International Symposium
"Coupling Sustainable Sanitation and Groundwater Protection"
Hannover, October 14 – 17, 2008

REPUBLIQUE TUNISIENNE

MINISTERE DE L'ENVIRONNEMENT ET DU DEVELOPPEMENT DURABLE

ONAS

Contribution of wastewater treatment to groundwater protection –experiences in Tunisia

Part 1: Wastewater treatment the case of Medjerda valley

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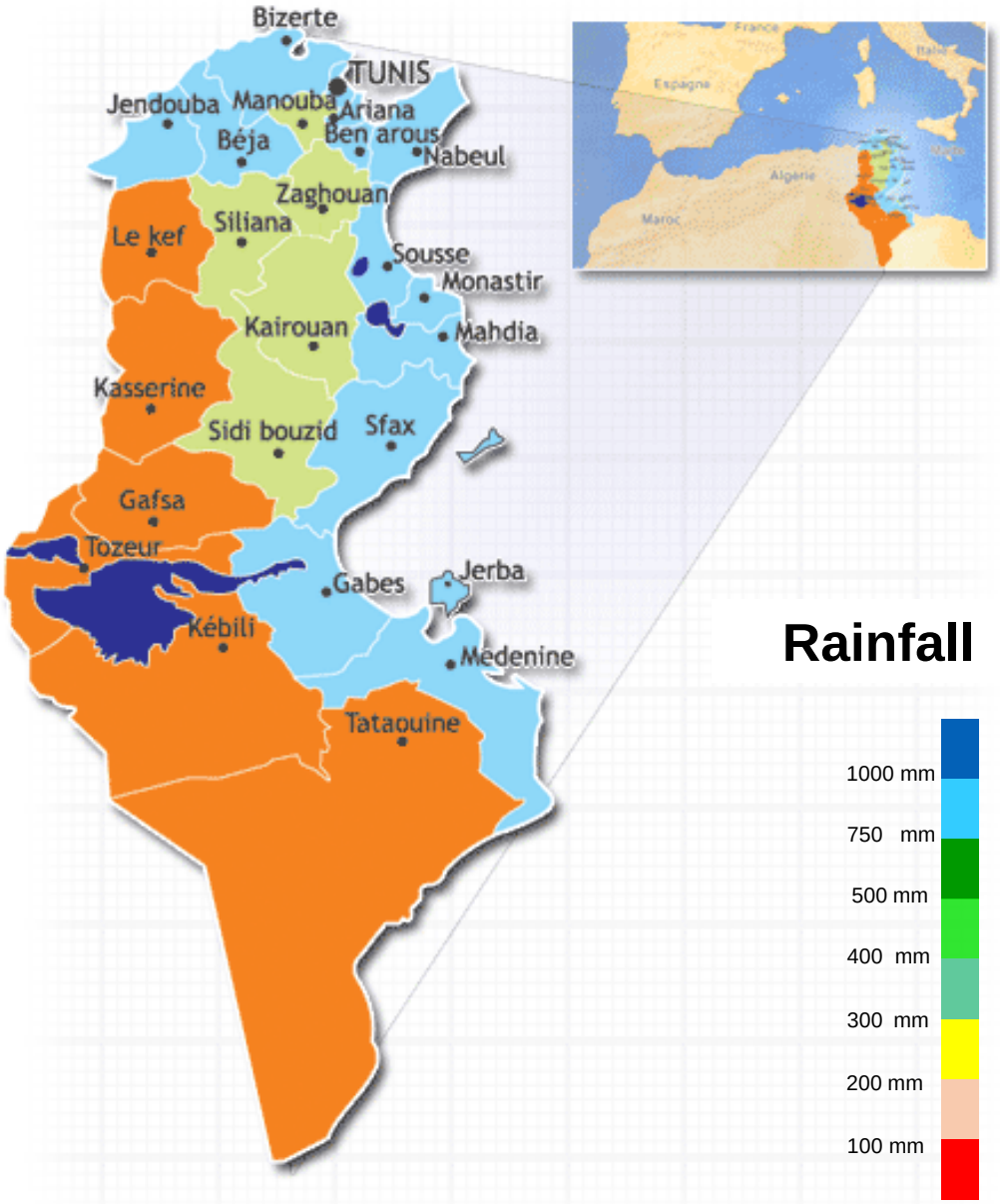
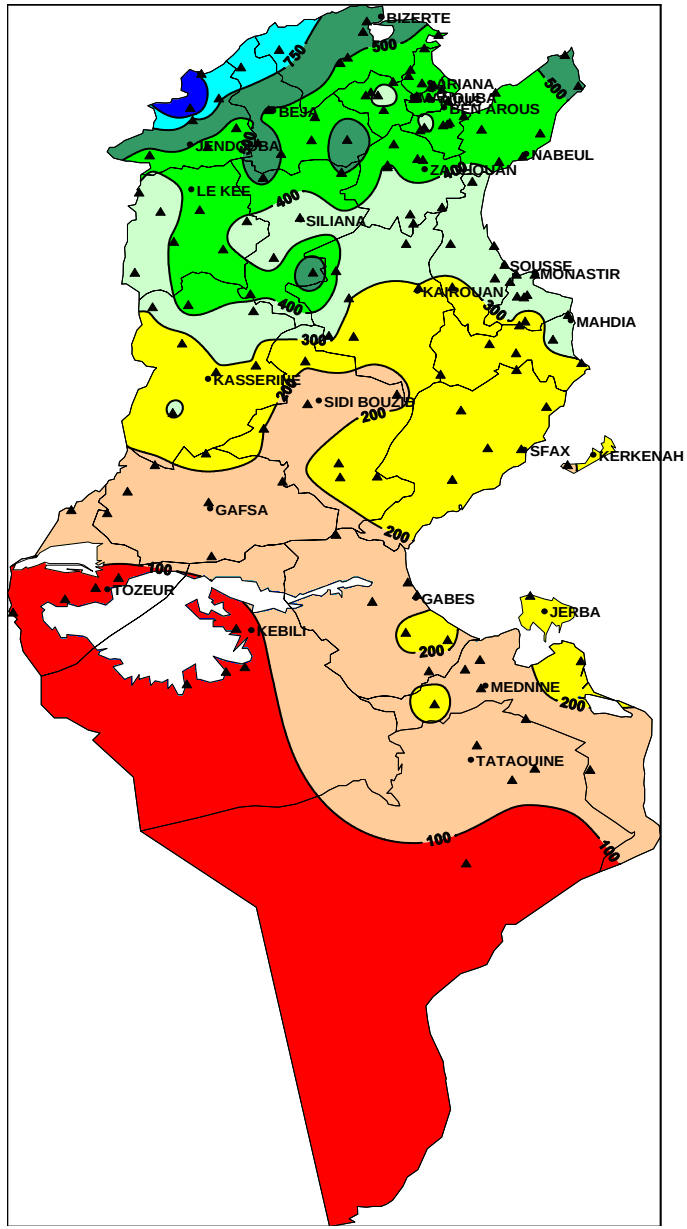
National Sanitation Utility "ONAS" (www.onas.nat.tn)

Tunisia

The Republic of Tunisia





Outline of the Presentation

- Missions of ONAS and DGRE

PART 1 (M. Mehrez - ONAS)

- Extent and practice of wastewater treatment and reuse in Tunisia
- Wastewater treatment in Medjerda valley: 11 cities sewage project
- Quality of treated wastewater

PART 2 (M. Béji - DGRE)

- Water resources in Tunisia
- Concept and design of groundwater monitoring in Tunisia
- Development of groundwater quality

CONCLUSIONS

- Achievements and challenges

The National Sanitation Utility “ONAS”

ONAS established in 1974 to manage the sanitation sector. Raised since 1993 to the status of a main operator for protection of water environment and combating pollution.

