Field water management

Flood-Based Livelihoods Network Foundation

SOIL MANAGEMENT AND MOISTURE CONSERVATION

Statement 1:
Most spate irrigation systems have excellent soil structures

Soils can be built up quickly from flood deposits

Scheme	Annual rise (mm/yr)
Wadi Zabid (Yemen) upstream	20-50
Wadi Laba (Eritrea)	5-32
Gash (Sudan)	139
Balochistan mountain systems	>50
Draban Zam (DI Khan) Upstream	16-47
Draban Zam (DI Khan) Middle section	13-26
Draban Zam (DI Khan) Downstream	20-49

Determing soil quality

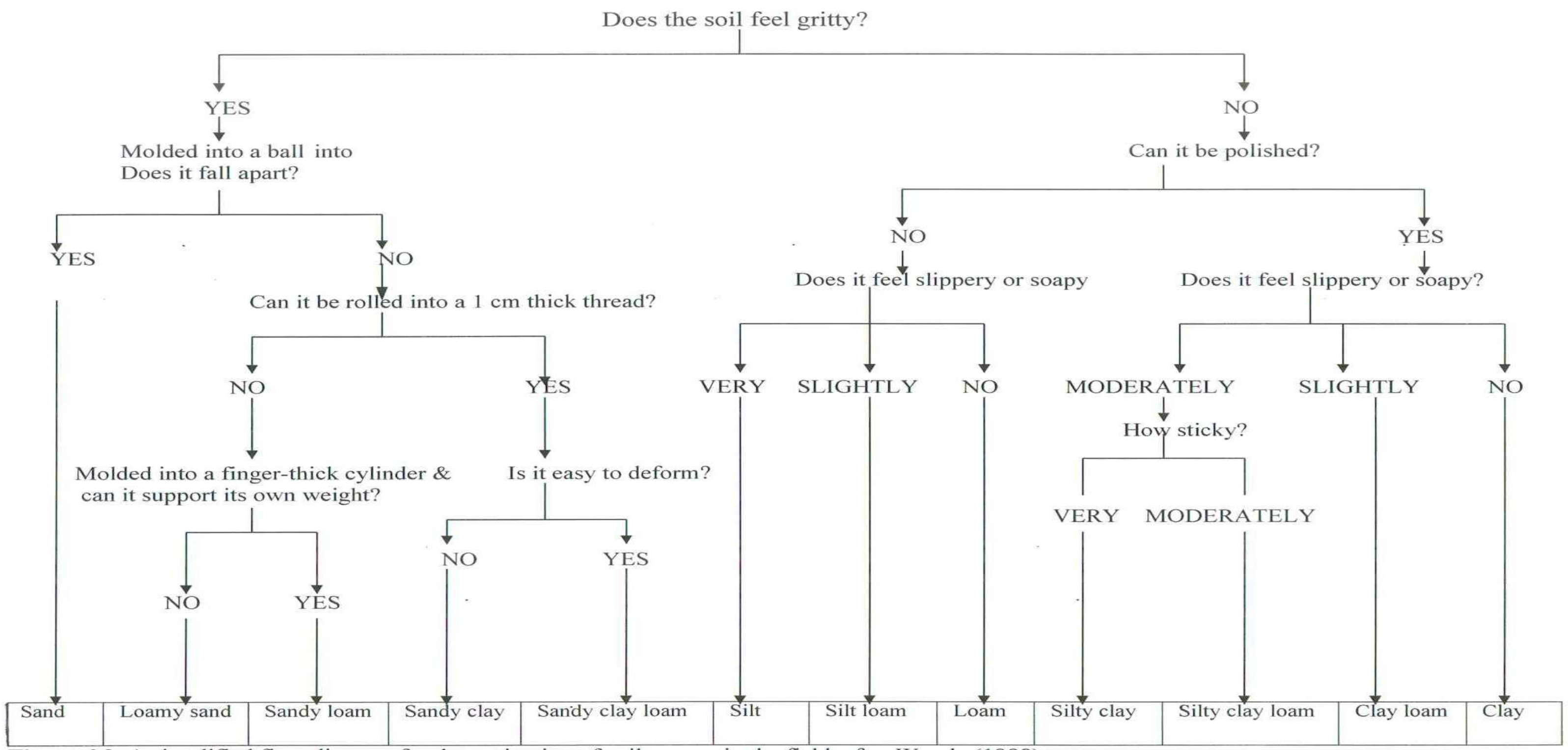


Figure 6.2. A simplified flow diagram for determination of soil texture in the field, after Woode (1988).

