



***DROUGHT MANAGEMENT AND
MITIGATION IN SEMI-ARID AREA :
MOROCCAN CASE STUDY***

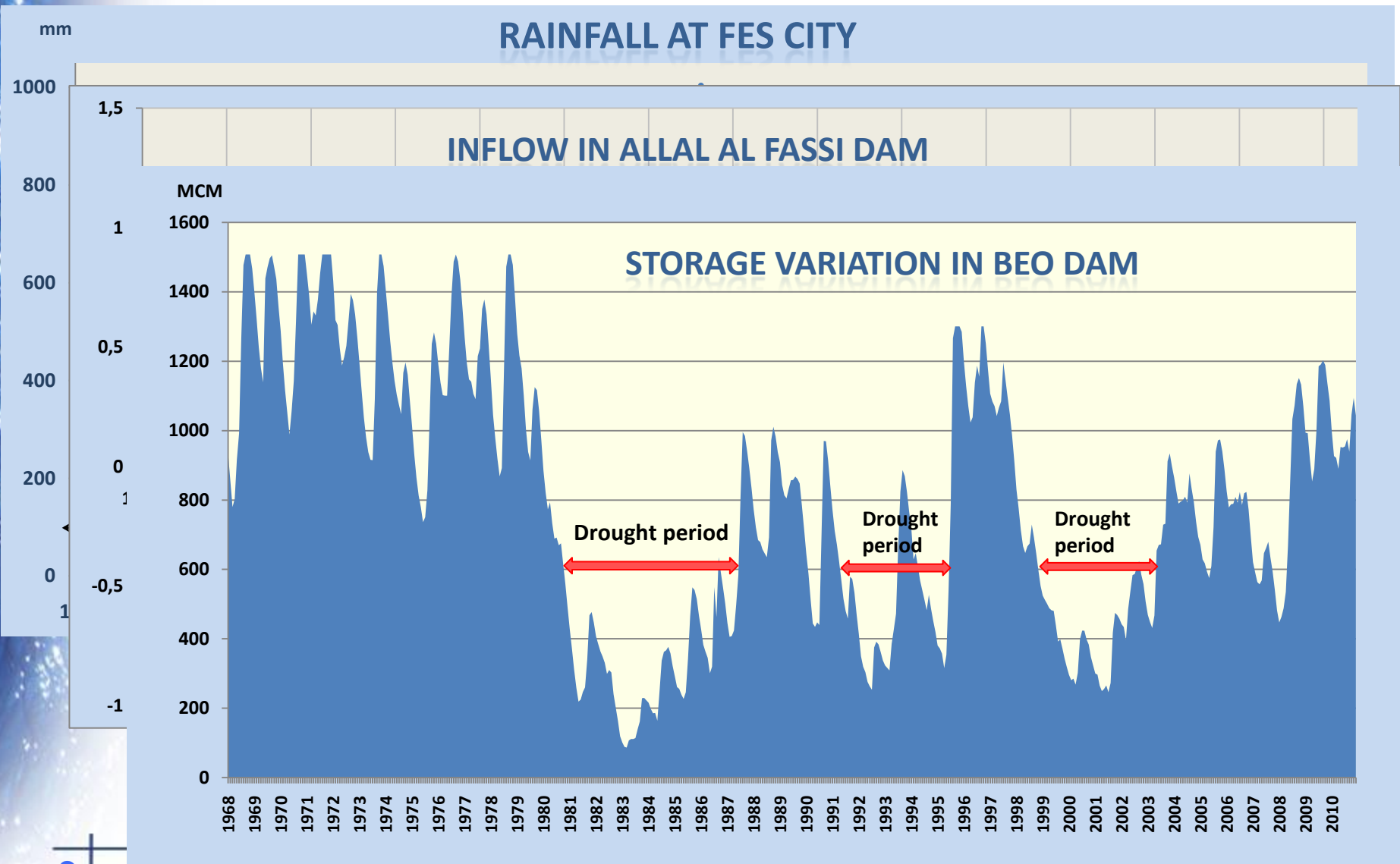
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OUTLINE

