

The Hydrology of Mountain Oases in Northern Oman

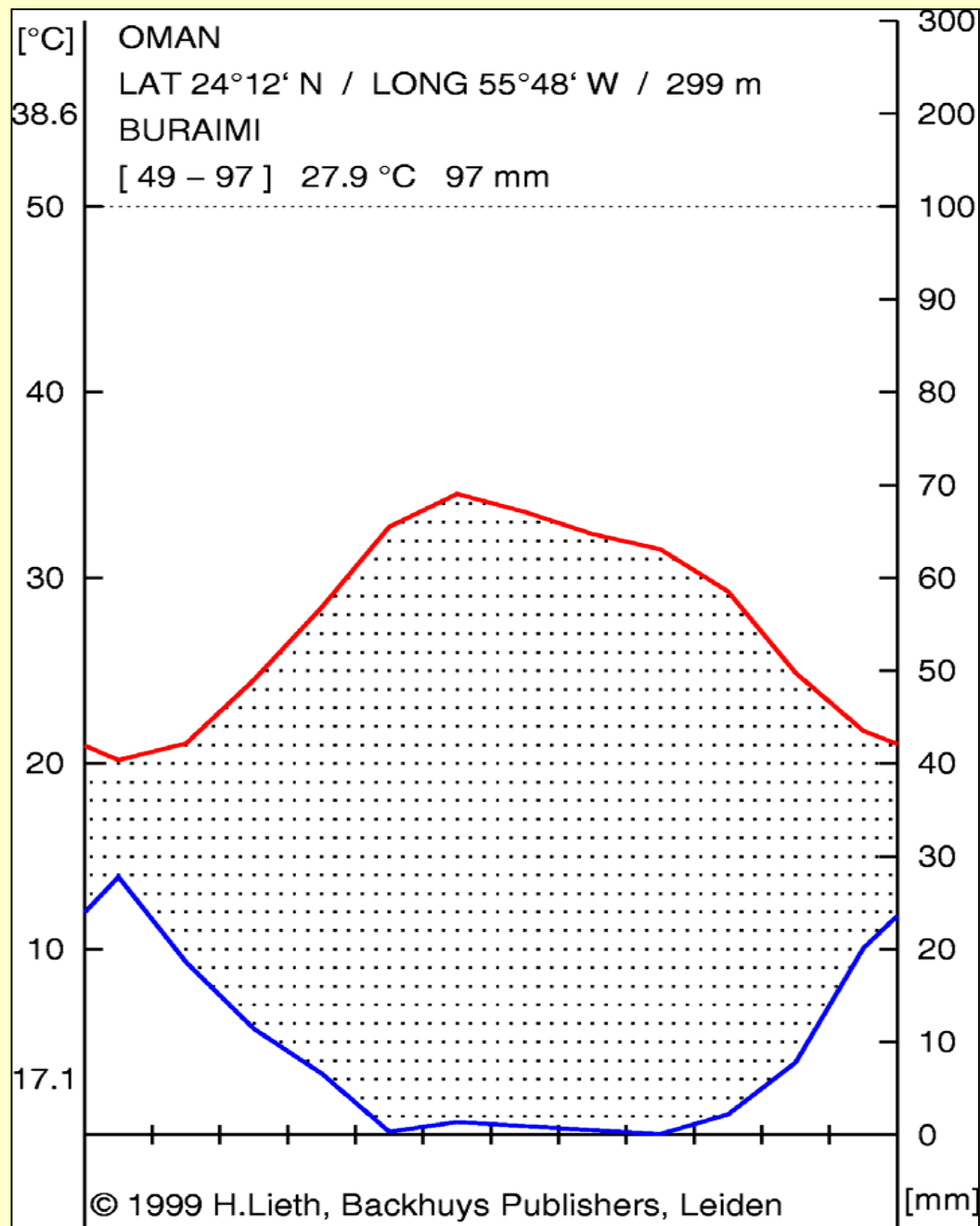
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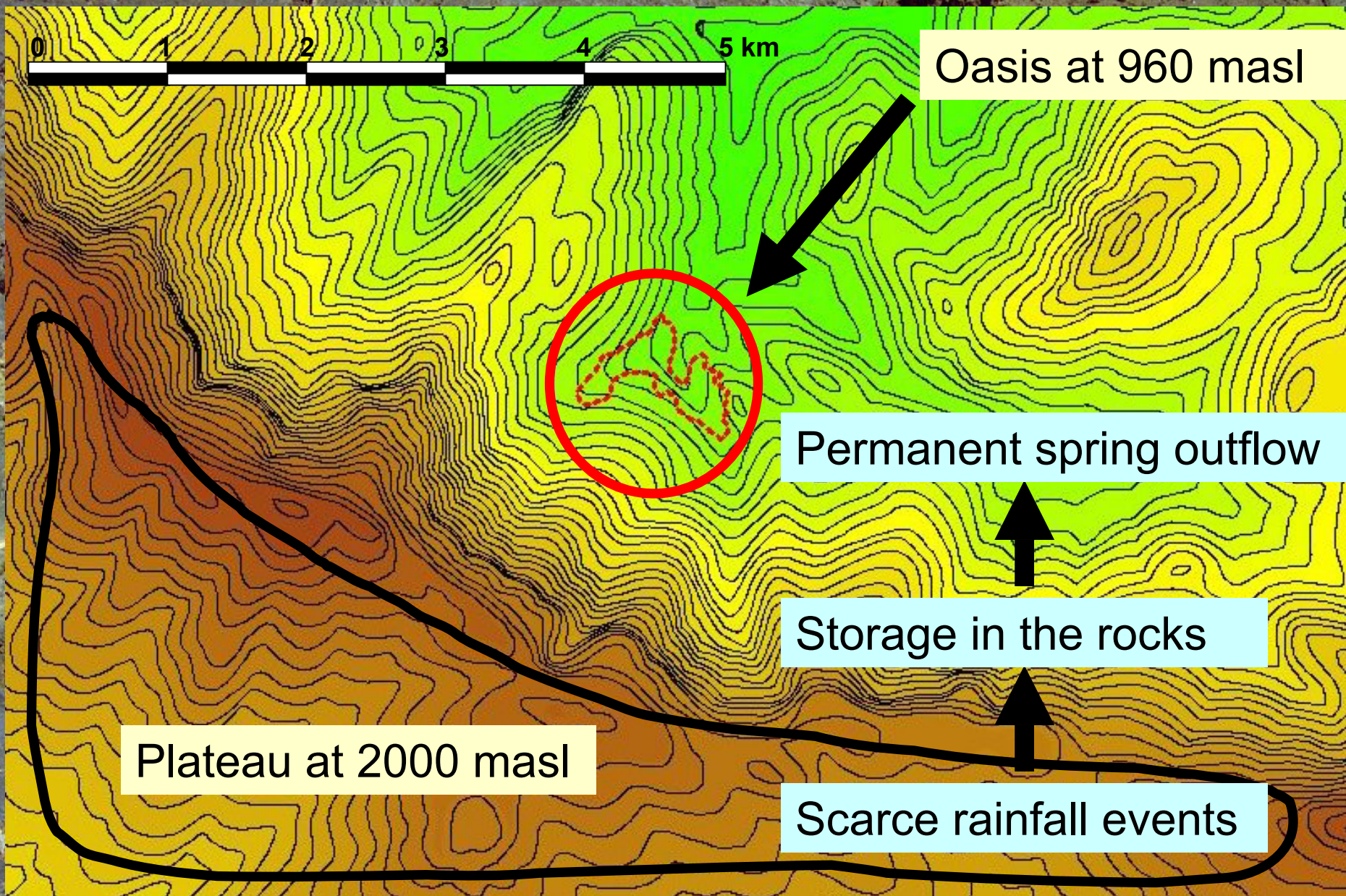
Structure

