

# The Khadin water harvesting system of Peru – an ancient example for future adaption to climatic change

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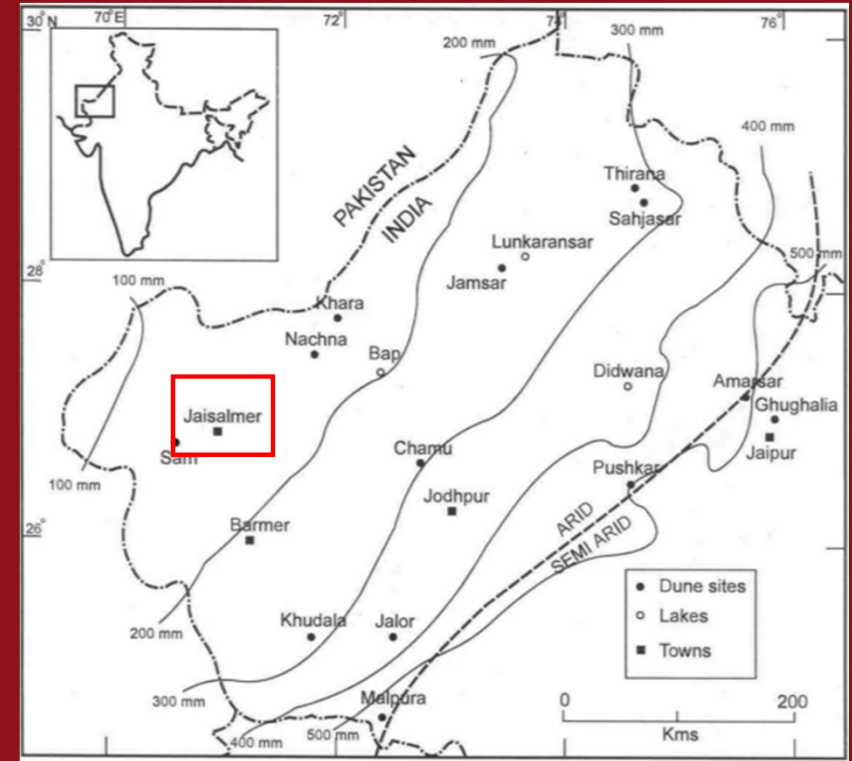
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Hydrogeology of Arid Environments, Hannover, 14.–17.3.2012