Soil development: blessing or curse..

- Blessing:
  - Good texture
  - Renewal of organic material – provided catchments are well vegetated – otherwise low organic content/ P-deficiency
- Curse
  - No time for weathering of soils
  - Areas may go out of command
  - Deposition of coarse material
- Remedies
  - Removal of sediment in field to field system/ breaches
  - Removal of sediment by repairing or heightening of field bunds
  - Create in field depression next to field bunds to settle sediments
  - Keeping some high (coarse) sediment floods out of the command area
  - Moving intakes upstream to regain command
  - Developing new command area

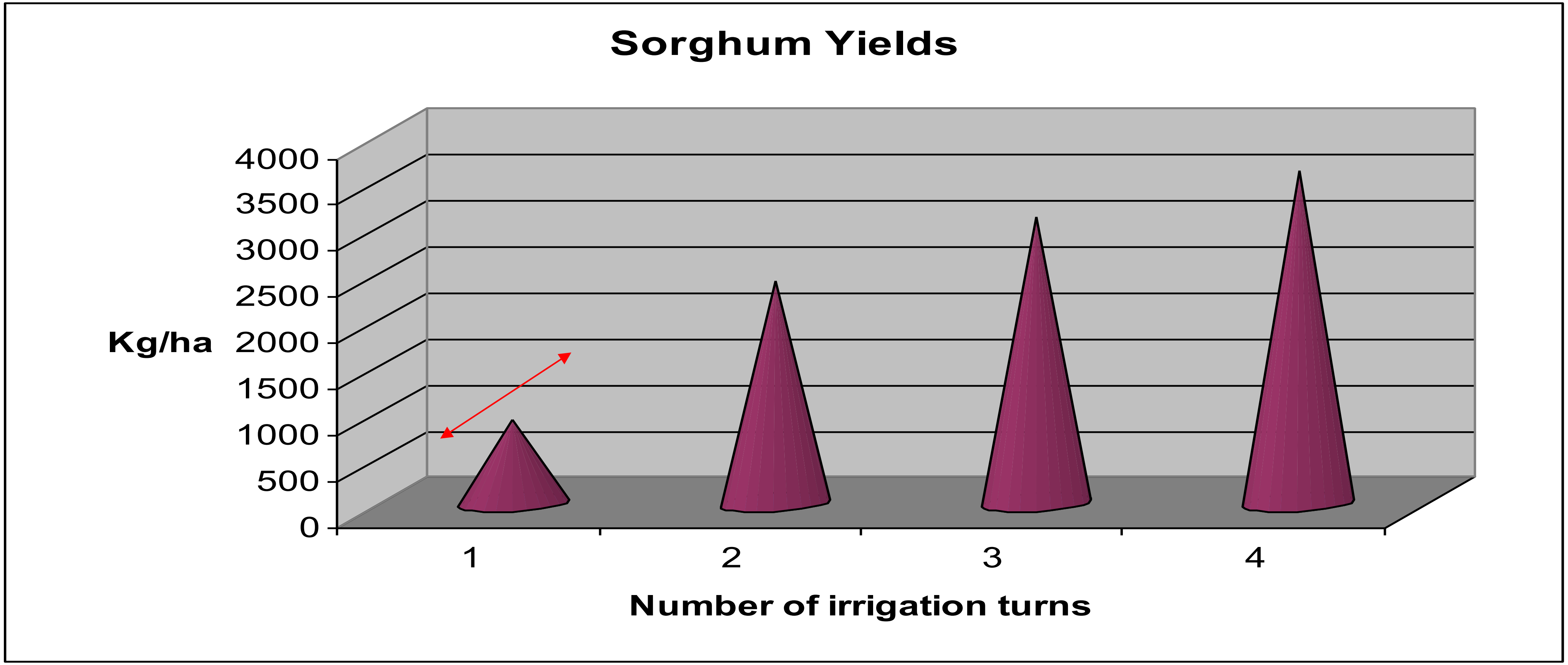
Statement 2:
Soil moisture conservation is one of the most important factors affecting crop yield in spate irrigation

