Groundwater in Water Accounting

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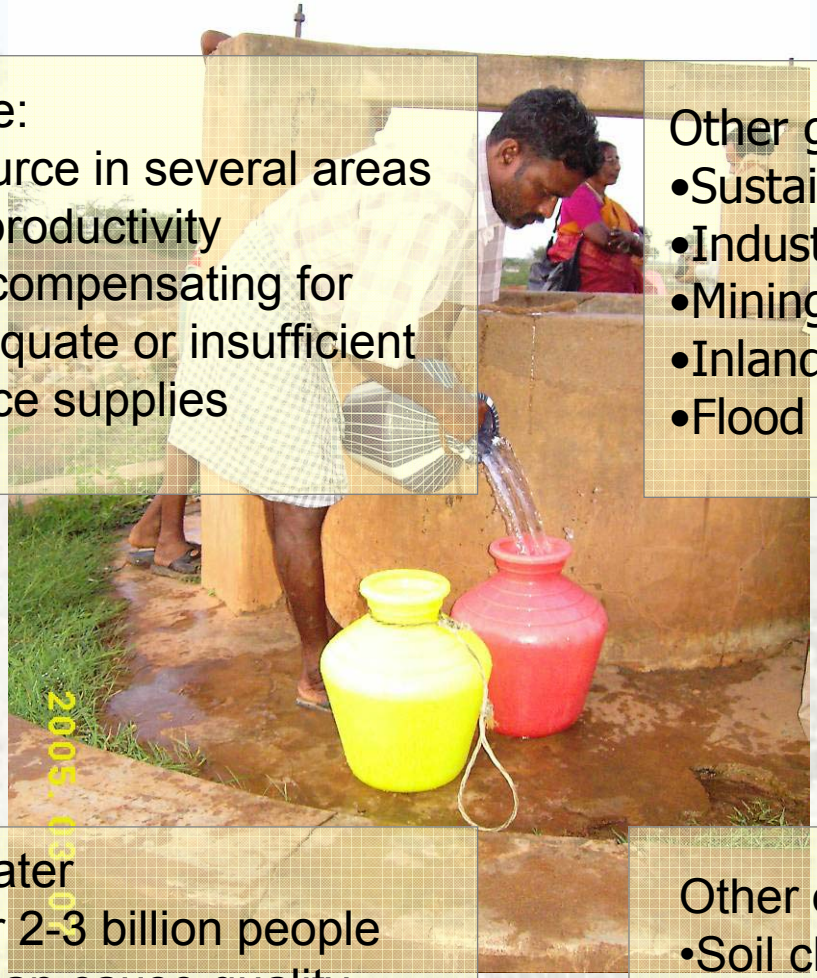
Session 5

Why groundwater is important

Agriculture:
- Major source in several areas
- Highest productivity
- Buffer – compensating for inadequate or insufficient surface supplies



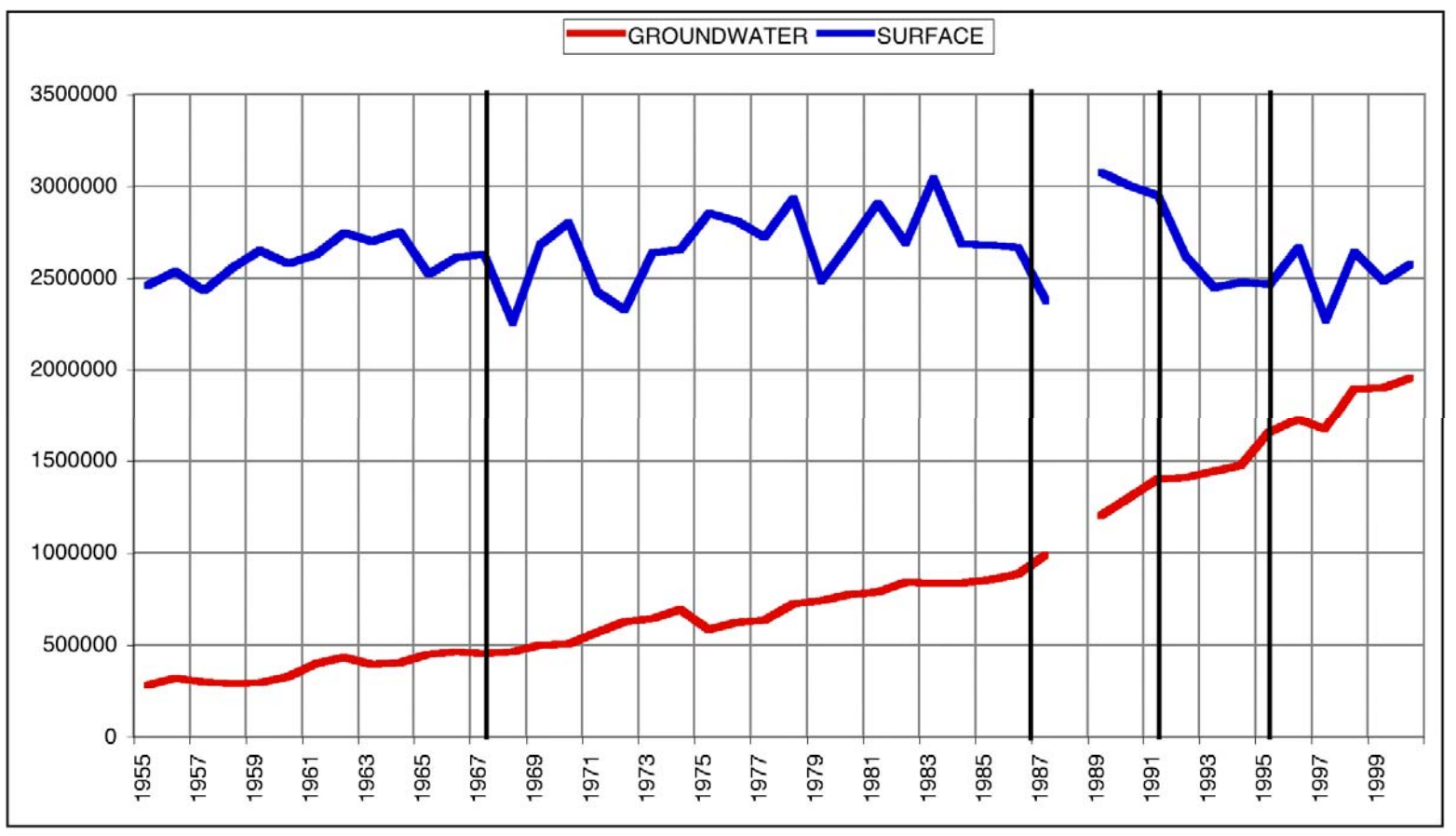
Other groundwater functions:
- Sustaining e-flows
- Industry
- Mining
- Inland fishery
- Flood buffer