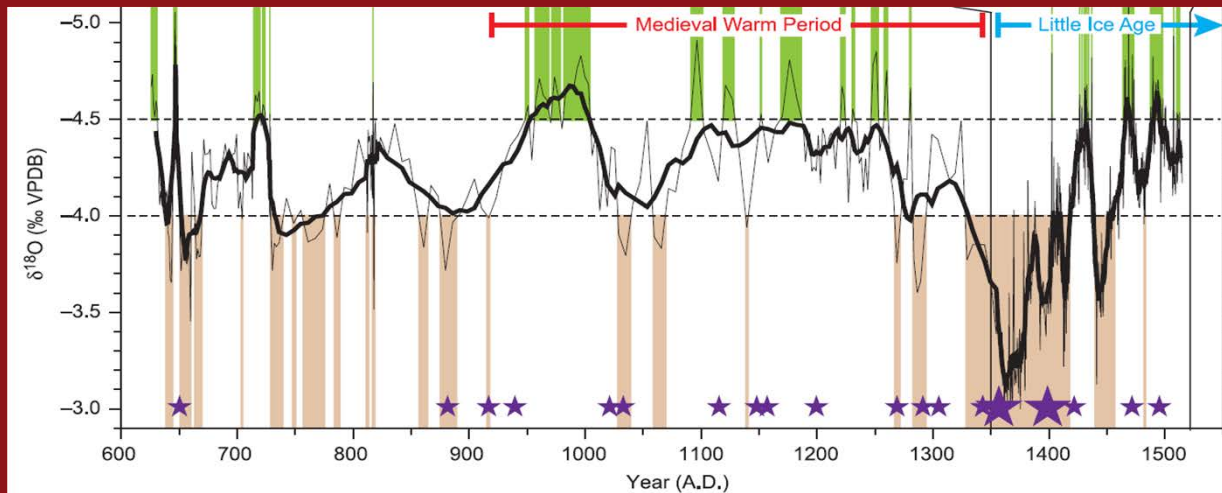
# 1. Introduction

# History of the Khadin system

- water concentration measure
- more than 5.000 years old (Near East)
- currently used in NW-India  
(Thar desert, Rajasthan)
- works with 70...150 mm mean ann. prec.
- full food subsistence for the people
- triggered by weak monsoons during the 14<sup>th</sup> century = adaption to climatic change



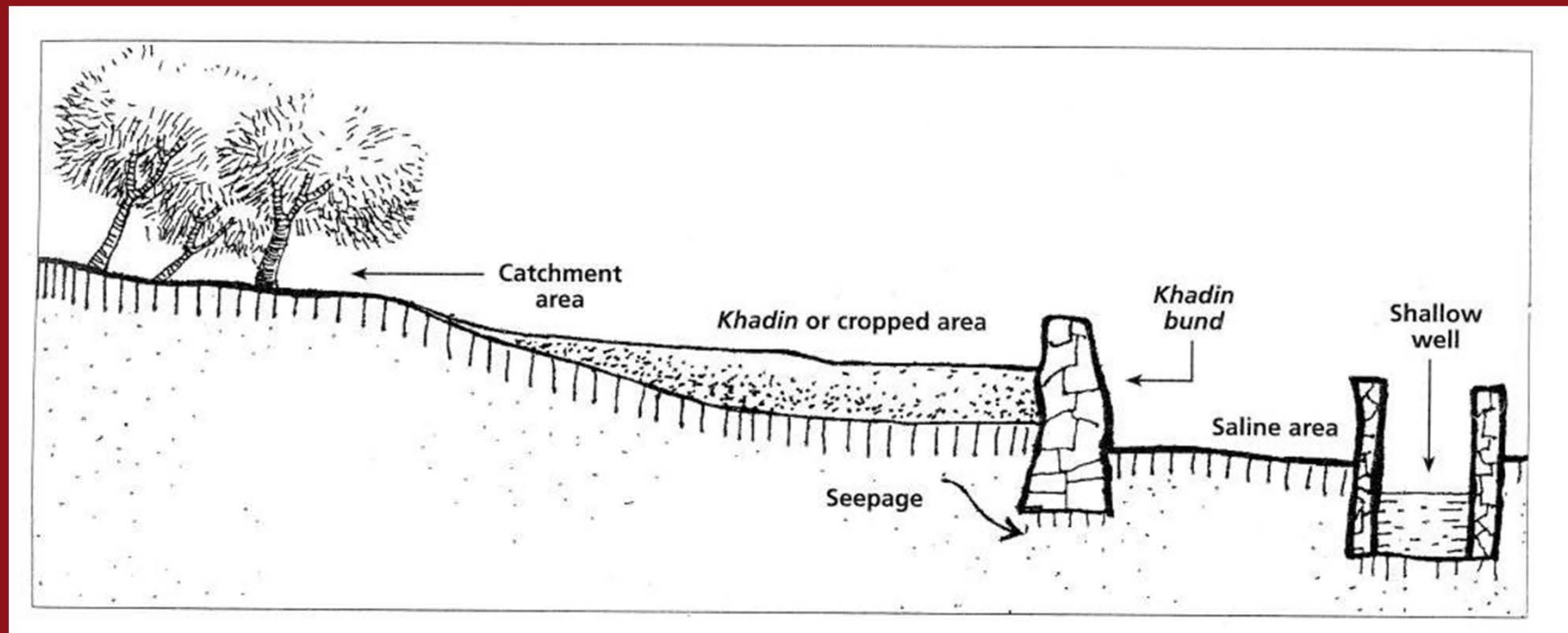
(Singhvi & Kar 2004)