Water retention capacity of different soils

Soil texture class	Available water (in mm) in 1 metr depth of soil
Loamy sand	39
Sandy loam	83
Silt loam	163
Clay loam	170
Silty clay loam	202

Lower water retention capacity in upstream areas

Crop increase from second irrigation higher than from first irrigation…

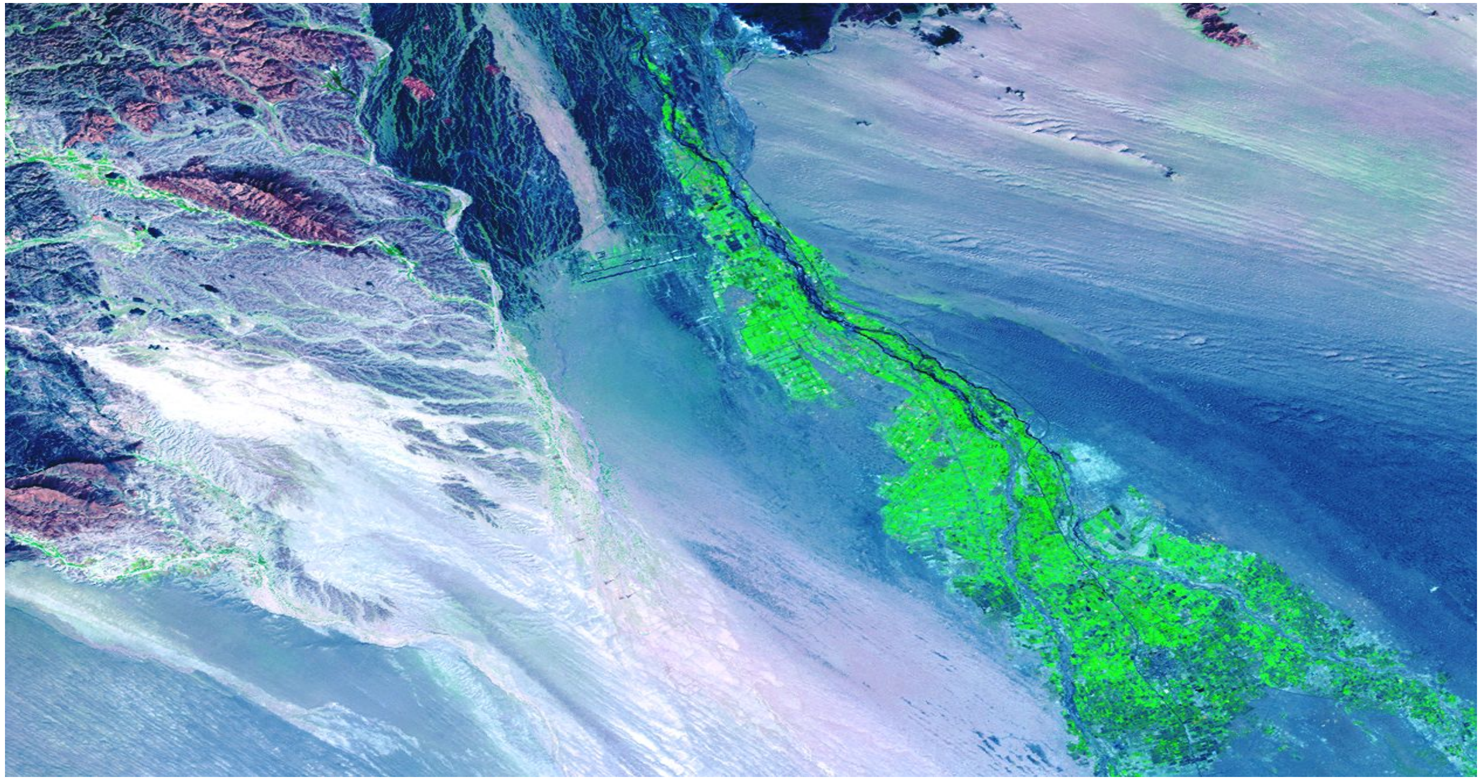


Eritrea, Eastern Lowlands

Source: Mehretab, personal

Two Strategies

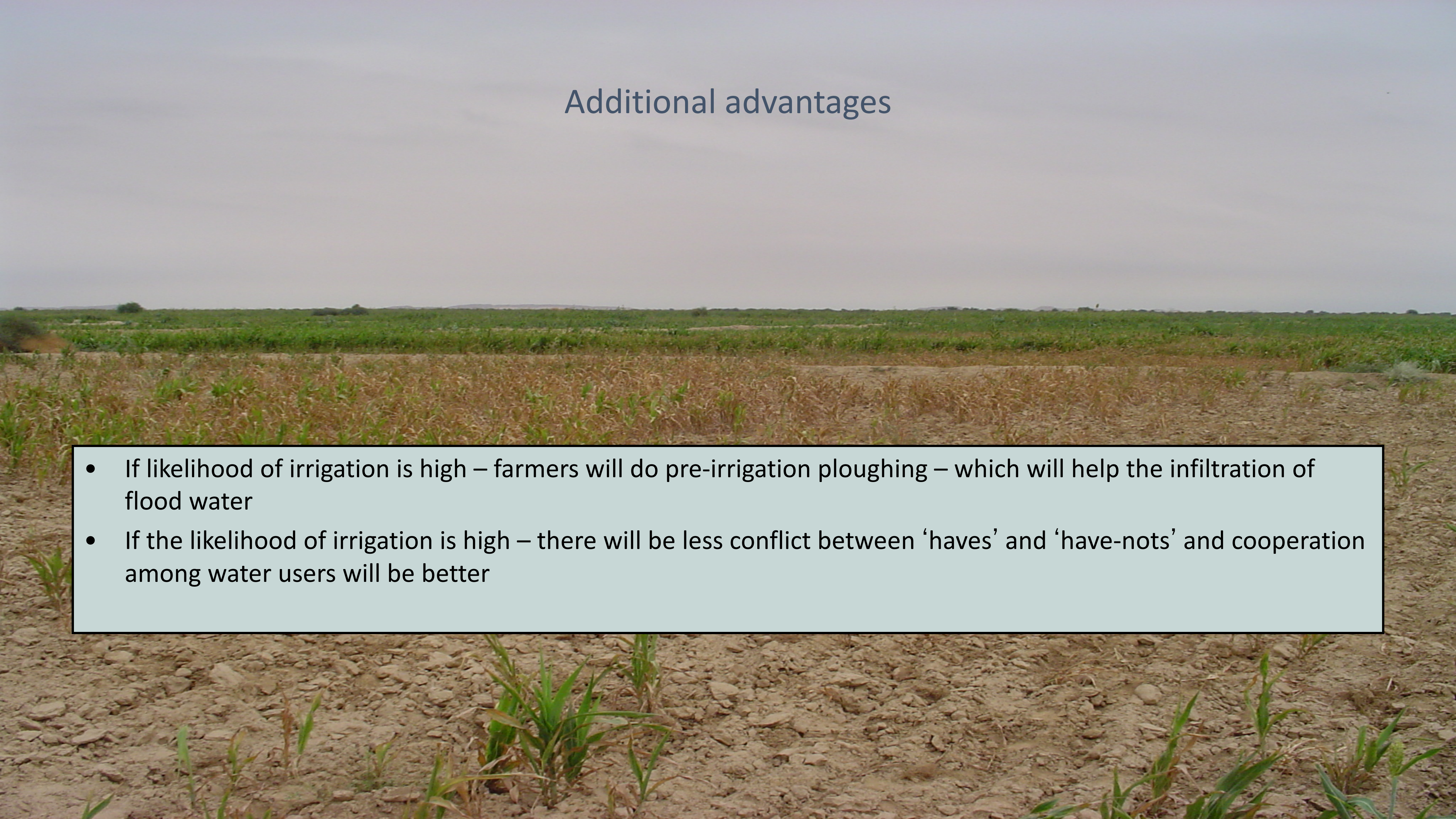
1. Avoid command area is too big and irrigation is spread too wide
2. Ensure adequate soil moisture conservation