- **Introduction**
- **Materials and Methods**
- **Results**
- **Conclusions**






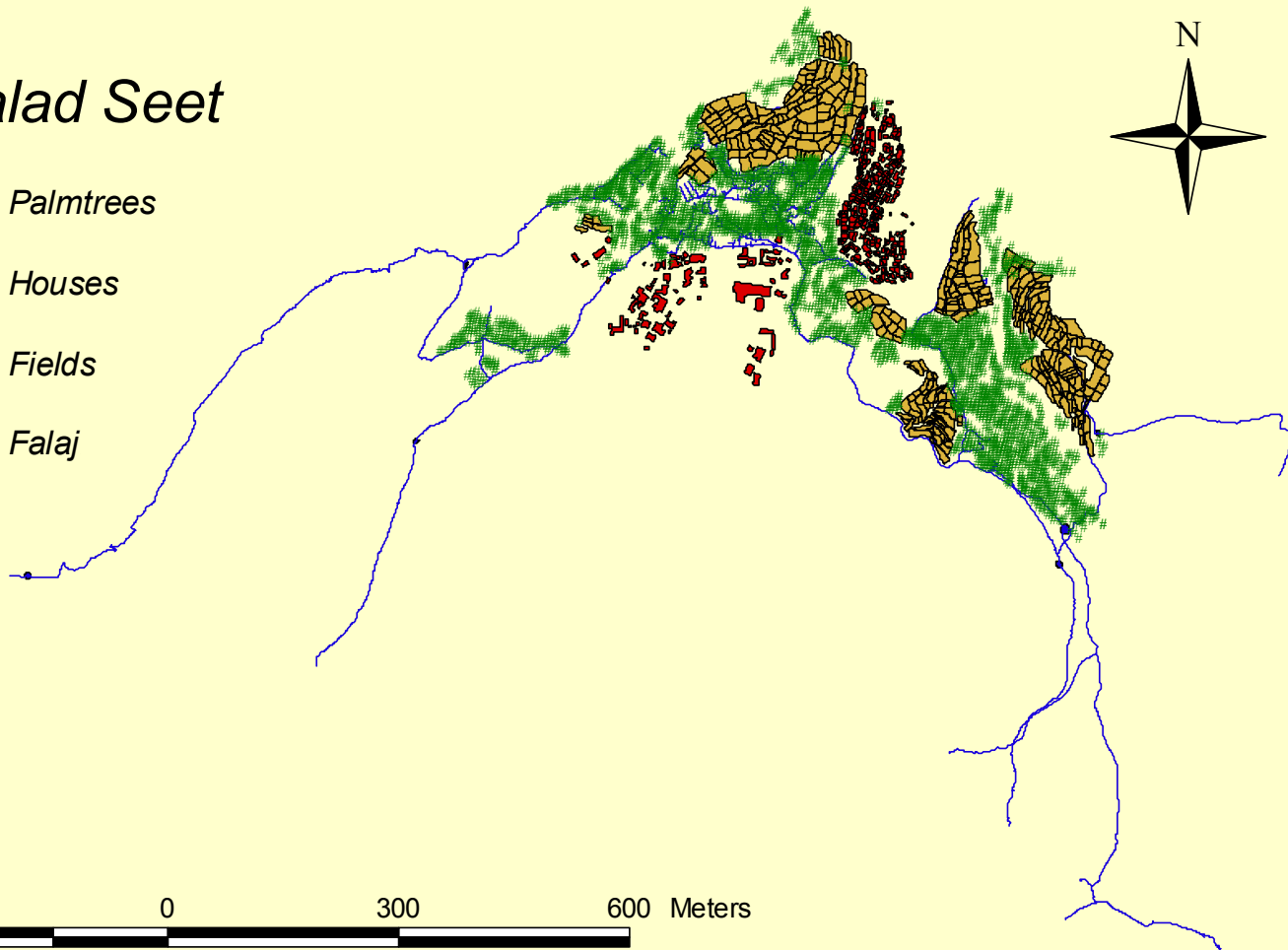
qta

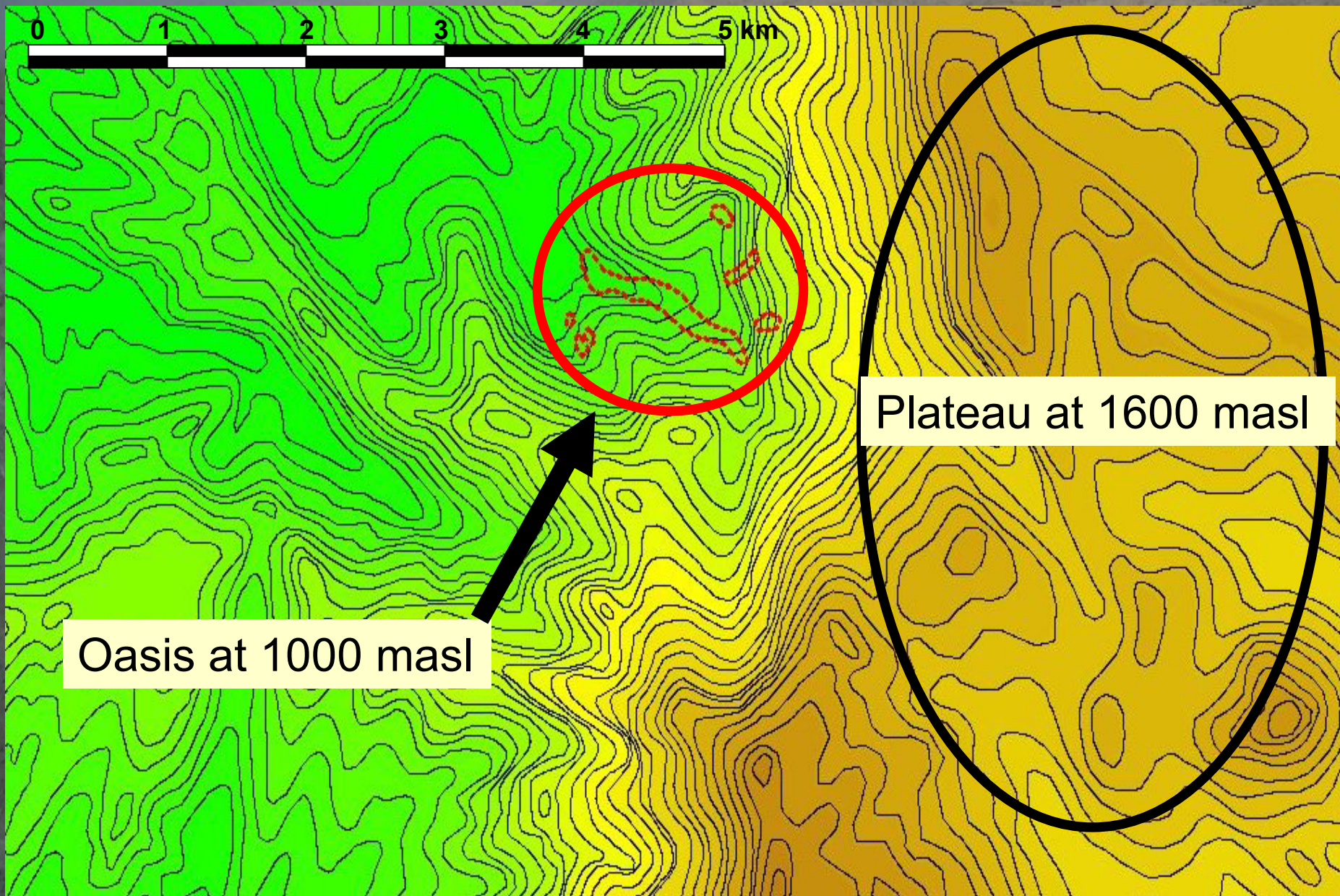


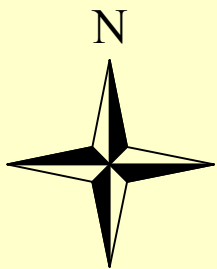
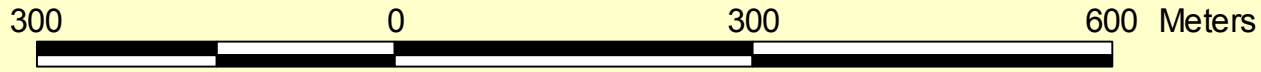