(Sinha et al. 2007)

Distinct geological and topographical requirements:

- bare rock, steep slopes
- (arteficial) sediment bodies (= storage)
- bund for collecting episodic runoff
- catchment to Khadin are ratio 25...15 : 1 (Kolarkar 1997)



(Kolarkar 1997)

## 2. Analogue from the New World

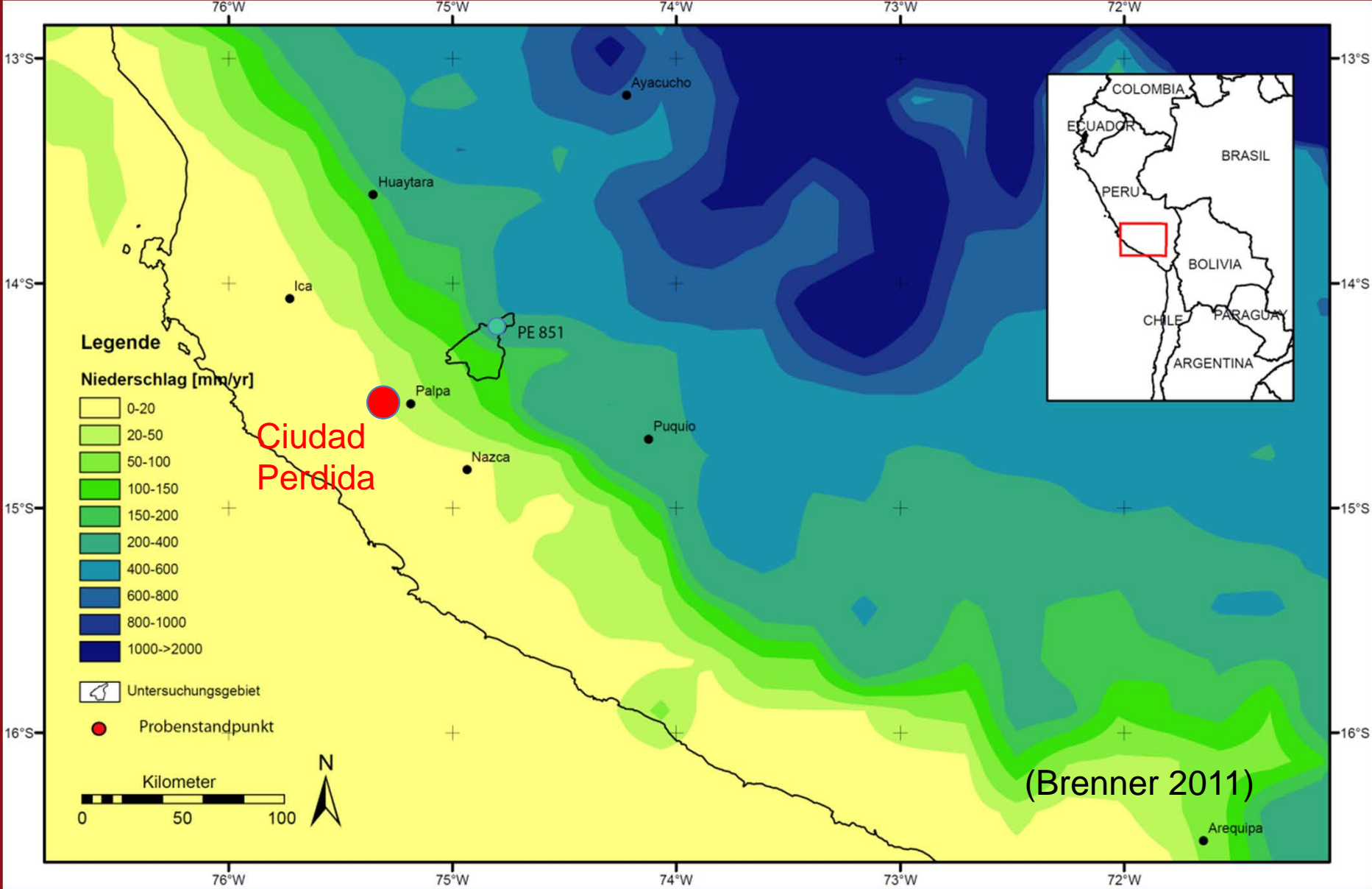
# The western Andean slope – a desert margin area