Strategy 1:
Keeping the command area concentrated

As far as water distribution rules allow

By concentrating the command area that has reliable Irrigation and even 2-3 irrigations increases and one avoids large marginal 'outwash' areas with very low productivity



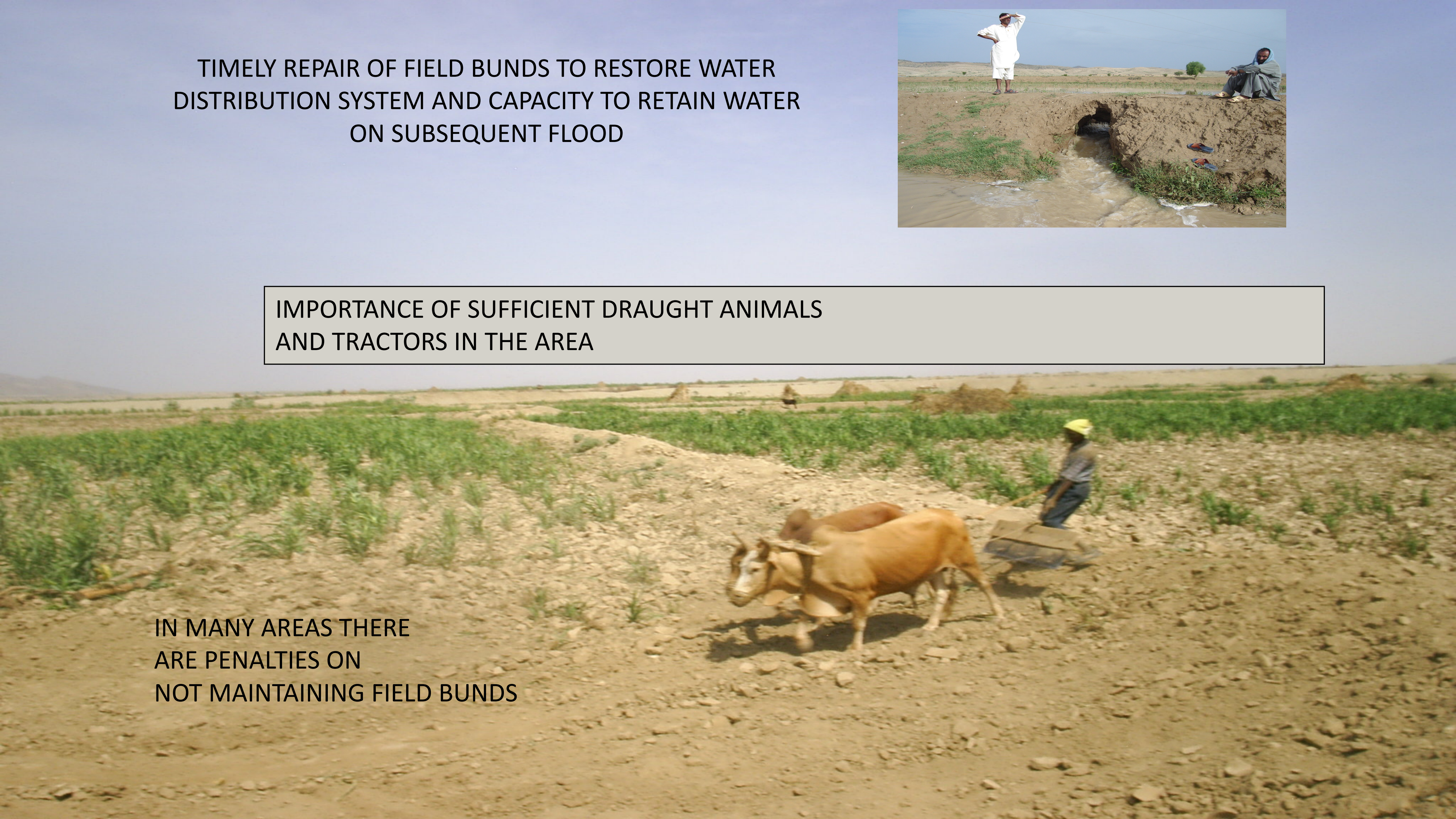
Additional advantages

- If likelihood of irrigation is high – farmers will do pre-irrigation ploughing – which will help the infiltration of flood water
- If the likelihood of irrigation is high – there will be less conflict between ‘haves’ and ‘have-nots’ and cooperation among water users will be better

In Pakistan it is quite common to have large areas that are only irrigated in exceptional years – this creates social tension and discourages land preparation

Strategy 2
Field moisture conservation

- Repair of field bunds
- Ploughing
- Mulching
- Inner field bunds


TIMELY REPAIR OF FIELD BUNDS TO RESTORE WATER
DISTRIBUTION SYSTEM AND CAPACITY TO RETAIN WATER
ON SUBSEQUENT FLOOD
IMPORTANCE OF SUFFICIENT DRAUGHT ANIMALS
AND TRACTORS IN THE AREA
IN MANY AREAS THERE
ARE PENALTIES ON
NOT MAINTAINING FIELD BUNDS

GOOD PRACTICES IN MAINTAINING FIELD BUNDS

Leaving grass and vegetation on inner field bund

Rat control

PLOUGHING IS ESSENTIAL TO CONSERVE SOIL MOISTURE AFTER IRRIGATION

- IN SOME AREAS PLOUGHING IS DONE IN TWO DIRECTIONS
- IMPORTANCE OF NOT DELAYING PLOUGHING TOO LONG

MULCHING EQUIPMENT CAN BE IMPROVED