Drinking water
- Lifeline for 2-3 billion people
- Overuse can cause quality deteroriation (fluoride/ arsenic)

Other effects:
- Soil chemics
- Link to soil moisture management
- Water retention

Success stories:

Andhra Pradesh, India, f.i. :



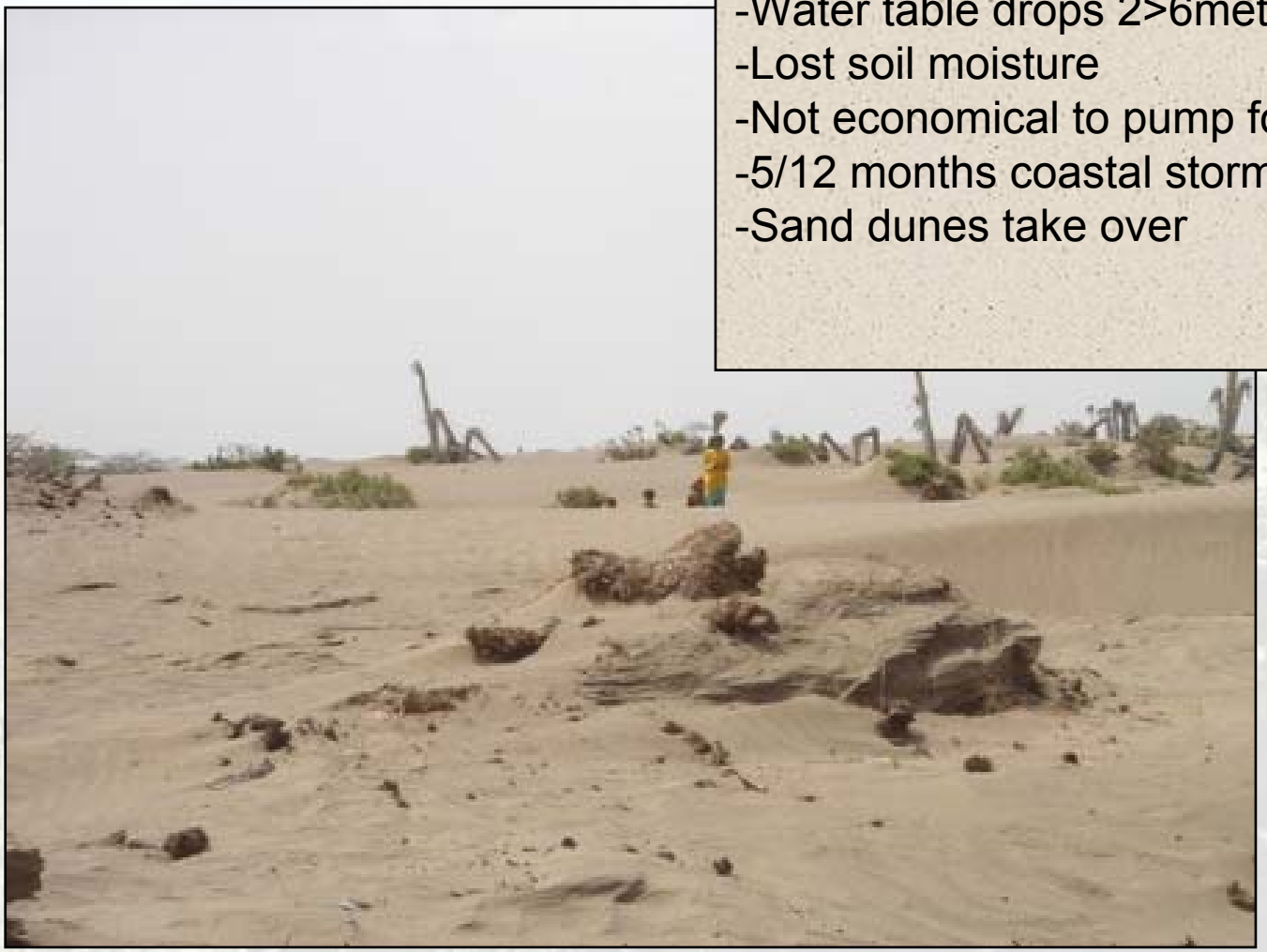
Millions of wells.. the conjunctive reality

In Punjab in Pakistan –
In the worlds largest contagious surface irrigation system 54% of the water at farm gate comes from groundwater

Success stories:

Also disaster areas..