- **DROUGHT CHARACTERISATION**
- **POTENTIAL IMPACTS OF RECENT DROUGHTS**
- **ACTIONS TO MITIGATE DROUGHT IMPACT**
- **CONCLUSION**

TIME VARIATION OF PRECIPITATION & WATER RESOURCES



DROUGHT IMPACTS

IMPORTANT ECONOMICAL IMPACT ON THE AGRICULTURAL SECTEUR

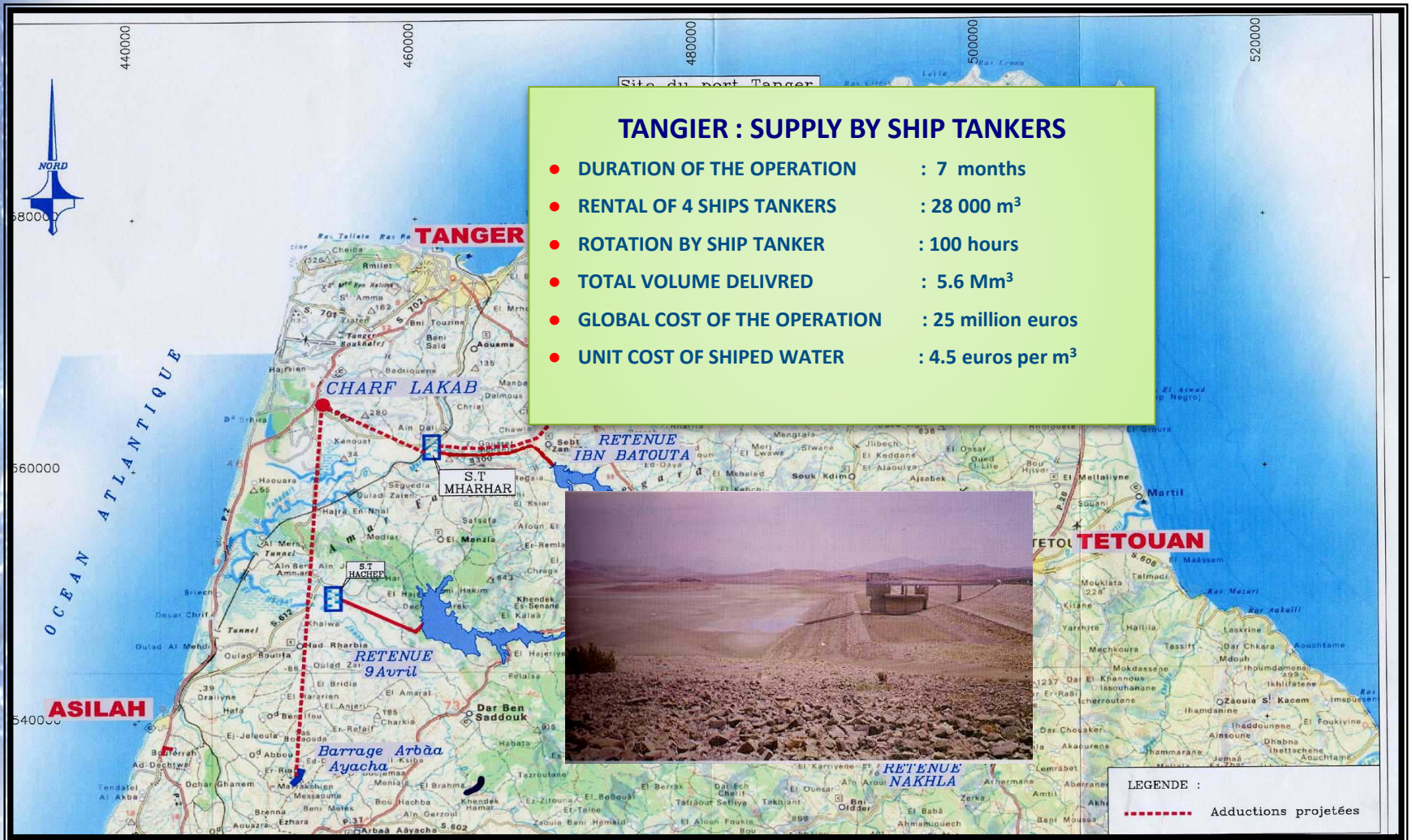
- Decline in grain production : About 60%.
- Important deficit in Irrigation : From 20 to 90%
- Decline in Agricultural GDP : From 30 up to 40%
- Increase of unemployment in rural areas : Agricultural job losses during severe year is estimated about 50 million days of work
- Indirect impact : Trade, Food agricultural industry



