

# Managing groundwater: links between California and Morocco

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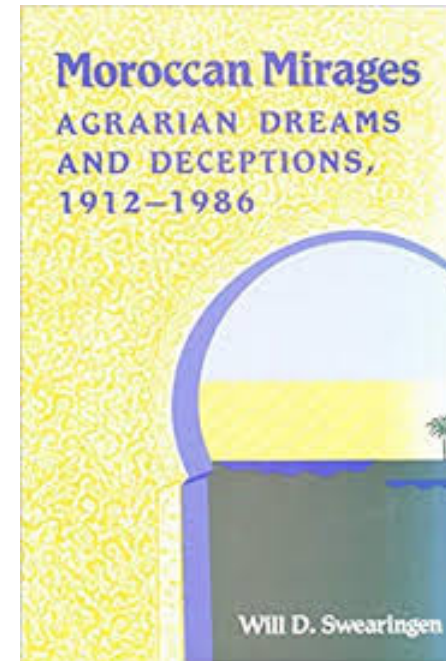
Sustainable Groundwater: Governance and Conflict Resolution

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# Linking irrigation development in California and Morocco through broad analogies

1. The “California dream”, Morocco producing high-value fruits and early vegetables for the markets of Europe:
  - High number of missions to California > 1928
  - California as a “beacon that could guide colonial Morocco out of its dark agricultural crisis” through its fruit industry (oranges, almonds, apricots, plums etc.)
  - Morocco had not only “California’s mild climate, water resources and rich earth”..., but had low labor costs and was also admirably situated near the large European markets (Swearingen, 1986).
  - Policy of big dams: 1 million ha of irrigated land
2. Inverse travel: Medjool date production in Imperial County, Ca > 1944
3. California as an innovation hub: e.g. Conference in Morocco on drip irrigation by Dr. F.K. Aljibury (Univ of Ca) and Mr. Norton (Rain-Bird International) on Octobre 5, 1972
4. California and Morocco faced with the limits of an irrigation model
  - issues of surface water scarcity, groundwater overexploitation
  - “Ground water management is a major issue in California” (Water Resources Bulletin 118-1980)

