F: WATER USERS ASSOCIATIONS AND FARM HOUSEHOLD SURVEY

Table of Contents

F: Water Users Associations and Farm Household Survey

F.1 Objectives and Survey Method ---------- F - 1
F.1.1 Survey Method ---------- F - 1
F.1.2 Survey Area and Method ---------- F - 1
F.1.3 Survey Implementation ---------- F - 2
F.2 Survey Results ---------- F - 2
F.2.1 General Situations ---------- F - 2
F.2.2 Current Situation of AUEA---------- F - 4
F.2.3 Water Resources ---------- F - 4
F.2.4 Opinions and Consciousness of Farmers on Current Water Resources ------- F - 4
F.2.5 Opinions of Farmers to Water Fee and Royalty Payment ---------- F - 6
F.2.6 Introduction of Water Saving Technique and Drip Irrigation System --------- F - 7
F.2.7 Consciousness of User's Participation to Water Resources Management ---- F - 7

Tables

Table F.1.1 Survey Points to Agricultural Water Users Association (AUEA)---------- F - 8
Table F.1.2 Survey Points to Farmers ---------- F - 8
Table F.1.3 Number of AUEA and Farmers Surveyed---------- F - 9
TableF.2.1 Agricultural Area by Farmers ---------- F - 9
Table F.2.2 Legal Status of Lands of Surveyed Farmers ---------- F - 9
Table F.2.3 Land Inheritance Type ---------- F - 9
Table F.2.4 Principal Culture by Surveyed Farmers---------- F - 10
Table F.2.5 Sources of Irrigation Water by Culture ---------- F - 10
Table F.2.6 Irrigation Type by Culture ---------- F - 10
Table F.2.7 Average Number of Livestock by Farmer ---------- F - 10
Table F.2.8 Possession of Agricultural Materials and Infrastructure by Farmers -------- F - 10
Table F.2.9 Major Problems and Constraints on Agricultural Activities ---------- F - 11
Table F.2.10 Annual Income of Farmers ---------- F - 11
Table F.2.11 Current Situation of Surveyed AUEA---------- F - 12
Table F.2.12 Irrigation Source of Farmers---------- F - 13
Table F.2.13 State of Irrigation Infrastructure ---------- F - 13
Table F.2.14 Problems and Constraints on Water Resources Use and Management by Farming Scale ---------- F - 13
Table F.2.15 Opinions of Users to Water Royalty of Channel by Farming Scale---------- F - 13
Table F.2.16 Opinions of Users to Water Royalty of Channel by Provinces ---------- F - 14
Table F.2.17 Intention of Channel Water Royalty Payment by Province ---------- F - 14
Table F.2.18 Opinions of Users to Ground Water Fee by Farming Scale---------- F - 14
Table F.2.19 Opinions of Users to Water Royalty of Well by Province ---------- F - 14
Table F.2.20 Opinions of Users to Some Envisaged Countermeasures for Water Resources Management by Farming Scale ---------- F - 15
Table F.2.21 Principals Reasons of Opinions to Envisaged Countermeasures for Water Resources Management ---------- F - 15

Figures

Figure F.1.1 Scale of Farmers by Area and Number of Farmers---------- F - 16
Figure F.1.2 Cultivation Area by Culture ---------- F - 16
Figure F.2.1 Water Quantity of Source Used for Irrigation---------- F - 16
Figure F.2.2 Knowledge of the Law 10-95 ---------- F - 17
Figure F.2.3 Problems and Constraints Mentioned by AUEA for Water Resources Use and Management---------- F - 17
Figure F.2.4 Problems and Constraints Mentioned by Farmers for Water Resources Use and Management---------- F - 18
Figuref.2.5 Necessity of Countermeasures Taking for Water Resources Use and Management ---------- F - 18
Figure F.2.7 Countermeasures for Water Resources Management Proposed by Users--- F - 19
Figure F.2.8 Opinions of Users to Water Royalty of Channel ---------- F - 19
Figure F.2.9 Intention of Channel Water Payment---------- F - 19
Figure F.2.10 Reasons to Channel Water Royalty Payment by Farmers ---------- F - 20
Figure F.2.11 Reasons to Channel Water Royalty Payment by AUEA ---------- F - 20
Figure F.2.12 Intention of Ground Water Payment ---------- F - 20
Figure F.2.13 Reasons to Water Fee Payment for Well by Farmers ---------- F - 21
Figure F.2.14 Reasons to Water Fee Payment for Well by AUEA---------- F - 21
Figure F.2.15 Practiced Water Saving Technique by Farmers---------- F - 21
Figure F.2.16 Constraints for Drip Irrigation System Introduction ---------- F - 21
Figure F.2.17 Opinions of Farmers to Some Envisaged Countermeasures for Water Resources Management ---------- F - 22
Figure F.2.18 Opinions of AUEA to Some Envisaged Countermeasures for Water Resources Management ---------- F - 22

F:WATER USERS ASSOCIATIONS AND FARM HOUSEHOLD SURVEY

F.1 Objectives and Survey Method

F.1.1 Survey Method

The survey aims to collect the socio-economic data of the survey zone and the information on agricultural water management to the Agricultural Water Users Associations (AUEA) and the farmers as the principal water users. It aims to know the intentions of the associations and the farmers for the farming and the water use and to collect their opinions on the water use and the management. This collected information in this survey will be used as source data to examine the actions relating to the water resources management (groundwater, surface water, irrigation) which will be proposed within the framework of present study.

F.1.2 Survey Area and Method

The survey was carried out in the whole of the intervention zone of the study, the provinces of Marrakech, Al Haouz, El Kelaâ des Sraghna and Chichaoua. This survey was carried out in close cooperation with the ABHT, the ORMVAH, DPA/Marrakech and DPA/Chichaoua.

The survey is consisted of the following stages:

Stage 1: Discussions and definition of the principles of execution for the survey and development of the TOR (Terms of Reference)

- Discussions with the ABHT counterparts on the principles of the survey and definition of the study points
- Elaboration of the survey questionnaire;
- Development of the TOR and the survey guide.

Stage 2: Training and coordination for obtaining of the survey execution authorization (ORMVAH, DPA, local Authorities)

- Contact of the organizations concerned by the survey (ORMVAH, DPA, local Authorities) and discussions for the survey implementation (objectives, contents and survey methods);
- Selection of the AUEA and farmers to survey;
- Elaboration of the survey program ;
- Discussion on the survey method ;
- Authorization to the local authority for the survey implementation.

Stage 3: Training of the investigators and the personnel of the concerned organizations

- The training was carried out to the investigators during 2 days;
- Preparation of the survey (preparation of the survey sheets, appointment etc).

Stage 4: Survey implementation

- Three (3) teams consisted of two (2) investigators carried out the survey on-site;
- The survey on-site lasted during twelve (12) days ;

1) 8 days devoted to the ORMVAH zone (19 AUEA and 39 farmers)

2) 2 days devoted to the DPA/Marrakech zone (6 AUEA and 12 farmers)

3) 2 days devoted to the DPA/Chichaoua zone (3 AUEA and 10 farmers)

Stage 5 : Data treatment and analysis of the survey results

F.1.3 Survey Implementation

AUEAs and the farmers were selected according to preset criteria's (geographical distribution, association size, area, activity types, modes of agricultural water use etc).

The investigation proceeded from October 26 to November 10, 2006 (12 days total). The survey was carried out according by the elaborated questionnaire and the interview.

Eighty six (86) surveys were carried out including twenty-eight (28) on AUEA and fifty-eight (58) on the farmers. The number of the surveyed AUEA and the farmers are given in TableF.1.3.

As the subject of the survey is focused on water, the majority of the farmers showed mistrust. Thus, before the starting of the survey, the investigators had amply explained to the farmers the survey objective (to collect information of the reality and to collect the opinions on the water use and management to examine the countermeasures relating to the water resources management to resole their concerns.

Photo 1. Survey with the AUEA members
(Tiguer Ziouine, CT Amizmiz, Al Haouz Province)

Photo 2. Survey with the farmers
(CMV404, CR Attaouya, El Kelaâ des Sraghna Province)

F.2 Survey Results

F.2.1 General Situations

(1) Agriculture Area and Land Legal Status

The agricultural areas by the surveyed farmers, scale and numbers of farmers by the area are shown in Table F.2.1 and Figure F.2.1 respectively.

The micro farmers less than 10 ha dominate three quarter of a total number of the studied farmers. On the other hand, the large farmers who have more than 20 ha of agricultural area dominate 74% of total area of the surveyed farmers.

Table F.2.2 shows the legal status of the land of the surveyed farmers. The characteristic of the land

status differs according to the provinces. The Melk is dominated more than 70% of the surface in the Province of Al Haouz and Chichaoua. On the other hand, the Guich and the State Domain are more representative in the Province of Marrakech. The Province of El Kerâa des Sragna is characterized by the predominance of the collective lands.

(2) Agriculture Production

Principal agricultural products, the production, the cultivated area and the irrigation type of the surveyed farmers is quote in Figure F.2.2 and Table F.2.4 respectively.

Among the surveyed farmers, the cultivation of cereals and arboriculture are dominated of total surface including 50.2% and 32.5 % respectively. Then, the vegetable cultivating (7.9%), the fodder crops (5.4%) and the food bean plant (4.1%) are cultivated.

For the number of farmers, the culture of olive-tree is represented 81% of the total number of the farmers and 3.5 ha on average. Then, the wheat (40 farmers) and the alfalfa (40 farmers) are cultivated by the farmers.

The source of the irrigation water and the irrigation type by the culture are quoted respectively in Table F.2.5 and F.2.6.

The gravitating irrigation is a irrigation method more represented, in particular, the cereals cultivation with a great surface. There is a tendency to introduce the drip irrigation system for certain cultures which have values such as melon, water melon, vegetables and the fruit trees.

(3) Agricultural Materials and Infrastructures

Table F.2.8 shows the possession of agricultural materials and infrastructures by the farmers. The possession rate of the well is relatively high (67.2%). The majority of well is used in parallel with the channels and seguias for the agricultural production. This tendency expresses a high dependence of the groundwater resources for the irrigation. Thus, the rate of diffusion of drip irrigation system is still low (13.8%).

(4) Problems and Constraints of Agricultural Activities

Table F.2.9 summarizes the problems and the constraints on the agricultural activities which are mentioned AUEA and farmers. The problems and the constraints of the agricultural activities in the study zone are diversified such as the weakness of the productivity, the insufficiency of the agricultural infrastructures and materials, the fall of market price and the rise of the production cost etc

The AUEA has shown the problems involved in the irrigation (the insufficiency of the irrigated water volume, the insufficiency and the irregularity of precipitation etc) and in the collective work such as the lowering of market price of agricultural produce. On the other hand the farmers, they have leaning to put importance the problems related directly to the farming such as the price rising of seeds and seedlings, the lack of agricultural equipments.

Concerning the irrigation cost, almost 70% of the farmers feel a burden for the irrigation expenses whereas 46% of the AUEA. It is because of the different position between the AUEA charged management of the channels and the seguias and the particular farmer who has an obligation of payment for the use of these facilities.

(5) Income of Farmers

When the foreigner asks questions about the income, the majority of the farmers shows mistrust and sometimes refuses the answer, because they think that these questions are for the taxation. Also, they are not accustomed to holding their accounts, quantified income as the farmer answers cannot be reliable.

Thus the annual income of 14 farmers quoted in Table F.2.10 is regarded as a reference. The annual income of one family which holds 5 members and 8 ha of the arable lands (average of 14 farmers) is 46,000 DH.

F.2.2 Current Situation of AUEA

The state of the activities of the Agricultural Water Users Association (AUEA) is summarized in Table F.2.11. Almost all the AUEA has the internal regulation and organizes the general assemblies. However, only 15 AUEA organize their general assembly since 2005 and half of the AUEA is not organized regularly.

12 AUEA (43%) do not collect the membership fees. Thus among 16 AUEA which collect the membership fees, 5 AUEA express the difficulty of collection.

Certain AUEA shows the other organizational problems such as lack of communication to the members (2 cases), the weak participation in the AUEA activities (5 cases) and the conflict enters the members (2 cases).

F.2.3 Water Resources

The farmers in the action zone of the ORMVAH use the Rocade channel and those which are in the zone of DPA use the seguias like the irrigation water sources. Also the many farmers have the well for the irrigation.

70% of the users of the channel and the well claim the lack of the water volume and 96% of the seguias users which is lowered or dried up during the dry season claim the lack of the water quantity (Figure F.2.3.).

Concerning the water level of the well, almost all the user claims that the water level is lowered year by year (of 0.5 with 1m per annum).

Table F.2.12 shows the current state of the irrigation infrastructures. The users show that 23.5% of the channel and 25.9% of the seguias are into bad condition or damaged. Principal maintenance of the channel and the seguias are the dredging out and cleaning.

The well, the pump and the irrigation system are in good condition or the passable condition (more than 80%). They are in general the private properties.

F.2.4 Opinions and Consciousness of Farmers on Current Water Resources

(1) Legislative Knowledge of Farmers

Figure F.2.4 shows the knowledge on the Water Law 10-95 by the AUEA and the farmers surveyed. According to the result, only 16% of the AUEA and farmers have knowledge on the Law 10-95.

The AUEA which have knowledge on the Law 10-95 are accounted for 32%, on the other hand 9% by the particular farmers. Because the members of the surveyed AUEA were the presidents and the

executives who have the occasion of meeting with the administrative services as the ORMVAH and the ABHT, it is supposed that the knowledge level of the AUEA is higher than the farmers.

(2) Consciousness of Farmers on Current Situation of Water Resources

Figure F.2.5 and F.2.6 summarize the problems and the constraints on the use and the management of the water resources which are mentioned by the AUEA and the farmers.

Principal common problems and constraints are as follows:

1) Insufficiency of the irrigation water volume (84.9%);
2) Difficulty for the maintenance of the hydraulic facilities (77.9%);
3) Insufficiency of the development of the channels and seguias particularly until the individual parcels (66.3%);
4) Difficulty to obtain the fuel for pumping (65.1%);
5) Lowering the water level of the well (57.0%);
6) Difficulty of payment of the water royalty (53.5%).

For the particular farmers, on the one hand, the drawdown of water level of the well and the insufficiency of adequate irrigation systems which are mainly the private owned are the remarkable problems. On the other hand for the AUEA which is in charge of hydraulic facilities management, the insufficiency of the irrigation networks development and the difficulty of hydraulic facilities repair are quoted as the major problems.

Table F.2.14 shows the problems on the water resources use and management by the farming scale. When the agricultural area increases, the problems as the water quantity insufficiency, the water level lowering in the well, the difficulty of fuel payment for pumping, are also increased. It is about the water level lowering by the overexploitation of the groundwater because it is difficult to satisfy the need for the irrigation water to the agricultural surface widening.

On the other hand, when the farming scale became smaller, the problems of the insufficiency of adequate irrigation means are increased. It can be expressed that it is difficult to invest the irrigation infrastructures for the small farmers who their financial capacities are low.

Vis-a-vis the problems on the water resources use and management, 81% of the farmers and 96% of the AUEA answered that it would be necessary to take some countermeasures to the water resources management to solve the problems quoted above (Figure F.2.7).

The majority of the principal reasons to take countermeasures are for the increase of the agricultural production and the reduction of the charge by the water users such as the water consumption saving, the productivity improvement by the irrigation cost reduction. Only 15% of the users answer that it is necessary to take the countermeasures for the water resources conservation.

The countermeasures for the water resources management which are proposed by the surveyed water users are quoted in Figure F.2.8. The majority of the proposal is accentuated to irrigation infrastructure development, the exploitation of the ground water resources, the interest of the users (assistance of the fuel for pumping, the reduction of the water royalty etc). The proposal for the water resources conservation like the effort of water saving and the water use regulation is not well found out. These

results can be translated by the lack of conscience of the users to the water resources crisis of the Haouz plain.

F.2.5 Opinions of Farmers to Water Fee and Royalty Payment

(1) Surface Water Royalty (Channel)

The opinions of the users (AUEA and farmers) on the water royalty of the channel are quoted in Figure F.2.9, Table F.2.15 and F.2.16 respectively. For the AUEA, 47% of the users answer that the royalty is expensive and 21% think that it is not expensive. On the other hand for the particular farmers, 54% of the users think that the royalty is expensive and only 5% answer that it is not expensive. The channel royalty is a charge for the farmers because it must be versed to the ORMVAH by each individual member (farmers).

More than 50% of the users think that the channel water royalty is expensive, 90% of the users of the Province of El Kelâa of Sragna particularly consider that it is expensive (Table F.2.16).

Figure F.2.10 shows the intention of the water royalty payment by the farmers and the AUEA, and then Table F.2.17 shows the intention of the royalty payment by the provinces respectively.

As for the intention of the channel water royalty payment, between 60% and 90% of the users in the ORMVAH zone answers that it is necessary to pay the water royalty. On the other hand in the DPA zone which the users use the seguias and the wells for the irrigation and currently do not pay the royalty, only between 25% and 55% of the users answer the participation of the water royalty payment (Table F.2.17).

The reasons of each opinion on the water royalty payment by the farmers and the AUEA show in Figure F.2.11 and F.2.12 respectively.

The guarantee for the irrigation water use is the more dominant reason for the water royalty payment (40%), then the economy of the water consumption and the obligation regulated by the law (27% respectively).

On the other hand, for the reasons which they are not necessary to pay the royalty, water must be ensured by the Government (37%), the users have the right of the use of the irrigation water (30%), the same farmers invested for the irrigation infrastructures and its functions (19%).

(2) Groundwater Fee (Wells)

Figure F.2.13 shows the intention of payment of ground water fee by the farmers and the AUEA, and then the opinions of the users to the ground water fee by the farming scale (agricultural surface) and by the provinces are shown in Table F.2.18 and F.2.19 respectively.

Concerning the payment of the ground water fee for the irrigation, about 75% of the users are vehemently opposed to pay the ground water fee.

As the agricultural surface scale increasing, the farmers oppose more and more to the ground water fee payment, in particular all the farmers having more than 10 ha of agricultural area.

The reasons of each opinion to the payment of the ground water fee by the farmers and the AUEA show in Figure F.2.14 and F.2.15 respectively.

To guarantee the sufficient water volume for the irrigation is the more dominant reason for the

payment of the ground water fee (31%), then the economy of the water consumption by the payment (the cost saving, 28%), the obligation regulated by the law (27%) and the protection of the acquirer.

On the other hand, the reasons which they refuse to pay the ground water fee, water (underground) must be free (38%), the insufficiency of the financial capacity (26%), the farmers already invest for the well realization, the purchase of the pumping system and its function (fuel, maintenance cost) (19%) and users will not have more the benefit if they pays (the 14%).

F.2.6 Introduction of Water Saving Technique and Drip Irrigation System

The techniques practiced for the water saving by the surveyed AUEA and farmers are quoted in Figure F.2.16. The control of the water loss by the dredging, cleaning, and the repair of the water leaks are the techniques of water saving more practiced by the farmers (59%). The introduction of the irrigation system such as drip irrigation and the improved gravitating are limited for its dissemiation (32%).

The major problem for the drip irrigation system introduction is the weak financial capacity of the farmers (more than 50%, Figure F.2.17).

To receive the subsidy, the difficulty of 40% of the assumption of the recipient and the complicated procedure of subsidy (it is necessary to invest initially by the recipient, then there is a long procedure of the request, the examination, the recognition and the subsidy delivery) are the limited factors for the drip irrigation system introduction.

F.2.7 Consciousness of User's Participation to Water Resources Management

The opinion and the intention of the user's participation to some countermeasures for the water resources management envisaged are quoted in Figure F.2.18 and F.2.19 respectively. And then, the opinion by the farming scale is shown in Table F.2.18. And also the principal reasons of the opinions to the countermeasures of the water resources management envisaged are quoted in Table F.2.19.

The majority of the users (94.2%) accept to the enlightenment activities for the sustainable water resources management and the water saving. The subsidy increasing in order to introduce the drip irrigation system, the introduction of the species which have the economical values and the function of the water economy are also obtained the favorable answer by the users (88% respectively). Also, 80.2% of the users accept the reinforcement of the monitoring and the control because it will be possible to avoid the overexploitation of water, to preserve the water resources and to use equitably.

On the other hand, the users vehemently oppose the countermeasures which require the charge to the recipient such as the increase in the channel water royalty (67.4% of the objection), the collection of the ground water royalty (66.3% of the objection) and the obligation of the volumemeter installation to the well (57.0% of the objection).

Table F.1.1 Survey Points to Agricultural Water Users Association (AUEA)

I. Generalities/AUEA status	Creation date and year, Objective of the association, AUEA members, Adhesion conditions, Composition of the administration council and internal regulation, Modality of the administration council members selection, General Assembly of the AUEA (frequency, principal subject of discussion, report or minute of meeting), AUEA zone, Property of the AUEA member
II. Production activities of the AUEA	Area and production, cultivate mode and irrigation technique, Existing infrastructures for agriculture, Results, problems and constraints
III. Financial Situation of the AUEA	Balance sheet (membership fee, expenditure, credit etc), Financial report presented to the General assembly
IV. Legislative knowledge	Legislative knowledge on the water management and use in particular the Water Law 10-95, Opinions to the regulations related to the water management
V. Relation with administration	Relationship type, frequency, Expectations to the administrative services
VI. Access to the financial sources	External support : Amount and support contents Agricultural credit : Amount and loan modalities
VII. Water resources management	Hydraulic infrastructure types (channels, seguias, wells, pumps, irrigation system), Intake and utilization of the water quantity, Agricultural water management system, Royalty modalities and situation, Problems/constraints for the water management
VIII. Opinion on the water resources management and use	Situation before/actual of the water resources (perception of the situation), Degree of consciousness on the participation to the water resources management of which the financial and physical participation, Motivation of the participation for the water resources management, Methods applied for the water saving

Table F.1.2 Survey Points to Farmers

I. Generalities of the household	Family structure (sex, age, avocation and education level), Estate status, land acquisition modes, Matters of concern for the daily life, Decision making in the household
II. Income and outgo	Annual income and outgo, Expenditure for the water pumping and intake
III. Production activities	Area and production, cultivate mode and irrigation technique, Existing infrastructures for agriculture, Results, problems and constraints
IV. Legislative knowledge	Legislative knowledge on the water management and use in particular the Water Law 10-95, Opinions to the regulations related to the water management
V. Relation with administration	Relationship type, frequency, Expectations to the administrative services
VI. Access to the financial sources	External support : Amount and support contents Agricultural credit : Amount and loan modalities
VII. Water resources management	Hydraulic infrastructure types (channels, seguias, wells, pumps, irrigation system), Intake and utilization of the water quantity, Agricultural water management system, Royalty modalities and situation, Problems/constraints for the water management
VIII. Opinion on the water resources management and use	Situation before/actual of the water resources (perception of the situation), Degree of consciousness on the participation to the water resources management of which the financial and physical participation, Motivation of the participation for the water resources management, Methods applied for the water saving

Table F.1.3 Number of AUEA and Farmers Surveyed

Province	Marrakech		Al Haouz		El Kelaâ Sraghna	Chichaoua
Category of Area	ORMVAH	DPA/M	ORMVAH	DPA/M	ORMVAH	DPA/C
Surveys to AUEA	5	1	4	5	10	3
TOTAL AUEA	6		9		10	3
Surveys to farmers						
over 20 ha	3		1	1	2	2
10ha-20ha	2	1	1	1	1	1
5ha-10ha	5	1	2	3	7	1
below 5ha	5		1	5	7	3
Unanswered					2	
TOTAL farmers	15	2	5	10	19	7
TOTAL Survey	23		24		29	10

TableF.2.1 Agricultural Area by Farmers

Category	Number	SAU (ha)	Irrigated area		
			Permanent (ha)	Seasonal (ha)	Mud/Flood (ha)
Less than 5ha	18	3.0	1.9	0.8	0.3
5ha-10ha	21	6.3	4.2	1.0	1.1
10ha-20ha	7	11.6	6.3	2.6	2.7
More than 20ha	19	79.6	20.2	27.8	31.6

Table F.2.2 Legal Status of Lands of Surveyed Farmers (%)

Legal status of the lands	Total	Marrakech	Al Haouz	El Kerâa des Sragna	Chichaoua
Melk	46.8	11.1	73.3	50.0	71.4
Guich	19.4	66.7	0.0	0.0	0.0
State Domain	11.3	22.2	13.3	4.5	0.0
Collective	21.0	0.0	13.3	40.9	28.6
Others	1.6	0.0	0.0	4.5	0.0

Table F.2.3 Land Inheritance Type (%)

Inheritance by parents	Inheritance by others families	Land purchase	Others
55.1	2.6	21.8	20.5

Table F.2.4 Principal Culture by Surveyed Farmers

		Area (ha)	Number of farmers	Area by farmers (ha)
Cereal culture	Wheat	327.0	40	8.2
	Barley	143.8	26	5.5
Vegetable culture	Potato	12.7	12	1.1
	Tomato	3.3	2	1.6
	Mellon, Water melon	53.0	3	17.7
Arboriculture	Olive	165.0	47	3.5
	Citrus plants	90.0	3	30.0
	Apricot	39.8	7	5.7
	Apple	5.8	3	1.9
Food bean culture	Fava bean	33.5	17	2.0
	Lentil	3.3	2	1.6
Fodder crops	Alfalfa	30.2	40	0.8
	Bersim	15.4	24	0.6

Table F.2.5 Sources of Irrigation Water by Culture (%)

	Cereal culture		Vegetable culture			Arboriculture				Food beans		Fodder crops	
	Wheat	Barley	Potato	Tomato	Melon・W.melon	Olive	Citrus	Apricot	Apple	Fava	Lentil	Alfalfa	Bersim
Channel	41.4	29.5	27.3	50.0	0.0	35.5	37.5	28.6	33.3	32.0	50.0	41.7	40.9
Modern seguia	17.1	29.5	18.2	50.0	0.0	19.4	25.0	14.3	0.0	16.0	0.0	20.8	22.7
Tradition seguia	1.4	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0	1.4	2.3
Well	24.3	22.7	50.0	0.0	100.0	34.4	12.5	42.9	50.0	44.0	50.0	25.0	25.0
Rainfall	15.7	18.2	4.5	0.0	0.0	7.5	25.0	14.3	16.7	8.0	0.0	11.1	9.1

Table F.2.6 Irrigation Type by Culture (%)

	Cereal culture		Vegetable culture			Arboriculture				Food beans		Fodder crops	
	Wheat	Barley	Potato	Tomato	Melon・W.melon	Olive	Citrus	Apricot	Apple	Fava	Lentil	Alfalfa	Bersim
Gravitating	82.5	69.2	75.0	50.0	0.0	78.7	66.7	71.4	100.0	52.9	50.0	90.0	95.8
Drip irrigation	0.0	0.0	8.3	50.0	100.0	8.5	0.0	28.6	0.0	23.5	50.0	2.5	0.0
Without irrigation	2.5	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No response	15.0	26.9	16.7	0.0	0.0	12.8	33.3	0.0	0.0	23.5	0.0	7.5	4.2

Table F.2.7 Average Number of Livestock by Farmer

Bovine	Ovine	Caprine	Domestic fowl	Horse	Donkey
3.0	22.4	2.1	2.3	0.2	0.3

Table F.2.8 Possession of Agricultural Materials and Infrastructure by Farmers (%)

Channel	Well	Séguia		Pump	Drip irrigation	Tractor	Vehicle of transport	Storage	Others
		Tradition	Modern						
58.6	67.2	67.2	32.8	50.0	13.8	17.2	8.6	27.6	12.1

Table F.2.9 Major Problems and Constraints on Agricultural Activities

Rank	AUEA	%
1	Lowering of the market price of production	89.3
2	Water quantity insufficiency for irrigation	85.7
3	Weak income	82.1
4	Insufficiency of rainfalls	82.1
5	Run-up of the seeds/seedlings price	78.6
6	Lack of storage means	78.6
7	Lack of transport means for products	78.6
8	Lack of agricultural equipments	75.0
9	Lowering of agricultural yield	75.0
10	Lack of technical training	75.0
11	Lack of commercialization/products valorization	71.4
12	Lack of irrigation infrastructure	67.9
13	Lack of financial sources (Loan, Subsidy by government, Aide…)	64.3
14	Knowledge insufficiency on cultivation technique	57.1
15	Lack of leading by the technical services	50.0
16	Run-up of irrigation fee	46.4

Rank	Farmers	%
1	Weak income	91.4
2	Run-up of the seeds/seedlings price	82.8
3	Lack of agricultural equipments	82.8
4	Lowering of the market price of production	81.0
5	Water quantity insufficiency for irrigation	79.3
6	Lowering of agricultural yield	77.6
7	Lack of storage means	75.9
8	Lack of commercialization/products valorization	74.1
9	Lack of transport means for products	70.7
10	Run-up of irrigation fee	69.0
11	Lack of irrigation infrastructure	65.5
12	Lack of financial sources (Loan, Subsidy by government, Aide…)	65.5
13	Insufficiency of rainfalls	63.8
14	Lack of technical training	63.8
15	Knowledge insufficiency on cultivation technique	56.9
16	Lack of leading by the technical services	51.7

Table F.2.10 Annual Income of Farmers

No	Annual income (DH)	Income sources	Annual expenditure (DH)	Principal expenditure	Agricultural area (ha)	Number of family
1	20,000	Olive, Cereal, Livestock	20,000	Education, Health care, Foods	5	8
2	25,000	Olive, Cereal, Livestock	25,000	Education, Health care	7	5
3	60,000	Olive, Cereal	50,000	Education, Health care, Animal fodder	12	6
4	60,000	Olive, Cereal, Potato, Milk	60,000	Education, Displacement, Foods	3	5
5	90,000	Olive, Cereal	80,000	Education, Labor, Fuel	7	8
6	80,000	Olive, Cereal, Potato, Livestock, Milk	80,000	Education, Foods	5	6
7	60,000	Olive, Cereal	50,000	Education, Seeds	12	3
8	42,000	Olive, Cereal, Apricot, Milk	42,000	Education etc.	8	6
9	60,000	Olive, Cereal, Citrus	62,000	Education, Seeds	8	6
10	20,000	Olive, Cereal, Apricot, Livestock, Milk	20,000		15	8
11	30,000	Olive, Cereal, Potato	30,000	Education etc.	22	4
12	35,000	Olive, Cereal, Potato	35,000	Education, Seeds	5	4
13	15,000	Olive			1.5	3
14	40,000	Olive		Education, Agricultural materials	5	7
	45,500		46,167		8	5