DISRUPTION IN DRINKING WATER SUPPLY

- Depletion of traditional water supply in rural areas (springs and wells
- Water rationing in urban area

DROUGHT IMPACTS : TANGIER CASE STUDY



DROUGHT IMPACTS

IMPACT ON HYDROPOWER GENERATION

- **Deficit in hydropower production : 50%**

IMPACT ON NATURAL ENVIRONMENT

- **Increase of water pollution :**
 - **Decline in dissolved oxygen downstream of waste discharge and in dam reservoirs**
 - **Eutrophication of dam reservoirs**
 - **Fish losses in rivers (Mortality)**
- **Dysfonction or break services of drinking water treatment plants**
- **Increase of waterborne diseases**
- **Deforestation and dewatering of natural lakes and springs**

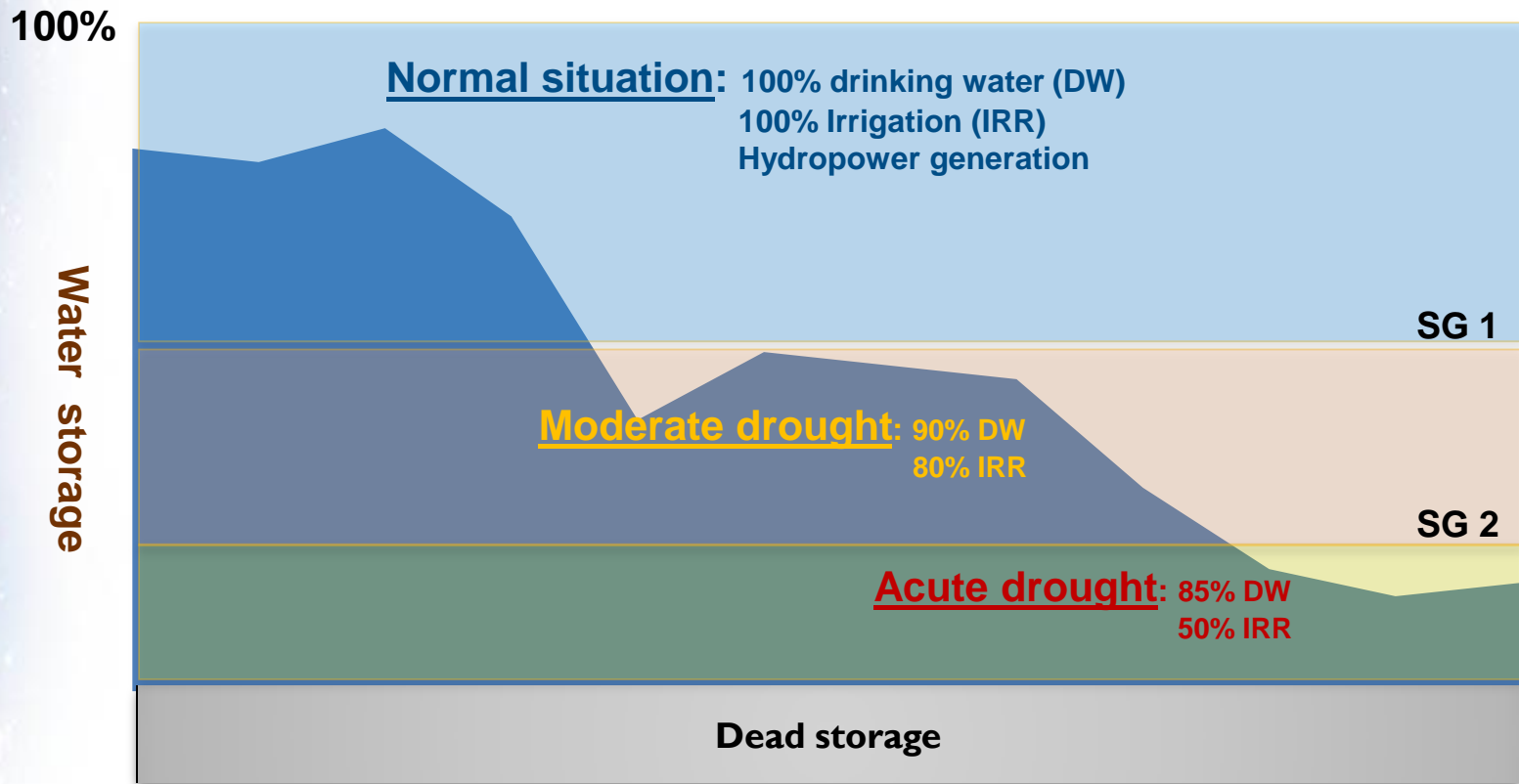
ACTIONS TO MITIGATE DROUGHT IMPACT

GENERAL PROVISIONS

- **Strengthen coordination : Vigilance committees are activated during drought periods**
 - **National committee: establish a national program (mitigate measures , financial and administrative arrangements)**
 - **Local committees: monitoring the implementation of actions**
- **Priority setting : drinking water, then irrigation and finally the hydropower generation**
- **Monitoring of changes in water supply, especially in the dam reservoirs**

ACTIONS TO REDUCE DROUGHT IMPACT

Water management at dam reservoirs through some rules developed since the severe drought



ACTIONS TO REDUCE DROUGHT IMPACT

GIVEN THESE PROVISIONS , THE FOLLOWING ACTIONS ARE TAKEN :

Technical measures to develop water supply

- Voluntary and temporary overuse of groundwater (new catchment works and rehabilitation of existing structures)
- Construction of small structures to mobilize surface water.
- Water transport

Water demand management actions

- **Drinking water supply :**
 - Reduce water losses in the network (through the reinforcement of maintenance and rehabilitation actions.
 - Enhance population awareness to reduce water consumption
- **Irrigation water :**