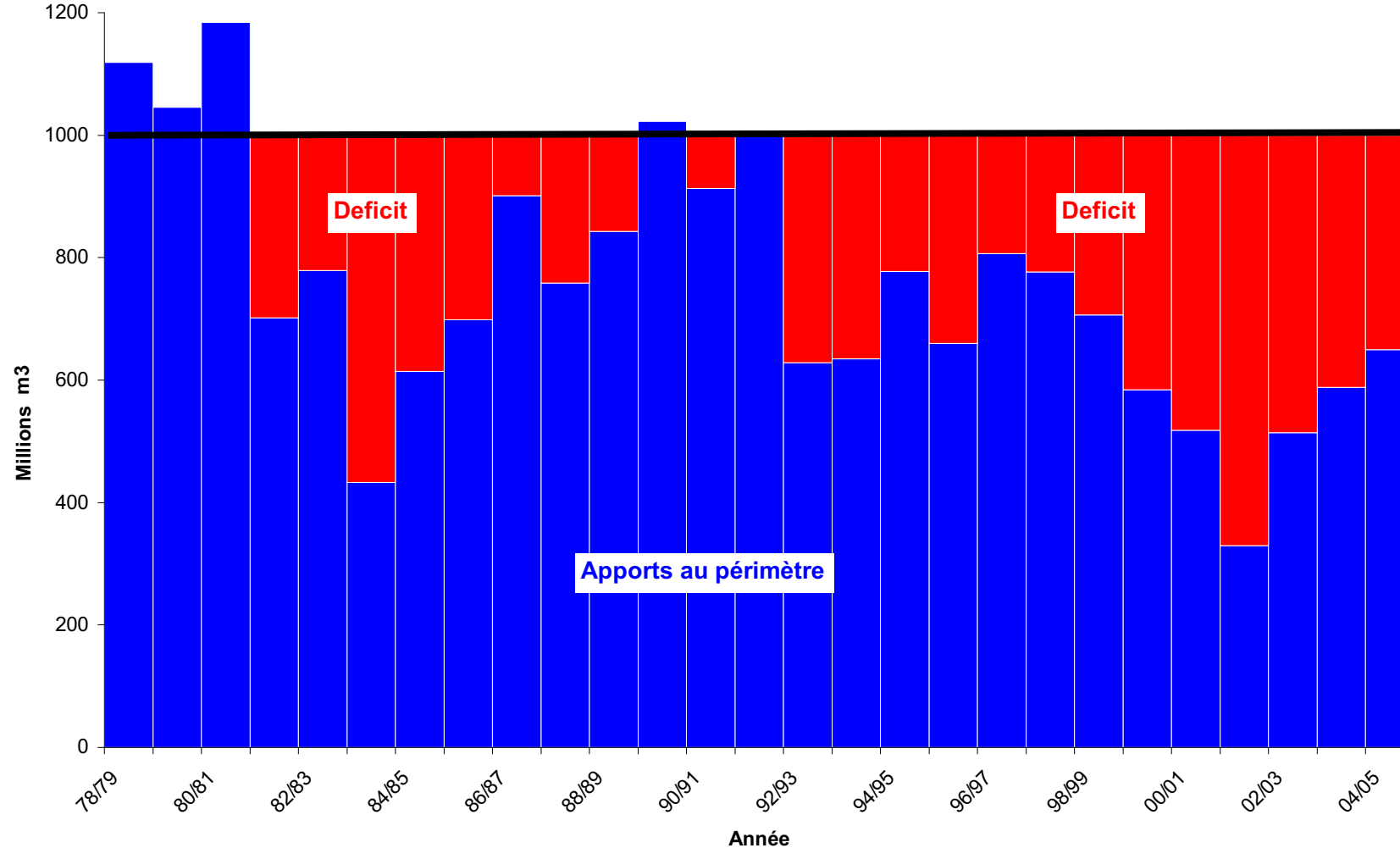


# The Tadla irrigation scheme: a Moroccan California?

- *“at the beginning of the 1950s, [the Moroccan California], imagined for us an objective and programs passionately pursued”* (Préfol, 1986)
- 100,000 ha large-scale irrigation scheme
- Two big dams
- Citrus fruits, sugar beet, cattle rearing, cereals