Former Data Groves,
Coastal Tihama, Yemen
-Less surface supplies from spate
-Less recharge
-More pumping
-Water table drops 2>6meter
-Lost soil moisture
-Not economical to pump for dates
-5/12 months coastal storm
-Sand dunes take over



And human tragedy...

Nellore, India

In 1990 there was a spurt in groundwater exploitation with many new borewells

Water tables dropped and drinking water was obtained from deeper layers

These deeper layers contained high fluor levels

Ever since dental problems, joint problems and kidney defects are endemic in the village

This villages is now stigmatized

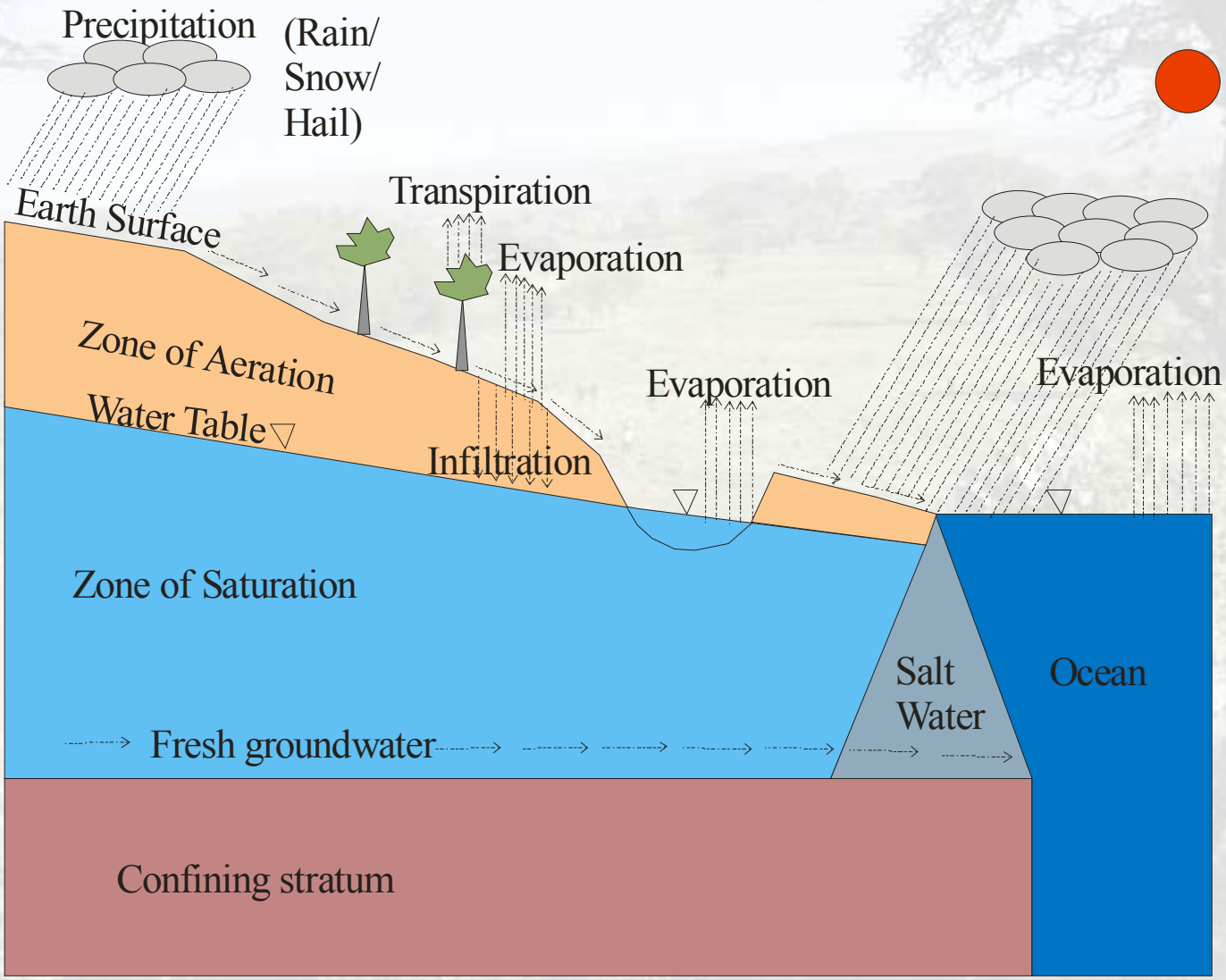
Much of groundwater use is new ..

