commodity which must not be wasted.

Public mobilization involves : information (motivation) and advertising.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

SENSIBILISATION DES POPULATIONS
DANS LA PROVINCE
DE KELAA DES SRAGHNA PHOTO N°8

توعية السكان
بإقليم قلعة السراغنة

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: «Kelaa Des Sraghna»; Commune: Sour El Az; Village: Sidi Boubker

DATE:8.4.96 التاريخ

Commune : SOUR EL AZ
Douar : SIDI BOUBKER

PHOTO N°9

جماعة : سور العز
دوار : سيدي بوبكر

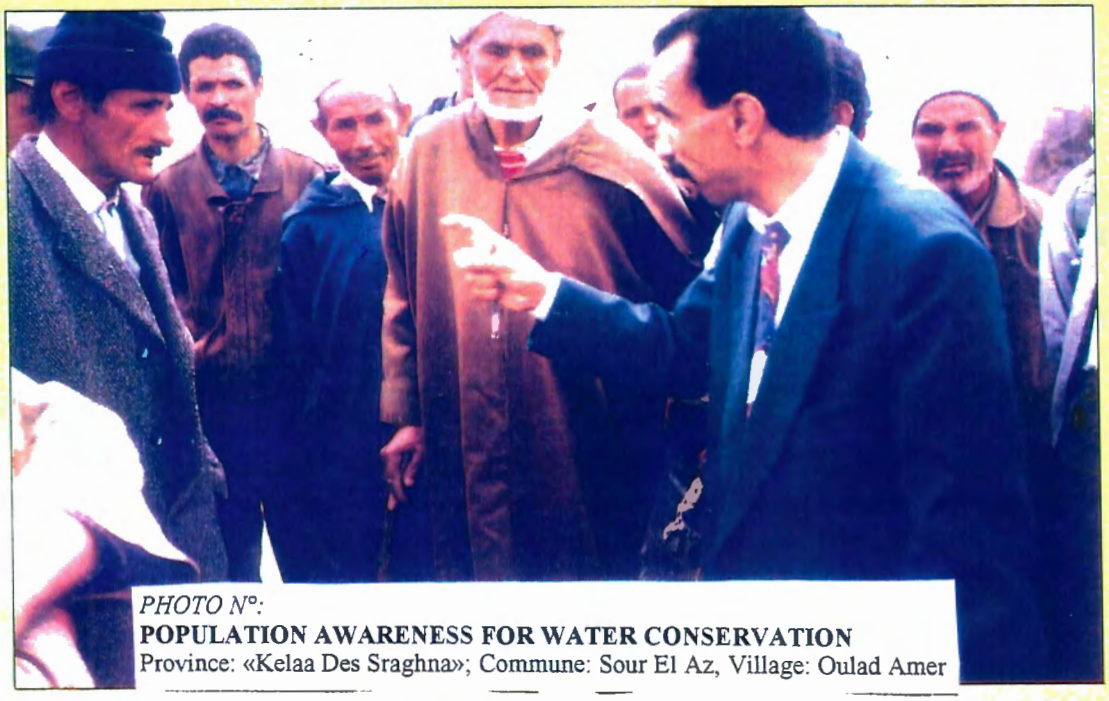


PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: «Kelaa Des Sraghna»; Commune: Sour El Az, Village: Oulad Amer

DATE:8.4.96 التاريخ

Commune : SOUR EL AZ
Douar : OULAD AMER

جماعة : سور العز
دوار : اولاد عمر

SOURCE: ONEP

SENSIBILISATION DES POPULATIONS
DANS LA PROVINCE
DE KHOURIBGA

توعية السكان
بإقليم خريبكة

PHOTO N°10

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Khouribga, Commune: Oulad Abdoun; Village: Oulad Haddad

DATE:7.5.96 التاريخ

Commune : OULAD ABDOUN — جماعة : اولاد عبدون
Douar : OULAD HADDAD — دوار : اولاد حداد

PHOTO N° 11

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Khouribga; Commune: Boulanouar; Village: Hamrad

DATE:9.5.96 التاريخ

Commune : BOULANOUAR — جماعة : بولنوار
Douar : HAMRAD — دوار : حمراد

SOURCE: ONEP

SENSIBILISATION DES POPULATIONS
DANS LA PROVINCE
DE AZILAL

توعية السكان
بإقليم أزيلال

PHOTO N° 12

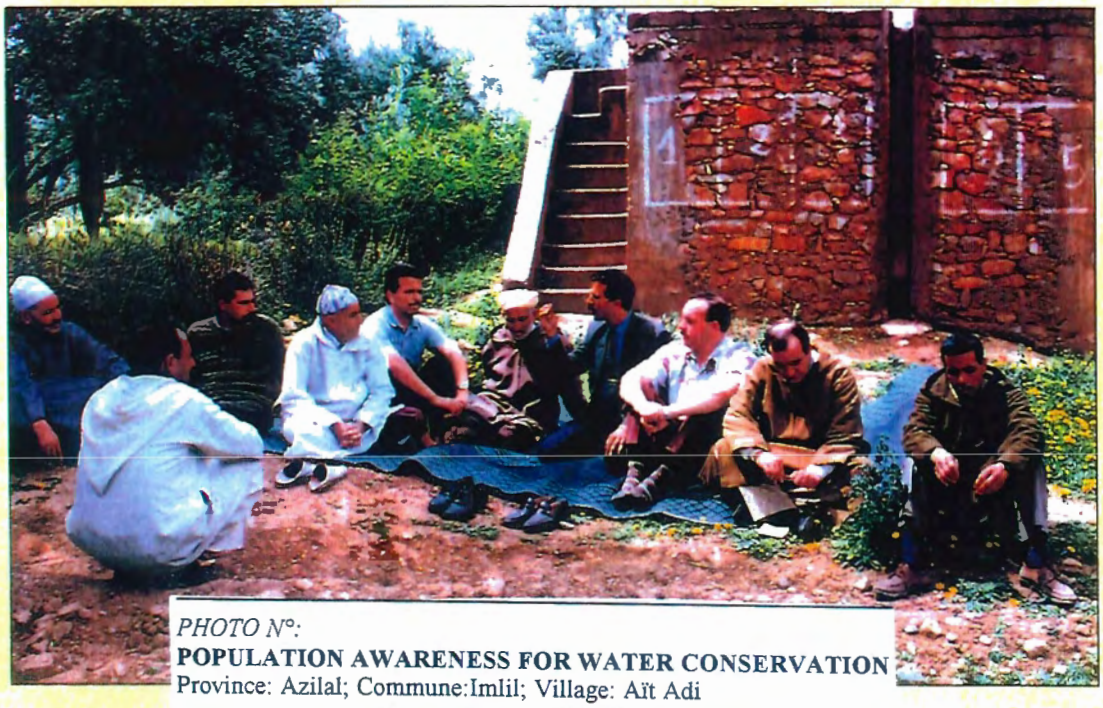


PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Azilal; Commune:Imlil; Village: Aït Adi

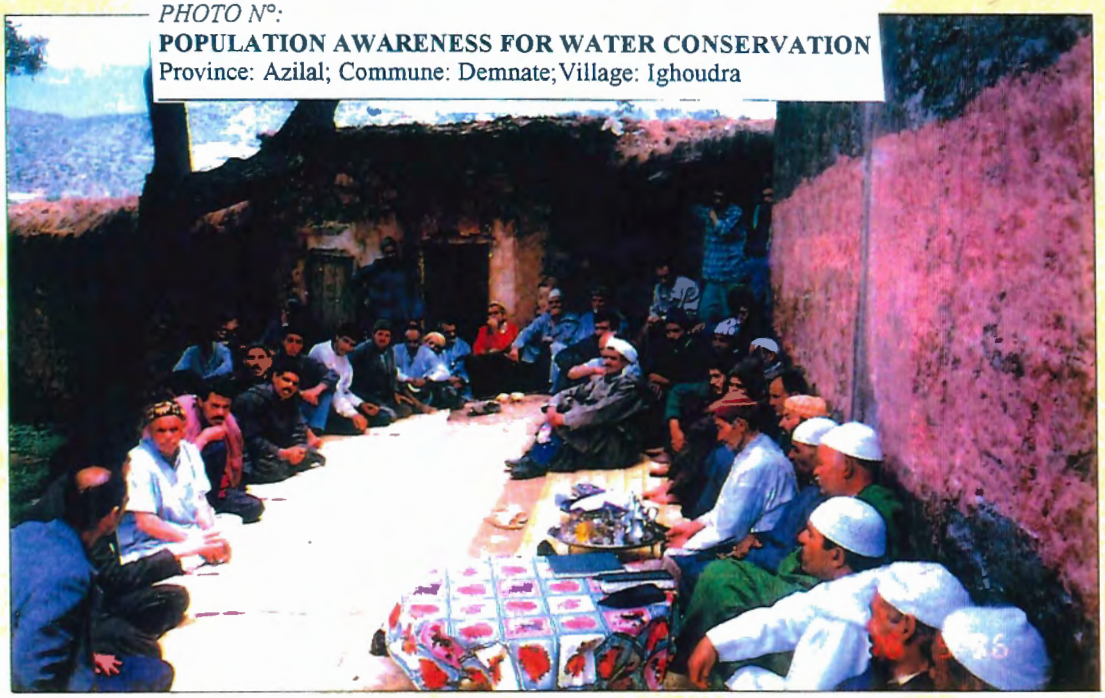
DATE:16.5.96 التاريخ

Commune : IMLIL
Douar : AIT ADI

جماعة : امليل
دوار : ايت عدي

PHOTO N° 13

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Azilal; Commune: Demnate;Village: Ighoudra



DATE:17.5.96 التاريخ

Commune : DEMNATE
Douar : IGHOUNDRA

جماعة : دمنات
دوار : اغوندرة

SOURCE: ONEP

SENSIBILISATION DES POPULATIONS
DANS LA PROVINCE
DE SETTAT

توعية السكان
بإقليم سطات

PHOTO N°14

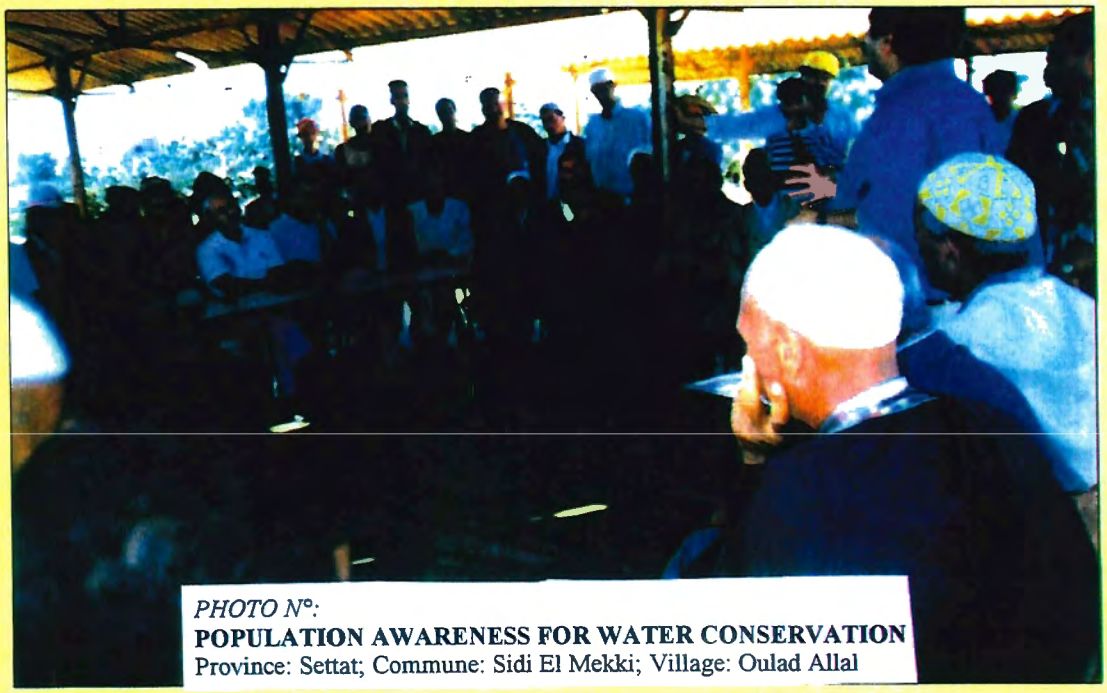


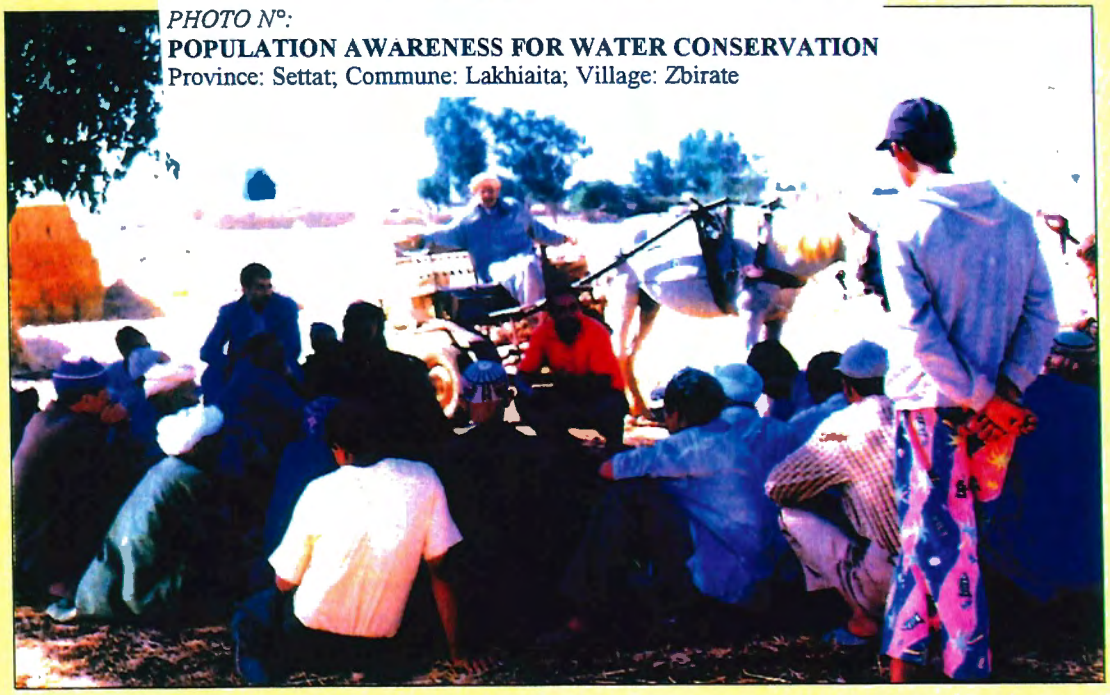
PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Settat; Commune: Sidi El Mekki; Village: Oulad Allal

DATE:15.7.96 التاريخ

Commune : SIDI EL MEKKI — جماعة : سيدي المكي
Douar : OULAD ALLAL — دوار : اولاد علال

PHOTO N°15

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Settat; Commune: Lakhiaita; Village: Zbirate



DATE:16.7.96 التاريخ

Commune : LAKHIAITA — جماعة : لخيايطة
Douar : ZBIRATE — دوار : الزبيرات

SOURCE: ONEP

SENSIBILISATION DES POPULATIONS DANS LA PROVINCE DE KHEMISSET

توعية السكان بإقليم الخميسات

PHOTO N°16

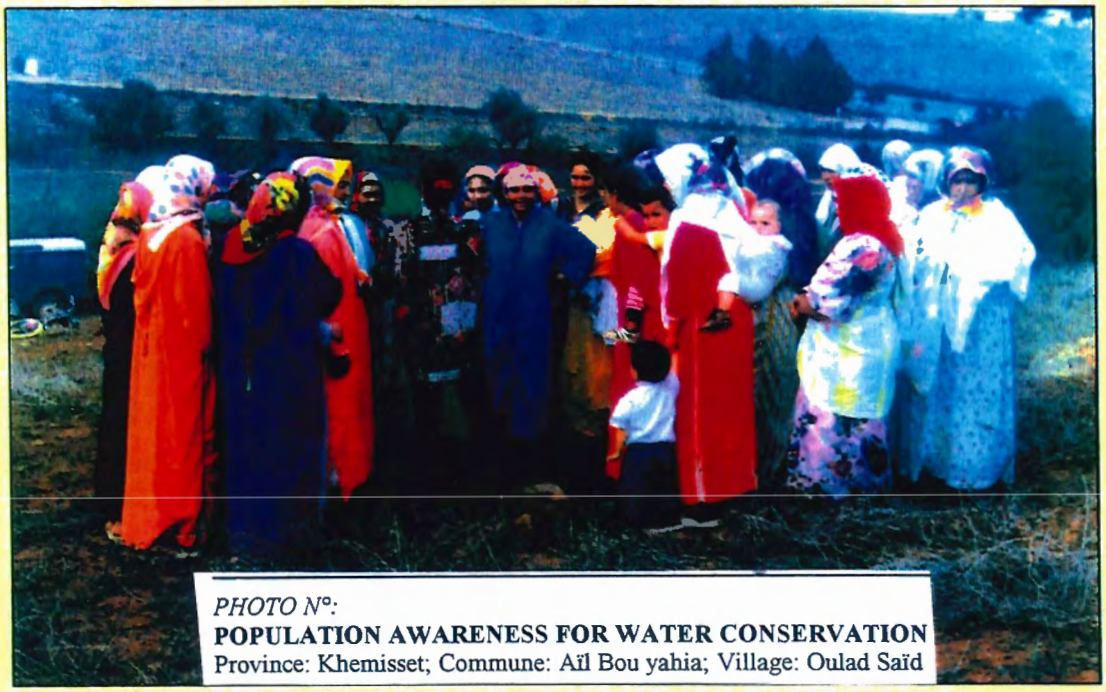


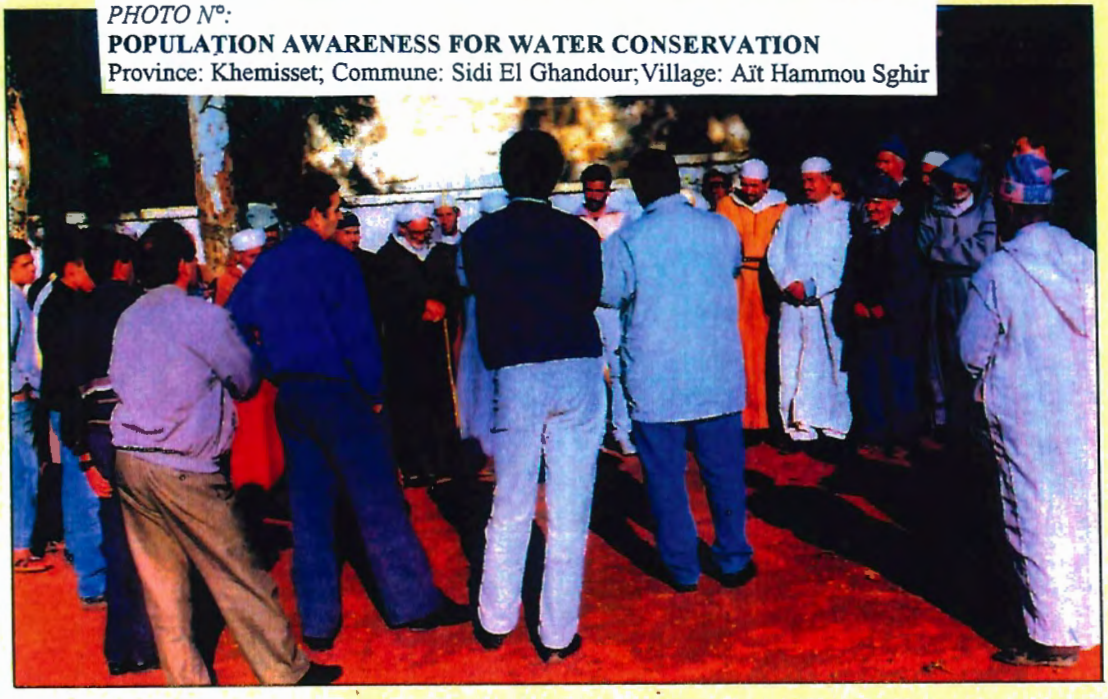
PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Khemisset; Commune: Aïl Bou yahia; Village: Oulad Saïd

DATE:14.10.96 التاريخ

Commune : AIT BOUYAHIA — جماعة : ايت بويحيى
Douar : OULAD SAID — دوار : اولاد سعيد

PHOTO N°17

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Khemisset; Commune: Sidi El Ghandour; Village: Aït Hammou Sghir



DATE:14.10.96 التاريخ

Commune : SIDI EL GHANDOUR — جماعة : سيدي الغندور
Douar : AIT HAMMOU SGHIR — دوار : ايت حمو الصغير

SOURCE: ONEP

SENSIBILISATION DES POPULATIONS
DANS LA PROVINCE DE
KELAA DES SRAGHNA

توعية السكان
بإقليم قلعة السراغنة

PHOTO N°18

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Kelaa Sraghna; Commune: Chtaïba; Village: Chorfas

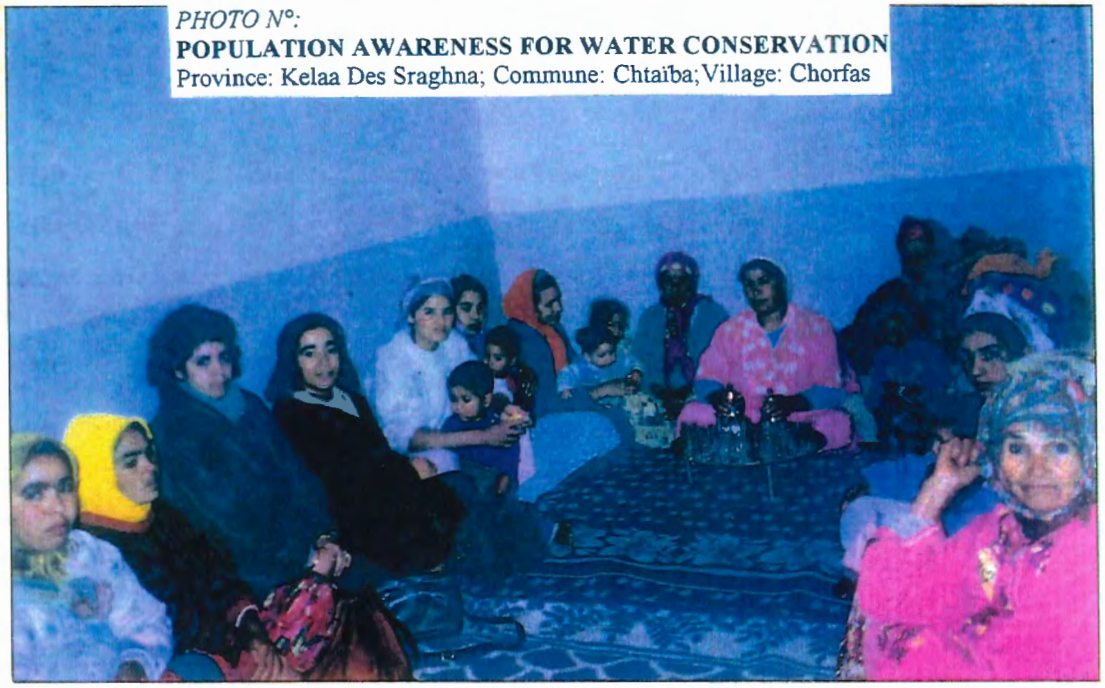
DATE:24.12.96 التاريخ

Commune : CHTAIBA
Douar : CHORFAS

جماعة : أشطيبة
دوار : الشرفاء

PHOTO N°19

PHOTO N°:
POPULATION AWARENESS FOR WATER CONSERVATION
Province: Kelaa Des Sraghna; Commune: Chtaïba; Village: Chorfas



DATE:24.12.96 التاريخ

Commune : CHTAIBA
Douar : CHORFAS

جماعة : أشطيبة
دوار : الشرفاء

SOURCE: ONEP

Program

WATER CONSERVATION AND EDUCATION

Case study of Cooperation in water conservation : "First international colloquium inter-universitary French - Morocco entitled : "Continental water : resources and sanitation", held in Fes 22-23 May 1986

Goals and objectives

For topics are developed in this colloquium :

- Infiltration and hydrogeology
- Water quality
- Wastewater and Sanitation
- Continental waters.

Implementor

- French Ministry of Education
- Moroccan Ministry o Education.

Context (Urban / rural)

University.

Target Audience (socio-demographics)

- Internation experts
- Professors
- Studients
- University
- Local collectivities
- Laboratories ...

Description of Activities

- The exhaustive list of papers presented : silting-up of Moroccan dams.

- A survey of a little known aquatic environment : the khettaras of the Marrakech district (the habitats and communities).

- Primary productivite of a temporary pond in the occidental meseta of Morocco.

- Fluctuations of a ripicoly community in relation to the water level and pollution in the anter-west Morocco.

- Hydrobiology of two brackish temporary hydrosystems : Zina and Sedd-El-Messjoun.

- The superficial sheets of underground waters, a vital but vulnerable natural resource. The example of the rural areas.

- Interest of heavy metals contamination study in agricultural production irrigated with wastewaters ...

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

- Moroccan Ministry of Education.

Photographs of Program

LIST OF THE VARIOUS COURSES I TEACH IN ENGINEERING SCHOOLS IN RABAT AND CASABLANCA AND CONCERNING WATER AND WATER CONSERVATION

1°) At Mohammadia Engineering School :

- Fluid mechanics (year : 1969/70 and 1970/71 and 1972/73)
- General hydraulics (1970-1971 and 1972/73)
- Hydrology (1972/73)
- Hydraulic machines (1973/74)
- Applied hydraulic of fluids (1974/75)
- Fluvial hydraulic (1976/77)
- Hydraulic managements (1984)
- Dams (1976/77)

I lead the following projects (of the last year of engineer formation) :

- "Nekor bassin management" (1976/77)
- "Hydraulic erosion and consequences on Idriss I sedimentation" (1979/80)
- "Auscultation of large dams", example of Mansour Ed Dahbi large dam"

2°) At Hassan II Agronomic Institute :

- Fluvial hydraulic (1975/76, 1976/77, 1977/78 and 1984/85)

3°) Superior school of forestry engineers in Salé town :

- General hydraulics 1975/76
- Practical works in general hydraulics

4°) National superior school of mineral industry :

- Fluid mechanics (1975/76)

5°) High school of public works (Casablanca)

- General hydraulic (1979/73)
- Fluid mechanics (1971/72)

SCIENTIFIC EDUCATIONAL MATTERS IN RELATIONSHIP WITH WATER AND WATER CONSERVATION

1°) Basis courses which are requisite for better water understanding :

Chemicals, biology, tectonic, hydrology, climatology, geology, pedology, oceanography, geomorphology, hydrobiology, ecology, biogeolographic toxicology, health, education, economy, security, informatic, legal procedures.

2°) Basis in environment sector in relationship with fluvial ecosystems :

Waters, soils, fauna and flora, society (pollution, protection, waste waters...)

3°) Activity sectors :

Agricultural, services, collectivities, territory management, transport, medicine, formation, education, communication, biotechnologies, energy transport and production, chemical industries and parachemicals, fertilizer industries, agro-alimentary industries.

PROGRAM

AWARENESS RAISING CAMPAIGNS FOR WATER CONSERVATION IN KHENIFRA AND M'RIRT TOWNS

Goals and objectives

The ONEP/GTZ (National Drinking Water Supply Office / Deutsche Gesellschaft für Technische Zusammenarbeit), project entitled : "Reinforcing of ONEP capacities in cleansing field", is a pilot activity in the awareness raising effort about pollution problems in general and about water resource protection in particular.

Implementor

ONEP and Kenifra commune with the participation of local government.

Context (Urban / rural)

Urban.

Target Audience (socio-demographics)

The population of Khenifra and M'rirt.

Description of Activities

Operations for the protection of the Oum Er Rbia river in particular, were carriedout between 17 April and 14 June 1995.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

The cost of this operation covered impact through financial cooperation) reached 48 MDH approximately.

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

SUMMER CAMPS AND AWARENESS RAISING CAMPAIGNS ABOUT WATER CONSERVATION

Goals and objectives

To undertake awareness raising activities about water sustainability and to persuade ONEP to help summer camp users in water testing and equipement maintenance activities.

Implementor

ONEP (National Drinking Water Supply Office)

Context (Urban / rural)

Urban

Target Audience (socio-demographics)

Young people

Description of Activities

- Discussing water - related issues with young campers ;
- Organizing different sporting events ;
- Organizing contests in the art of drawing, with special emphasis on water ;
- Arranging for exhibitions of drawings made by children about water, as well as posters and signboards developed by ONEP on water-related subjects ;
- Entertainment, drama, music and other cultural activities, with special emphasis on water.

Gender Impact

The same for male and female populations alike.

Record of Success in Solving Problems

The widening range of such activities which are increasingly taking place in summer camps is evidence of the success of this approach.

Relevance to the Region

Positive impact nation-wide

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

FIRST EDITION OF "THE CHILDREN'S CITY" : AN EXHIBITION FOR SENSITIZING CHILDREN ABOUT WATER-RELATED ISSUES

Goals and objectives

Exhibition of drawings and paintings by children on the subject of water, in addition to contests in music and literature, prizes and games supervised by qualified staff. All these activities are centered on the subject of water and the environment.

Implementor

ONEP (National Drinking Water Supply Office).

Context (Urban / rural)

Both urban and rural.

Target Audience (socio-demographics)

130,000 children visited the exhibition at the Casablanca International Fair site from 16 to 26 december 1993.

Description of Activities

See above under "Goals and objectives".

Gender Impact

The same for male and female populations alike.

Record of Success in Solving Problems

The large-scale attendance (130,000) attests to the success of this first edition of "The children's city" exhibition.

Relevance to the Region

Very useful.

Explanation of How Environmentally Friendly

These events stimulate awareness among young people about the need to ensure the sustainability of water resources and protect the environment.

List of Contacts

ONEP (National Drinking Water Supply Office).

Photographs of Program

PHOTO N°20 and N°21

Program

AWERENESS RAISING CAMPAIGN ABOUT RATIONALIZATION OF WATER USE FOR ANY PURPOSE, AS PART OF AN EVENT CALLED "DROP OF HOPE"

Goals and objectives

Efficient management of water resources (dams, groundwater) destined for drinking, farming or industrial use.

Implementor

ONEP (National Drinking Water Supply Office).

Context (Urban / rural)

Urban.

Target Audience (socio-demographics)

Specific program designed for young audiences.

Description of Activities

This activity was implemented with the support of UNDP. It was initiated in Rabat (Oct. 93), Marrakech (Nov. 93) and Fez (Nov. 93). The major attraction was a 24 - meter high montgolfier shaped like a drop of water and carrying the phrase "Drop of Hope". This was the logo chosen for the campaign designed to sensitize young people about water conservation objectives.

Gender Impact

The same for boys and girls alike.

Record of Success in Solving Problems

- Poems, essays and slogans were presented by young participants,
- Statement by the Resident Representative of UNDP in MOROCCO,
- Statement by the Minister of Public Works.

Relevance to the Region

Each drawing carries a message about the special value of water and the need for its conservation.