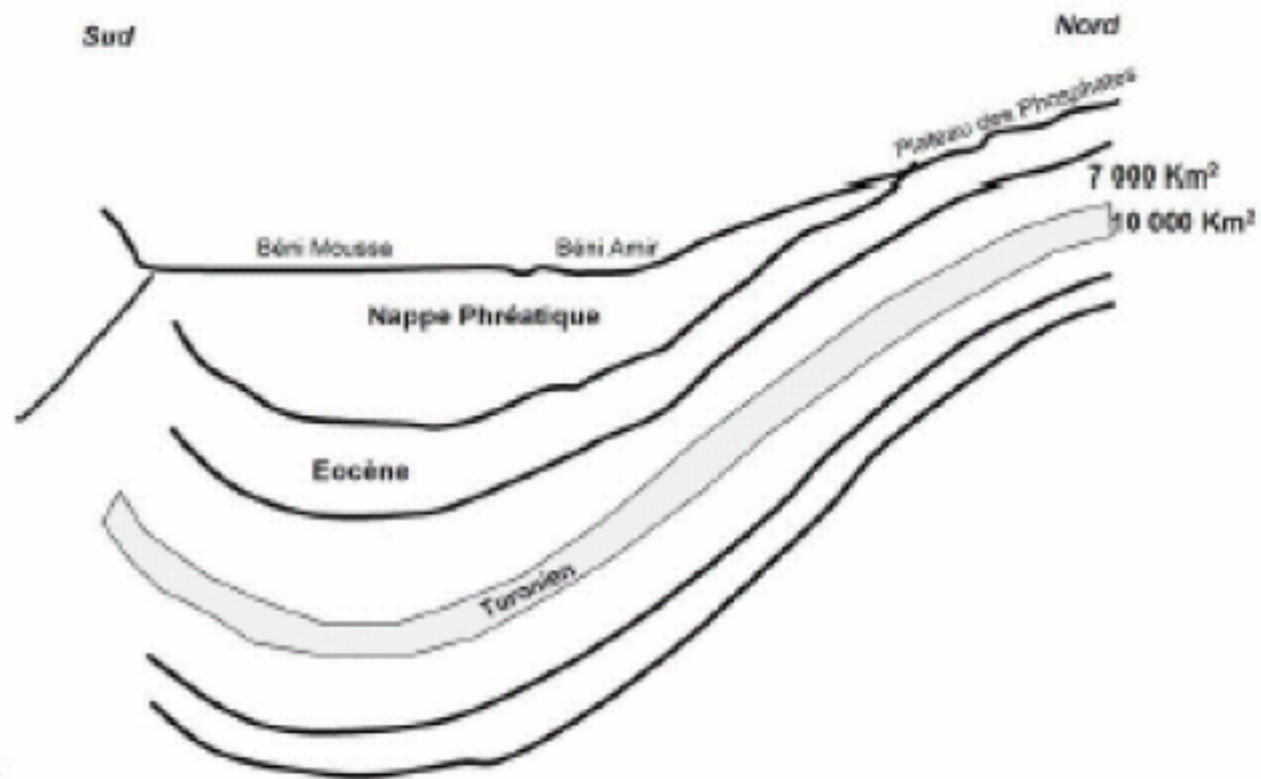
# Surface water from dams: an increasing deficit from the 1980's onwards