Large part of the increase in water use in the world since 1970 is due to groundwater development

Drawing first water in West Bengal, India

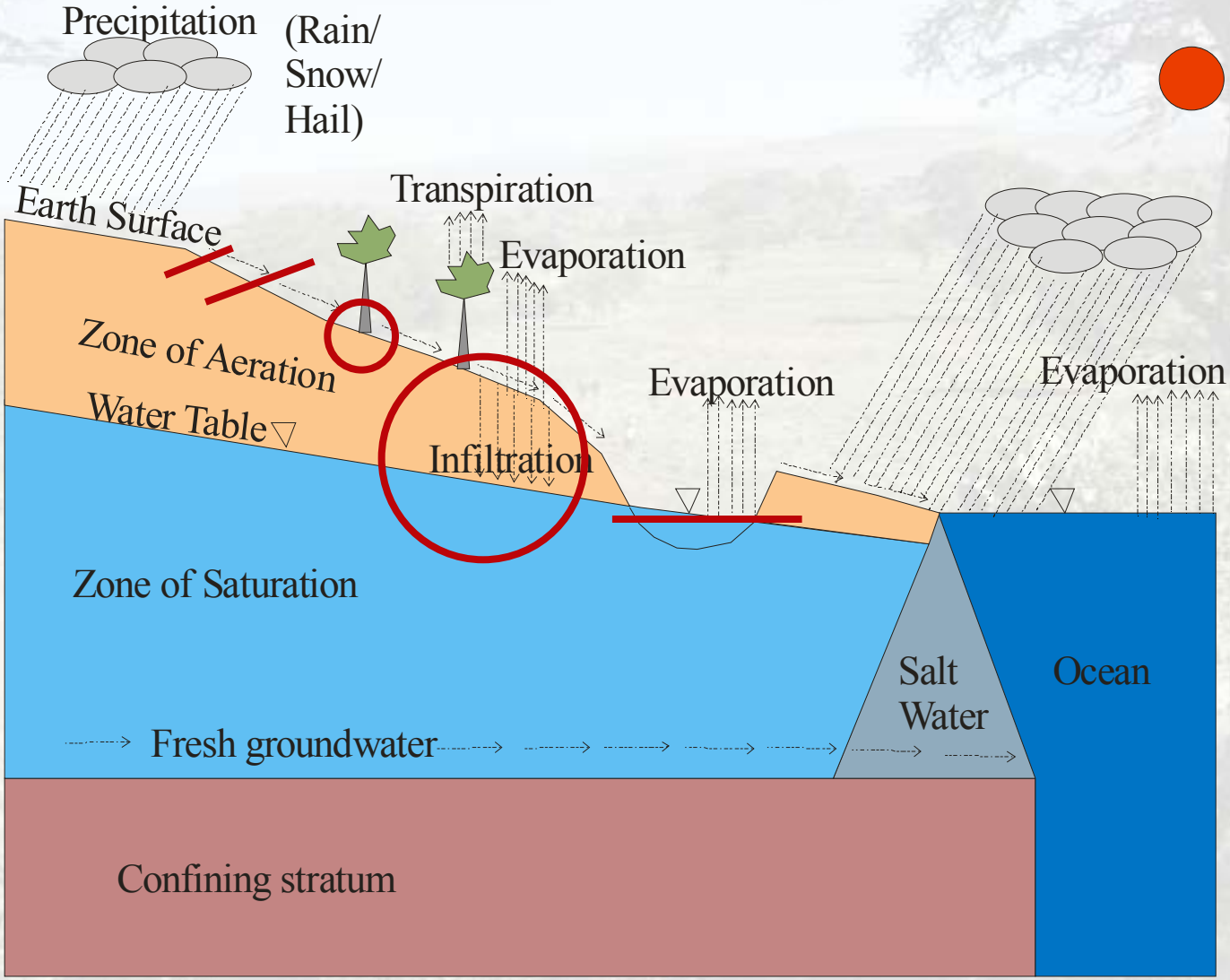
And in spite of its importance largely unmanaged

What is missing from this picture?



Earth's Water Cycle or Hydrologic Cycle

TRIPPLE R:
Recharge
Retention
Reuse



Earth's Water Cycle or Hydrologic Cycle

Groundwater in Water Accounting

Groundwater =

- Deposit (recoverable under water terms)
- Source of water
- Important side-effects

But what kind of deposit?

Statement:

In water accounting understanding the nature of the deposits is essential

and

needs to determine how water is managed at basin level

- Shallow or deep aquifer?
- Annual or centennial cycle?
- Quality of salinity

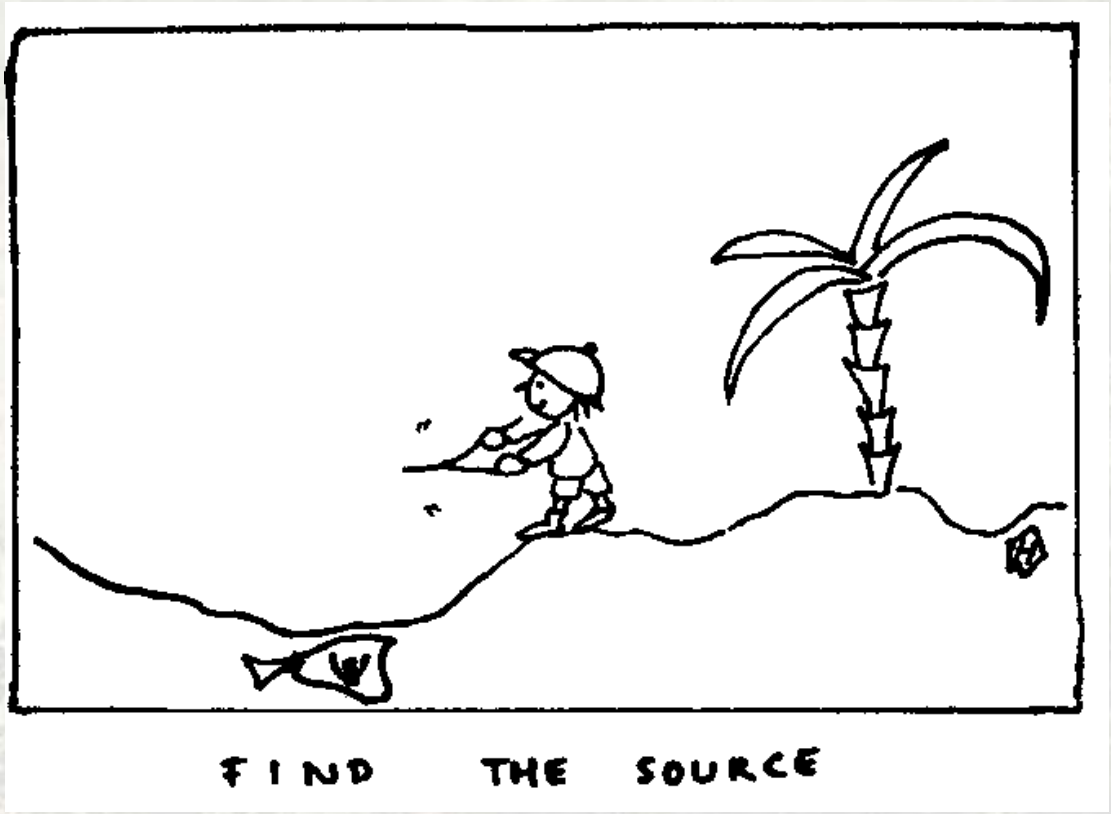
The nature of the deposit (what is recoverable and what is not and how ...)

- Shallow or deep aquifer
  - Shallow aquifer intensive interaction with surface water: conjunctive management, drainage/ retention, link to soil moisture
  - Deep aquifer: strategic asset
- Annual or long-range cycle
  - Annual cycle (small basins, moderate rainfall fi) – overextraction can be corrected annually
  - Long range cycle – overextraction can be cause irreversible change
- Quality of groundwater
  - Limits scope for reuse
  - Health hazards related with overextraction

Nothing paying attention to nature of deposit things can go wrong

FINDING THE DEPOSIT..

Measuring groundwater



Classic indirect methods: discharge

Well population	Electricity connection – illegal connection (may be 35%)? Diesel pumpsets – how to count? PTO's: counting wells or pumps?
Capacity	At best informed guess
Pumping hours	Can be easily factor 2 off
Cropped area	
Crop water requirements	How to account for variation
...	

Classic indirect methods: recharge

Rainfall	Coverage of met-stations Accuracy of reading Pattern (gentle or cloudbusts)
Recharge factor	Average number = correct? Which average number? Areas classified?
Interaction with streams, secondary recharge	Speculative..

Problems with indirect methods for assessing recharge and discharge:

- **Imprecision galore – sum of errors**
- **Average figure in space and time**

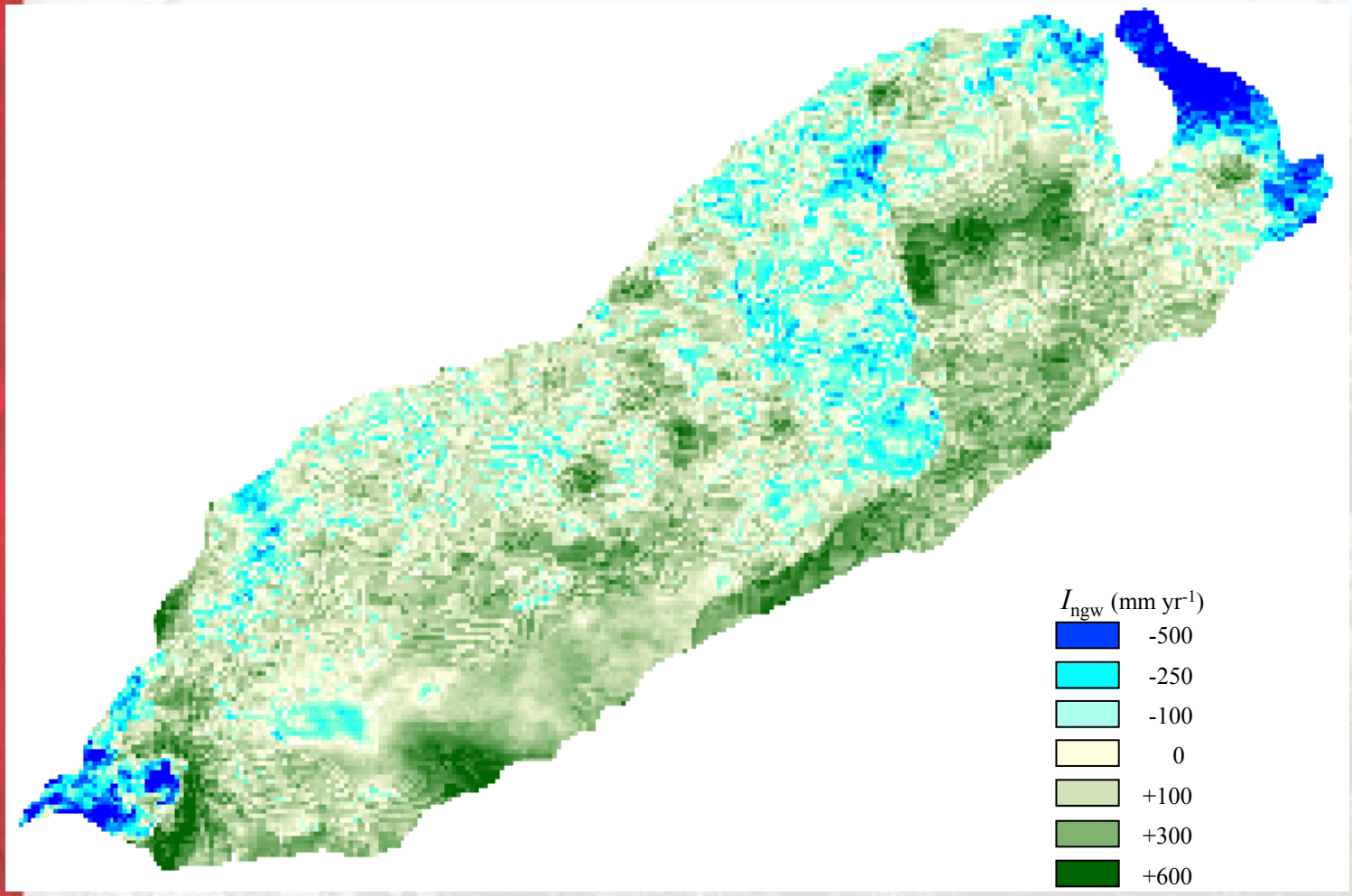
Direct remote sensing based methods to assess recharge and discharge