- Agriculture is limited to river oases



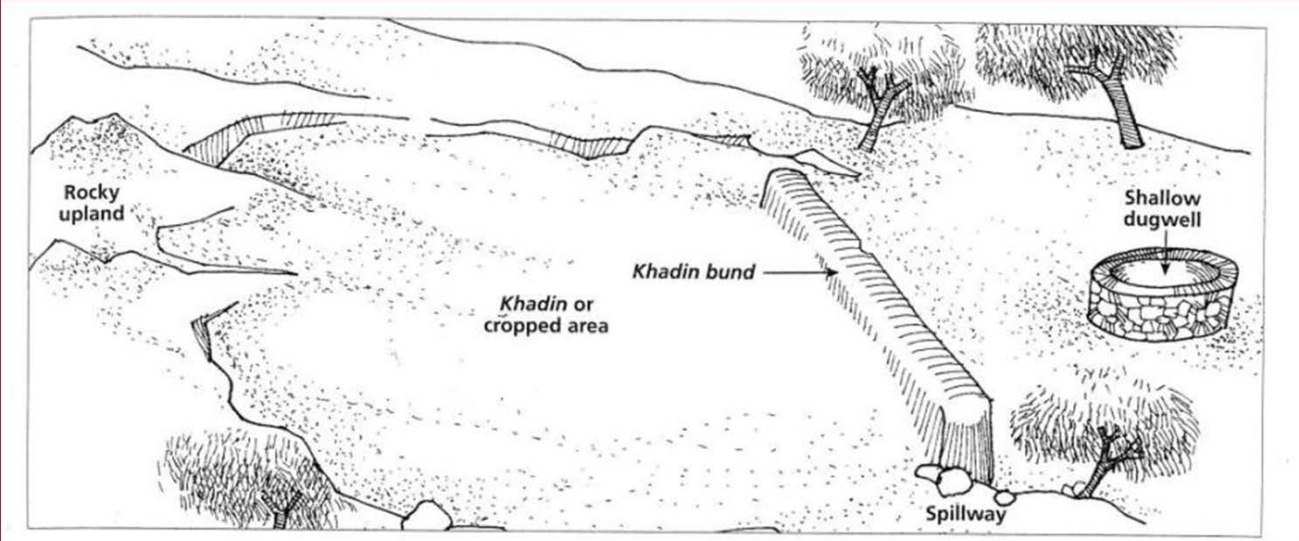
# Mean annual precipitation

- ~ 20 mm/yr = hyperarid conditions



# Adaption, independent from the Old World

## The first description of Khadin water harvesting in Peru (?)



(Kolarkar 1997)