Missions :

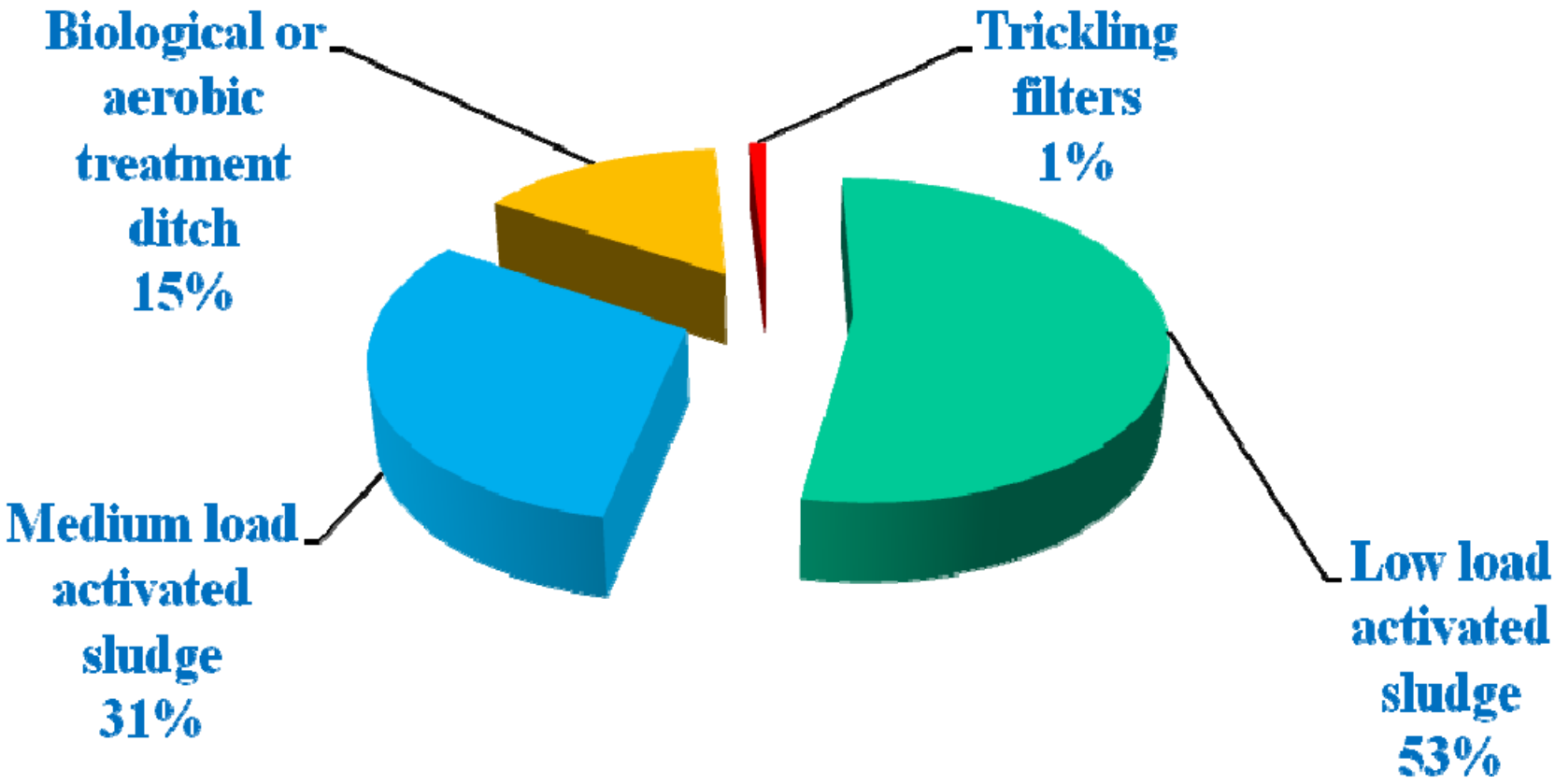
- Combating water pollution;
- Planning and implementation of sanitation sector programs and integrated wastewater treatment & storm water disposal projects;
- Construction, operation and maintenance of facilities intended for the sanitation of towns assigned to ONAS by decree;
- Sale and distribution of sub-products such as treated wastewater and sludge.

Evolution of main sanitation indicators in Tunisia

Indicators	unit	1975	1987	2007
Rate of connection to sewerage network in **urban area**	%	**20.6**	**35.9**	**81.6**
Rate of connection to sewerage network in **ONAS intervention areas**	%	**45.7**	**60.3**	**86.8**
Number of wastewater treatment plants	plant	**5**	**24**	**98**
Number of Subscribers	Million	**0.123**	**0.318**	**1.382**
Collected volume of wastewater in **ONAS intervention areas**	Mm^3	**42**	**91**	**237**
Volume of treated wastewater	Mm^3	**6**	**77**	**225**

Decentralized sanitation in rural areas based on private initiative.