Balad Seet





- # Palmtrees
-  Houses
-  Fields
-  Falaj

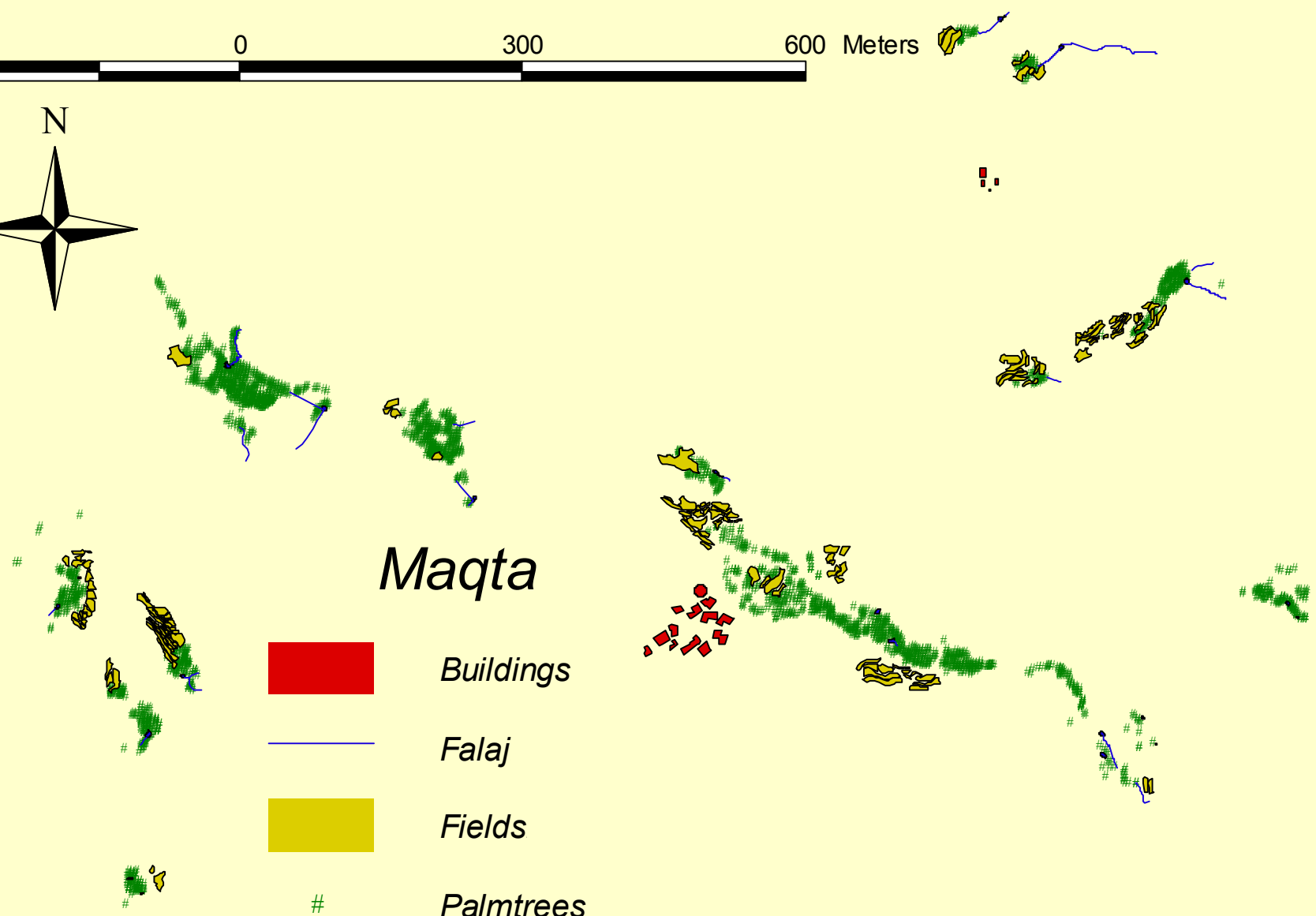






Maqta

-  Buildings
-  Falaj
-  Fields
-  Palmtrees



Materials and Methods



Soil moisture



Water age

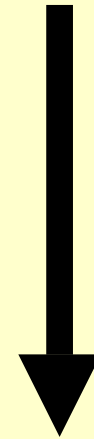


Falaj outflow

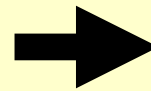


Soil moisture

Measurement of volumetric
water content



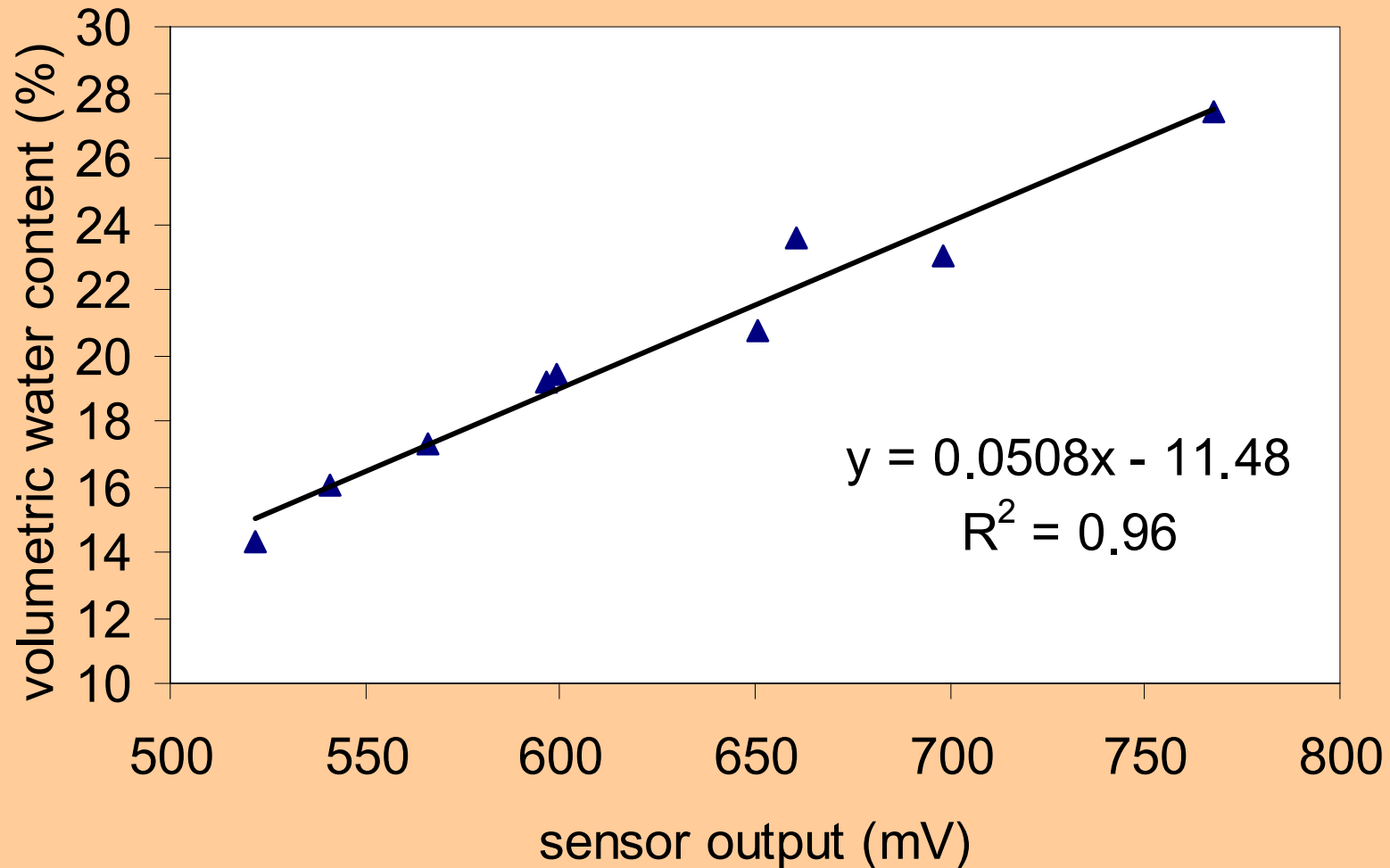
Measurement of electric
conductivity of the soil using
ECH₂O dielectric probes



Correlation



Soil moisture





Soil moisture

Installation of 4 probes in the topsoil of an irrigation plot

Measurements over several irrigation periods in 30 min intervals

Soil moisture

Application of 25 mm irrigation water with bromide tracer (10 g as KBr)