MULCHING REDUCES SOIL MOISTURE EVAPOTRANSPIRATION:
-SOMETIME DONE TWICE
-ALSO SOMETIMES FINE SAND COVER PROVIDED (‘SAND MULCHING’)

IMPROVED TECHNIQUE: DISC PLOUGHING AND MULCHING

Inner field bunds

- The main fields (bundras) in Pakistan are very large (from 0.4 to 17 ha in DI Khan for instance)
- Water depth in these large fields differs obviously (from 30-196 cm in head reach)
- This effect however is mitigated by:
  - Inner field bunds
  - Differential planting within the bundra
- Some have argued for land levelling – this is however impractical, too expensive and not necessary

Distribution Structures

Gabion Distribution Structures

- Advantages:
  - Stabilize the channel bed
  - Proportional distribution of the flow
- Disadvantages
  - Downstream scour and gullying may undermine the structure
  - Gabions may be difficult to repair (gabion mats not easily available)

Model 1: Flow divider

Flow divider

- Advantages
  - Easy to adjust flow distribution
  - Not sensitive to gullying

- Disadvantages
  - Only works where soil is hard and stony – otherwise it creates scour and erosion of banks

Model 2: Flow distribution structure

SOME HINTS

Important to survey channel bed downstream and check for gullies

The downsteam apron should be long and deep enough to withstand the upstream formation of gullies

SOME HINTS

Use of geotextiles

Prevents wash-out of fine materials underneath the gabions, which can lead to overturning

