
# Methodology and Estimation on the Cost Assessment of Water Resources Degradation and Remediation

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# Why An Economic Valuation of Water Resources at the Basin Level

- **The Outcome of Work Package #1 on Water Governance and Mainstreaming includes:**

  (a) Water considerations are promoted using a participative approach, also at local level;

  (b) Water concerns are mainstreamed in other relevant sectoral policies and in national development plans;

  (c) Economic valuation is carried out to assess the costs and benefits of mitigation actions on water degradation and

  (d) Climate change considerations are mainstreamed in national strategies, plans and policies, with primary emphasis on no-regret actions.

# Achievement of the Outcome

In order to reach the outcome : A pillar on cost assessment of water resources degradation at the basin level was designed and implemented It consisted of 4 components:

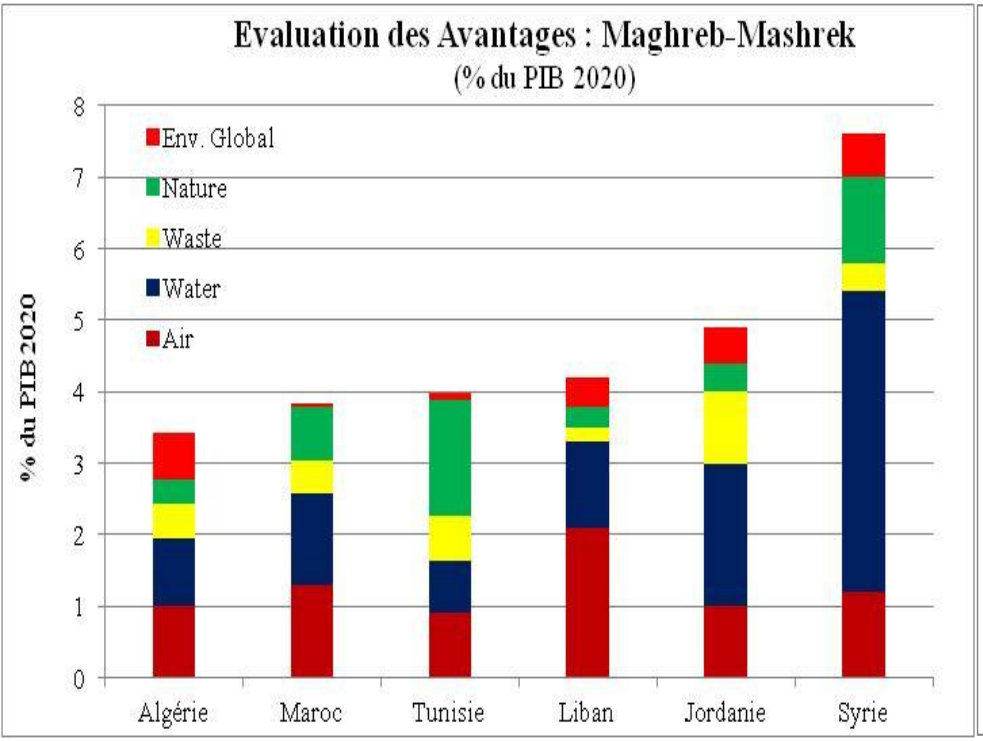
- Cost of water resources degradation due to water and waste water pollution
- Cost Benefit or Cost Effectiveness Analyses of Remedial Actions and Preparation of Investment Interventions
- Building the capacity of the decision makers on the methodologies of economic evaluation
- Validation and Dissemination of the Investment Interventions

# Why An Economic Valuation of Water Resources at the Basin Level

- Much of the past interventions at the national level have been on "engineering" investments without a systematic evaluation of the benefits achieved, and without consideration of other investments' alternatives that would generate both economic and environmental benefits.
- Less is even known at a more detailed river basin level as no accurate identification of problems and evaluation of the associated costs of degradation have been undertaken so far. However it is at the basin level, that decisions have to be taken as to the management, and the protection and conservation of water resources