- Comparing ET and P
- Comparing ET on irrigated plot with non irrigated plot
- Difference corrected with irrigation efficiency – gives actual discharge

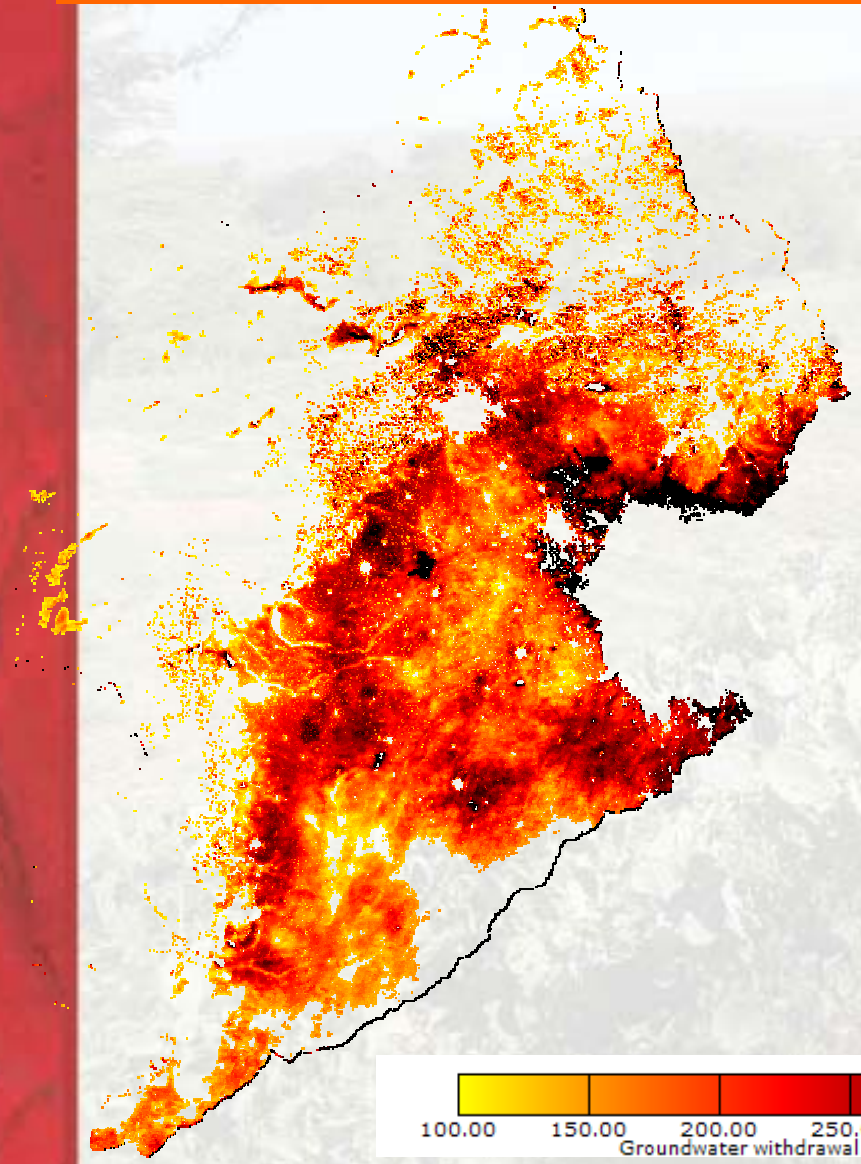
Advantages

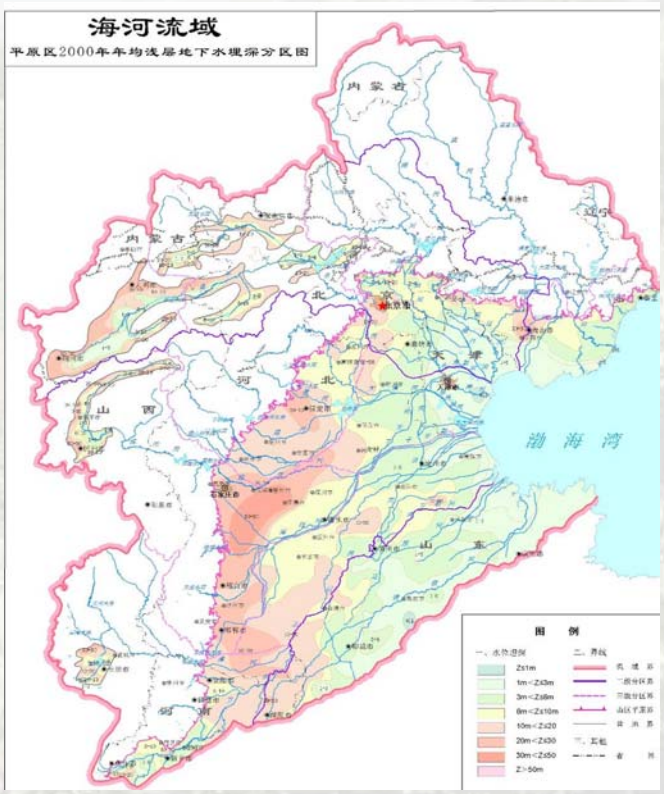
- Full area coverage
- Seasonal and annual analysis
- Accuracy of SEBAL and TRIM
- No composites

