Africa's dry zones: feast or famine?

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Session outline

1. Challenges facing African drylands

2. Tunisia in context
   - Climate
   - Physical environment
   - Politics
   - Economics

3. Agriculture in Tunisia

4. Water mgt for agriculture in Tunisia

1. Challenges for African drylands

What, in your opinion, are the challenges facing society in African drylands?

- Extreme environment: harsh climate, precarious water quantity and quality, poor soils

- Environmental degradation: deforestation, overgrazing, intensive cultivation, heavy industry = soil erosion, salinization, desertification, land/water/air pollution

- Climate change

- Tenuous economic development

- Political unrest

- Population growth/decline and movement

We will examine these issues with respect to Tunisia: focusing on water management for agriculture

2. Tunisia in context

Climate

- Three climate zones (N - S):

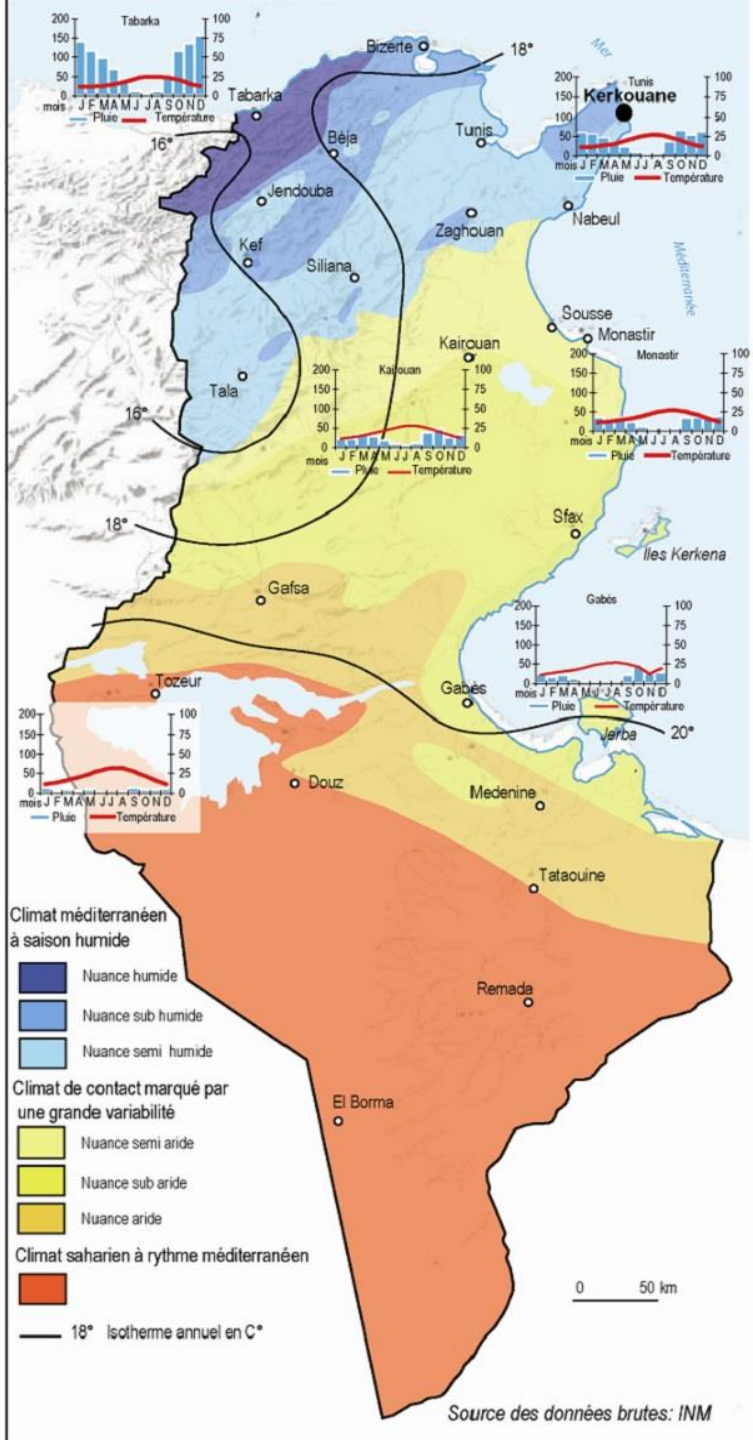
1. Mediterranean:
   - average annual rainfall 400-600 mm