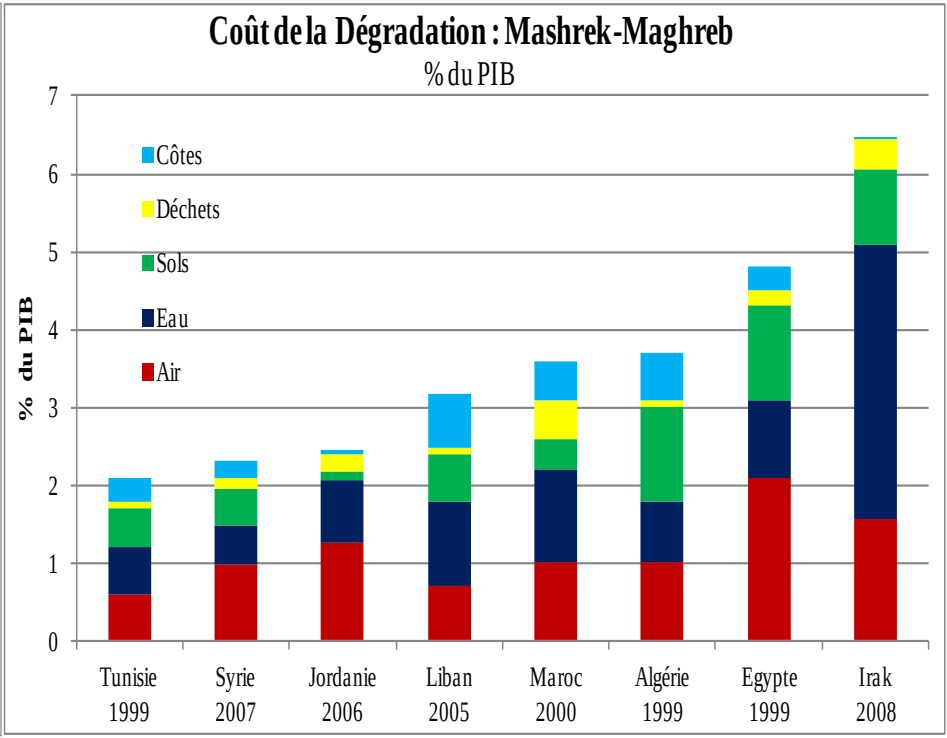
# International Financing Institutions estimated the Cost of Environmental Degradation at the National Level

## The European Union




http://www.environment-benefits.eu/

## The World Bank




Sarraf et al, & Doumani:Cost of Environmental Degradation, METAP/World Bank 1999-2008

# However, these national estimates are limited

- These estimates in terms of orders of magnitude were useful to alert policymakers about the seriousness of the water degradation problem.

- They cannot be used directly to provide an OPERATIONAL response as they did not include the costs and benefits of possible solutions to the watershed degradation problem which would affect the NON OPTIMAL USE of THESE RESOURCES.

# Cost of Water Degradation and Remediation should be used to take decisions at the basin level

- Choice of general priorities based on cost-benefit ratios (e.g. to invest in waste water treatment or in forestation),
- Choice of concrete projects and activities based on cost-benefit ratios or Net Present Value (NPV),
- General or project priorities based on analysis of cost-effectiveness (in cases where monetary valuation is difficult),

# Objective of the CAWRD

- The main objective is to value the cost of water resource degradation (CAWRD) in a selected watershed to assist decision-makers at national and local levels to identify and prioritize specific actions to improve the management of this basin through potential funding of projects related to environmental and water benefits and the reduction of negative externalities.
- This allows to bring the costs of degradation to a common denominator to prioritize selected investments based on cost/benefit analysis

# Limitations of the CAWRD

**The CAWRD is valued by using the available data – their source cannot be totally reliable. Moreover, due to the lack of data many hypothesis were assumed . The results are therefore considered as an indicative order of magnitude with lower and higher bound in order to take into account the uncertainties**

# Description of the CAWRD

- Assess the costs of water degradation caused by water contamination, salinity , water logging  floods risk, dam siltation. In particular, it will estimate in monetary terms the impact of each problem on all water uses, to the extent that data allow.
- Identify a priority for intervention (investment projects) in a specific location of the river, particularly affected by pollution or natural resources degradation
- Undertake an economic analysis (such as cost-benefits analysis or cost effective analysis) of potential interventions necessary to reduce water pollution/ natural resource degradation in the areas previously selected; and will identify cost-effective measures to reduce pollution and natural resources degradation and improve the overall quality of the river.