Soil sampling
on two different
dates

Determination of downward movement of soil water

Water Age

- Natural concentration of Tritium (^3H) in the atmosphere
- Exchange with water exposed to atmosphere



Fixed ^2H - ^3H ratio in water



Steady decay of ^3H to ^3He



Infiltration
exchange cut off

Water Age

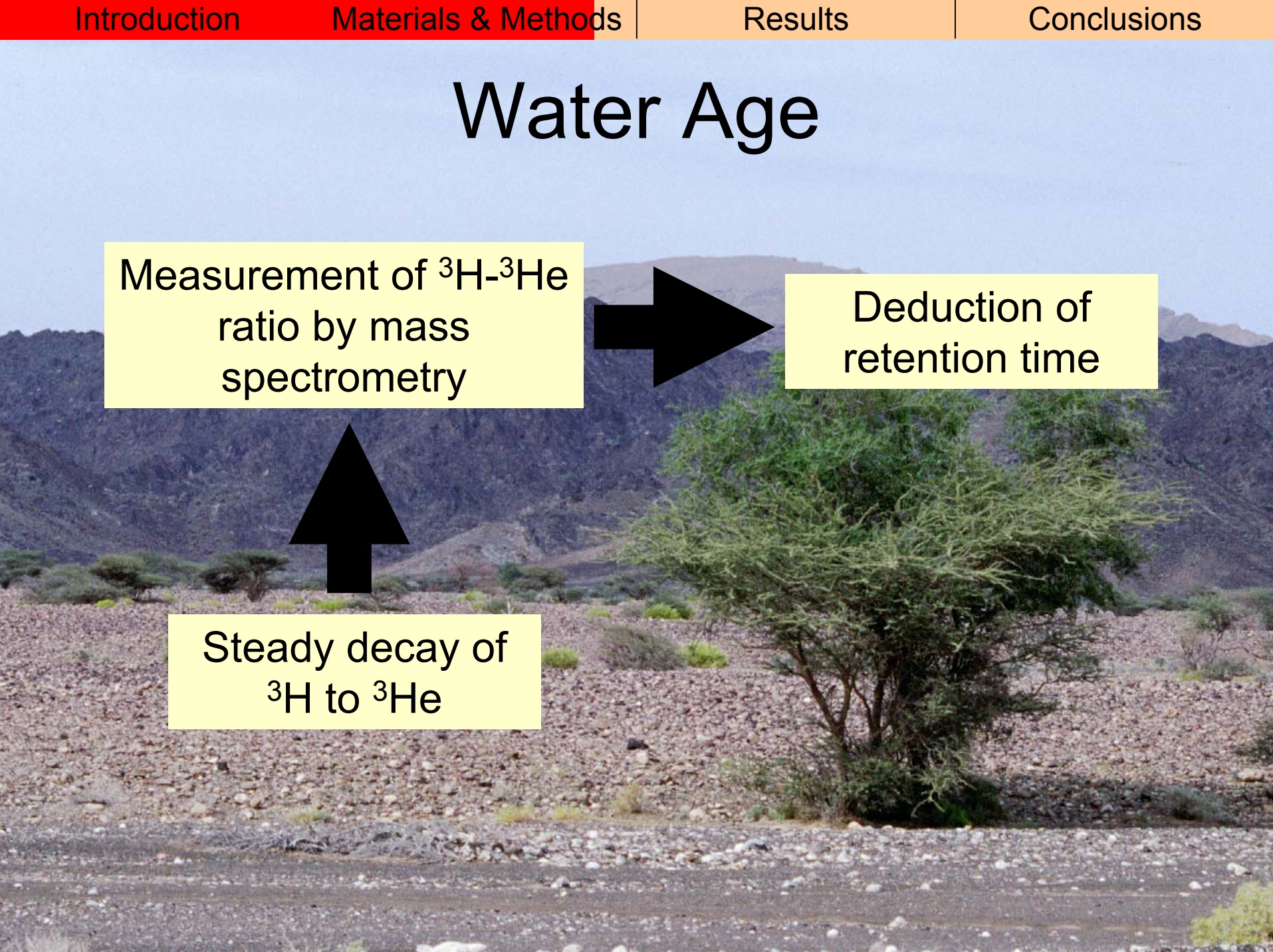
Measurement of ^3H - ^3He
ratio by mass
spectrometry



Deduction of
retention time



Steady decay of
 ^3H to ^3He



Falaj outflow

Regular volumetric measurements of the outflow of the main springs in Balad Seet (19 months) and Maqta (11 months) in a period of drought