Table F.2.11 Current Situation of Surveyed AUEA

ID	Name of AUEA	Creation year	Province	Leading Service	Members			Membership fee	Financial report	Internal regulation	Regular general assembly
					M	F	Total				
1	EL KASSIMIA (D2)	1979	El Kerâa Sragna	ORMVAH	250	25	275	○	○	○	○
2	ATTAOUIA CHAIBIA	1979	El Kelâa des Sragna	ORMVAH	50	8	58	○	×	○	○
3	SIDI AHMED	1998	El Kelâa des Sragna	ORMVAH	463	0	463	×	×		○
4	BOUROUTIA	1978	El Kelâa des Sragna	ORMVAH	1,100	0	1,100	×	○	○	○
5	EL AARGOUB	2000	El Kelâa des Sragna	ORMVAH	240	0	240	×	×	○	○
6	Saada G1	1999	El Kelâa des Sragna	ORMVAH	245	30	275	○	○	○	○
7	El Fath (Moderne)	1979	El Kelâa des Sragna	ORMVAH	142	30	172	○	○	○	○
8	Saltania (Traditionnelle)	1992	El Kelâa des Sragna	ORMVAH	23	0	23	○	○	○	○
9	El Amal	1994	Narrakech	ORMVAH	95	15	110	×	×	○	○
10	Seedikia	1973	Narrakech	ORMVAH	17	1	18	×	×	○	○
11	Bouhssinia	2002	Al Haouz	ORMVAH	47	0	47	○	○	○	○
12	El Hakkoukia	1990	El Kelâa des Sragna	ORMVAH	58	12	70	○	○	○	○
13	El Wifaq	2000	El Kelâa des Sragna	ORMVAH	50	13	63	○	○	○	○
14	Ait Matene	1998	Al Haouz	ORMVAH	310	20	330	×	×	○	×
15	Talghoumte	1991	Al Haouz	ORMVAH	500	0	500	×	×	○	×
16	Tazakorte	1992	Marrakech Menara	ORMVAH	226	0	226	○	○	○	○
17	Agafay	2000	Marrakech Menara	ORMVAH	495	30	525	×		×	○
18	Tamezguelft	2001	Marrakech Menara	ORMVAH	1,047	0	1,047	×	×	○	×
19	Coopérative Zouhria	1969	Al Haouz	ORMVAH	8	1	9	×	×	○	○
20	El Houaouiya (El Khir)	1991	Marrakech Menara	DPA/M	369	0	369	×	×		×
21	Sidi Hassan	1992	Al Haouz	DPA/M	540	50	590	○	○	○	○
22	Makhfanane	1993	Al Haouz	DPA/M	60	6	66	○	○	○	○
23	Tiguen Ziouine	1990	Al Haouz	DPA/M	120	0	120	○		○	○
24	Sidi Ali	2000	Al Haouz	DPA/M	62	0	62	○	○	○	○
25	Amzough	1999	Al Haouz	DPA/M	168	10	178	○	○	○	○
26	Tajoujt	1972	Chichaoua	DPA/C	20	6	26	×	○	○	○
27	Ruuiguia	1993	Chichaoua	DPA/C	14	3	17	○	○		○
28	Coopérative Bouzida	1973	Chichaoua	DPA/C	16	9	25	○	○	○	○

Table F.2.12 Irrigation Source of Farmers

Province	Leading Service	Channel	Séguia	Well	Total
El Kerâa des Sragna	ORMVAH	19	0	16	35
Marrakech	ORMVAH	13	6	10	29
	DPA/M	0	0	2	2
Al Haouz	ORMVAH	2	3	5	10
	DPA/M	0	10	4	14
Chichaoua	DPA/C	2	2	6	10
TOTAL		36	21	43	100

Table F.2.13 State of Irrigation Infrastructure

	Channel		Séguia		Well		Pump		Drip irrigation	
	AUEA	Farmer	AUEA	Farmer	AUEA	Farmer	AUEA	Farmer	AUEA	Farmer
Good	33.3	36.4	9.1	20.0	45.5	24.1	33.3	44.4	40.0	33.3
Passable	27.8	24.2	45.5	40.0	36.4	62.1	33.3	50.0	20.0	66.7
Bad	22.2	15.2	18.2	20.0	0.0	0.0	0.0	5.6	0.0	0.0
Damaged/Outage	16.7	0.0	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonresponse	0.0	24.2	9.1	20.0	18.2	13.8	33.3	0.0	40.0	0.0

Table F.2.14 Problems and Constraints on Water Resources Use and Management by Farming Scale (%)

	Insufficiency water quantity	Aggravation water quality	Lowering water level of the well	Lack of adequate irrigation means	Insufficiency channel/séguia development	Difficulty of royalty payment	Difficulty of fuel payment	Difficulty facilities repair	Insufficiency infrastructures	Others
Less5ha	72.2	5.6	50.0	66.7	66.7	55.6	55.6	77.8	22.2	11.1
5ha-10ha	85.7	0.0	57.1	47.6	66.7	52.4	66.7	81.0	33.3	4.8
10ha-20ha	100.0	0.0	71.4	42.9	57.1	42.9	71.4	71.4	57.1	14.3
Plus 20ha	90.0	10.0	100.0	30.0	50.0	50.0	90.0	70.0	40.0	20.0

Table F.2.15 Opinions of Users to Water Royalty of Channel by Farming Scale (%)

	Less 5ha	5ha-10ha	10ha-20ha	Plus 20ha
Royalty is expensive	61.1	60.0	42.9	44.4
Royalty is not expensive	5.6	5.0	0.0	11.1
We don’t know	33.3	35.0	57.1	44.4
Nonresponse	0.0	5.0	0.0	0.0

Table F.2.16 Opinions of Users to Water Royalty of Channel by Provinces (%)

	Total	Province					
		El Kelâa des Sragna	Marrakech		Al Haouz		Chichaoua
		ORMVAH	ORMVAH	DPA/M	ORMVAH	DPA/M	DPA/C
Royalty is expensive	51.2	89.7	60.0	0.0	44.4	0.0	20.0
Royalty is not expensive	10.5	3.4	25.0	100.0	0.0	0.0	0.0
We don't know	30.2	0.0	10.0	0.0	33.3	86.7	80.0
Nonresponse	8.1	6.9	5.0	0.0	22.2	13.3	0.0

Table F.2.17 Intention of Channel Water Royalty Payment by Province (%)

	Total	Province					
		El Kelâa des Sragna	Marrakech		Al Haouz		Chichaoua
		ORMVAH	ORMVAH	DPA/M	ORMVAH	DPA/M	DPA/C
We must pay the royalty.	62.1	79.3	90.0	54.5	62.5	26.7	40.0
It is not necessary to pay the royalty	17.2	6.9	5.0	18.2	25.0	33.3	30.0
We have an intention but we can not pay the royalty	10.3	13.8	5.0	27.3	0.0	6.7	0.0
We don't know	10.3	0.0	0.0	0.0	12.5	33.3	30.0

Table F.2.18 Opinions of Users to Ground Water Fee by Farming Scale (%)

	Less 5ha	5ha-10ha	10ha-20ha	Plus 20ha
Necessary to pay	44.4	9.5	0.0	0.0
Not necessary to pay	50.0	85.7	100.0	100.0
Nonresponse	5.6	4.8	0.0	0.0

Table F.2.19 Opinions of Users to Water Royalty of Well by Province (%)

	Total	Province					
		El Kelâa des Sragna	Marrakech		Al Haouz		Chichaoua
		ORMVAH	ORMVAH	DPA/M	ORMVAH	DPA/M	DPA/C
Necessary to pay	25.0	44.8	15.0	33.3	0.0	13.3	10.0
Not necessary to pay	73.5	51.7	85.0	66.7	100.0	73.3	90.0
Nonresponse	1.5	3.4	0.0	0.0	0.0	13.3	0.0

Table F.2.20 Opinions of Users to Some Envisaged Countermeasures for Water Resources Management by Farming Scale

	Limit of canal water intake	Introduction of value and water conserved species	Royalty raising for channel	Limit of well construction and water intake	Instillation of well meters	Royalty to wells obligatory	Surveillance reinforce	Subvention for drip irrigation systems	Enlightenment activities
Less 5ha	22.2	72.2	22.2	61.1	44.4	44.4	94.4	77.8	94.4
5ha-10ha	52.4	95.2	9.5	57.1	23.8	9.5	81.0	90.5	95.2
10ha-20ha	57.1	100.0	0.0	71.4	28.6	0.0	100.0	100.0	100.0
Plus 20ha	40.0	80.0	10.0	40.0	10.0	10.0	70.0	90.0	90.0

Table F.2.21 Principals Reasons of Opinions to Envisaged Countermeasures for Water Resources Management

Envisaged countermeasures	Reasons for arguments	Reasons for objection
Limit of channel water intake volume	Require irrigation water saving and management	Insufficiency of the current water quantity and also in the future
Introduction of the species which have more economic value and which can save water	It is necessary for the water saving under the condition of the production increasing and of the market ensuring	Lack of the knowledge and the leading for the dissemination
Channel water royalty raising	Argument under the condition of the production increasing and of the intaking water ensuring	Royalty cost is already expensive
Limit of well construction and water intake approval	For minimize the overexploitation of the ground water	Farmers have the right of the ground water exploitation
Instillation of the volumemeter to the well	To regularize the water intake volume and to avoid the overexploitation of the ground waters	Wells are individual property Investment is already done for the wells function
Payment obligatory of the water royalty from the wells	It is regulated by the Water Law 10-95	Wells are individual property Investment is already done for the wells function Users will not have more the benefit if they pays
Reinforcement of the surveillance and the control	For the equitable water management To avoid the overexploitation and infraction of the water resources	-
Subvention expansion for the drip irrigation systems installation	To save irrigation water and to improve the agricultural production	-
Organization of the Enlightenment activities for water resources and water saving	Training of the water saving technique and the water management Lack of the information on the current situation of the water resources in the Haouz plain It is efficient the enlightenment activities for the water resources management	-

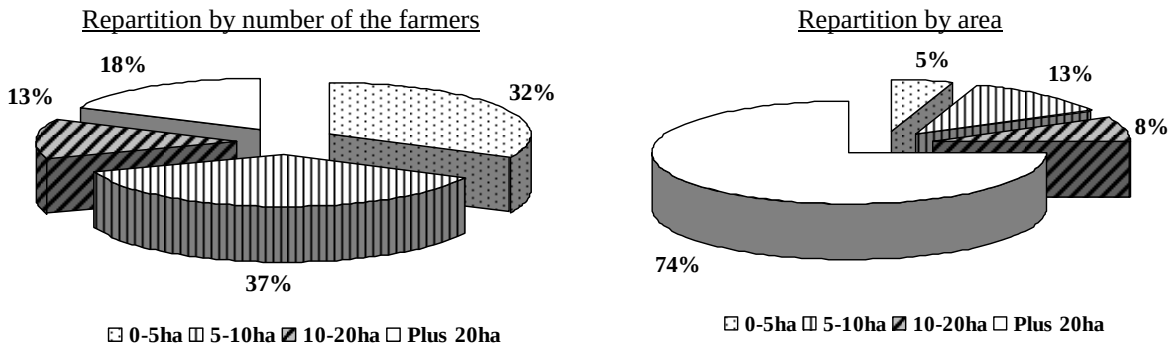


Figure F.1.1 Scale of Farmers by Area and Number of Farmers

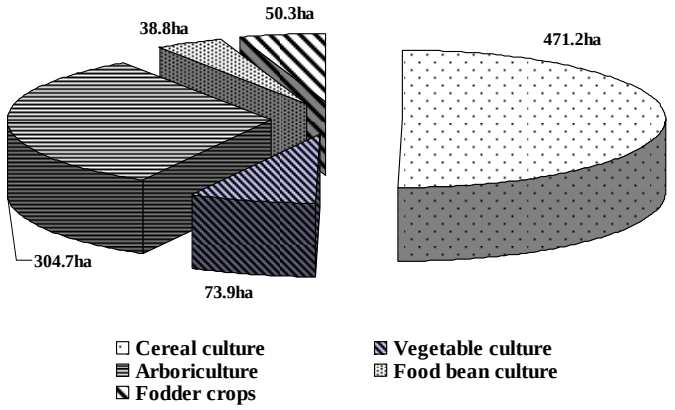


Figure F.1.2 Cultivation Area by Culture

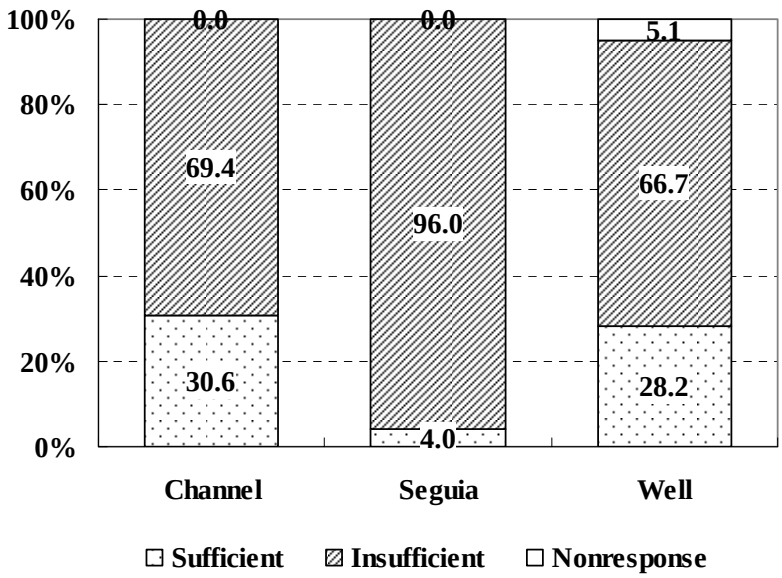


Figure F.2.1 Water Quantity of Source Used for Irrigation

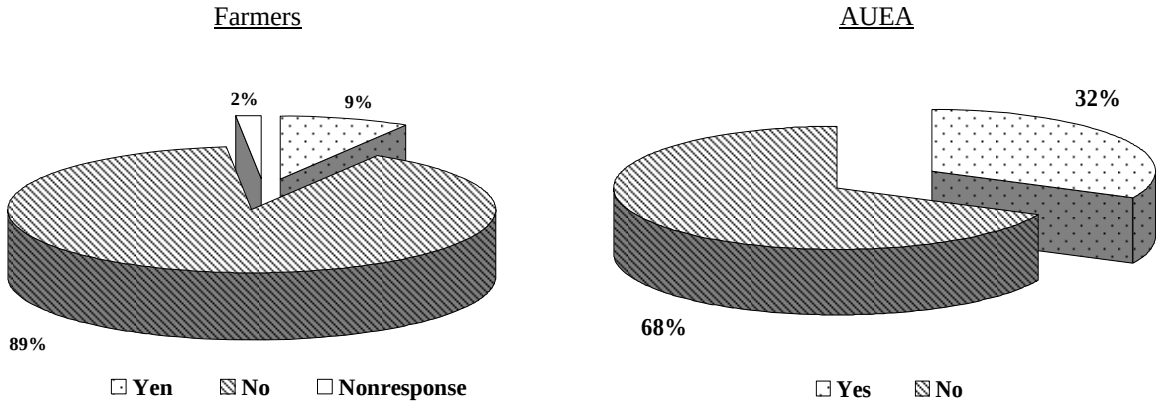


Figure F.2.2 Knowledge of the Law 10-95

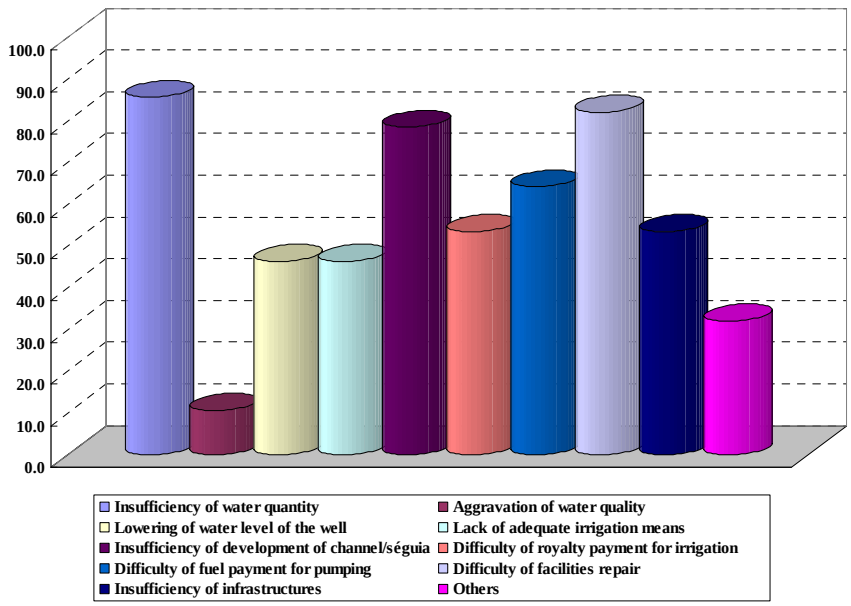


Figure F.2.3 Problems and Constraints Mentioned by AUEA for Water Resources Use and Management (%)

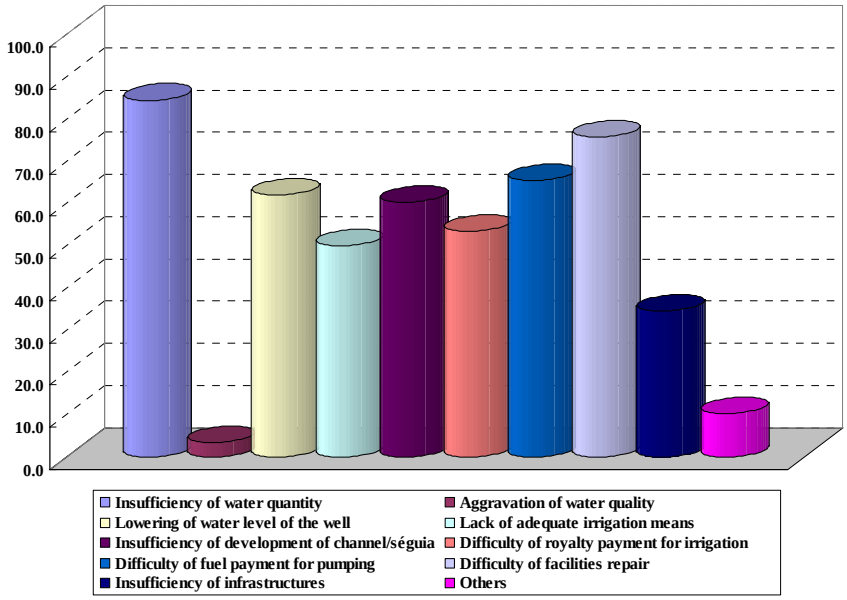
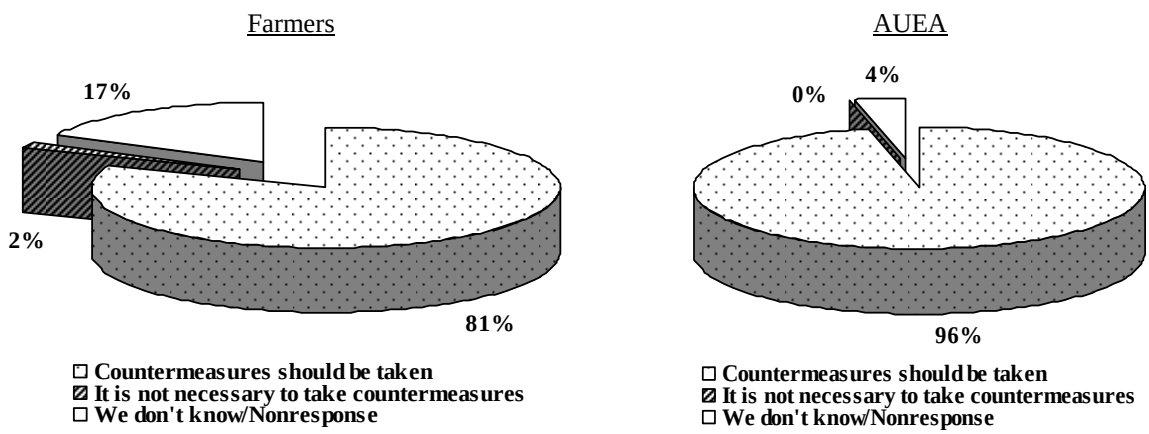


Figure F.2.4 Problems and Constraints Mentioned by Farmers for Water Resources Use and Management (%)



Figuref.2.5 Necessity of Countermeasures Taking for Water Resources Use and Management (%)

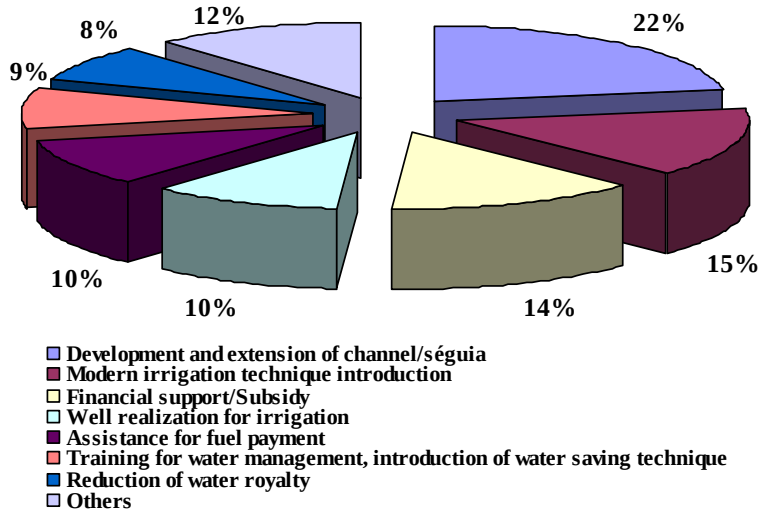


Figure F.2.7 Countermeasures for Water Resources Management Proposed by Users

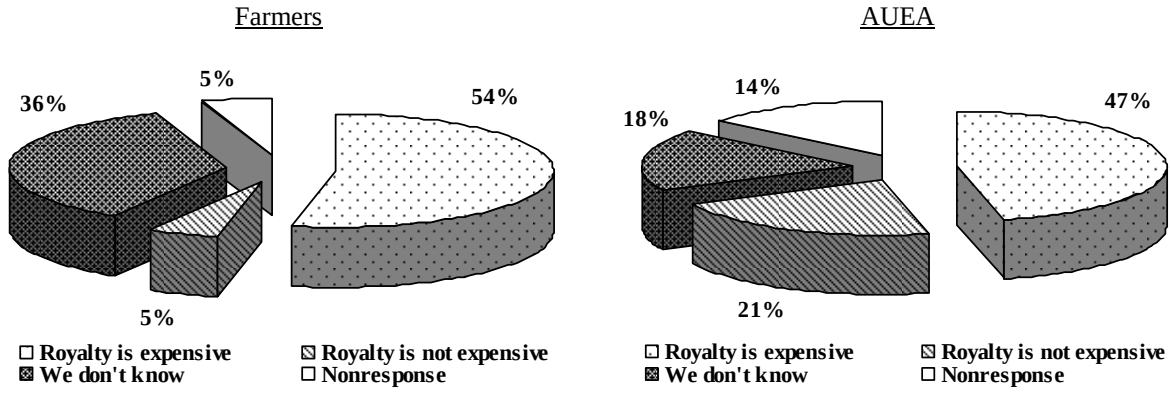


Figure F.2.8 Opinions of Users to Water Royalty of Channel (%)

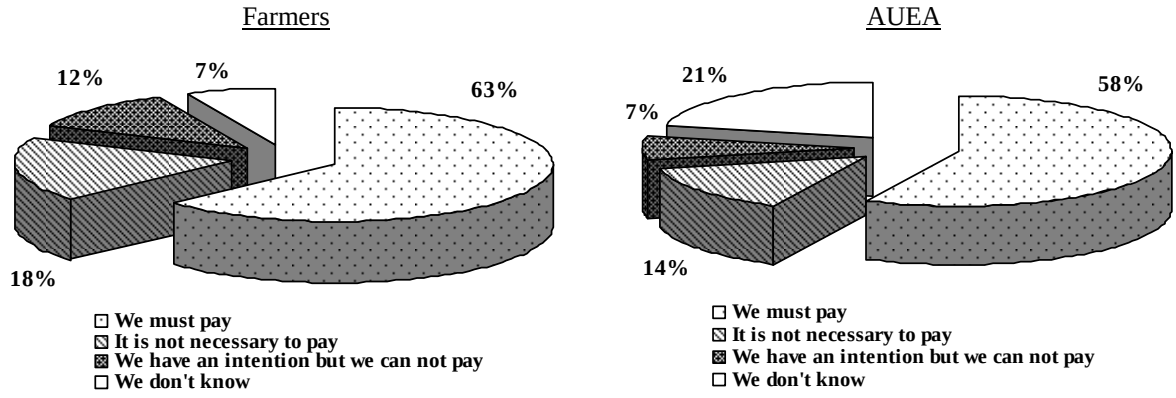


Figure F.2.9 Intention of Channel Water Payment (%)

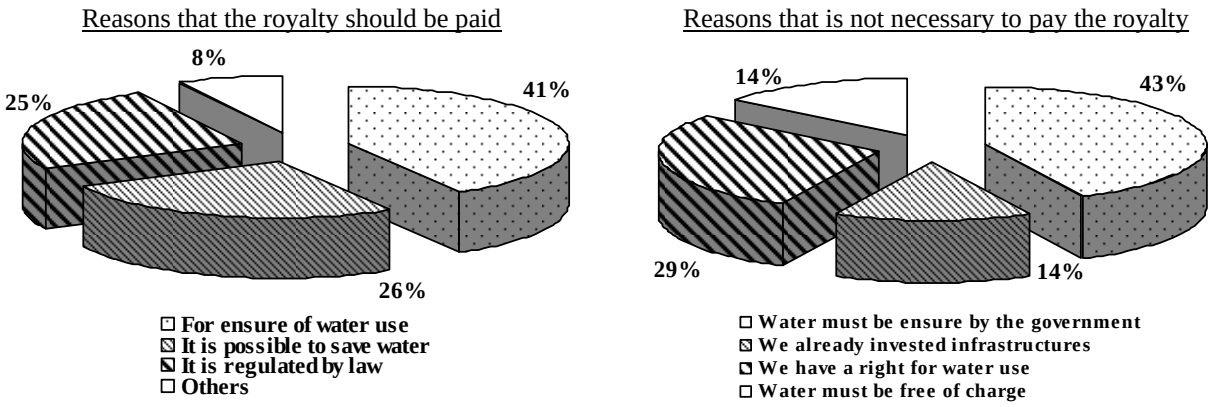


Figure F.2.10 Reasons to Channel Water Royalty Payment by Farmers

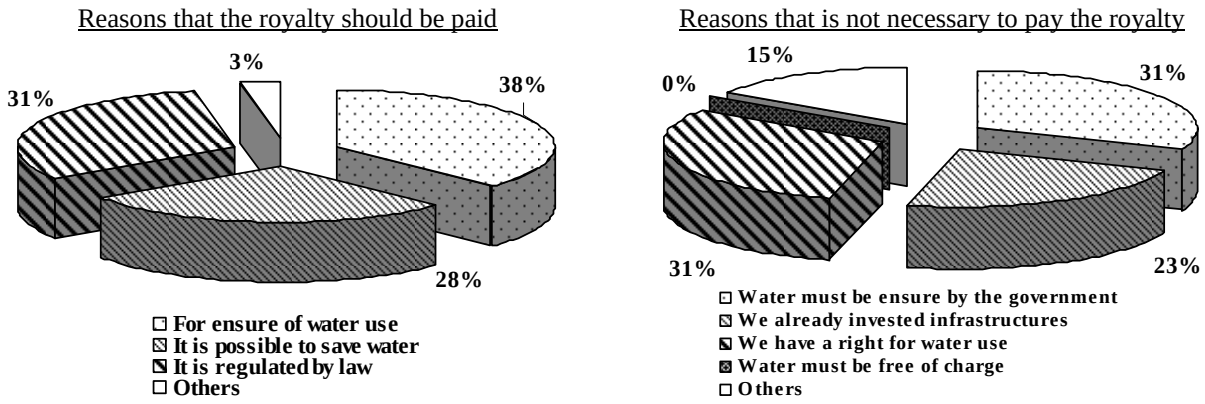


Figure F.2.11 Reasons to Channel Water Royalty Payment by AUEA

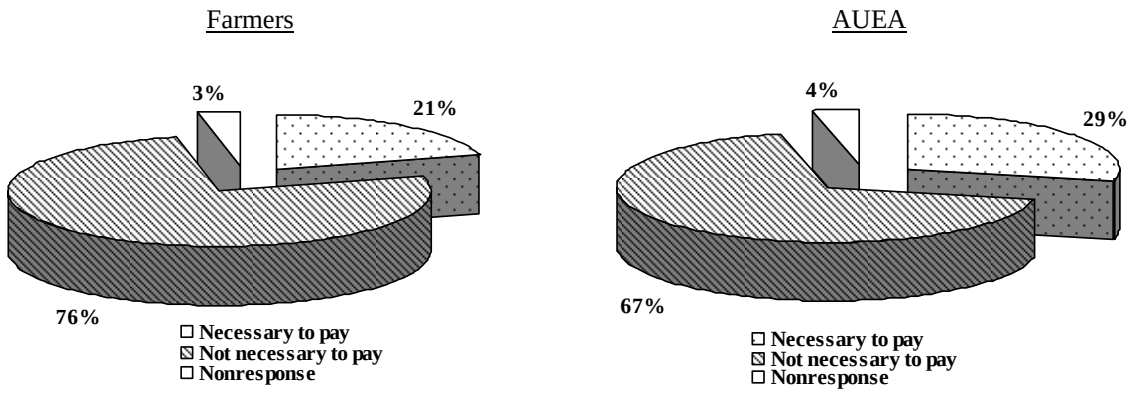


Figure F.2.12 Intention of Ground Water Payment (%)