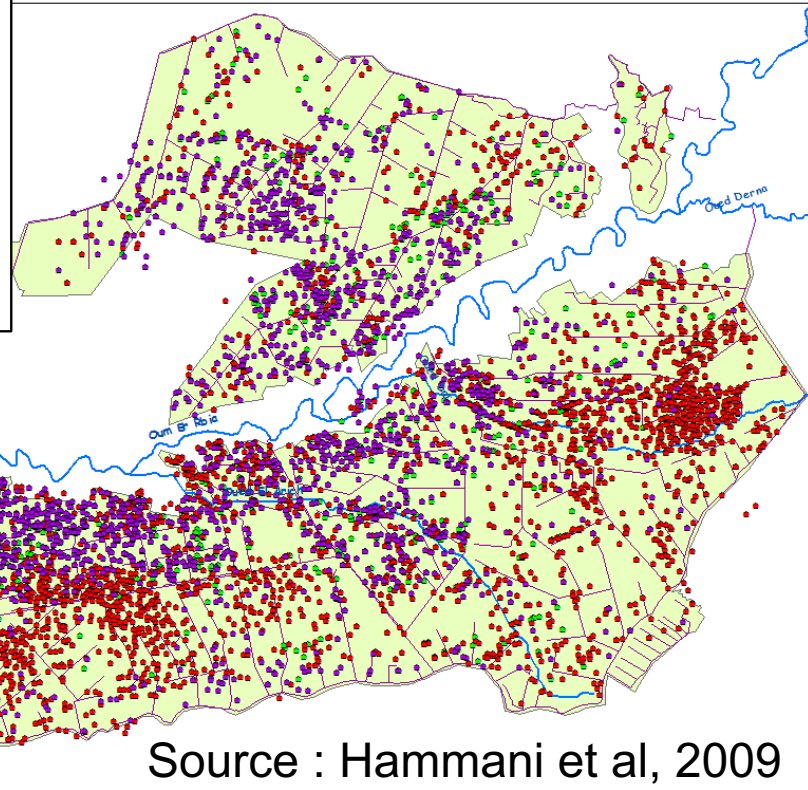
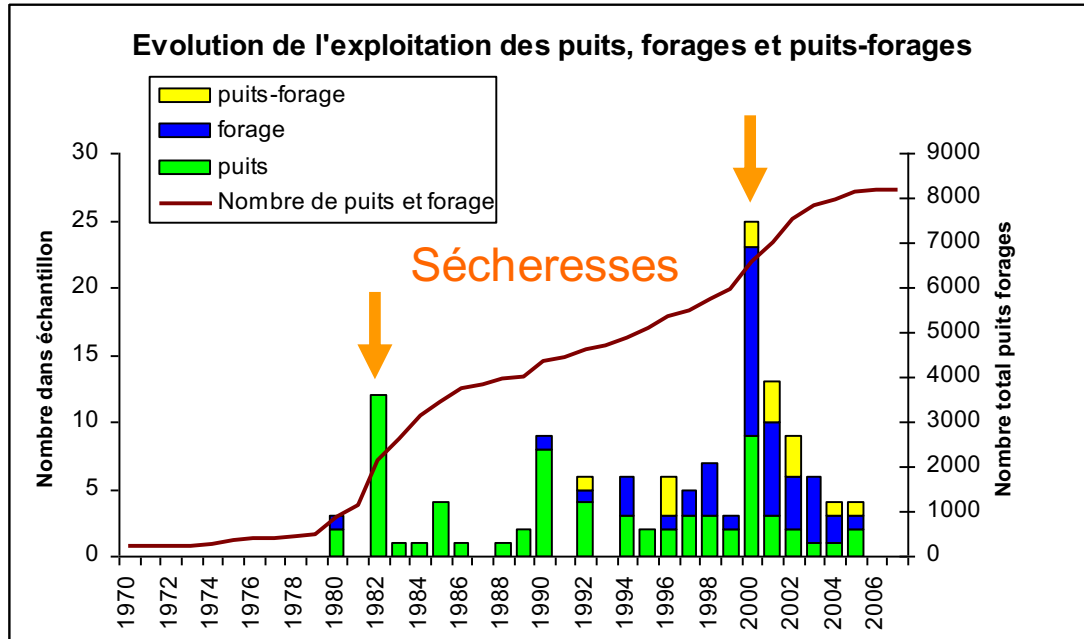
- Droughts
- Extension of other irrigation schemes (Doukkala, Haouz)
- Other uses: drinking water, industry