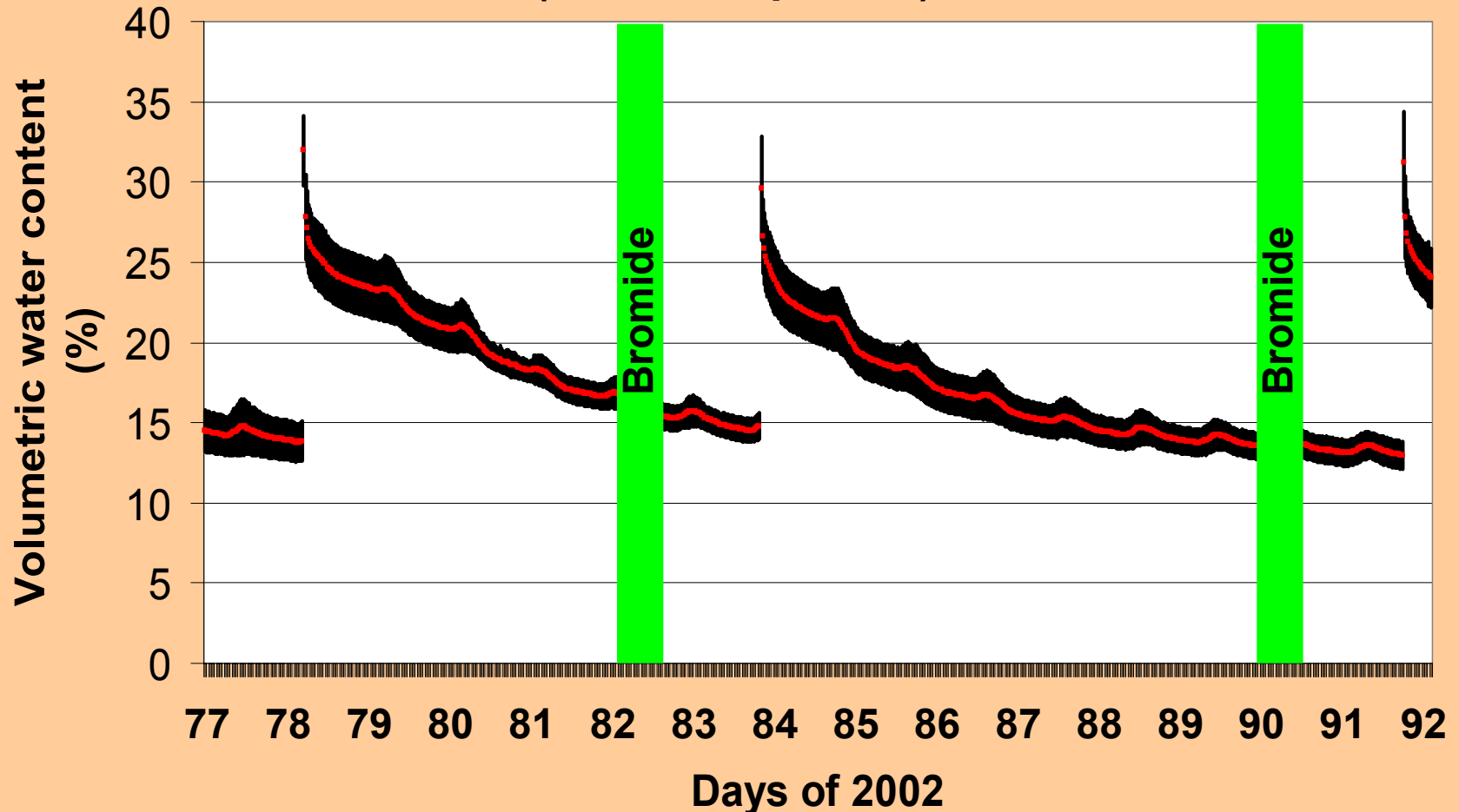


Results

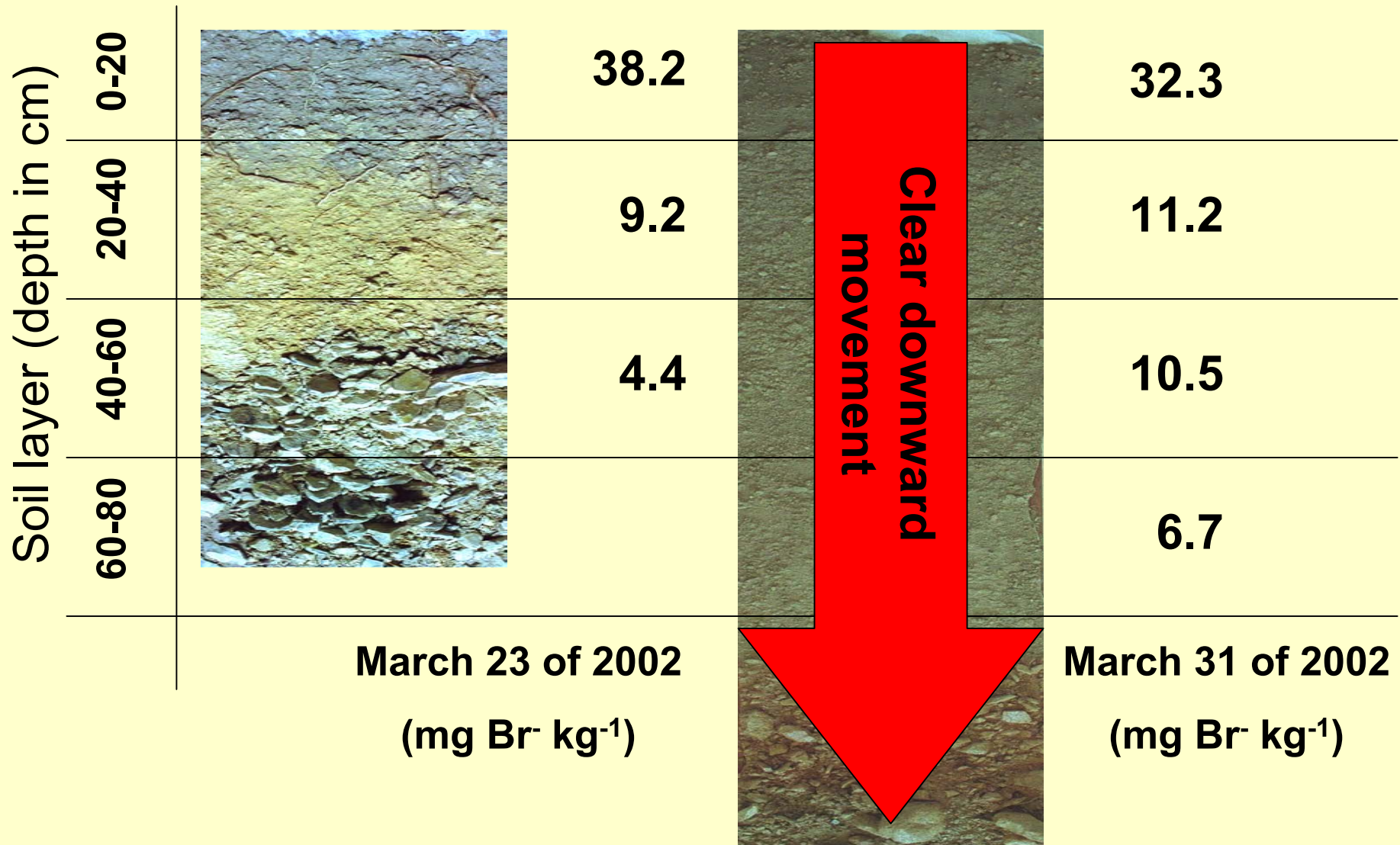


Soil moisture

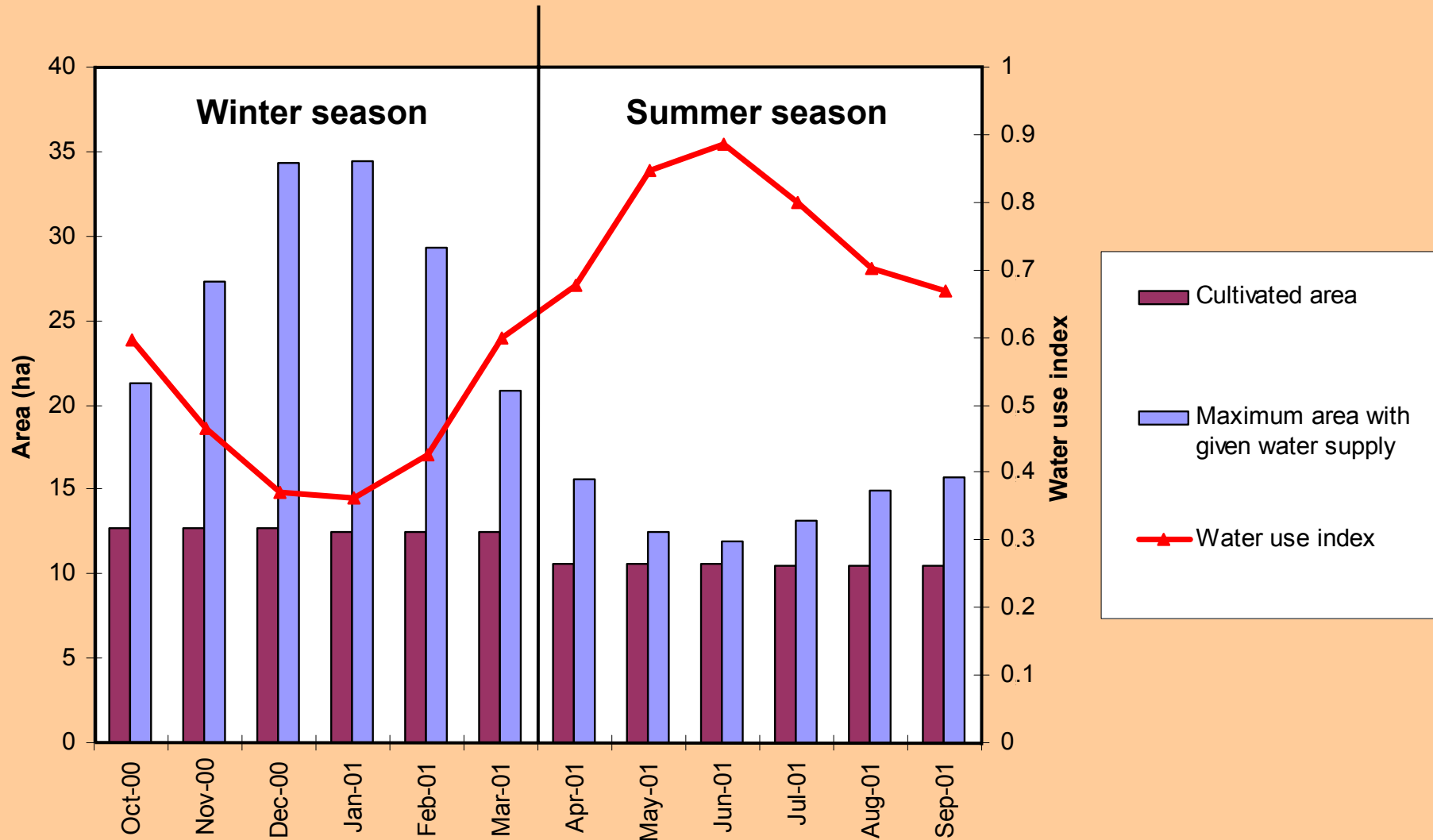
Soil moisture curve over two irrigation periods
(mean of 4 probes)