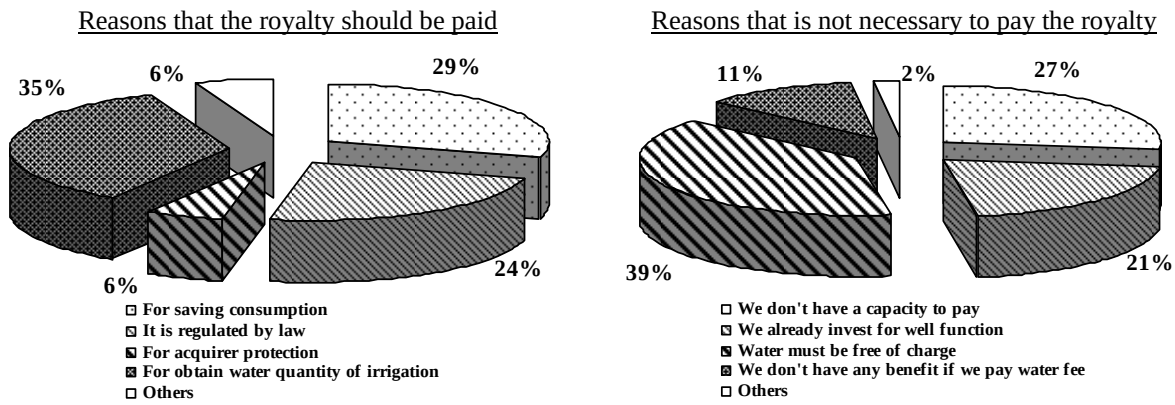


Figure F.2.13 Reasons to Water Fee Payment for Well by Farmers

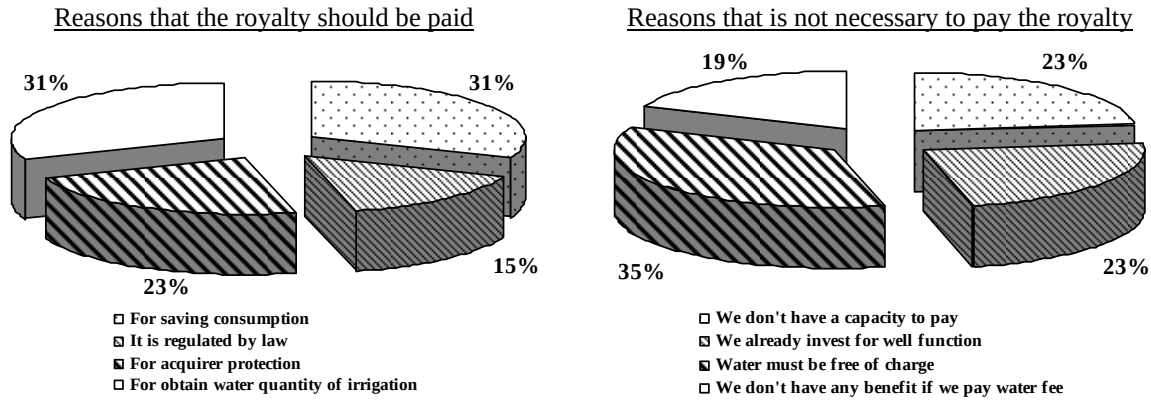


Figure F.2.14 Reasons to Water Fee Payment for Well by AUEA

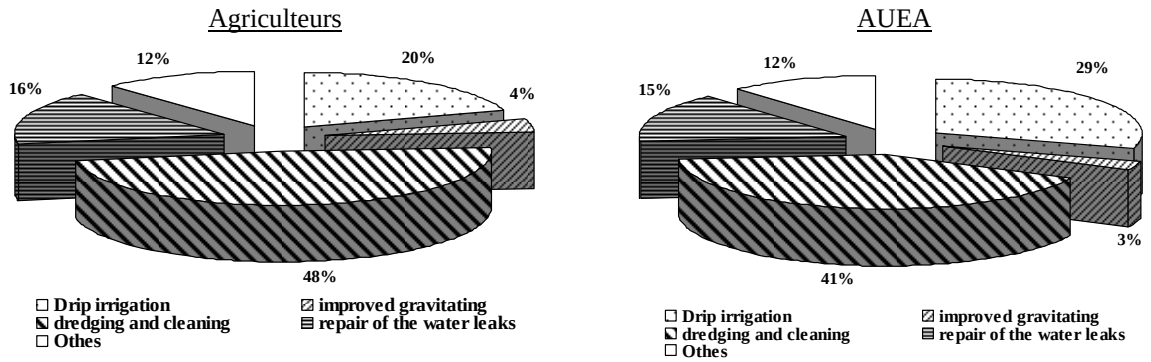


Figure F.2.15 Practiced Water Saving Technique by Farmers

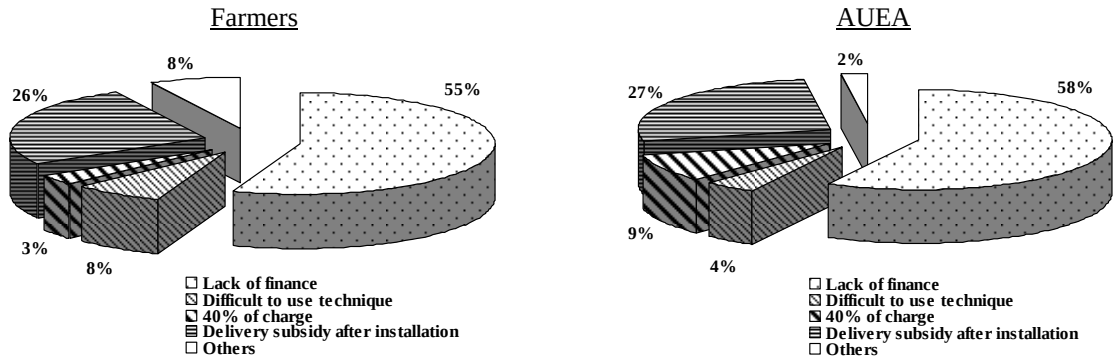


Figure F.2.16 Constraints for Drip Irrigation System Introduction

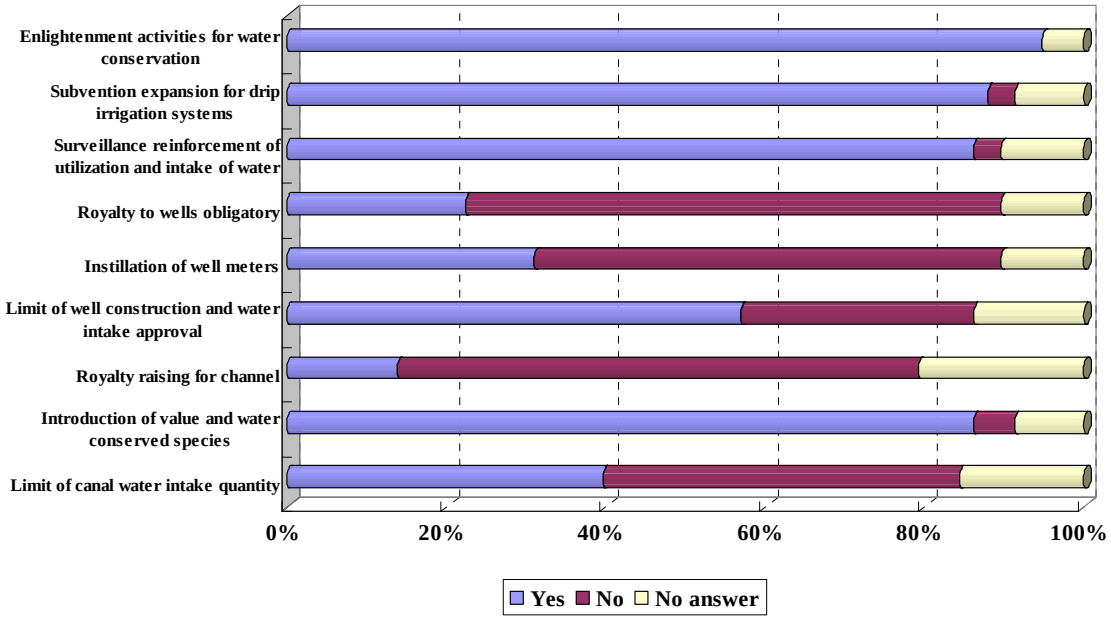


Figure F.2.17 Opinions of Farmers to Some Envisaged Countermeasures for Water Resources Management

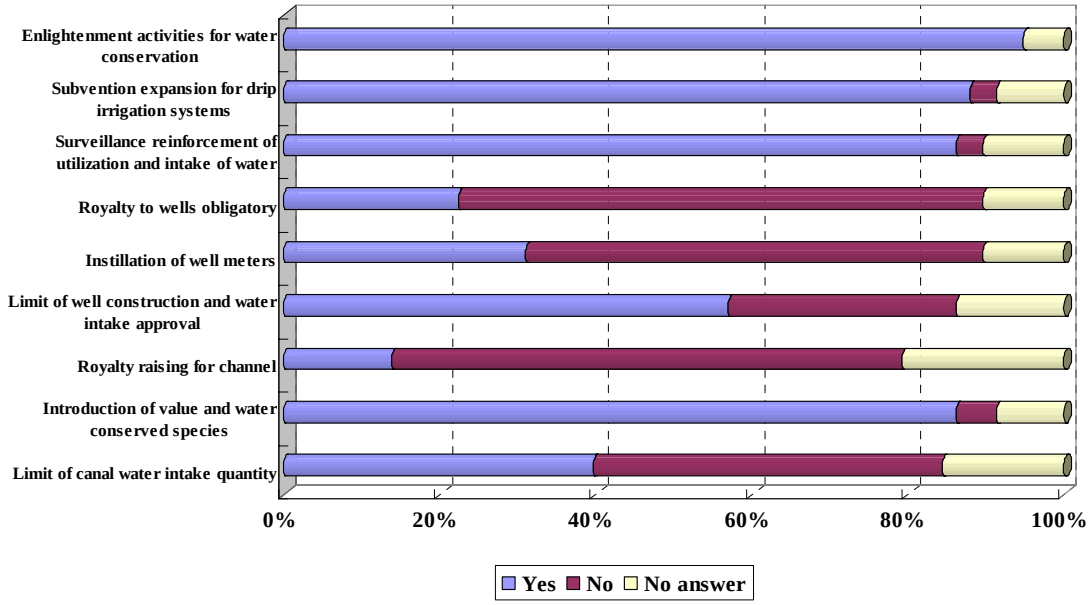


Figure F.2.18 Opinions of AUEA to Some Envisaged Countermeasures for Water Resources Management

G: GROUNDWATER MODELLING

Table of Contents

G: GROUNDWATER MODELLING

G.1 Update of Groundwater Flow Modelling ---------- G - 1
G.1.1 Model Limits and Aquifer Geometry ---------- G - 1
G.1.2 Understanding of Water Balance beneath Agricultural Sectors ---------- G - 1
G.1.3 Model Entry and Boundary Conditions ---------- G - 2
G.1.4 Calibration of Permeability ---------- G - 3
G.1.5 Calibration of Storativity ---------- G - 4
G.1.6 Generalities about Groundwater Flow ---------- G - 4
G.1.7 Capture zone of Marrakech Water Supply Well Fields ---------- G - 4
G.1.8 Water Balance ---------- G - 5
G.2 Simulation of Future Scenarios ---------- G - 6
G.2.1 Continuation, Maximum Demand, Basic and Major Actions ---------- G - 7
G.2.2 Upgrade of Basin and Major Action Scenarios ---------- G - 8
G.2.3 Synthesis ---------- G - 9

Tables

Table G.1.1 List of Agricultural Sectors ---------- G - 10
Table G.1.2 Summarized Water Balance from 1994 to 2004 ---------- G - 10
Table G.2.1 Indicators Values Obtained from Groundwater Flow Simulations for 4 Initial Scenarios (Simulated Period from 2006/07 to 2020/21) -------- G - 10
Table G.2.2 Indicators Values Obtained from Flow Simulations of Upgraded Regional Actions (Simulated Period from 2006/07 to 2020/21) ---------- G - 11

Figures

Figure G.1.1 Piezometric Map in 2002 and Model Limits ---------- G - 12
Figure G.1.2 Model's Mesh ---------- G - 12
Figure G.1.3 Substratum Map (and Variographic Analysis) ---------- G - 13
Figure G.1.4 Map of Agricultural Sectors ---------- G - 13
Figure G.1.5 Water Balance beneath Agricultural Sectors ---------- G - 14
Figure G.1.7 Map of Boundary Conditions ---------- G - 14
Figure G.1.7 Fixed Head in Lalla Takerkourst Dam - Details of the Step Values --------- G - 15
Figure G.1.8 Map of Calibration Sectors Where Colours Are Proportional to Log(K) --- G - 15
Figure G.1.9 Measured Heads Versus Calculated Heads for Steady State Mode, 1997/98 Situation ---------- G - 15
Figure G.1.10 Calculated Piezometric Map for Reference Situation ---------- G - 16
Figure G.1.11 Map of Calibrated Permeabilities ---------- G - 16
Figure G.1.12 Measured Heads Versus Calculated Heads for Steady State Mode, 1993/94 Situation ---------- G - 17
Figure G.1.13 Map of Calibrated Storativities ---------- G - 17
Figure G.1.14 Water Table along Few Slides in Haouz Plain ---------- G - 18

Figure G.1.15 Map of Capture Zone of Marrakech Water Supply Well Fields (Situation in 2004) ---------- G - 19
Figure G.1.16 Global Aquifer Balance from 1994 to 2004 ---------- G - 19
Figure G.1.17 Location of Sectors Where Artificial Recharge is Applied ---------- G - 20
Figure G.2.2 Extension of Significant Drawdown Zone in 2021 for Basic Actions Scenarios ---------- G - 20
Figure G.2.3 Piezometric Changes Simulated beneath Piezometer 2162/44 for Basic Actions and Major Actions Scenarios ---------- G - 21
Figure G.2.4 Piezometric Changes Simulated beneath Piezometer 2555/53 for Basic Actions and Major Actions Scenarios ---------- G - 21
Figure G.2.5 Piezometric Changes Simulated beneath Piezometer 2576/53 for Basic Actions and Major Actions Scenarios ---------- G - 21
Figure G.2.6 Piezometric Changes Simulated Beneath Piezometer 2941/44 for Basic Actions and Major Actions Scenarios ---------- G - 22
Figure G.2.7 Piezometric Changes Simulated Beneath Piezometer 0167/53 for Basic Actions and Major Actions Scenarios ---------- G - 22

G: GROUNDWATER MODELLING

G.1 Update of Groundwater Flow Modelling

The last groundwater flow model (2003), constructed using MODFLOW under the GMS software, still shows some imperfections. The two main problems faced here are: i) the aquifer bottom elevation is artificially lowered by 50 m to prevent mesh drying, and ii) the aquifer storativity is set from 5 to 20%, largely overestimated compared to the pump test data which shows figures from 1 to 8% (see Bernert and Prost, 1975[1]).

G.1.1 Model Limits and Aquifer Geometry

The updated model limit is set to the extension of the mio-plio-quaternary plain, excluding the oriental Haouz (outside the Tensift Basin limit) which appears to be separated from the rest of the plain by a piezometric crest, i.e. a no flow limit (Figure G.1.1).

The updated model includes the part of the plain located south of the Jebel Timrar (Guemassa sector), as it appears on the hydrogeological map drawn in 1972 (Bernet, Boudon and Prost). This sector was not modelled in the last modelling works but clearly appears on geological maps as mio-plio-quaternary sediments in continuation with the rest of the plain. This sector includes the Lalla Takerkourst dam which is constructed over some 100 m of mio-plio-quaternary sediments. The primary outcrop (Jebel Timrar) which appears in the Gamassa sector is not represented in the model: the groundwater flows within these terrains are very slow compare to those in the Haouz plain sediments; the Primary outcrop can be considered as a no-flow limit as shown with the piezometric lines mainly perpendicular to this limit.

The model is extended to the Tensift river in the north-western sector of the plain, including some Jurassic limestone outcrops, as the piezometric heads are unknown in the sedimentary plain but clearly fixed at the riverbed elevation in the Jurassic limestone.

The current updated model is constructed using the Feflow® software (a WASY program), using the finite element technology. It is 3083 nodes and 5894 elements. Figure G.1.2 shows the mesh mapping.

The top of the aquifer is set to the topographic elevation, extracted from the public SRTM90 digital elevation model (DEC).

The aquifer bottom map (Figure G.1.3) was drawn based on the substratum point's database (source ABHT). In the updated model, a constant value of bottom elevation is set by sector, at the minimum bottom elevation found in the sector from this map. The sectors are those where constant K and S values are set (see § G.1.4 and § G.1.5 and Figure G.1.8). Setting the bottom elevation node by node is only possible if the K value is calibrated element by element, which is not possible here, due to the poor number of piezometric measurement points.

G.1.2 Understanding of Water Balance beneath Agricultural Sectors

The Haouz plain is divided in urban sectors (Marrakech city) and agricultural sectors. Three types of agricultural sectors are mapped: the GH sectors, where the ORMVAH provides surface water; the

[1] Bernert G., Prost J-P (1975), Le Haouz de Marrakech et le bassin du Mejjate *in* Ressource en Eau du Maroc Tome 2, Plaines et bassins du Maroc Atlantique. DRE, Rabat

PMH sectors, where groundwater is abstracted for irrigation (see Progress Report 1 for the methodology of mapping these PMH sectors); and the other areas, where no groundwater is abstracted (including the PMH sector irrigated from surface water only). The map Figure G.1.4 gives the extension of the agricultural sectors.

Three water sources are identified beneath agricultural sectors: rainfall, surface water and groundwater. The rainfall is well known beneath the plain, as well as surface water in the GH sectors. The surface water is neglected beneath the PMH sectors irrigated from groundwater: where a groundwater well is constructed, it is used as the main water facility.

Part of the rainfall over the field (in GH as well as PMH) satisfies the plant water demand. This part, called "efficient rainfall" is evaluated to some 90% (see progress Report 1). The remaining 10% either runs-off or infiltrates to the aquifer.

Part of the surface water (beneath GH sectors) is lost for regulation. According to the irrigation experts, this part does not exceed 5% of the surface water delivered to the field. The remaining 95% either infiltrates, evaporates, or satisfies the plant water demand.

The behaviour of the groundwater abstracted in order to complement the surface water (if any) is equivalent: it either infiltrates, evaporates, or satisfies the plant water demand. The Net abstracted groundwater is the abstracted groundwater minus the re-infiltrated irrigation water.

Part of this irrigation water is lost by evaporation. The evaporation is estimated by the irrigation experts to some 15% when traditional irrigation is applied and to 5% when drip irrigation is applied.

This net abstracted groundwater is estimated from the crop water demand: this demand is first satisfied by the "efficient rainfall". The remaining crop water demand is then satisfied by the surface water (except regulation losses and evaporation) if any and the net groundwater abstraction.

G.1.3 Model Entry and Boundary Conditions

The current updated model is based on the Inflow/Outflow values as detailed in the Progress Report N°1. The boundary conditions are set as follow:

- The part of the direct infiltration of the rain is recognised by most of the authors as limited, and possibly negligible. Using isotopic techniques, Abourida *et al.*[2] show that most of the natural groundwater recharge comes from the infiltration of rainfall at some 1200 to 1900 m of altitude, far from the altitude of the Haouz plain (250 to 800 m). The authors couldn't quantify the part of direct rainfall infiltration over the plain, but it can be considered that this figure is less than 10 to 20% of the total inflow to the aquifer. In the model, the aquifer recharge is set to 3% of the rainfall everywhere in the plain, except beneath Marrakech city where no infiltration from rainfall is considered. This 3% represents some 10% of the total water inflow (see § G.1.8). This figure was adjusted during the calibration process;
- The Net Groundwater abstraction for irrigation as defined in § G.1.2 per agricultural sector (see map of agricultural sectors Figure G.1.4) as explained above;

[2] Abourida A, Leduc C., Errouane S., Blavoux B – Apport de la géochimie à l'étude de la recharge de la nappe du Haouz (Maroc central), under review

- The main individual wells are represented, i.e. those for Marrakech water supply;
- Rural water supply defined as a global value applied all over the plain, based on prospective allocation;
- A possible drainage of the aquifer in the river bed (see drainage points in map Figure), at the topographic elevation (extracted from the 50.000 scale topographic maps);
- An infiltration of a percentage of the flood volumes in the river bed and along the main *seguias* (simulated by an infiltration around the river beds –Neuman condition-, see infiltration zones in map Figure G.1.6). This percentage varies according to the importance of the flood volume as described in the table below:

Ratio Annual flood vs. Average annual flood	Percentage of annual flood infiltrated
	35%
70%	
	25%
130%	
	20%
200%	
	15%

  - ✧ For oueds El Mal, N'Fis and Ourika, monthly infiltration volumes were calculated based on the monthly flood volumes.
  - ✧ For the monthly infiltration, the infiltration volume is calculated by steps. It represents: 75% of the flood volume up to a total of 20% of the average monthly flood,
  - ✧ then 25% of the remaining flood volume up to a total of 60% of the average monthly flood,
  - ✧ then 22% of the remaining flood volume up to a total of 120% of the average monthly flood,
  - ✧ then 19% of the remaining flood volume up to a total of 500% of the average monthly flood,
  - ✧ then 16% of the remaining flood volume.

  The details of these coefficients were calibrated during the calibration of the Storativity in transient mode.

- Constant hydraulic heads (see distribution of points in map Figure G.1.6):
  - ✧ Beneath the Lalla Takerkourst dam, at the average water elevation. In transient mode, the hydraulic head is fixed per period (Figure G.1.7),
  - ✧ Beneath the main springs in Chichaoua sector,
  - ✧ Beneath the oued entry points in the plain, from the Jbeliat and Atlas mountains, and from Jebel Timrar.

G.1.4 Calibration of Permeability

The calibration of the permeability (K) was conducted in steady state mode. According to the

piezometric history, a pseudo steady state situation can be found for the 1997-1998 period, and the piezometric campaign conducted in September-October 1998 can be considered as a reference situation. This campaign is complemented with additional piezometric values extracted from the ABHT piezometric network database and with piezometric heads measured at different dates in two additional points located close to the aquifer border (i.e. where the expected piezometric changes are potentially quite small). The total number of reference points is 96 (see distribution in Figure G.1.10). The topographic elevation of these points is taken from the 50.000 scale topographic maps, based on the point position. The precision in this topographic elevation, and then the precision in the corresponding piezometric heads is then not greater than 15 m.

Using this 96 reference points, a K calibration of the model was conducted by sectors. Some 81 different sectors were defined (see map Figure G.1.8), each of them controlled by one or more reference point.

The accuracy of the calibration is attested by the graph in Figure G.1.9 showing the measured piezometries and the corresponding calculated values. The map Figure G.1.10 gives the piezometry calculated everywhere in the plain for the steady state situation (1997/98) with these calibrated permeabilities.

The calibrated permeabilities (see map Figure G.1.11) indicates limited sectors with bad hydraulic properties (K less than 1E-5 m/s), and most of the plain with K from 2E-5 to 5E-4 m/s. The hydraulic properties of the Mejate plain (western part of the Haouz plain) are clearly higher than elsewhere, with K from 2E-4 to more than 1E-3 m/s.

G.1.5 Calibration of Storativity

The calibration of the storativity (S) was conducted in transient mode for the period between October 1994 and September 2004. The initial situation was obtained from a steady state calculation based on the conditions of the 93-94 agricultural campaign, which appears to be pseudo-steady state conditions. The validity of this calculation was given by the 38 piezometric values obtained around August 1994 (see calibration fit Figure G.1.12).

As for the permeability (K), the same 81 sectors of constant Storativity (S) were defined. Some 31 reference piezometers were used for the calibration. These points are mapped in Annexe. The details of the calibration fit for these 31 reference points are given in Annexe. The best fit is obtained for Storativities mainly comprise from 0.4 to 8% (see map of calibrated Storativities in Figure G.1.13), consistent with the figures obtained from pumping tests (Bernert and Prost, 1975[1]).

G.1.6 Generalities about Groundwater Flow

The slides in Figure G.1.14, obtained from the 2004 piezometric situation, indicate that the highest hydraulic gradients are from South to North. Most of the flow is clearly from South to North, due to these gradients. The East-West flow appears to be limited: it is interrupted by the important groundwater abstraction in the northern part of the plain. Beneath this northern sector, the water thickness is very limited.

G.1.7 Capture zone of Marrakech Water Supply Well Fields

The capture zone of the Marrakech water supply well fields was drawn from the 2004 piezometric map, based on the flow lines (advective flow only) given by the model. In order to take into account

the convective flow, a buffer zone of 700 m was added outside of this advective flow. (Figure G.1.15)

G.1.8 Water Balance

The water balance was calculated per agricultural campaign for the calibration period. It is summarized Table G.1.2.

(1) Inflow

The direct rain and the infiltration from flood were fixed with the entry conditions. They represent some 15 to 30% of the total inflow. The remaining part comes from the Southern border (and for a very small part from the Jbilet border): it is the groundwater flow in the oued valleys and lateral inflow from aquifer terrain of the Atlas Mountains. The calculated figures, about 420-430 MCM/year, are significantly higher than the previous estimates. Part of this difference comes from the increase of the drawdown of the water table which increases the hydraulic gradient.

BERNERT and PROST (1975[1]) estimated the lateral inflow for the Central Haouz to 45.2 MCM for an average year. This work, modified in 2003[3] and extended to the Mejate plain, gives some 152 MCM (including 67 MCM at south and south-east of the Mejate plain) and the previous groundwater modelling study conclude of a value close to 221 MCM in 2000/01 (including 86 MCM at south and south-east of the Mejate plain). According to the piezometric maps and specially those drawn for 1972 before the development of the irrigated perimeters and the closer to natural conditions, a large amount of the aquifer flow comes from the southern limit of the Central Haouz part of the aquifer: it is there facilitated by major colluvial structures. There is no indication that the lateral inflow south and south-east of the Mejate plain is higher. The last two estimates, which give a lateral inflow beneath the Central Haouz plain from 1,3 to 1,6 times larger than beneath the Mejate plain, certainly reflect the distribution of these flows, the border of the aquifer being there approximately 1,7 times longer than the Mejate's one.

According to the ABHT 2004 estimate, the major part of this inflow is located at the oueds entrance in the plain. The authors estimate a lateral inflow of about 17,5 MCM/year: 4.0 MCM for the Central Haouz and 13.5 MCM for the Mejate plain. These figures, abnormally low (especially for the Central Haouz part) should be compare to an estimate of the infiltration of irrigation water which reach 250 MCM/year, certainly largely overestimated.

For this three studies, the potential ascending leakage from the Eo-cretaceous aquifers underlying the Plio-quaternary series of the Haouz plain aquifer is not integrated in the balance. In 1975[1], the aquifer recharge from the Lias reservoir (including the oriental Haouz sector) was estimated to 50.5 MCM/year. In 1987[4], an estimate of the inflow from Cenomanian-turonian aquifer gives some 9.5 MCM/year.

(2) Outflow

More than 50% of the outflow is fixed by the entry conditions: net groundwater abstraction for

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[3] Etude de synthèse hydrogéologique pour l'évaluation des ressources en eau souterraine du bassin hydraulique du Tensift. (2004) ANTEA-ANZAR for ABHT

[4] Etude du Plan Directeur Intégré d'Aménagement des Eaux du Bassin du Tensift (1987), ABHT internal document.

irrigation and all other abstraction types. The remaining part of the outflow is due to drainage to the oueds.

(3) Global Aquifer Balance

The global aquifer balance (Table and Figure G.1.16) shows that when the rainfall is important (as for 95/96 or 96/97), the aquifer balance can be positive due to a combination of three factors: i) the agricultural efficient rainfall is important and the necessary irrigation water is reduced; ii) the available surface water is important and the complementary groundwater is limited; iii) the rainfall infiltration increased. On another hand, when the rainfall is limited, the aquifer global balance is negative (up to -400 MCM in 2000/01) due to a combination of the same 3 factors.

G.2 Simulation of Future Scenarios

The expected levels of the groundwater table and balance beneath the Haouz plain were obtained from groundwater flow simulations for a period from 2006 to 2021 (the period from 2004 –end of calibration- and 2006 was simulated based on the observed conditions for rain, available surface water, ONEP¨abstraction…). Several scenarios of groundwater abstraction conditions were simulated, based on the possible actions on the water balance. Two types of indicators were defined and measured at the target year (end of the 2020/21 agricultural campaign) in order to evaluate the results of the simulations and thereby the impact of the scenarios application: indicators of the groundwater resource availability and indicators of economic impacts.