2. Semi-arid:
   - average annual rainfall 200-400 mm

3. Arid:
   - average annual rainfall 100-200 mm

- aquifers important in south

- Tunisia highly vulnerable to water scarcity & poor water quality



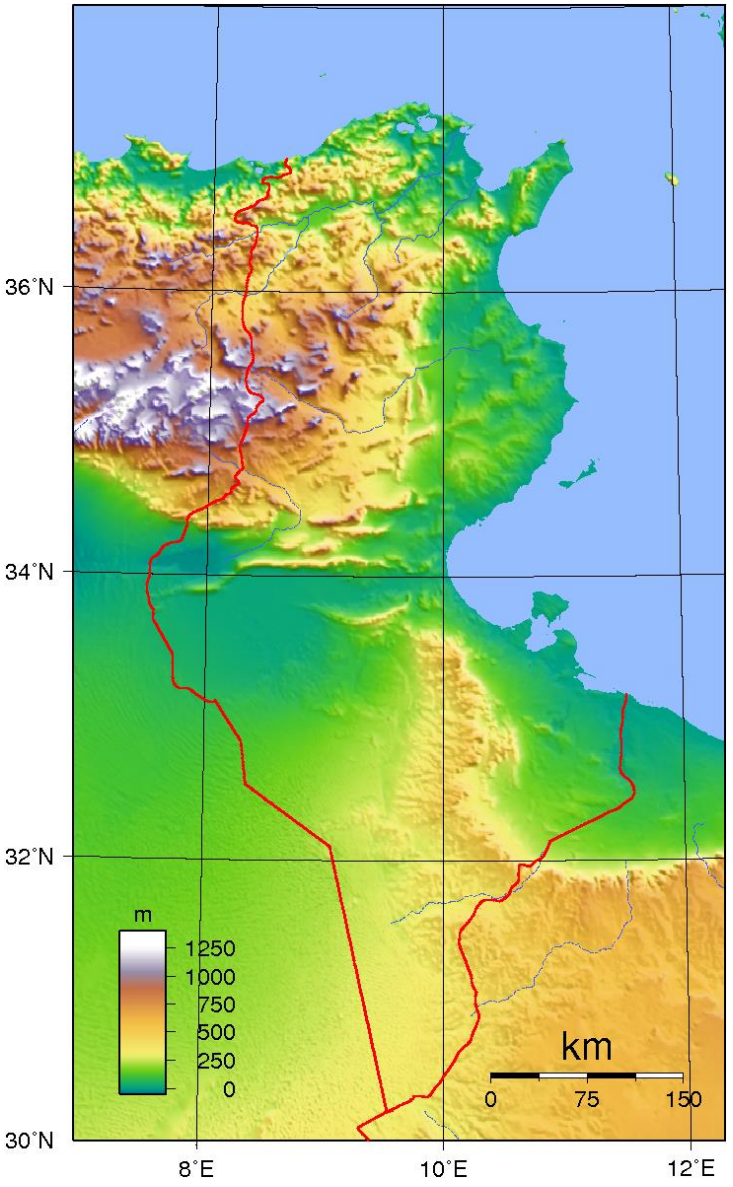
Physical environment

- mountains in north (Dorsale)
- central plains (steppe)
- southern sand dunes (Saharan edge)

- most fertile soils in north:
  rich sandy-clay alluvial soils cover valley bottoms

- steppe region: some clay soils of medium fertility

- soils in south tend to be rocky, sandy and salty



Politics

France) in 1956

d for 31 years:

sm

- protests started in Tuni
  unemployment (>16%),
  below poverty line) and h
  Ali

- interim ‘national unity government’ formed January 2011
- December 2011 - human rights activist Moncef Marzouki elected president by the constituent assembly
- elections for a permanent government held end of 2014
- Beji Caid Essebsi elected first president under country’s new constitution
- March 2015 - Islamic State extremist group claims responsibility for an attack on the Bardo Museum in Tunis: 22 people were killed
- June 2015 - terror attack by single extremist in the resort of Port El Kantaoui kills 38 people