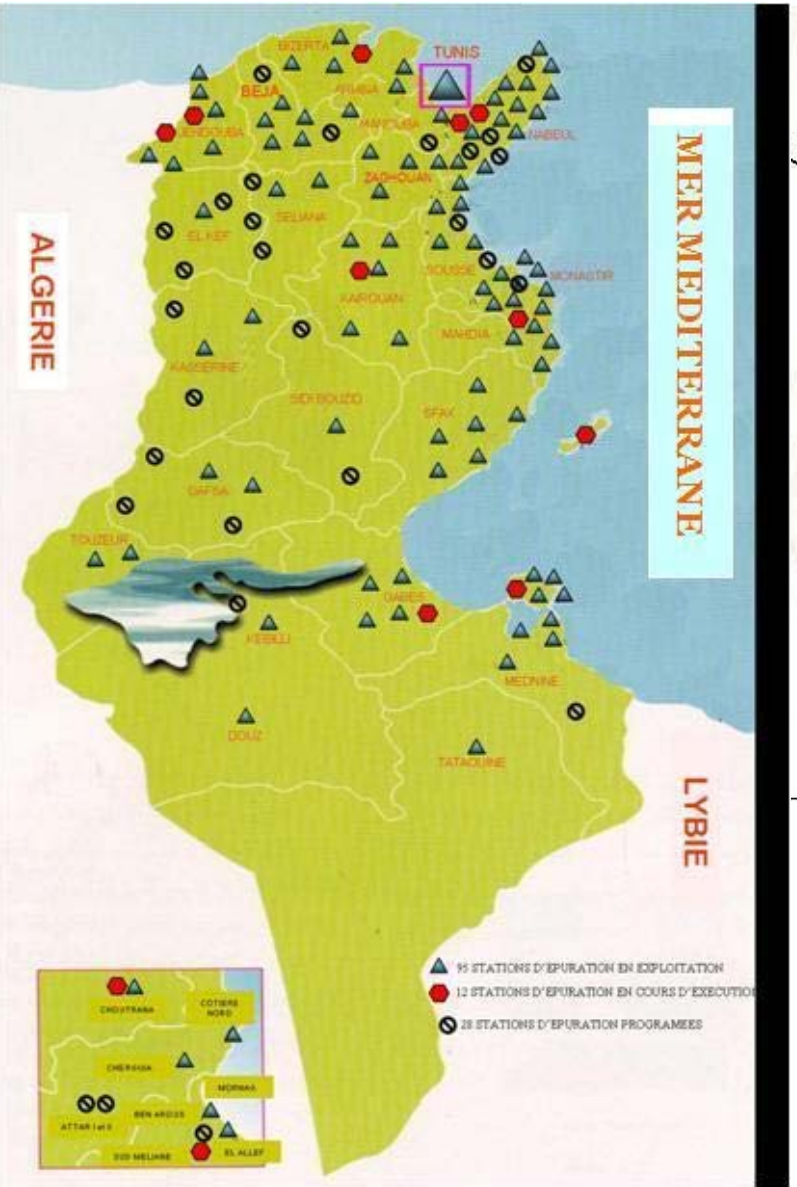
Wastewater treatment processes in Tunisia

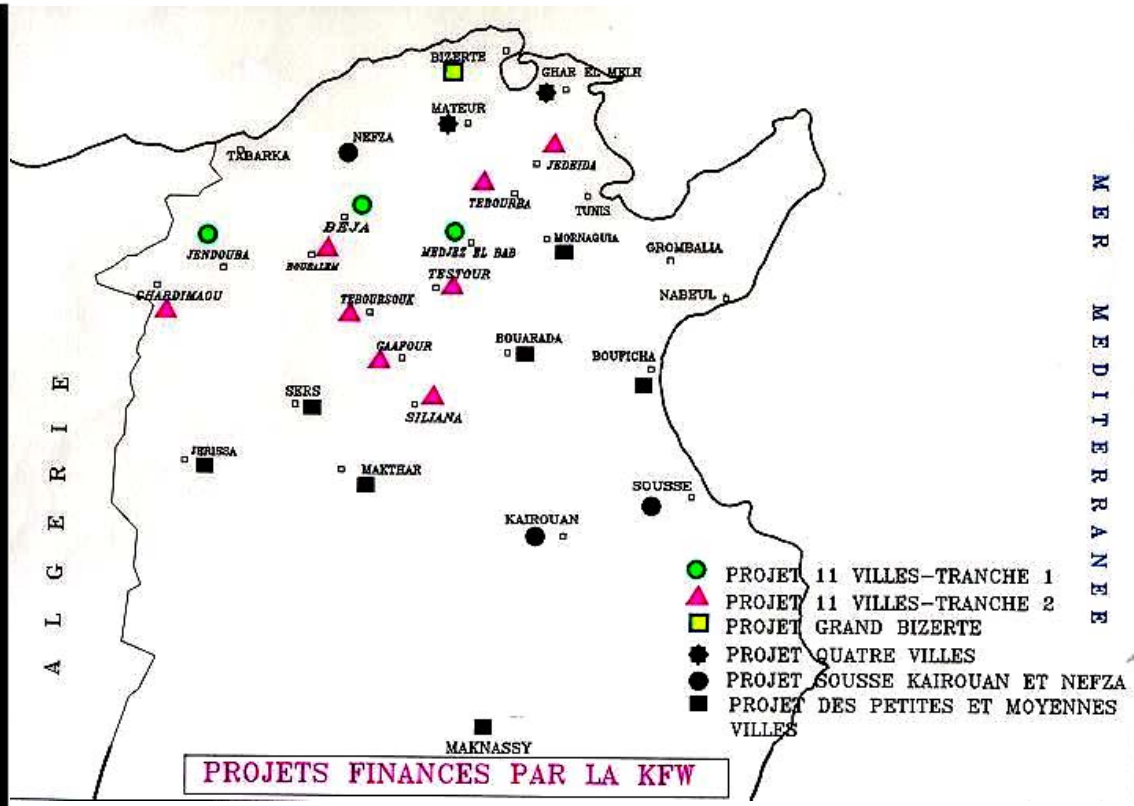


Reuse of treated wastewater in Tunisia

- Reuse of wastewater is an integral part of national water resources strategy;
- **29%** of treated wastewater is reused for irrigation in **9400 ha** (2007) distributed as follows :
- **8100 ha** of agricultural lands;
- **900 ha** golf courses;
- **400 ha** green spaces;
- **1%** of treated wastewater used for groundwater recharge and wetland conservation.

Localization of wastewater treatment plants financed by KfW Development Bank





The 11 Cities Sewage Project in Medjerda valley

Beja, Jendouba, Mdjez El Bab, Teboursouk, Testour, Boussalem, Tebourba, Siliana, Jedaida, Gaafour and Ghardimaou.

Objectives:

- Protection of the ecosystem of Medjerda valley;
- Avoidance of all water pollution and protection of water resources, including groundwater resources;
- Reduction of hygienic risks and improvement of living; conditions (development of connection rate to sewage system).

Achievements:

- Average **96%** connection rate to sewage system in 11 cities;
- Protecting urban inhabitants from epidemics;
- Protecting surface water and groundwater by reducing the pollution load and (partly) nutrients (phosphorus and nitrate).