In order to evaluate the changes in the availability of the groundwater resource, three indicators were selected:

- The average depth of the groundwater table. According to the constructed model, it was about 36.9 m at the end of the 2005/06 agricultural campaign. Modifications of this parameters will give an overview of the changes in the wet aquifer volume;
- The gross surface of dry aquifer. At the end of the 2005/06 agricultural campaign, the thickness of wet aquifer is locally very limited according to the groundwater flow model, but no large sectors appears to be totally dry;
- The total groundwater balance from 2006 to 2021 and the annual balances for the first and the last agricultural campaign simulated (i.e. 2006/07 and 2021/21). A negative balance indicates that part of the abstracted groundwater is taken from the reserve.
- In order to understand the economic impact of each of the scenarios, three indicators were selected:
- As well as an indicator for the groundwater resource availability, the average depth of the groundwater table may also be considered as an economic indicator. Changes in the static water levels will significantly impact the cost of the groundwater abstraction, directly proportional to the groundwater table depth;
- The changes in the gross surface where the depth of the water table is higher than the average depth of boreholes (about 50 m according to the last boreholes inventories conducted by the ABHT). Beneath these areas (hereafter known as Change50), 50% of the boreholes will dried out and should then be deepened (mostly new drilling nearby the dried out one);

- The number of boreholes that will dry out by 2021. This figure is estimated to 100% of the boreholes in the dry aquifer sector, and 50% of the boreholes in the Change50 sectors (see above). In order to preserve the present irrigation conditions, all of these boreholes need to be substituted.

G.2.1 Continuation, Maximum Demand, Basic and Major Actions

For the "**Continuation**" scenario, the present observed conditions of groundwater abstraction and groundwater recharge were continued up to 2021:

- same level of water demand (irrigated surfaces and crop water satisfaction) in the GH sectors fixed as the average value calculated from set up of the sectors;
- continuation of the observed 2% increase of groundwater abstraction in the PMH sector;
- same high level of evaporation (15%) in agriculture, resulting from the present irrigation practices;
- planned increase of the water demand for golf courses (see Progress Report n°1);
- containment of the surface water potential as the average value of the past 35 years;
- same rainfall as the average value of the past 35 years;
- containment of the flood infiltration rates as estimated for the 1993/2004 period.

A "**Maximum Demand**" scenario was simulated, which illustrated the impact of a possible increase in the water demand for agriculture. All the conditions of the "**Continuation**" scenario were kept, except:

- the water demand in the GH sectors was increased in order to cover 100% of the planned irrigated surfaces and an 100% of crop water satisfaction (end of the 20% water stress, i.e. an increase of 20% of the water demand);
- the water demand in the PMH sectors was increased in order to cover 100% of crop water satisfaction (end of the 20% water stress);

A "**Basic Actions**" scenario was constructed to simulate the impact of a first step of positives measures on the water demand as well as the water resource. All the conditions of the "**Continuation**" scenario were kept, except:

- reduction of the level of evaporation from 15% to 5% over 85.000 ha (see details in Progress Report n°2) as the result of the introduction of drip irrigation system;
- use of 19.4 MCM/year of treated wastewater from 2010 for the existing and planned golf courses.

Then, a "**Major Actions**" scenario was simulated for the evaluation of the introduction of a second stage of positives actions. All the conditions of the "**Basic Actions**" scenario were kept, except:

- The groundwater abstraction in the PMH sector was kept as the 2007/2008 level. No new borehole in the PMH sector is authorized and an efficient control is introduced (the only authorized boreholes are those drilled to replace dry or clogged boreholes).

The Table G.2.1 gives the values of each of the indicators for these 4 scenarios. For all of the tested scenarios, a large part of the Haouz plain aquifer dried out. For most of them, this dried out area is

localized beneath a PMH sector north of the N'Fis GH sectors. For the Maximum Demand scenario, the dried out area covers this sector and extends eastward to Marrakech city, it extends to the Marrakech Issil well field and in the eastern part of the plain.

The Table G.2.1 clearly shows that none of the tested scenarios enables to reach a stabilization of the water balance. The actions tested in the **Major Actions** scenarios appear to be minimal options necessary to prevent an extension of the present deficit:

- Introduction of drip irrigation over some 85.000 ha;
- Immediate stop of the extension of the groundwater abstraction in the PMH sector (through a deep control of the borehole drilling);
- No extension of the global water demand for irrigation (no changes in the irrigated surfaces in the GH sector and continuation of a 20% water stress in whole PMH and GH sectors);
- No additional water demand for the golf courses: the golf courses water demand should be covered by the available treated wastewater only.

The sum of these actions gives the opportunity to nearly keep the present deficit conditions, i.e. about -40 MCM/year. The economic impact of such a deficit cannot be neglected: an increase of the cost of groundwater abstraction and the drying out thousands of hectares of irrigated land only relaying on groundwater will cause majors socio-economic changes in the agricultural sector.

G.2.2 Upgrade of Basin and Major Action Scenarios

(1) Priority Area for Drip Irrigation

The main water resource problems appear in the N'Fis Left Bank sectors (ZR and PMH), where important drawdown and aquifer dried out is expected. In order to reduce the important drawdown expected in the lower part of the N'Fis left bank, regionalised actions were simulated: for the basic actions as well as for the major actions scenarios, 100% drip irrigation is simulated over the N'Fis ZR sector (GH) and the PMH sector in the immediate North of this GH sector, and the percentage of drip irrigation is reduced in the other sector for a total drip irrigated surface of still 85,000 ha.

(2) Artificial Recharge

The artificial recharge was simulated by increasing the volume of water infiltrated along the oueds (see Figure G.2.1 for the location of the sectors where artificial recharge is applied): the facilities simulated are a series of sills along the upper part of the low-flow channel[5]. Four oueds were selected for artificial recharge: oued R'Dat, where a pilot project is about to start; oued Rheraya, upstream of the Marrakech water supply well fields; oueds Ourika and Zat, where the volume of surface water available for artificial recharge is important. Artificial recharge is simulated for one new oued per year, starting from 2008 (i.e. the 2008/09 agricultural campaign), the expected date for the completion of facilities along oued R'Dat.

[5] An equivalent effect (but un-quantified) will be obtained by a change in the flood regime after reforestation works in the upper basins of the oueds (Atlas mountains)

Average Volume of Possible Articifial Recharge

Oued name	Possible* artificial recharge (Mm3/an)	Starting year
R'Dat	2.1	2008
Rherhaya	2.9	2009
Ourika	3.8	2010
Zat	5.5	2011

* see Final Report, §4.4.2 for the details of the estimate of available volume for artificial recharge

(3) Reallocation of Surface Water

The main water resource problem in the N'Fis Left Bank sector is that important drawdown and aquifer dried out are expected. In order to reduce these negative evolutions, some surface water may be transferred from the Eastern sectors to the West. The simulation was done for 6 Mm^3/year: this volume (presently allocated to ONEP from the Lalla Takerkourst reservoir) was allocated to the N'Fis ZR sector and the available surface water from the Rocade Canal was reduced by the same volume for irrigation (ONEP increase by 6 Mm^3/year the volume taken from the Rocade canal). In the model, this simulation only consists of changes in the abstracted groundwater in the GH sectors (increased in the Eastern sectors, reduced in the Western).

G.2.3 Synthesis

The upgrade of the simulated actions clearly improves the negative evolution of the aquifer (see indicators in Table G.2.2). Some important changes are observed in the extension of the significant drawdown zone (i.e. the zone where the expected drawdown from 2006 to 2021 is higher than 0.5 m/year) as shown in Figure G.2.2 for the Basic Actions: this zone is reduced when the Basic Actions are regionalised; then it nearly not changes when the artificial recharge is introduced (the artificial recharge mainly affect the eastern part of the aquifer) and it is significantly reduced when the reallocation is introduced; it reduces much more when both artificial recharge and reallocation are applied. The same tendency is observed with the Major Actions scenarios.

The impact of the reallocation of the surface water can clearly be observed in the piezometers located in this zone of significant drawdown (the lower part of the N'Fis left bank) as for 2162/44, 2555/53 and 2576/53 described Figure G.2.3, G.2.4 and G.2.5. These figures show that up to 40 m of drawdown could locally be saved and aquifer dried out could be prevent with the introduction of appropriate actions as regionalised drip irrigation and transfer of surface water from East to West.

The positive impact of the artificial recharge can be observed in the Eastern part of the aquifer (where this recharge is applied), as beneath piezometer 2941/44 (Figure G.2.7) or piezometer 0167/53 (Figure G.2.6) in the Marrakech water supply well fields. The addition of artificial recharge and reallocation is positive when applied to the Major Actions scenario (i.e. Basic Actions plus end of the development of groundwater irrigated PMH). In that case, the water table in the Eastern part of the aquifer can locally slightly recover.

Table G.1.1 List of Agricultural Sectors

N°	Type	Secteur	Sous-secteur
1	Grande Hydraulique (grands périmètres irrigués)	N'Fis	N1-2
2			N2
3			N1-4b
4			N3
5			N1-1
6			N4
7			N5
8			N1-3
9			N1-4a
10			N'Fis Secteur Réhabilité
11		Tessaout Amont	BUIDDA
12			SKHIRAT
13			bordure est
14		Z7	
15		Z1 - R3	
16		Ceinture verte	
17		H2	
44		R1	
45		R1Aval	

N°	Type	Secteur	Sous-secteur
46	PMH	PMH aval N'Fis	
18		Other PMH	
19			
21			
25			
26			
27			
28			
29			
31			
32			
33			
35			
36			
38			
40			

N°	Type	Secteur	Sous-secteur
20	No Abstraction		
22			
23			
24			
30			
34			
37			
39			
41			
42			
43	Marrakech City		

Table G.1.2 Summarized Water Balance from 1994 to 2004

	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04
Inflow										
Direct rain	*58*	*85*	*73*	*57*	*48*	*43*	*29*	*41*	*50*	*57*
Flood (oueds and seguias)	*105*	*284*	*152*	*153*	*93*	*152*	*35*	*64*	*95*	*133*
Lateral inflow	*413*	*410*	*410*	*415*	*421*	*429*	*436*	*443*	*441*	*439*
Total inflow	576	780	635	625	562	624	500	548	586	629
Outflow										
Drainage to oueds	*322*	*337*	*343*	*335*	*321*	*309*	*284*	*265*	*255*	*254*
Abstraction RAK Water Supply	*13*	*12*	*9*	*10*	*15*	*12*	*16*	*13*	*10*	*10*
Net abstraction for irriguation	*303*	*188*	*248*	*323*	*367*	*400*	*546*	*504*	*426*	*354*
Other abstraction (Golfs, Rural WS…)	*14*	*15*	*15*	*16*	*16*	*17*	*18*	*19*	*19*	*20*
Total outflow	652	551	616	684	720	739	864	801	710	637
Balance	-76	228	18	-58	-158	-115	-364	-253	-125	-8

Table G.2.1 Indicators Values Obtained from Groundwater Flow Simulations for 4 Initial Scenarios (Simulated Period from 2006/07 to 2020/21)

		Continuation	Maximum Demand	Basic Actions	Major Actions
Surface "Change50" (ha)		29 000	97 000	16 000	-1 000
Groundwater balance	Whole period	-1 310	-3 440	-1 020	-500
	2006/07	-39	-126	-36	-36
	2020/21	-121	-263	-93	-34
Average depth of the groundwater table -presently 36.9 m- (financial impact Mdhs)		41.4 (3 757)	48.4 (7 605)	40.2 (1 061)	38.2 (1 650)
Dried out aquifer surface (ha) (financial impact Mdhs)		9 100 (448)	44 000 (2 166)	8 200 (404)	6 000 (295)
Number of dried out boreholes (financial impact Mdhs)		1 805 (253)	6 883 (964)	1 237 (173)	413 (58)
Unemployed persons		4 306	20 821	3 880	2 839

Table G.2.2 Indicators Values Obtained from Flow Simulations of Upgraded Regional Actions (Simulated Period from 2006/07 to 2020/21)

		Regionalised Basic Actions (+ realocation + art. rech.)	Regionalised Major Actions (+ realocation + art. rech.)
Surface "Change50" (ha)		3,690	-6,214
Groundwater balance	Whole period	-696	-289
	2006/07	-35	-35
	2020/21	-70	-21
Average depth of the groundwater table -presently 36.9 m- (financial impact Mdhs)		38.7 (2,385)	37.3 (1,998)
Dried out aquifer surface (ha) (financial impact Mdhs)		3,589 (177)	3,714 (183)
Number of dried out boreholes (financial impact Mdhs)		414 (58)	283 (40)
Unemployed persons		1,699	1,758

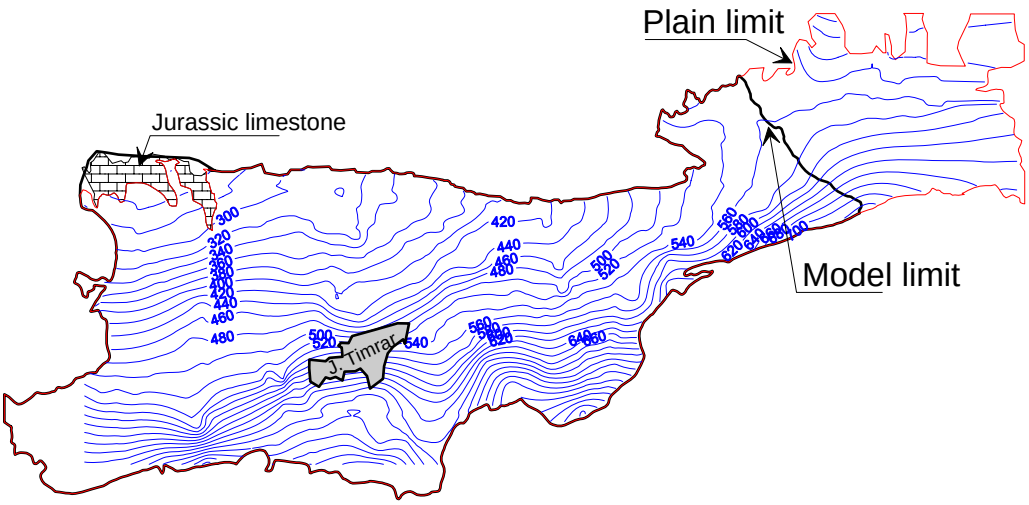


Figure G.1.1 Piezometric Map in 2002 and Model Limits

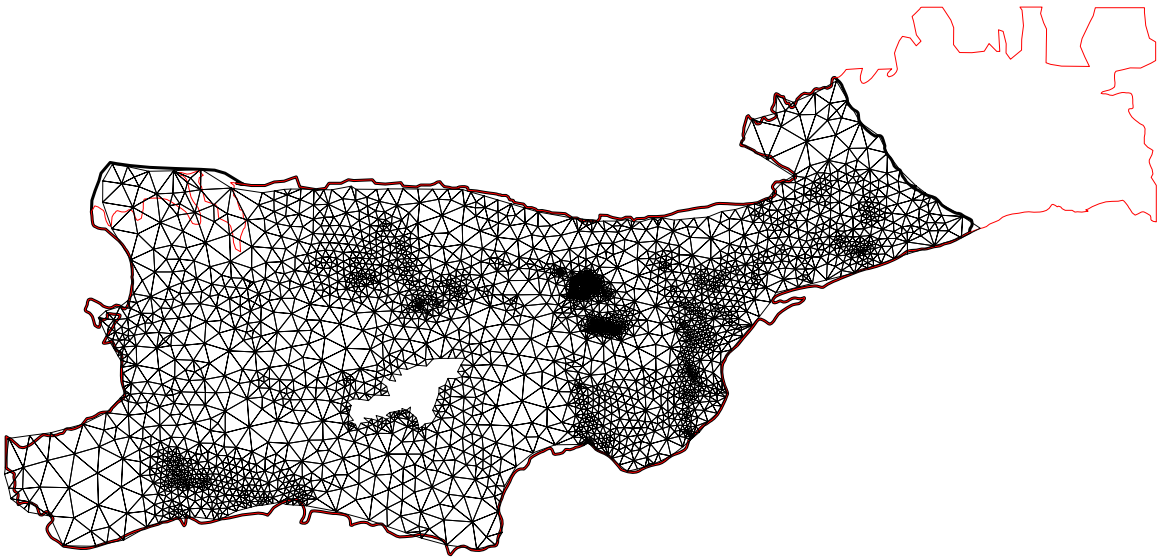


Figure G.1.2 Model's Mesh

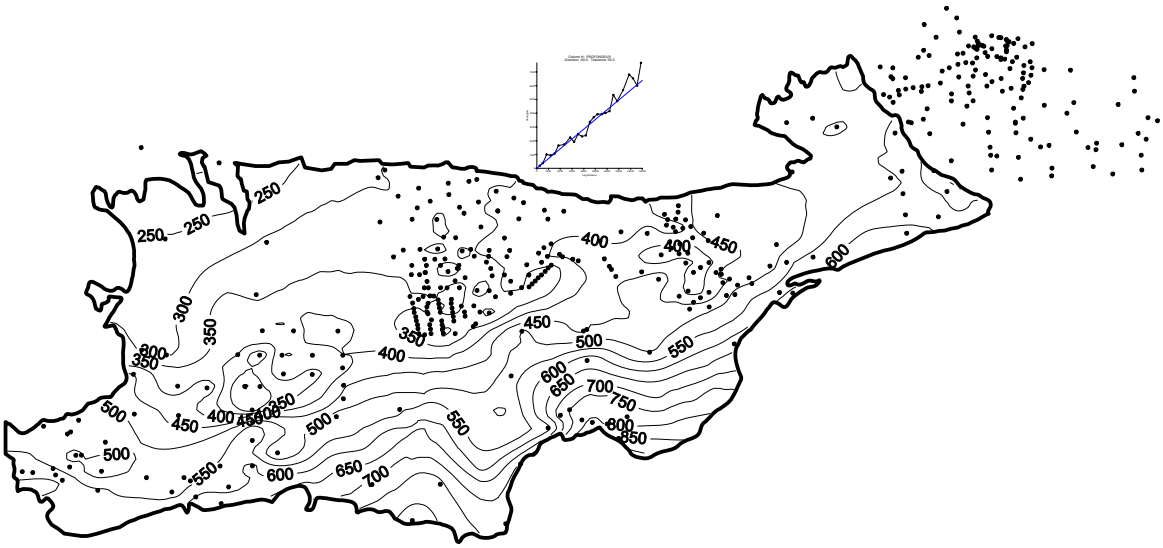


Figure G.1.3 Substratum Map (and Variographic Analysis)

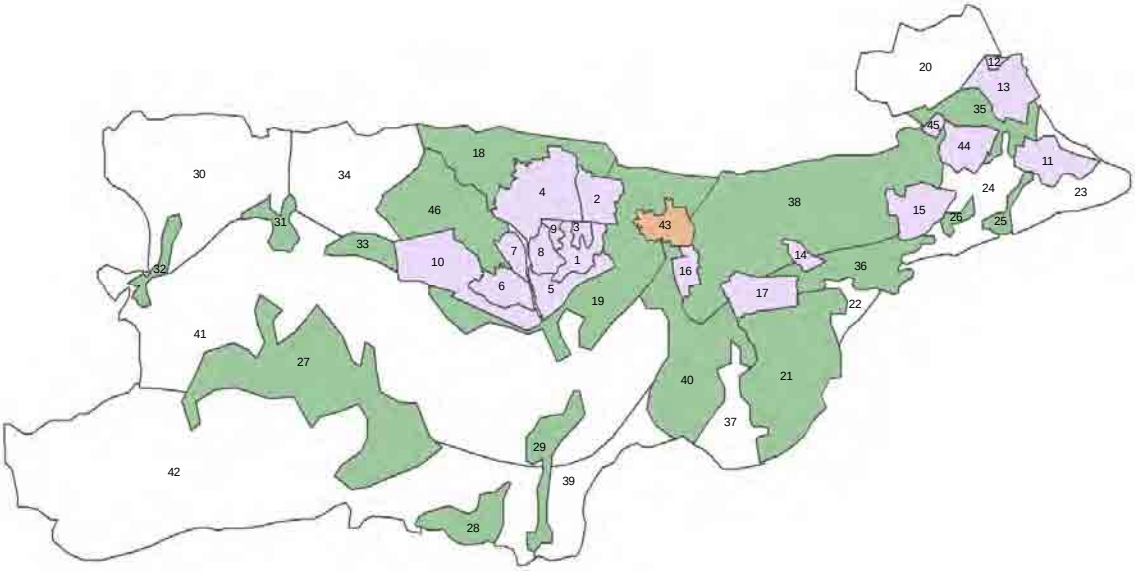


Figure G.1.4 Map of Agricultural Sectors

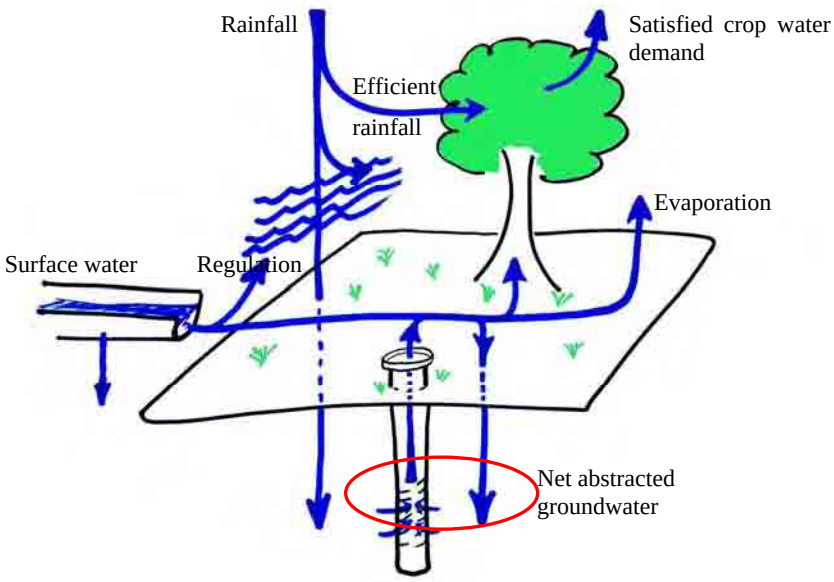


Figure G.1.5 Water Balance beneath Agricultural Sectors

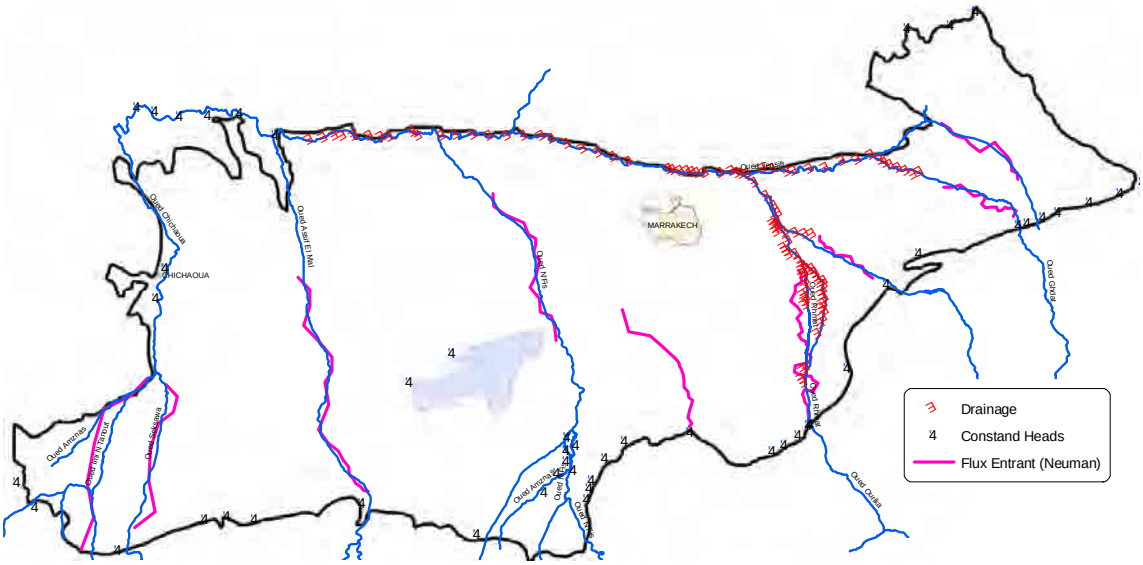


Figure G.1.7 Map of Boundary Conditions

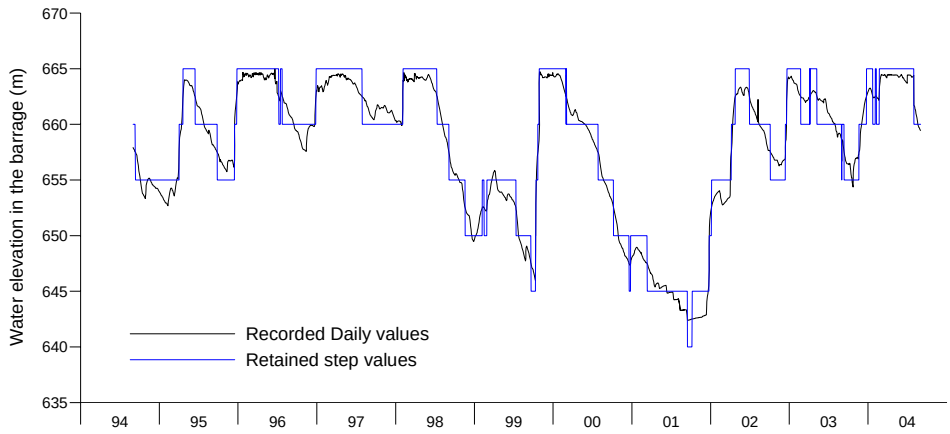


Figure G.1.7 Fixed Head in Lalla Takerkourst Dam - Details of the Step Values

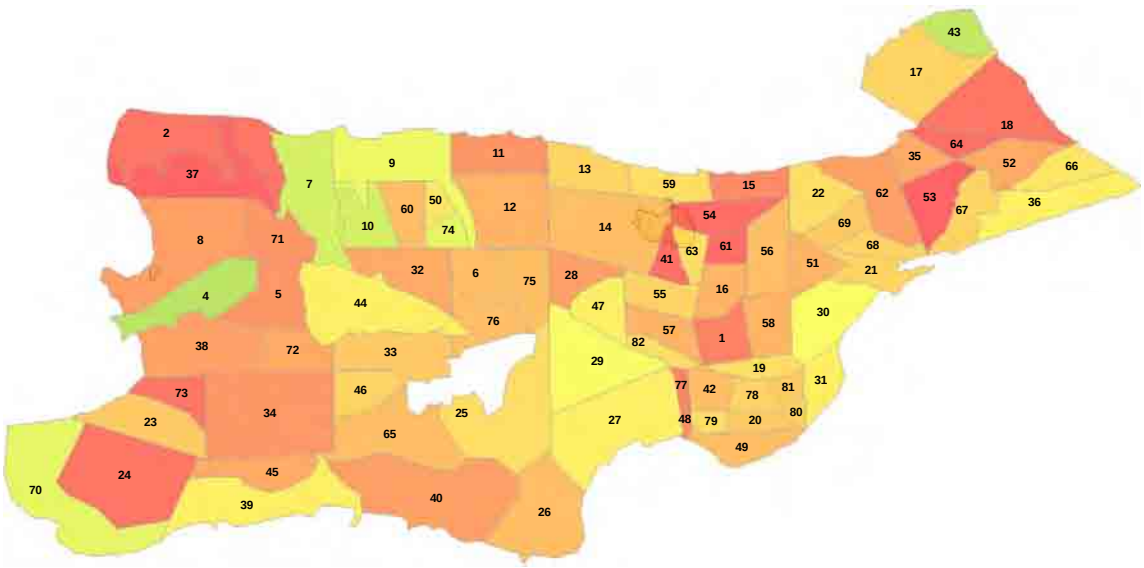


Figure G.1.8 Map of Calibration Sectors Where Colours Are Proportional to Log(K)

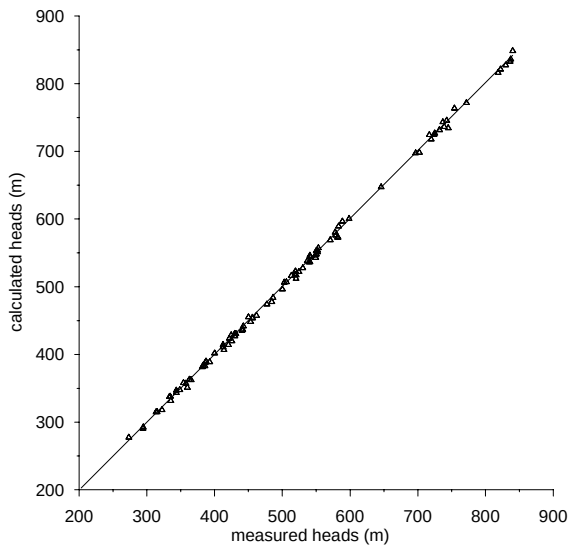


Figure G.1.9 Measured Heads Versus Calculated Heads for Steady State Mode, 1997/98 Situation