Economics

- Tunisia has a diverse, market-oriented economy
- key exports include food products, textiles, beverages, petroleum products, chemicals and phosphates
- ~ 80% exports are bound for Tunisia's main economic partner: European Union
- decades of strong annual GDP growth (4% - 5%) and improving living standards up to January 2011 uprising
- Tunisia’s credit rating downgraded during 2012 and 2013
- economy recovering, but government still struggling with budget deficits and high unemployment (GDP 2.8% in 2014)

(www.cia.gov/library/publications/the-world-factbook/geos/ts.html)

3. Agriculture in Tunisia

- agriculture is an important part of the economy in N. African countries

- just under 15% labour force employed in agriculture, but it comprises 82% national water consumption (CIA Factbook, 2014)

Agricultural products:
Cereals, olives, citrus fruit, tomatoes, sugar beets, dates, almonds; beef, dairy products

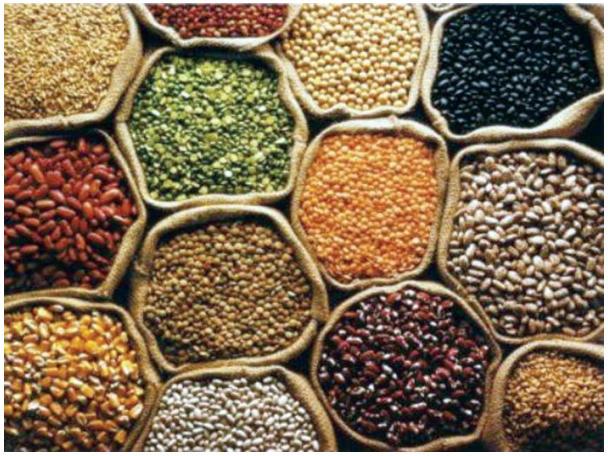
- irrigated land = 3,970 sq km (2003)

- freshwater withdrawal: 2.85 cu km/yr (domestic/industrial/agricultural: 14%/4%/82%)

4. Water management for agriculture in Tunisia

- there has been diversification of the Tunisian economy:
  - industrialization
  - growth of services sector
  - expansion of tourism

- but ... agriculture remains important for its contribution to the achievement of national objectives:
  - food security
  - employment
  - social cohesion



- water is the major limiting factor for agriculture in Tunisia
- due to annual water deficit and high unpredictability - water must be collected and stored to support agriculture
- this tends to occur i) below the surface in the soil/groundwater or ii) at the surface as reservoirs
- but how do we manage water use sustainably … and what are the threats to sustainable management?

Rainwater harvesting versus dams in Tunisia

- distinct climate zones mean contrasting water management techniques
- south: traditional rainwater harvesting via terraced slope systems
- centre: modern dam irrigation