Explanation of How Environmentally Friendly

"Let us save the Universal nutriment" was adopted as a motto.

List of Contacts

All these events received wide media coverage (audio-visual and the press in its diversity).

Photographs of Program

Program

WASTING AND SAVING AT THE DISTRIBUTOR'S LEVEL (ONEP)

Goals and objectives

1- Origin and causes fo water squandering

- At the distributor's level squandering can bee discrabied as follows :

* bad chek of consumption standposts (clandestine connections)

* leakages in the network which has several reasons.

- Main causes of leaks : earth movement, channels erosion, trafic (heavy vehicles), high pressures, road works, old pipes, low temperature, defective pipes (manufacturing), defective joins, bad installation technics.

2- Installation returs

- The best indicator of squandering in distribution networks is returns. In Morocco, the best definition is the ratio quantity of water billed for customers (noted on their counter) and the quantity of water delivered at the network of counters.

- Knowing the technical return of the network and following up its improvement require :

. a perfect knowledge of the network
. mastering the customer's management
. mastering countening problems.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

The preliminary measures undertaken in Morocco are :

a- Knowledge of the network.

- Mapping out of the network with all the facilities : division floodgates, draining, firehydrants and public standposts.

- Work out a network plan at 1/1000 on the basis of codaster presented in boards.

- Work out a foodgate plan with numbers of gates and a notebook of gates where each knot is drawn.

- Work out a connection directory drawn at 1/200 from stitchings on the pipe to the counter completed with related technical and administrative information.

b- Customer's management

- Elaborate questionaries that can be processed by computer.

- Delievering points identification (reports of the geographical location at the plots level, replacement of defective counters, technical information on the state of installations).

- Process the questionaries in computer to compare with the existting file, any anomaly in the file will be rejected by the computer.

- Identification of costumers whose files were rejected and conduct an investigation.

- Close temporally connections belonging to iregular customers.

- Register useless counters and definitely close the corresponding connections in time - spass to be agreed upon.

c- Metering

- For large counters (feeder's counters, network counters, aquares counters).

- The need to work out a general countring policy (type of counter, management).

- The need to have, at least at the national level, a testing bench for large diameter counters.

- Expect, as much as possible, possibilities of counter references on the spot, when making installation.

- For small - caliber counters (costumers counters), then exist in general testing benches. It is important to examine the following points :

- Choice of the counter type, volum counter or speed counter.

- Systematic policy of maintenance, check up and renewal of counters.

- Organisation of the counter's reading : duration, frequency and check up.

4- Improvement of the technical returs

* Improving the technical returns of a water distribution network is first of all fight leaks at various levels :

- At the level of network conception (preventive action)

- At the level of manufacturing the network (preventive action)

- At the level of the network global management

- At the level of leaks detection

- At the level of exiting leaks detection.

* At the network level conception

- Limiting pressures by creating floors of distribution of settings up pressure reducers.

- More generally, studies on network's optimisation.

* At the network manufacturing level :

- Choice of materials taking into account the nature of soil and carried water.

- Check the manufacturing norms in the firms.

- Controlling and checking the norms in piper's setting.

* At the level of the network's general management :

- Using a centralized system of information and command mainly helps : influence consumption by modulating pressures on the network, manage of best reservoirs, reduce damages, limit leaks in the network and in the customer's internal installations.

It can deduced that setting up an adequate pressure zone and an automatic control enabling to modulate pressures in the network with a satisfactory service will help spare 6 to 10 % of the overall consumption, which is a very important fact for a great city.

The following principal means are used :

- Inspection of reservoirs.

- Setting pressure - reducers in the network.

- Setting pressure - reducers in the costumer's place.

- Systematic investigation in uncontrolled consumptions (for example forbidding of limiting lavatory flushes in draining networks, valus on fire-hydrants).

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

PHOTO N° 22 and 23 PHOTOS OF ADOPTED STRATEGY (BY ONEP) FOR MAINTENANCE WORKS IN PRODUCTION AND DISTRIBUTION

HOW TO CONSERV AND SAVE WATER IN AGRICULTURE

The present paper is meant to heighten people awareness to the gravity of water saving by drawing attention not only to the advantages and the need to spare water but also on the various actions undertaken to achieve this goal. This program develops the following subjects :

1- Water resources are limited : many studies show that in medium term, that balance can be reached between water demand and supply, and the problem of resources will emerge.

- Need is continuously increasing (7 to 8 % average).

- High cost of water wasting : the cost of water wasting is very hight for the individual and the community (because of bad exploitation of existing investments, early scheduling of new investments, abnormally high exploitation costs ...).

- Need for optimal use of water : as needs of water develop, important efforts ; optimal mobilisation of resources requires planning of resources and a policy of resources affectation closely related to the general policy of Moroccan economic development ; campaigning against water squandering remains a priority ;

"Because of the importance of future needs and the increasingly high cost to meet these needs, seeking maximum efficiency in water resources mobilisation and in the repartition of resource should be permanent concern of town planning" : conclusion of seminar held in 1980 in Rabat.

Struggle against squandering and quality and quantity degradation of water resources should be conducted at all levels and in the frame of all general mobilisation of all those interested in water, planners and users. It should no longer be the problem only of technical departments in charge of mobilisation, repartition or distribution to become the concern of all involved departments (planning, agriculture, industry, energy, equipement, health, interior, justice, housing) which requires a perfect coordination within the administration in addition to permanent consultation with consumers. It is thus a real awareness that is needed for various participants in water issues.

2- Planning and optimum use

- Water, a scarce resource, expensive and vital in all sectors should be used and managed with the maximum efficiency at all levels : dams reserves, draining channels, distribution networks, consumption sites.
- A policy of discipline and rigor should be set up to achieve on optimum use both at the quality and up quantity levels avoiding squandering and resources degradation.
- Extension fo the field of mobilisable water resource : pumping in sheets of water infiltrated in stream banks, using brakish water in irrigation, recycling of streamings water.
- Extend the field of water need covering through recycling of used water : reuse of residual water of irrigation or purification waters either directly or indirectly by re-loading of sheets, reprocessing urban, household and industrial used waters.
- The discharge of urban used waters is a wastewater and a source of pollution. After a scanty treatment, they may constitute, a fertilizing contribution for the agricultural neighbouring lands. They may contribute, if certain precautions are taken, to the loading of groundwater.
- Irrational or arbitrary exploitation of groundwaters is likely to lead to irriversible deterioration of the resource if sea water in coastal areas invade these waters.
- Pollution of all sorts and origins (natural, artificial, perpetual, periodical or accidental) may result in an irreversible deterioration in prohibitive treatment costs.

3- Saving water in the agricultural sector

- By 2000, agriculture will use 83 % of its mobilized resources to meet its needs. That means that a policy of saving water will be a priority by mastering water in agriculture.
- The strategy of saving water must be considered on various levesl from conception to management : at the level of mobilization.
- At the level of distribution

- reducing losses by infiltration
- reducing losses, which requires an efficient system of regulation : the installment of reserves in open canals and dynamic or hydrodynamic regulation systems
- policy of sustained maintenance
- national management based on meteorological forecasting, a bulletin of local cultivation knowing of the needs of cultivations in water, water deficiency of plants.

- At the level of the plot : in a policy of saving water many interdependant factors must be taken into consideration, some of these are :

  - a judicious development of the soil
  - a network of irrigation that is well adjusted to local conditions
  - a well adapted material of irrigation
  - a convenient environment
  - a sufficient training of staff
  - appropriate techniques of cultivation

  The main means of saving water at the level of plot are :

  - appropriate techniques, of irrigation
  - meeting the real needs of plants in water
  - a rational management of irrigation water by making appropriate release at adequate times
  - fixing a price for irrigation water, which would encourage users to make a rational use of it.

Waste water reuse in Agriculture, near Ouarzazate town

In Morocco, many epuration types were realized, particularly : lagunage, filtration, percolation, algual chenal in Marrakech, Agadir, Rabat and Ouarzazate towns.

The pilot experience realized under the responsability of MOR 86/018 Project (UNDP, FAO, WHO) for the use in 1990 of Ourzazate waste water irrigation. The goals and objectives of this operation is to protect public health and environment and to optimize water monitoring especially during the long last drought period. Theses activities consist on different interventions of water (epuration) to eliminate any contamination risk.

Impact of treated waste water

It is necessary to define all the impacts of treated waste water, as follows :

- The impact of irrigated crops by treated waste water on food sanitary.

- The impact of treated waste water by groundwater quality.

- The definition of atapted crops to optimize the use of waste water.

In this waste water experience pilot, a comparison between crude and epured waste water was undertaken on 2,5 ha with 4 different irrigation systems, with considering that witness crops was irrigated by groundwater.

The pre-treatment is defined as follows :

- Degrillage

- Take-up oil

- Dessilting (by chanals disposed in parallel).

The primary and secondary treatment are realized by lagunage by using anareobic basin of 1800 m^3 capacity during 4 days and additionally by 5 basins of 3780 m^3 capacity and 262 days stay and by 26 maturation basins of 280 m^3 each capacity and a stay of 1.8 day each one and finally a storage basin of 150 m^3 capacity.

Many experts in different fields as health, agonomy, irrigation, hydraulic, chimical and physics, epidimiology, biometry, economy have participated at the project establishement, at the realization and finally at the maintenance.

The experience field of treated waste water use presents the following characteristics :

- 60 elementary plots
- piezometers and weels
- The used crop
- Alfa - alfa
- The irrigation types are : gravitary, micro-jet, calibrated ajutage, aspersion, aspersion with mud flowing and finally aspersion by epurated waste water and other crops were used.
- The water quality was subjected to different analysis by the microbiology laboratory of IAV (Agronomical and Veterinary Institute Hassan II).

Program

ANAEROBIC LAGUNAGE
Case Study : Pilot station in Marrakech

Goals and objectives

Elimination of eggs of parasite worms to enhance agronomic potentiel of effluents.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

In hot periods, significant differences are measured for suspended matters between the two discharges : 25 % for a discharge 2 l/s and 40 % for 44 l/s. In cold periods there are little differences, probably because of emergence of mud as a result of anaerobic fermentation.

In this anareobic basin there is always a microalgal film (seaweed) which eliminates olfactive effects. The thermic stratification during summer period permits to stabilize the system : loosen reduction of sediments and oxygenation of upper layer due to photosynthesis phenomena.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

The purification efficiency of organic matters depends on the seasons. In hot periods incoming matters are lower than in winter because of the long journey of effluents in the "seguia".

The purification efficiencies concerning azote Kjeldahl are weak and the purification efficiency concerning phonphoreous reaches 56 % in cold period only. For heavy metals, depletions are 56 % for zinc, 52 % for lead and 7 % for chrome. Any depletion for copper is also reported.

In sanitary field, the depletion in CF is weak during the cold season. The tests performed show one depression for Helmithe eggs which reached 85 % because of mud rising up which left parasite eggs in surface.

List of Contacts

Photographs of Program

PROTECTION OF SURFACE WATERS

ACCIDENTAL POLLUTIONS RECORDED BY ONEP

TABLE N° 23

N°	Accident location	Pollution type	Pollution consequences
1	Abdelmoumen large dam	Hydrocarbon	The treatment station stopped working for 10 days
2	Treatment station of Fez (directly on wadi leben river)	Hydrocarbon	The treatment station stopped working for one day
3	Abdelkrim El Khattabi large dam on wadi Nekor	Pesticides	1 day
4	El Kansera large dam on wadi Beht	Hydrocarbon	No interruption
5	Abdelmoumen large dam	Hydrocarbon	-
6	El Kansera large dam (1991)		-
7	El Kansera large dam	Milk	No risk
8	Sidi Mokhtar Marrakech (1993)	Infiltration	No risk
9	Upstream Ibn Batouta, a large dam on wadi Hmatoun, near Tangier (1996)	Hydrocarbon	No interruption

Program

AWARENESS RAISING ACTIONS ABOUT TRAINING AND QUALITY MONITORING PRINCIPAL RESULTS OF STUDY OF NATIONAL DRINKING WATER SUPPLY MASTER PLAN FOR RURAL POPULATIONS

Goals and objectives

Unlike urban areas, the rural zones did not benefit from the same endeavour for the following reasons :

- Weakness of the institutional system (communes currently deprived from technical, financial, organizational and human means).

- Scattered housing which makes adequate operation of public service difficult.

- Low investment allocated to rural drinking water. Rural inhabitants benefit only from the 1/10th of the money invested yearly for urban inhabitants.

In order to find a solution to inadequate equipement of rural drinking water service, the Higher Water Council has decided to undertake the elaboration of a National Water Supply Master Plan. The study now completed, will help the government provide for the improvement in quantity and quality of drinking water service in rural zones.

Paragraph 8 of this study, entitled "Sensitive actions, training and quality monitoring", addresses the following topics :

- 8.1 : Purpose

The national plan objectives in terms of distribution are ambitious. They involve significant equipement purchases. In the field of water drinking allocation in rural zones where the dispersion and diversity of equipements and of socio-cultural contexts are very significant. Taking into account the social and sanitary dimensions guarantees an efficient investment, supply and demand adequation, and service sustainability.

Implementor

Hydraulic Administration and ONEP

Context (Urban / rural)

Rural.

Target Audience (socio-demographics)

Very important targuet audience because the current rate of the allocation of drinking water to rural populations can go up to 80 % in the long run.

Sensitization is important to insure the plan efficicency.

Description of Activities

8.2 What actions are needed to provide public awareness ?

1- Upstream

Objectives : To ensure participation of the population in projected systems and in training the population in monitoring activities.

Actions :

- The pre-requisite is to train educators and popularization leaders from among existing staff who are actually readily prepared to contribute to this effort (Provinces, medical personnel, ONEP, at an average of 10 trainers per province).

- Mobilisation of local authorities and decision - makers.

Means

- Health education, sensitization about water hygiene and training in equipement monitoring activities.

- Maintenance techniques.

- Financial aspects of monitoring activities concerning maintenance.

- Communal participation.

2- Downstream

The basic problem is water quality monitoring to ensure that it is up to the norms and standards of Who.

Objectives

The national plan calls for Who standards and norms applied in urban centers to be observed in rural areas as well.

Actions

- The proposed procedures will take place gradually, by 5 year stages, but require multi-dimensional efforts from one stage to another.

- They define the following analysis frequency :

* The three analysis types of WHO are :

. Type 1 : normal analysis

. Type 2 : monitoring analysis

. Type 3 : comprehensive analysis.

* Distribution systems

. Networks < 1000 inhabitants

. Networks from 1000 to 5000 inhabitants

* Monitoring points in the networks

. Captage

. Production / storage

. Distribution / networks

Means

- This activity is under the responsability of Health Ministry which can request chartered Laboratory services.

- The official responsible for monitoring should be independent from the distributor (except ONEP).

- The health services should respect monitoring programs, implement the results and undertake inspection activities.

Gender Impact

The same for male and female rural populations alike.

Record of Success in Solving Problems

From 14 % of rural population currently consuming drinking water, this rate can reach 80 % in the long run.

Relevance to the Region

All the sensitive types discribed in this programm can be extended to any country which presents the similar socio-economic and geographic conditions.

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

MASTER PLANS AND WATER CONSERVATION

Goals and objectives

The master plan for water resource development should be integrated within the framework of a national plan of water and waste disposal development, in order to be able to control and watch effectively water resource development at the national scale. They will also be permanently updated to take into account the changes in the indicators that served for their elaboration.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

MASTER PLAN FOR DRINKING WATER SUPPLY IN RURAL AREAS

Goals and objectives

This plan was developed with the support of UNDP. It provides for two (2) activities :

- Activity one : to assess the current situation and underetake an in depth study of the drinking water status in rural areas in Morocco (water sustainability, sanitation, water-related diseases, social issues, community involvement, institutional and financial aspects).
- Activity two : to draw up a long term plan (20 years) covering technical, financial and institutional aspects as well as the water supply / demand aspect.

Implementor

Department of Hydraulics, Rabat, with the support of UNDP.

Context (Urban / rural)

Rural

Target Audience (socio-demographics)

Raising awareness among local leaders and decision makers.

Description of Activities

The national plan is far reaching in terms of services, facilities and equipement. Dispersion of population along with social and cultural traiditions are often major problems in the rural world. Social and sanitary aspects must also be taken into account in order to enhance investment efficiency. Awareness raising campaigns as well as training and water quality control activities are planned for this purpose.

Gender Impact

The same for male and female populations alike.

Record of Success in Solving Problems

Relevance to the Region

Upstream : To encourage the population's interest in and commitment to the proposed systems and provide training in operating such facilities, through :

1- Training of educationists, campaign leaders and trainers from among existing personnel with the relevant background (local medical staff, ONEP regional branches, etc ...), at an average of 10 trainers per province.

2- Awareness raising among local leaders and decision-makers.

3- Training / Sensitizing users by trainers, mainly through health education, information about water conservation and training in equipment operation, maintenance practices and financial management involving cost-sharing by the community.

Explanation of How Environmentally Friendly

Downstream : Emphasis will be on the control of water quality to ensure that it is up to the standards. The plan provides therefore for the restoration of water control prarctices. It recommends that the WHO standards apply to cities in Morocco be observed in rural areas as well, with slight differences tolerated with respect to approach only. The procedures considered under the plan are to be introduced gradually over successive 5-year periods. They determine the frequency of analysis to be carried out, including those recommended by WHO, namely : on-going analysis, monitoring analysis and comprehensive analysis.

- Supply systems : (PEA), networks for less than 1,000 inhabitants, networks for 1,000 to 5,000 inhabitants ;

- Network check points : water collecting, production / storage, distribution / networks.

This activity will be carried out under the supervision of the Ministry of Public Health.

List of Contacts

Ministry of Public Works (department of Hydraulics), Ministry of Interior, Ministry of Agriculture, Ministry of Public Health, ONEP (National Drinking Water Supply Office).

Reference : Project MOR 88/020

Photographs of Program

Program

WATER TRANSFERS FROM ONE WATERSHED TO ANOTHER AND WATER CONSERVATION

Goals and objectives

Morocco has a long experience in water transfer. As early as 1930, Morocco resorted to the transfer of Wadi Sebou water to supply the city of Casablanca. Many transfers have been identified and examined by the Water Higher Council. Preliminary studies of transfer activities have already started. During the following years, these studies will be conducted in detail to start the procedures for finding financing sources.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

EUTROFICATION AND CONSERVATION OF WATER IN LARGE DAMS, LAKES ..., : CASE STUDY OF SIDI MOHAMED BEN ABDELLAH LARGE DAM BUILT TO SATISFY WATER SUPPLY REQUIREMENTS BETWEEN THE CITIES OF KENITRA, RABAT AND CASABLANCA

Goals and objectives

The Sidi Mohamed Ben Abdellah large dam, located about twenty kms from the capital Rabat, is caracterized by the following :

TABLE N°24

River	: River Bou Regreg
Type of dam	: Rockfil dam with corce
Normal reservoir level	: 50 meters
Height above foundation	: 100 m
Actual reservoir capacity	: 490 million m^3
Area covered by the dam	: 32 km^2
Watershed area	: 9,400 km^2
Annual average flow	: 21,4 m^3 / s
Annual average run off	: 880 million m^3
Maximum probable flow	: 12,000 m^3/s
Annual average flow volume	: 12,000 m^3/s
Annual average precipitation	: 600 to 700 mm
Annual average sedimentation	: 2 million m^3 / $year^{-1}$
Annual mean soil watershed degradation	: 200 $t.km^{-2}$ $year^{-1}$
Mean temperature variation between epilimnion and hypolimnion	: 15°c

The dam was constructed to satisfy the rapid by this drinking and industrial water supply requirements in the costal zone between Kenitra, Rabat and Casablanca, and supplies approximately four million people.

Since 1980, the station has treated 9 m^3/s (283 million m^3 $year^{-1}$) of drinking water and it is planed to treat 13 m^3/s (410 millions cu.mm/year) at the end of this centry. The reservoir was impounded in 1974.

The reservoir was built in 1974 and has full retetntion capacity of 493 $10^6 m^3$. The eutrophication problem and those related to water quality were investigated by the Swedich Institute of water and Air Pollution and OMS during the period between 1979-1982. The analysis has shown an absence of dissolved oxygen in the hypolimnion, particularly during stratification periods, i.e. between April and December. The concentration of nitrates increases during flood flows and decreases during summer and fall. Primary production varies during the year between 300 and 600 gc m^{-2}. Maximal algal biomass appears during mid-June and 70 % of it is formed by the genus peridinium.

A short time after the station went into service, an important reduction in raw water quality was observed especially at the end of dry season. The eutrophication of the lake involves the water and bottom sediments becoming enriched with nutrients to a point where the water quality deteriorates. The symptoms observed of this lake eutrophication are :

- Development of plankton.
- Increase of number of swimming microorganisms due to algae.
- Disappearance of oxygen in the deeper layer in summer.
- Appearance of sulphuretted hydrogen.

The eutrophication phenomena induce problems at the treatment plants : directly by an increase in the chlorine demand and the floculant product and also by taste and odor, and, indirectly, by the appearance of hydrogen sulfide.

In an attempt to determine and understand europhication problems and to assess the means to combat or reduce the eutrophication effects, an important study of all the factors governing the water quality in the lake, was undertaken, simultaneously by ONEP (National Drinking Water Supply Office) with the support of UNDP (United Nations Development Programme) and WHO (World Health Organization). The mathematical models simulating hydraulic and biological process in lake, the impact and effects of a large number of solutions selected to reduce the europhication impact, have been described elsewhere (Landner and Liljabad, 1980).

Implementor

ONEP (National Drinking Water Supply)
Ministry of Public Works

Context (Urban / Rural)

The context is mainly urban

Sidi Mohamed Ben Abdellah large dam supplies drinking water for four million people.

Target Audience (socio-demographics)

Allocation of water supply in the coastal zone between Kenitra, Rabat and casablanca.

Description of Activities

Three types of mathematical models have been used : one dimensional hydraulic model, two-dimensional hydraulic model and water quality model. They have been used particularly for suggesting possible means for water quality improvement. The following means were considered : Reduction of nutrient income, wash-out of the reservoir, biological method, increase of the amount of osydative substances in the hypolimnion and water treatment plant construction. The models have been also used to test effectiveness of the different means considered.

The situation of reservoir varies widely with the seasons. During summer, the reservoir is stratified and the movement of the flow to and from it is hardly important : in this case it is necessary to describe the dispersion process. During winter (and early spring and autumn), the stratification is non-existing and a significant flow to and from the reservoir is observed : in this case it is important to describe the advected flow. The density effect is to take into account in this analysis.

Hydraulic Model : The reservoir is represented by a series of coupled sections or sub-basins. The model calculates the temperature profile in each section or sub-basin.

The dispersion coefficient and the vertical and longitudinal flow are function of depth in each section which is represented by a serie of slices. Each horizontal slice is called an element and is characterized by upper and lower area, thickness and volume.

The impact of inflows and outflows is calculated with empricial formulas in low-flow periods. This effect becomes uncertain in flood flow series.

The principle of conservation of heat and mass is used to derive the following differential equations for the dynamics of heat and biotic materials is infinitesimal volume-element :

$$v.\frac{\delta c}{\delta t} = \Delta z \,.\, q_z \frac{\delta c}{\delta z} + z \,.\, A_z D_z \frac{\delta^2 c}{\delta z^2} + \sum_i qin_i \, cin_i - \sum_i qout_i \,.\, c + \frac{dv}{dt} \,.\, c + s \qquad (1)$$

Where

c = Concentration of heat or constituent concentration in appropriate units ($Kcal/m^3$, mg/l)

v = Volume of element in m^3

t = time co-ordinate

z = water elevation in meters (zero at the surface of the Atlantic)

Qz = vertical advection in m^3/s

Az = horizontal element surface in m^3

Dz = dispersion coefficient at the elevation z in m^2/s

Qin_i = lateral inflow No. i, in m^3/s

Cin_i = thermal concertation or constituent concentration for inflow No i, in appropriate units.

$Qout_i$ = lateral outflow No i, in m^3/s

S = all sources and sinks within the element in appropriate units (Kcal/s, g/s)

The terms of the equation (1) have the following meaning :

$v \,.\, \frac{Jc}{Jt}$: rate of change in mass or heat accumulation in the element

$z.qz.\frac{\delta c}{\delta z}$: rate of change in mass or heat in the element according to vertical advection

$z.A_z.D_z.\frac{\delta c^2}{\delta z^2}$: rate of change in mass or heat in the element according to vertical dispersion

$\sum_i qin_i Cin_i$: rate of change in mass or heat in the element according to all relevant lateral inflows, i.e external inflows (from rivers) and adjacent upstream section

$\sum_i qout_i C_{oit}$: rate of change in mass or heat in the element according to all relevant lateral outflows, i.e external outflows to the adjacent downstream section.

$\frac{dv}{dt} . c$: correction term for change of volume in the element. This term is zero in every element except the surface element.

S : The rate of change in mass or heat according to all sources and sinks. This term for heat is limited to external heat fluxes. For water quality constituents, source and sinks may include first order decay reaeration, chemical transformations, biological up-take and releases, growth, respiration, etc ...

Gender Impact

Record of Success in Solving Problems

The principal technical solutions selected to combat europhication effects (as tested by mathematical model simulations) are :

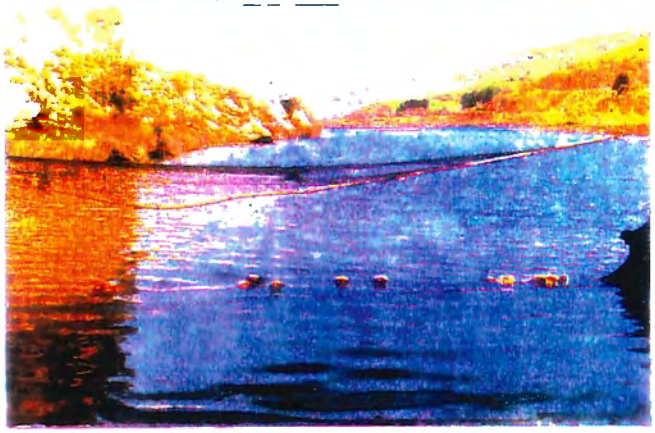
- The introduction of silver carp and fish algae-eater
- The stimulation of artificial ciruclation of the reservoir
- The hight enging of the dam

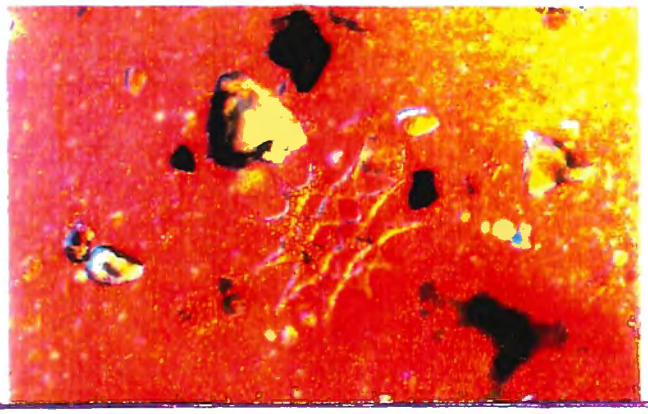
Simulation of the temperature profile : the reliability of model was tested for the period of April 1 - Decembre 31. 1979. The results are :

CHEMICALS ABSORBED ON THE SURFACE OF THE SEDIMENTARY PARTICLES AND ENTER THE RESERVOIR WITH THE SEDIMENT. WATER QUALITY OF THE LAKE DETERIORATED THROUGH ION EXCHANGE

PHOTO N°24

Pose du filet séparant le bras du reste de la retenue





DISSOLVED OXYGEN CONTENT IN THE WATER CHANGED DUE TO INCREASE IN SUSPENDED SEDIMENT

Program

AWARENESS AND INFORMATION CAMPAIGN FOR DRINKING WATER BENIFICIARIES, IN RURAL AREAS NEAR ONEP REGIONAL WATER FACILITIES

Goals and objectives

ONEP has planned a number of projects to supply villages near its installations. To ensure the success and viability of these operations, ONEP has opted for involving the population in implementing, monitoring and developing of these projects.

The success of pilot operations developed by ONEP with financial support from the German Federal Republic, conducts to the extend of this approach type for PAGER projects (Program of water supply for populations). The present following document describes the methodology, the realization and the first result of this pilot experience in the field of community participation in drinking water.

In 1994, a director scheme of drinking water allocation for rural zones was undertaken in Superior Council of Water and Climate : the objective of this plan is to reach a rate of drinking water allocation in rural zones estimated at 80 % in 2010 instead of 14 % in 1991.

Implementor

ONEP and German Federal Republic

Context (Urban / rural)

Rural

Target Audience (socio-demographics)

The impact of this program is very important for socio-economical development and ameliores sanitary conditions of rural populations ; the investment and monitoring costs for the realization of these projects induce ONEP to adopt a strategy with the objective the mobilization and implication of the population against pollution, tarification ...) and also

consists on keeper manager formation in maintenance and monitoring of fountains.

For this purpose an awareness program is undertaken as follows :

- awareness :

The information and awareness campaign aim three distinct target audience : local authorities, elected persons, and population which benifits byt the project.

- The awareness of local authorities

The meeting with local authorities is fixed by a letter addressed to Mr the Governor, presenting the projects, the cost and financial modality of the project and define the villages concerned in the Province.

By this letter which explains awareness activities projected and their objectives, it is demanded to the Governor to organize a meeting in Province. Are present : ONEP representant, local authorities of villages interested bu the project.

In this meeting are developed :

- The project by persons in charge of ONEP (from Central Direction of monitoring, of finance and communication, and of regional director and / or provincial concerned by the project).
- The pratical modalities of campaign realization.
- The definition of date and location of the second step with elected persons.
- The financial participation.

- The awareness of elected persons

The meeting with elected persons discusses the following problems :

- The presentation of the project
- The elected persons interventions in the campaign and the collect
- The defintion of the awareness modalities by population and also the collect (date, location ...)

- The population awareness

The meeting with population are realized suiting a planing fixed with local authorities and elected persons. These meeting are located in an habitation mosque, school, public place, and animated by office representants which are charged of information and awareness mission, of water economy and of the combat against pollution.

PROGRAM

WATER RESOURCE PROTECTION AND ONEP SUPPORT IN SOLVING WATER CLEANSING

Goals and objectives

The provide for the conservation of drinking water in small communities and rural areas near major regional water supply sources by drawing on ONEP'S experience in the field of awareness raising and in implementation of water related projects. The aim is to speed up implementation of drinking water supply programs in rural areas as well as to encourage the setting up of micro-firms in charge of maintenance and management of water supply facilities and equipments.

Implementor

GTZ (Gessels chaft für Technische Zusammenarbeit) : for technical support.

FKW (Kreditansatalt für Wiederaufbau) for financial support.
ONEP

Context (Urban / rural)

Target audience (socio-demographics)

Mainly rural population

Record of Success in Solving Problems

The total project cost is evaluated 1924 MDH (Cooperation and donation).