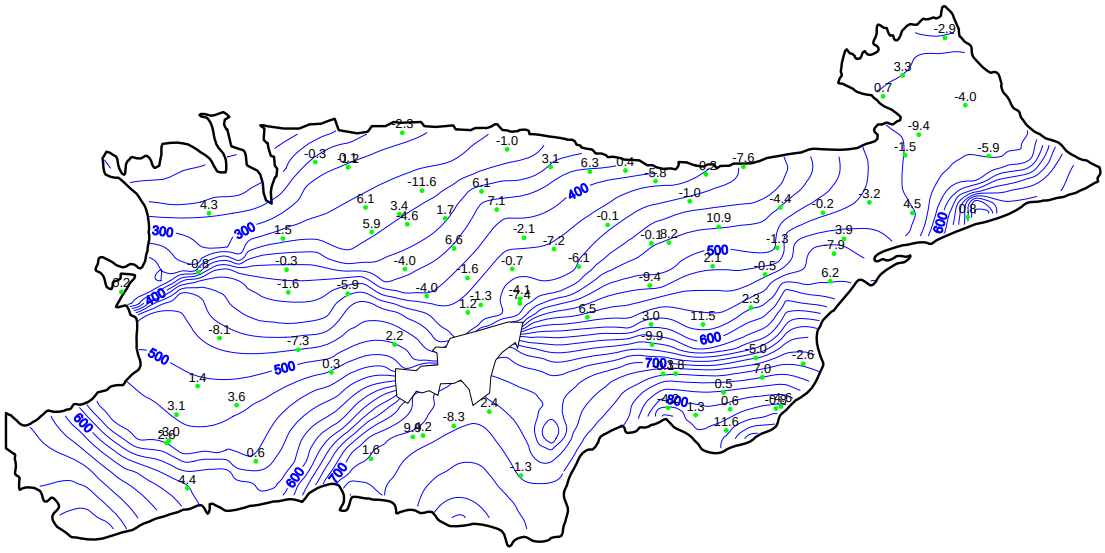


Figure G.1.10 Calculated Piezometric Map for Reference Situation (and Reference Points, with Indication of Difference between Measured and Calculated Hydraulic Head, in Meters)

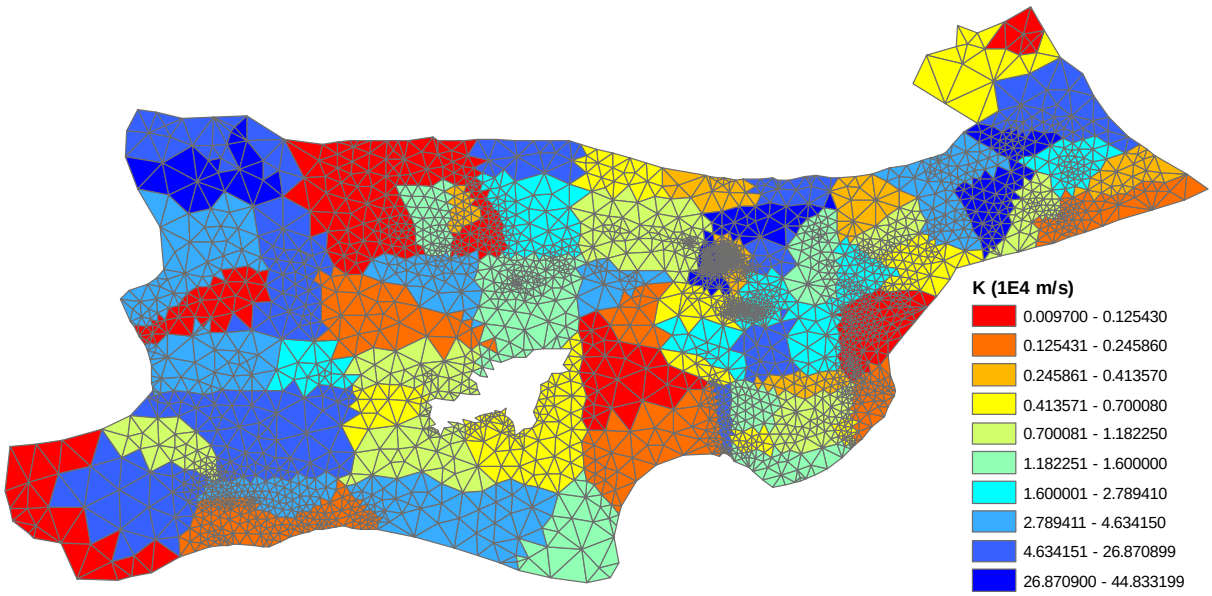


Figure G.1.11 Map of Calibrated Permeabilities

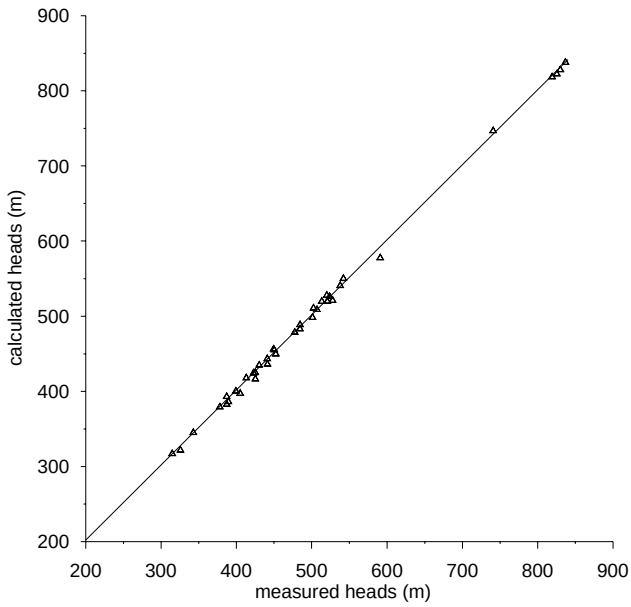


Figure G.1.12 Measured Heads Versus Calculated Heads for Steady State Mode, 1993/94 Situation

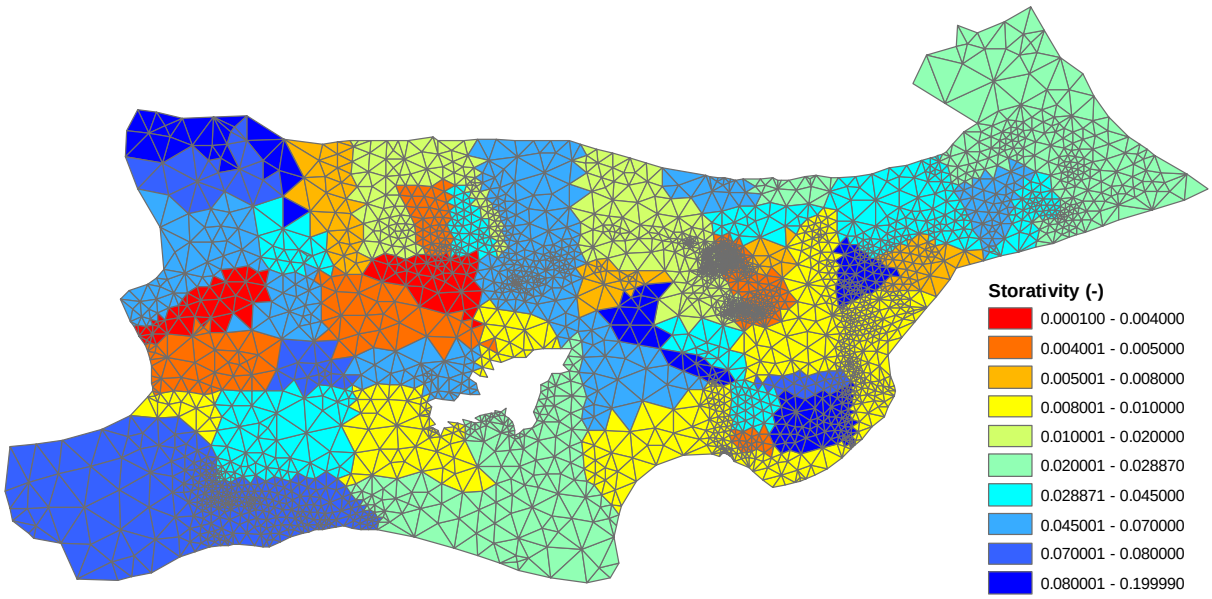


Figure G.1.13 Map of Calibrated Storativities

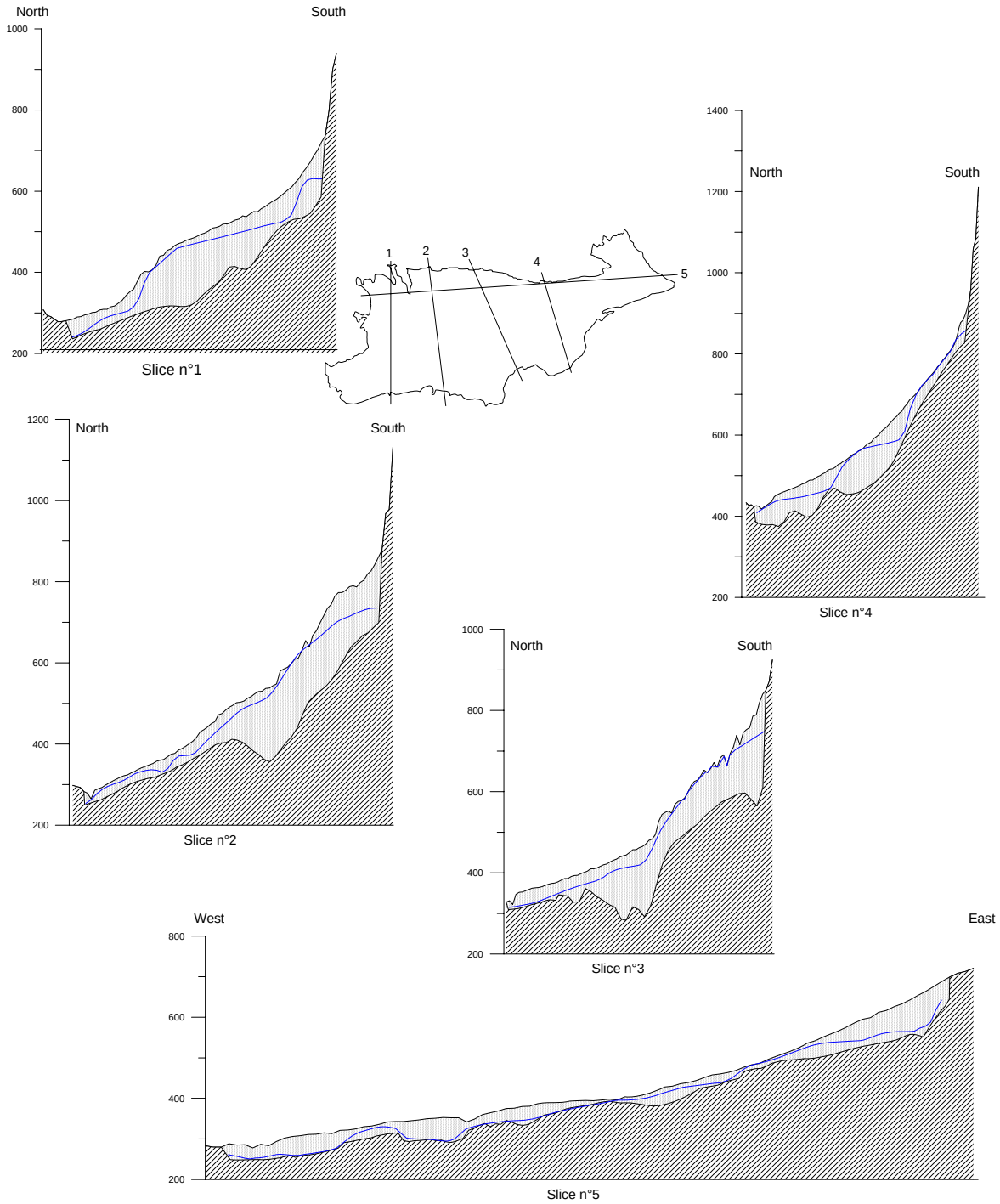


Figure G.1.14 Water Table along Few Slides in Haouz Plain

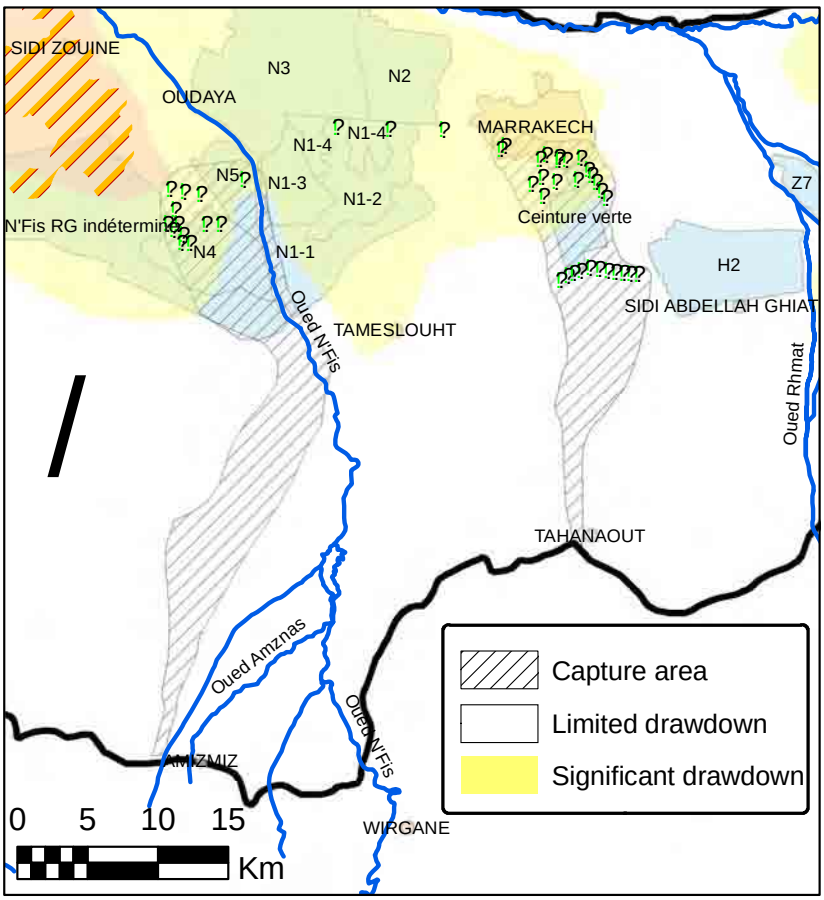


Figure G.1.15 Map of Capture Zone of Marrakech Water Supply Well Fields (Situation in 2004)

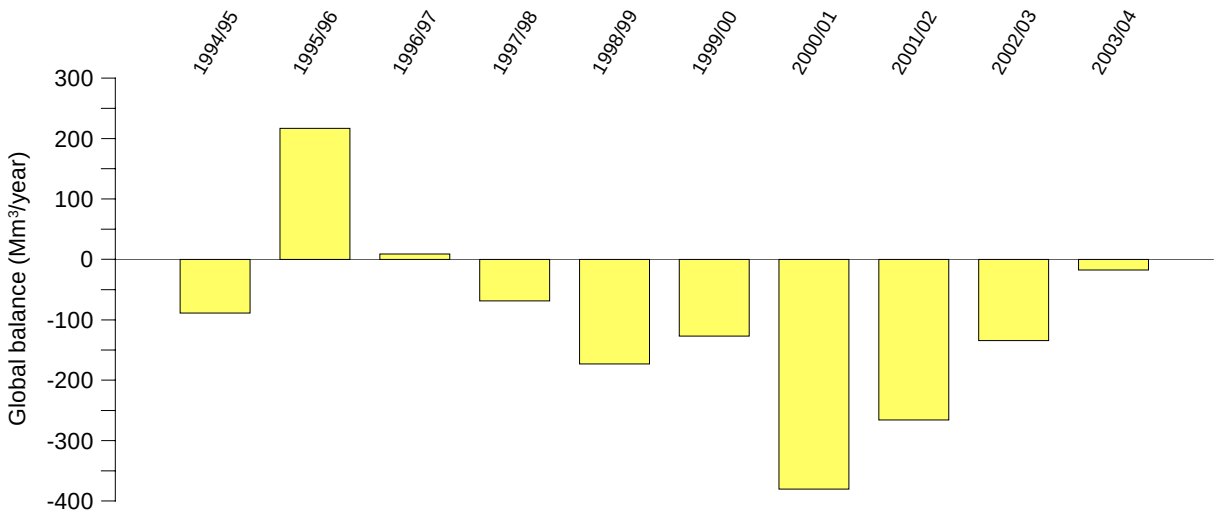


Figure G.1.16 Global Aquifer Balance from 1994 to 2004

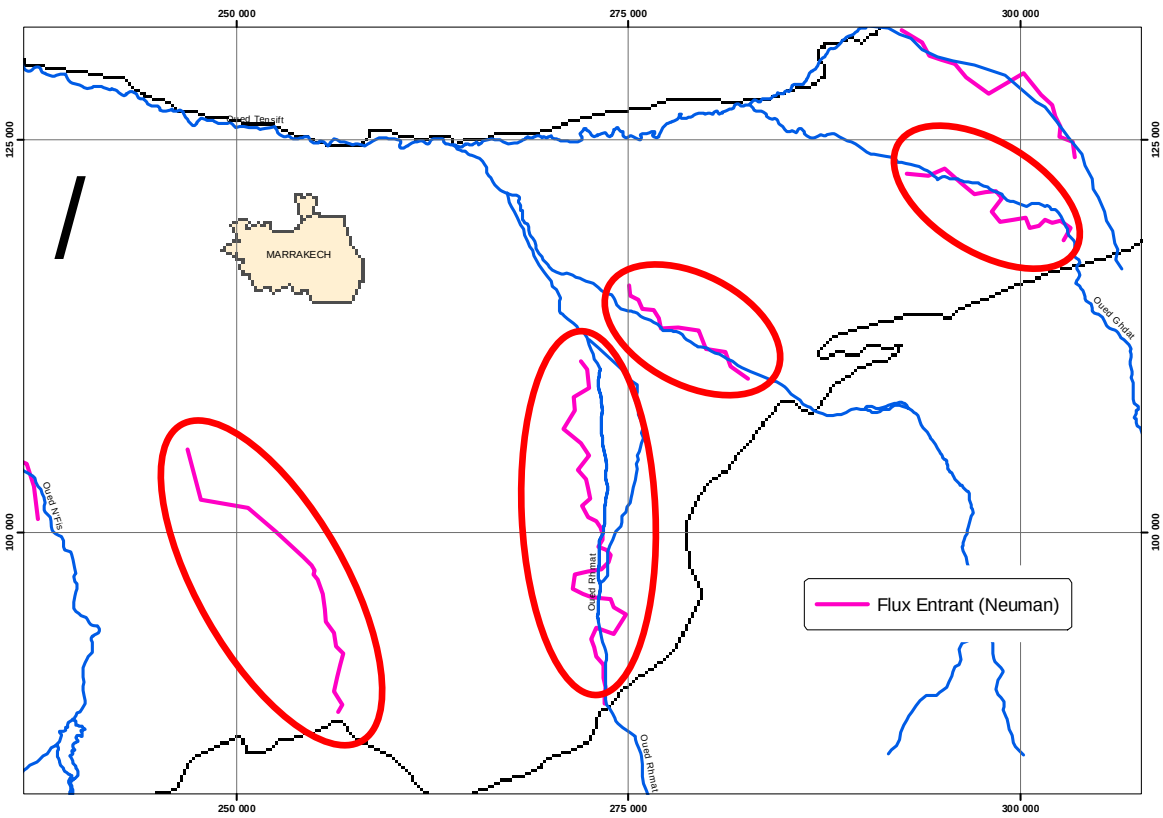


Figure G.1.17 Location of Sectors Where Artificial Recharge is Applied

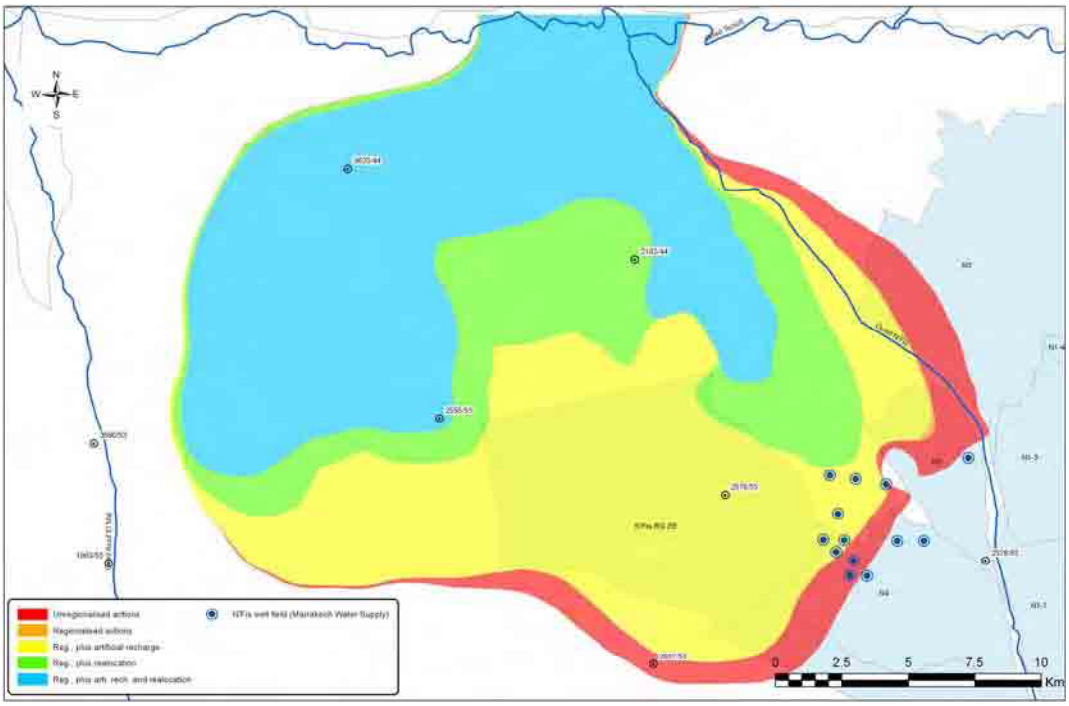


Figure G.2.2 Extension of Significant Drawdown Zone in 2021 for Basic Actions Scenarios

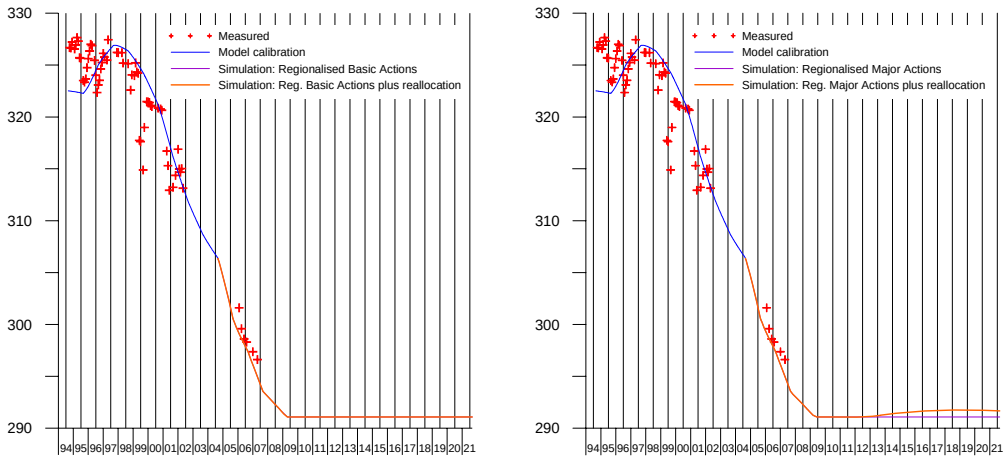


Figure G.2.3 Piezometric Changes Simulated beneath Piezometer 2162/44 for Basic Actions and Major Actions Scenarios

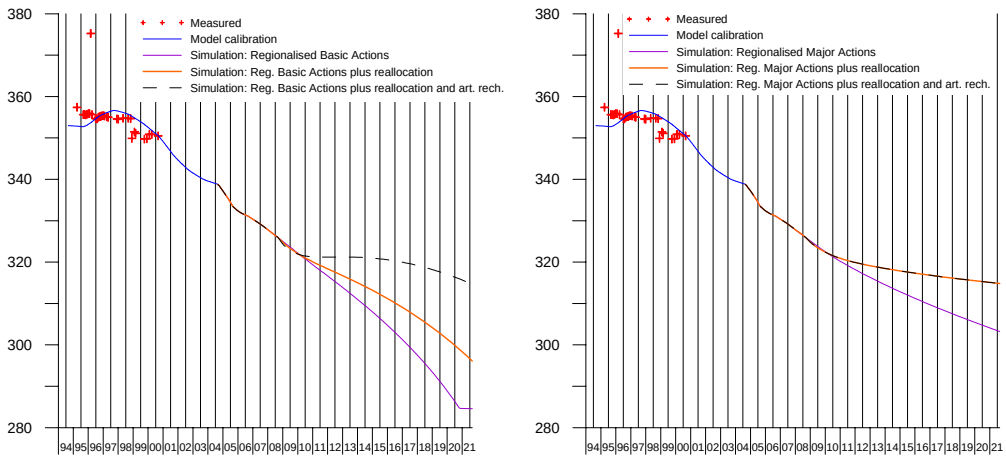


Figure G.2.4 Piezometric Changes Simulated beneath Piezometer 2555/53 for basic actions and Major Actions Scenarios

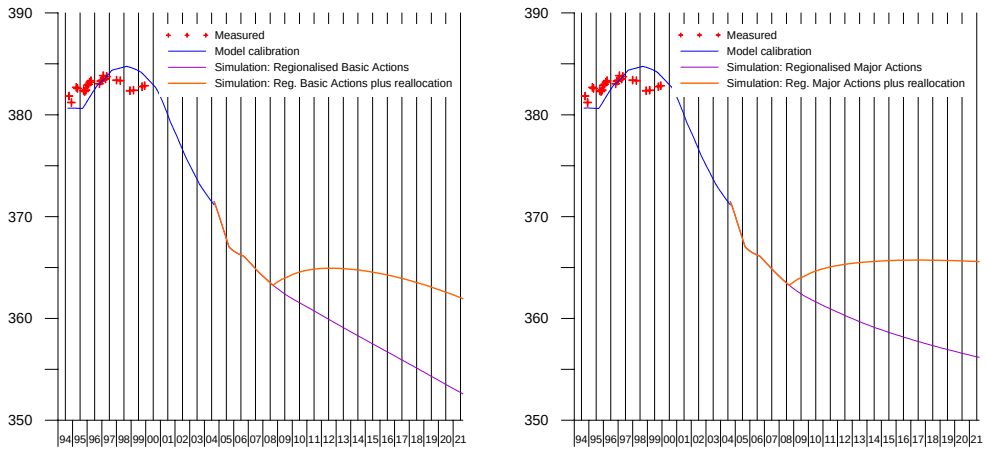


Figure G.2.5 Piezometric Changes Simulated beneath Piezometer 2576/53 for Basic Actions and Major Actions Scenarios

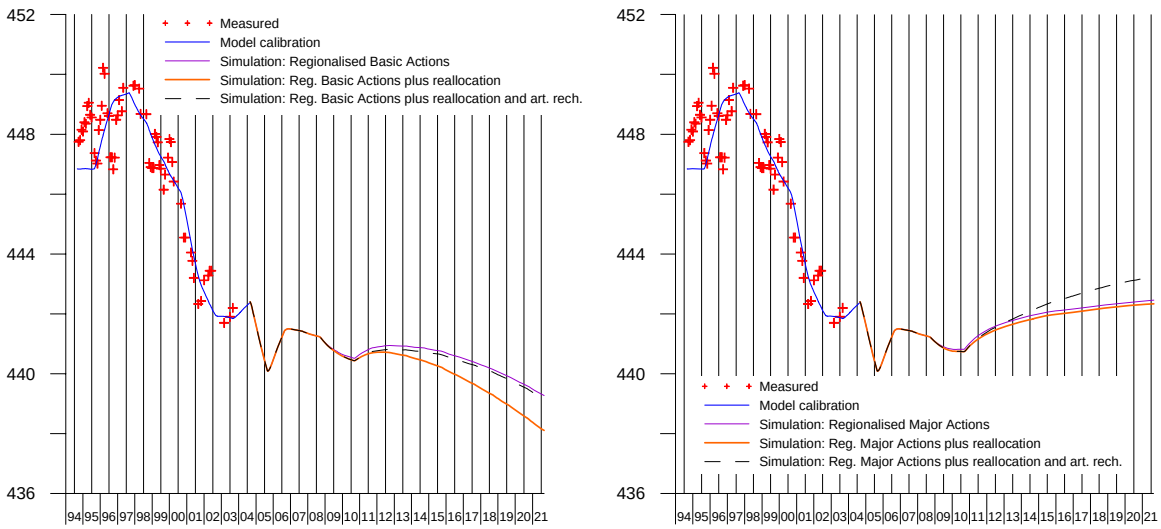


Figure G.2.6 Piezometric Changes Simulated Beneath Piezometer 2941/44 for Basic Actions and Major Actions Scenarios

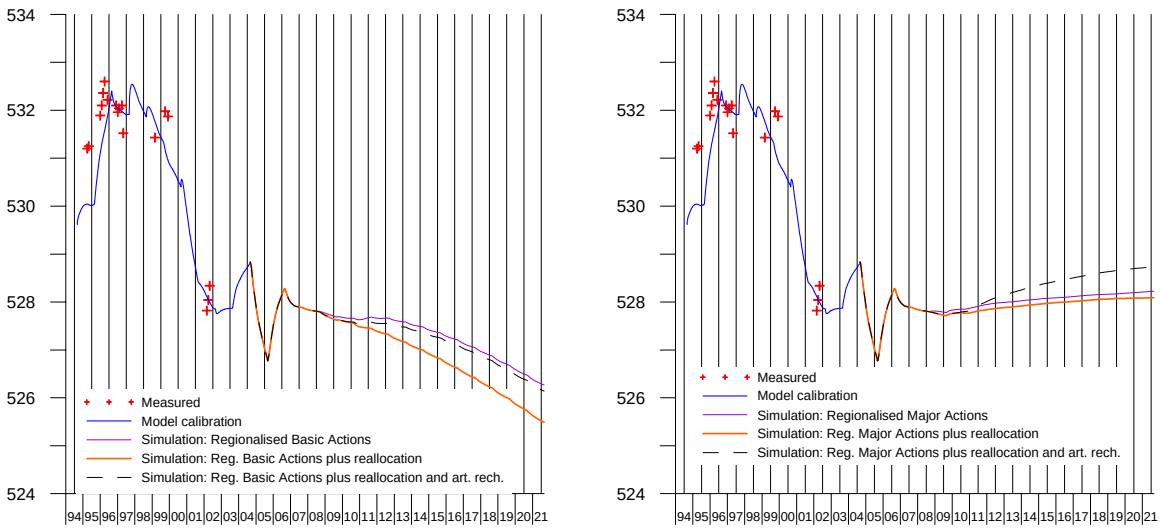


Figure G.2.7 Piezometric Changes Simulated Beneath Piezometer 0167/53 for Basic Actions and Major Actions Scenarios