Study areas

Matmata Plateau

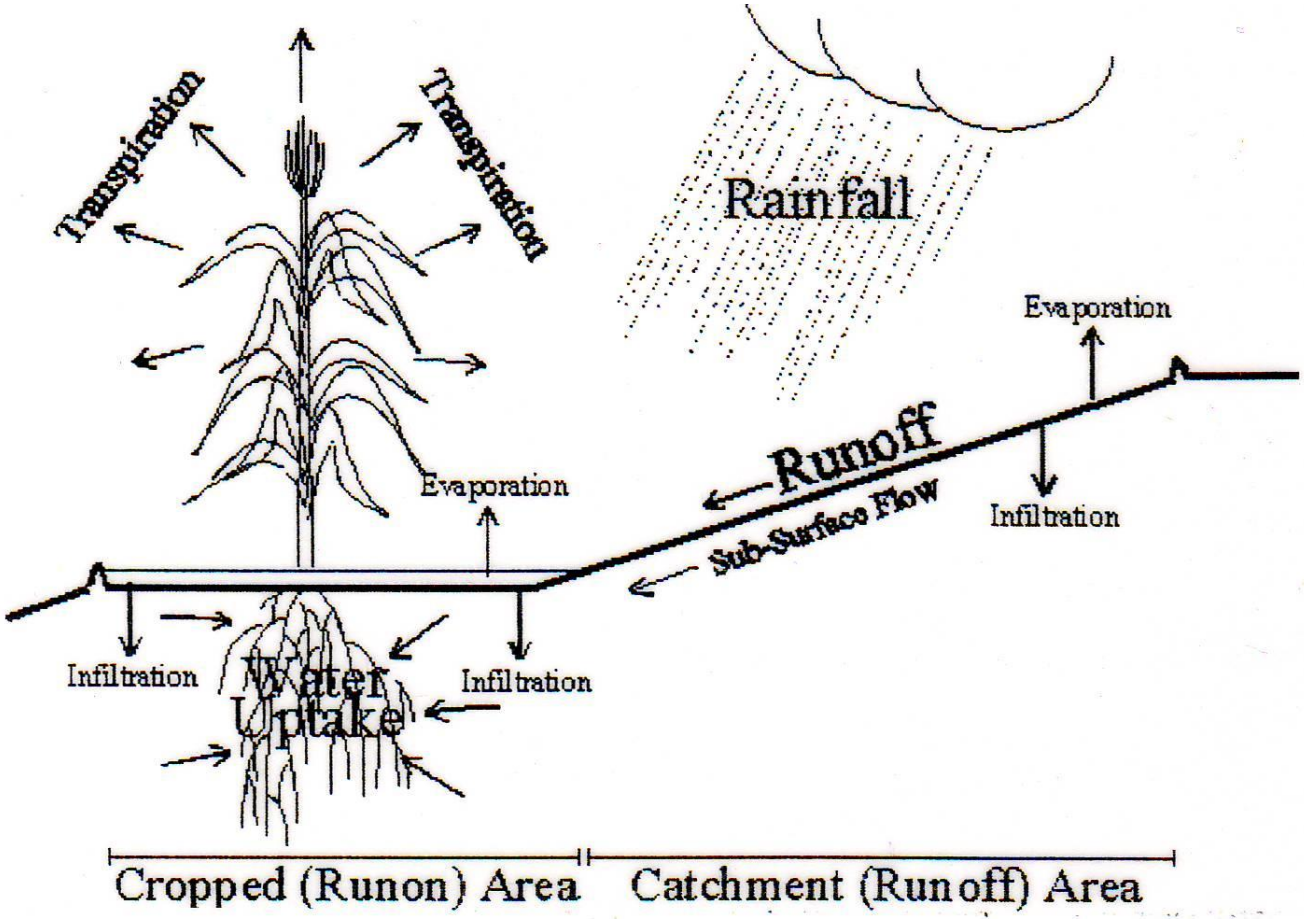
- falls just within arid zone
- negative annual water balance of 200mm-300mm
- loess soils; sparse vegetation
- rainwater harvesting