Impact environmental positif

Liste des partenaires et des contacts

Photos des programmes

Program

ARTIFICIAL RECHARGE OF CHARF AL AKAB GROUNDWATER

Goals and objectives

The aim is to retain the water in groundwater which is located in highly fractures zone of Pliocene limestone, with a view to catering for the drinking water needs of the city of Tangier and preventing further loss of water resources through evaporation or flow into the sea. He use of this groundwater during the periods of drought observed in MOROCCO since 1980, has turned out to be a determining factor in stocking surface water during the winter season for future use in periods of water shortage.

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.

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 m^3 per day. The same groundwater is injected with an additional 120,000 m^3 of water released from Hachef dam (Built in 1989) and processed subsequently.

Gender Impact

The program has the same impact for male and female population alike.

Record of Success in Solving Problems

The surccess of this comprehension program can be assessed in light of the volume of water drawn from the groundwater (7 million m^3 between 1975 and 1989) in 1984, 384,000 m^3 of water were injected each day into fault n°12 and pits 1 through 9.

Relevance to the Region

If maximum water resources are taken from basin fault and pits during high hydraulicity periods and injected into the groundwater, then there will be no need for shipping water to Tangier from JORF AL ASFAR, as was the case a few years ago during a period of drought.

Explanation of How Environmentally Friendly

During the critical 1980-1985 drought period in MOROCCO, the volume of surface water derived from Ibn Batouta dam was rather low. This resulted in a decline in the activity of the Bougdour water treatment station. It then became necessary to pump water from the groundwater in order to reduce the shortage in drinking water supplies.

List of Contacts

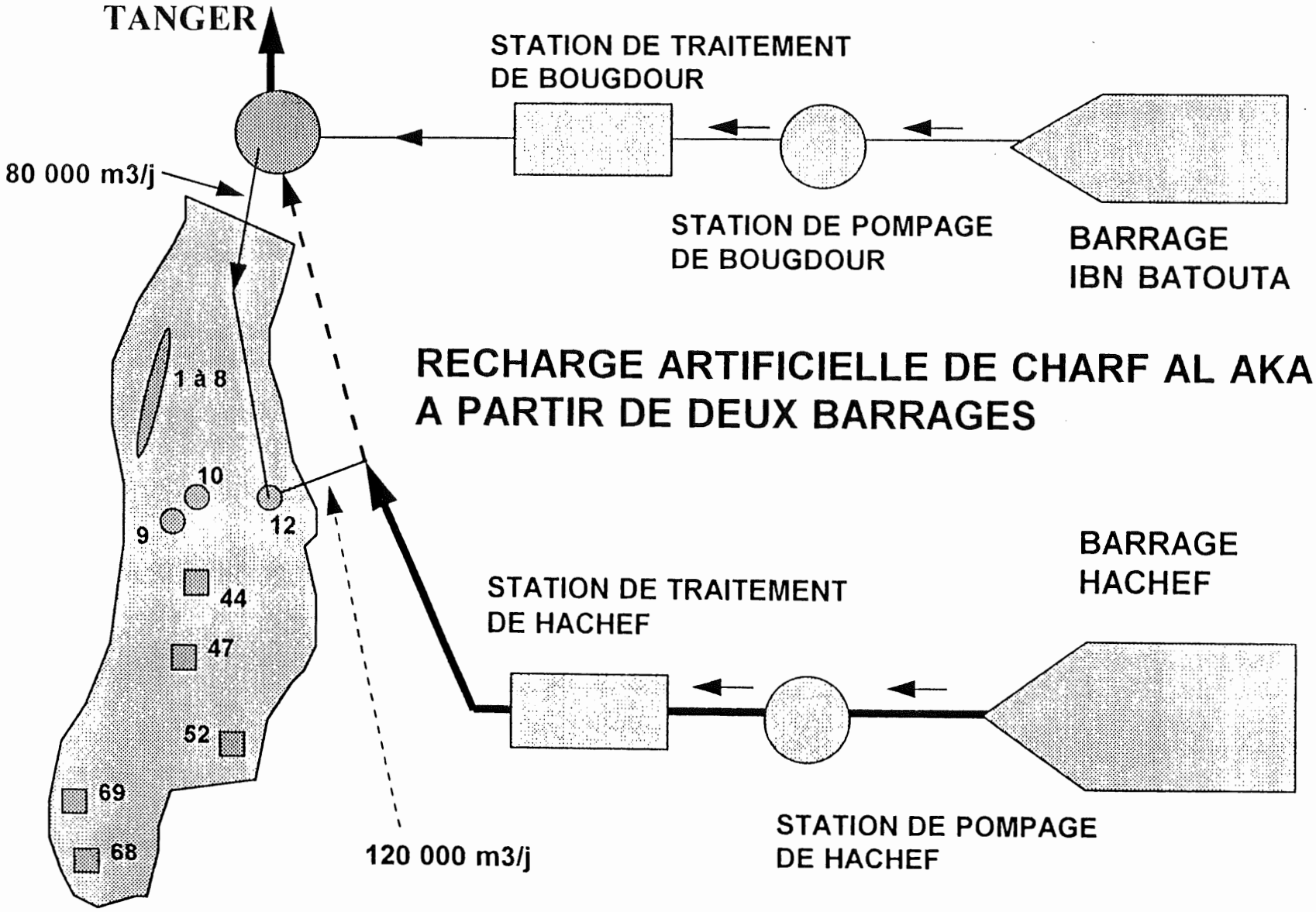
- The regional director, hydraulics, Tangier
- The management, water treatment station, Bougdour
- The management, water treatment station, Hachef.

Photographs of Program

PHOTO N°25 PLAN OF CHARF AL AKAB LOCATION
(FOR ARTIFICIAL RECHARGE)

GRAPHIC N°13

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



E2

Program

ARTIFICIAL RECHARGE THROUGH OUED N'FIS BED, NEAR MARRAKECH AND PROTECTION OF WATER FROM EVAPORATION RISKS.

Goals and objectives

These artificial recharge facilities have made it possible during the drought period to stock 1.2 millions m^3 of water in groundwater by injecting it from basins located in a granular zone.

Implementor

Ministry of Public Works, Regional Directorate, Hydraulics, Marrakech.

Context (Urban / rural)

Thanks to this arrangement it has been possible to provide the Marrakech region with 1.2 million m^3 of water during a period of acute drought.

Target Audience (socio-demographics)

Both urban and rural populations benefit from the program.

Description of Activities

Features of infiltration basins on N'Fis Oued (River) : width 500 m ; average gradient 1/150, embanking depth 20 to 3 meters. The injected flow is regulated from Lalla Takerkoust dam onward upstream. The three infiltration basins have a surface of : 7,100 m^2 ; 5,425 m^2 and 6,275 m^2 respectively. Infiltrated flow : 300 l/s, injection period : 43 days.

Gender Impact

The same fro male and female popualtions.

Record of Success in Solving Problems

43 days after the recharge of the water groundwater, the piezometric effect was visible some 6.000 meters downstream ; the resulting piezometric variation ranged from one to two meters.

Relevance to the Region

In times of drought the pumping out of the 1.2 million m^3 of water which had been injected, turned out to be very useful and profitable for the popualtion.

Explanation of How Environmentally Friendly

This artificial recharge activity made it possible to improve water conservation conditions in physical and chemical terms.

List of Contacts

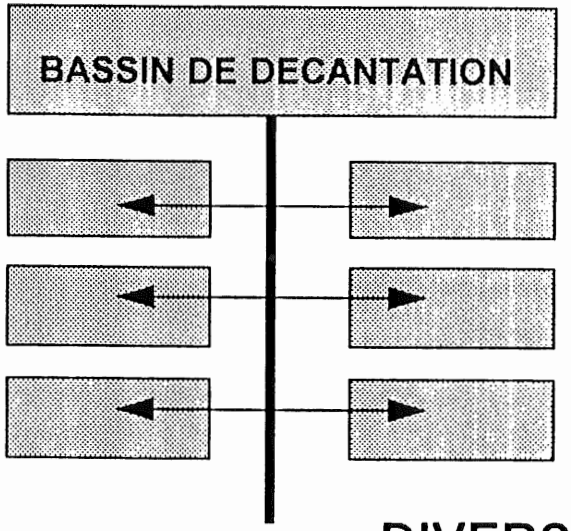
- Ministry of Public Works
- Department of Hydraulics, Rabat
- Department of Hydraulics, Regional branch Marrakech.

Photographs of Program

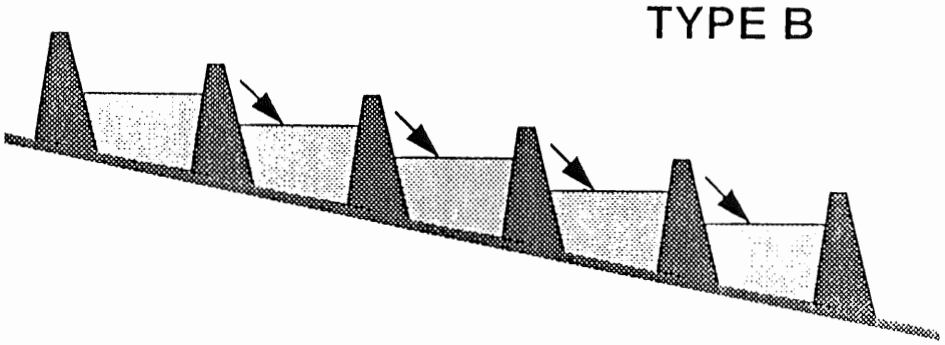
PHOTO N° 26 AND N° 27 CONSTRUCTION OF DECANTATION AND INFILTRATION BASINS ON OUED N'FIS RIVER (INJECTION OF 1,2 MILLION m^3 OF ~~FO~~ WATER)

GRAPHIC 14

SCHEME N° ARTIFICIAL RECHARGE PRINCIPLE

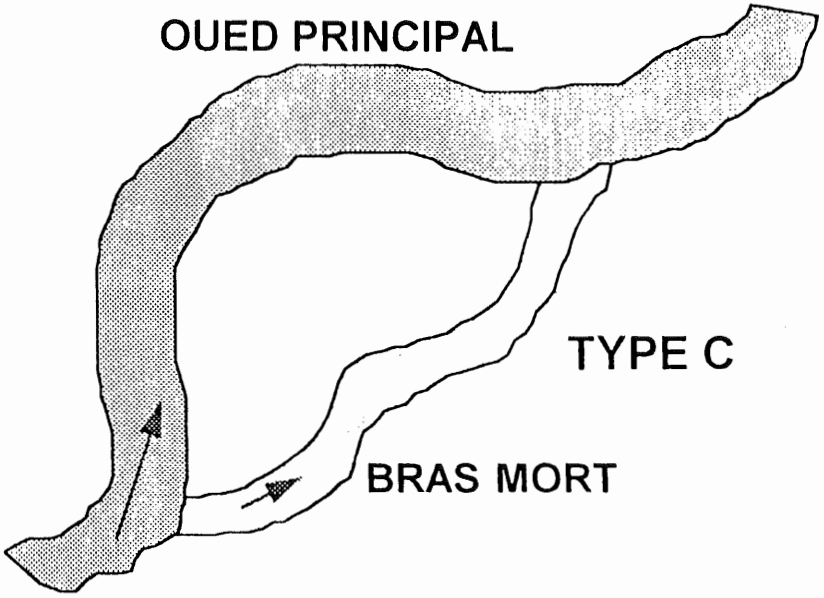


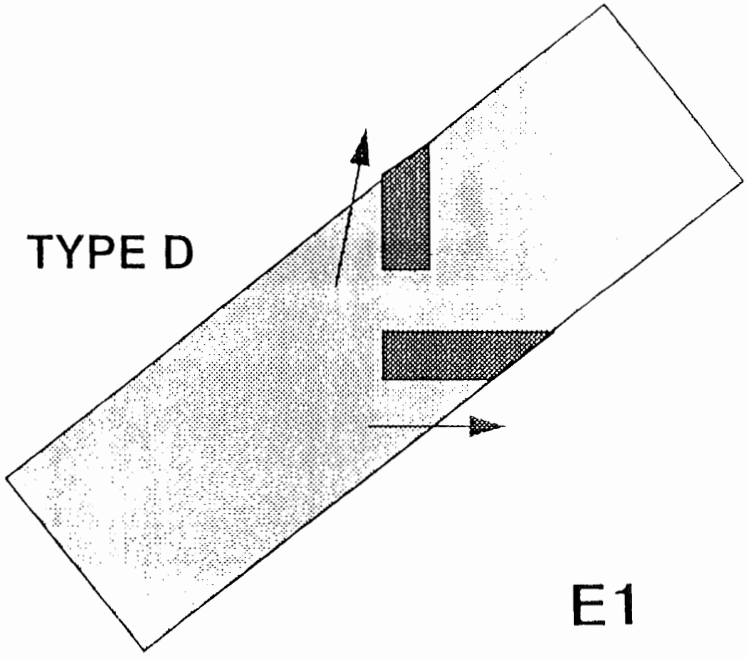
TYPE A



TYPE B

DIVERS TYPES DE RECHARGE ARTIFICIELLE APPLIQUES DANS LE MONDE





TYPE D

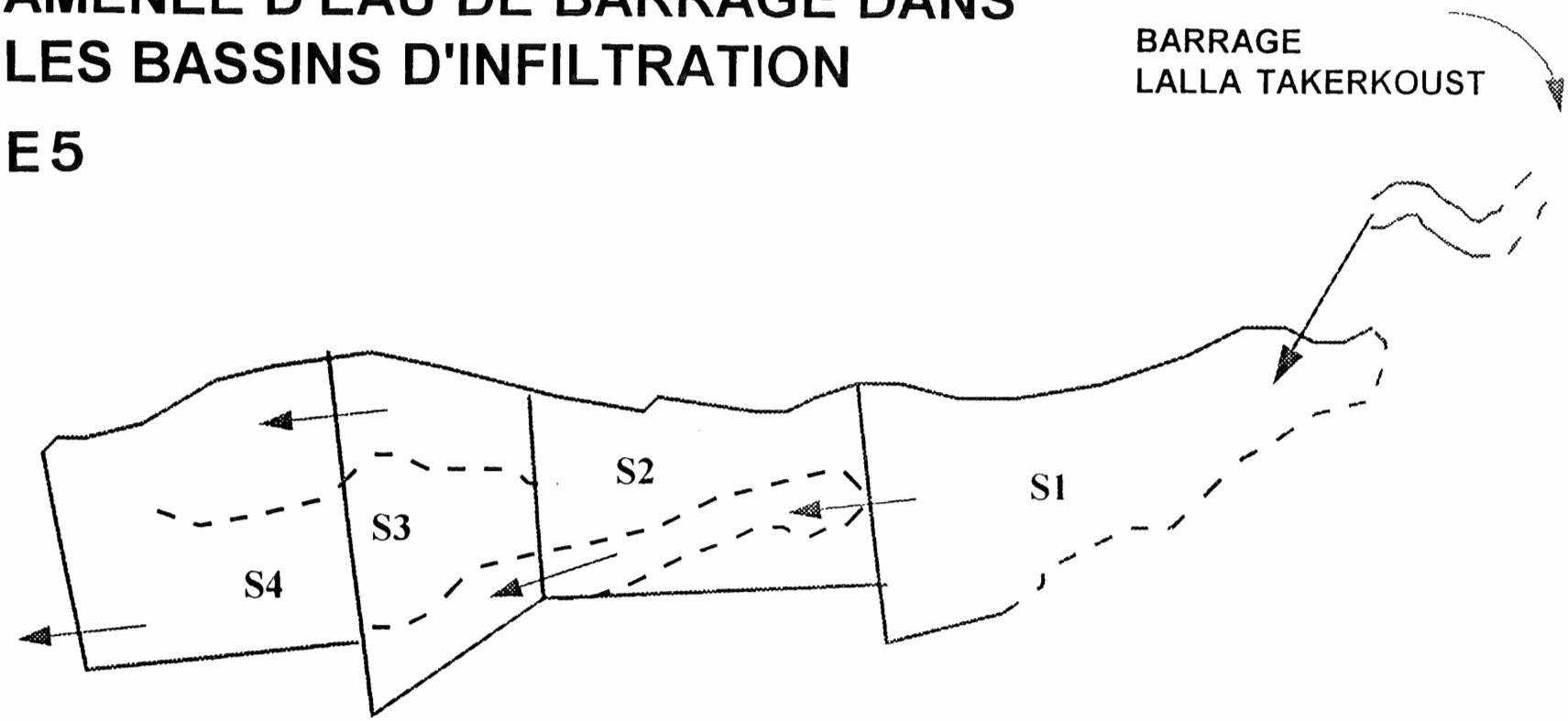
E1

GRAPHIC N°15

SCHEME N° LOCATION OF DECANTATION BASSINS (FOR SEDIMENT DEPOSITION) AND OF INFILTRATION BASIN (LEGEND : S : BASIN SURFACE). THE DISCHARGE IN BASINS IN REGULATED BY LALLA TAKERKOUST LARGE DAM IN UPSTREAM)

RECHARGE ARTIFICIELLE PAR AMENEE D'EAU DE BARRAGE DANS LES BASSINS D'INFILTRATION

E5



S1=7550 m²; S2= 7100 m²; S3= 5425 m²; S4= 6275m²

Program

ARTIFICIAL RECHARGE EXPERIENCES APPLICABLE TO OTHER WATERSHEDS IN MOROCCO WITH A VIEW TO CONSERVING WATER POTENTIALITIES

Goals and objectives

The possibility to generalize artificial recharge operations can be reproduces in the following aquifers which fulfil particular hydrodynamic conditions, they are defined by their location and characteristics to optimize integrated surface water and groundwater resources.

Implementor

Ministery of Public Works.

Context (Urban / rural)

Urban and rural.

Target Audience (socio-demographics)

The use of non conventional water resources by artificial recharge is very important particularly during the latest drought period observed in Morocco.

Description of Activities

Following is the list of potential sites in Morocco, where it is possible to apply artificial recharge hydraulic management.

Gender Impact

Record of Success in Solving Problems

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

- to raise the piezometric level of overexploited aquifer.
- to avoid water degradation of groundwater through over exploitation.

- to secure good quality water with no need for first treatment.
- to avoid the evaporation of great quantities of water.
- to monitor and regulate surface water and groundwater simultaneously.
- to reduce the allocation of water shortages (for different uses : drinking water, irrigation, hydraulic energy, ...) particularly during drought periods.
- to expand investment program (comparatively to the program adopted for hydraulic management of large dams).
- to avoid multiannual water scarecicty which accured in large dams (interannual regulation).

From an economic point of view, making a dam fully operation can take a long time (10 years in some cases : due to auscultation operations or to the delay of hydroagriculture works) and the corresponding cash-flows are much complex. We have demontrate that with a actualization rate of 6 % the artificial recharge operation becomes competitive comparatively with a great hydraulic management (large dam) : we can consider artificial recharge as a entire hydraulic management.

We have also demontrate that the best economic solution consists on the built of a dam combined with artificial recharge operation : this operation reduces the large dam cost and protects environment by reducing the areas flooded by dam construction.

Relevance to the Region

TABLE N°25

N°	Name of the zone	Location and objective
1	- Feija d'Allougoum - Feija d'Akhagane - Feija of Toozoone plan - Feija Assa	All these sites are located in Draa watershed Objective : to ameliore discharge captage of Foum Zguid
2	Guelmim	The artificial recharge in the captive field of Guelmim which recuperes a great quantity of flood flow waters generally lost
3	Guir	Location to define exactly
4	Tensift	- Wadi Chichaoua site - Wadi Assif Al Mal site

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

LIST OF NGOS IN MOROCCO

The title of NGOS are as follows :

1°) In the Children field

- "Association marocaine de soutien de l'UNICEF"
- "Ligue marocaine pour la protection de l'enfance"
- "Association de l'enfance polupalaire"
- "Association, fondation RITA ZNIBER"
- "Association l'heure joyeuse"
- Association marocaine d'études pour l'enfance"
- "Asociation "AL IHSANE" pour les enfants"
- "Union des Associations maghrébines de la protection de l'enfance"

2°) In the Woman field :

- "Union nationale des femmes marocaines"
- "Comité des femmes marocaines pour le développement"
- "Groupement d'études et de recherche pour le développment de la femme rurale"

3°) In the young field :

- "Association les bâtisseurs"

4°) In the éducation and training :

5°) In environment and development fields :

- "Mouvement national des écologistes"
- "Association Gerère"
- Association écologique marocaine"

- Club marocain d'éducation en matière de population et d'environnement"
- "Société protectrice des animaux"
- "Société marocaine pour le droit de l'environnement"
- "Association du Bassin du Sebou"
- "Association marocaine pour le civisme et le développement"
- Association marocaine des améliorations foncières, de l'irrigation et du drainage"
- Association marocaine pour la protection de l'environnement"
- "Association marocaine pour l'environnement et le développement"
- "Association marocaine pour la mer"
- "Association Maghreb-Machrek pour l'eau (ALMAE)
- "Association des sciences naturelles"
- "Association des enseignants, sciences de la vie et de la terre"

RELATIONSHIP BETWEEN CONSERVATION OF WATER AND POLLUTION : CASE STUDY OF SEBOU AND FES RIVERS

Sebou River Characteristics

The Sebou Watershed presents a total area of 40,000 km^{-2} (it is the second basin in Morocco by taking into account the surface). The average annual runoff of Sebou River at the lowest hydrological stations is 6.6 billion m^3/year (the first rale of river inflow in Morocco).

On a total national volume of wastewater of 300 million m^3 per year in Morocco, 180 Mm^3 are flowed annually into Sebou River, showing the importance of polution in this watershed.

Industrial and Urban pollution in Sebou basin

Generated by alimentary and agricultural industries : as sugar refineries of Mechra Bel Ksiri, Sidi Allal Tazi and Beht, cooperatives as "COLAIT", national sugar-cane refineries.

SUNACAS, sugar-cane refineries SURAC, vegetable oil : Ben Azzouz, canning factory, society of sugar derived : SODERS, vegetable oil industrial oil industrial society : SIOF, mineral waters society : Sotherma, textile industries : spinning, weaving, manufacture, chimical and para-chimical industries : fertilizers, detergents, skins, paste-paper and pasteboard manufacture : CELLULOSE of Morocco, Paper-making of North ; tanneries : MANUCUIR, Petroleum refinery : SCP (Cherifian Petroleum Society), Manufacture of Chimical and para-chimical products : Society of treatment and exploitation of marine algas, industries of non metallic minerals : great cementeries Farin Ben Zel, drinking manufacture, mecanical and electric industries : metals affinement, foundings, sheet-metal works ... Thermic central of Kenitra, POLAMP : society of ampulla manufacture ...

TABLE N° 26

Inventory of Principal industrial unities of Sebou River

N°	Industry type	Production	Localisation	Receptor medium
1	**Agro-alimentary** (food)			
	- Society of suggar derived	- Fresh yeat	FES	FES RIVER
	- (Vegetable) Oil industrial society	- Edible oil	FES	FES RIVER
	- Sotherma society	- Mineral waters	FES	SEBOU RIVER
2	**Drink making**			
	- Brevery Branoma	- Drink	FES	FES RIVER
	- Gasous drink	- Drink	FES	FES RIVER
3	**Paste paper and Company Manufacture**			
	- Paper-making (of North)	- Papers	FES	FES RIVER
4	**Tanneries**			
	- Fes Tanneries	Skin	FES	SEBOU RIVER
5	**Industries of non metallic minerals**			
	- Great Ciment - making Farina Benzel	- Materials of construction	FES	FES RIVER
	- Electric proudcts - making	- Ampulla	FES	SEBOU RIVER

The cities which are more polluants in Sebou hydrographic network are, from downstream to upstream : Kenitra, Sidi Allal Tazi, Mechra Bel Ksiri, Douar El Gueddari, Sidi Slimane, Sidi Yahia of Gharb, Sidi Kacem, Meknes and Fes.

Agricultural pollution

Due particularly to drained water coming from irrigation perimeters which affectes aquifers by fertilizers presence at high rates non controled, for example : Gharb groundwater and Saïss aquifer.

The third pollution types : industrial, domestic and agricultural affectes Sebou basin.

Correlatively to the national total pollution (N), the share of Sebou pollution (S) is showed in the following table :

TABLE N° 27

Pollution Receptor medium	Annual quantity of oxydable matters due to domestic and industrial pollutions at national scale in tons / year	Percent of Sebou pollution correlatively to the national pollution tons / Y	%
1- RIVERS	68,000 t / Y	41,500	61 %
2- SOIL AND UNDER-SOILS	51,000 t / Y	15,000	30 %
3- SEAS	99,000 t / Y		

We remark that Sebou Watershed pollution is very high in Morocco (61 % for rivers and 30 % for soils and under soils, correlatively the total national pollution rate).

In the other hand, on the total of 68,000 t/year of oxidizable matters overflowed in the rivers in Morocco, domestic pollution participates for 40,000 t/year : the Sebou watershed intervenes alone for 22,500 t/Y even 56 % of the total domestic wastwater. The total of industrial pollution is 28,000 t/Y : The Sebou basin participates for 19,000 t/Y even 67 %.

Comparison between actual and future pollution of Sebou river, in relationships withother Moroccan rivers

The two following tables indicate with details the distribution of domestic and industrial pollution overflowed in the rivers, the soil and in the sea (Mediterranean and Atlantic seas) for all watershed in Morocco and predicted situation of the pollution in year 2020.

The forth parameters : DBO_5, DCO, NH_4^+ et P_T where the basis elements of the auto-epuration model simplified, in the view of predicted water quality in year 2020 : a simple hypothesis was used consisting on a direct correlation between the overflowed pollution and water consumption : effectively, in the reality, the pollution is more critical, many parameters are to be taken in consideration.

TABLE N° 28

Domestic and industrial pollutions overflowed in the rivers, soils and seas, in Morocco

Watersheds	Domestic pollution tons of oxydizable matters / Year			Industrial pollution T/Y of oxydizable matters		
	Hydr. Resources	Soil	Seas	Hydr. Resource	Soil	Seas
Sebou	22.500	13.000	-	19.000	2.000	-
Z.C Atlantique	-	4.500	79.000	-	500	1.500
Souss 1 Massa	-	1.600	5.000	-	1.000	2.600
Oum Er Rbia	4.000	11.200	-	7.500	600	-
Tensift	-	7.000	-	-	-	-
Moulouya	6.576	6.420	14	1.153	1.388	-
Loukkos	7.083	1.502	8.900	110	-	1.360
Total	40.159	45.222	92.914	27.763	5.488	5.460

TABLE N° 29

Predictive flux of overflowed Wastewater from basins in Morocco (Year 2030)

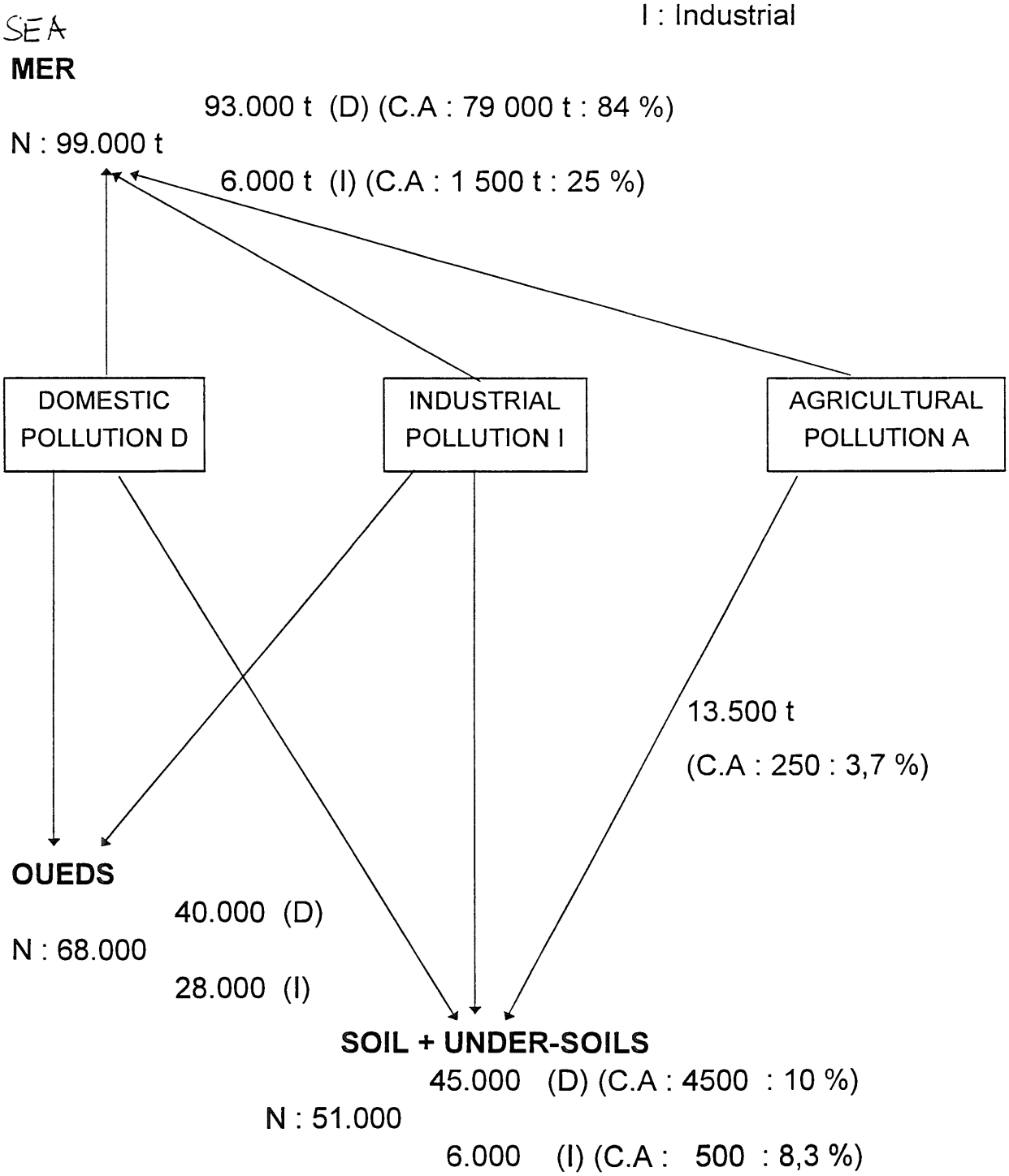
Receptor Medium	Basin	Overflowed pollution in eq. inhabitants		
		1985	2000	2020
Hydrographic Network	Oum Er Rbia	959.000	1.137.600	1.342.700
	Moulouya	66.940	264.319	478.446
	Sebou	1.975.000	2.600.000	3.500.000
TOTAL		3.000.940	4.001.919	5.321.146
Soil, seas, rivers	Oum Er Rbia	254.940	373.960	553.040
	Loukkos	618.947	897.473	1.435.957
	Sebou	730.000	917.000	1.250.000
	Moulouya	279.000	350.000	578.500
	Souss & Massa	406.000	646.000	1.040.000
	C. Atlantique	4.400.000	6.300.000	9.500.000
	Tensift	272.740	395.473	632.757
TOTAL		6.961.627	9.879.906	14.990.254
TOTAL GENERAL		9.900.000	13.900.000	20.300.000

GRAPHIC N°16

Annual pollution of coastal atlantic waterseds

Legend :

N : National
D : Domestic
I : Industrial



Pollution prediction of Sebou basin in year 2020

The situation correlatively to the anterior pollution state in very aggravated.