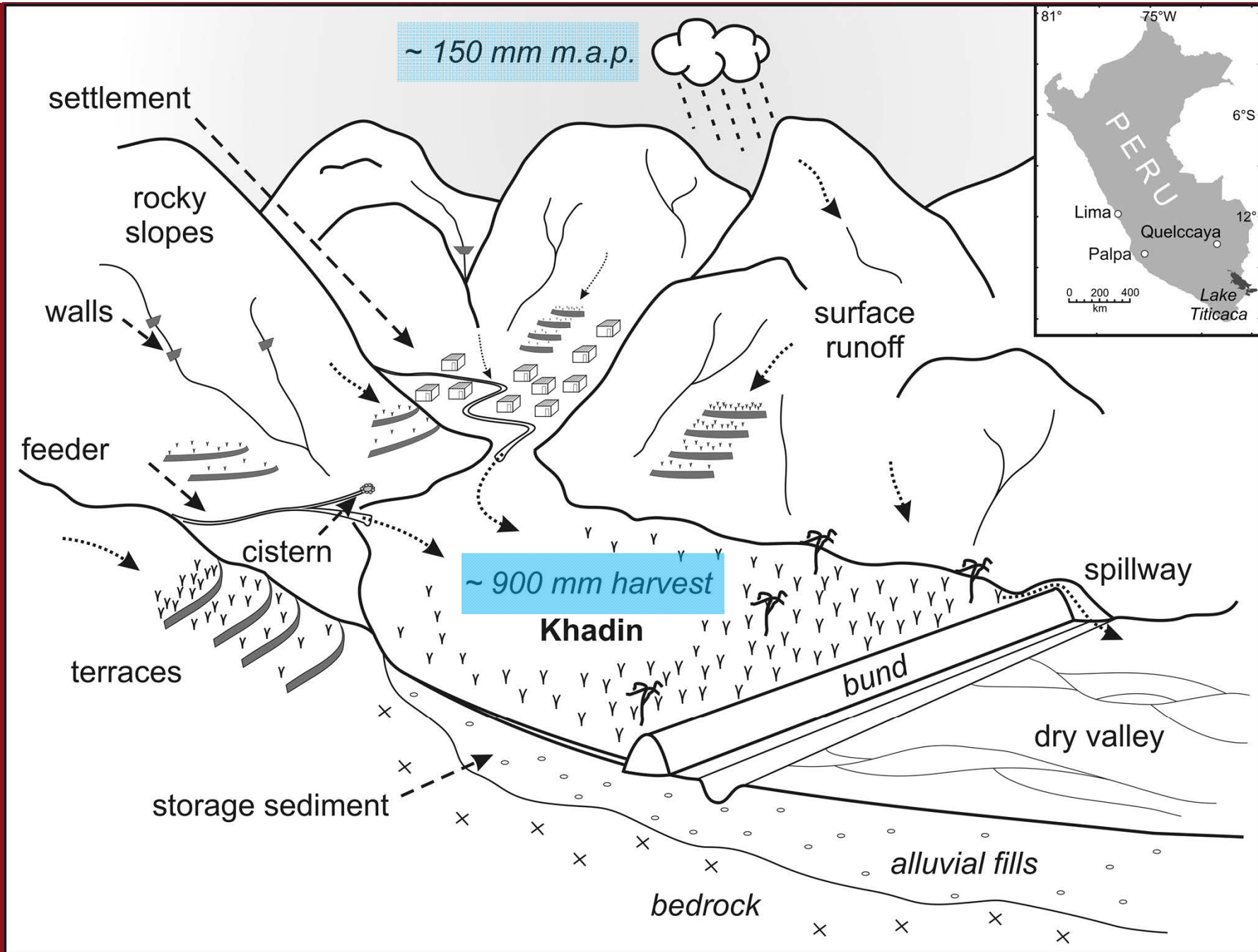


ancient Khadin, abandoned due to climatic change → palaeoclimatic archive



- large settlement, stone architecture
- terraced slopes
- walls (runoff control)
- feeders
- cisterns