# Methodology

- The cost of water resources degradation is a measure of the loss in a nation's welfare due to water degradation and depletion. As such, it includes losses at three levels:
  - social, e.g. premature death, pain and suffering from illness due to inadequate quality of drinking water
  - economic e.g. reduced soil productivity due to irrigation with saline water, lower energy production due to dam sedimentation.
  - environmental, e.g. reduced recreational value for lakes and beaches due to water contamination
- It places a monetary value on the consequences of such degradation. This often implies a three-step process:
  - quantifying water degradation (e.g. monitoring water quality).
  - quantifying the impacts of degradation on different water uses (e.g. reduced agricultural production due to water salinity and waterlogging)
  - estimating the impacts in monetary terms (e.g. estimating the cost of soil productivity losses).

# Valuation Techniques

The main methods for estimating impacts are grouped around three pillars with specific techniques under each pillar

Change in production.

Value of changes in productivity such as reduced agricultural productivity due to salinity and / or loss of nutrients in the soil;
Approach the opportunity cost of such shortfall of not re-selling the recycled waste;
Approach replacement cost when for example the cost of construction of a dam to be replaced by a dam that was silted.

Change in condition with the dose-response function to establish between pollutant (inhalation, ingestion, absorption or exposure) and disease.

The value associated with mortality through two methods: the future shortfall due to premature death, and the willingness to pay to reduce the risk of premature death..
The approach to medical costs such as the costs when a child under 5 years is taken to the hospital to be cured of diarrhea.

# Valuation Techniques ( ctd)

- **Changing behavior with two sub-techniques: revealed preferences, and stated preferences.**
  - **Revealed preferences by deriving the costs associated with behavior: e.g., hedonic method where for instance the lower value of land around a landfill is derived; trying to derive travel costs to visit a specific place ; and preventive behavior as when a household buys a filter for drinking water.**
  - **Stated preference where a contingent valuation is used to derive willingness to pay through a survey for example, improve the quality of water resources**

# Categories, sub-categories, impacts and methods used for the valuation of degradation and remediation

| Category | Sub-category | Impact | CAWRD | Cost of Remediation |
|---|---|---|---|---|
| Water | **Water-borne diseases:** improved drinking water supply and sanitation and change in behavior with regards to hygiene | Illness associated with drinking water supply quality and quantity as well as sanitation and poor hygiene (see Annex II for water-borne disease) | HCA/VSL and COI | Coverage rate of improved drinking water supply and sanitation, and hygiene awareness campaigr |
| | **Quality and treatment:** drinking water in urban and rural areas | Consumer preference (tap water vs. bottled water); filter use or chlorine addition; boiling water; etc. | CR et CB (additional cost of treatment) | Desalination for dilution with potable water and upstream investments ; water treatment improvement and improvement of potable wate and tariff/charge adjustments |
| | **Quality of services**: drinking water in urban and rural areas, and irrigation | Costs of alternative sources of water (bottle, tank, wells, etc.); technical losses (financial losses are not considered as services are provided but tariff/charges are not collected) while considering the opportunity cost and economic externalities (subsidies) ; lost time hauling water | CR and CO | Improved delivery, service effectiveness; and tariff/charge adjustments |
| | **Quality of the resource** (anthropogenic): effluents and seepage (see Solid waste) | Surface water quality affecting : water use (domestic, agricultural, fisheries, industrial et mining) ; basin ecosystem and (eutrophication, etc.) coastal zones; territories ; and eco-tourism | CV (restoration of water quality) | Wastewater investments, reduction of industrial effluents) and reduction of pesticide and nitrate use (See Solid waste); and tariff/charge adjustments |
| | | Underground water quality affecting : water use (domestic, agricultural and industrial); basin ecosystem and coastal zones; territories ; and eco-tourism | CV and RC (restoration of water quality) | Artificial recharge for dilution ; substitution wells or water desalination/transport |
| | **Salinity** (anthropogenic and natural): surface and underground water, marine environment and soil | Salinity of soils, effects on health **(see Quality and treatment)**, reduction of agricultural and fishery productivity and effects on ecosystems. | CP (agricultural productivity) | Fertilizer increase (short term measures) and lan use planning (long term measures to reduce salinity) |
| | **Quantity** (anthropogenic and natural):surface water flow reduction and underground water drawdown | Surface : treated and untreated water use that could cause contamination of the food chain; and in extreme cases, substitution effects through desalination | CP (agricultural productivity and additional cost of pumping/substitution) | Opportunity cost of treated and reused water; and of desalination and water transportation; an tariff/charge adjustments |
| | | Underground : deeper pumping, substitution wells or desalination (rapid drawdown or fossil water) to overcome domestic needs and/or agricultural productivity | CP (agricultural productivity and additional cost of pumping/substitution) | Opportunity cost of pumped/substitution water; and tariff/charge adjustments |
| | **Erosion and Storage:** soil management is affected by erosion and exacerbated by | Soil nutritional losses and sedimentation of dams, hill lakes, river beds and coastal zones exacerbated upstream by poor land use management due notably to deforestation, wind and water | CP et RC (dredging ; increase the dam height or construction of new | Costs : Land use planning to prevent and reduce erosion |