Zeroud Basin

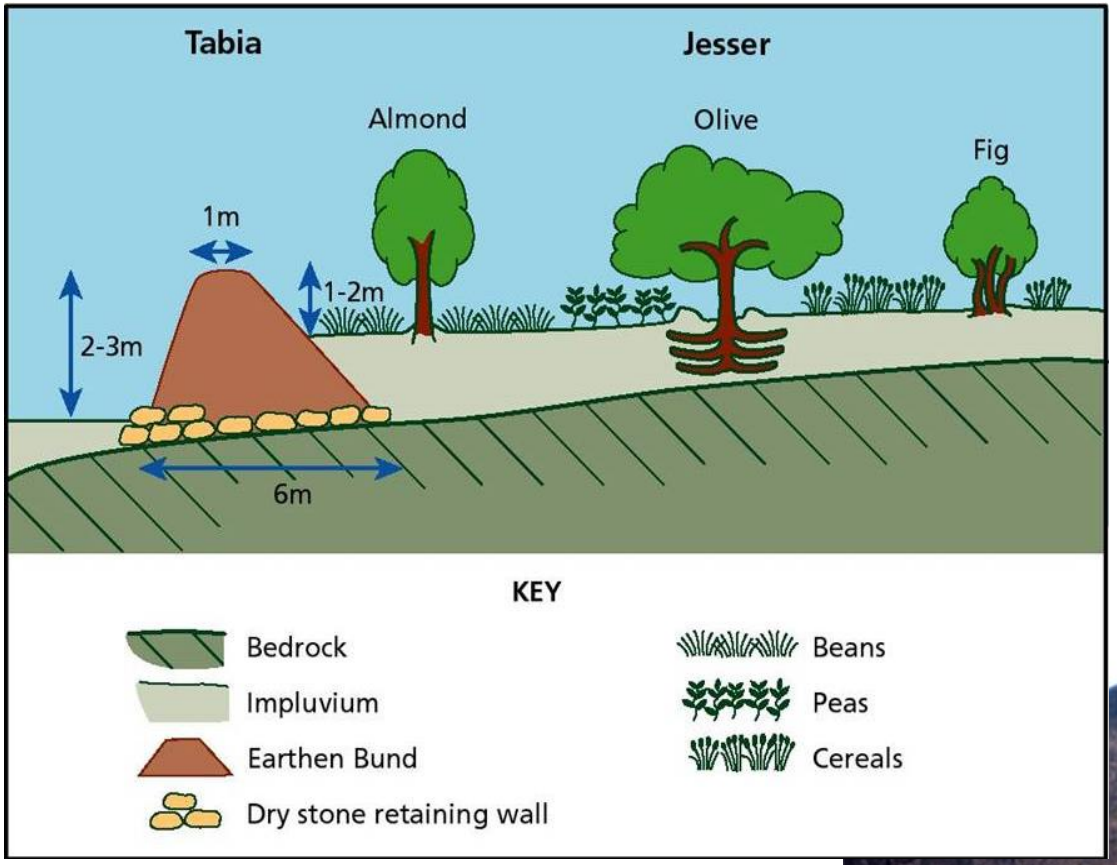
- negative annual water balance of 300mm-400mm
- runoff collected quickly by wadis
- dam irrigation

Rainwater harvesting (r.w.h.) (Matmata Plateau)

- climate + topography + soils = favourable for r.w.h.