## Potential für crop production (K. Ross)

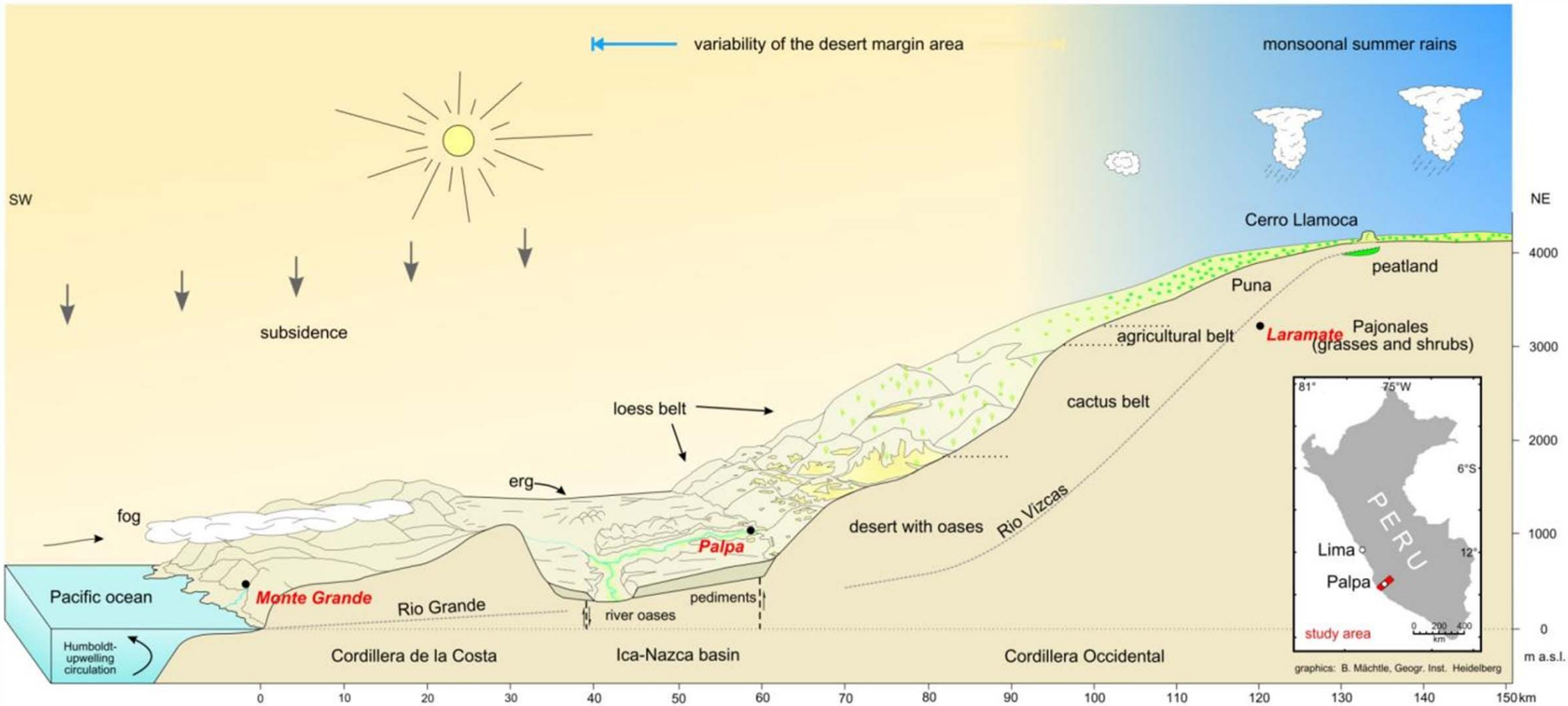
- Soil properties: 62 % of field capacity = plant available
- Maize water needs 344 l/kg
- Khadin area 2.5 ha
- Maize yield 5.000 kg/ha
- Dwellers ~180 (33 % maize diet, 1800 kcal/day)



# 3. From Past to Future

# Khadin – adaption measure under **favourable** conditions?

- Last humid period: 1150–1450 AD, high population
- Khadin gives evidence of 150 mm mean annual precipitation → dry spell