Annexes

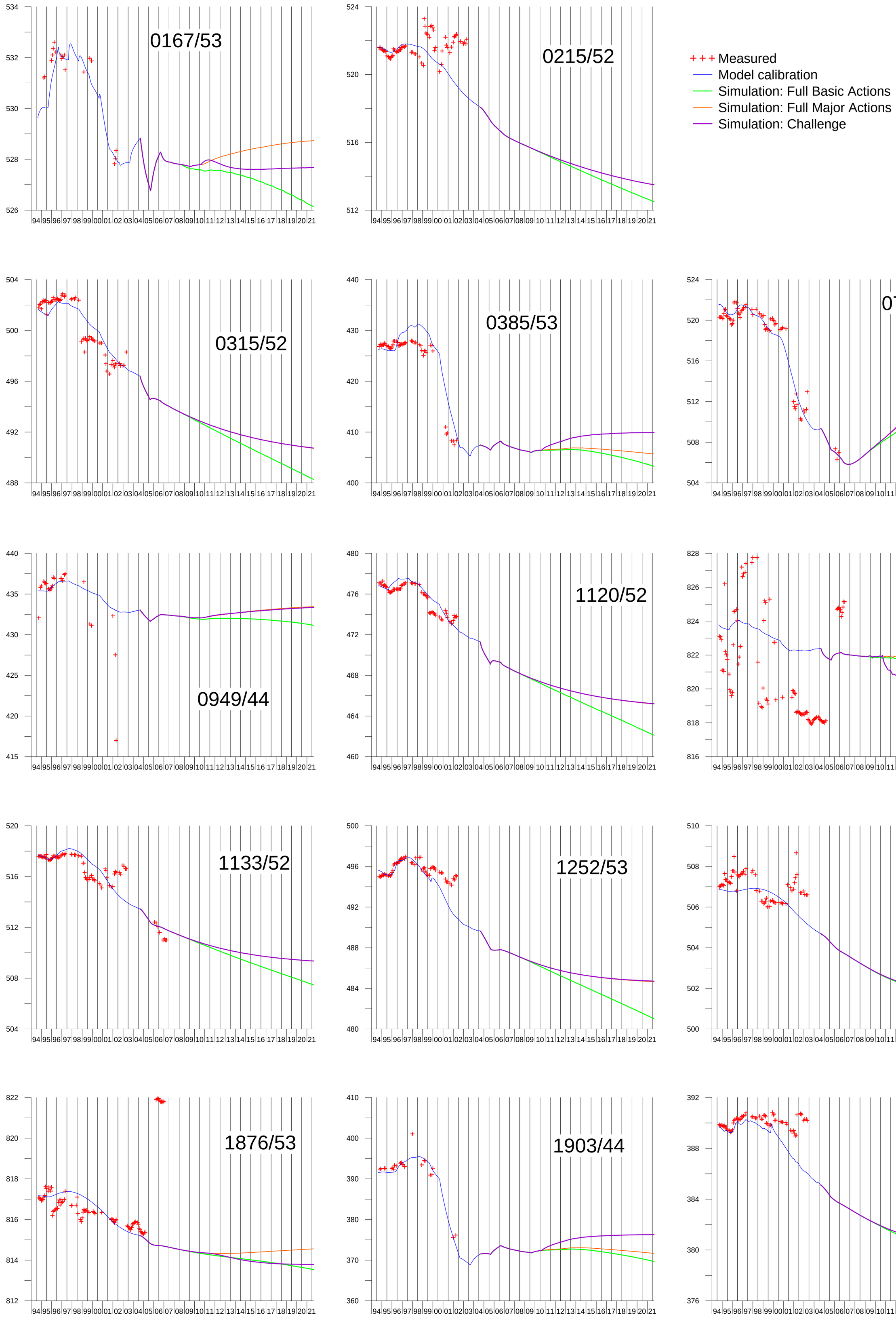
Annexe 1 – Details of the piezometric measures and computation in transient mode

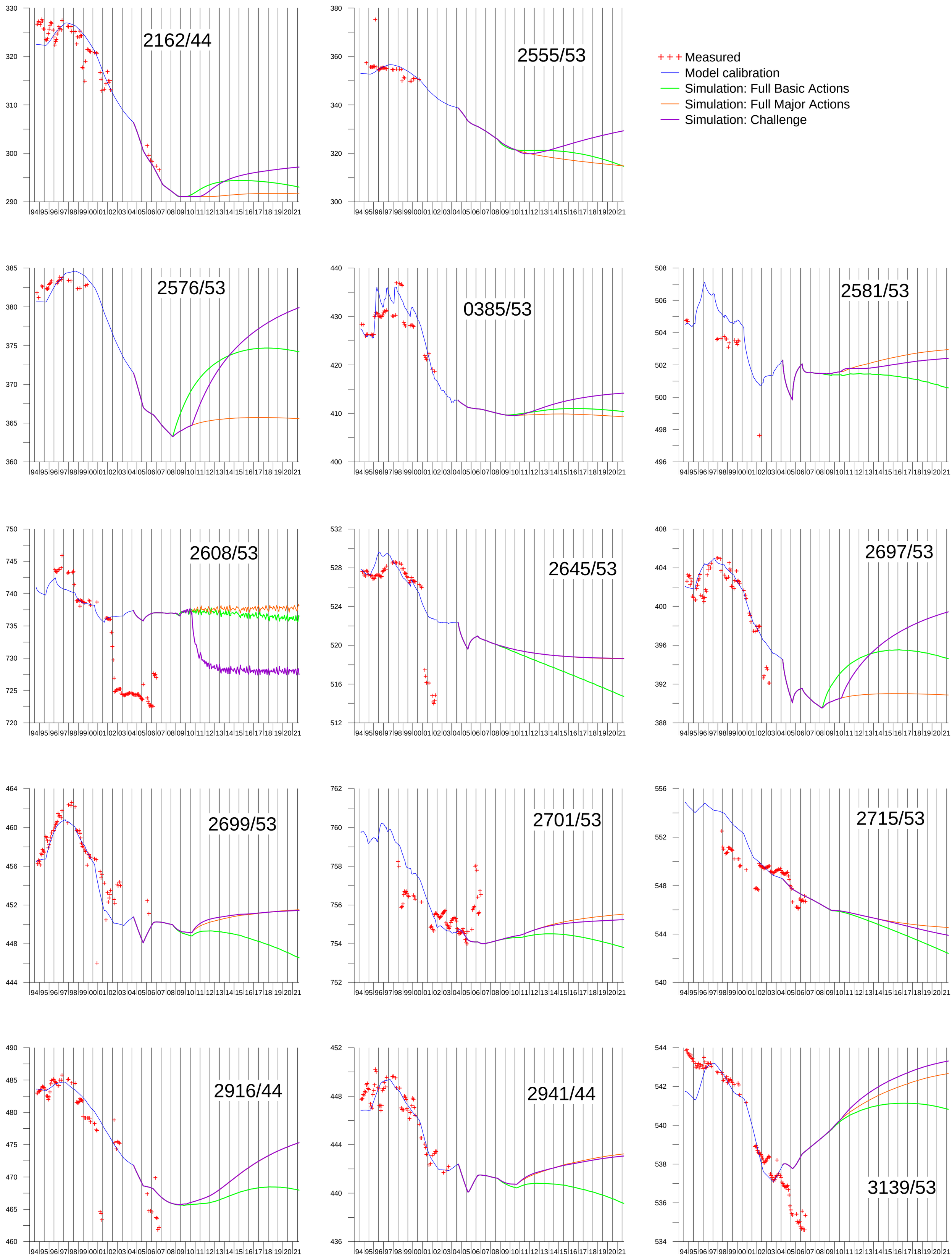
Annexe 2 – Annual rainfall

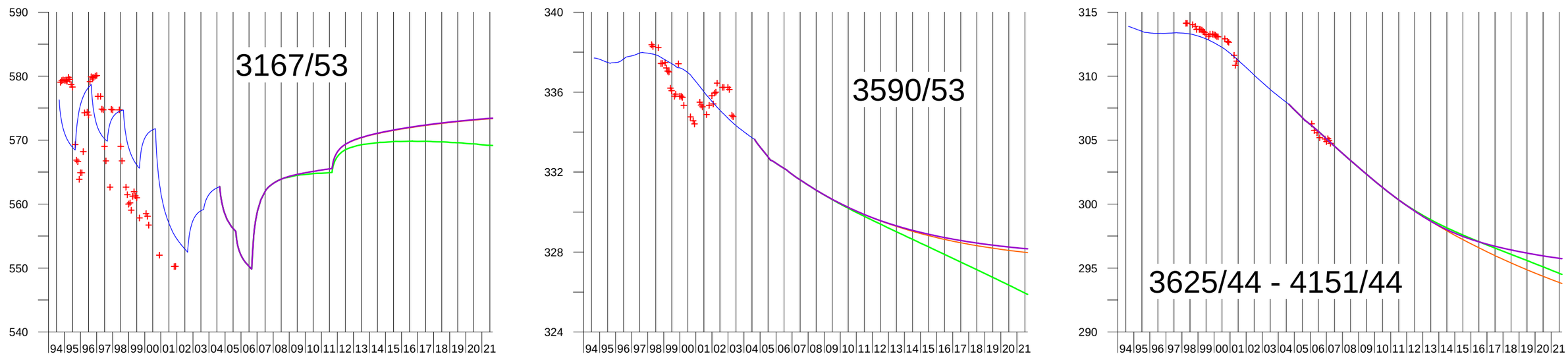
Annexe 3 – Groundwater production for Marrakech water supply

Annexe 4 – Annual flood volumes and infiltrated part

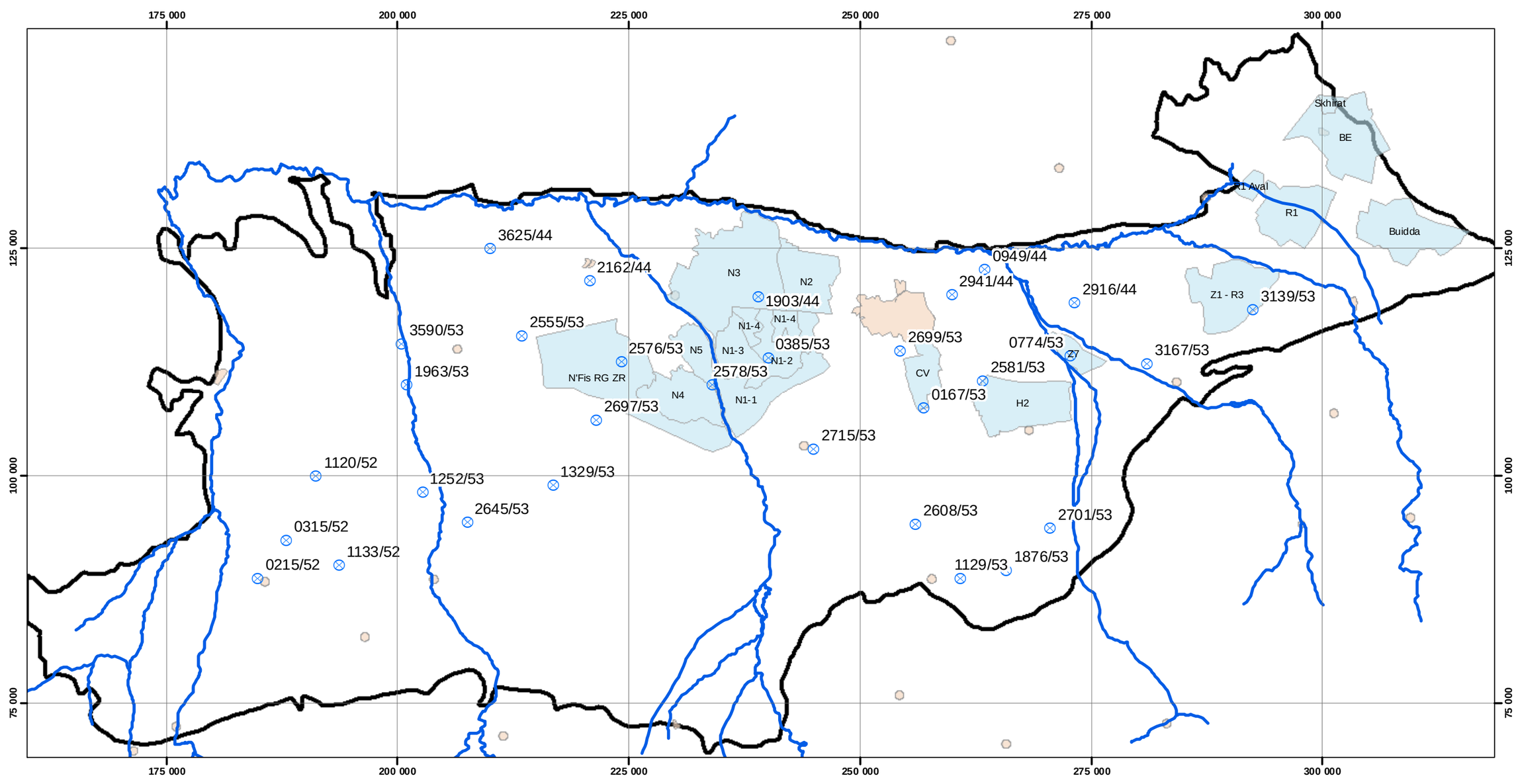
Annexe 1


0167/53
0215/52
0315/52
0385/53
0774/53
0949/44
1120/52
1129/53
1133/52
1252/53
1329/53
1876/53
1903/44
1963/53
+++ Measured
Model calibration
Simulation: Full Basic Actions
Simulation: Full Major Actions
Simulation: Challenge


2162/44
2555/53
2576/53
0385/53
2581/53
2608/53
2645/53
2697/53
2699/53
2701/53
2715/53
2916/44
2941/44
3139/53
+++ Measured
Model calibration
Simulation: Full Basic Actions
Simulation: Full Major Actions
Simulation: Challenge



+++ Measured
Model calibration
Simulation: Full Basic Actions
Simulation: Full Major Actions
Simulation: Challenge



Annexe 2 - Données pluviométriques annuelles

Station N°	NOM DE LA STATION	X	Y	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/27
1	ABADLA	200 000	129 500	202.6	195.4	311.3	296.1	185.9	129.2	148.9	87.7	134.3	215.8	201.7	97.3	238.1	175.8
2	CHICHAOUA	181 525	111 200	228.9	213.8	295.1	294.5	217.1	136	159.2	89.8	139.4	182.2	196.1	99.8	293.7	187.7
3	ILOUDJANE	176 245	70 525	389.4	350.5	390	518.1	380.8	355.4	394.6	229	268.6	329.9	508.3	231.6	403.9	316.2
4	SIDI BOUATHMANE	209 400	74 300	386.5	415.3	559.1	394.1	397.9	392.9	327.6	209.8	291.6	277.4	440.5	241.8	369.2	371.1
5	SIDI HSAIN	229 100	70 170					165.9	399.1	358.5	266.5	435	325	457.5	299.2	461.9	
6	B.LALLA TAKERKOUS	239 500	88 200	231.1	334.7	389.4	462.4	286.7	226.1	187.5	165.3	217.2	335.5	248.9	122.8	295.6	252.3
7	IMIN EL HAMAM	241 400	72 400	374.9	309.8	553.3	522	401.8	393.6	319.7	161.6	379.9	221.1	482.6	261.1	362.4	373.1
8	TAHANAOUT	255 900	80 400	416	329.6	539	469.4	354.8	372.9	280.2	212.1	296.2	289.7	466.9	212.7	606.7	374.7
9	AGHBALOU	276 150	83 050	647.8	359.4	725.1	515.2	560.3	552.4	449.4	379.6	481.9	406.1	704.7	324	542.6	537.0
10	TAFERIAT	291 250	107 500	468.1	396.4	913.4	420.9	415.9	395	308.3	234.6	299.1	274.4	338.3	215.2	334.6	406.6
11	SIDI RAHAL	303 100	117 800	359.9	346.3	648.2	429.6	388.5	349	266.3	195.8	241.3	347.3	389.7	197	389.8	348.5
12	MARRAKECH	250 000	110 000	214.8	287.1	350.3	337.6	270	191.5	158.7	102.8	181.8	207.4	227.4	107.9	252.8	220.4