# Process used for the Cost Assessment of Water Resources Degradation and Remediation (Restauration) in SWIM-SM

- Selection of the basin in accordance with the established criteria and at the request of the SWIM focal point
- Identification mission in the country for meeting with national and water authorities and for data collection
- Analysis of the impacts and estimates of the cost of degradation using the different valuation tools
- Estimation of the cost of investments and remedation (benefits accrued) with a Net Present Value over 20 years and a discount rate of 10%.
- Prioritize investments for which Benefit/Cost is Bigger than 1
- Drafting a report with recomendation for interventions
- Presentation and Validation of the report in the country

# Criteria for the Selection of the Basins

- The water way is a major river in the country and is a source of potable water and irrigation
- The basin is a country priority for socio economic development and for integrated water demand management, however socioeconomic development in the basin has not kept pace with that of other regions in the country
- Rural population and livestock pressures on the land, coupled with inadequate land management , over exploitation of groundwater increasingly induce resource degradation
- Water pollution is an issue for water quality
- Climate change is emerging as a major challenge for the agricultural sector with increased incidence of flash floods

# Basin Selection

Two basins were selected in 2012

- Morocco-Oum Er Rbia
  River length: 600 Kms
  Watershed surface : 48,000 Km2
  Population: 5.0 million

- Tunisia- The Medjerda
  River length: 350 Kms
  Watershed surface: 15,930 Km2
  Population:1.3 million

Two basins were selected in 2013

- Algeria-The Seybouse
  River length: 240 Kms
  Watershed surface : 6,471 Km2
  Population: 1.6 million