Source: Ormvat

# Looking for water: a rich multiple layer aquifer system



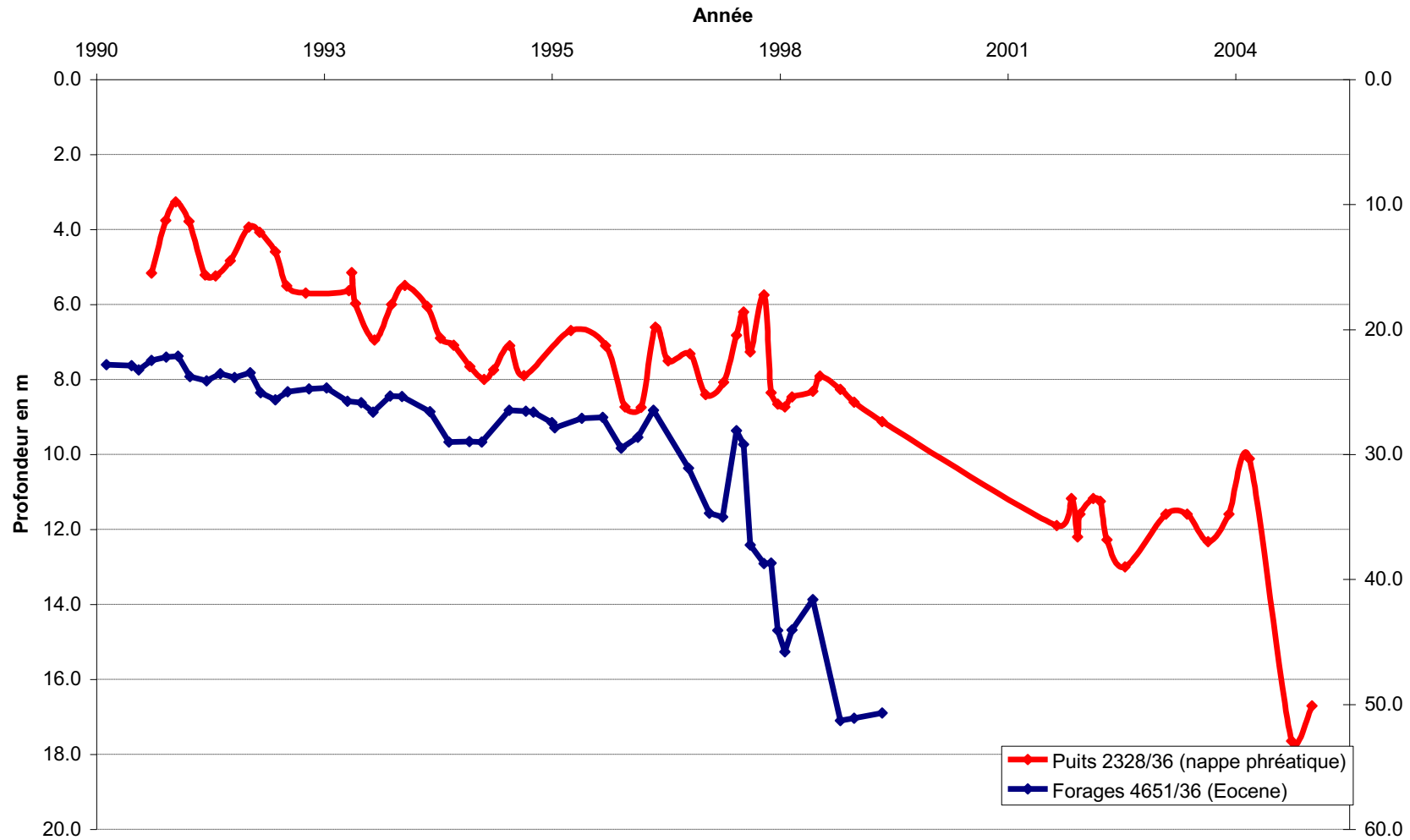
# A silent revolution since the 1980's: development of a conjunctive use environment