Annexe 3
-
Marrakech water supply

Details of the monthly production per well and consolidation

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 1995
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	62500	30800	44070	27270	31650	28440	33840	29070	59050	49110	26820	51390	474010
P	1199/53	65310	22890	43700	42000	22200	52800	43260	61200	71850	78500	66900	80800	651410
P	2061/53	60010	48590	27310	20720	44850	43440	33900	26770	28500	14690	1000	8560	358340
P	2070/53	33500	23600	11140	28600	15040	28890	34260	36210	66020	59190	34110	14320	384880
P	2078/53	20560	9150	160	36630	57260	44670	46530	44550	69500	62450	39650	33570	464680
P	2357/53	740	0	15670	22450	16800	10600	11200	17170	29310	46410	3520	0	173870
P	2575/53	130	0	0	7950	45330	33300	41040	38310	49720	25390	6300	4520	251990
P	2584/53	38750	8100	2580	20890	11010	19090	25710	30120	61960	48140	3020	26220	295590
TOTAL		**281500**	**143130**	**144630**	**206510**	**244140**	**261230**	**269740**	**283400**	**435910**	**383880**	**181320**	**219380**	**3054770**
FORAGEOUED ISSIL														
F	1543/53	0	0	2540	8500	8870	19240	14180	26710	32980	29020	21220	20500	183760
F	1544/53	44310	40720	38550	23830	42730	40980	40770	41260	37680	39940	35500	10380	436650
F	2364/53	38700	34220	27930	19630	40200	39600	22700	31060	32690	32850	29030	9030	357640
F	2365/53	0	0	0	0	3650	28880	41180	30810	29200	40340	37160	10280	221500
F	2366/53	0	0	3060	8520	13350	17510	12810	18520	20910	6030	60	4150	104920
TOTAL		**83010**	**74940**	**72080**	**60480**	**108800**	**146210**	**131640**	**148360**	**153460**	**148180**	**122970**	**54340**	**1304470**
PUITS MENARA														
P	2603/53	10170	10410	15130	9950	13370	18880	10500	15160	33540	13400	2220	5090	157820
P	2671/53	13130	9260	13580	8550	10480	16210	7700	18250	30460	12530	850	4240	145240
TOTAL		**23300**	**19670**	**28710**	**18500**	**23850**	**35090**	**18200**	**33410**	**64000**	**25930**	**3070**	**9330**	**303060**
PUITS OURIKA														
P	2064/53	51100	15500	35170	21520	24630	27650	38300	38270	62340	38400	19250	39650	411780
P	2360/53	57370	40150	43610	47470	30590	0	13490	0	0	69330	73530	58340	433880
P	2367/53	39900	29950	30790	0	32100	24800	0	0	0	180	20890	89330	267940
TOTAL		**148370**	**85600**	**109570**	**68990**	**87320**	**52450**	**51790**	**38270**	**62340**	**107910**	**113670**	**187320**	**1113600**
PUIT IZIKI														
P	2116/53	1460	1160	40	20	0	250	0	630	32890	20260	150	65	56925
TOTAL		**1460**	**1160**	**40**	**20**	**0**	**250**	**0**	**630**	**32890**	**20260**	**150**	**65**	**56925**
ADDUCTION GRAVITAIRE														
S	38-215/53	166190	188820	236420	333090	455310	394710	308360	183520	140410	173790	193390	236340	3010350
TOTAL		**166190**	**188820**	**236420**	**333090**	**455310**	**394710**	**308360**	**183520**	**140410**	**173790**	**193390**	**236340**	**3010350**
ADDUCTION N'FIS														
F	2355/53	31490	9250	0	0	0	0	0	0	0	0	23470	8100	72310
F	2356/53	3930	20720	16100	5270	1090	1380	0	9440	9660	13600	8040	0	89230
F	2458/53	26220	0	1510	8260	1500	1950	30	2220	4600	3020	0	0	49310
F	2459/53	56550	0	2780	16140	3870	4020	0	4730	10140	6460	0	0	104690
F	2460/53	0	0	0	60220	81990	64770	26010	77560	12060	55750	13140	0	391500
F	2481/53	2800	44030	19810	71900	8500	8210	2500	21000	84000	152000	148800	150160	713710
F	2482/53	19000	108880	10560	11300	5130	6220	3700	7960	18760	10590	0	0	202100
F	2483/53	8980	53470	10870	37040	2620	3590	1750	4510	0	4120	350	0	127300
F	2549/53	6950	37910	25440	0	0	0	0	2900	8730	30430	18750	0	131110
F	2551/53	67470	0	12940	60670	83000	83220	86700	37000	22500	56190	80290	80900	670880
F	2554/53	106240	0	0	2300	0	0	430	10430	41500	17000	0	28500	206400
F	2560/53	52710	0	13330	53100	69770	70020	70600	27000	11430	6730	0	15360	390050
F	2561/53	14900	122910	137310	99900	5840	3320	2300	10300	29830	51880	0	30	478520
TOTAL		**397240**	**397170**	**250650**	**426100**	**263310**	**246700**	**194020**	**215050**	**253210**	**407770**	**292840**	**283050**	**3627110**
PUITS BAHJA														
P	2646/53	65710	59390	54500	35600	0	0	0	0	0	0	3720	1900	220820
P	2664/53	4000	0	0	0	0	0	0	0	0	0	0	0	4000
TOTAL		**69710**	**59390**	**54500**	**35600**	**0**	**0**	**0**	**0**	**0**	**0**	**3720**	**1900**	**224820**
TOTAL PROD SOUT		**1170780**	**969880**	**896600**	**1149290**	**1182730**	**1136640**	**973750**	**902640**	**1142220**	**1267720**	**911130**	**991725**	**12 695 105**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 1996
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	23540	16130	1970	19810	920	35990	15420	32610	0	9480	16870	17250	189990
P	1199/53	11650	3650	0	11450	4530	38200	12490	0	0	2890	13530	2580	100970
P	2061/53	8110	3220	540	6650	4150	20140	8310	7770	1810	10250	37180	9130	117260
P	2070/53	31240	3290	70	20520	260	12580	10000	21010	40	11650	1200	3720	115580
P	2078/53	17810	40280	17110	26100	14730	37200	29050	39390	32920	18030	41720	50850	365190
P	2357/53	0	2240	0	14480	570	4700	5500	0	0	4000	0	0	31490
P	2575/53	11110	3200	3770	5000	5670	30090	6010	0	680	15990	45830	11520	138870
P	2584/53	3880	2490	0	7990	410	28130	8170	970	220	2270	2010	1170	57710
TOTAL		**107340**	**74500**	**23460**	**112000**	**31240**	**207030**	**94950**	**101750**	**35670**	**74560**	**158340**	**96220**	**1117060**
FORAGEOUED ISSIL														
F	1543/53	25900	17500	950	6070	2590	8150	5310	25840	9920	3660	24000	23450	153340
F	1544/53	37190	31950	0	4610	750	6520	0	0	0	0	10	1080	82110
F	2364/53	35240	26740	70	4090	470	5930	130	0	390	730	100	80	73970
F	2365/53	40970	31080	120	4690	380	0	400	0	20	0	50	0	77710
F	2366/53	730	0	80	70	490	0	310	0	0	0	0	0	1680
TOTAL		**140030**	**107270**	**1220**	**19530**	**4680**	**20600**	**6150**	**25840**	**10330**	**4390**	**24160**	**24610**	**388810**
PUITS MENARA														
P	2603/53	3370	2150	150	6570	3480	28950	8050	2460	2590	5200	12670	2120	77760
P	2671/53	2620	1550	180	4030	2380	31270	6190	2320	1310	4130	11230	1800	69010
TOTAL		**5990**	**3700**	**330**	**10600**	**5860**	**60220**	**14240**	**4780**	**3900**	**9330**	**23900**	**3920**	**146770**
PUITS OURIKA														
P	2064/53	39450	30520	7420	24300	7150	31440	20720	39710	20540	17140	33480	24570	296440
P	2360/53	16670	0	0	0	0	0	0	0	0	0	0	0	16670
P	2367/53	50540	33110	22660	18250	5180	59400	33480	30160	3640	36100	25800	17630	335950
TOTAL		**106660**	**63630**	**30080**	**42550**	**12330**	**90840**	**54200**	**69870**	**24180**	**53240**	**59280**	**42200**	**649060**
PUIT IZIKI														
P	2116/53	195	90	30	0	310	12420	0	0	0	47810	5960	7270	74085
TOTAL		**195**	**90**	**30**	**0**	**310**	**12420**	**0**	**0**	**0**	**47810**	**5960**	**7270**	**74085**
ADDUCTION GRAVITAIRE														
S	38-215/53	256450	369950	465060	510300	461410	461230	249050	359290	287730	253200	222150	334950	4230770
TOTAL		**256450**	**369950**	**465060**	**510300**	**461410**	**461230**	**249050**	**359290**	**287730**	**253200**	**222150**	**334950**	**4230770**
ADDUCTION N'FIS														
F	2355/53	27350	53420	7830	27380	10060	47000	7500	2200	0	0	33740	59870	276350
F	2356/53	0	0	0	0	920	10570	340	0	0	50	10680	3510	26070
F	2458/53	0	0	0	33110	13180	11980	22350	35420	17630	500	460	29290	163920
F	2459/53	0	0	0	800	53490	19060	2540	860	6990	950	880	880	86450
F	2460/53	0	0	76210	85560	21530	26640	5400	2080	10070	2140	1760	1720	233110
F	2481/53	111000	0	0	1820	15110	140000	72000	0	0	0	2650	3400	345980
F	2482/53	33500	116240	20990	1230	2880	32670	10210	460	26260	105920	113110	113330	576800
F	2483/53	18230	68430	69800	4920	10900	15430	5610	0	5210	0	1830	1250	201610
F	2549/53	0	0	0	0	16120	14640	1750	320	12460	50200	51120	10890	157500
F	2551/53	58360	0	0	920	1800	32420	81990	89000	44520	1990	1800	1760	314560
F	2554/53	1260000	43280	0	0	4970	56830	99280	3230	5710	11310	10750	2600	1497960
F	2560/53	24470	0	0	0	1090	35480	24280	310	0	8100	1690	2750	98170
F	2561/53	0	80	127320	149110	36580	60150	76080	3420	6640	9600	1750	2950	473680
TOTAL		**1532910**	**281450**	**302150**	**304850**	**188630**	**502870**	**409330**	**137300**	**135490**	**190760**	**232220**	**234200**	**4452160**
PUITS BAHJA														
P	2646/53	1480	2930	0	9170	4250	7590	0	0	360	0	0	0	25780
P	2664/53	0	0	0	0	0	0	0	0	400	6970	2340	0	9710
TOTAL		**1480**	**2930**	**0**	**9170**	**4250**	**7590**	**0**	**0**	**760**	**6970**	**2340**	**0**	**35490**
TOTAL PROD SOUT		**2151055**	**903520**	**822330**	**1009000**	**708710**	**1362800**	**827920**	**698830**	**498060**	**640260**	**728350**	**743370**	**11094205**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 1997
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	28400	19710	24350	7880	4910	8140	2410	7450	24180	7960	6060	1060	142510
P	1199/53	3780	3060	4830	28870	23530	27460	6800	26460	50120	28210	143330	420	346870
P	2061/53	1910	3810	7610	15340	1610	4070	1470	3940	26310	4200	9280	36450	116000
P	2070/53	10430	3580	5300	3380	5730	8890	0	0	17610	16480	12520	2280	86200
P	2078/53	18680	32850	41420	19080	17230	14410	4860	9050	48180	60160	13630	4110	283660
P	2357/53	0	1130	1750	1400	1190	0	0	0	6400	4230	12450	6700	35250
P	2575/53	310	9770	20590	3800	340	410	2480	4050	30900	23190	13510	10560	119910
P	2584/53	840	3720	3100	15270	5980	6660	14220	14080	32310	25200	15370	0	136750
TOTAL		**64350**	**77630**	**108950**	**95020**	**60520**	**70040**	**32240**	**65030**	**236010**	**169630**	**226150**	**61580**	**1267150**
FORAGEOUED ISSIL														
F	1543/53	3540	30660	33460	26060	21070	21070	9270	8840	9830	22470	0	1020	187290
F	1544/53	120	850	850	1650	190	190	730	790	1800	3920	150	200	11440
F	2364/53	790	720	530	2130	840	840	3110	2850	560	10100	4060	4670	31200
F	2365/53	430	1210	920	1210	220	220	230	560	10100	4060	4670	170	24000
F	2366/53	280	770	610	730	180	180	0	400	14200	2580	4960	220	25110
TOTAL		**5160**	**34210**	**36370**	**31780**	**22500**	**22500**	**13340**	**13440**	**36490**	**43130**	**13840**	**6280**	**279040**
PUITS MENARA														
P	2603/53	4640	2330	3620	4170	3260	2330	5451	6771	17873	19645	1810	0	71900
P	2671/53	3990	1180	11060	21010	4010	2796	1034	4606	17334	18040	17330	21120	123510
TOTAL		**8630**	**3510**	**14680**	**25180**	**7270**	**5126**	**6485**	**11377**	**35207**	**37685**	**19140**	**21120**	**195410**
PUITS OURIKA														
P	2064/53	18640	11940	0	1820	440	2260	5010	2580	0	29600	6300	5290	83880
P	2360/53	32870	44400	27500	15500	560	14670	2810	17960	74090	42100	19970	160	292590
P	2367/53	15700	21050	4870	17800	6450	11770	8060	15690	40460	51690	19640	7330	220510
TOTAL		**67210**	**77390**	**32370**	**35120**	**7450**	**28700**	**15880**	**36230**	**114550**	**123390**	**45910**	**12780**	**596980**
PUIT IZIKI														
P	2116/53	850	3790	4440	3750	4320	3514	0	0	4256	2890	10690	3350	41850
TOTAL		**850**	**3790**	**4440**	**3750**	**4320**	**3514**	**0**	**0**	**4256**	**2890**	**10690**	**3350**	**41850**
ADDUCTION GRAVITAIRE														
S	38-215/53	339330	288730	238020	393450	513000	490290	452580	283740	197910	310900	287480	311160	4106590
TOTAL		**339330**	**288730**	**238020**	**393450**	**513000**	**490290**	**452580**	**283740**	**197910**	**310900**	**287480**	**311160**	**4106590**
ADDUCTION N'FIS														
F	2355/53	11070	7690	15840	8940	13650	22990	29510	27880	24330	26870	27770	20480	237020
F	2356/53	730	10370	6020	11910	12020	9490	24050	17870	22480	26830	22340	16240	180350
F	2458/53	660	12400	9130	15400	14570	11080	23540	23710	15880	10740	23390	6350	166850
F	2459/53	24890	18880	23450	19980	20500	14080	30320	29890	18680	43120	28270	8260	280320
F	2460/54	21310	13580	19680	23470	23410	18220	35700	36680	25620	28890	38040	0	284600
F	2481/53	38350	22470	34340	0	0	0	0	0	24880	7030	0	44820	171890
F	2482/53	1920	34400	21340	34950	30460	31770	38860	57940	67700	69460	0	23820	412620
F	2483/53	25440	18290	25270	19260	16490	4100	23290	22920	18370	27620	27290	7040	235380
F	2549/53	0	15350	8400	16800	15130	12410	33230	7190	15450	6150	12240	0	142350
F	2551/53	29000	21480	28680	10540	13830	45850	58040	39740	39200	39170	32540	14850	372920
F	2554/53	38940	25570	15210	37840	31700	48760	98240	34490	70260	26870	16030	0	443910
F	2560/53	41050	27530	16920	24650	25570	85780	110460	40150	58820	61450	22560	21580	536520
F	2561/53	24130	19390	43510	22960	38140	53110	63380	85040	61470	53900	52410	0	517440
TOTAL		**257490**	**247400**	**267790**	**246700**	**255470**	**357640**	**568620**	**423500**	**463140**	**428100**	**302880**	**163440**	**3982170**
PUITS BAHJA														
P	2646/53	910	1810	19160	1400	1290	1570	4230	1400	7570	7590	12140	19110	78180
P	2664/53	290	0	360	4030	6070	4170	3510	1870	7230	10840	10550	6520	55440
TOTAL		**1200**	**1810**	**19520**	**5430**	**7360**	**5740**	**7740**	**3270**	**14800**	**18430**	**22690**	**25630**	**133620**
TOTAL PROD SOUT		**744220**	**734470**	**722140**	**836430**	**877890**	**983550**	**1096885**	**836587**	**1102363**	**1134155**	**928780**	**605340**	**10602810**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 1998
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	4590	2120	11310	7090	28120	62210	53540	62030	28700	34440	39150	58300	391600
P	1199/53	130	1420	7050	640	18940	99850	58070	1250	2488	41970	20860	91620	344288
P	2061/53	42140	74780	52100	55310	71150	79780	7790	510	12540	5060	18670	67240	487070
P	2070/53	92540	70460	24200	91790	80660	71050	7430	2710	27570	10330	33660	102590	614990
P	2078/53	7558	62200	53000	80590	74570	87980	6040	3690	16920	10040	27380	75490	505458
P	2357/53	6280	12850	0	0	6800	18200	1050	0	0	26000	20600	37730	129510
P	2575/53	70280	34850	60050	66360	51620	40190	7130	270	3640	2910	29020	86790	453110
P	2584/53	69930	58700	57110	74330	64810	77270	1830	3740	9200	20	27420	82120	526480
TOTAL		**293448**	**317380**	**264820**	**376110**	**396670**	**536530**	**142880**	**74200**	**101058**	**130770**	**216760**	**601880**	**3452506**
FORAGEOUED ISSIL														
F	1543/53	2310	260	1410	3030	3290	8540	16150	30700	27950	26000	25200	24200	169040
F	1544/53	120	0	180	0	14730	45900	28340	5950	2120	16170	11740	5990	131240
F	2364/53	1220	130	30	0	12050	42000	25560	10760	0	18720	14630	21320	146420
F	2365/53	1250	20	1200	100	17080	54920	30410	24930	429690	34200	31970	11570	637340
F	2366/53	760	30	1310	60	10900	10530	2460	0	0	0	37320	31040	94410
TOTAL		**5660**	**440**	**4130**	**3190**	**58050**	**161890**	**102920**	**72340**	**459760**	**95090**	**120860**	**94120**	**1178450**
PUITS MENARA														
P	2603/53	130	0	6910	2130	1798	60140	40580	41190	6700	25460	15800	42380	243218
P	2671/53	6420	4720	12100	2950	9970	53620	33590	39430	6150	33000	33790	11090	246830
TOTAL		**6550**	**4720**	**19010**	**5080**	**11768**	**113760**	**74170**	**80620**	**12850**	**58460**	**49590**	**53470**	**490048**
PUITS OURIKA														
P	2064/53	2050	1000	10640	12150	28380	66940	60450	64770	39550	38960	42840	68730	436460
P	2360/53	2210	340	20090	12200	50290	76180	75820	81450	40410	44440	25440	88610	517480
P	2367/53	6320	0	7380	9580	34580	85110	83510	74510	41980	54820	34790	0	432580
TOTAL		**10580**	**1340**	**38110**	**33930**	**113250**	**228230**	**219780**	**220730**	**121940**	**138220**	**103070**	**157340**	**1386520**
PUIT IZIKI														
P	2116/53	2230	2410	4700	2460	7330	17590	10380	4270	9860	14810	15500	14150	105690
TOTAL		**2230**	**2410**	**4700**	**2460**	**7330**	**17590**	**10380**	**4270**	**9860**	**14810**	**15500**	**14150**	**105690**
ADDUCTION GRAVITAIRE														
S	38-215/53	316190	279630	254520	338140	382550	329950	256430	154640	119330	108680	105750	115130	2760940
TOTAL		**316190**	**279630**	**254520**	**338140**	**382550**	**329950**	**256430**	**154640**	**119330**	**108680**	**105750**	**115130**	**2760940**
ADDUCTION N'FIS														
F	2355/53	460	150	9730	88080	20170	52130	3000	43380	20260	49920	8790	43310	339380
F	2356/53	8430	11620	24930	41270	16110	26290	2680	30	14800	13060	7790	220	167230
F	2458/53	420	260	7870	6900	5590	44410	2420	180	0	8480	8200	250	84980
F	2459/53	660	310	9070	8310	12200	41160	20	100	18800	19220	5460	7090	122400
F	2460/54	23890	510	16590	13550	11290	75040	4540	0	47730	11380	0	0	204520
F	2481/53	34010	12630	28340	19480	20200	56590	16150	0	56150	57030	0	14500	315080
F	2482/53	12470	3840	55800	15950	15830	60580	5430	71520	35510	11020	52340	0	340290
F	2483/53	260	260	9330	9690	0	10130	10350	10510	0	0	37040	430	88000
F	2549/53	13210	230	9310	52790	20120	34430	3550	0	18340	960	720	4410	158070
F	2551/53	1160	9670	15440	10850	11360	44180	7750	49620	1250	26350	14280	22860	214770
F	2554/53	0	0	0	0	0	43250	93760	12910	0	32510	8080	51390	241900
F	2560/53	1350	0	0	0	0	38830	1750	81810	7250	43800	33140	9440	217370
F	2561/53	11240	640	24220	21500	37000	99500	79650	0	0	101600	53680	72610	501640
TOTAL		**107560**	**40120**	**210630**	**288370**	**169870**	**626520**	**231050**	**270060**	**220090**	**375330**	**229520**	**226510**	**2995630**
PUITS BAHJA														
P	2646/53	0	2200	860	180	1630	26720	180	0	9930	14770	6280	4930	67680
P	2664/53	350	300	200	530	2600	14650	8000	0	7250	8200	8750	9200	60030
TOTAL		**350**	**2500**	**1060**	**710**	**4230**	**41370**	**8180**	**0**	**17180**	**22970**	**15030**	**14130**	**127710**
TOTAL PROD SOUT		**742568**	**648540**	**796980**	**1047990**	**1143718**	**2055840**	**1045790**	**876860**	**1062068**	**944330**	**856080**	**1276730**	**12497494**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 1999
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	64800	38620	56150	21590	36720	40770	52810	41750	38180	63770	17230	59620	532010
P	1199/53	85760	42380	63250	24380	36980	34090	68300	41450	60750	61050	38120	67500	624010
P	2061/53	83160	82690	66280	22760	50600	74060	81780	80870	71290	77630	11520	59950	383040
P	2070/53	77640	52760	66840	31190	47940	77040	71490	70990	66800	68230	26400	82800	740120
P	2078/53	85810	65750	100630	41130	42590	0	8230	83440	77190	84470	27510	43520	660270
P	2357/53	30500	24500	13490	9890	11080	37440	86390	30330	6040	23440	6890	51090	331080
P	2575/53	63820	52690	67470	32350	35350	44870	60940	56180	54000	43610	21050	53730	586060
P	2584/53	62700	39640	83010	33500	54450	69870	87710	74660	80900	75540	20590	60900	743470
TOTAL		**554190**	**399030**	**517120**	**216790**	**315710**	**378140**	**517650**	**479670**	**455150**	**497740**	**169310**	**479110**	**4600060**
FORAGEOUED ISSIL														
F	1543/53	28520	24500	22900	9470	3480	17130	23360	21830	19200	20560	17810	14950	223710
F	1544/53	34260	25240	16060	7870	4650	9810	25770	23050	6990	15030	9070	10530	188330
F	2364/53	38530	34890	30430	18030	2720	21250	32120	30910	25010	21890	16930	10050	282760
F	2365/53	0	0	0	0	0	0	0	15390	18480	8350	1330	760	44310
F	2366/53	53360	46070	0	10830	1900	15050	44380	49500	39900	38920	46880	34890	381680
TOTAL		**154670**	**130700**	**69390**	**46200**	**12750**	**63240**	**125630**	**140680**	**109580**	**104750**	**92020**	**71180**	**1120790**
PUITS MENARA														
P	2603/53	79030	69110	45360	12480	20680	800	1770	23020	31610	31970	1510	270	317610
P	2671/53	0	5870	53740	10680	22830	43760	67500	64330	56700	55800	6900	19900	408010
TOTAL		**79030**	**74980**	**99100**	**23160**	**43510**	**44560**	**69270**	**87350**	**88310**	**87770**	**8410**	**20170**	**725620**
PUITS OURIKA														
P	2064/53	71950	40370	68180	26560	36340	44080	62240	59250	32400	48100	14490	61280	565240
P	2360/53	36590	28410	53190	0	0	28640	74080	49740	28960	43720	41640	72650	457620
P	2367/53	0	47290	83870	29970	41250	57470	80110	66860	34090	49300	40060	78670	608940
TOTAL		**108540**	**116070**	**205240**	**56530**	**77590**	**130190**	**216430**	**175850**	**95450**	**141120**	**96190**	**212600**	**1631800**
PUIT IZIKI														
P	2116/53	36380	25530	25140	11940	0	0	0	0	0	3620	700	0	103310
TOTAL		**36380**	**25530**	**25140**	**11940**	**0**	**0**	**0**	**0**	**0**	**3620**	**700**	**0**	**103310**
ADDUCTION GRAVITAIRE														
S	38-215/53	139350	187000	267130	294910	331500	314930	194460	117030	107500	162680	272100	317200	2705790
TOTAL		**139350**	**187000**	**267130**	**294910**	**331500**	**314930**	**194460**	**117030**	**107500**	**162680**	**272100**	**317200**	**2705790**
ADDUCTION N'FIS														
F	2355/53	38100	31960	31440	10650	910	38290	22500	4000	1200	12500	12960	11290	215800
F	2356/53	24710	15400	22110	15270	0	0	0	0	0	0	0	0	77490
F	2458/53	19440	40010	15610	6160	0	60	11730	1100	660	4310	0	0	99080
F	2459/53	19680	33500	11880	4540	0	0	17240	15260	11920	6350	0	0	120370
F	2460/53	12500	65000	46700	17000	0	35030	48560	52540	27410	9750	0	0	314490
F	2481/53	74000	85000	72740	27670	2120	65820	119480	20860	7220	23550	4580	4520	507560
F	2482/53	56980	64090	72680	4310	0	0	27080	7520	1800	7650	0	0	242110
F	2483/53	22350	44380	10010	2150	80	0	43000	1100	0	0	0	0	123070
F	2549/53	36790	5400	25170	17570	20570	28890	10720	0	0	0	0	0	145110
F	2551/53	57370	56550	62860	3500	80	0	9740	2330	0	11060	0	0	203490
F	2554/53	71580	59810	6870	9500	1280	3680	59080	3370	5230	19700	0	170	240270
F	2560/53	54140	76280	90750	4950	30	3120	76360	34240	93600	31000	0	0	464470
F	2561/53	108440	112760	127200	7690	2250	58640	99580	128250	121250	56500	0	0	822560
TOTAL		**596080**	**690140**	**596020**	**130960**	**27320**	**233530**	**545070**	**270570**	**270290**	**182370**	**17540**	**15980**	**3575870**
PUITS BAHJA														
P	2646/53	1730	9480	24670	7760	2810	6780	8890	7490	6910	7650	450	0	84620
P	2664/53	3500	5460	7050	6830	7760	6750	5740	620	5030	7470	1720	0	57930
TOTAL		**5230**	**14940**	**31720**	**14590**	**10570**	**13530**	**14630**	**8110**	**11940**	**15120**	**2170**	**0**	**142550**
TOTAL PROD SOUT		**1673470**	**1638390**	**1810860**	**795080**	**818950**	**1178120**	**1683140**	**1279260**	**1138220**	**1195170**	**658440**	**1116240**	**14605790**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2000
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	18770	62770	44130	18550	27800	35710	68760	70576	73280	62060	51290	30150	563846
P	1199/53	50300	66610	63740	48140	61370	66320	61570	58940	55450	47700	45450	27630	653220
P	2061/53	63620	7580	49140	54350	61370	66320	73350	74700	77690	73780	59710	41100	702710
P	2070/53	70900	86990	76490	65880	84590	79210	84220	77800	68470	60190	48640	27870	831250
P	2078/53	28840	96320	27060	130	4240	86160	106180	92930	105960	110000	79450	74090	811360
P	2357/53	19580	35880	36610	41730	24710	6780	2360	2040	750	1690	1300	1780	175210
P	2575/53	47970	55510	52360	44720	48390	51100	54330	47840	44330	36110	30550	9260	522470
P	2584/53	49350	78550	68720	65130	74470	75110	87850	86400	87120	68270	67050	47190	855210
TOTAL		**349330**	**490210**	**418250**	**338630**	**386940**	**466710**	**538620**	**511226**	**513050**	**459800**	**383440**	**259070**	**5115276**
FORAGEOUED ISSIL														
F	1543/53	5830	6780	8820	4790	5770	5190	5530	6100	3150	9820	6060	15540	83380
F	1544/53	10040	19840	12320	7700	12940	15010	7500	26610	43530	28680	12310	16650	213130
F	2364/53	24240	24680	28290	19950	20040	25810	31880	31450	35300	26330	24230	20350	312550
F	2365/53	6100	60	20210	25610	3350	38770	2910	0	0	46730	0	0	143740
F	2366/53	26930	52500	55250	40500	52300	52500	602000	50500	59000	49000	47850	33020	1121350
TOTAL		**73140**	**103860**	**124890**	**98550**	**94400**	**137280**	**649820**	**114660**	**140980**	**160560**	**90450**	**85560**	**1874150**
PUITS MENARA														
P	2603/53	0	1100	34100	22340	23530	45020	5480	46450	49260	42230	32500	26000	328010
P	2671/53	30950	63660	51520	38860	43990	56610	71440	59750	65560	54130	44160	33310	613940
TOTAL		**30950**	**64760**	**85620**	**61200**	**67520**	**101630**	**76920**	**106200**	**114820**	**96360**	**76660**	**59310**	**941950**
PUITS OURIKA														
P	2064/53	39250	73770	50210	27400	32490	54470	77380	69190	80250	71280	51740	37660	665090
P	2360/53	51960	67300	52500	27710	43310	39930	57560	59450	45530	22360	17650	22710	507970
P	2367/53	50240	72200	49470	26370	40490	50480	61500	57160	56350	45690	42690	29720	582360
TOTAL		**141450**	**213270**	**152180**	**81480**	**116290**	**144880**	**196440**	**185800**	**182130**	**139330**	**112080**	**90090**	**1755420**
PUIT IZIKI														
P	2116/53	0	890	0	0	2520	3370	2220	0	16420	0	6320	0	31740
TOTAL		**0**	**890**	**0**	**0**	**2520**	**3370**	**2220**	**0**	**16420**	**0**	**6320**	**0**	**31740**
ADDUCTION GRAVITAIRE														
S	38-215/53	279510	239170	174280	185020	278940	266810	173740	63830	43020	52600	74350	85750	1917020
TOTAL		**279510**	**239170**	**174280**	**185020**	**278940**	**266810**	**173740**	**63830**	**43020**	**52600**	**74350**	**85750**	**1917020**
ADDUCTION N'FIS														
F	2355/53	10250	19820	33260	32990	28980	35870	38710	6040	7690	5490	15210	16350	250660
F	2356/53													
F	2458/53	0	360	0	100	410	3290	330	21780	19540	25090	8350	1400	80650
F	2459/53	0	0	0	0	0	40	520	24120	2950	6950	3550	2480	40610
F	2460/53	0	0	0	0	0	0	0	80	36770	2880	5760	78830	124320
F	2481/53	12550	6750	2730	250	7660	36150	20050	9110	0	8010	0	0	103260
F	2482/53	0	910	0	240	650	390	1550	16840	27530	3220	80	0	51410
F	2483/53	0	0	0	120	440	50	360	17360	21020	2820	5280	5440	52890
F	2549/53	0	0	0	50	1510	0	0	0	4910	3360	10660	18900	39390
F	2551/53	0	70	0	0	0	0	0	1800	10730	1130	1020	0	14750
F	2554/53	1860	3170	110	0	0	0	0	0	8500	3750	8840	36910	63140
F	2560/53	0	460	0	130	440	220	0	47840	8550	6270	7030	91850	162790
F	2561/53	400	1890	1590	340	3390	1290	8870	50960	63010	9120	10270	80690	231820
TOTAL		**14810**	**13610**	**4430**	**1230**	**14500**	**41430**	**31680**	**189890**	**203510**	**72600**	**60840**	**316500**	**965030**
PUITS BAHJA														
P	2646/53	0	59	0	0	60	20	0	1940	4410	0	40	0	6529
P	2664/53	0	0	0	660	0	0	0	0	0	0	0	0	660
TOTAL		**0**	**59**	**0**	**660**	**60**	**20**	**0**	**1940**	**4410**	**0**	**40**	**0**	**7189**
TOTAL PROD SOUT		**889190**	**1125829**	**959650**	**766770**	**961170**	**1162130**	**1669440**	**1173546**	**1218340**	**981250**	**804180**	**896280**	**12607775**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2001
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	50540	59390	63010	75320	73580	68820	69030	69000	65910	67810	65100	66990	794500
P	1199/53	44520	42950	48580	43990	45450	36010	30760	25430	21490	18720	16340	16800	391040
P	2061/53	51110	51650	51510	49790	61170	58810	55940	50500	46530	45360	42230	43320	607920
P	2070/53	57840	67640	70290	45540	67370	47730	46560	32340	28100	29020	17500	20570	530500
P	2078/53	98100	94990	100540	107500	100890	72270	96000	66640	81090	82670	38480	83850	1023020
P	2357/53	0	0	23800	38970	36170	29750	25240	19150	14740	11040	6450	8340	213650
P	2575/53	1900	0	21650	44960	28720	0	13260	46540	43950	40050	26590	69570	337190
P	2584/53	55630	41260	40200	28890	54970	70130	68190	66000	62420	45130	48500	69570	650890
TOTAL		**359640**	**357880**	**419580**	**434960**	**468320**	**383520**	**404980**	**375600**	**364230**	**339800**	**261190**	**379010**	**4548710**
FORAGEOUED ISSIL														
F	1543/53	0	3430	4620	4100	18300	33230	32000	3590	16900	28350	16010	23210	183740
F	1544/53	0	0	0	5620	43520	42120	41270	39880	35490	4660	0	0	212560
F	2364/53	0	0	24040	32880	36290	28660	31490	29850	8010	8240	19990	25620	245070
F	2365/53	0	0	0	0	27830	40380	45370	43240	40580	38750	23630	31740	291520
F	2366/53	1920	0	34320	47620	28710	19920	53500	47860	44370	40320	24520	25330	368390
TOTAL		**1920**	**3430**	**62980**	**90220**	**154650**	**164310**	**203630**	**164420**	**145350**	**120320**	**84150**	**105900**	**1301280**
PUITS MENARA														
P	2603/53	48570	42710	0	0	41010	16010	44480	36350	37420	35480	21920	7270	331220
P	2671/53	49720	54420	64020	73250	75520	71210	67990	57130	55080	56770	55630	60460	741200
TOTAL		**98290**	**97130**	**64020**	**73250**	**116530**	**87220**	**112470**	**93480**	**92500**	**92250**	**77550**	**67730**	**1072420**
PUITS OURIKA														
P	2064/53	53180	63600	68750	86260	88570	86080	89920	84910	82790	87500	84680	87260	963500
P	2360/53	43460	49180	53450	48350	40500	51400	49280	46000	42160	41210	38470	39200	542660
P	2367/53	48820	52630	50510	49270	47030	37200	30110	24060	35330	34210	22310	28700	460180
TOTAL		**145460**	**165410**	**172710**	**183880**	**176100**	**174680**	**169310**	**154970**	**160280**	**162920**	**145460**	**155160**	**1966340**
PUIT IZIKI														
P	2116/53	55500	0	47200	54100	870	64400	76050	57500	65500	65200	45000	73550	604870
TOTAL		**55500**	**0**	**47200**	**54100**	**870**	**64400**	**76050**	**57500**	**65500**	**65200**	**45000**	**73550**	**604870**
ADDUCTION GRAVITAIRE														
S	38-215/53	146060	144050	141550	90460	56820	21840	10080	750	0	0	0	0	611610
TOTAL		**146060**	**144050**	**141550**	**90460**	**56820**	**21840**	**10080**	**750**	**0**	**0**	**0**	**0**	**611610**
ADDUCTION N'FIS														
F	2355/53	30000	29600	0	3730	25150	32510	20470	0	10590	26290	100	22140	200580
F	2356/53	0	0	0	3230	16190	11240	14250	13360	12030	6600	10930	10640	98470
F	2458/53	14780	21500	29420	26790	24250	19950	18900	18500	16500	15000	0	7810	213400
F	2459/53	57530	50620	59340	53970	51000	52440	56190	50830	46220	47200	220	45380	570940
F	2460/53	72740	51400	75330	76940	74980	65060	63100	56800	49410	53080	34550	21430	694820
F	2481/53	0	410	0	79710	101730	7960	0	6100	0	0	0	0	195910
F	2482/53	20980	58370	70860	84250	87050	85020	87480	87010	83160	86610	83820	44610	879220
F	2483/53	29770	51460	8120	0	53150	67660	38390	55630	51040	26380	35050	39650	456300
F	2549/53	38350	30590	31410	24570	21150	24780	27500	27220	25240	14240	28040	14200	307290
F	2551/53	4490	10040	65770	54920	59680	63430	67980	70680	61660	67020	18820	41260	585750
F	2554/53	112720	78170	97000	90940	101010	95920	94160	88590	79370	42080	79240	79580	1038780
F	2560/53	4580	43890	80920	75620	81790	78960	81000	88500	84330	71390	87640	46520	825140
F	2561/53	107010	56320	110420	111300	110510	100860	97190	91100	82290	64500	75310	72380	1079190
TOTAL		**492950**	**482370**	**628590**	**685970**	**807640**	**705790**	**666610**	**654320**	**601840**	**520390**	**453720**	**445600**	**7145790**
PUITS BAHJA														
P	2646/53	51240	8520	47860	54220	57140	60680	64310	60150	55300	59540	56210	55920	631090
	2664/53	11640	7850	0	5910	20460	9960	0	0	0	0	0	0	55820
TOTAL		**62880**	**16370**	**47860**	**60130**	**77600**	**70640**	**64310**	**60150**	**55300**	**59540**	**56210**	**55920**	**686910**
TOTAL PROD SOUT		**1362700**	**1266640**	**1584490**	**1672970**	**1858530**	**1672400**	**1707440**	**1561190**	**1485000**	**1360420**	**1123280**	**1282870**	**17937930**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2002
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	66100	55880	60270	60070	59730	56170	53160	59240	54000	55470	110	16520	596720
P	1199/53	14520	11370	10470	9470	12640	11630	160	16460	22770	19560	7680	12170	148900
P	2061/53	41510	34350	35980	34240	8450	18560	21310	23080	28310	36980	33770	17460	334000
P	2070/53	29450	48920	51350	58200	46900	45120	42900	33590	42040	43120	38170	35350	515110
P	2078/53	75420	35490	0	0	3450	53200	27790	42370	54200	56680	18240	10230	377070
P	2357/53	9480	22450	17060	23830	20500	21140	14990	17260	9110	14570	9700	5000	185090
P	2575/53	39130	35210	34760	36920	31520	28080	13550	29680	24530	25190	23880	24920	347370
P	2584/53	34520	0	0	740	23040	28640	37290	33040	35520	33260	30250	12100	268400
TOTAL		**310130**	**243670**	**209890**	**223470**	**206230**	**262540**	**211150**	**254720**	**270480**	**284830**	**161800**	**133750**	**2772660**
FORAGEOUED ISSIL														
F	1543/53	26690	23830	24280	24090	23410	24220	19570	23510	22500	0	0	0	212100
F	1544/53	0	0	0	0	0	0	23270	23780	26040	19970	27740	27500	148300
F	2364/53	20010	0	0	0	0	11000	9490	14840	9860	800	0	1000	67000
F	2365/53	38090	29350	34840	26500	28000	30000	20000	0	0	0	22000	29500	258280
F	2366/53	34630	28450	23120	18480	15540	13590	6010	3270	5540	19980	9180	30	177820
TOTAL		**119420**	**81630**	**82240**	**69070**	**66950**	**78810**	**78340**	**65400**	**63940**	**40750**	**58920**	**58030**	**863500**
PUITS MENARA														
P	2603/53	23900	0	0	0	13520	16170	5840	17800	24590	15630	2670	6780	126900
P	2671/53	58400	54460	60100	57320	27530	30460	35030	25140	18060	2280	380	450	369610
TOTAL		**82300**	**54460**	**60100**	**57320**	**41050**	**46630**	**40870**	**42940**	**42650**	**17910**	**3050**	**7230**	**496510**
PUITS OURIKA														
P	2064/53	86890	77560	85920	69430	96480	87400	28850	82450	89500	85880	36620	1710	828690
P	2360/53	37630	32800	34190	32060	30390	23780	29900	2670	12060	20930	0	9890	266300
P	2367/53	27060	20880	22480	20820	19430	17930	19980	21870	19340	21190	22220	17550	250750
TOTAL		**151580**	**131240**	**142590**	**122310**	**146300**	**129110**	**78730**	**106990**	**120900**	**128000**	**58840**	**29150**	**1345740**
PUIT IZIKI														
P	2116/53	74550	66480	66970	57980	63890	53430	58250	60060	37110	20050	0	0	558770
TOTAL		**74550**	**66480**	**66970**	**57980**	**63890**	**53430**	**58250**	**60060**	**37110**	**20050**	**0**	**0**	**558770**
ADDUCTION GRAVITAIRE														
S	38-215/53	0	0	0	98400	203090	400930	167970	96310	42060	61130	94370	143770	1308030
TOTAL		**0**	**0**	**0**	**98400**	**203090**	**400930**	**167970**	**96310**	**42060**	**61130**	**94370**	**143770**	**1308030**
ADDUCTION N'FIS														
F	2355/53	23030	6650	1500	290	1010	680	3270	490	60	0	0	60	37040
F	2356/53	10290	7080	9470	8570	5180	970	0	1740	3050	0	1900	3250	51500
F	2458/53	17130	580	1520	19230	8660	850	0	1120	1910	0	0	60	51060
F	2459/53	12160	37550	45170	40420	40720	25120	43320	27560	7540	0	1350	1450	282360
F	2460/53	56010	49960	49680	46890	26630	46900	43370	41620	36630	45100	18080	0	460870
F	2481/53	0	0	0	0	32220	132610	63280	38710	92000	100000	30800	16100	505720
F	2482/53	9610	77840	10080	0	0	0	0	0	0	0	0	0	97530
F	2483/53	47310	21650	110	0	39200	2140	0	0	0	0	0	0	110410
F	2549/53	0	13800	26360	25130	25420	20890	23390	16670	10510	0	0	0	162170
F	2551/53	47440	54070	59520	58870	51420	52480	54390	46080	42900	51520	31070	12290	562050
F	2554/53	77100	68390	73850	71440	65860	67670	57000	43000	6490	1290	0	6030	538120
F	2560/53	87920	76490	84530	81960	74060	76930	80980	38490	65690	59000	40000	12280	778330
F	2561/53	67900	59600	65300	28950	13810	55590	54070	43250	39330	46310	18390	470	492970
TOTAL		**455900**	**473660**	**427090**	**381750**	**384190**	**482830**	**423070**	**298730**	**306110**	**303220**	**141590**	**51990**	**4130130**
PUITS BAHJA														
P		55710	46550	52880	44350	48710	39110	53990	52800	39260	47020	38260	27650	546290
		0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		**55710**	**46550**	**52880**	**44350**	**48710**	**39110**	**53990**	**52800**	**39260**	**47020**	**38260**	**27650**	**546290**
TOTAL PROD SOUT		**1249590**	**1097690**	**1041760**	**1054650**	**1160410**	**1493390**	**1112370**	**977950**	**922510**	**902910**	**556830**	**451570**	**12021630**