 - Reduce water losses in the canals through adequate maintenance ;
 - Allocate water for less water consuming crops with a priority to perennial crops;
 - Encourage use of efficient irrigation techniques.

Water quality preservation

- **Water release from the reservoirs to prevent further water quality deterioration.**

CONCLUSION: LESSONS LEARNED

LESSONS LEARNED FROM ANALYSIS OF PAST EXPERIENCES

- **Drought is a structural rather than an exceptional phenomenon in Mediterranean region, specially in the south shore countries**
- **Drought events in the Mediterranean have become more frequent since the begin of the eighties**
- **Initial reactions of authorities have focused on exceptional measures that may require heavy and inefficient investments**
- **Agriculture and drinking water in rural areas were heavily affected by drought**

CONCLUSION: BEST PRACTICES

- **Move from reactive actions to the proactive management approach:**
 - Drought characterization through some hydro-climatic indicators (climatic, hydrologic, water storages, ...) in order to declare drought levels and corresponding alerts
 - Measures or action plans to mitigate drought impact, established in advance and developed in consultation with all stakeholders
- **Integrate the drought in water resources planning process.**
- **Diversifying sources of water mobilization and interconnection of water supply systems by promoting systems less vulnerable to climate change :(Improve inter-annual regulation of river flows and promote desalination of seawater to secure drinking water supply in coastal cities).**
- **Integrate Water Management : Conjunctive use of both surface water and groundwater : Strategic role of groundwater during drought periods.**
- **Promote water demand management and improve efficiency of water use, such as structural adaptation measures to climate change.**
- **Promote the economic and financial measures: Insurance, natural disasters funds.**



QUESTIONS?