The branch of Sebou River located between the Oued Ouergha confluence at the guard dam present a maintained water quality do to the following reasons :

- The new sugar - reffineries treats their effluents with high technology similar to the best ones in the world.

- The overflow in the Sebou river from february to Jully for sugar-cane and from may to Jully for sugar-bet, are operated in high hydraulicity conditions by taking into account the management of hydraulic reservoirs : in those conditions, the overflowed pollution will presents better dilution.

The water quality level have to be defined, in any point of Sebou River in function of apropriated criteria fixed primarly. That is the reasons for way the dipollution planification of Sebou River take into account the water use and the water quality in relationships with this use.

POLLUTION OF O. FES RIVER

The Almoraoide dynasty (12ème century) and Merinide dynansty (856-869 Hegir) have and realized many important hydraulic managements on O. Fes River, particularly the drainage of wastewater (two seperated adductions : one for drinking water by spring water source and another for used water)

The sensitive decline of O.Fes discharge

The O.Fes inflows are measured in Bab Mechouar from 1919 (the longuest hydrological data observed in Morocco).

I undertake the O.Fes hydrological study on 34 years period (1919 to 1990) and I obtain the following results.

TABLE N° 30

HYDROLOGICAL CHARACTERISTICS OF O.FES RIVER

Period	Average annual discharge m^3/s
- 1919 to 1990	2.44
- 1919 to 1936	3.82
- 1965 to 1971	2.99
- 1919 to 1970	3.64
- 1919 to 1984	3.41
- 1982 to 1984	0.34 m^3/s (drought)

I use Pearsons III, Hazen, Foster ... hydrological models in the objective to define discharge frequency distribution since 1919.

- For too moist period (frequency up to 10 %), the average annual discharge is 5 m^3/s.

- For mean hydraulicity, the O.Fes discharge varies from 2.7 m^3/s to 3.4 m^3/s (25 % < f < 65 %)

- For dry period (65 % < f < 90 %)

- For very high dry period (as obsesrved from 1980 to 1985), and with f > 90 %, the O.Fes discharge is 0.23 m^3.

PHOTO N°28 OUED FES POLLUTION Photo (10 Sept. 1997)

PHOTO N°29 Oued Fes Pollution (10 Sept 1997)

PHOTO N° 30

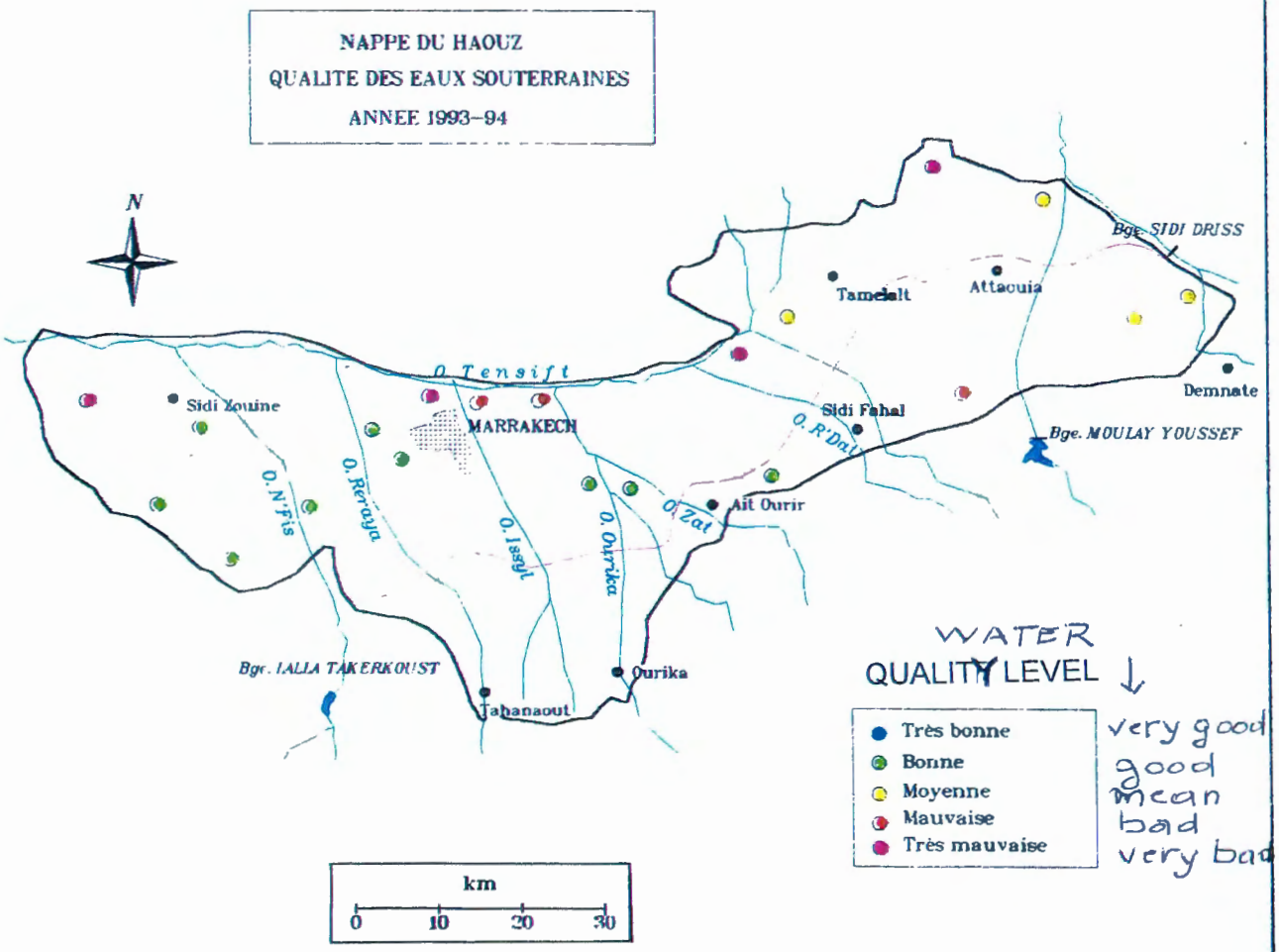
PHOTO N° 31 OUED FES POLLUTION (leather works)

OUED FES POLLUTION (textile)

GRAPHIC N°17

SCHEMEN° HAOUZ AQUIFER : WATER QUALITY

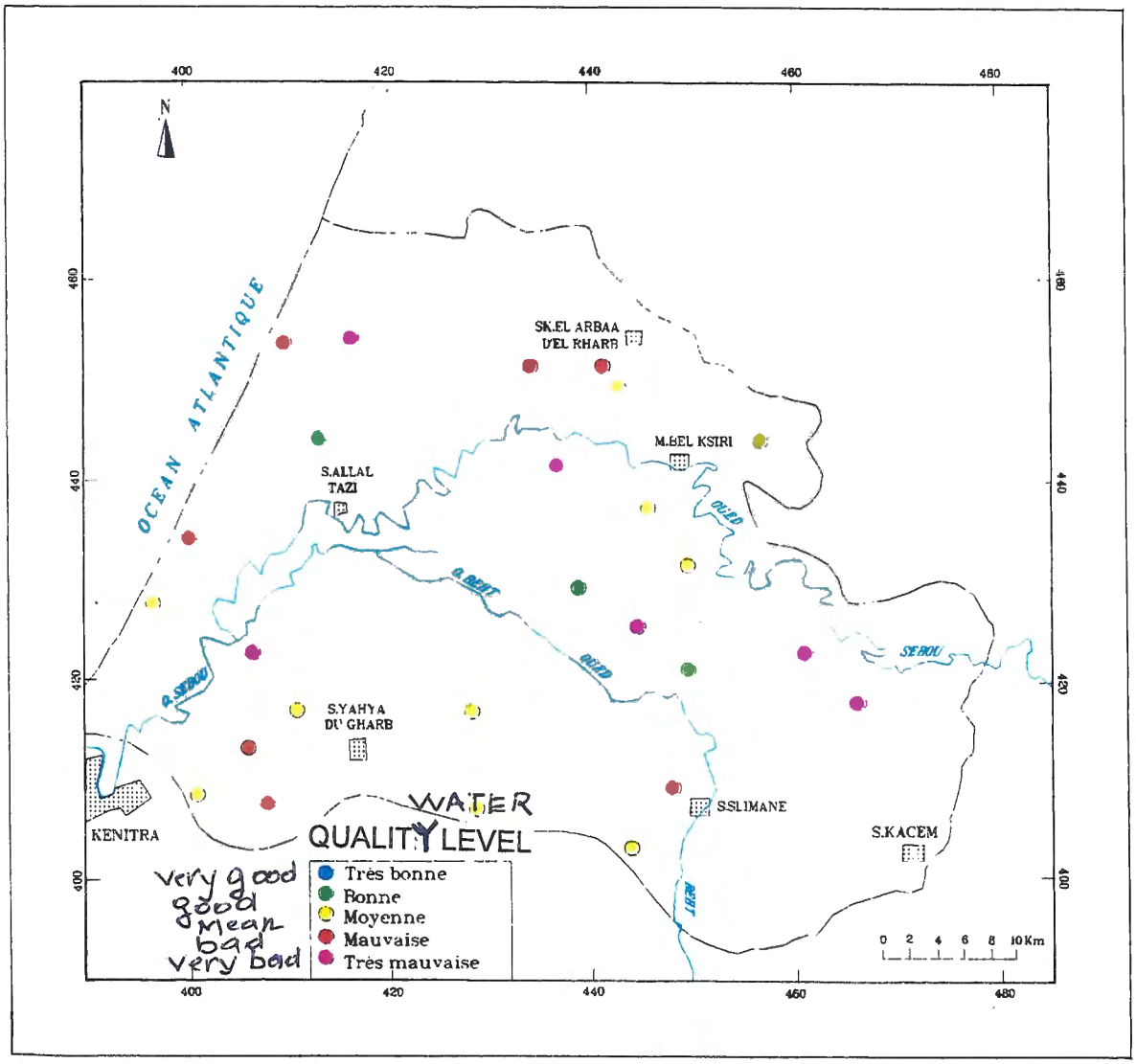
Year 1993/94



GRAPHIC SCHEME N°18 GHARB AQUIFER : WATER QUALITY

Year 1993/94

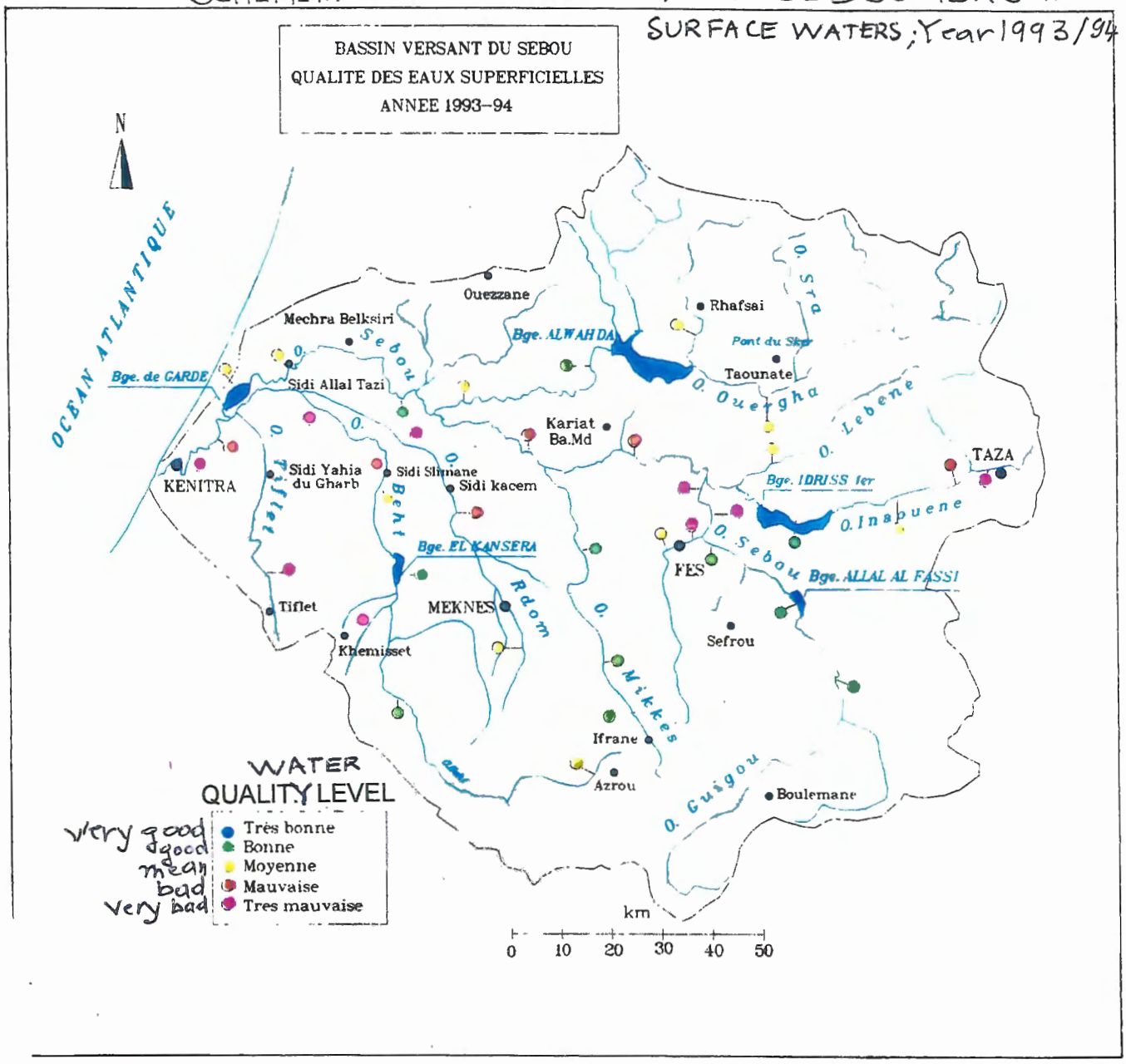
NAPPE DU GHARB
QUALITE DES EAUX SOUTERRAINES
ANNEE 1993–94



GRAPHIC N°18

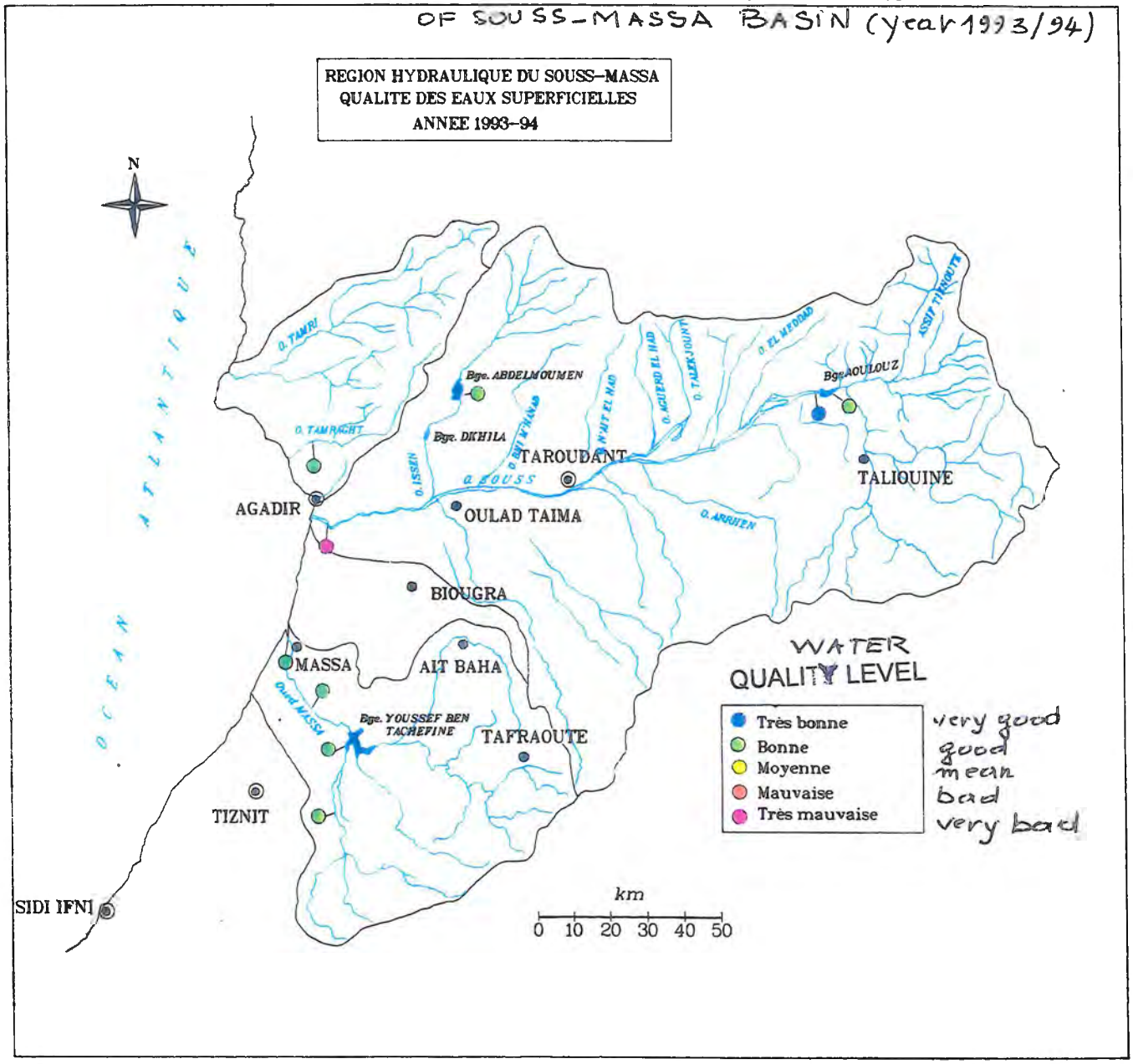
SCHEMEN: WATER QUALITY OF SEBOU BASIN

SURFACE WATERS; Year 1993/94



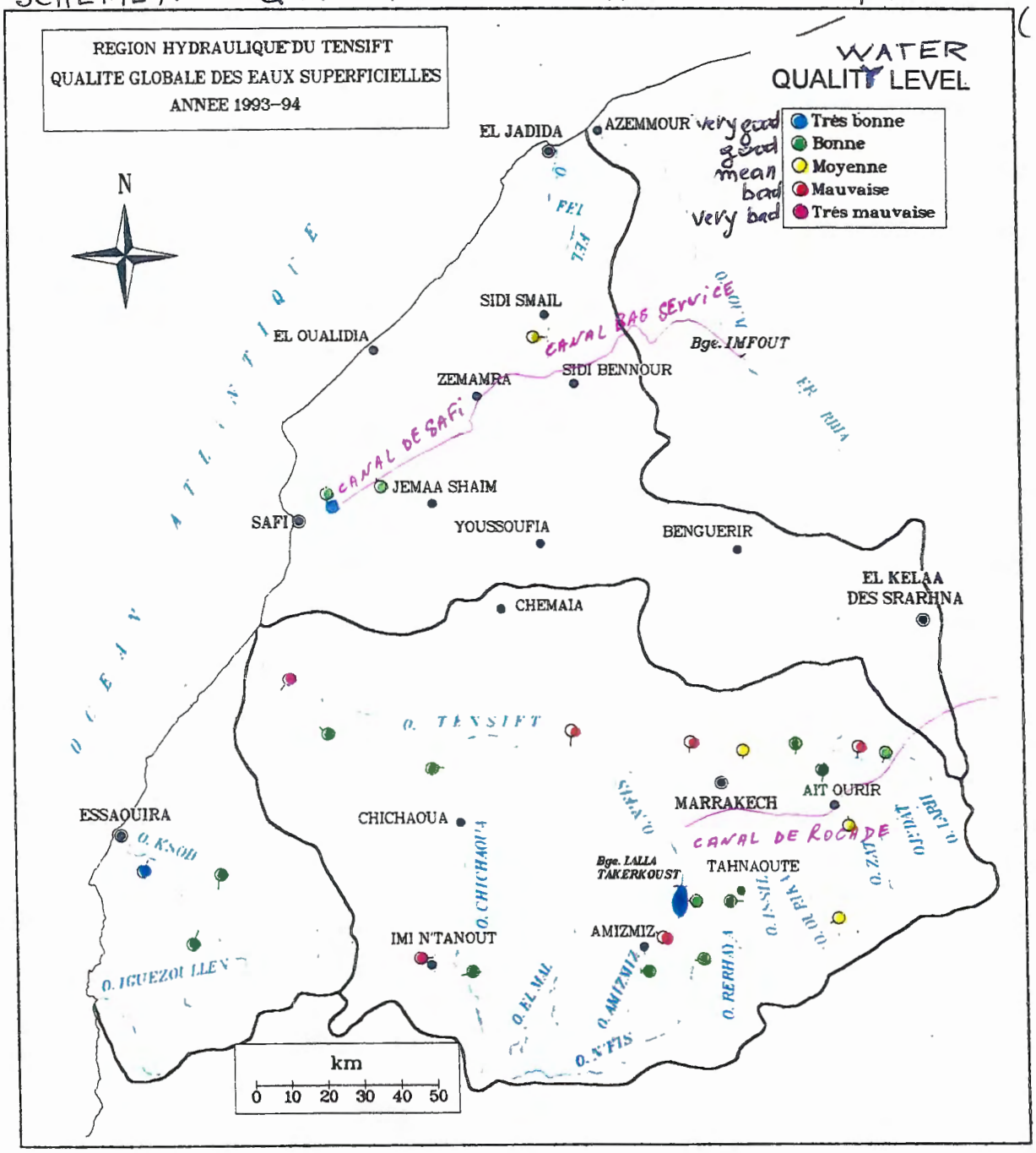
GRAPHIC N°20

SCHEME N° : QUALITE OF SURFACE WATERS OF SOUSS-MASSA BASIN (year 1993/94)