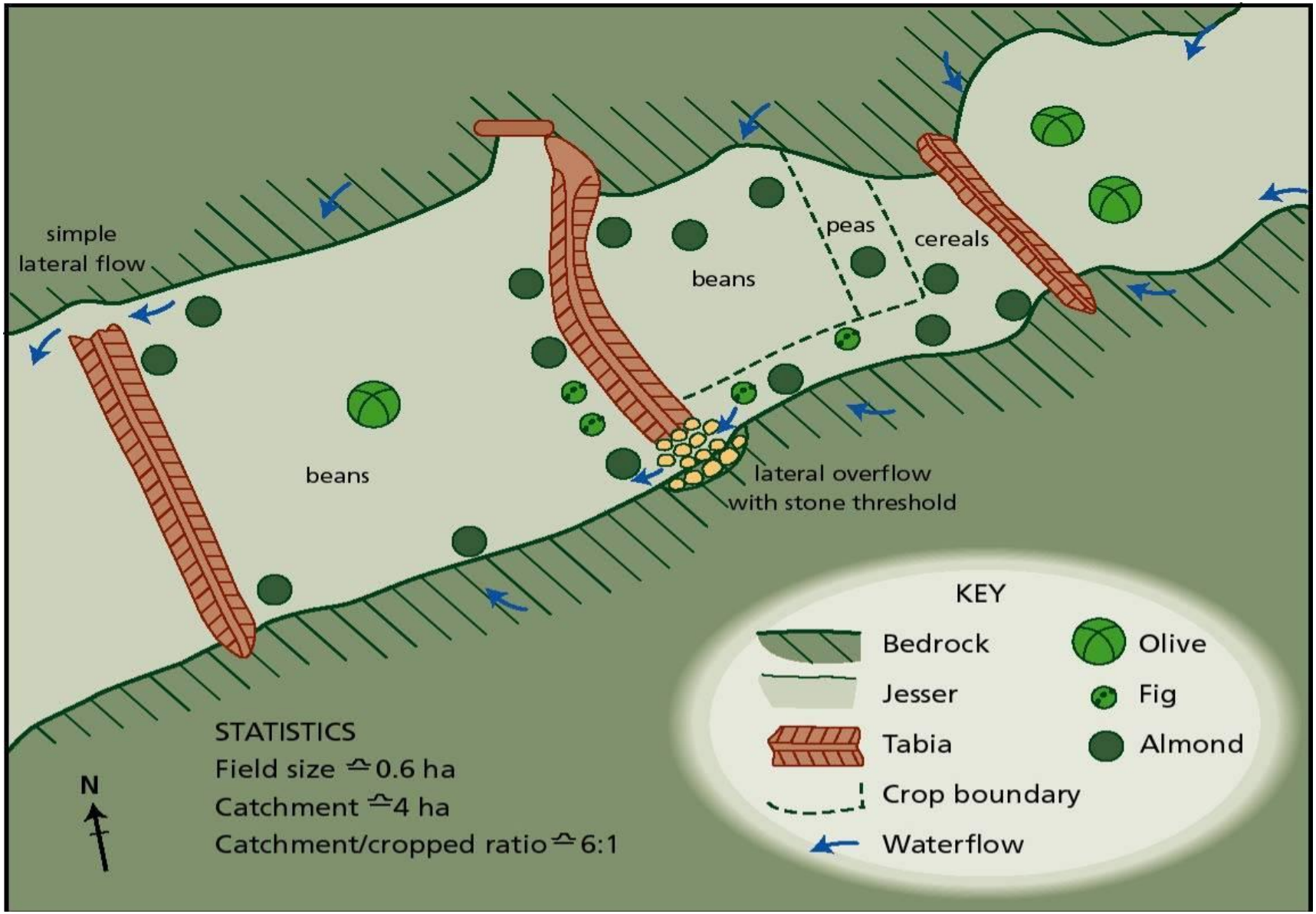
The r.w.h. system



Agroforestry is practiced in the fields

Earthen check dams (tabias) trap soil and form level agricultural fields (jessour)

fields are sited progressively downslope through valleys



Tier 1

Tier 2

Water trapped behind the bunds creates a local water supply

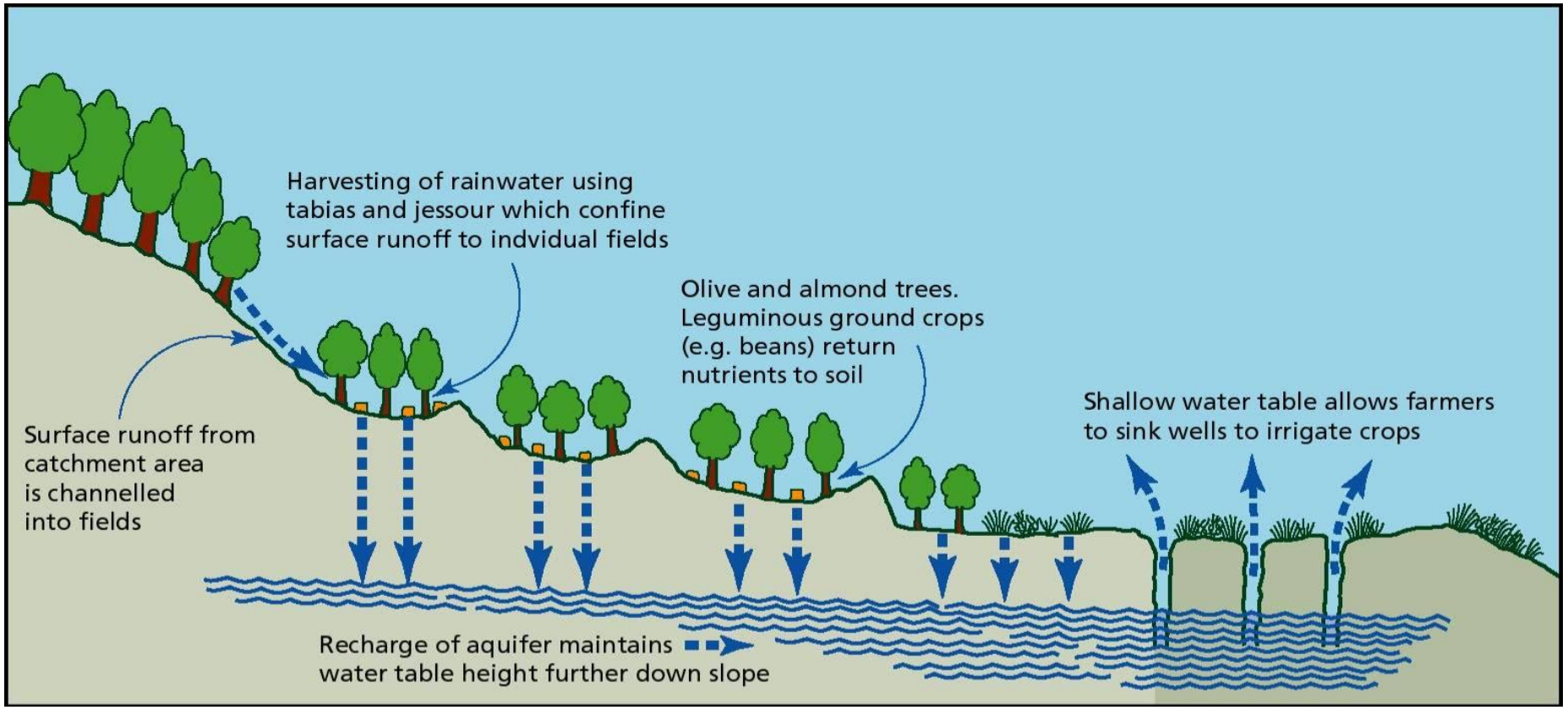
- cultivation largely subsistence, limited surplus sold at local markets