Bromide tracer movement



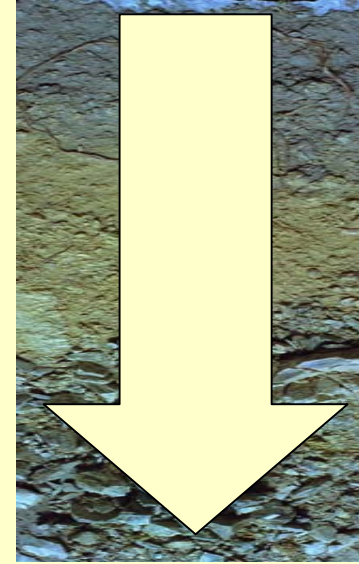
Water use index of Balad Seet



Soil moisture



Water use index extremely high



Salinity is avoided by terrace structure

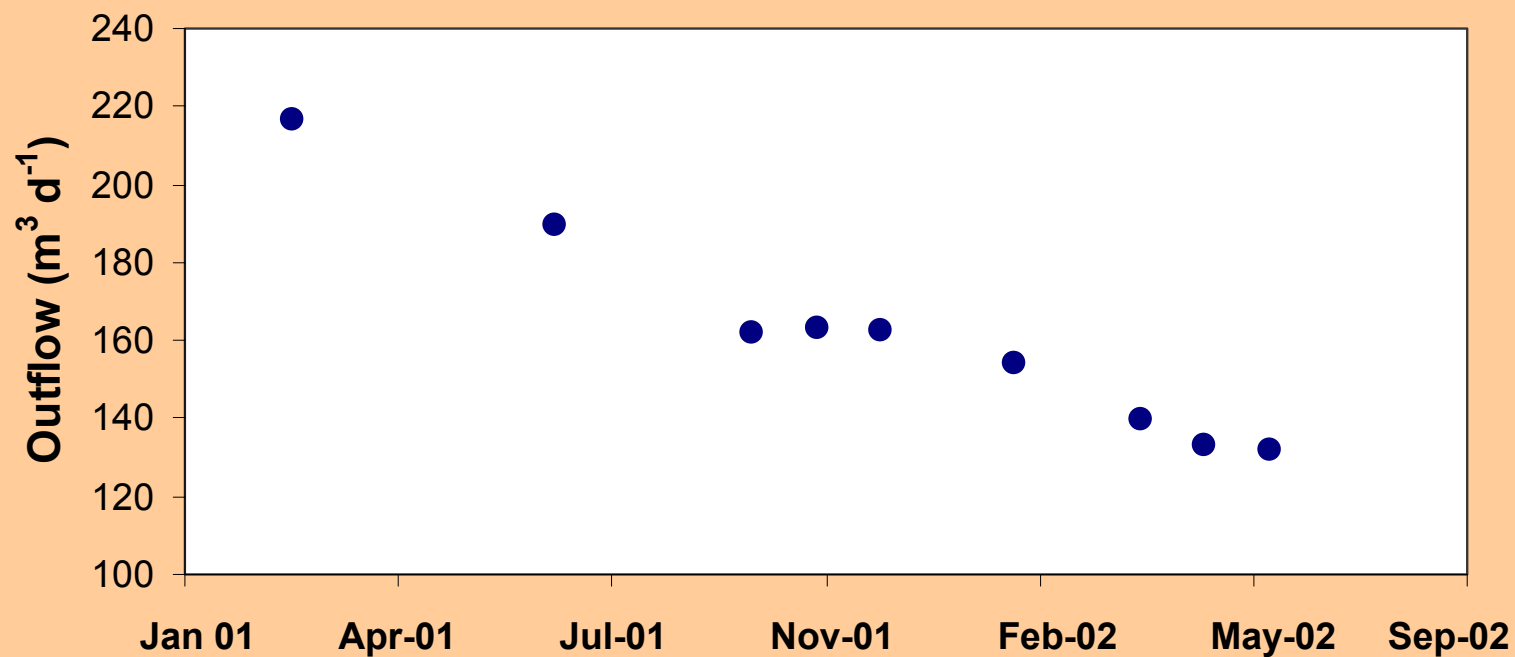
Very efficient and balanced irrigation system

Water age

	^3H (TU)	^3He ($\text{cm}^3\text{STP g}^{-1}$)	$^3\text{H}/^3\text{He}$ ratio ($\text{TU} (\text{cm}^3\text{STP g}^{-1})^{-1}$)	Age (yr)
Balad Seet	1.73 ± 0.30	$5.29 \cdot 10^{-9}$ $\pm 3.47 \cdot 10^{-10}$	$3.27 \cdot 10^8$ $\pm 8.40 \cdot 10^7$	3.28 ± 2.37
Maqta	1.44 ± 0.30	$3.81 \cdot 10^{-9}$ $\pm 3.49 \cdot 10^{-10}$	$3.77 \cdot 10^8$ $\pm 1.26 \cdot 10^8$	6.18 ± 2.44