GRAPHIC N°21

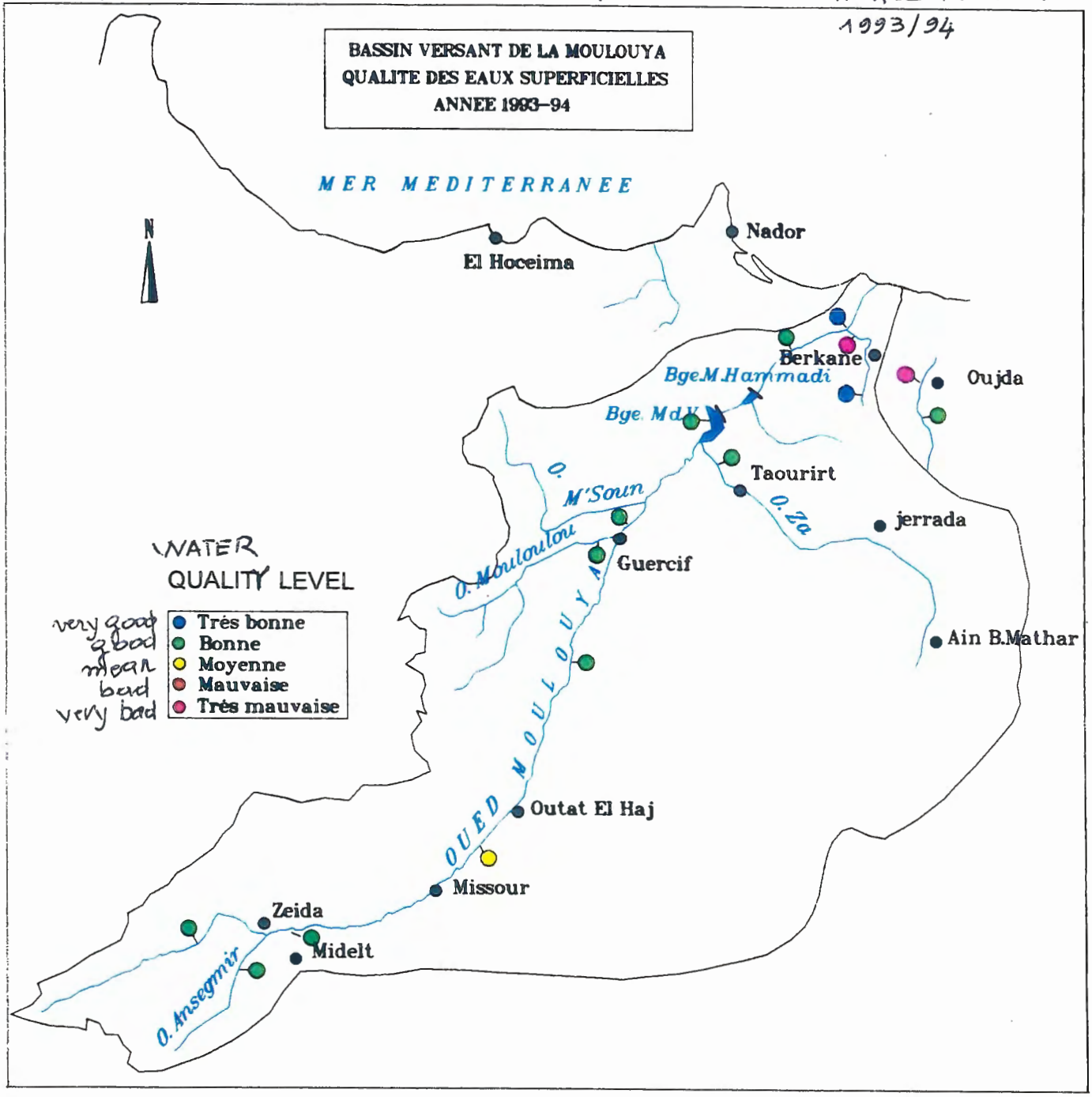
SCHEME N° QUALITE OF SURFACE WATER of TENSIFT BASIN (1993/94



GRAPHIC Nº 22

SCHEMEN: WATER QUALITY OF MOULOUYA BASSIN SURFACE WATERS

1993/94

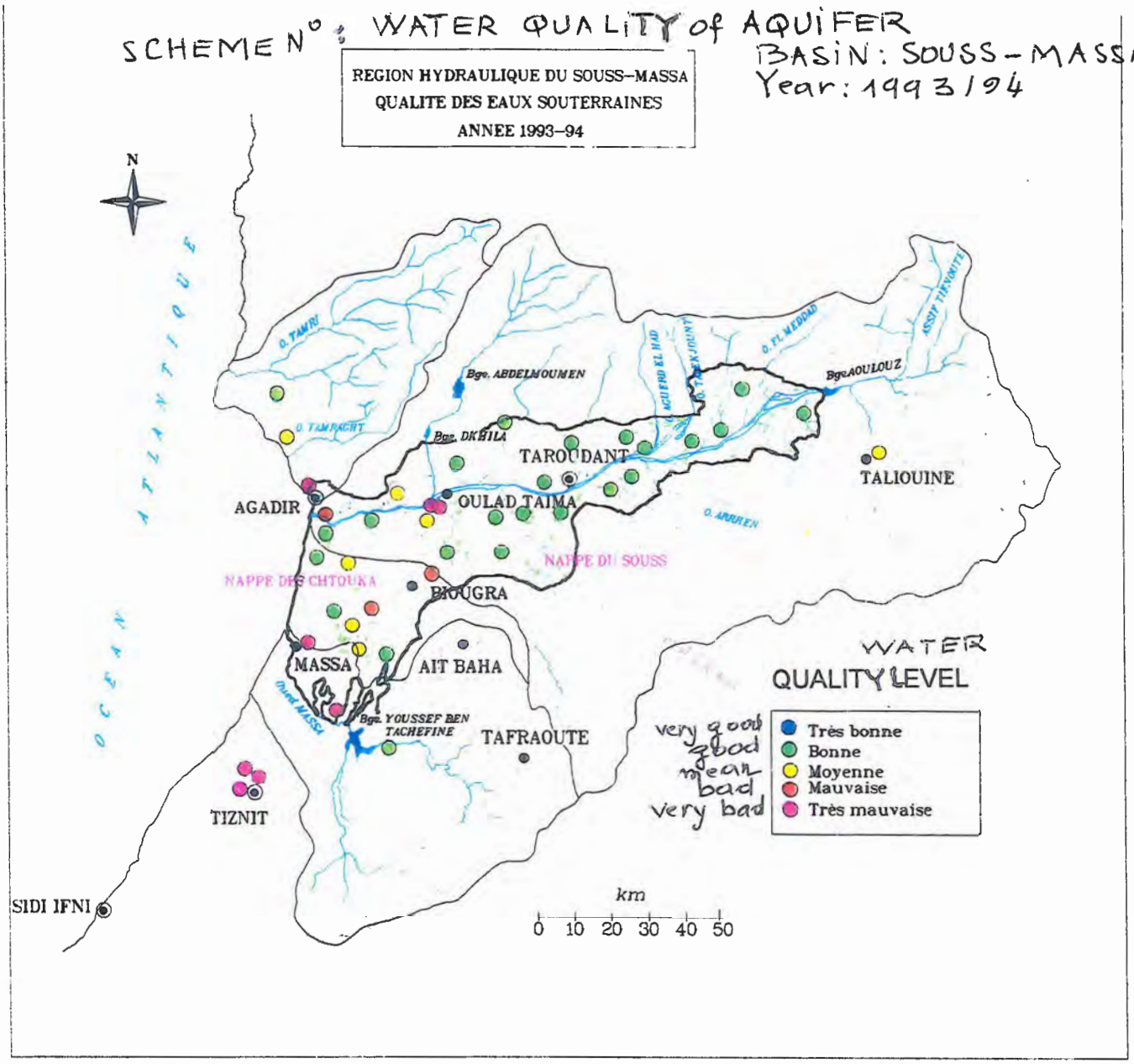


GRAPHIC N°23

SCHEME N°: WATER QUALITY of AQUIFER

BASIN: SOUSS-MASSA

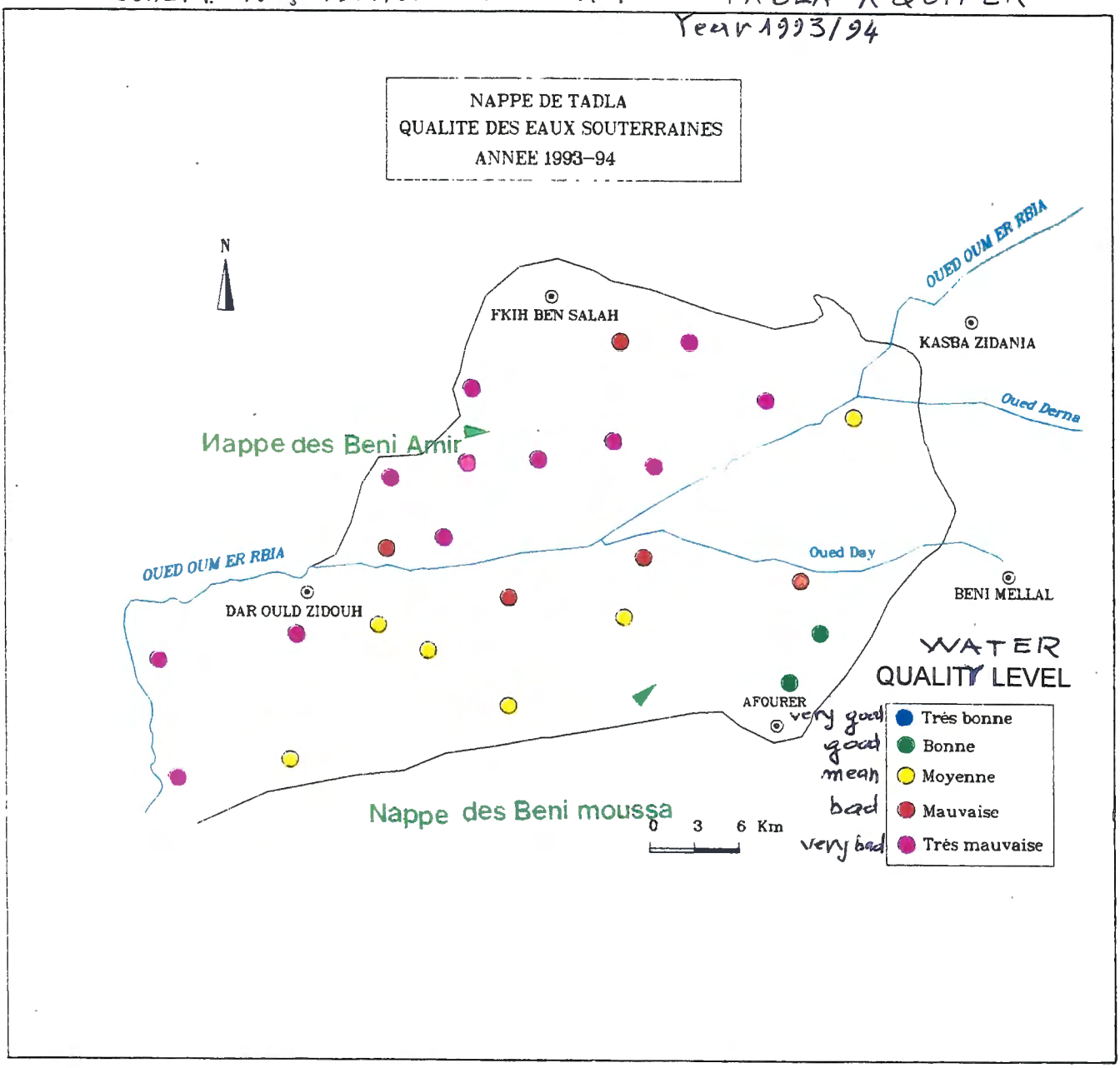
Year: 1993/94



GRAPHIC N°24

SCHEME N°: WATER QUALITY OF TADLA AQUIFER

Year 1993/94



LAGUNAGE ANAEROBIC

station (pilot) MARRAKECH

GRAPHIC N° 25

ANAEROBIC LAGUNAGE

LAGUNAGE ANAEROBIE

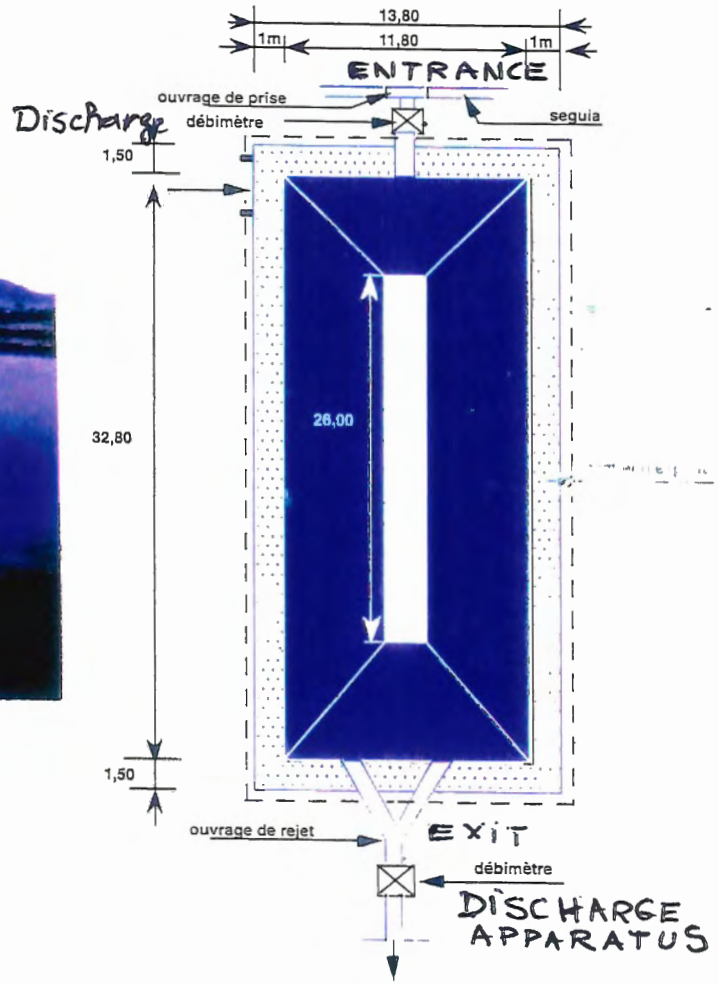


PHOTO N° 32 MARRAKECH LAGUNAGE

BASIN DIMENSION (CHARACTERISTICS)

SOURCE: GENERAL DIRECTION OF LOCAL COLLECTIVITIES (GDLC)

PHOTO N° HIGH-RATE ALGAL POND IN FAECAL COLIFORMS AND HELMINTH EGGS REMOVALS (R : ELHAMMOUR) SITE N°2 RABAT

TABLE N° 31

	BDO5	CDO	S.M				
	DBO5mg/l	DCO mg/l	MES mg/l	N.NH4mg/l	P.PO4 mg/l	CFnb/100ml	Oeufs nb/l
Entrance	417	695	220	39	12,56	2,4.10(8)	9a220
EXIT	50	163		11,9	6,07	5,3.10(3)	>1
%	88%	76,50%		69,40%	51,70%	99,99%	insuffisant

LEGEND : SM: suspend matters
CF: Coliforms

PHOTO N° 33

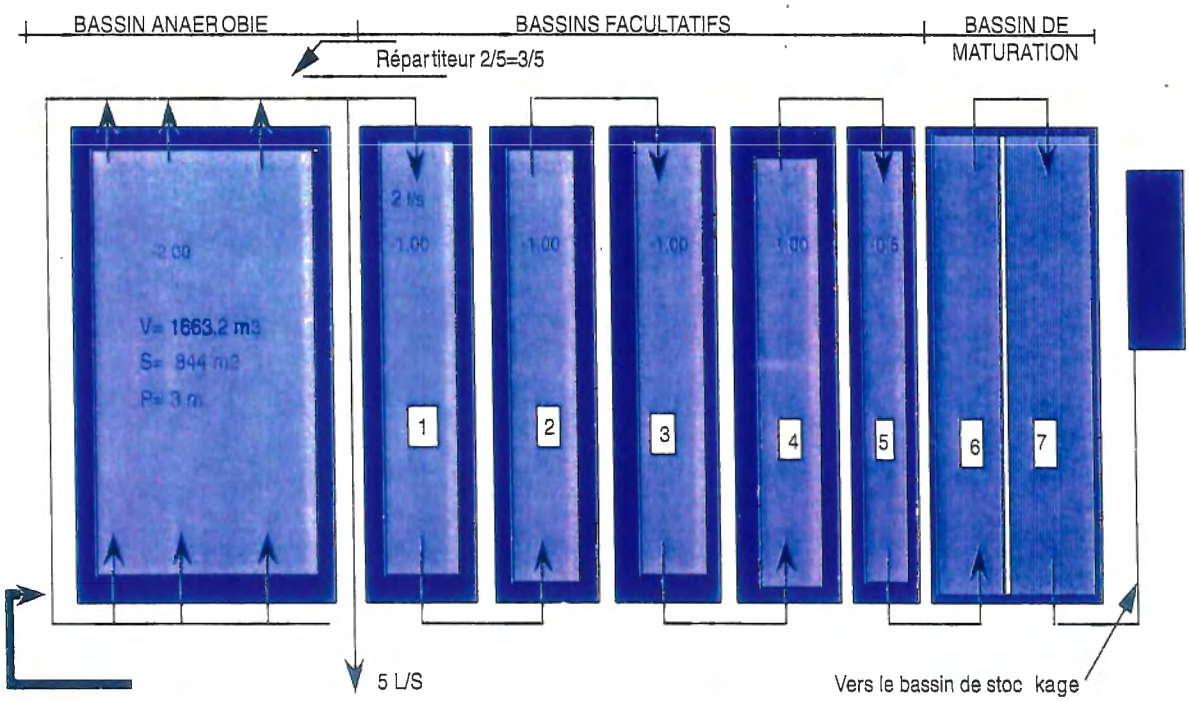
(Photo El Hammorri)

Références
El Hamouri, B., Khallayoune, K., Bouzoubaa, K., Rhallabi, N. et Chalabi, M. - 1992 - High-rate algal pond performances in faecal coliforms and Helminth eggs removals.

SOURCE: GENERAL DIRECTION OF LOCAL COLLECTIVITIES (G.D.L.C.)

SCHEME N° PLAN OF STABILIZATION BASINS IN OURZAZATE

GRAPHIC N°26



TRAITEMENT PRIMAIRE
DEGRILLAGE-DESHUILAGE-DESSABLAGE

1-2-3-4 : V=857,6 m3 S=614,4 m2 P= 2 m

5 : V=411,2 m3 S= 478,7 m2 P= 1,5 m

6 : V=281,2 m3 S=281,2 m2 P= 1 m

7 : V=308,9 m3 S=308,9 m2 P= 1,5 m

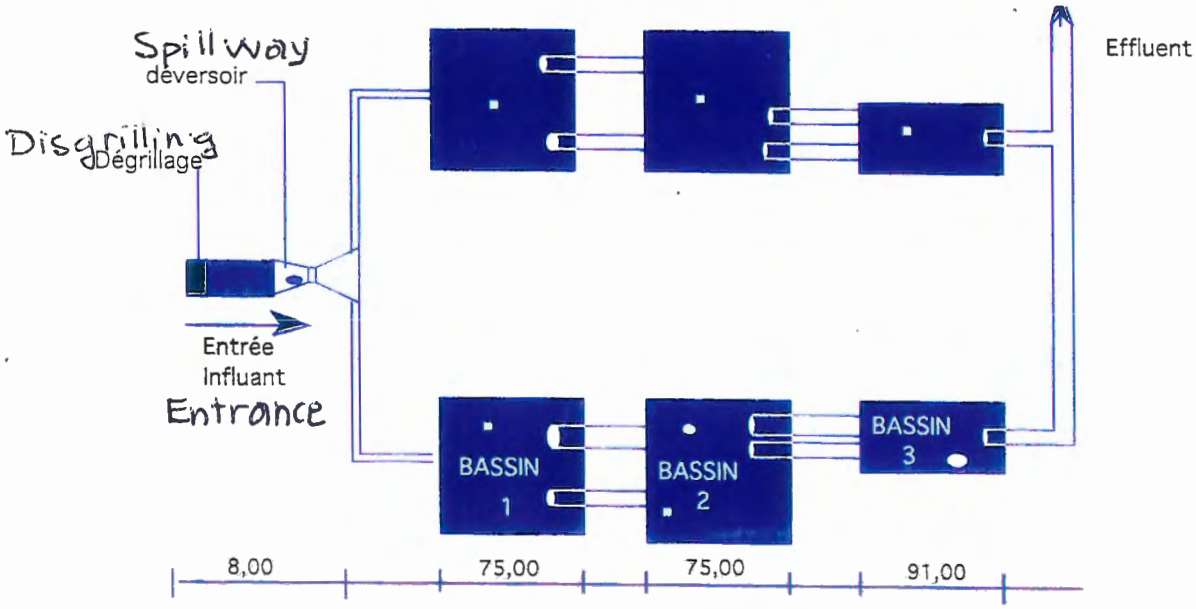
LEGEND:
V : capacity
S : surface

SOURCE GDLC

SCHEME N° SYNOPTIC SCHEME OF WASTE WATER SOFTENING STATION IN BOUZNIKA

DISGRILLING, ENTRANCE, BASIN 1, BASIN 2, BASIN 3, DEEP : 1.5 m, SAMPLING POINT o

GRAPHIC N°27



o Point de prélèvement ▪ Profondeur 1,5 m

o Sampling point Deep 1.5m

PHOTO N° 34

BOUZNIKA LAGUNAGE

SOURCE "Direction Générale des Collectivités locales" General Direction of local collectivities (GDLC)

CONTROLED FLOW IN 4 PLOTS FOR SPINKLING REED -BED

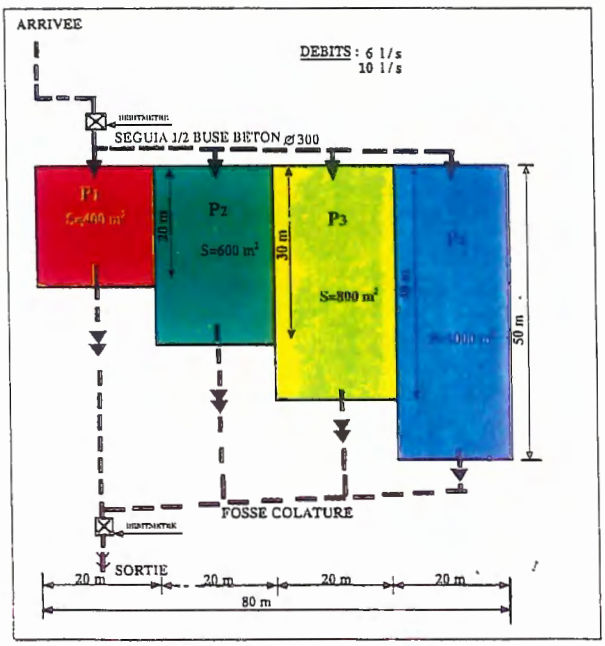
Reuse of water

PHOTO N° 35

TABLE N° 32

			BDO5	CDO	SM			CF	EGGS
			DBO5	DCO	MES	NTK	Pt	CFnb/100ml	Oeufs nb/l
		P1						2,5 10(5)	
Entrance	Entrée	P2						2,7.10(5)	4à34
		P3	240 Kg/j	423 Kg/j	210 Kg/j			3 . 10(5)	
		P4						3,1.10(5)	
		P1	18%	30%	50%			2,1.10(5)	0
Exit	Sortie	P2		44%	53%			1,5.10(5)	0
		P3	35%	54%	43%			1,8.10(5)	0
		P4	43%	53%	74%			1,7.10(5)	0

GRAPHIC N° 28



Scheme n°

CHARACTERISTICS of BASINS

(sanitary station)

SOURCE GDLC

Program

NON CONVENTIONAL WATER RESOURCES : WATER USE AND WATER CONSERVATION

Goals and objectives

Many studies are undertaked on expected relationships between water resources and needs (in different scenarios). They show that deficits are expected in long term. So the water reuse constitutes a solution to alleviate these deficits expecially for irrigation. In Morocco, the priority is allowed, because of the hydric deficit of many regions, to reuse for agriculture the urban waste water.

Implementor

General Direction of Local Collectivities (Ministry of Interior).

Research Direction of water Planification (Ministry of Public works).

Context (Urban / rural)

Target Audience (socio-demographics)

Actived mud station of Nador town.

Description of Activities

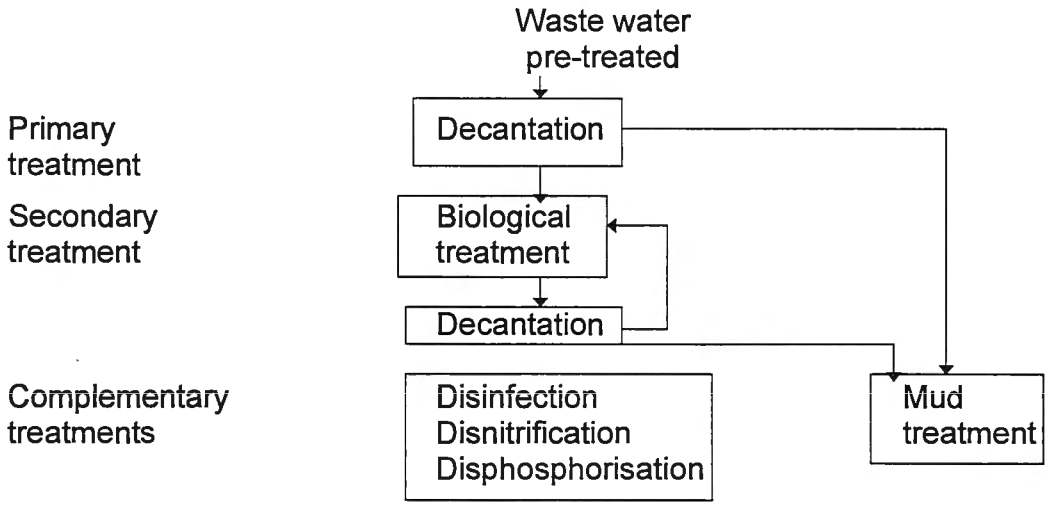
After 80 years of studies on reuse water, many models of water purification are adopted in the world. Some of them, named : traditional, intensive or compact stations need for a great electric energy consumption and for mechanical sophisticated mechanical equipments and needs for specialized persons in maintenance problems. Other cleaning stations named extensive are based on natural purifying process, without energy consumption but which needs for important areas.

The preliminary pre-treatments of waste water before any purification process for any type of station (compact or extensive : by lagunage or soil infiltration), are realized.

TABLE N° 33

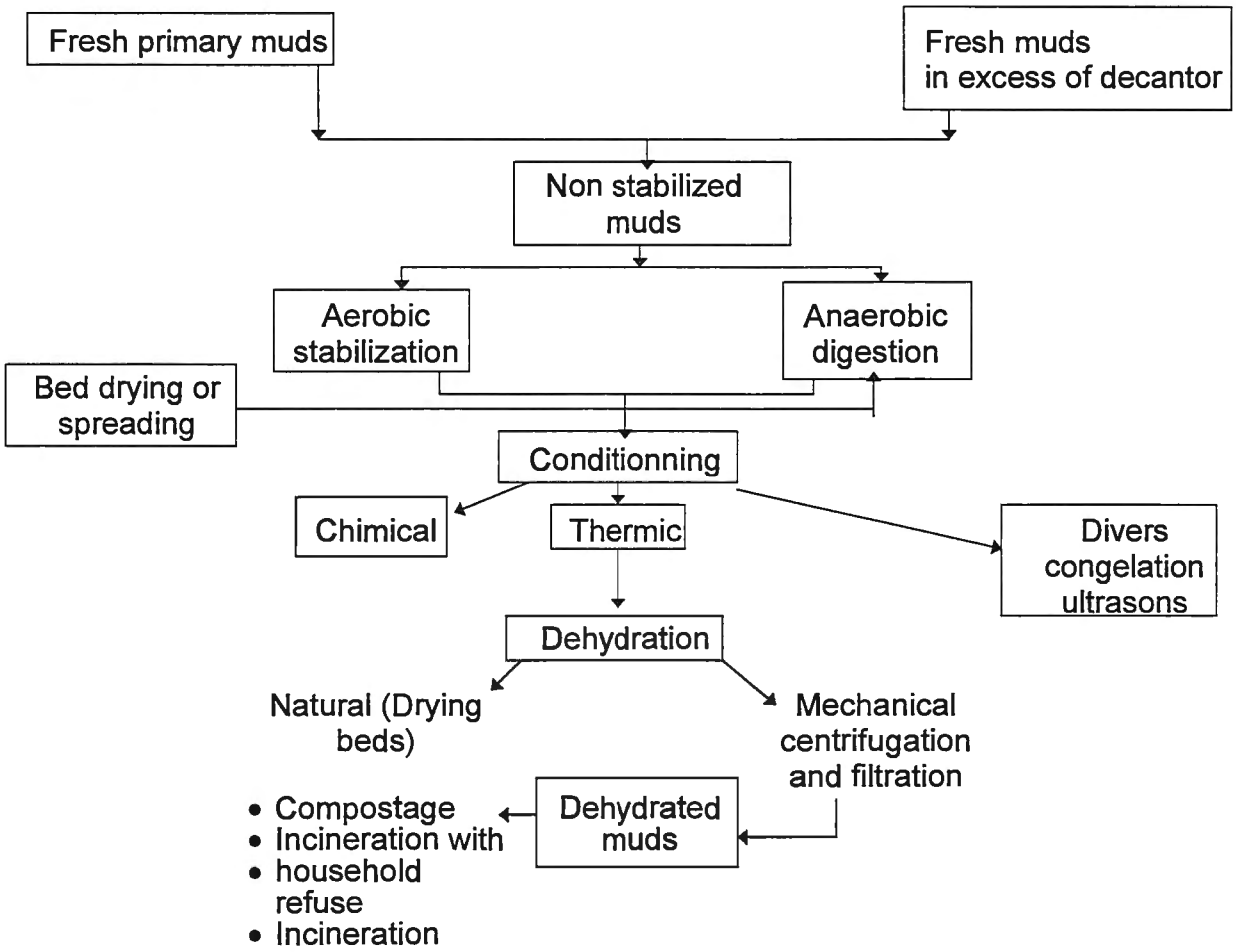
The classical process of waste water treatment (for domestic waste water) consists on :

Scheme N°



Mud treatment :

Scheme N°
Different steps of mud treatment



The volumic charge characterizes the functionning of mud actived station : it the DBO5 mass (in kg) eliminated, by day and by basin m^3

- a station with feable charge (or prolonged aeration) eliminates 0.7 to 1.2 Kg DBO_5 / m^3.

- a station with middle charge eliminates between 1.2 and 18 kg $DB0_5/m^3$.

- a station with high charge eliminates between 1.8 and 4 Kg $DB0_5/m^3$.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Experiences in reuse are realized in many moroccan regions :

- Marrakech
- Agadir
- Ouarzazate
- Boujaâd

Explanation of How Environmentally Friendly

The principal objective and environment impact of purification station is to assure an sufficient sanitary abatment for reuse of waster water in agriculture.

List of Contacts

- Engineers of Ministry of Public works
- Engineers in Local Collectivity Direction
- Engineers in the Ministry of Agriculture and Agrian Reform.

Photographs of Program

Program

HARD - WATER, SEA - WATER DESALINATION

Goals and objectives

A great quantity of hard water are sometimes given off. However there are not utilized because they do not respond to the usual quality standards. Dismineralization of this water allows to solve the problem of supplying some centres with drinking water. In some cases, the authorities turn to sea water desalination to satisfy the population needs for water.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

Gender Impact

Record of Success in Solving Problems

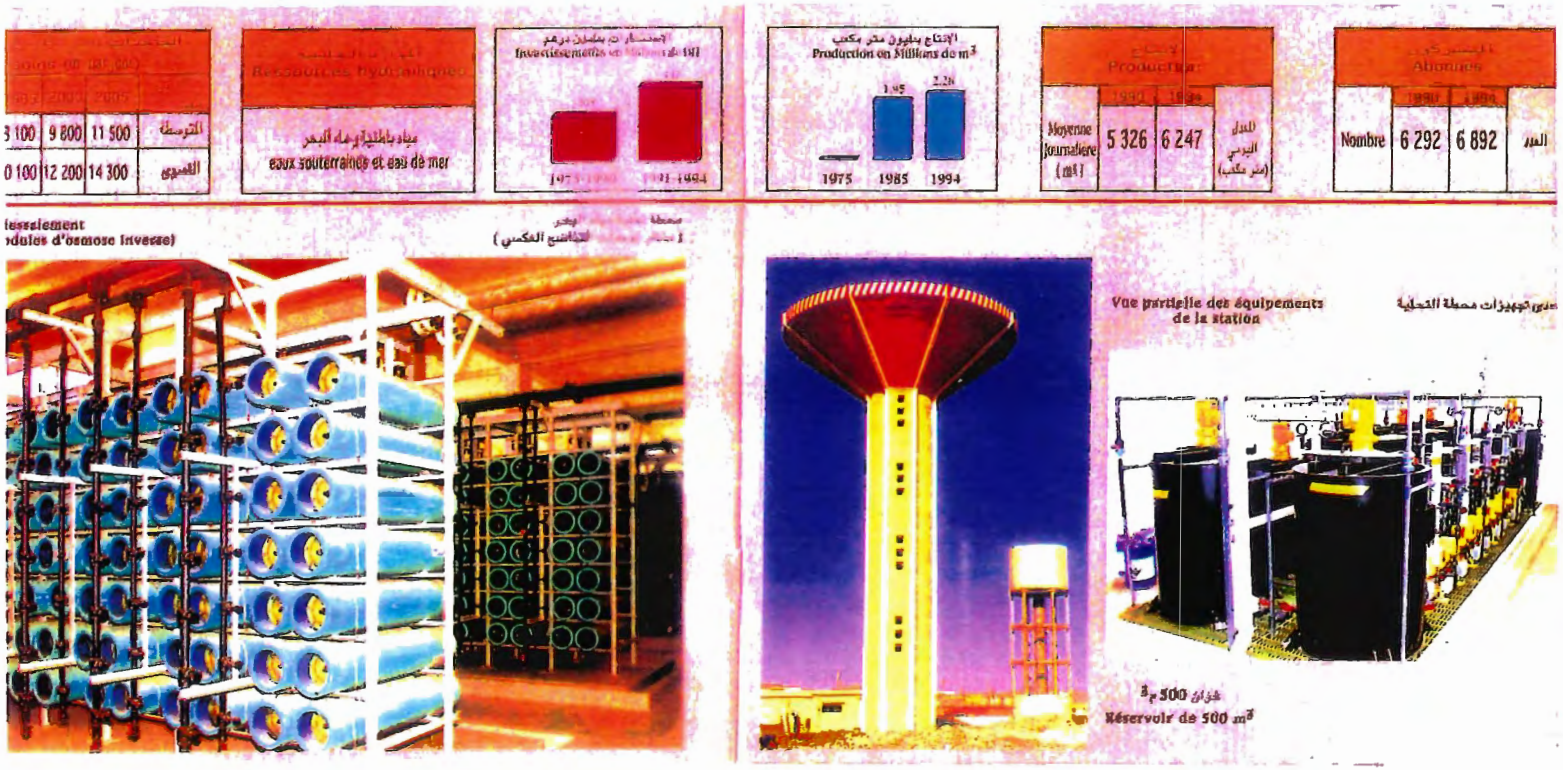
Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

PHOTO N° 36 LAYOUNE DESALINATION STATION



Program

WATER SUPPLY OF LAAYOUNE TOWN : DESALINATION OF SEA WATER AND GROUNDWATER ARE USED FOR THIS OBJECTIVE

Goals and objectives

To satisfy drinking water needs for Laayoune town, desalination was combined with fresh water are used.

Implementor

ONEP.

Context (Urban / rural)

Urban.

Target Audience (socio-demographics)

All the Boujdour population.

Description of Activities

ONEP had implemend a combined project : of desalination water (from Atlanci Ocean) with a dricharge 7000 m^3/day added with fresh water obtained from Foum El Oued aquifer with the discharge of 12,500 m^3/day. This operation will satisfy the drinking water needs to 2000 to satisfy the needs at year 2005, it is predicted to ad supplementary desalination module.

Gender Impact

Alike for women and men.

Record of Success in Solving Problems

The towns growth is one impact of this adduction.

Relevance to the Region

Economic development.

Explanation of How Environmentally Friendly

- Satisfactory needs
- Better sanitary conditions.

List of Contacts

- Exploitation Director / ONEP
- ONEP Engineers.

Photographs of Program

Program

DESALINATION OF BOUJDOUR TOWN

Goals and objectives

To cover and satisfy the water drinking needs to year 2000 of Boujdour the water desalination was used.

Implementor

ONEP.

Context (Urban / rural)

Urban.

Target Audience (socio-demographics)

Inhabitants of Boujdour town.

Description of Activities

Since 1977 one desalination unite was implemented in 1977, with a discharge of 250 m^3/day. For water supply generalization of all the Boujdour population by individual connection, ONEP realizes a second disalination unity from oceanic sea with a discharge of 800 m^3/day, one reservoir of 500 m^3 capacity and extension of 16 kms of distribution network.

Gender Impact

Alike for women and men.

Record of Success in Solving Problems

The town development.

Relevance to the Region

To cover the consumption water needs to year 2000.

Explanation of How Environmentally Friendly

- Better sanitary conditions
- Satistory needs.

List of Contacts

- Director of Exploitation (ONEP)
- ONEP Engineers.

Photographs of Program

Program

SAVING DRINKING WATER IN MOROCCO

Goals and objectives

Needs for drinking water are important and urgent to satisfy and are considered as a priority comparatively to agricultural water allocations. The fact that the rate of drinking needs is smaller than agricultural one, does not justy a less rigourous interventions, in many levels, in seeking to save water.

A recent study shows that a 15 % profit in yield from a distribution networl of a town of about 500000 inhabitants, represent in year 2000 an enormous feeding which permits to allow water for a large irrigation perimeter in Morocco.

Origin and causes of squandering :

- Concerning particular consumers

  - The usual way of thinking the fact that water is primarly considered as a natural propriety (freethis mentality) does not help to fight against squandering.
  - Relative to conception of installments and particularly :
    - bad conception of internal installments
    - their lapidation
    - bad maintenance
  - Relative to household appliance
  - Excessive pressure on the network.

This problem conducts to the apparition of leaks, equipment deteriorations and results on over consumption.

- Concerning industry operators

- Concerning collective installments.

Implementor

ONEP

Context (Urban / rural)

Urban and rural.

Target Audience (socio-demographics)

The saving drinking water present a great target audience in the consumption reduction of drinking water by the various uses (in internal and domestic installations, at the distributor's and industrialist's levels, ...).

Description of Activities

* Prompt collective awareness

- information campaigns on water saving

- campaigns to sensitive people to the need of repairing internal leakage.

* Improvement of internal installations

- Create means to have existing norms and rules.

- Improve plumbing rules to fight water squandering in internal installations.

- Standardize sinks and lavatory flushes mechanisms.

- To undertake study on the making and functionning of household fittings concerning water consumption.

* Actions at the distributor's level :

- Limit service pressures at the subscriber's place, either through action at the network level or by including pressure - reducers when connecting.

- Examine the interest of creating at the distribution level (ONEP agencies), sanitary plumbing services that will, when required by the customer, interfere in internal installations after counter.

* Actions at the prices level

Several studies were conduced by ONEP on the dissucisive role of princing to fight water wasting.

* Actions at the industrialist's levels.

- Carry on research to modify industrial means to reduce water consumption.

- Pomote generalisation of equipment recycling in industry facilities with high water consumption.

* Actions at the administration and town concil's level.

Water consumption in public administrations and services stand for about 34 % of urban consumption.

Gender Impact

The program has the same impact for male and female population.

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

WATER CONSERVATION STRATEGIES

Since 1980, the beginning of critical drought in Morocco, Public Authorities decide to undertake a battery of measures and implementations aiming to promate water conservation. Because of the sharp rise in demand : 8 % per year and the climatic fluctuations, the consumer behaviour is effectively influenced by this reccurential phenomena. These measures touched upon a number of demand components.