- sites managed on collective basis following local custom

- systems utilise indigenous technical knowledge on a small scale …

Traditional rainwater harvesting & sustainability

- awareness of relationship between surface water and groundwater
- r.w.h. promotes soil conservation & aquifer recharge



Dam irrigation (Zeroud Basin)

- integration of farming into world markets since independence

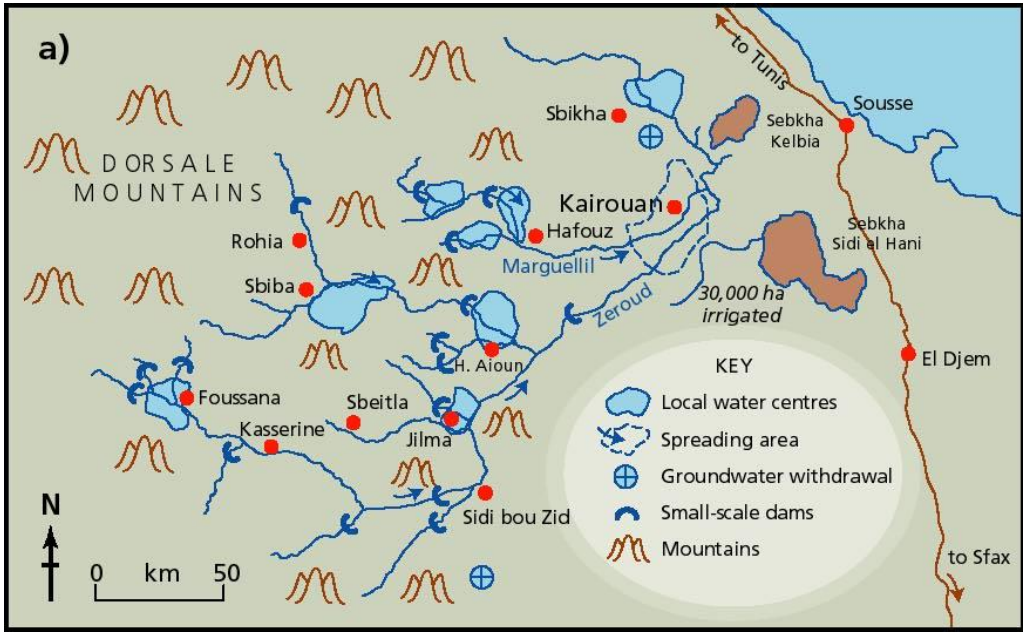
- community management replaced by centralised control