- Lebanon- The Litani
  River length: 170 Kms
  Watershed surface: 2.168 Km2

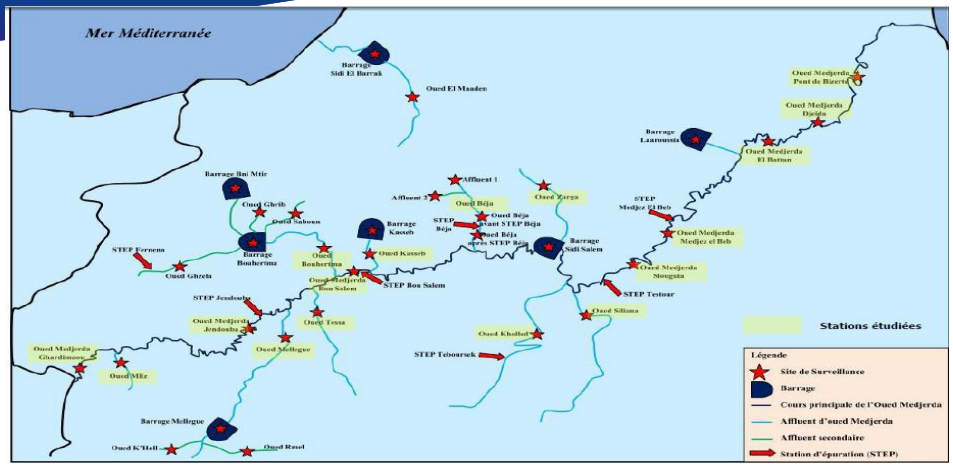
# Analysis of Impacts

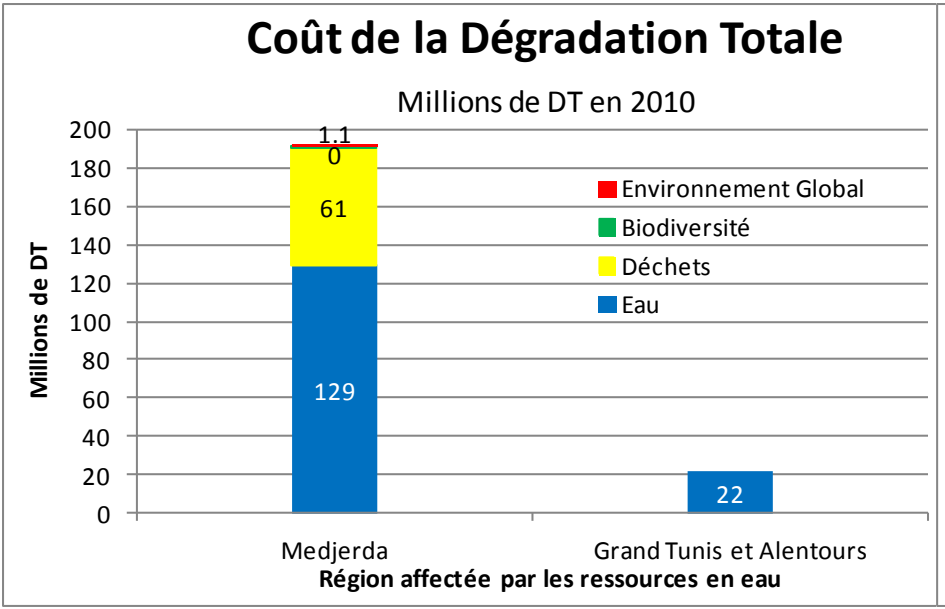
The following impacts were assessed: water salinity, contamination, water-logging, dam sedimentation and overexploitation of groundwater, climate change variability, pollution due water, waste water, and municipal waste

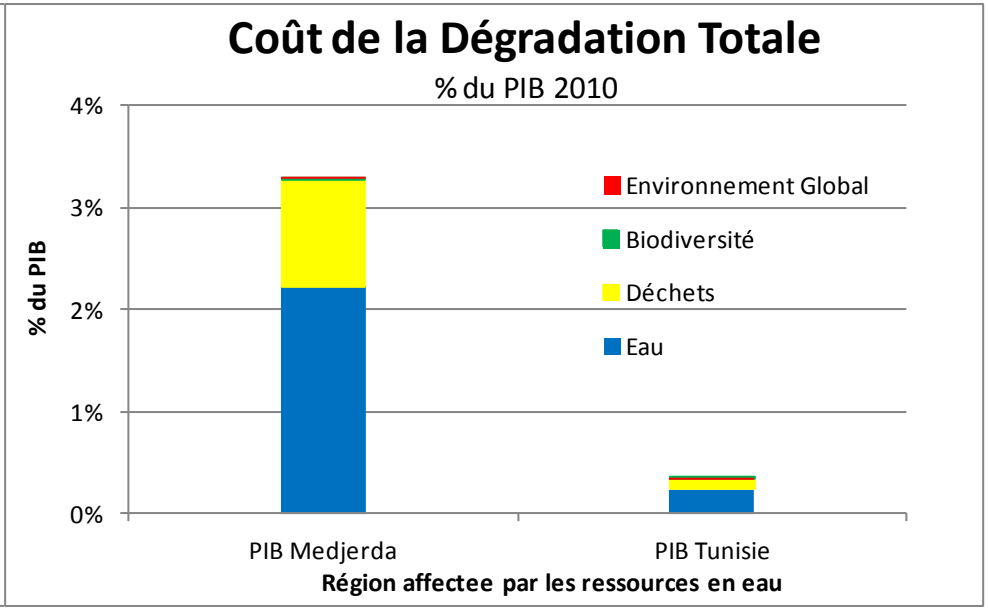
| | Agriculture | Fishery | Domestic, sanitation, health | Hydropower | Industry | Tourism | Environment |
|---|---|---|---|---|---|---|---|
| Salinity | | | | | | | |
| Waterlogging | | | | | | | |
| Contamination* | | | | | | | |
| Sedimentation | | | | | | | |