Concerning the institutionnel level, the anterior free water supply to the administrative housing premises have been canacelled. Watchdog Committes involving all parties concerned are setting up, as the intervening parties, the local collectivities or the local authorities : a combat of water wastage at the level of the industrial consumers, is developed concerning the technical level, the output of the production and distribution units will result in securing a gain of many years in the mobilization. A nation wide large scale rehabilitation program is undertaken with the assistance of the UNPD, the WHO and the IBRD, as well as other organizations namely the cooperation with Germany through the KFW (Kreditanstalt für Wiederaufbau). This program is also completed with a training scheme.

Moreover, these various actions were coupled with an information media campaign aiming at sensitizing the consumers to the fact that water has a streadily increasing price that should be shared by all concerned. The subscribers connections to the network increases from 62 % in 1991 to 75 % in 1989 to in 1997.

It seems that this package of measures allows for the control of water conservation behaviour, and insures access to water facilities to a large section of the population.

Program

THE WATER QUALITY CONTROL LABORATORY (ONEP)

Goals and objectives

Well aware of the responsibity for the monitoring of the drinking water quality task, the National Office of Potable Water (ONEP) realized the need (since its creation in 1972) for the development of its Laboratory infrastructure which controls the pollution hazards looming over the resources.

Implementor

ONEP.

Context (Urban / rural)

Urban.

Target Audience (socio-demographics)

Description of Activities

- 27 laboratories disseminated across the country (in addition of the Office's central laboratory) : the results of the analysis conducted by these laboratories an transmitted to the Office's Central Laboratory for analysies, interpretation and follow up the quality of water.

- In 1989, 1600 sampling points were checked among which were 25 treatment and desalination stations, accounting for 540000 tasks units grouped in 10 types of different analyses bulletin.

The following is a list of some other aspects of the some scope of importance.

- Tests and analyses in the course of project design in order to select the best catchment, to protect it against pollution hazards and to conceive of the most appropriate treatment steps.

- The role of a technical council capable of pointing out to any operating organization all the improvements to be made in terms of water quality control or drinking water production unit monitoring.

- Pollution control of the water assets liable to be tapped for human consumption.

- Urban waste water characterization campaign which are required for the sanitation studies schemes for a number of towns.

- Urban and industrial waste water purification studies.

- Applied research in the fields of the Office's laboratory activities.

- Participation in legislative regulatory efforts pertaining to water and the environment in general.

Moreover, and in view of its very conception, the Central Laboratory keeps constant contacts with the issues of water, and partakes in the scientific events and conferences be they national or international.

These contents have led to the developement of cooperation programmes focusing on applied research activities which are given primary importance.

The cases studies or in the course of being studied concern among other issues nitrate-generated underground water pollution, dam reservoir eutrophication aspects, biological toxicity tests, water demineralization and the protection of the water production infrastructures.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

Explanation of How Environmentally Friendly

List of Contacts

Photographs of Program

Program

GROUNDWATER POLLUTION BY NITRATES : CASE STUDY OF TADLA AQUIFER

Goals and objectives

Groundwater resources in the plain of tadla are ever threatned by nitrates pollution. A current study undertaken in the aquifer shows a contineous degradation and groundwater quality deterioration. Because fo groundwater is the only drinking water resource for rural local population, this problem is being of great concern. The nitrates concentration observed in some observation wells indicate an annual increases annualy with a rate of 5 mg/l of nitrates. This rapid increase is confirmed calculated by the nitrates balance in the Tadla plain. The objective of this Program is to present the approach adopted of an implementationof an appropriate strategy for the control of groundwater pollution by nitrates.

Implementor

Hydraulic Administration : Direction of water Research and planification.

Context (Urban / rural)

Rural.

Target Audience (socio-demographics)

Rural population of Tadla plain.

Description of Activities

The high degree of groundwater pollution by nitrates is genereted by intensive use of azoted fertilizes (farmers) and also by domestic waste water and also by industrial effluents (agro-alimentary effluents) which present a great rate of organic components.

Domestic pollution

The domestic waste water are injected directly in Oum Er Rbia River without any treatment.

TABLE N° 34

Urban centers	Inhabitants in 1985	Inhabitant connected to assainissement network	Water consumption 10^3m^3/year	Effluent quantity ejected 10^3m^3/year	Pollution					
					DBO t/year	DCO t/year	MES t/year	M.DT t/year	N t/year	P t/year
Beni-Mellal	110.000	70	3323	2658	1516	3388	1540	2810	254	31
Afourar	5.500	60	171	137	65	145	66	120	11	1
Dar O. Zidouh	5.800	60	187	150	69	153	70	127	12	1
Fkih Ben Salah	55.000	75	1008	806	813	1815	825	1506	137	17
Souk Sebt	2.900	52	900	720	297	664	302	550	50	6

Gender Impact

Alike.

Record of Success in Solving Problems

Relevance to the Region

Industrial pollution

The pollutant charges of the three sugar-refineries SUBM, SUNAT and SUTA are estimated as 1075000 equivalent-inhabitants.

TABLE N° 35

Sugar-refinery	Mean Pollution flux		Equivalent inhabitant number
	DBO5 (kg/T)	DCO (Kg/T)	
SUBM	3,21	3,35	242000
SUNAT	2,54	3,44	268000
SUTA	9,74	17,20	565000

Agricultural pollution

The intensive use of fertilizer and of phytosanitary products is the principal reason of groundwater nitrates pollution in Tadla : 4000 tons of azoted fertilizers are injected each year in the aquifer. In some place, the

nitrate rate is up than 50 mg/l constituting the national norm or standard of water potability.

The nitrates spatial distribution indicates that the highest concentration rates of nitrates are located in the zones where aquifer table level is no deeps.

It is recommended to develop a global model of nitrates transport through all the aquifer in the objective to adopt a strategy for fertilizer use : an vulnarability card of the aquifer to the nitrate pollution is to dress, in function of agricultural crops, of pedological and hydrological characteristics.

Explanation of How Environmentally Friendly

Important : It is necessary to fiv the rate of fertilizer and to apply a legal procedure and law to fight nitrates groundwater pollution, to assess the following actions are developed :

- Physio-chimical measurements (since 1955) in 62 water points. This network is choiced in the objective to represent the water quality control in all the aquifer. In 1990 a large campaign is undertakes with 87 water points analysis in Beni Amir and 53 in Beni Moussa.

- The spatial distribution of nitrates rates operated.

List of Contacts

- Hydraulic Administrations : Ex. Service Chief of control and water pollution.

Photographs of Program

Program

IMPACT OF EROSION AND SILTING-UP OF LARGE DAMS, ON WATER CONSERVATION

Goals and objectives

The increasing pace of water resource exploitation with the aim of developing water resources all over MOROCCO brings with it a greater and greater need for a through knowledge (both in theory and in practice) of the widespread erosion of drainage basins, of the resulting transport of sediment, and of the silting-up of reservoirs. In MOROCCO the high degree of climatic variability, the torrential nature of storm runoff, the low vegetation cover, and the excessive soil exploitation, have a great impact on erosion, sediment yield, and fluvial transport, on dam sedimentation and consequently, on socio-economic conditions. An analysis of sedimentation of 17 large dams in MOROCCO and of turbidity measurement at gauging stations, has been used to investigate relationship between sediment yield, basin area, dominant lithology and mean annual runoff ; and to establish a series of formulae for predicting the sedimentation rate of dams before construction for various lithologies. In order to assist in the establishment of appropriate policies for reducing the negative impacts of erosion and sedimentation through implementation of anti-erosive measures. Existing methods are assessed and strategies to be adopted in the short, medium and long terms, are reviewed in terms of both technology and legal planning aspects. This analysis provides a contribution to the underestanding and quantification of the complex factors associated with the erosion of drainage basins, the transport of sediments, reservoir siltation, and the environmental impact of these aspects. In MOROCCO, the need to develop improved models of sediment transport as well as of reservoir sedimentation is highlighted. The social, economic and environmental impacts of reservoir siltation in the short-medium- and long-term, as well as the effects of sediments (particularly in drinking water reservoirs), on eutrophication, the stability of banks, and the risk of flooding caused by the rise in water level in rivers upstream from important large dams, are also considered. The need to start, to undertake multi-criteria and systematic economic impact studies, using a maximum number of

parameters related to erosion, sediment transport and reservoir sedimentation, in order to demonstrate external losses due to such factors in corresponding analytical matrix inputs, is emphasized.

In Morocco a vast dam building program was launched in 1975 aimed at irrigating one million hectares before the year 2000. There are currently 85 large dams (meeting the International Commission of Large Dams ICOLD). Their total capacity exceeds 13,4 x 10^9 m^3 and they supply 772.000 ha of irrigated land. A current objective is also to reduce the country dependence on external sources of energy. Other objectives include the management of surface water resources for domestic and industrial uses. Demand is increasing at a rate of 8 % per year and the dams currently supply 64 % of the demand.

The increased development of water resources in MOROCCO increasingly demands an improved knowledge and undestanding of the sediment generation, transport and deposition which seriously threatens the life of many reservoirs. Annual sedimentation rates can reach as much as 50 x 10^6 m^3 $year^{-1}$ in MOROCCO. The total annual loss of storage due to reservoir siltation is 0.5 % per year for MOROCCO and the total sedimentation of all dams since their construction is 0,8.10^9 m^3. Sediment yields in MOROCCO are as high as 5900 t km^{-2} $year^{-1}$ (Mohamed Ben Abdelkrim Al Khattabi large dam).

Implementor

Ministry of Agriculture : Administration of Water and Forests

Ministry of Public Works : Hydraulic Administration.

Context (Urban / rural)

Both Urban and Rural.

Target Audience (socio-demographics)

All the populations, industries and agriculture perimeters located of downstream, the dams, profit from anti-erosive and desiltation operations.

Description of Activities

Studies of erosion, sediment transport and reservoir sedimentation in MOROCCO have progressed substantially during the last 20 years

because of the interest of decision makers, the improved undestanding, and the development of various new techniques, and, finally, because of the cooperation with international organizations.

Many methods have been used to establish sedimentation rates. These include :

- Determination of the sediment yield from the upstream watershed.
- Measurments of fluvial sediment transport at gauging stations, including both bed load and supended sediment.
- Bathymetric surveys (range-lines).
- Aerial surveys, especially after the drawdown of the water level (due particularly to the current drought period). This is the method used at present. It is possible to determine reservoir sedimentation with an error of 0.10 m (in the level).
- Radiosotopy methods.
- Mathematical models for predicting reservoir siltation.

The results are presented in tables. The specific sediment yields estimated for a number of rivers and basins in MOROCCO, and based on reservoir sedimentation surveys, are presented.

REMEDIAL MEASURES TO CONTROL EROSION AND RESERVOIR SEDIMENTATION

The following methods have been employed to control erosion and reservoir sedimentation.

(a) Preventive methods

- Watershed management ;
- Maintenance of river banks ;
- Reservoir management :
  - Sediment transport diversion
  - Emptying and water supply management
- Legislative and regulation control.

(b) Curative methods

- Evacuation of sediment by appropriate management :
  - flushing at lower reservoir level,
  - flushing without bringing down the reservoir level
- Allocation of a "dead zone" for sediment storage
- Dredging of sediment
- Raising of dams and establishment of new sites.

The following consequences of reservoir sedimentation have been identified :

- Capacity loss and reduction of regulate volumes
- Economic implications of capacity loss
  - reduction of drinkable, irrigation and industrial water
  - reduced employment
- Height of the reservoir
- Security of dam
- Flood flow lamination
- Annex management (valves, gallery-visit, spill-way)
- Europhication

TABLE N° 36

SILTING - UP OF MOROCCAN LARGE DAMS

N°	Dams	Watershed (km²)	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 ($10^6 m^3 year^{-1}$), the watershed areas S (Km²) and the ratio [reservoir capacity C / [inflow (A)] is as follows : $E = 10^{-2.228}.S^{0.699}.(C/A)^{-0.259}$. 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 alreay full of sediments.

TABLE N° 37

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 1995	In 2030	In 2000	In 2030	In 2000	In 2030	In 1995	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 10^6 KWh in MOROCCO.

TABLE N° 38

RATIO : TOTAL SEDIMENTATION / INITIAL CAPACITY, FOR SOME DAMS IN MOROCCO

N°	DAM (NAME)	RATIO SEDIMENTATION / INITIAL CAPACITY (%)
1	Mohamed Ben Abdelkrim El Khattabi	16 %
2	Ibn Batouta	12,8 %
3	Nakhla	47 %
4	Oued El Makhazine	4 %
5	Moulay Youssef	11 %
6	Lalla Takerkoust	23 %
7	Idriss 1er	2,3 %
8	Bin El Ouidane	7 %
9	Hassan Eddakhil	6 %
10	Mansour Ed Dahbi	11 %
11	Al Massira	3 %
12	El Kansera	20 %
13	Mohamed V	35 %
14	Youssef Ben Tachfine	5 %
15	Sidi Mohamed Ben Abdallah	4,5 %
16	Abdelmoumen	0,6 %

The "dead zone" is full by sediments for the dams n°1, 2, 9, 10, 12 and 13.

RECOMMENDATIONS CONCLUSIONS AND QUESTIONNAIRES

(a) There is an important need for soil conservation in MOROCCO due to the high erosion rates.

(b) Training of specialists in anti-erosion management and also in river sediment transport is required.

(c) Erosion and anti-erosion management courses should be included at different levels of primary, secondary and higher education and both fundamental and applied research on erosion should be developed to reduce erosion.

(d) There is a need to integrate anti-erosion measures before dam construction.

(e) In response to the high rate of population growth and the associated pressure on vegetation cover, erosion is increasing exponentially in MOROCCO. It is necessary to reduce this trend using both biological methods (e.g. reforestation) and mechanical methods (eg. construction of debris dams).

(f) There are socio-economic constraint to combating erosion, particularly in basins with high population densities.

(g) Basins subject to anti-erosion management will have different degrees of fertility and will be subject to different laws. Any management strategy will need to take into consideration the best approach to apply, the financial source, and other constraints.

(h) The objective of anti-erosion management is to increase the soil productivity and to protect the existing infrastructures.

(i) The participation of the local population in anti-erosive management in an important requirement and an equilibrium should be established between the upstream and downstream areas of a drainage basin. It is recommended that the population should be made aware of negative consequences of erosion problems.

(j) Because of the relationship between erosion and other erosion parameters, it is necessary to develop multicriteria economic analysis

for assessing the economic impacts of erosion problems (and sedimentation) on environmental and social conditions. The sound environmental management of sediment projects should be orientated towards the establishment of a long-term dynamic equilibrium between sediment projects and their environment. It is necessary not only to assess but also to manage the environmental impacts of sediment projects on both a short and a long-term basis.

(k) After the establishment of anti-erosive management programs, cost-benefit studies aimed at assessing the real efficiency of the programme and developing the best methods and conservation systems for future program should be undertaken.

(l) There is a need to increase the frequency of bathymetric measurements, especially after large floods (bathymetric surveys at 2-year intervals) to provide more exact information on the magnitude of annual sedimentation.

(m) A special investigation for theoretical and pratical aspects of suspended sediment and bed load measurement should be established. Such measurements are required, particularly in flood periods, to establish exactly the sediment loads of MOROCCO rivers.

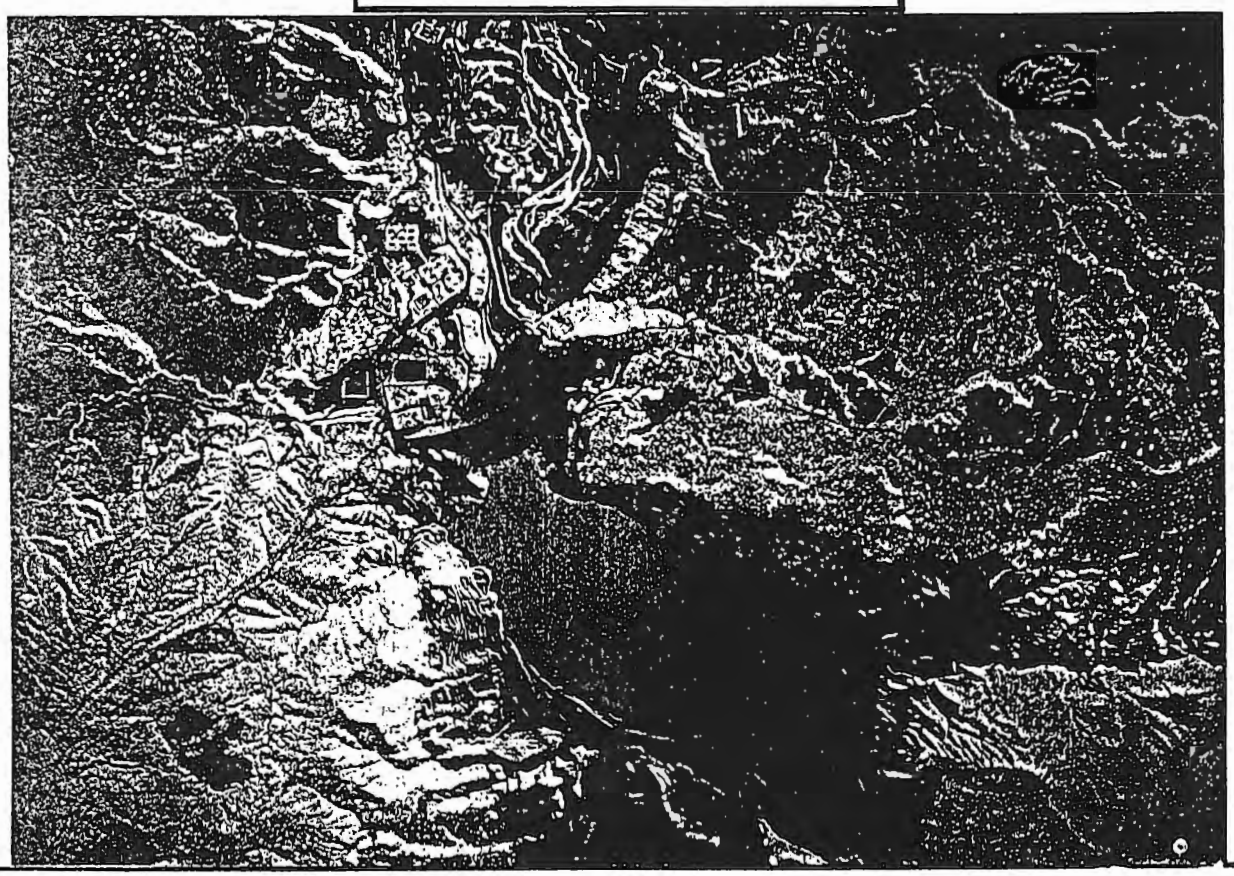
(n) There is a need to implement sedimentation models to forecast reservoir silting.

(o) The complex phenomena of erosion, fluvial sediment transport and reservoir sedimentation in MOROCCO produces a need for both empirical datas and for models describing relationship between upstream and downstream conditions in rivers.

PHOTO N° 36 BANK SLIDES of SEDIMENTS AROUND IDRISS 1st LARGE DAM

GRAPHIC N°29

AERIAL PHOTOS

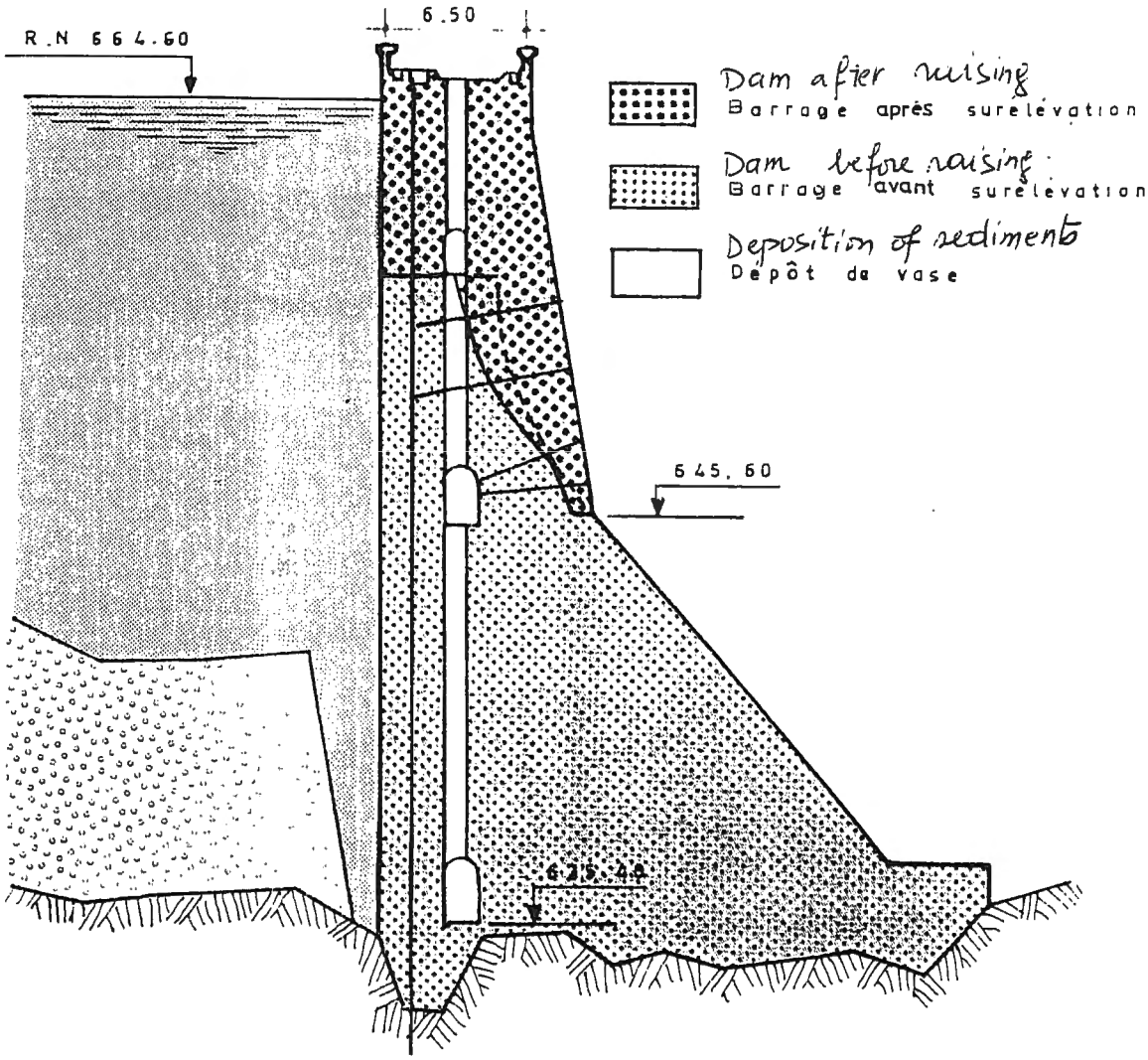


AERIAL SURVEYS AFTER THE DRAW-DOWN OF THE WATER LEVEL IN LALLA TAKERKOUSTE, MOULAY YOUSSEF LARGE DAMS

ADDITIONAL SURVEY IS REQUIRED AFTER THE PASSAGE OF A MAJOR FLOOD

SCHEME N° RAISING OF LALLA TAKERKOUST LARGE DAM

GRAPHIC N° 30



× Height of raising
Hauteur de surélévation : 9 m

× Water capacity raising
Augmentation de capacité : 44 millions de m^3

× Operation cost
Coût de la surélévation : 130 millions de DH (1987) (3 DH/m^3)

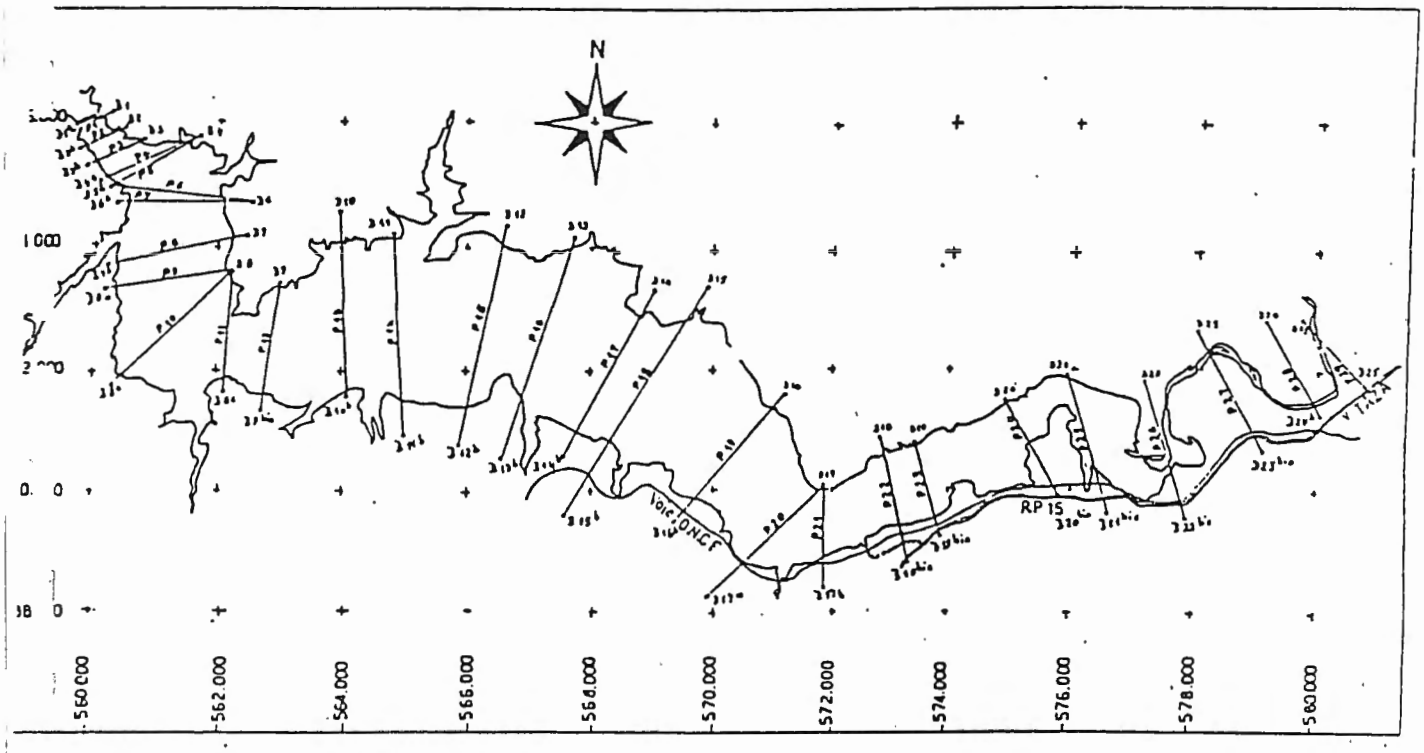
1 DH ≃ 0.1 $ American

HEIGHT OF RAISING ADDED VOLUME OF WATER CAPACITY RAISING
OPERATION COST : 130 MILLION DIRHAMS ≈ 13 MILLION AMERICAN DOLLARS