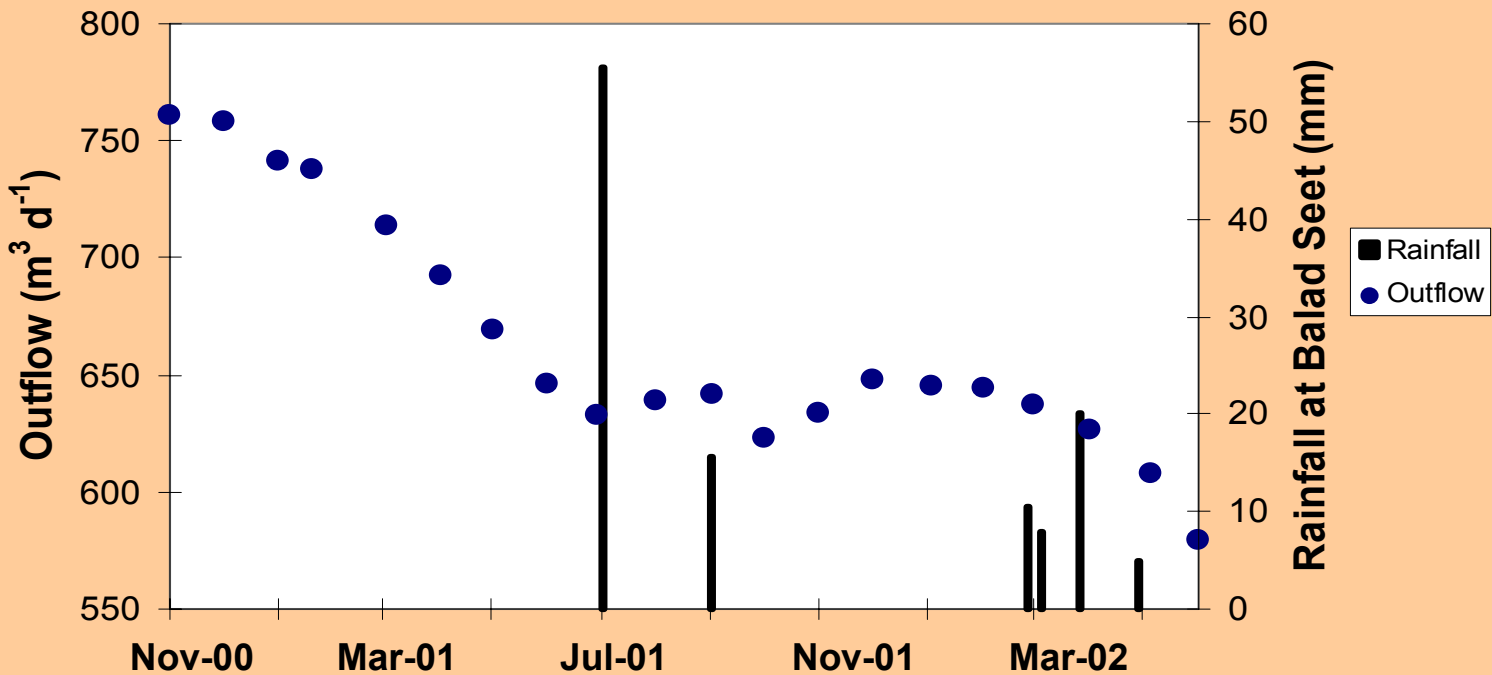
Falaj outflow

Falaj outflow in Maqta

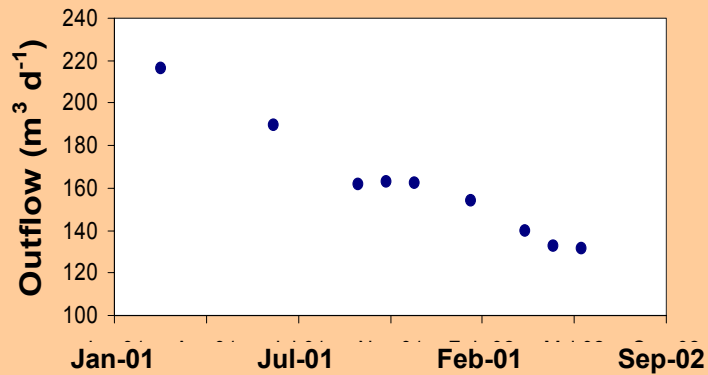


Falaj outflow

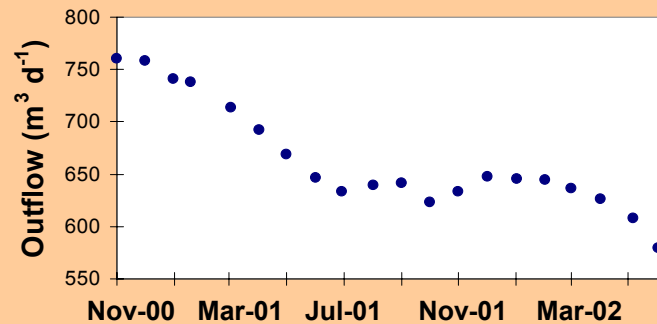
Rainfall and falaj outflow in Balad Seet



Maqta



Balad Seet



**Starting
outflow
(m³ d⁻¹)**

220

**Final
outflow
(m³ d⁻¹)**

130

**Total
decrease
(%)**

39

**Average
monthly
decrease
(%)**

3.3

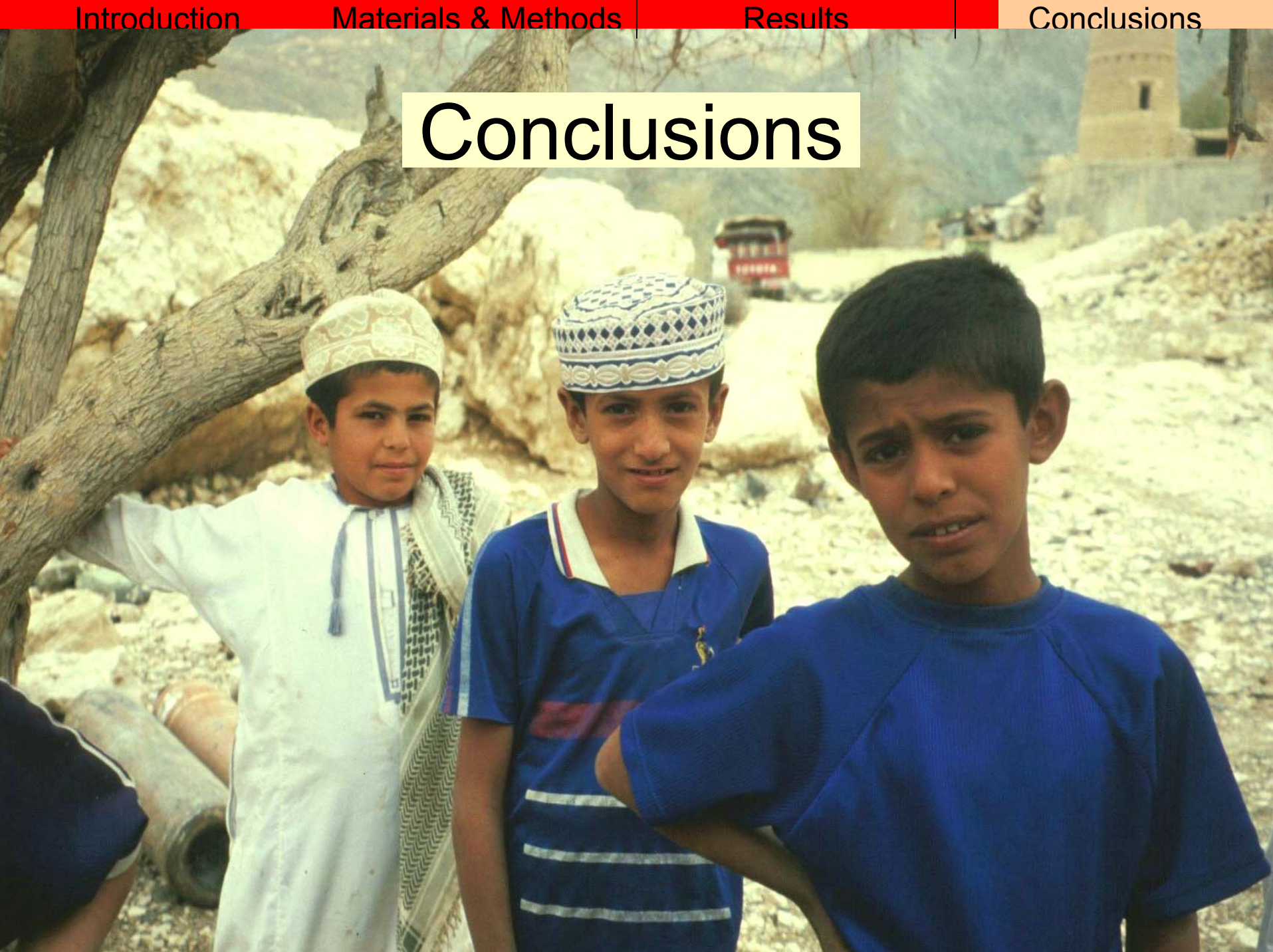
760

580

24

1.4

Conclusions



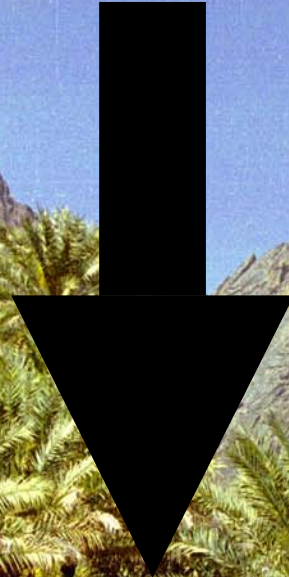


Rock storage buffers short-time water fluctuations

Retention
time of
3-6 years

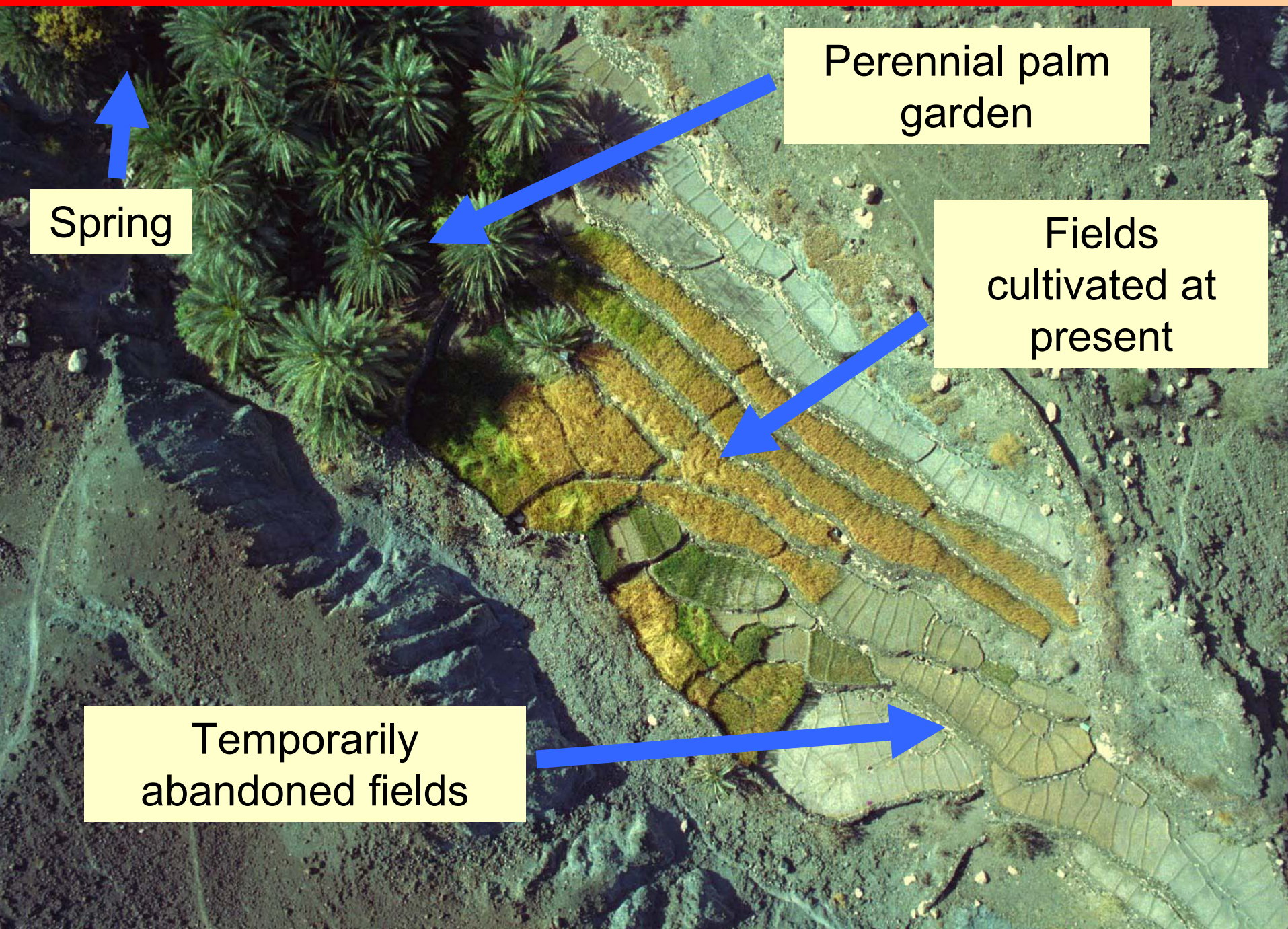
**Long time
fluctuations are not
buffered by the
rocks**