# Example: Degradation cost of the Medjerda

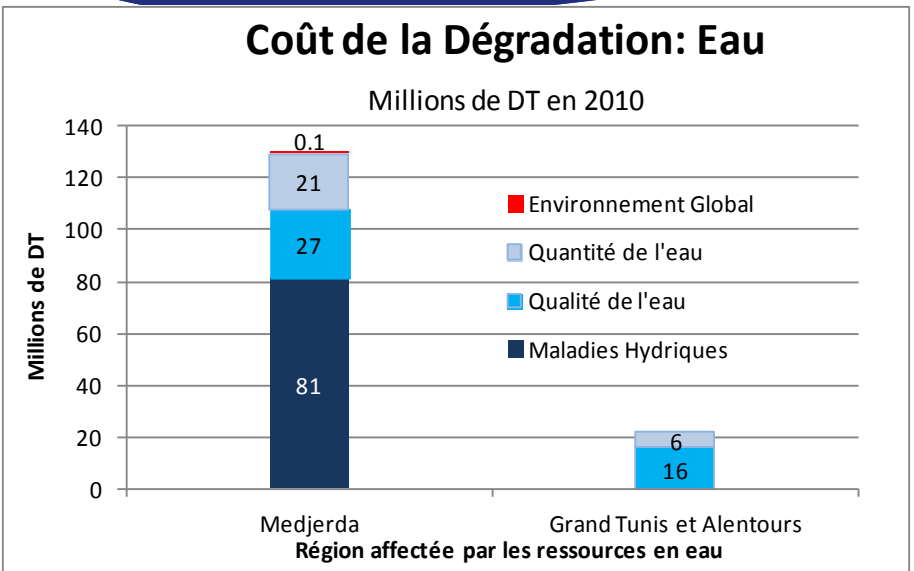
## 192 millions DT ( 101 million Euro) equivalent to 3.3% of the Basin's GDP; 0.34% of the current Tunisian GDP