GRAPHIC N°31

BATHYMETRIC SURVEY

IDRISS 1er DAM



GRAPHIC N° 32

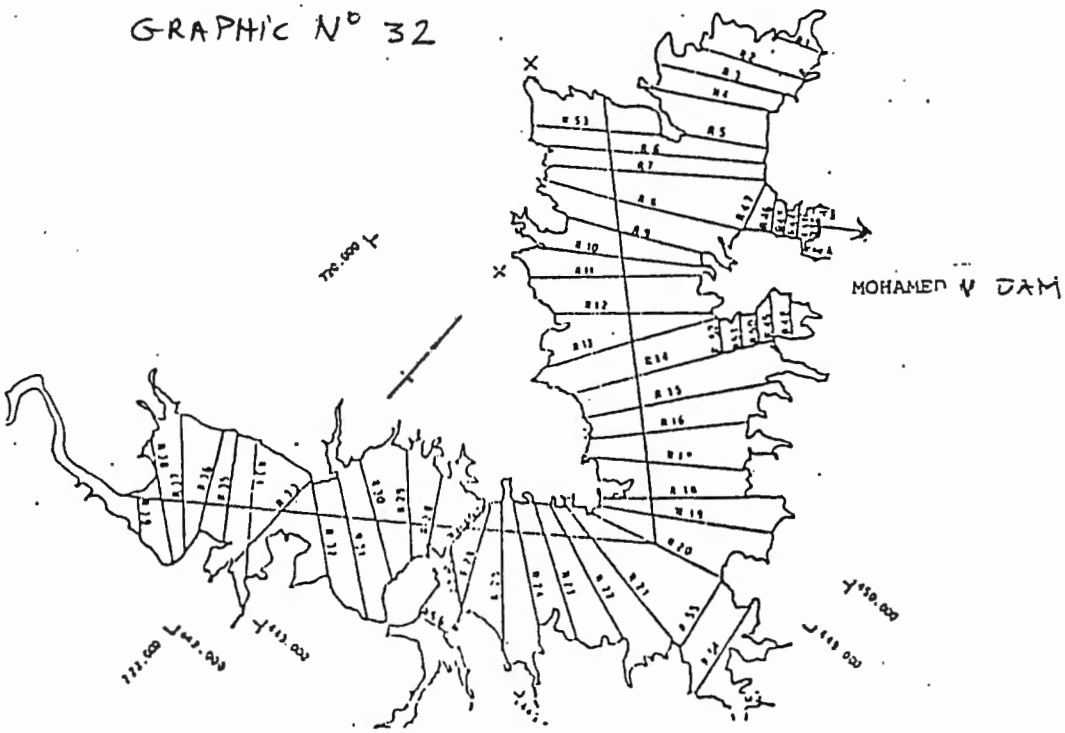


PHOTO N° 36

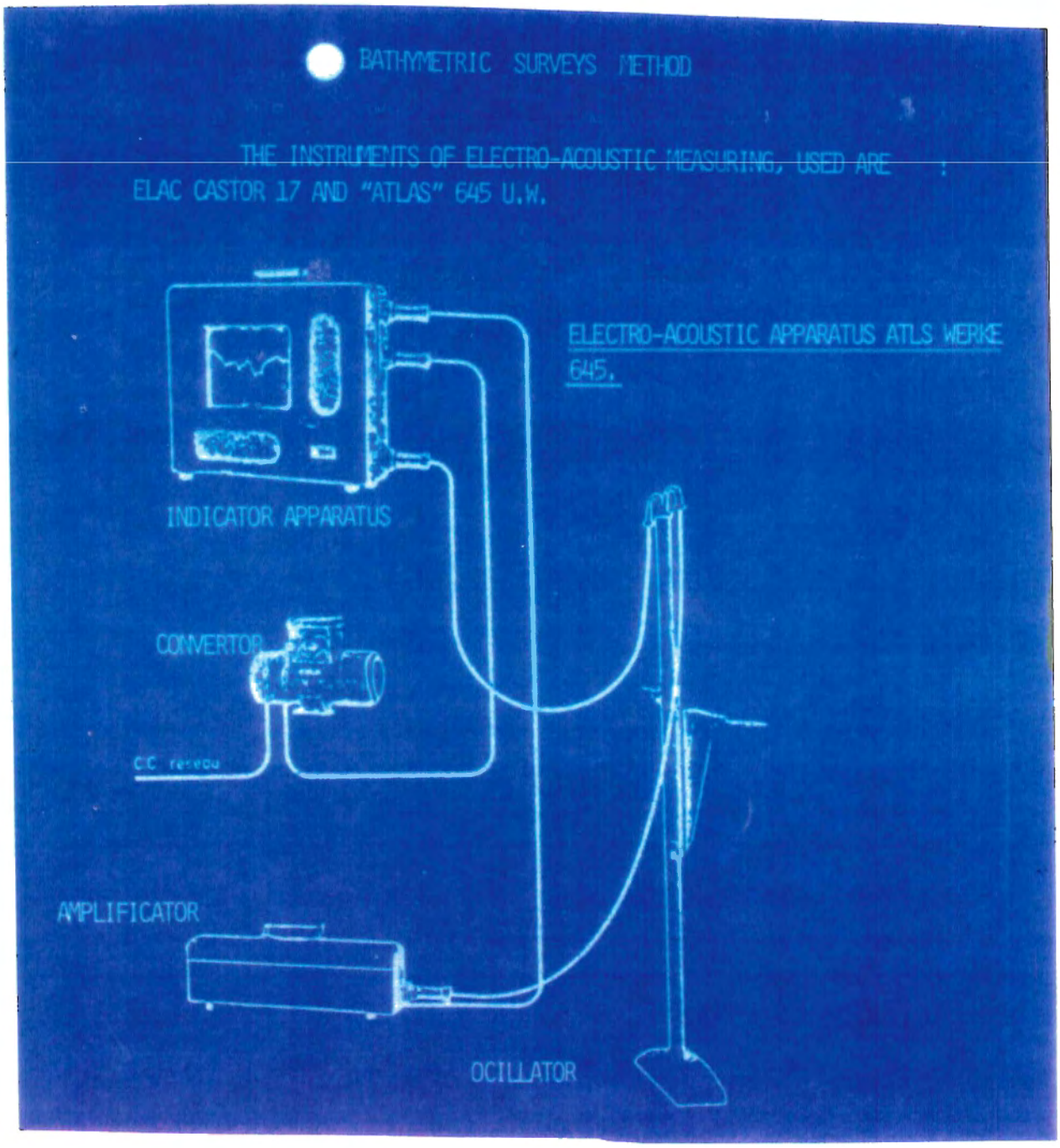
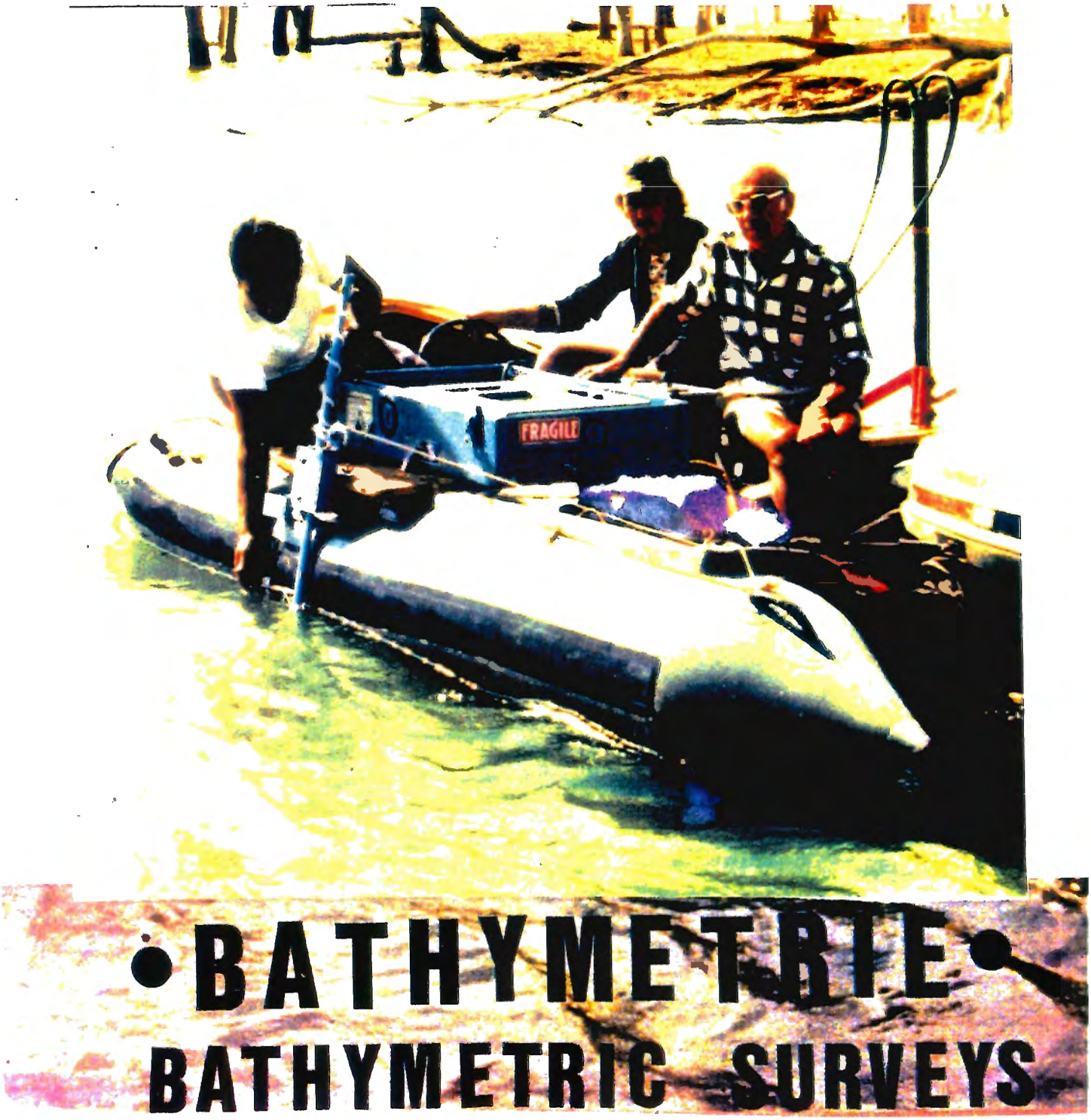

BATHYMETRIC SURVEYS METHOD
THE INSTRUMENTS OF ELECTRO-ACOUSTIC MEASURING, USED ARE :
ELAC CASTOR 17 AND "ATLAS" 645 U.W.
ELECTRO-ACOUSTIC APPARATUS ATLS WERKE 645.
INDICATOR APPARATUS
CONVERTOR
AMPLIFICATOR
OCILLATOR

PHOTO N° 37

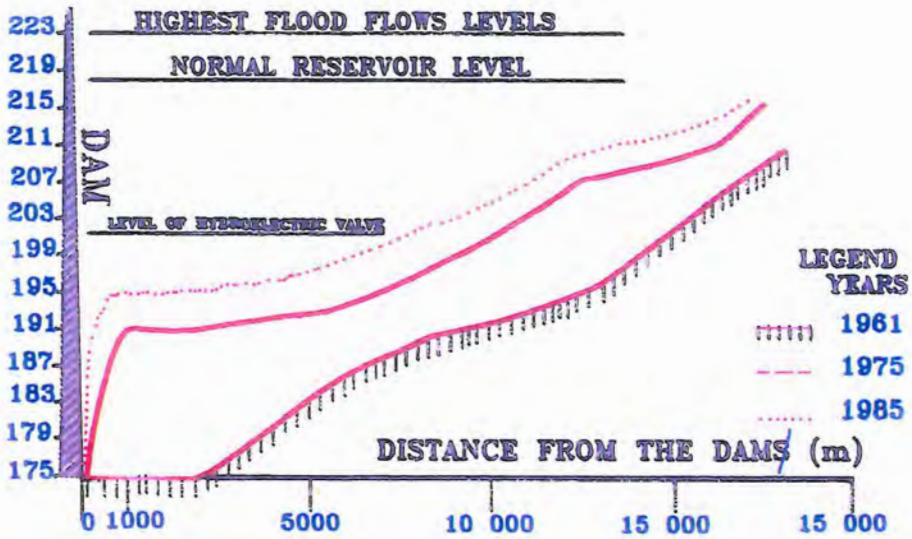
ECHO - SONDEUR ELAC CASTOR 17

SUR ZODIAC



GRAPHIC N° 33

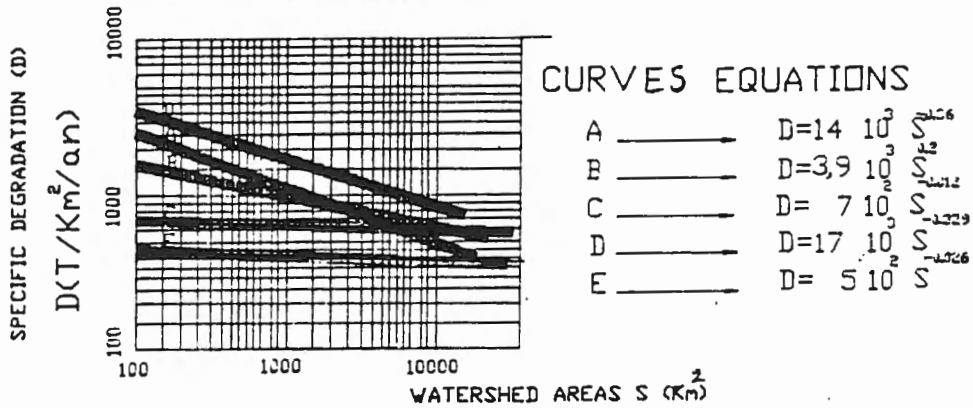
DEPLETION OF EFFECTIVE STORING
DUE TO SEDIMENT ACCUMULATION
LOSS OF STORAGE CAPACITY OF
MOHAMED V LARGE DAM



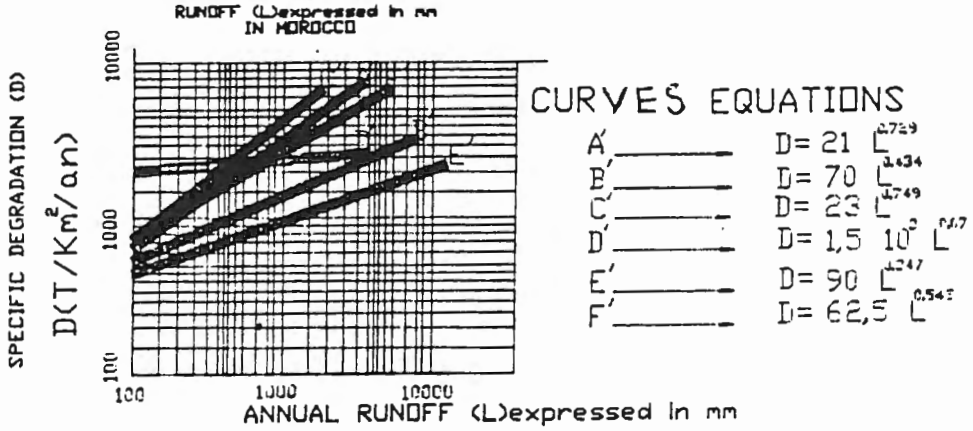
GRAPHIC N° 34

RELATIONSHIP BETWEEN ANNUAL SPECIFIC EROSION AND WATERSHED AREAS AND ANNUAL RUNOFF (expressed in mm)

1° RELATIONSHIP BETWEEN ANNUAL SPECIFIC EROSION (D) AND WATERSHED AREA IN MOROCCO



2° RELATIONSHIP BETWEEN ANNUAL SPECIFIC EROSION AND ANNUAL RUNOFF (L) expressed in mm IN MOROCCO



SEDIMENT PREDICTION MODELS IN RESERVOIRS, IN MOROCCO

Many numerical and analytical models are used actually in the world : there are based on Saint-Venant hydrodynamic equation with equation of sediment continuity, and on equation which estimates sediment discharge and also on equation which estimates friction (ex : Kishi-Kuroki, Englund, Einstein-Barbarossa, Vanoni-Brooks, Alam-Kennedy, Rijn or Karim-kennedy).

New models like illuvial of Karim and Kennedy or CARICHAR of IMG (France), include granulometric conditions and are based on Gessler formulae. Furthermore the Fluvial-11 model indicates distribution of sediment in the width, taking into account the energetic models, concerns, particularly :

- The sediment transport equation type : (Toffaletti, Larsen, Du-Boys, Yang for HEC-6 model ; Du-Boys modified by Graf for FLUVIALL-11 model ; Akers and White, Toffaletti for MOBED model ; Karim and Kennedy for IALLUVIAL model ; and finally Meyer-Peter for CARICHAR model).
- The friction equation type for steady, moving, flat or configured beds.
- The hydrodynamic equation type (permanent or permanent regimes).
- The resolution method type : by finit elements or finit differences.
- The boundary condition type.

Analytical new models are no tested for real measures : ex De Vries (parabolic and hyberbolic models), ex : Jain Group, Ribbernick, Lu, Kahawita and Hou-Zang : all these models are based on differential equation with respecting boundary considered condition with some hypothesis and specially in relation with solid equation form and the friction equation.

So, many sediment transport numerical models are used in North africa :

- For permanent and uniform flows : HEC - 6 model of Us Army, based on Toffaletti, Laursen, Du-Boys, Yang models, with friction equation.
- For no permanent flows :
  - Fluvial - 11 model of Chang, based on Du-Boys model
  - MOBED model of Krishnappan (modifyed), based on Akess and White, Toffaletti, March model with friction (moving bed).
  - Illuvial model of Karim and Kennedy model, with friction.
  - Garichar model of IMAG Grenoble, based on Meyer Peter with taking into account the paving.
  - WENDY model of Delft

For bed load sediment transport, the selection of models is complicated.

- The calibration and proving of models constitutes a great problem because of we find a great difference between the real measurement, and the model.

TABLE N° 39

THE INFLUENCE OF LITHOLOGY ON MEAN ANNUAL SEDIMENT YIELD IN NORTH AFRICA

THE RELATIONSHIPS BETWEEN ANNUAL DEGRADATION D ($T\ KM^{-2}\ YEAR^{-1}$) AND THE SURFACE AREA OF THE BASIN S (KM^2) FOR THE DIFFERENT DOMINANT LITHOLOGICAL, FORMATIONS

A- SEDIMENT YIELD FOR MARL SCHIST, MICASCHIST FORMATIONS

SHALES FLYSCH FORMATIONS

$D = 25.6\ 10^3\ S^{-0.392}$	IN MOROCCO
$D = 22.7\ 10^3\ S^{-0.432}$	IN TUNISIA
$D = 14.7\ 10^3\ S^{-0.384}$	IN ALGERIA
AND $D = 12.10^3\ S^{-0.327}$	IN MOROCCO

B- SEDIMENT YIELD FOR LIMESTONE MARL-IMESTONE, AND SHALE-LIMESTONE FORMATIONS

$D = 4.5\ 10^2\ S^{-0.154}$	IN ALGERIA
$D = 2.5\ 10^2\ S^{-0.14}$	IN TUNISIA
$D = 7.10^2\ S^{-0.016}$	IN MOROCCO
AND $D = 23.10^2\ S^{0.033}$	IN NORTH AFRICA

C- SEDIMENT YIELD FOR QUARTZITE AND GRANITE FORMATIONS

$D = 14.7\ 10^3\ S^{-0.384}$	IN ALGERIA
$D = Z.7\ 10^3\ S^{-0.432}$	IN TUNISIA
$D = 32.10^3\ S^{-0.434}$	IN MOROCCO
AND $D = 18.7\ 10^3\ S^{-0.393}$	IN NORTH AFRICA

SILTING-UP PHYSICAL MODEL OF MOHAMED BEN ABDELKRIM EL KHATTABI M.B.A.K LARGE DAM

To restrain the sediment transport and deposits in M.B.A.K. large dam, various solutions have been adopted, first with a mathematical model and leter with hydraulic experimental model.

The characteriscrtics introduced in this physical model are :

- Dam heights analysed : h = 140 ; 135 ; 128 and h = 124 m

- Flow discharge Q = 2600 ; 2000 ; 1000 and Q = 40 m^3/s.

- Spillway discharges Q' = 3660 ; 1750 ; 800 ; 10 and Q' = 0 m^3/s

In this model 34 various cases are analysed and 7 cases interests particularly the study of submersible guide embankment in the retenue.

- Sediment granulometries adopted : d < 0.002 mm : 15 % ; d < 0.01 mm ; 80 % ; d < 0.06 mm : 50 % ; d < 0.2 mm : 70 % and finnaly d < 2 mm : 90 %.

The principal consequences of this physical model study are :

- The construction of a submersible guide embankment with the purpose to lead suspended sediment transport to the spillway structures.

- The construction of submersible dikes and correction of the river bed channel crossing the reservoir.

Furthermore operating procedure guidelines (specially for the spillway gates operating control during flood flow period) have been defined in the objective to reduce sediment deposition in the reservoir.

CHARACTERISTICS OF MOHAMED BEN ABDELKRIM AL KHATTABI (LARGE DAM) PHYSICAL SEDIMENTATION MODEL

- The testings are realized in Hydraulic Research Laboratory in Lausanne (Actually we have in Morocco an important hydraulic Laboratory for reduct physical models).

- The principal difficulty resides in the choice of material type in the objective to simulate the sediments of Nekor River : Opalit was adopted.

The physical characteristics are as follow :

- The scale 1/200 (geometric simulation coefficient).

- The supply principal basin of capacity : 10 m^3, equiped with helicoïdal agitators.

- The inflow discharge entring in the reduct reservoir is regulated by gradueted valve.

- The flushing discharge is regulated by the spillway valves (regulation system in relation with servo-motor).

- The water level is measured with the precision of $\pm$ 4 cm (real value).

- The quantity of sediments flushed by spillway is measured by an aerometer.

- The height of sediments is measured by a sonde with point.

- The flow speed is determined by automatically photos.

67 testings was realized to define the maximum of parameters and the realization of submersible guide embankment and of the construction of submersible dikes crossing the reservoir.

ONE OF THE IMPORTANT MEASURE TO DELAYING THE DELTA FORMATION IS TO BUILT DEBRIS DAMS UPSTREAM FOR TRAPPING OF COARSE PARTICLES 12 SEDIMENT DAMS ARE CONSTUCTED IN NEKOR WATERSHED

PHOTO N° 38

WATER CONSERVATION IN ESTUARY :
DREDGING OF SEBOU ESTUARY

TABLE N° 40

THE FOLLOWING QUANTITIES OF SEDIMENT ARE DREGRED FROM SEBOU RIVER AT KENITRA CONFLUENCE :

YEAR	AMOUNT OF DREDGED SEDIMENTS (tons)
1977	899,000 t
1978	425,000 t
1979	665,000 t
1980	509,000 t
1981	544,000 t
1982	316,000 t
1983	859,000 t
1984	720,000 t
1985	490,000 t
1986	520,000 t

PHOTO N°39 and 40 SILTING-UP OF IMFOUT LARGE DAM : ENTRANCE OF AGRICULTURAL GATES

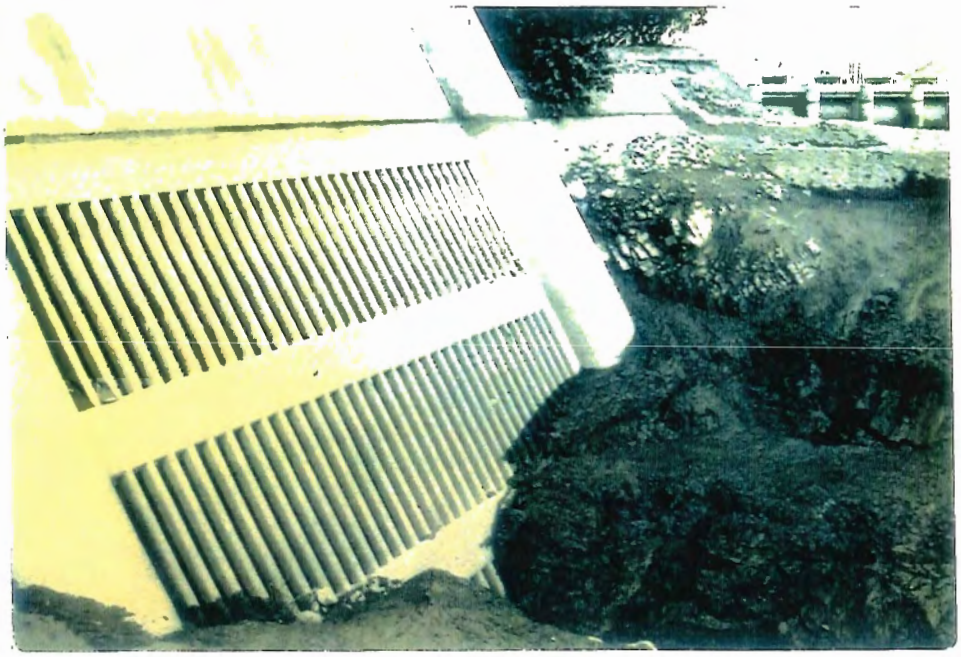


PHOTO N° 41 CLEANING OF ZEBRA CHANNEL (TO CONSERV WATER)

PHOTO N° 42

PHOTO N° REAPER BOAT (TO CUT DEPOSITED SEDIMENTS IN BOUAREG CHANNEL)

PROGRAM

REDUCTION OF WATER QUANTITY (IN FLOW AND RUN OFF) DUE TO THE DROUGHT : ANALYSIS OF CRITICAL DROUGHT OBSERVED IN MOROCCO FROM 1980 TO 1985

Goals and objectives

The determining cause of the drought in MOROCCO is particularly the existence of high centred pressures on the Açores, forming screen at disruption of forehead polar and generator, in general, of important precipitations.

Four types of dryness have interested simultaneously the MOROCCO during the period from 1980 to 1985.

1- The Hydraulic dryness which had impacts on the rarefaction of water brought in the dams, the lakes, the rivers, the sources and the inderground tables.

2- The meteorological dryness, is marked by a decreasing very sensitive of precipitations correlatively to the normal situation.

3- The agricultural dryness due to a reduction of the soil most.

4- The energetic dryness.

Implementor

Ministery of Public Works

Ministery of Agriculture

Ministery of Energy National Meteorological Administration

Context (Urban / rural)

Urban and rural.

Target Audience (socio-demographics)

Description of Activities

1- Hydraulic drought in Morocco

Afferwards are stated the dates when the observed water inflows were at very low level in rivers of hydrographic basins inflows :

TABLE N° 41

DAMS	YEAR
- Nakhla dam (Nakhla Catchment area)	: 1982 - 83
- Oued El Makhazine (Loukkos) dam	: 1966-67
- Sidi Mohamed Ben Abdellah Bou-Regreg dam	: 1966-67
- Ibn Batouta (Mharhar) dam	: 1944-45
- Bin El Ouidane (Oum Er-Rbia) dam	: 1982-83
- Mohamed V (Moulouya) dam	: 1984-85
- Moulay Youssef (Oum Er-Rbia) dam	: 1982-85
- Youssef Ben Tachfine (Souss) dam	: 1960-61
- Hassan Eddakhil (Ziz) dam	: 1983-84
- El Kansera (Sebou) dam	: 1984-85
- Idriss 1er (Sebou) dam	: 1944-45
- El Massira (Oum Er-Rbia) dam	: 1983-84
- Mansour Eddahbi (Ouerzazate) dam	: 1983-84
- Lalla Takerkoust (Tensift) dam	: 1960-61
- Kasba Tadla (Oum Er-Rbia) dam	: 1982-83

The very dry year was, by catchment area :

- 1944-45 (M'harhar and Sebou in the Inaouene River)
- 1960-61 (Souss, Lalla Takerkoust)
- 1966-67 (Loukkos, Bou-Regreg)
- 1982-83 (Nakhla, Oum Er-Rbia in Bin El Ouidane and in Kasba Tadla).

A detailed study of inflows showed that the average yearly deficits stated at dam level, analysed on the period of 5 years (and relatively to average hydraulicity Inflows), are :

TABLE N° 42

DAMS	AVERAGE YEARLY DEFICITS (%)
- Hassan Addakhil	87 %
- Sidi Mohamed Ben Abdellah	78 %
- Mansour Eddahbi	74 %
- Idriss 1er	66 %
- Mohamed Ben Abdekrim Al Khattabi	65 %
- Bin El Ouidane	65 %
- Al Massira	63 %
- Ibn Batouta	60 %
- Moulay Youssef	60 %
- Mohamed V	58 %
- El Kansera	62 %
- Lalla Takerkoust	52 %
- Ksba Tadla	51 %
- Youssef Ben Tachfine	46 %
- Oued El Makhazine	40 %
- Nakhla	38 %

2- Meteorological Drought

On the other hand, in Morocco, in view of standed up precipitations, the years 1944-45 and 1982-83 being by simultaneously in the whole regions of moroccan territory ; the five years from 1980 to 1985 being successively dry for the whole parties of Morocco while the years 1965-1967 being localized for certain areas.

For the five dry years, the observed pluviometric situation by the National Meteorology has been the following :

- 1980-81 : deficit everywhere in the country except in North-East.

- 1981-82 : strongly excess on the whole of Morocco, only the GHARB plain differs with a deficit of 20 %.

- 1983-84 : excess on the whole of the country except for a narrow band on the oceanic coastal.

- 1984-85 : normal of slightly excess on the South-Ouest of country, deficit everywhere else.

For these periods spreading out from 10 to 20 years the sequence of moist and dry years, only the pluviometry deficit being relatively filled in, while, for periods from 20 to 25 years, the observations of precipitations notice a neat unbalance causing important deficits.

This situation does not remain valid is a normal phenomenon came to appear in disrupting the overall cycle of the atmospheric circulation, for example, an unusual increase of carbonic gas rate creating a local warming.

With regards to the prediction we could say that globally, the dryness of the last five years was like that of 1945-50.

The problem set at present is to know the periodicity of the sum of alternative sequences rainy and dryness, on a very long period of observation, with a view to deduct a prediction of the appearance frequency ulterior of these sequences.

At the international scale, it exists computerised numerical models allowing to expect the dryness in basing exclusively on each of parameters conditioning the dryness to know, for example, the rates of carbonic gas increase in the atmosphere, the oceans impact on the precipitations, the soil moist, the atmospheric circulation type, but now it does not exist any of numerical model allowing to expect, on a final and absolute way the dryness making to intervene every parameters.

The development of the present technology, by the using of radios, sounding balls, rockets, satellites and computers, does not allow meteorologic predictions not exceeding 2 to 3 days in the tropical regions, and 5 to 6 days in the temperated regions. For information only, the French National Meteorology, for the etablishment of two predictions of 0 H to 12 H sets, at starting, of 200.000 reliefs, which the treatment requires many milliards of operations for prediction in 24 h term only very powerful computers (First Cray 1 could realize 50 millions of operations per second, and Cray xmp. Which makes 200 millions of operations per second), are the same to realize the appropriate predicitons of calculations.

3- Agricultural Drought

This dryness comes by the appearance of a reduction of the soil humidity particularly during the period of cultivation development.

For information only, the World Meteorological defines 59 signs of dryness, printed out. The relations between the humidity supplied byt the soil and that which is required.

Certainly, in Morocco, the precipitation bases of months March and April could enjoin the harvesting losses.

As an example, the contraints full at the starting of agricultural countryside 1980/81 for the two successive dryness years 1981 and 1982 by the GHARB office which the agricultural waters come from Idriss 1er and El Kansera dams, are the following :

- The safeguard of charged cultivation.

- The safeguard of fodder cultivation (with 50 % of endowment reduction).

- The limitation of yearly cultivation not unavailable.

- The self confidence of vital needs in citrus fruits (with reduction of endowment).

- The self confidence of vital needs of the sugar canes (endowment reduction of 30 %).

- The farming of the whole new planting of trees.

- The decreasing of cotton program (500 ha insted of 1.500 ha and decreasing of the irrigation dose).

- The banning of market gardening.

- The vital need of water carried along a development of the deprived irrigation, by the increase in the number of moto-pumps groupes.

* The incitement of technic committee offices to create charged vigilance committee to enforce the instituted water towers, to struggle against the whole of degradation.

* The treatment and recycling of water used notably by the industrials.

* The water economy.

* The integral covering of irrigation water dues.

For information only, the impact of the dryness on the agricultural area shows that the drop in earnings due to the vegetable production in the course of the countryside 1980/81 (in comparison with an average year in the GHARB office) is of 600 millions of DH and, surface area of 127 000 ha.

The further details, relating to the agricultural dryness are, as follows :

The agricultural productions are realized by the large perimeters of irrigation (Doukkala, Gharb, Haouz, Loukkos, Moulouya, Ouarzazate, Souss-Massa, Tadla and Tafilalet), did not suffer during the 5 years of dryness (and in reference with the year 1979/80), that a limited decreasing. The realization of large hydraulic works presented a positive impact, in the course of this critical period, for the country.

We noticed that the report between the product value per one hectare, average of large irrigated perimeters to that of one hectare average of other areas, is passed from 5 (for the year of reference 1979/80) to 5,6 in 1980/85 with a maximum of 10 in 1980/81, this explicites the advantage of irrigated perimeters.

4- Energetic Drought

As soon as the starting of the dryness, the water plan of reservoirs to energetic vocation, has lowered below limited levels. It is in order of brutal fall of the hydro-electric energy production from centrals, never observed in Morocco, but fortunately the thermal was here for supplying, at appointed point, to energetic drop.

The O.N.E. has supplied the impact of the critical dryness of 5 years (1980 to 1985) and particularly on the overall filling coefficients of the set of hydroelectric dams, on the hydraulic and thermal production.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

The critical dryness which had been observed in Morocco from 1980 to 85, leads to the following actions :

- The institution of strict politic distribution of the whole water uses : drinkable, agricultural and industrial, taking into account that drinkable water has the first priority.
- A management of the groundwater and superficial water (rivers, lakes, reservoirs ...).
- The use of all possible means to apply the water economy.
- The incitement to development of private irrigation by additional use of equipment such as moto-pumps, to complete the few superficial water resources.
- The construction planning of future dams (we should indicate that small dams have supplied us positive results during the dryness).
- The maintenance unit fitted the hydraulic networks.
- The organization of special committees which have started : their principal objectives are to reduce the use of water and the endowment of irrigated areas.
- Furthermore, we suggest to actualize the regularization studies.
- The intensifiction of the artificial rain using in the surrounding area of large reservoirs.
- The necessity of adoption of legislative measurements for the management of hydraulic works particularly to multiple goals.
- The development of artificial groundwater recharge ...

Explanation of How Environmentally Friendly

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PROGRAM

ARTIFICIAL RAIN AND WATER CONSERVATION IN UPSTREAM WATERSHEDS, PARTICULARLY IN DROUGHT PERIOD

Goals and objectives

In MOROCCO, the artificial rain has been used from march, 1953 to April 1954 and in 1984/85 and 1995/96, with a view to abtain the rain particularly in the region of Bin El Ouidane (large dam), with a view to provide the inadequacy of water resources (and particularly in drought period) ; the program "AL GHAIT" of artificial rain, started in 1984, and had been applied to the catchment area of Oum Er Rbia (catchment arrea of electric energy production in MOROCCO and 2nd catchment area of water brought), is for objective the precipitation in ereases incited in water and snow, this program is organized by the ROYAL AIR FORCES with the support of the organization of the National Meteorology, for the basis of the snowing using and a deeper knowledge in the cloud physics.