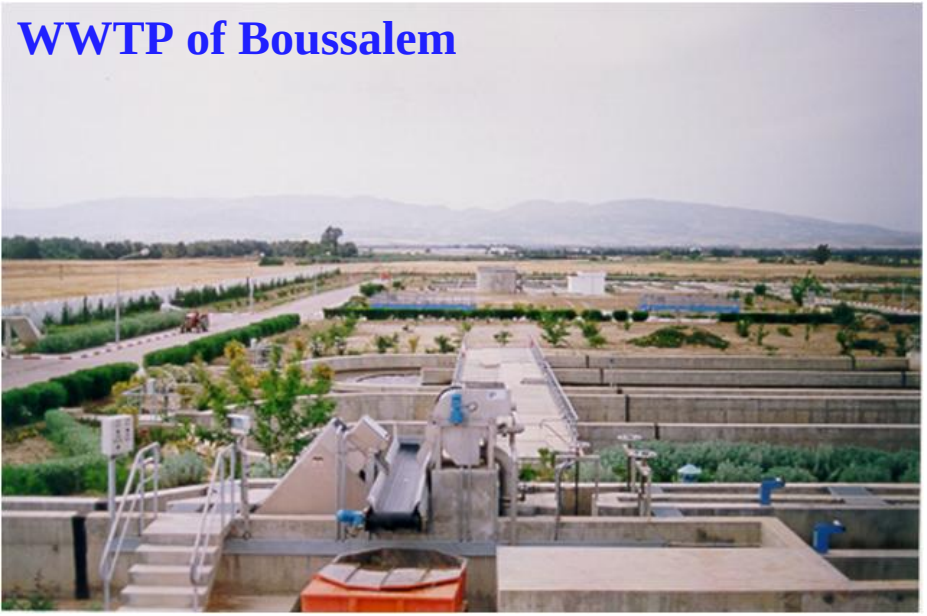
WWTP of Siliana

WWTP of Teboursouk

WWTP of Jendouba

WWTP of Mdjez El Bab

WWTP of Boussalem

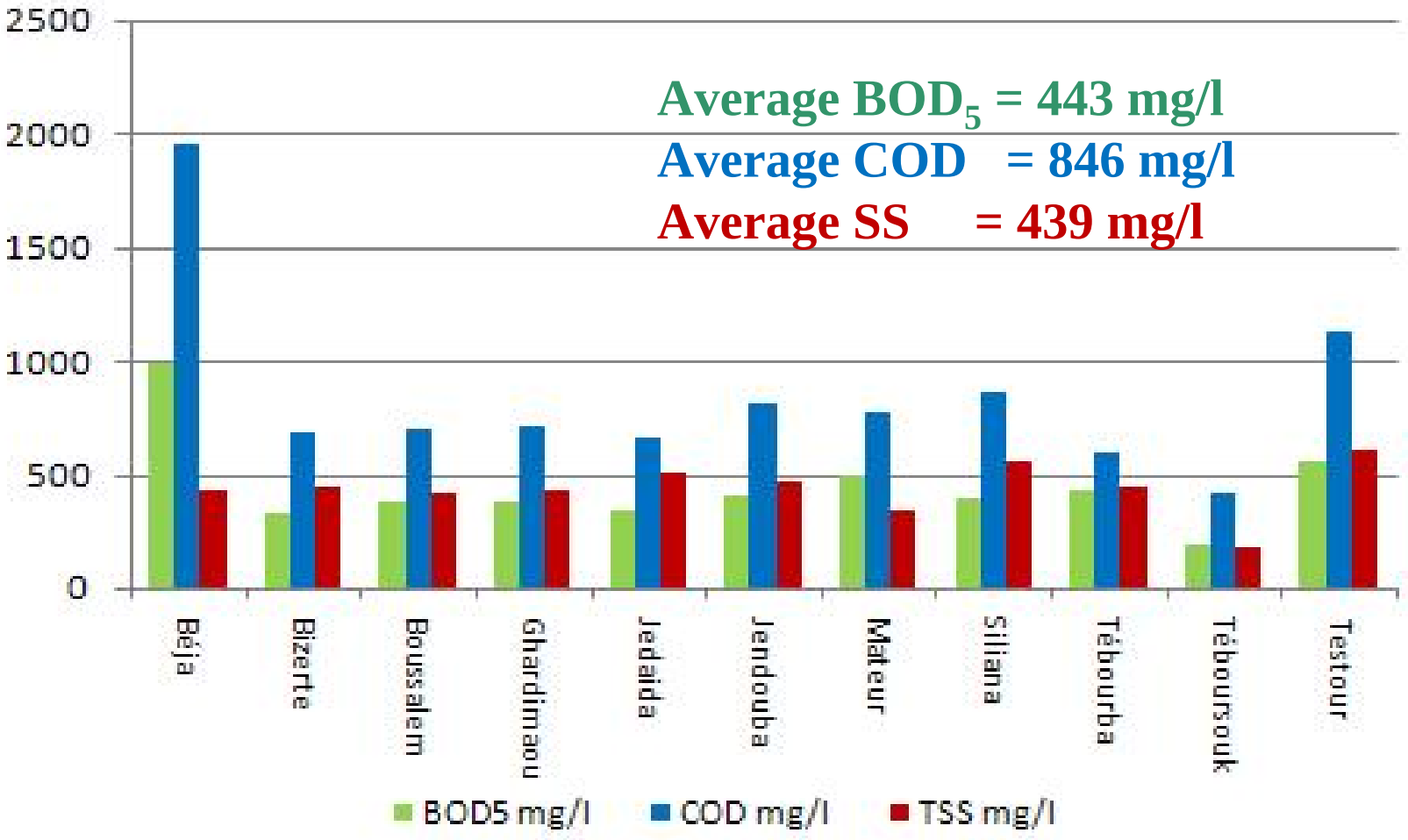


WWTP of Beja

Sanitary landfill of Mdjez El Bab

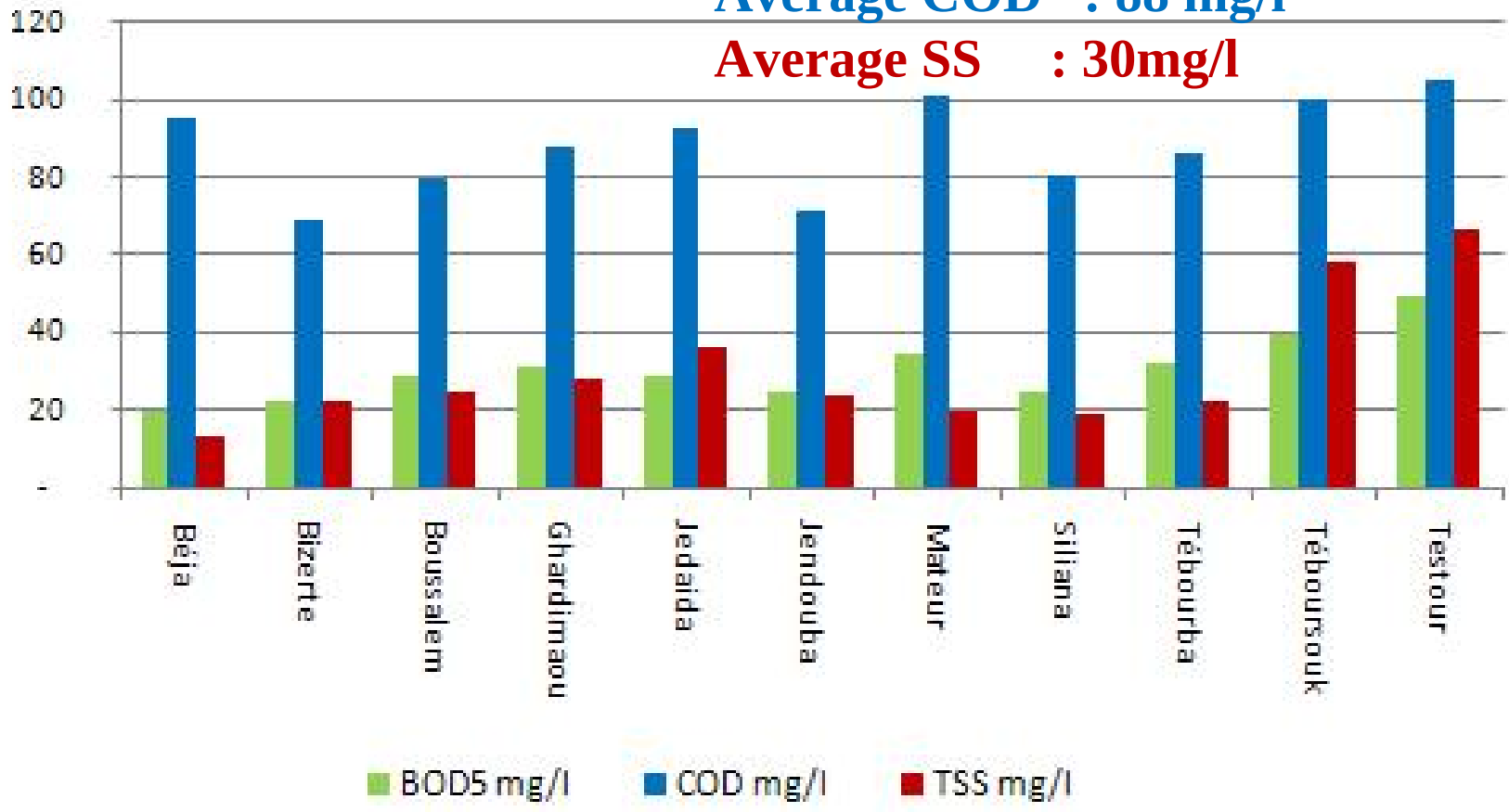
Sanitary Landfill of Siliana

BOD_5, COD and SS before treatment



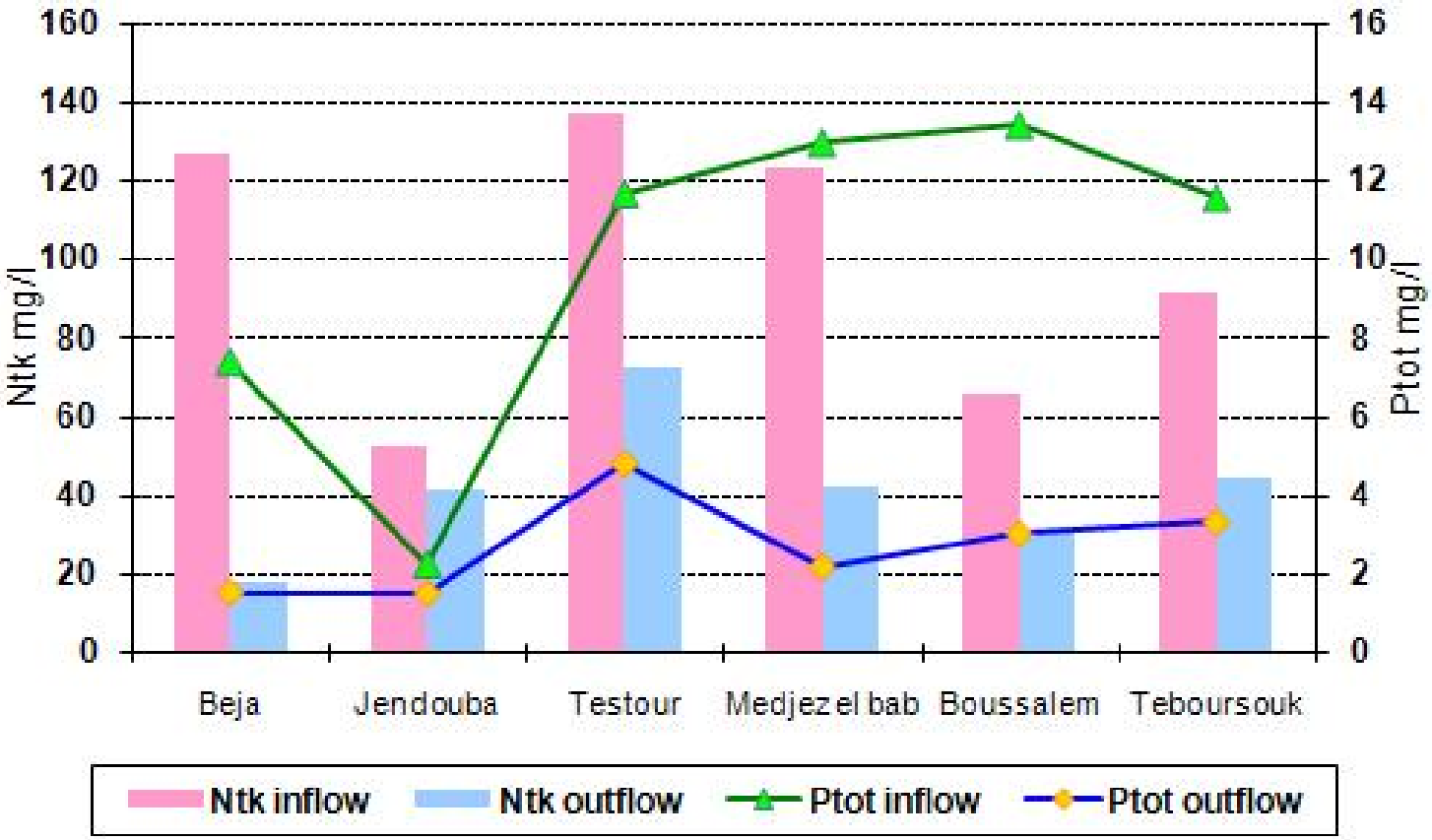
BOD5, COD and SS after treatment

Average BOD_5 : 30 mg/l
Average COD : 88 mg/l
Average SS : 30mg/l



Medjerda valley: elimination of nutrients

Ntk & Ptot concentration inflow and outflow of WWTPs



Average Ntk : 85 mg/l (inflow); 35 mg/l (outflow)
Average Ptot : 8 mg/l (inflow); 2 mg/l (outflow)

Medjerda valley: characteristics and water quality

- The Medjerda river runs **484** km, starting in Algeria and lead to the Mediterranean Sea;
- Drainage area: **23,700** km², of which **16,100** km² in Tunisia;
- Salinity **0.7-1.2** g/l (left bank **0.5-0.8** g/l, right bank **1-2.4** g/l)
- Concentration of nitrate < **20** mg/l (higher in some tributaries)
- COD **20** to **40** mg/l (> **100** mg/l in some tributaries)

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REPUBLIQUE TUNISIENNE

Direction Générale
Des Ressources en Eau
D.G.R.E

Ministère de l'Agriculture
et des Ressources Hydrauliques
M.A.R.H

Contribution of wastewater treatment to groundwater protection –experiences in Tunisia

Part 2: Groundwater Monitoring

Ridha BEJI
General Directorate of water Resource "DGRE"
Tunisia

The General Directorate of Water Resources DGRE

The General Directorate of Water Resources is one directorate of the Tunisian Ministry of Agriculture and Water Resources

Mission:

- Management of Water Resources (strategic studies)
- Monitoring of Water Resources (networks and data management;
- Publication of directories (Yearbooks) related to rainfall, hydrometry, water quality, piezometry, water use and water exploitation.