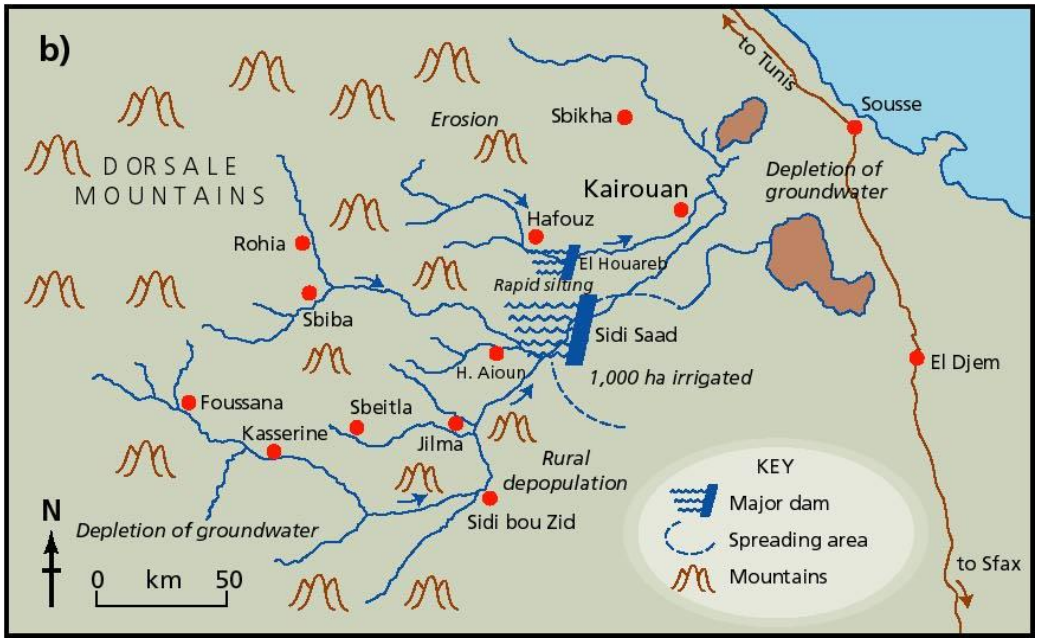
e.g. Kairouan Programme (1975)

- replaced small barrages & 30 local dams with two large dams (Sidi Saad (1982) and El Haoureb (1990))

Original barrages & small dams:

- irrigated 30,000 ha
- replenished aquifers
- cost £3 million
- employed 40,000 locals





Sidi Saad Dam:

- originally irrigated 4,000 ha, now 1,000 ha
- cost £30 million

Dam irrigation & sustainability

- spatially and temporally unpredictable sediment input → dam siltation
- life expectancy of Sidi Saad Dam is 87 yrs
- if the dam had been constructed prior to 1969 autumn floods it would have been filled completely with sediment!
- dams are outside limits of climatic viability: high evaporative losses
- groundwater depletion in upper catchment
- over-irrigation of agricultural land → salinization

Conclusions

Rainwater harvesting

- transforms hazardous env. into one of relative security
- maximises long-term resource potential of landscape
- carrying capacity delimited by nature
- exemplifies flexible adaptation to dynamic/extreme envs.
- decentralised, allowing community autonomy

Modern dams

- neglect long-term resource potential of landscape: can lead to insidious env. degradation
- carrying capacity delimited by society
- rigid structures in a dynamic environment
- centralised control & decision-making

The future for sustainable water management

- balance large- & small-scale developments to maximise water use from across the hydrological cycle

- will allow flexibility under climate change:

  projections suggest less precipitation will occur (drop of 5% - 20% by 2020) but average temperatures will increase (expected rise of 2^{o}C - 4^{o}C by 2010) (Tunisian Ministry of Environment, 2002)

mix of **traditional & modern methods** and **working with physical and social systems** will be the foundation to sustainable water use in Tunisia

... and possibly elsewhere