Coupled with  
economic  
liberalization

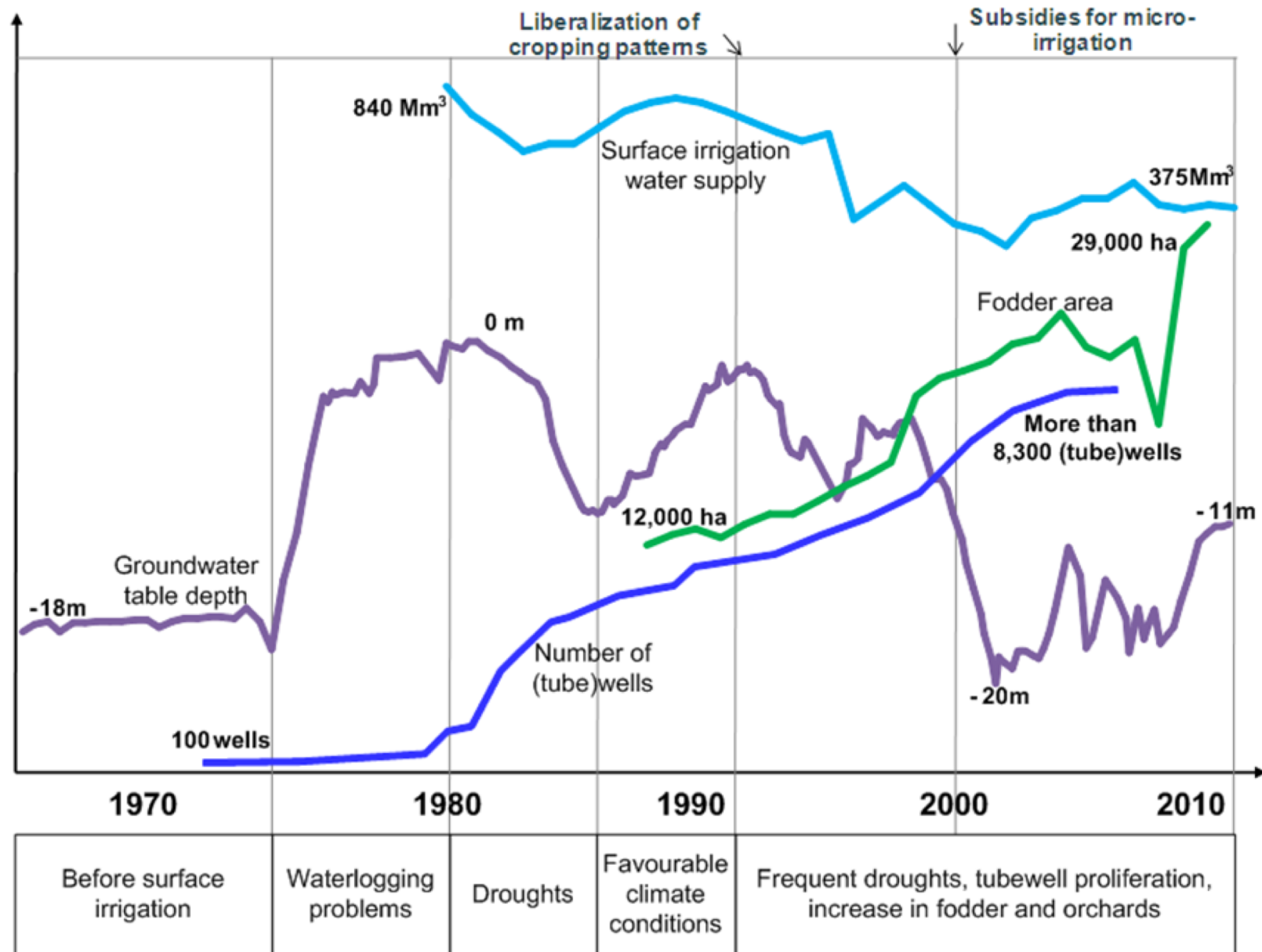
Source : Hammani et al, 2009

# Increased pressure on aquifers



# Synthesis: a forty-year conjunctive use environment

- Decreased surface water availability
- Groundwater overdraft
- Inequalities: 46% farmers have access to GW on 70% of the area



Source : Kuper et al., 2012



# Two options considered in 2007

Option 1: reinforcement and correction conjunctive use

- What are the complementarities between dam water and groundwater?
  - The water cycle
  - Flexibility vs. volume
  - Drought management (annual, multi-year)

Option 2: Conversion to localized irrigation

- Re-centralize water management (rationalization)
- Reduce groundwater use

# An ambitious drip irrigation program

- Individual conversion on 39,700 ha
- Collective conversion on 49,000 ha
- Results in 2018: 25,000 ha individual, 10,000 ha collective
- However, farmers link the public surface water drip irrigation system to private (tube-)wells → continued concerns for groundwater overdraft



# Groundwater management: a continued concern in both contexts?

- The notion of circularity, linking surface water and groundwater
- The difficulty of controlling groundwater overdraft
- The continued emphasis on increasing supplies (transfer, desalination)
- Increased uses outside of agriculture : the shift of drinking water from groundwater to surface water

# References

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