Conventional water resources of Tunisia million m^3/year

Resources		Potential	Usable	Used	% use/ mobilization
Surface water (56 %)		2. 700	2. 500	2. 200	88 %
Underground water (44 %)	**shallow**	0.740	0. 740	0. 740	100 %
	deep	1. 400	1. 400	1. 140	81.5 %
T O T A L (100 %)		**4. 840**	**4. 640**	**4. 080**	**87.5 %**

Non-conventional water resources million m^3/year

Resource	Infrastructure	Potential	Used	% use
Treated Wastewater	98 WWTP	**225**	Irrigation : **65** Recharge : **2.25**	29 % 1 %
Desalted Water	33 Stations	**30**	**30**	100 %
Drainage water	North : ~ 10 000 ha Lower valley Medjerda:~20 000 ha oases in south :~ 9 000 ha	**100 à 140**	**0**	0 %

Set-up of the Groundwater Monitoring System

- Monitoring system of piezometers & water quality since 1998

Approach:

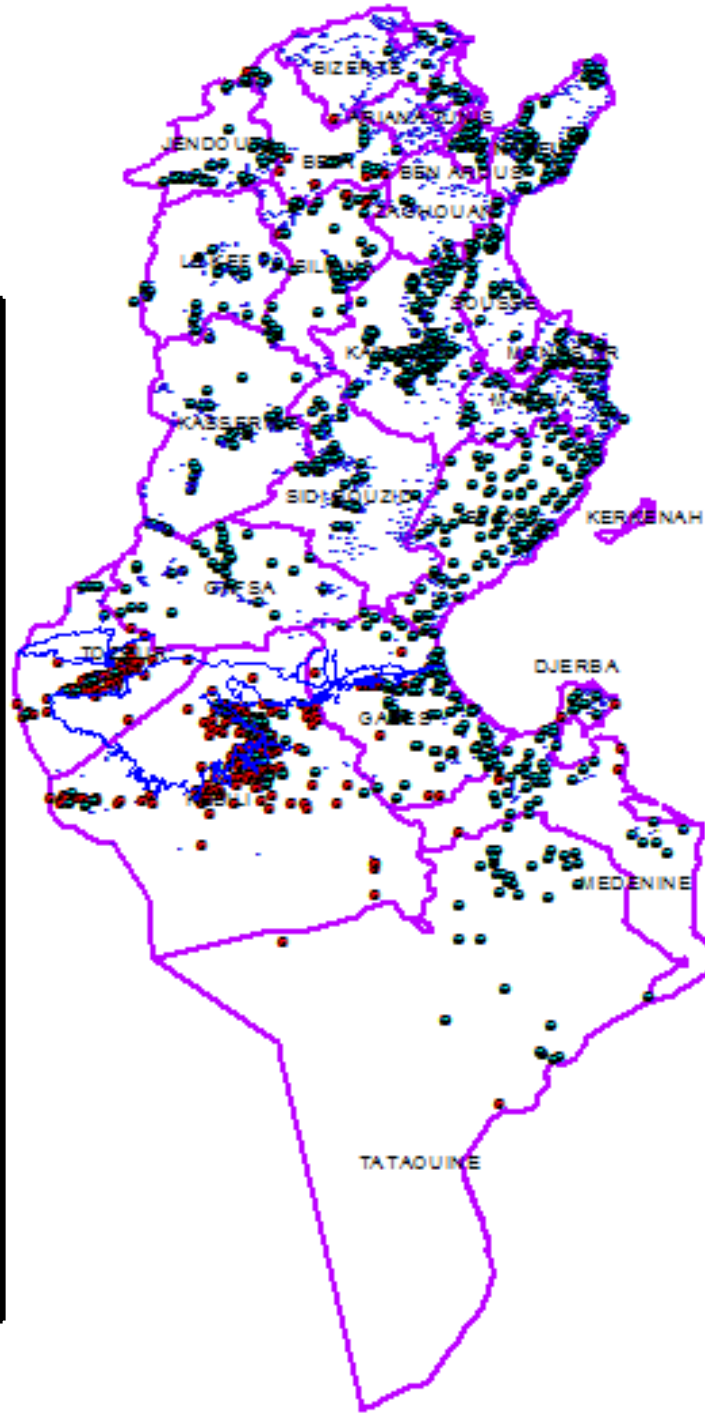
- Representative monitoring points in main aquifers (shallow and deep groundwater) regarding extend of groundwater table, importance of resource, degree of exploitation, fragility…

Objective:

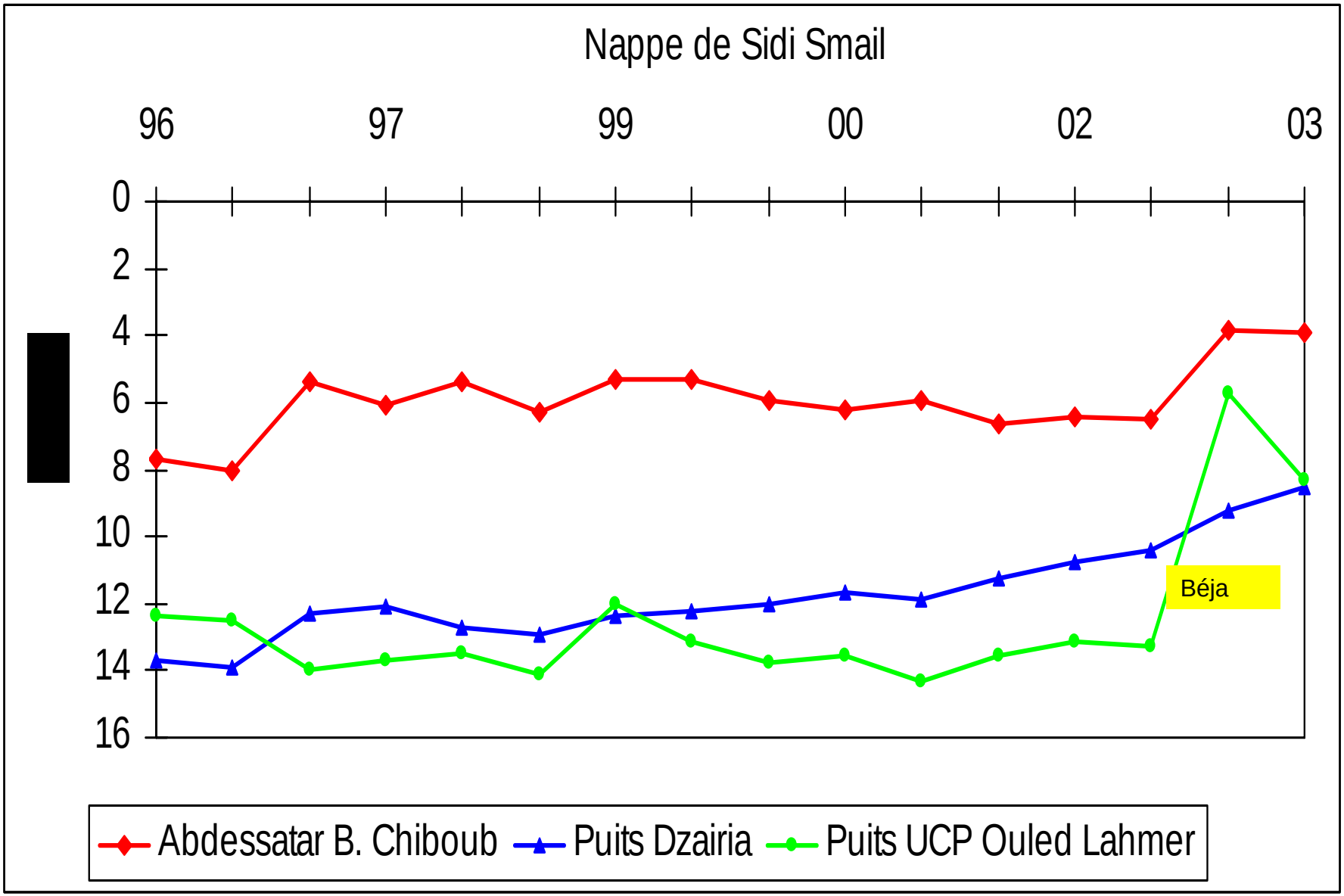
- Know chemical composition and evolution of groundwater resources as part of water resource management
  - ~ water balances
  - ~ over-exploitation ➔ salinisation
  - ~ groundwater recharge
  - ~ intensive agriculture ➔ pollution
- Respect of legal standards (for drinking water supply)
- Relevant data for ground water models and special studies (EIA, drought or inundation, fragility of aquifers…)