Net groundwater use, Rechna Doab Pakistan



Groundwater abstraction Hai Basin

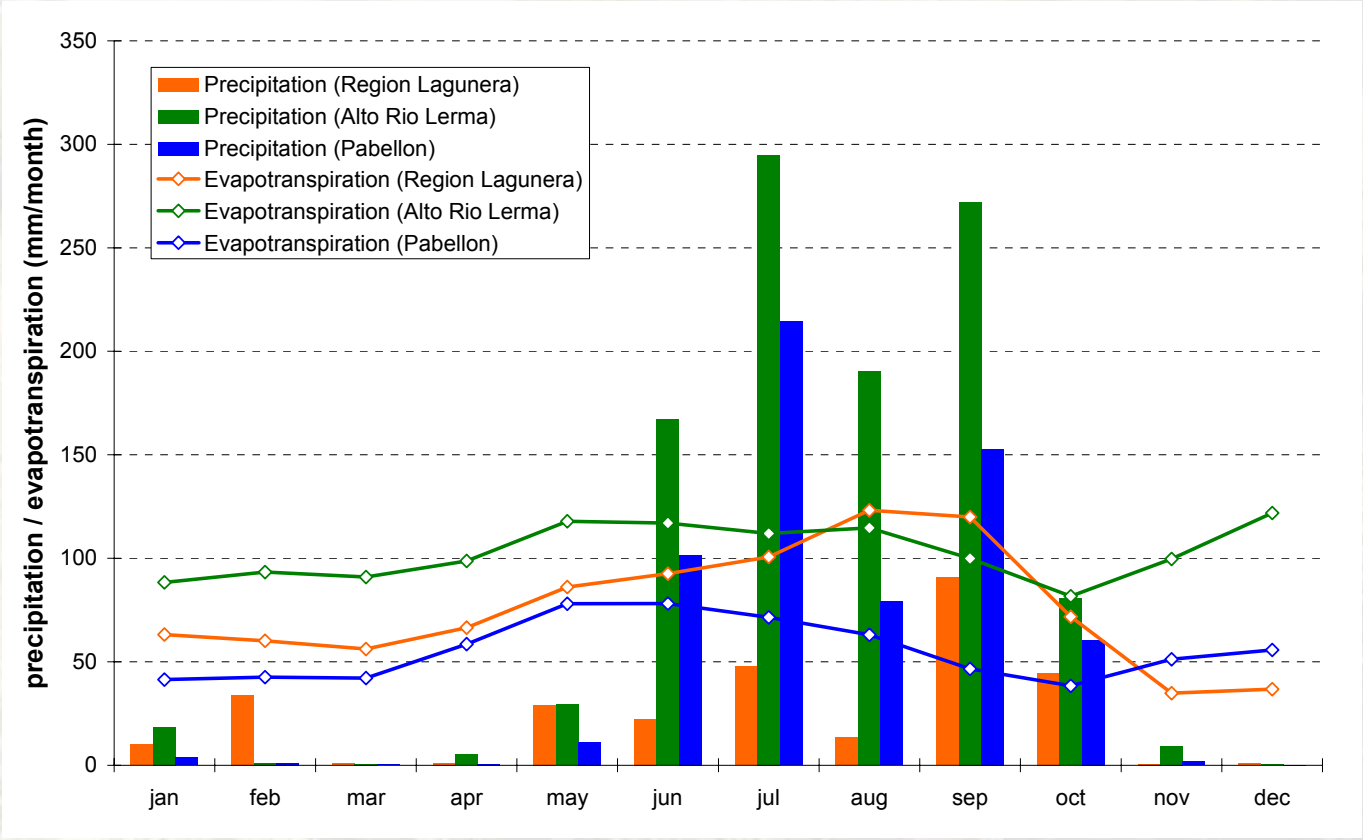




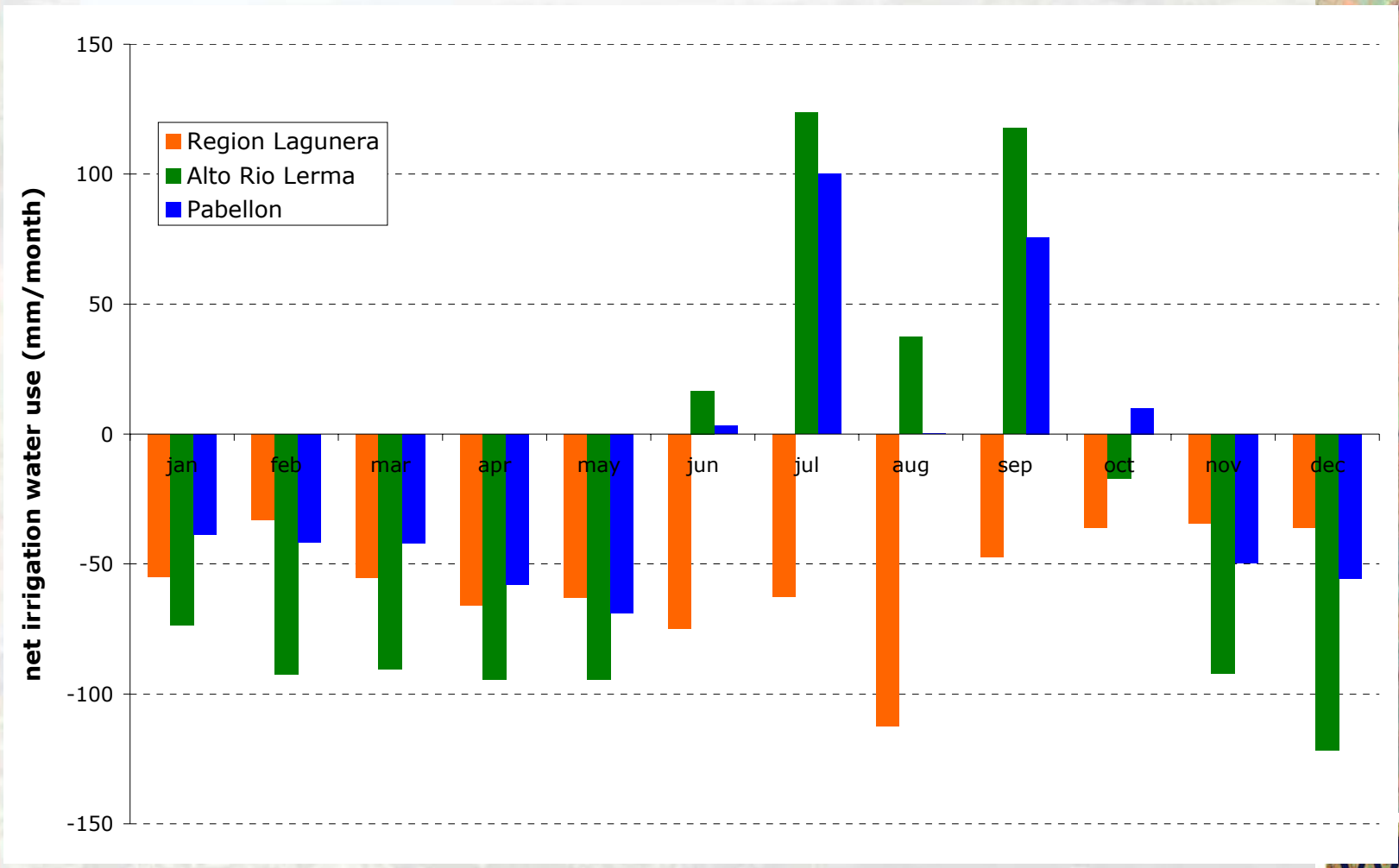
Hai basin

China

Mexico


Precipitation (Region Lagunera)
Precipitation (Alto Rio Lerma)
Precipitation (Pabellon)
Evapotranspiration (Region Lagunera)
Evapotranspiration (Alto Rio Lerma)
Evapotranspiration (Pabellon)
precipitation / evapotranspiration (mm/month)
350
300
250
200
150
100
50
0
jan
feb
mar
apr
may
jun
jul
aug
sep
oct
nov
dec

Mexico



WaterWatch

Advantage 1:

Remote sensing gives a relative fast and geographically comprehensive insight in water abstraction and recharge – showing differences in time and space.
It makes it possible to assess the magnitude of the order, that needs to be restored

There is a range of measures –
that can be used to bring back the balance
and usually only very little of this is practiced
even though much of this is not 'sacrificial'
but falls in the ambit
of better resource management
and may even bring bigger yields

Recharge measures

Landscaping, road recharging, controlled sand mining

Unconventional sourcing

Supplementary wet season irrigation

Changing cropping patterns

Micro-irrigation: sprinkler, drip..

Soil moisture conservation measures

Local regulation: zoning, crop bans, drilling moratoriums

Advantage 2:

Water accounting helps to get the total picture on all (land-based) water uses – over the entire area and over many years – and can help mitigate some of the (sometimes unwaranted) alarmism prevalent in ground water discussions

One word of caution however:

- Who are the water managers?
- In groundwater there are millions of independent users and potential water managers
- These often already act on individual estimates of available discharge
- Need to engage – on basis of local hydrological units or sub-basins
- Remote sensing should not lead to distant management

Still one important recommendation

In groundwater management remote sensing is the way to go...