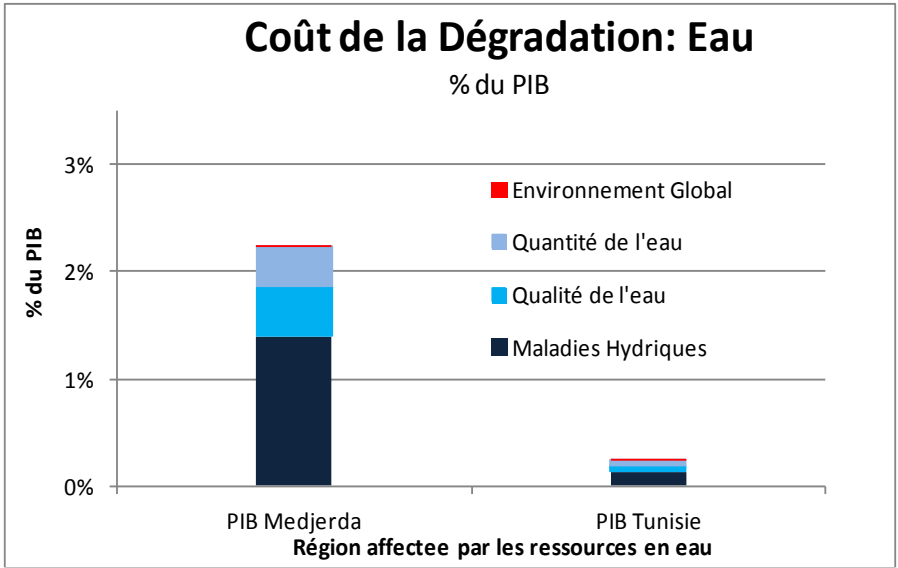


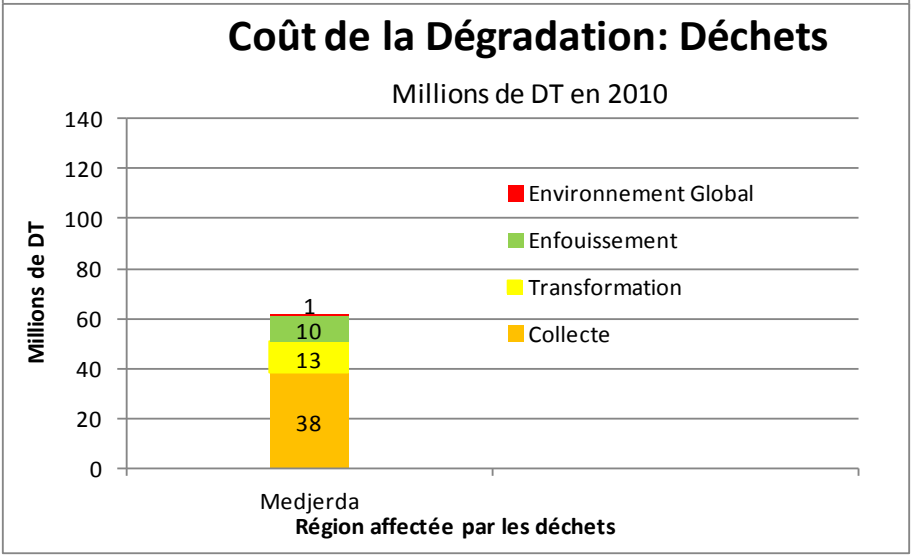



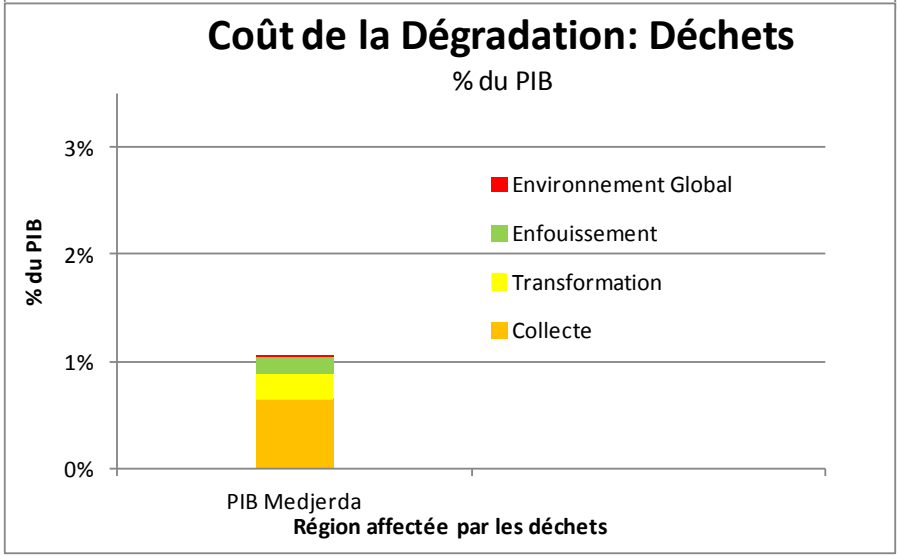



# Degradation cost: Disaggregated results

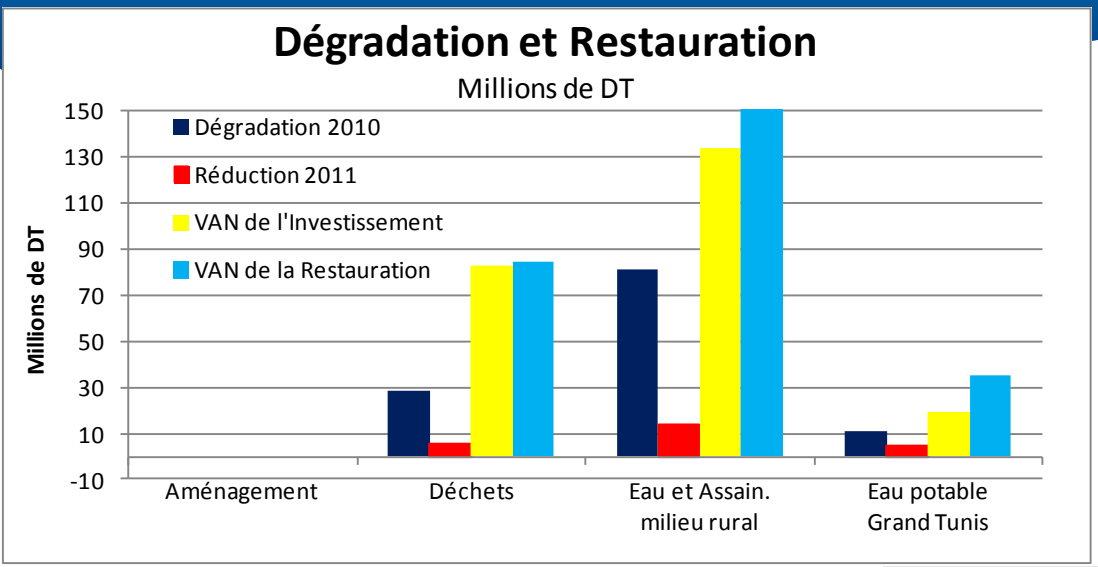


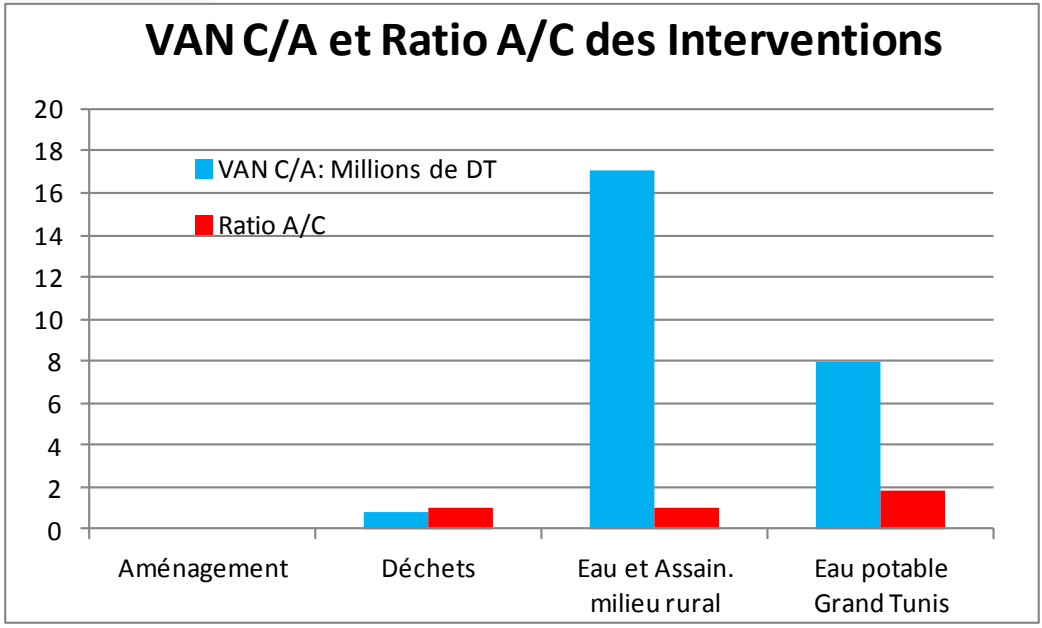



# Degradation and Remedial costs: Disaggregated results



# Major Interventions Proposed for the Medjerda

- The gradual shift in the policy of intensifying natural resources exploitation, especially through mobilization of water resources
- Focusing primarily on efficient investment for domestic pollution control in rural and peri-urban areas that have been neglected in the past
- Planning of upstream interventions that reduce dam siltation
- A decentralized information network for continuous observation, tracking, monitoring of the environment and natural resources in the Medjerda basin
- An horizontal action for overall, integrated water management in the Medjerda watershed is highly recommended

# General Benefits from the CAWRD Pillar

**By assigning monetary values to water degradation and remediation at river basin level, the study:**

- **Provides a comprehensive and holistic approach for assessing the impacts of water degradation;**
- **Offers a useful instrument to rank the different types of degradation costs according to their relative importance;**
- **Gives decision-makers a tool to improve the integrated water resource management at river basin level**
- **Improves the investment opportunities of the government at the governorate/watershed/basin and sub- national levels in order to effectively curb water degradation**
- **Associates the stakeholders and interest groups in the identification of the water issues, definition of remediation plans and preparation of investment plans**

مع خالص شكري
وامتناني

**Thank you**
**for your attention**

**Merci pour**
**votre attention**

*For additional information please contact:*
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