1150 AD

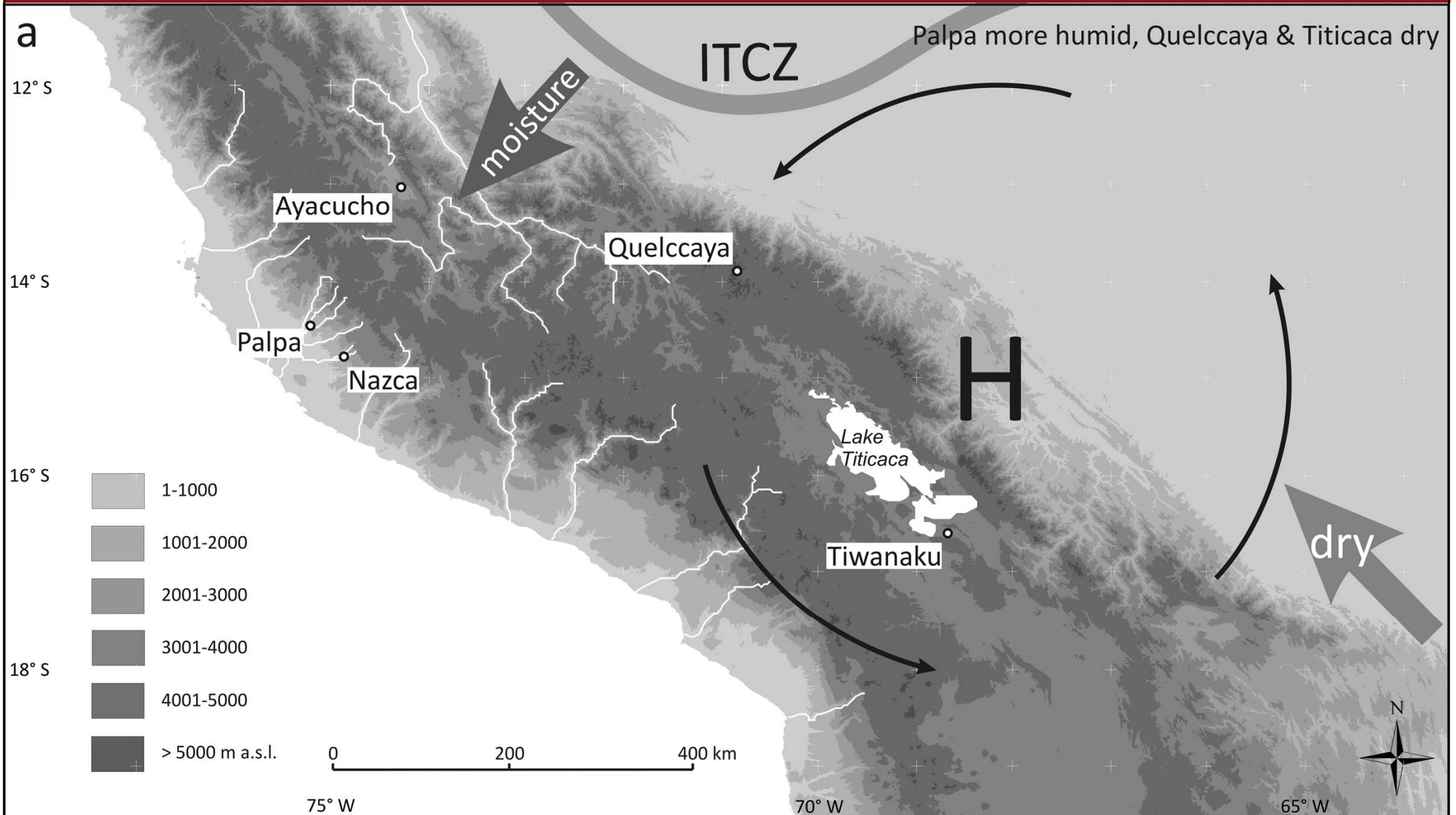
1260 AD

1350 AD

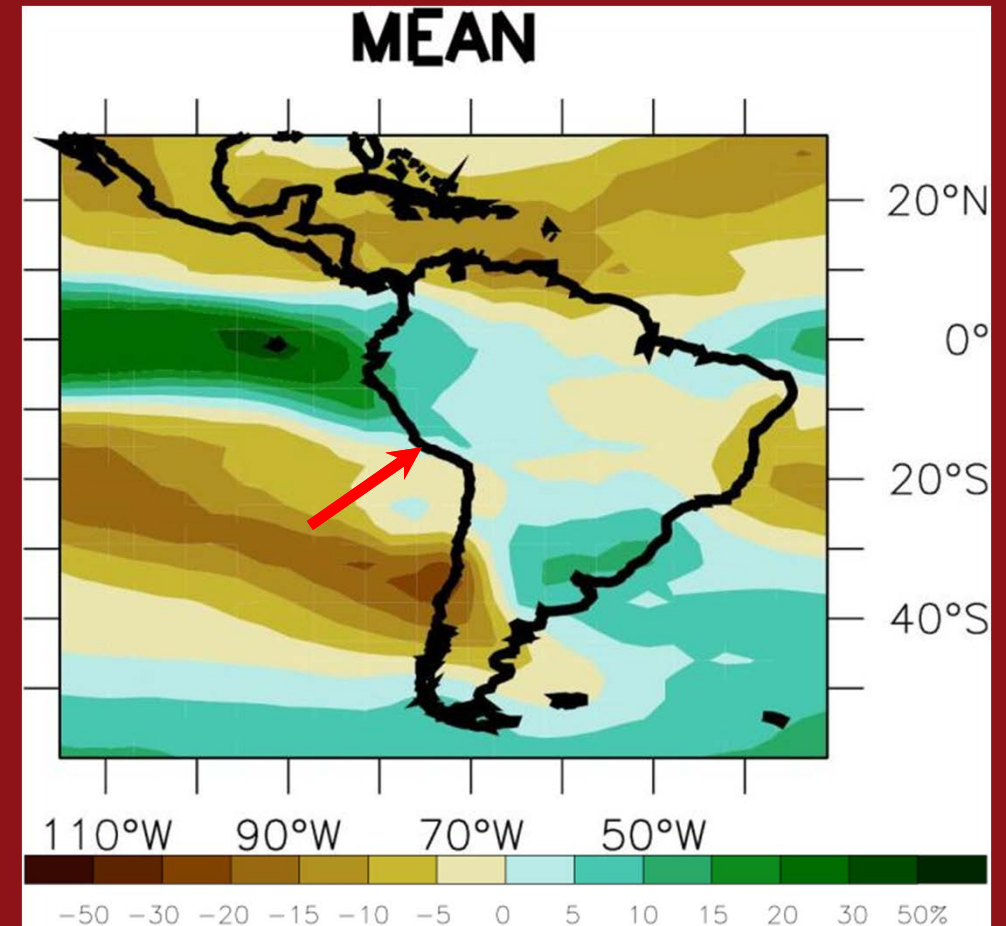
1450 AD

2000 AD

- Period of drought at the end of the 13<sup>th</sup> century → trigger for Khadin construction



- IPCC (2007) prediction: changes in global circulation mechanisms
  - ITCZ, monsoons, westerlies shifts → shifts of desert margin areas
- basic limitation: circulation models
  - frequent mismatch with paleo-record
- changes in Palpa (1980-99 against 2080-99):
  - more humid (< 10% increase)  
= more El Niño-like conditions
- changes in Chile:
  - southward displacement of the westerlies  
= more La Niña-like conditions!
- paleo-record: high sensitivity!



- Khadin systems are very useful for adaption to increased drought, if topography and geology are adequate
- cheap and easy to construct
- **where** Khadins will be needed depends on real regional impact of climate change  
→ shift of desert margins
- but it is obvious **that** the Khadin is needed as adaption measure to climate change





**Thank you**

**& thanks to the**

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