No dead or suffering
plants



**Additional
(management?)
buffering system at
work**



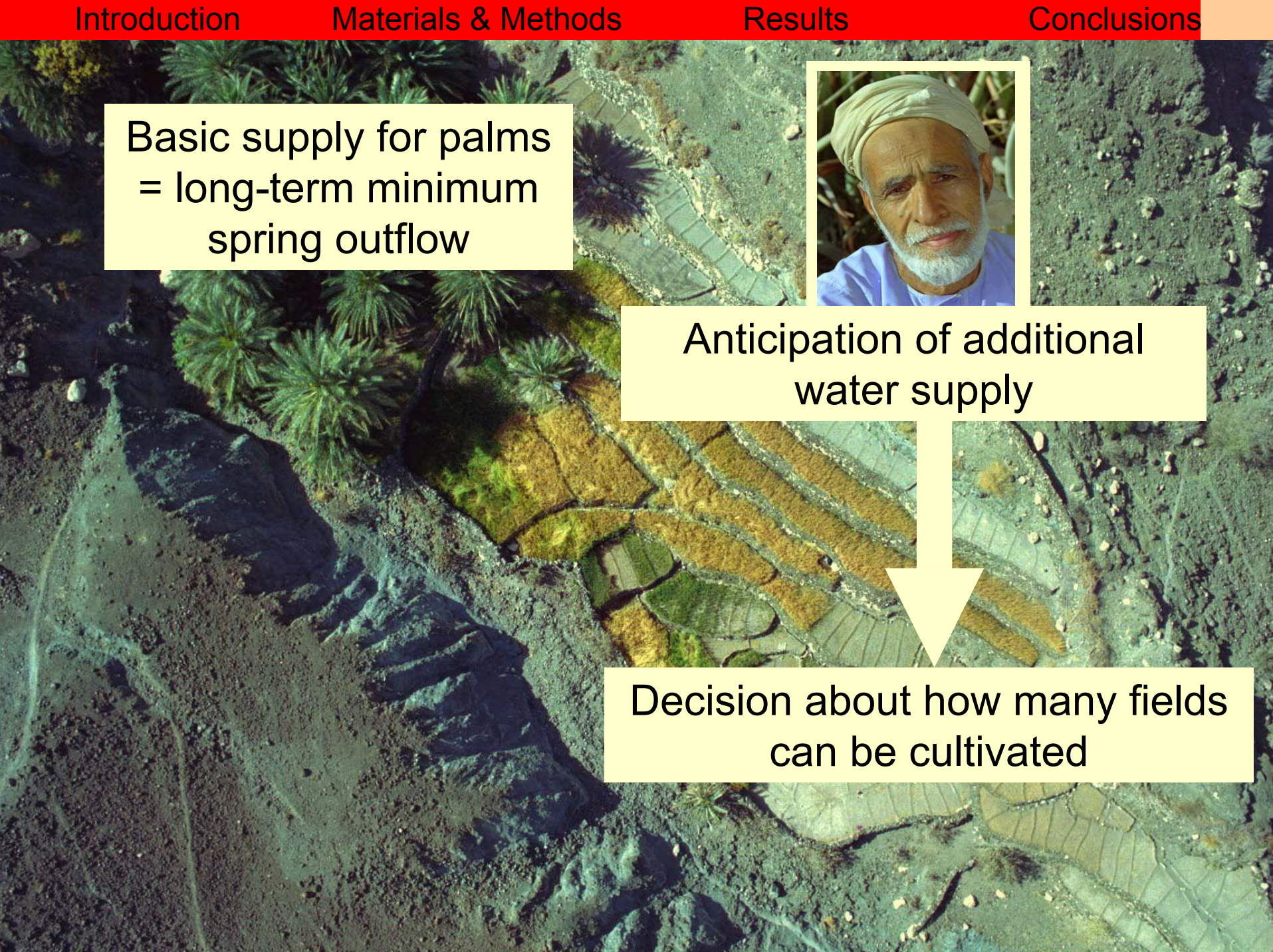


Spring

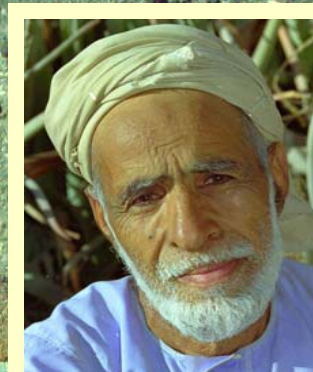
Perennial palm garden

Fields cultivated at present

Temporarily abandoned fields

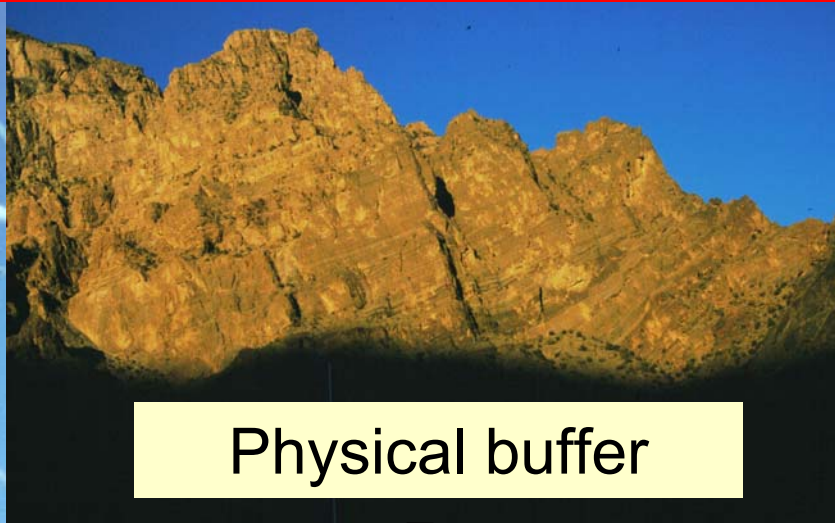


Basic supply for palms
= long-term minimum
spring outflow



Anticipation of additional
water supply

Decision about how many fields
can be cultivated



Physical buffer



Management buffer



Sustainability over millennia

A large, dark green tree stands in the center of a rocky, arid landscape. The ground is covered in light-colored rocks and sparse vegetation. In the background, there are rugged, brown mountains under a clear sky. The text "Thank you for your attention !!" is overlaid in bright green on the tree.

**Thank you for
your attention !!**