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2003
CENTRE MARRAKECH														
PRODUCTION SOUTERRAINE														
PUITS AGUEDAL														
P	1152/53	21150	50930	28350	30050	62440	58880	60240	54090	55640	52390	19000	57850	551010
P	1199/53	10630	180	18450	34690	33850	29750	28470	25360	22930	23610	55460	23580	306960
P	2061/53	14140	27050	39000	34580	43830	36780	39600	35260	28550	31800	27010	33890	391490
P	2070/53	13350	30790	25710	56290	55050	51270	41030	34480	36870	40770	38440	43000	467050
P	2078/53	16570	12650	52970	58490	75780	66160	71900	61390	60720	58580	56390	50970	642570
P	2357/53	0	50	12200	3590	21250	12050	5510	22770	11720	31140	28860	24970	174110
P	2575/53	8480	16150	0	5160	33640	32190	31820	28650	8680	0	0	0	164770
P	2584/53	14420	34380	20540	40050	44770	39550	37350	35170	32570	940	29110	28300	357150
TOTAL		**98740**	**172180**	**197220**	**262900**	**370610**	**326630**	**315920**	**297170**	**257680**	**239230**	**254270**	**262560**	**3055110**
FORAGEOUED ISSIL														
F	1543/53	1160	30	720	6570	5510	13153	0	0	0				27143
F	1544/53	8320	230	0	2720	14930	27160	24280	23700	2160	200	230	260	104190
F	2364/53	5140	10	0	3530	33870	30520	28320	27300	25130	25790	9860		189470
F	2365/53	9850	1360	0	3950	33260	3730	2870	20	0	20170			75210
F	2366/53	0	0	0	0	0	0	6840	0	0	760			7600
TOTAL		**24470**	**1630**	**720**	**16770**	**87570**	**74563**	**62310**	**51020**	**27290**	**46920**	**10090**	**260**	**403613**
PUITS MENARA														
P	2603/53	5290	18780	24790	21000	27200	2690	29970	27540	17220	770	24140	30540	253530
P	2671/53	14150	30650	39470	36940	52140	46040	49000	45080	42210	43900	40120	40110	479810
TOTAL		**19440**	**49430**	**64260**	**57940**	**79340**	**48730**	**78970**	**72620**	**59430**	**44670**	**64260**	**70650**	**733340**
PUITS OURIKA														
P	2064/53	0	13340	65270	53560	67070	53620	84090	68010	70380	94980	88940	92380	751640
P	2360/53	0	0	8390	5000	31110	29840	35940	31560	22420	19690	25770	26340	236060
P	2367/53	0	32190	22510	31030	29730	16780	31790	29310	23800	23960	23420	2590	289810
TOTAL		**0**	**45530**	**96170**	**89590**	**127910**	**100240**	**151820**	**128880**	**116600**	**138630**	**138130**	**121310**	**1277510**
PUIT IZIKI														
P	2116/53	370	15210	28770	44680	48000	45600	47100	48500	40200	47000	45000	45900	456330
TOTAL		**370**	**15210**	**28770**	**44680**	**48000**	**45600**	**47100**	**48500**	**40200**	**47000**	**45000**	**45900**	**456330**
ADDUCTION GRAVITAIRE														
S	38-215/53	147420	111230	124480	120660	119480	108340	111920	84280	55140	67460	83290	85780	1219480
TOTAL		**147420**	**111230**	**124480**	**120660**	**119480**	**108340**	**111920**	**84280**	**55140**	**67460**	**83290**	**85780**	**1219480**
ADDUCTION N'FIS														
F	2355/53	0	30	0	0	0	0	0	0	0				30
F	2356/53	460	0	230	0	0	2290	0	0	0				2980
F	2458/53	750	0	3920	220	0	0	0	0	0				2490
F	2459/53	0	0	9750	4070	32900	25690	27000	23640	16640		9110	23700	172500
F	2460/53	7470	4250	6800	5060	40730	45450	42310	39320	34010	18640		26560	270600
F	2481/53	5390	3280	0	0	60	77960	47290	83850	78730	52390	8030	56160	413140
F	2482/53	0	10	11930	69870	37750	14850	21000	0	25870	11860	21360	20970	235470
F	2483/53	0	0	0	0	12980	23110	21490	21440	18470				97490
F	2549/53	0	0	0	0	0	0	0	0	0				0
F	2551/53	9990	29480	25840	19020	18920	43760	53880	48710	44640	41970	21110	44750	402070
F	2554/53	7580	25850	460	7220	47830	47790	22920	0	0	3040	32320	33080	228090
F	2560/53	8280	31040	51780	76910	74180	67260	68010	66520	61080	52290	62220	54080	673650
F	2561/53	4700	3270	4980	12240	33460	34000	43000	34670	23290	31610	13980	3430	242630
TOTAL		**44620**	**97210**	**115690**	**194610**	**298810**	**382160**	**346900**	**318150**	**302730**	**211800**	**168130**	**262730**	**2741140**
PUITS BAHJA														
P	2646/53	56590	47810	34220	0	0	0	27130	45830	42140	40550	38970	40770	374010
P	2664/53	0	0	0	0	0	0	0	0	0				0
TOTAL		**56590**	**47810**	**34220**	**0**	**0**	**0**	**27130**	**45830**	**42140**	**40550**	**38970**	**40770**	**374010**
TOTAL PROD SOUT		391650	540230	661530	787150	1131720	1109863	1142070	1046450	901210	836260	802140	912660	10262933

CAPTAGES		JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2004
CENTRE MARRAKECH														
PUITS AGUEDAL														
P	1152/53	75740	54280	58960	59780	61800	58950	55610	52380	49970	51270	51700	53290	665730
P	1199/53	22970	19600	0	25300	26600	32870	23230	22300	21850	18510	6680	15440	226350
P	2061/53	26020	11120	9700	30050	35790	38080	31800	33330	23530	18750	31150	13890	303210
P	2070/53	44400	42570	46510	41070	39670	35760	37360	35430	38300	40230	23310	57760	483270
P	2078/53	30650	14780	25800	49550	61980	66800	54190	59550	38310	34800	3450	2040	441900
P	2357/53	0	0	0	0	0	19350	22960	0	0	12600	320	1360	56590
P	2575/53	15290	9240	31210	27900	24510	28830	24630	27550	17610	23640	0	15320	245730
P	2584/53	12090	4200	500	33370	38480	42080	42170	37100	33520	24170	4400	17130	289210
TOTAL		**227160**	**155790**	**172680**	**267020**	**288830**	**322720**	**291950**	**267640**	**223090**	**223970**	**121010**	**176230**	**2711990**
FORAGEOUED ISSIL														
F	1543/53					18490	28220	26730	23110	18850	13100	5970	650	135120
F	1544/53						5460	14460	25300	16790				62010
F	2364/53	9120						21730	16700	14640	11070	4870		78130
F	2365/53						330	9420	23720	20940	6070			60480
F	2366/53					16200	34940	30330	13440	15620	16220	8010	600	135360
TOTAL		**9120**	**0**	**0**	**0**	**34690**	**68950**	**102670**	**102270**	**86840**	**46460**	**18850**	**1250**	**471100**
PUITS MENARA														
P	2603/53	10600	4130	9230	11540	16260	26020	22820	23620	14650	12710		130	151710
P	2671/53	19570	10040	18570	32960	43030	50290	48470	47930	30920	27830	5960	21870	357440
TOTAL		**30170**	**14170**	**27800**	**44500**	**59290**	**76310**	**71290**	**71550**	**45570**	**40540**	**5960**	**22000**	**509150**
PUITS OURIKA														
P	2064/53	92950	86150	91210	88210	89380	63990	85820	80850	76200	78110	6110	84030	923010
P	2360/53	29830	20890		27550	21910	25500	21440	21780	19770	13900	74260	3870	280700
P	2367/53	13390	25050	11730	18020	25690	23600	23670	23130	21620	14520	7480	3160	211060
TOTAL		**136170**	**132090**	**102940**	**133780**	**136980**	**113090**	**130930**	**125760**	**117590**	**106530**	**87850**	**91060**	**1414770**
PUIT IZIKI														
P	2116/53	**49500**	**44000**	**50690**	**49310**	**49840**	**49240**	**50590**	**46370**	**46290**	**46650**	**45630**	**47910**	**576020**
TOTAL		**49500**	**44000**	**50690**	**49310**	**49840**	**49240**	**50590**	**46370**	**46290**	**46650**	**45630**	**47910**	**576020**
ADDUCTION GRAVITAIRE														
S	38-215/53	**111680**	**91490**	**96430**	**113470**	**110690**	**100960**	**180410**	**93420**	**58920**	**48560**	**66300**	**72050**	**1144380**
TOTAL		**111680**	**91490**	**96430**	**113470**	**110690**	**100960**	**180410**	**93420**	**58920**	**48560**	**66300**	**72050**	**1144380**
ADDUCTION N'FIS														
F	2355/53									18840				18840
F	2356/53										9300			9300
F	2458/53										8950			8950
F	2459/53	1680	50		2800	6580	19370	20680	18780	16330	34800	730		121800
F	2460/53	3600		1540	5730	12500	32000	35000	30000	28500		21000	1900	171770
F	2481/53	13250					65660	77600	75820	66280	59070	35520	73810	467010
F	2482/53	1600			8000	14500	36500	34000	22000	9000	36950	3830		166380
F	2483/53				3040	7890	22610	21960	20350		7250			83100
F	2549/53							4200	5930	5900	20200	70		36300
F	2551/53	7530	2290		11500	20680	47800	38680	34290	34670		28230	2660	228330
F	2554/53	7110	2110	50	23930	44930	47930	24990	23060	20310	48200	3220	3220	249060
F	2560/53	45230	62650	64140	61190	61610	44080	48180	38710	49330	10000	43660	48510	577290
F	2561/53						14550	2290	3840	50	33190			53920
TOTAL		**80000**	**67100**	**65730**	**116190**	**168690**	**330500**	**307580**	**272780**	**249210**	**267910**	**136260**	**130100**	**2192050**
PUITS BAHJA														
P	2646/53	43080	40780	45300	41770	42540	37770	30410	35830	33150		35060	37100	422790
P	2664/53						2000	1650	3150	3010	3890	3760	3980	21440
TOTAL		**43080**	**40780**	**45300**	**41770**	**42540**	**39770**	**32060**	**38980**	**36160**	**3890**	**38820**	**41080**	**444230**
TOTAL PROD SOUT		**668880**	**545420**	**561570**	**766040**	**891550**	**1092540**	**1167480**	**1018770**	**863670**	**784510**	**520680**	**581680**	**9462790**

CAPTAGES			JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2005
CENTRE MARRAKECH															
PRODUCTION SOUTERRAINE															
PUITS AGUEDAL															
F		3825/53	0	0	0	0	0	0	0	0	0	0	760	0	760
P	A1	1152/53	12060	33320	28940	59570	53210	46810	46380	49320	35670	37180	49580	51700	503740
P	A2	1199/53	25480	410	19510	26200	30910	25620	23450	21630	13980	20710	13470	15050	236420
P	A8	2061/53	48160	16910	31520	38040	34550	31370	30680	27750	17090	26150	20280	19520	342020
P	A4	2070/53	40620	41250	22680	42740	39330	35030	32640	33590	30420	29910	18500	10540	377250
P	A5	2078/53	30770	26610	39610	58360	48860	52580	33230	50500	23420	49310	28700	16590	458540
P	A3	2357/53	14580	19110	500	20150	22890	17240	18390	12320	4650	15670	7250	40	152790
P	A7	2575/53	17120	23680	14490	26000	28970	22500	25460	22340	14470	25540	11310	8280	240160
P	A6	2584/53	0	0	25070	28380	54100	44280	41010	38220	37150	41150	39690	19090	368140
TOTAL			**188790**	**161290**	**182320**	**299440**	**312820**	**275430**	**251240**	**255670**	**176850**	**245620**	**189540**	**140810**	**2679820**
FORAGEOUED ISSIL															
F	F1	1543/53	220	90	710	1050	1100	23180	27500	15020	0	0	0	0	68870
F	F2	1544/53		890				140	0		0	0	0	0	1030
F	F4	2364/53			2030	8590	18620	13140	20000	19000	22000	22900	19000	7500	152780
F	F5	2365/53		80					0		0	0	0	0	80
F	F6	2366/53			510	21330	25450	19080	16100	13220	12850	12440	12470	5090	138540
TOTAL			**220**	**1060**	**3250**	**30970**	**45170**	**55540**	**63600**	**47240**	**34850**	**35340**	**31470**	**12590**	**361300**
PUITS MENARA															
P		2603/53		50	12710	17640	20720	19240	18250	15050	9230	14610	16000	15550	159050
P		2671/53	27550	20830	21640	39920	38050	33140	33390	28720	17660	27030	23690	20360	331980
TOTAL			**27550**	**20880**	**34350**	**57560**	**58770**	**52380**	**51640**	**43770**	**26890**	**41640**	**39690**	**35910**	**491030**
PUITS OURIKA															
P		2064/53	71130	10440	36740	88200	81620	73890	74300	75910	70790	73390	71570	74750	802730
P		2360/53	18310	42250	2680	36500	31240	23580	22230	20230	17640	29550	15830	15200	275240
P		2367/53	4380		13850	33000	29760	24960	20700	18450	17570	19740	15390	9010	206810
TOTAL			**93820**	**52690**	**53270**	**157700**	**142620**	**122430**	**117230**	**114590**	**106000**	**122680**	**102790**	**98960**	**1284780**
PUIT IZIKI															
P		2116/53	47850	42250	46450	43060	43430	39870	35020	0	33190	40750	20830	41540	434240
TOTAL			**47850**	**42250**	**46450**	**43060**	**43430**	**39870**	**35020**	**0**	**33190**	**40750**	**20830**	**41540**	**434240**
ADDUCTION GRAVITAIRE															
S		38-215/53	**61720**	**57740**	**82240**	**45910**	**115060**	**127340**	**92450**	**41730**	**38520**	**46090**	**87600**	**110180**	**906580**
ADDUCTION N'FIS															
F		2355/53	0	0	0	0	0	0	0	0	0	0	660	0	660
F		2356/53	0	0	0	0	0	0	0	0	0	0	0		0
F		2458/53	0	0	0	0	0	0	0	0	0	0	0		0
F		2459/53	0	0	0	13100	13400	10370	1570	0	0	0	0	0	38440
F		2460/53	0	410	3610	22740	23640	11910	19590	13830	15360	18490	18790	5700	154070
F		2481/53	21330	0	0	0	46590	55090	53050	47680	44390	39600	44430	45960	398120
F		2482/53	0	0	0	33500	16100	21850	23510	20710	19820	20220	21360	9270	186340
F		2483/53	0	0	0	0	0	9650	14800	12690	9920	0	0	0	47060
F		2549/53	12210	0	0	16780	20320	16230	0	0	0	1870	19100	15770	102280
F		2551/53	3140	23050	1330	30760	34650	27600	28500	25410	23490	21370	24100	25230	268630
F		2554/53			31810	27710	23430	23600	25610	24320	24770	24070	24920	20480	250720
F		2560/53	49670	44860	48530	42740	43900	37850	37800	32500	31020	28000	24490	23210	444570
F		2561/53	0		0	0	0	0	0	0	0	0	0	0	0
TOTAL			**86350**	**68320**	**85280**	**187330**	**222030**	**214150**	**204430**	**177140**	**168770**	**153620**	**177850**	**145620**	**1890890**
PUITS BAHJA															
P		2646/53	12960	23980	9990	2220	19880	18650	26940	24720	25300	25880	25960	15450	231930
P		2664/53	3230				2580	1450	1520	0	1110	0	0	0	9890
TOTAL			**16190**	**23980**	**9990**	**2220**	**22460**	**20100**	**28460**	**24720**	**26410**	**25880**	**25960**	**15450**	**241820**
SAADA1									0	12600	7240	4470	4170	670	**29150**
SAADA2									0	7740	3060	2300	0	0	**13100**
TOTAL			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**20340**	**10300**	**6770**	**4170**	**670**	**42250**
TOTAL PROD SOUT			**522490**	**428210**	**497150**	**824190**	**962360**	**907240**	**844070**	**725200**	**621780**	**718390**	**679900**	**601730**	**8332710**

CAPTAGES			JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNEE 2006
CENTRE MARRAKECH															
PRODUCTION SOUTERRAINE															
PUITS AGUEDAL															
F		3825/53	54630	48440	56710	54730	56410	54580	56410	56520	54490	55360	54860	59000	662140
P	A1	1152/53	6690	18210	24640	15650	18890	21020	25330	23310	17440	19980	6190	22380	219730
P	A2	1199/53	7030	13760	24510	18340	19750	20670	25210	19180	21470	22750	18960	24560	236190
P	A8	2061/53	0	29890	41410	35040	36790	33580	37270	35290	32400	33570	33420	25100	373760
P	A4	2070/53	0	34570	47830	42970	47400	44110	46670	46240	44500	46020	44510	28640	473460
P	A5	2078/53	0							12700	9480	0	910	0	23090
P	A3	2357/53	0						9130	33320	12760	5000	6950	18440	85600
P	A7	2575/53	0	38950	46190	45910	50870	39950	49660	48600	38520	38070	37310	19570	453600
P	A6	2584/53													
TOTAL			**68350**	**183820**	**241290**	**212640**	**230110**	**213910**	**249680**	**275160**	**231060**	**220750**	**203110**	**197690**	**2527570**
FORAGEOUED ISSIL															
F	F1	1543/53					3660	1000	3300	6090	3500	2200	4250	1680	25680
F	F2	1544/53	0	0	0	0	0	0		28090	10040	0	6270	0	44400
F	F4	2364/53	0	0	0	0	0	0		15600	5400	0	17750	9750	48500
F	F5	2365/53	0	0	0	0	0	0			0	0	0	0	0
F	F6	2366/53	0	0	0	0	0	0		19570	0	0	20600	11270	51440
TOTAL			**0**	**0**	**0**	**0**	**3660**	**1000**	**3300**	**69350**	**18940**	**2200**	**48870**	**22700**	**170020**
PUITS MENARA															
P		2603/53	2580	8920	20760	11990	16800	37520	20620	13750	16750	13770	9360	17770	190590
P		2671/53	7360	29060	38640	23260	33780		41520	31020	14140	1000	0	0	219780
TOTAL			**9940**	**37980**	**59400**	**35250**	**50580**	**37520**	**62140**	**44770**	**30890**	**14770**	**9360**	**17770**	**410370**
PUITS OURIKA															
P		2064/53	76630	70060	77720	74200	76630	71200	75010	45410	77470	69890	36080	52910	803210
P		2360/53	11360	9110	26250	21220	19350	21700	18530	16030	15830	6230	9900	7250	182760
P		2367/53	9240	18290	27180	24130	24530	21370	14190	14880	19860	11460	9990	6400	201520
TOTAL			**97230**	**97460**	**131150**	**119550**	**120510**	**114270**	**107730**	**76320**	**113160**	**87580**	**55970**	**66560**	**1187490**
PUIT IZIKI															
P		2116/53	39830	34500	33540	38690	2200	0	22080	31100	30760	29780	29080	23930	315490
TOTAL			**39830**	**34500**	**33540**	**38690**	**2200**	**0**	**22080**	**31100**	**30760**	**29780**	**29080**	**23930**	**315490**
ADDUCTION GRAVITAIRE															
S		38-215/53	101990	93990	104040	107550	193460	251320	174710	133790	68720	41140	96630	101210	1468550
TOTAL			**101990**	**93990**	**104040**	**107550**	**193460**	**251320**	**174710**	**133790**	**68720**	**41140**	**96630**	**101210**	**1468550**
ADDUCTION N'FIS															
F		2355/53	0	0	0	0	0	0							0
F		2356/53	0	0	0	0	0	0							0
F		2458/53	0	0	0	0	0	0							0
F		2459/53	0	0	0	0	0	0		3490	0	0	0	0	3490
F		2460/53	0	0	2910	17470	14690	13940	12840	11510	10110	9330	9970	6270	109040
F		2481/53	48170	45350	46200	33640	29870	30900	27120	25070	23710	27260	27130	15940	380360
F		2482/53	0	0	0	18500	16000	0		15660	26730	27500	28780	16560	149730
F		2483/53	0	0	4130	2440	5570	11130	10830	5310		0	0	0	39410
F		2549/53	19900	19100	22890	21870	21710	20520	20490	20000	18600	19300	19160	9640	233180
F		2551/53	24040	14550	26720	20700	20370	20050	17850	12830	14460	14800	13910	12540	212820
F		2554/53	26640	18710	25500	24710	25750	23380	23110	21620	19820	20050	20470	20270	270030
F		2560/53	28500	12180	11660	0	17390	29660	30030	29500	24000	28900	24000	22000	257820
F		2561/53	0	0	0							0	0	0	0
TOTAL			**147250**	**109890**	**140010**	**139330**	**151350**	**149580**	**142270**	**144990**	**137430**	**147140**	**143420**	**103220**	**1655880**
PUITS BAHJA															
P		2646/53	0	180	15700	21000	25000	25500	8000			0	0	0	95380
P		2664/53	0	160	0	0	0	0				0	0	0	160
TOTAL			**0**	**340**	**15700**	**21000**	**25000**	**25500**	**8000**	**0**	**0**	**0**	**0**	**0**	**95540**
FORAGES SAADA															
F		3972/53	920	1100	1600	2200	9310	1610	230	0	6250	1300	0	0	24520
F		3973/53					1800	3080	1550	4820	0	3600	5930	4050	24830
TOTAL			**920**	**1100**	**1600**	**2200**	**11110**	**4690**	**1780**	**4820**	**6250**	**4900**	**5930**	**4050**	**49350**
TOTAL PROD SOUT			**465510**	**558740**	**711030**	**655210**	**762980**	**772290**	**763690**	**780300**	**637210**	**548260**	**592370**	**537130**	**7784720**

Seasonal groundwater production for Marrakech water supply

Season	Production (m3/year)
1993_94	15 030 580
1994_95	13 315 080
1995_96	11 572 204
1996_97	9 418 389
1997_98	10 425 518
1998_99	15 127 764
1999_00	12 207 557
2000_01	16 311 249
2001_02	12 891 752
2002_03	9 766 860
2003_04	9 561 203

Distribution (%) of the production for Marrakech water supply per well field

Well Field	93/94*	94/95*	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04
Aguedal	19.6900%	19.6919%	15.4158%	9.9401%	25.5209%	29.4927%	39.8042%	29.0590%	22.6189%	30.0620%	29.5760%
Bahja	3.3700%	3.3692%	0.2426%	0.6581%	1.1539%	1.2162%	0.2494%	2.7998%	4.3012%	3.7810%	4.7863%
Iziki	0.0500%	0.0450%	0.5190%	0.8653%	0.5982%	1.0209%	0.1039%	2.2811%	5.2001%	3.4861%	5.5822%
Gravitaire	27.2800%	27.2758%	30.2937%	43.3921%	28.1929%	15.2845%	19.6693%	5.2292%	6.6949%	13.1915%	11.7046%
Menara	2.2900%	2.2921%	1.6258%	1.3059%	3.5356%	4.6304%	6.2381%	6.5689%	5.2336%	5.6291%	6.2356%
N'Fis	30.4500%	30.4518%	38.2619%	36.1915%	27.2220%	27.5773%	6.2248%	34.8339%	37.0429%	27.0356%	23.1488%
Oued Issil	8.3800%	8.3850%	6.2849%	2.5713%	4.1913%	10.0762%	13.8433%	7.9771%	7.6013%	5.6200%	3.9558%
Ourika	8.4900%	8.4892%	7.3564%	5.0756%	9.5852%	10.7016%	13.8669%	11.2511%	11.3071%	11.1947%	15.0107%

* Estimate

Annexe 4 - Annual flood infiltration

Oueds flood (MCM)	Agricultural campaign													
	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02	02/03	03/04	04/05	05/06	Average
Imintanout*	47.3	15.6	122.0	26.8	34.0	0.9	63.6	1.8	8.7	14.5	12.4	1.8	4.8	31.6
Seksaoua	42.9	14.2	110.7	24.3	30.8	0.9	57.7	1.6	7.9	13.2	11.3	1.6	4.3	28.7
El Mal	50.1	9.8	75.7	46.4	13.7	8.9	50.8	0.8	11.3	11.5	7.1	7.2	24.2	26.0
N'Fis	159.7	81.8	485.0	254.4	225.0	52.9	159.5	25.7	37.0	80.6	94.1	72.4	73.7	150.5
Rherhaya	64.3	30.6	101.5	27.8	40.4	16.6	34.4	2.6	18.1	14.9	21.4	21.4	21.0	33.9
Ourika	287.0	100.6	211.9	86.7	74.7	76.3	102.2	14.5	95.6	65.9	124.9	84.8	65.8	112.8
Zat	135.3	61.5	199.0	60.9	108.2	41.3	183.2	20.5	16.8	46.4	79.2	41.9	11.2	86.6
R'Dat	106.3	32.8	234.0	72.2	46.0	77.6	44.2	8.1	12.6	27.4	127.7	65.4	72.7	71.7
Lahr*	27.5	8.5	60.6	18.7	11.9	20.1	11.4	2.1	3.3	7.1	33.1	16.9	18.8	18.6

* Estimated value

Ratio annual value vs average

Imintanout*	150%	49%	386%	85%	107%	3%	201%	6%	27%	46%	39%	7%	17%
Seksaoua	150%	49%	386%	85%	107%	3%	201%	6%	27%	46%	39%	7%	17%
El Mal	193%	38%	291%	178%	53%	34%	195%	3%	43%	44%	27%	29%	99%
N'Fis	106%	54%	322%	169%	149%	35%	106%	17%	25%	54%	63%	52%	53%
Rherhaya	190%	90%	300%	82%	119%	49%	101%	8%	53%	44%	63%	67%	66%
Ourika	255%	89%	188%	77%	66%	68%	91%	13%	85%	58%	111%	79%	62%
Zat	156%	71%	230%	70%	125%	48%	212%	24%	19%	54%	91%	54%	14%
R'Dat	148%	46%	326%	101%	64%	108%	62%	11%	18%	38%	178%	92%	102%
Lahr	148%	46%	326%	101%	64%	108%	62%	11%	18%	38%	178%	92%	102%

Estimated proportion of flood infiltrated

Imintanout*	20.0%	35.0%	15.0%	25.0%	25.0%	35.0%	15.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Seksaoua	20.0%	35.0%	15.0%	25.0%	25.0%	35.0%	15.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
El Mal	20.0%	35.0%	15.0%	20.0%	35.0%	35.0%	20.0%	35.0%	35.0%	35.0%	35.0%	35.0%	25.0%
N'Fis	25.0%	35.0%	15.0%	20.0%	20.0%	35.0%	25.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Rherhaya	20.0%	25.0%	15.0%	25.0%	25.0%	35.0%	25.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%
Ourika	15.0%	25.0%	20.0%	25.0%	35.0%	35.0%	25.0%	35.0%	25.0%	35.0%	25.0%	25.0%	35.0%
Zat	20.0%	25.0%	15.0%	25.0%	25.0%	35.0%	15.0%	35.0%	35.0%	35.0%	25.0%	35.0%	35.0%
R'Dat	20.0%	35.0%	15.0%	25.0%	35.0%	25.0%	35.0%	35.0%	35.0%	35.0%	20.0%	25.0%	25.0%
Lahr	20.0%	35.0%	15.0%	25.0%	35.0%	25.0%	35.0%	35.0%	35.0%	35.0%	20.0%	25.0%	25.0%

Volume of flood infiltrated (Mm3/year)

Imintanout*	9.5	5.5	18.3	6.7	8.5	0.3	9.5	0.6	3.0	5.1	4.4	0.6	1.7
Seksaoua	8.6	5.0	16.6	6.1	7.7	0.3	8.7	0.6	2.8	4.6	4.0	0.6	1.5
El Mal	10.0	3.4	11.4	9.3	4.8	3.1	10.2	0.3	3.9	4.0	2.5	2.5	6.1
N'Fis	39.9	28.6	72.8	50.9	45.0	18.5	39.9	9.0	13.0	28.2	32.9	25.4	25.8
Rherhaya	12.9	7.6	15.2	7.0	10.1	5.8	8.6	0.9	6.3	5.2	7.5	7.5	7.3
Ourika	43.0	25.1	42.4	21.7	26.2	26.7	25.5	5.1	23.9	23.1	31.2	21.2	23.0
Zat	27.1	15.4	29.8	15.2	27.0	14.5	27.5	7.2	5.9	16.2	19.8	14.7	3.9
R'Dat	21.3	11.5	35.1	18.1	16.1	19.4	15.5	2.8	4.4	9.6	25.5	16.4	18.2
Lahr	5.5	3.0	9.1	4.7	4.2	5.0	4.0	0.7	1.1	2.5	6.6	4.2	4.7