Monitoring of Groundwater Level

Region	Observation Points			Total
	Open wells	Piezometres and Boreholes		
		Shallow Ground-water	Deep Ground-water	
North	1,120	417	283	1,820
Centre	788	233	199	1,220
South	406	131	190	727
Total	2,314	781	672	3,767



Example Béja: Piezometrical Variations

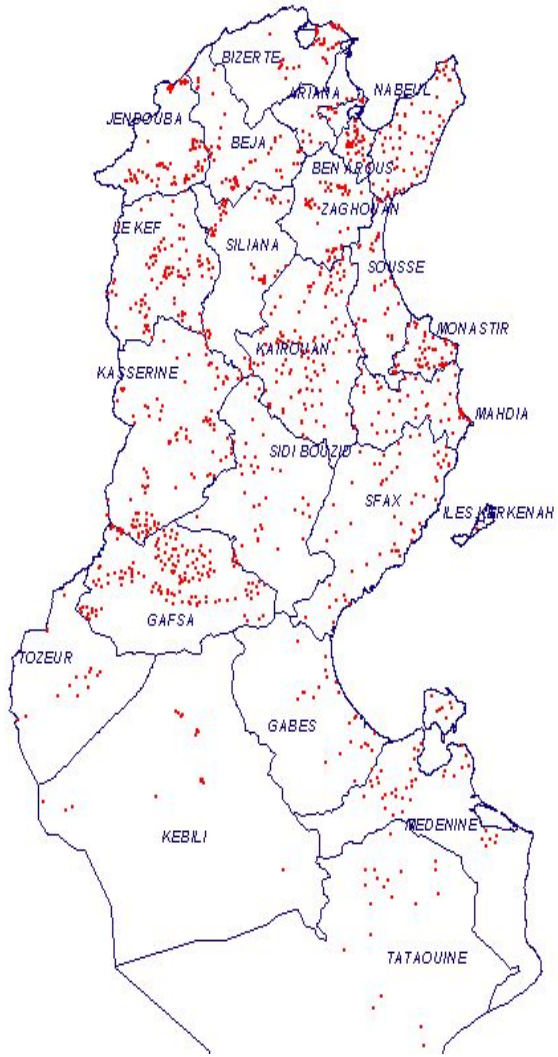


Monitoring of Groundwater Quality

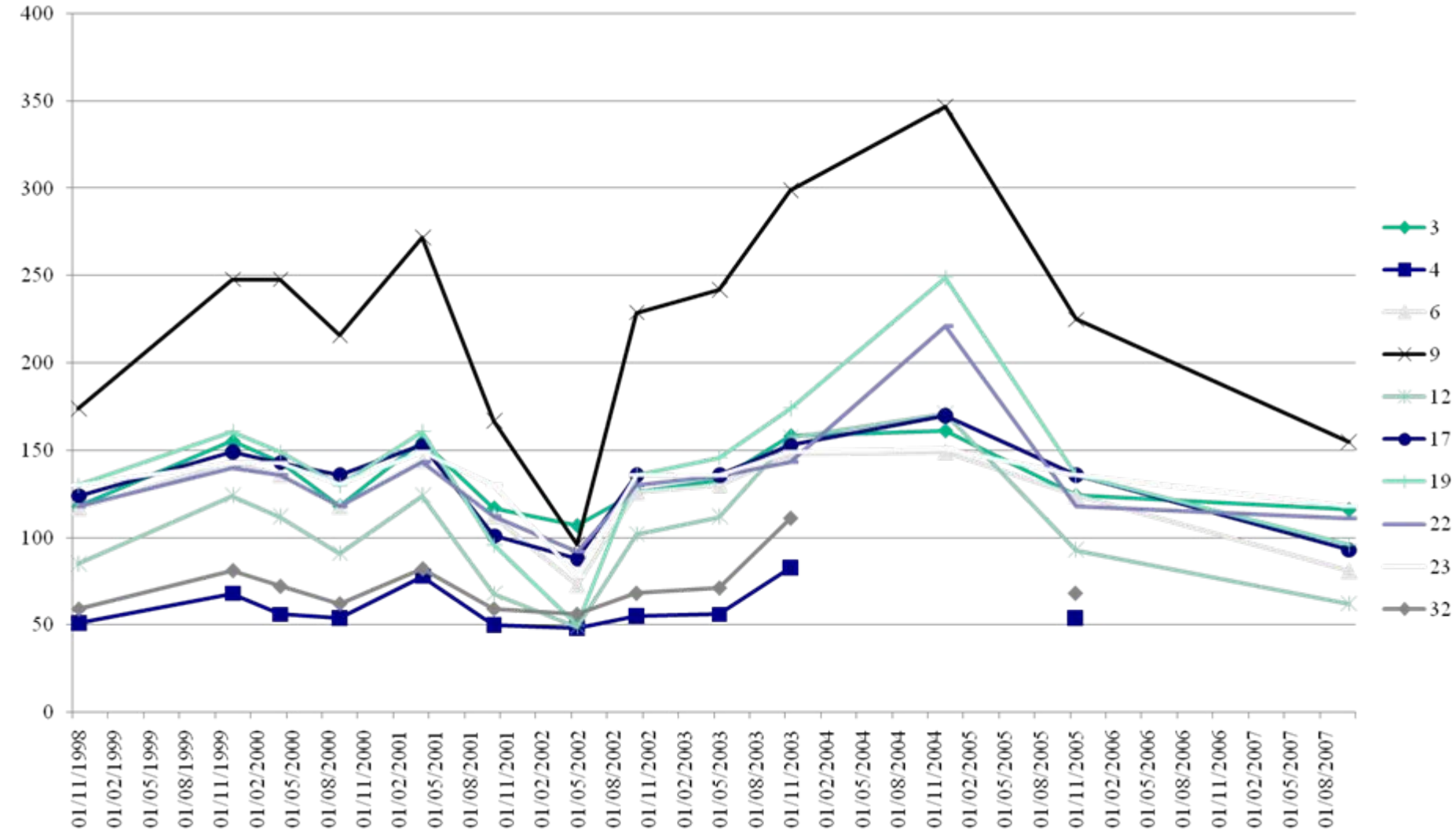
Region	Shallow ground-water	Deep Ground-water	Total
North	321	149	470
Centre	197	212	409
South	111	213	324
Total	629	574	1,203