Implementor

National Meteorological Direction.

Context (Urban / rural)

Rural and Urban.

Target Audience (socio-demographics)

Description of Activities

With a view to use the well scientific search that adapted in MOROCCO context, the following operations have been carriend out :

- The expansion, in the clouds, of chimical products is based on silveriodure, has been realized by the service of 4 planes O.V.10 and 2 king 100 modified and of burners Furthermore, technology apparatus moved forward and allowing to record, to treat in real time and to post the

meteorological given tahe obtained in the plane area, will be place in 2 king 100.

- The cloud treatment, by sending up pyrotechnic cartouches has been realized by the mean of Alpha Jet plane that suplied by a meteorology radar.

- The other elements intervening in the "AL GHAIT" program are :

- The installing, in the national meteorology of Casablanca, of a receiving of METEOSAT images.
- The implantation, in Khouribga, of a meteorolgy radar of a ray of 400 kms.
- The putting into place, in the target area, of a station gathering the meteorological given in real time from METEOSAT receiving.

He obained results from the qualifying and quantitative analysis of preliminary program of two carried out interventions in 1984/85 and in 1985/86 are encouraging.

The National director of Committee "AL GHAIT" is consisted by : Royal air Forces Ministries of Transports, of the Interior, of the agriculture, of the Equipement, vacational training and management training, of the energy and of the mining and Geological, of Posts and Tele-Communications, of the Royal police forces, and National Centre for the Coordination and the planning of the scientific and technic searches.

Gender Impact

Record of Success in Solving Problems

Relevance to the Region

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WATER CONSERVATION AND LEGAL PROVISIONS WATER LAW ACT 10 - 1995 CONCERNING LEGAL DISPOSITIONS UNDERTAKEN 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 straightenning out of streams. Clearance is required to engure that such activities are truely in the public interest,
- diverting water from public canals and dams and from streams,

- extracting building material from sites who 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 way :

  - threaten constructions built on PHP sites to deal with possible floods,
  - endanger population and property downstream, as flood risks may be hightened by installation built on PHP upstream,
  - hinder proper management and exploitation of PHP.

- Erecting obstacles or dumping waste and rejects within PHP bonndaries.

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 cottle 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 ocupation of PHP sites is still governed by the 1918 Dahir (Royal Decree). Occupation of such sites may involve reajusting free - boards on dam reservoirs or rivers by installing tourism and leisure amenities and equipement (for swiming, 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 mode 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 of othermise) into usrface 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 commitarrent in uriting inviting 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 esception of pouring house - bold waste water into filtration wells preceded by septic tanks ;

- scattering house hold 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 bounndaries.

Water quality status (Article 56)

- The Regional water Authority shall :

  - assess the quality of underground and surface water, prepare a report there on and make it available to users and to the public at large ;
  - prepare charts showing degree of vulnerabily of threatened underground water.

- The above documentary material shall be reviewed and updated by the relevant water authority periodically and when ever 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
- The 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 shell 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).

Program

CONSERVATION OF MARINE AN COASTAL WATERS AGAINST HYDROCARBON CONTAMINATIONS : CASE STUDY OF KHARG V SPILL OIL EVENT IN 1990 RECOMMENDATIONS

Goals and objectives

Coastal and littoral zone in Morocco covers approximatively 3,500 kms lenght. The contamination risk by spill oils is very heigh.

Many models are to establish in the view to predict the best response at marine and coastal pollutions.

List of some spill oil accidents in Gibraltar Strait

* Between 1955 and 1980, 688 spill oil accidents was listed with spilled oil volume superior than 500 t. (IFP : Petroleum French Institut).

* Between 1955 and 1979, there were 5 spill oil accidents in Gibraltar Detroit, 4 of them with a spilled oil volume contained between 500 and 15,000 t and one spilling of educated between 15,000 and 40,000 t.

* All these accidents occurred in 1980 were located in detroits, ports and near the coasts. This fact indicates the high risk nature of straits in Mediterranean sea.

To insure a better resolution of risk assessments of marine contamination the following studies, located in many backgrounds fields (technical, ecological, toxicological, social, training and legal ...), have to be developped with maximum understanding :

- Climatic fluctuations on marine watters (ozone hole reduction, greenhouse effect, enso ...).

- Remote sensing.

- Oceanography (tides, swells, temperatures, pressures, oceanic currents ...) and other hydrodynamic problems like propagation models of hydrocarbons in coastal zones ...

- Petroleum flowing into sea (characteristics, yield walue pressure, temperaturer, evaporation, mixture ...).

- Ocean water pollution by hydrocarbons and the establishment of predicting models of marine contamination.

- Adequate methods to diffuse petroleum in sea.

- Recovering methods for floating petroleum.

- Contamination impacts by marine accidents on natural communities and on marine ecosystems.

- Maximum ecological studies undertaken in past and actual marine accidents. The key role of ecotoxicologist is indicated to undertake the preparation of contingency and emergency planning and the setting-up of operations aimed to reduce environmental marine contamination.

- Necessity, for the future, to improve the techniques concerning construction of petroleum tankers, by using small laboratory models (simultaneous similarity).

- Legal marire problems will be presented with their gaps like international convention of 1969 (on the intervention in high sea consequenty to a marine accident, which can induce hydrocarbon contamination and pollution), and th results of international conferences of 1971, 1973, 1975, and the protocols of 1975, 1978, 1984 are presented.

- Finally, the case study of marine accident of kharg-5, occured this year in the atlantic sea, not far from the moroccan coast, is developped with defining the adequate contingency plan adopted (technical, ecological ...) Morocco is located near an marine axis highly frequented by tankers of high hydrocarbon tonnage which conturns south africa and qlzso mediterranean sea. For that, a special care ought to be undertaken in the undertstanding of all the factors and their relationships (and defined above) to predict any other accident such as kharg-5 ; the prompt and rational responses may really limit predicting ecological damages and heir success ful will be assured by a high level of preparation based on the understanding of all the basis parameters.

Implementor

Context (Urban / rural)

Target Audience (socio-demographics)

Description of Activities

The necessary contents of cotingency plan to response --> prompty at marine and coastal pollutions.

The most important questions which the plan has to address are listed below :

- Goverage
- Spill risk assessment
  . Sources
  . Size
  . Locations
- Behaviour and fate of spilled oil
  . Meteorological data
  . Oceanographic data
  . Characteristics of oils
- Shoreline (ligne de rivage) Classification
  . Types of shoreline
  . Biological ressources
  . Human activities
  . Priorities for protection
  . Less important areas
- Organization of response activities
  . Responsibilities
  . Communications
  . Activation of the plan
  . Documentation of Actions
  . Public relations
  . Liaison with other interested parties
  . Training and exercises

. Financing
. Compensation and liability
. Strategy of oil spill combating
. Oil combating technic
. Manpower

- Oil spill response
  . Equipment and products
  . Transport, storage and disposal of collected oil.

Gender Impact

The same for mal and female alike.

Record of Success in Solving Problems

The experience undertaked during spill oil occured in Morocco in 1990 give a great experience for Moroccan technician in this field.

Relevance to the Region

The impact of spill oils events in Mediteraneen and Atlantic seas is important for the development of these countries.

The extrapolation of this experience for another country is possible.

Moroccan littoral pollution by oil

This pollution is undertaken on the basis of one hundred and fifty five measurement stations observed on 22 coastal points on beaches at locations : Martill (in Mediterranean coast), as far as Safi (Atlantic coast). This operation starts on 15th April 1986 and finishes on May 4th 1986. The sampled zone concerne 30 Kms establishec along a coast zone of 500 kms. The result of this research reveals that both zones SAFI-EL JADIDA and MOHAMMADIA-RABAT are mostly contaminated by oil.

We observe that the oil concentration varies from 12 g by linear meter of beach in SKHIRAT to 400 g/m in AL JADIDA. We can adopt an average value of 100 g/m. The oil residues represents 30 % of a determined sample. Consequently the contamination level in GIBRALTAR DETROIT reaches 80 g/m whereas the level of the Atlantic littoral reaches 120 g/m. The high frenquency and the great level of tanker trafics and the

operation of cleaning up of tankers in the atlantic coast are the determining causes of oil pollution.

Aspects and characteristics of experimented zones

The beach zones analysed are preferably located in neighbourhood of touristic areas, port zones, terminal and oil refineries. These zones are :

- In the North (Martil beach, Ksar Es Sghir, Tangier and Asilah), this research shows that the average oil pollution varies from 40 g/m in Tangier to 153 g/m in Asilah.

- In the Mohammadia coast, this analysis shows average oil pollution veries from 25 g/m to 300 g/m.

- In the North Coast of Safi, the research revealed that oil pollution varies from 20 g/m to 320 g/m in EL JADIDA.

Method used for samples analysis

I.S.P.M adopted 35 trancets in RIF, 27 in RABAT, 23 in MOHAMMADIA 27 in CASA, 27 in SAFI. The oceanographic parameters like amplitude, celerity of swells, tides, wind and their direction, are principal to determine the impact of this measurements. The number of adopted stations of measurements is naturally function of the concentration density of oil residiums deposited on the beach. The statistical analysis (by Student coefficient) are adopted.

Description of KHAEG-V Accident

The KHARG-V contained 284.000 tons of crude oil and was in very bad condition. Coming form the persian Gulf, the tanker sailed to north europe. The fire was broken out on board. The erews was constituted by 35 men. They commit the umpardonable error to leave the tanker and to take refuge in another boat.

The Iranian super tanker was located, in this time, between Canarisles and moroccan coasts, in open sea of Safi, (S.W) when the alert was make in Devember 31, 1989, 70.000 tons of crude oil particularly fluid (Arabian light) and fortunately volatile, was flowing into sea.

In December 22, 1989, spanish technicians which approach firstly the Kharg-V, find difficulties because of the high of waves which exceed 8

meters in the first time the wind turned and, instead to take away the oil sheep ; the wind pushed it in the direction of Moroccan coasts in this time the situation ought toi be catastrophic : an important shell oil threatened Moroccan coasts (more dangerous than, in Marsh 1989, the Exxon Valedez which had touched the alaska coast). Finally the ta,ker was on two towards "CAP-VERT" isle.

Really on 70.000 T of oil escaped from Kharg-V, 30.000 tons were evaporated.

2- Some characteristics of iranian oils pilled from khatg-V Accident

* The viscosity of iranian oil spilled (in December 20th, 1990, near coastal zones of Morocco), is 270 centistokes.

* The iranian oil presents a lower density (18,3), a lower point of flowing (near the value of ambient temperature : 26 degrees), comparatively to Lybian oil which presents a density of 40,6 and a flowing point of 39 degrees Celsius.

* The iranian oil si very light and easily subjected to chemical dispersion, to the influence of evaporation dilution, oxidation and biodégradation (on 70,000 t of oil spilled from KHARG-V, 30.000 T were immediately evaporated).

For example the dispersion method will no use to the dispersion of Lybian oil in accident case. It is the same for the VENEZUELA oil (viscosity : 3,700 to 20,000 centistokes) and for Mexico oil (viscosity 4,700 centistokes).

3- Some characteristics of international crude oils

TABLE N° 43

Countries	Oil density	Oil viscosity (Centistokes)
Lybia	36,1	13
Indonesia	37,7	3
Venezuela	10,8	275
Brazil	39,2	17
Egypt	27,5	18
Angola	32,9	20
Iran	18,3	270
Mexico	12,8	4,700

4- The legal emptiness in case of Kharg-V

Kharg-V was abandoned by spanish, english and dutch ships while it was located beyond 200 milles of economic zone from moroccan coasts.

Explanation of How Environmentally Friendly

Strategy provil of marine environment protection in Morocco.

The objectif of this strategy is to preserve fishing against any from of pollution and to protect the health of consumators. It is based on two actions :

Technical and scientific action :

- The knowledge of our marine environment and the assessing of all pollution sources.
- The continue survey of sea (lagoons, portuar bains ...).
- The setting-up of following systems :
  * The contingency plan and national system of alert in the case of massive spilling of chemical and pollutants.
  * The survey plan of colorated waters.
  * The conception of impact studies.
  * The adoption of proper technolgoies e.g. industries which not product toxic polluants.
  * The treatment of industrial effluents to eliminate some toxic substances in sea.

Legal and institutional case

It is necessary to establish a national strategy of environment protection based on good national reglementation with :

* An qualified technical personals (the personal which have the responsibility to control and to survey marine pollution have to be specialist and to have possibilities to take decisions).

* Dissuasive sanctions.

* The work repartition between different administration, concerned organisms and institutions of scientific research.

* The setting-up of laws and national norms.

RECOMMENDATIONS

A- Recommandations on oil pollution

1- That all Mediterranean Countries should develop detailed contingecy plans to combat oil pollution. These plans should include : models to predict the movement of oil slicks : a list of sensitive locations in inshore or coastal areas which need special protection from oil pollution. With a priority ranking given to these resources : and the restrictions on the use of certain agressive clean-up procedures within these individual areas toi prevent unnecessary damage to such resources.

2- That chemical and biological monitoring should be carried out to measure the rate of recovery of areas affected by oil spills.

B- Recommandations on chemical pollution

1- Ail Mediterranean countries should obtain basic hydrographica information on water currents in their coastal waters so that the movement of chemical spills can be predicted using a regionally acceptable model.

2- A regionally agreed data base on the hazardous properties of chemicals should be developed taking the GESAMP Reports ans Studies 35 as a Starting point. More detailed hazard porfils need to be developed for highly toxic chemicals carried in chemicla tankers and container vessels : these profiles should contain the date necessary foir a risk assessment of a Cargo lost at sea. A number of data banks exist for the harunful properties of chemicals and these can be collated into a series of Hazard profiles siutable for risk assessment. Such profiles should be given regional recognition, Moreover they need to be continuously evaluated and undated on the basis of toxicological research which may be under taken within the region.

3- The extent to which date on the hazardous properties of chemicals in fresh-water can be utilized foir marine risk assessment need further examination especially in the context of a rapide response.

C- General recommandations

1- Accurrate risk assessments should be made for all accidental releases of oils and chemicals in order to :

a- Inform the public of the true extent of the risk.

b- Justify the action taken to minimise the risk.

The use of regionally acceptable data basis and models will increase the authority of a risk assessment. Moreover the methodology of such risk assessments should be standardized for the region so as to facilitate the exchange of information and experiences between scientists and administrtors in the Mediterranean region. Accidents will always happen when unexpected and fortunately arequite infrequent. The valibility and appropriateness of the risk assessment made durin the accident should be properly evaluated and the experience thereby gained should be made evailable to all Mediterranean states.

2- The information thereby generated will be of great benefit not only the country concerned but to all Mediterranean coastal states. As such since monitoring may be prohibitally expensive and / or greatly limited by the lack of local resources. It should be suported by other countries and international agencies within the framework of the Mediterranean Action Plan.

3- Training of scientists in the use of data to prepare risk assessments is essential to ensure a rapid response to chemical spillages in the marine environment.

List of Contacts

The concerned ministeries.

Photographs of Program

TABLE N° 44

LIST OF INTERNATIONAL WATER PUBLICATIONS EXISTING IN UNITED NATIONS INFORMATION IN RABAT

REFERENCES	AUTHOR	SUBJECT	TITLE	DATE	PAGE	COUNTRY	LANGUAGE
ECN17/1997/3 A	ECOSOC	EAU	L'EAU UNE RESSOURCE AUX MULTIPLES FONCTIONS	01.01.1997	12	NY	F
ECE WATER 41	CEE/ONU	EAU	INCIDENCES DES SOURCES D'ENERGIE NON CLASSIQUES SUR L'EAU	01.01.1986	78	NEW YORK	F
ID B 262	ONUDI	EAU	UTILISATION DE L'EAU A DES FINS INDUSTRIELLES	01.01.1981	12	VIENNE	F
NOTRE PLANETE 8/3/96	PNUE	EAU	L'EAU	01.01.1996	36	NAIROBI	F
OMS EURI 87	OMS	EAU	LA DISTRIBUTION D'EAU EN ZONE RURALE	01.01.1985	70	NEW YORK	F
ST ECA 154	ONU	EAU	LE DROIT DE PRISE D'EAU ET LES UTILISAITONS DE L'EAU REGIMES JURIDIQUES	01.01.1975	123	NEW YORK	F
E CN17/1997/9	ECOSOC	EAU DOUCE	INVENTAIRE RESSOURCES MONDIALES EN EAU DOUCE	01.01.1997	35	NY	F
ST TCD 17	ONU	EAU GESTION	CRITERIA FOR APPROACHES TO WATER QUALITY MANAGEMENT IN DEVELOPING COUNTRIES	01.01.1990	388	NEW YORK	F
CERES 156	FAO	EAU POTABLE	QUAND L'EAU VIENT A MANQUER LE TEMPS D'AGADIR	01.01.1995	52	ROME	F
OMS DEC EAU 83	OMS	EAU POTABLE	DECENNIE DE L'EAU POTABLE, LES PLANS NATIONAUX, REPONSE A 8 QUESTIONS	01.01.1983	19	GENEVE	F
ST TCD 7	ONU	EAU POTABLE DECENNIE	LES OBSTACLES JURIDIQUES ET INSTITUTIONNELLES DE LA DECENNIE DE L'EAU POTABLE	01.01.1991	135	NEW YORK	F
A 45/327	AG	EAU POTABLE / DECENNIE	RESULTATS DE LA DECENNIE DE L'EAU POTABLE	01.01.1990	25	NY	F
A C2/45/3	AG	EAU POTABLE/DECL	DECLARATION DE NEW DELHI	01.01.1990	2	NY	FA
ECE CHEM 78	CEE/ONU	EAU TRAITEMENT	L'UTILISATION RATIONNELLE DE L'EAU ET SON TRAITREMENT DANS L'INDUSTRIE CHIMIQUE	01.01.1990	139	NEW YORK	F
ECE WATER 16	CEE/ONU	EAU USEES	PRINCIPES DE STIMULATION ECONOMIQUE EB EAU ET L'EVACUATION DES EAUX USEES	01 01 1976	0	NY	F
SER TEC PNUE 1	PNUE	EAUX CONTINENTALES AFRIQUE	ECOLOGIE ET UTILISATION DES EAUX CONTINENTALES AFRICAINES	01.01.1983	212	NAIROBI	F
BUL PED FAO 68	ROME	EAUX DE SURFACE	MESURES DE TERRAIN ET DE L'ECOULEMENT DES EAUX DE SURFACE	01.01.1996	151	ROME	F
ST ESA 13	ONU	EAUX SOUTERRAINES	EMMAGASINEMENT SOUTERRAIN DES EAUX ET RECHARGES ARTIFICIELLES	01.01.1977	187	NEW YORK	F
BUL IRR DRAIN 018	FAO	EAUX SOUTERRAINES	LES EAUX SOUTERRAINES	01.01.1995	285	ROME	F
BUL IRR DRAIN 021	FAO	EAUX SOUTERRAINES	GROUNDWATER MODELS	01 01 1973	235	ROME	F
FAO ET LEG 40	FAO	EAUX SOUTERRAINES	LE STATUT DES EAUX SOUTERRAINES EN DROIT INTERNATIONAL	01.01.1987	83	NEW YORK	F
FAO ETUDE LEG 40	FAO	EAUX SOUTERRAINES	LE STATUT DES EAUX SOUTERRAINES EN DROIT INTERNATIONAL	01.01 1987	83	ROME	F
ST ESA 112	ONU	EAUX SOUTERRAINES	LES EAUX SOUTERRAINES DE L'EST MEDITERRANEEN ET DE L'ASIE OCCIDENTALE	01.01.1983	220	NEW YORK	F
ST ESA 35	ONU	EAUX SOUTERRAINES	LES EAUX SOUTERRAINES DE L'HEMISPHERE OCCIDENTAL	01.01.1977	123	NEW YORK	F
ST ESA 90	ONU	EAUX SOUTERRAINES	PROGRAMME ONU POUR LA RECHERCHE ET LA MISE EN VALEUR DES EAUX SOUTERRAINES DANS LES PVD	01.01.1981	123	NEW YORK	F
ST TCD 5	ONU	EAUX SOUTERRAINES	LES EAUX SOUTERRAINES DE L'AFRIQUE SEPTENTRIONALE ET OCCIDENTALE	01.01.1987	250	NEW YORK	F
ECE ENG AUT 18 V ½	CEE / ONU	EAUX USEES	MATERIEL MECANIQUE ET ELECTRIQUE ET MOYENS AUTOMATISES POUR LA GESTION DES EAUX USEES PAY	01.01.1984	118	NEW YORK	F
OMS EURO 90	OMS	EAUX USEES	LA TECHNOLOGIE APPROPRIEE AU TRAITEMENT DES EAUX USEES DANS LES PETITES LOCALITES	01.01.1984	69	NEW YORK	F
BUL IRR DRAIN 020	ROME	EAUX / DROIT DES PAYS MUSULMANS	DROIT DES EAUX DANS LES PAYS MUSULMANS	01.01.1975	256	ROME	F
BUL IRR DRAIN 010	FAO	EAUX / GESTION DES	GESTION INTEGREE DES EAUX DANS LES EXPLOITATIONS AGRICOLES	01.01.1971	52	ROME	F
E CONF 70/29	ONU	EAU / CONF	RAPPORT DE LA CONFERENCE DES NATIONS UNIES SUR L'EAU	01.01.1977	121	NY	F
BUL IRR DRAIN 08	FAO	EAU / ENVIRONNEMENT	L'EAU ET L'ENVIRONNEMENT	01.01.1971	58	ROME	F
FAO DOC TEC CPCA 22	FAO	EAU/GESTION/AFRIQUE	INTENSIFICATION DE LA GESTION DES PETITS PLANS D'EAU EN ARIQUE FRANCOPHONE	01.01.1994	58	ROME	F
BUL PED FAO 70	FAO	EAU/GESTION/BIOMASSE / FERTILITE	INTRODUCTION A LA GESTION CONSERVATOIRE DE L'EAU, DE LA BIOMASSE ET DE LA FERTILITE DES SOLS	01.01.1994	415	ROME	F
BUL IRR DRAIN 029	FAO	EAU / QUALITE	LA QUALITE DE L'EAU EN AGRICULTURE	01.01.1988	268	ROME	F
GES EAU IR MAN FOR 8	FAO	EAU / REGULATION / DISTRIBUTION	OUVRAGES DE REGULATION ET DE DISTRIBUTION DE L'EAU	01.01.1995	71	ROME	F
BUL IRR DRAIN 033	FAO	EAU / RENDEMENT	REPONSE DES RENDEMENTS A L'EAU	01.01.1987	258	ROME	F
BUL IRR DRAIN 023	FAO	EAU / RESSOURCES	UTILISATION DES METHODES DE SIMULATION POUR LA MISE EN VALEUR DES RESSOURCES EN E	01.01.1974	125	ROME	F
FIN DEV V. 31/2/94/1	FMI	EAU/RESSOURCES/MAGHREB	RESSOURCES EN EAU / GESTION / MAGHREB / MARCHE	01.01.1994	15	WASHINGTON	F
WB 1995/02	BM	EAU / SECURITE	FROM SCARCITY TO SECURITY / WATER CRISIS IN MIDDLE EAST AND NORTH AFRICA	01.01.1995	32	WASHINGTON	AN
BUL IRR DRAIN 013	ROME	EAU / USAGE	WATER USE SEMINAR DAMASCUS	01.01.1972	218	ROME	F
OMS EURO 87	OMS	EAU / ZONE RURALE	LA DISTRIBUTION D'EAU EN ZONE RURALE	01.01.1985	70	GENEVE	F

REFERENCES

- R1 : World Meteorological Organization, (May 1995), "African conference on water resources : policy and assessment" Proceeding of the conference held in Adis Abeda 20-25 Mars 1995.

- R2 : General Hydraulic Administration, (January 1994) : "Study of National Drinking Water Supply Master Plan in favor of rural populations", with UNDP (United Nations Development Program of Developement). The study is undertaken by BRGM, SOGREAH, SCET-MAROC and CINAM Consultants, Rabat.

- R3 : ONEP (April 1991) : "Fight againt water eutrophication of Sidi Mohammed Ben Abdellah large dam", brochure.

- R4 : ONEP, (October 1990), "Water Conservation strategies", brochure.

- R5 : M. Khalid Nadifi and Mr Rachid Wahabi, "Water Resources in Morocco. The state of art and the future prospects", Nov. 1993 published in Regional Symposium on the utilisation and conservation symposium on the utilisation and conservation of water ressources", Amman 28 November - 02 December 1993.

- R6 : ONEP, (Sept. 1995), "Awareness campaing of children for water economy", brochure.

- R7 : ONEP, (Dec. 1994), "Drinking water supply by public fountains", brochure.

- R8 : ONEP, June 1997, "Characteristic indicators of drinking water evolution, Report.

- R9 : General Direction of local collectivities, Direction of water and cleasing, Ministery of Interior. "Synthesis of experimental studies", Report with Cooperation of French Foreign Affairs Ministry : French Ambassy in Morocco, Cultural technic and cooperation service.

- R10 : ONEP (April 1991), "Water pollution control, actions underken by ONEP", brochure.

- R11 : Food an Agriculture organization of the United Nations FAO, (1997), "Irrigation in the near east regions, in figures", water Report n°9. Rome.

- R12 : ONEP, Mars 1996, "Surface water quality of Oum Er Rbia watershed", brochure.

- R13 : ONEP, (1996), "Evolution of water quality in drinking water supply systems, study of BIOFILM", brochure.

- R14 : ONEP (June 1990), "Methodology of general studies of distribution network rehabilitation". Technical assistance for the realization of maintenance program. Morocco - French Cooperation in water field.

- R15 : ONEP (April 1991), "The water quality control Laboratory", brochure.

- R16 : ONEP (January 1994), "Cleansing and wastewater reuse". ONEP contribution, brochure.

- R17 : ONEP (April 1995), "Water drinking supply of South Provinces", brochure.

- R18 : ONEP, (June 1989), "Actions in water pollution control for drinking water", brochure.

- R19 : ONEP and International water center of Nancy (France) : "Development of water drinking supply of rural and semi-rural areas". Synthesis report of the seminary, organized with the French ambassy in Rabat (Conference 8-10 January 1996), Rabat.

- R20 : M. LAHLOU Abdelhadi : May 1972, PALERMO (SICILIA), First International Conference on water planification.

  M. LAHLOU Abdelhadi : 11-15 Septembre 1978, RABAT, HASSAN II Agronomic and Veterinary institute, Symposium on EROSION AND WATERSHED MANAGEMENTS IN MEDITERRANEAN COUNTRIES".

  Presented and publication of the paper entitled :

  - "ANTI-EROSIVE TREATMENT OF NEKOR MATERSHED"

- R21 : M. LAHLOU Abdelhadi : 1981 (RABAT), Arab International conference on hyrology.

  Presentation, in "question 2", of the following publication :

  - "SPECIFIC WATERSHED DEGRADATION AND ITS IMPACT ON SILTING-UP OF MOROCCAN DAMS"

- R22 : M. LAHLOU Abdelhadi : July 1982, Exeter (England), First International Conference of IAHS (International Association of Hydrological Sciences). On Recent development in the explanation and prediction of erosion and sediment yield.

  Presentation of the paper entitled :

  - "AVERAGE ANNUAL WATERSHED SPECIFIC DEGRADATION AND ITS IMPACT ON THE SEDIMENTATION OF MOROCCAN RESERVOIRS"

- R23 : M. LAHLOU Abdelhadi : 1-22 April 1984, Province Hajjah in Arab Republic of North Yemen, Expertise (surface and groundwater) of hydraulic resources potentialities of Hajjah Province, on behalf of the AOAD (Ararb Organization of Agricultural Development), located in Khartoum (SOUDAN). The study is printed in 3 languages : Arabic, English and French.

- R24 : M. LAHLOU Abdelhadi : 8-15 June 1985, BRUSSELS (BELGIUM), Fifth International Congress of IAWR (International Association of Water Resources).

- R25 : M. LAHLOU Abdelhadi : 22-23 Mai 1986, Fez (MOROCCO), First inter-university MOROCCAN-FRENCH on CONTINENTAL WATERS RESOURCES AND SANITATION

- R26 : M. LAHLOU Abdelhadi : 15-20 June 1987 PRAHA, (TCHEQUE REPUBLIC) International Symposium on LIMNOLOGY.

  Publication by the Academy of Sciences of PRAHA of the paper entitled :

  - "WATER EUTROPHICATION OF SIDI MOHAMED BEN ABDELLAH LARGE DAM".

- R27 : M. LAHLOU Abdelhadi : June 1988, OTTAWA (CANADA), Sixth International Congress Of IAWR : International Association of Water Resources.

  Presentation and publication in the Proceedings of the paper entitled :

  - "CRITICAL DROUGHT OBSERVED IN MOROCCO FROM 1980 to 1985".

- R28 : M. LAHLOU Abdelhadi : August 1989, Wallingford (England), Hydraulic Research Laboratory, International Commission of Irrigation and drainage (I.C.I.D). International personal participation to the establishment of the report OD 105 (in August 1989) realized by T.E. Brabben concerning : "ENVIRONMENT IMPACTS OF IRRIGATION AND DRAINAGE PROJECTS AND FLOOD FLOW CONTROL", further international questionnaires. This report contains the results of international risponses and is established with association of work group of ICID commission of Irrigation, drainage and flood flow control. (I was permanent representant of this ICID Commission in MOROCCO).

- R29 : M. LAHLOU Abdelhadi : December 1989, CAIRO (EGYPT) International Symposium on "CLIMATIC FLUCTUATIONS AND WATER MANAGEMENTS".

  The paper presented and published in the Proceedings is entitled :

  - "CRITICAL DROUGHT OBSERVED IN MOROCCO FROM 1980 to 1985, CASE STUDY OF EL KANSERA LARGE DAM ZONE".

- R30 : M. LAHLOU Abdelhadi : 7-12 May 1990, TUNIS (TUNISIA), International Conference, organized by ENIT (TUNISIAN NATIONAL SCHOOL OF INGENIEURS), on "APPLICATION OF MATHEMATICAL MODELS TO ASSESS WATER QUALITY MODIFICATIONS".

  Presentation of the paper published in the Proceedings and entitled :

  - "MODELS OF NORTH AFRICA LARGE DAMS SEDIMENTATION FORECAST" P. 312 - P. 324.

- R31 : M. LAHLOU Abdelhadi : 5-9 August 1990, Manaus (BRAZIL), International Conference on Hydrology and AMAZON HYDRAULIC MANAGEMENTS,

  The paper is entitled :

  - "RESERVOIR WATER EUTROPHICATION IN HOT COUNTRIES. CASE STUDY OF SIDI MOHAMED BEN ABDELLAH LARGE DAM. POSSIBLE APPLICATION TO AMAZON BASIN".

- R32 : M. LAHLOU Abdelhadi : 26-30 August 1991, BRATISLAVA SLOVAK REPUBLIC, Personal expertise and participation with WMO (WORLD METEOROLOGICAL ORGANIZATION) AND UNDP (UNITED NATIONS DEVELOPMENT PROGRAMME).

  The title of study is :

  - "INFORMATION NEEDS FOR WATER QUALITY ASSESSMENT AND MANAGEMENTS".