1,203 points of TSS and nitrate monitored twice per year and included in a GIS data set

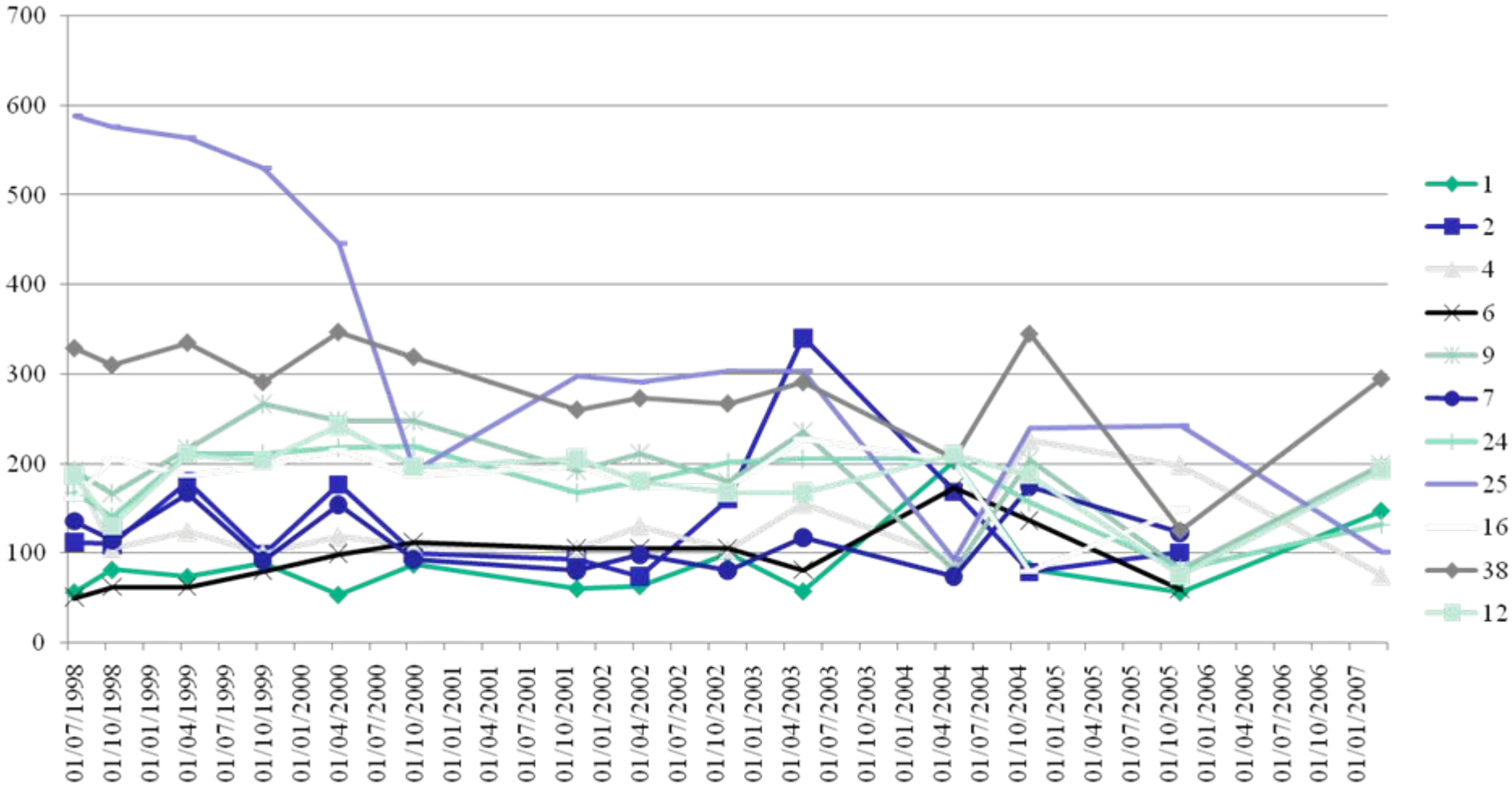
Répartition régionale du réseau de suivi de la qualité des eaux souterraines



Evolution of nitrate content of shallow groundwater in Siliana



Evolution of nitrate content of shallow groundwater in Nabeul



Main Results of Groundwater Monitoring

- Salinity of groundwater tables increases from North to South and from inland to the coast
- High nitrate values in shallow groundwater; nitrate pollution a general tendency;
- Decreasing level of nitrates in the groundwater of Ariana, Kasserine, Kef, Medenine, Mahdia, and Monastir;
- Little change (Sousse, Siliana) or increase of nitrates in the groundwater of Bizerte and Nabeul.

Main Constraints

- Monitoring is costly
- Many stakeholders, Scattered data
  - * Ministry of Agriculture and Water Resources;
  - * Ministry of Environment and Sustainable Development;
  - * ONAS
  - * Ministry of Public Health;
- Negligence of bacteriological aspects (for dinking water supply: responsibility of Ministry of Public Health), while quality of treated wastewater for irrigation and infiltration varies;
- Schedule of two measurements per year (moreover with only RS and NO3) allows to follow general tendencies, but not to detect accidental pollution

Conclusions

- Monitoring and control of groundwater resources is very important for decision making, conservation of the environment and integrated water resource management
- Different monitoring systems for different types of water use (irrigation, drinking water, industry, tourism) ➔ protocol of rules is indispensable
- Need of complementary action of different stakeholders (Ministries, ONAS, SONEDE,ANPE)
- Use of a joint data-basis
- Public access to data-basis and publication of results;
- Medjerda catchment : positive contribution of WWT confirmed by the improvement of Groundwater quality in most cities;
- Groundwater quality monitoring must be a requisite component of all sanitation project➔ Need of close coordination between the different ministries and other stakeholders.


THANK YOU
FOR YOUR
ATTENTION