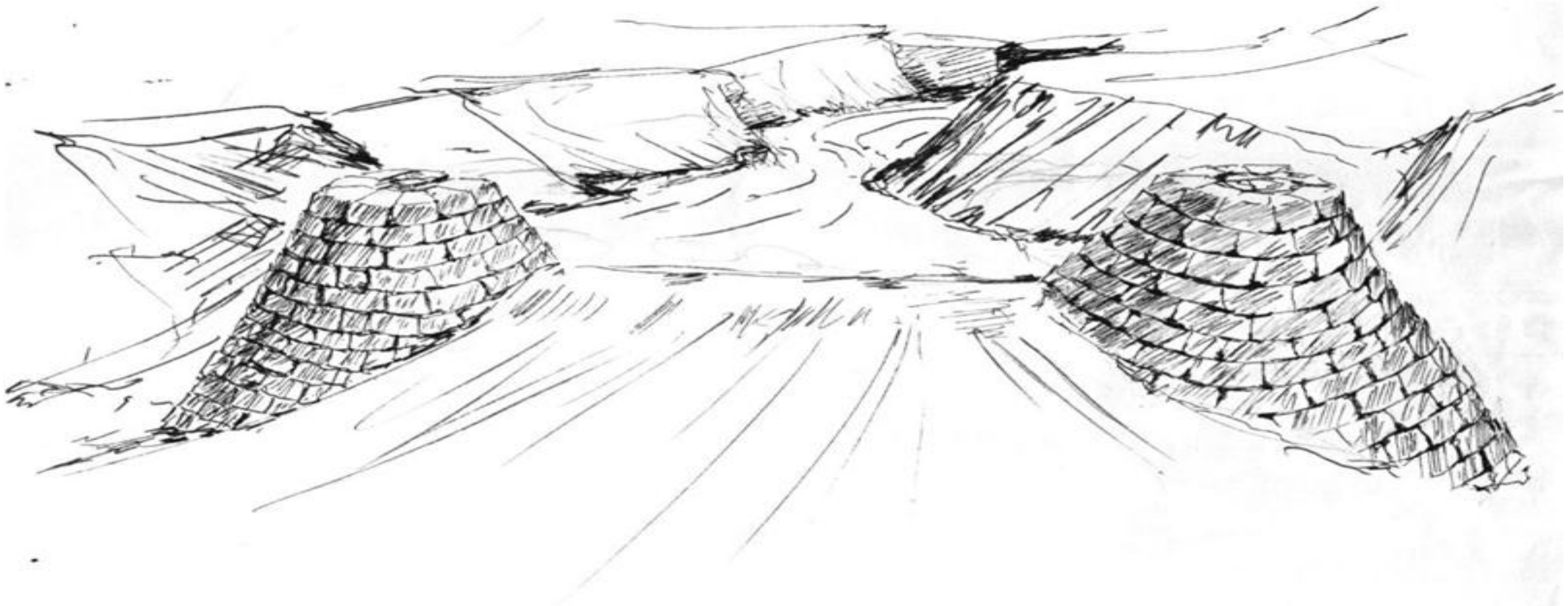
SOME HINTS

Geotextile inside gabion mattrass

Alternative to gabion structures

Stone cones buried deep inside river bed (Hadramawt, Yemen)

Stone cones



General principle!

Discuss and agree the water distribution structures with the representative and authorized group of water users:

- location
- proportion
- design

GROUNDWATER MANAGEMENT IN SPATE IRRIGATION SYSTEMS

Ground water use

- Source of drinking water, locally and regionally
- Cultivate high value horticultural crops


High value crops
For instance:
Papaya, Mango, Banana, Vegetables
Especially close
to main river bed
shallow water levels are high

Yet overuse occurs

Banana plantation (Yemen) failed because of ingression of saline water

Statement:
Because groundwater is very valuable, need to optimize recharge in spate irrigation areas

How to optimize recharge from spate flows?

- Recharge mainly from main riverbed – far less from main wadi flood channels or fields
- Recharge most effective from gravelly sections of the river bed
- Recharge most effective, if spate flows slow
- Recharge from flat sections of the river bed
- Recharge from water ponded at bunds and weirs
- Recharge from (subsurface) base flow
- Spread spate over large area to optimize recharge

What to do to optimize recharge from spate flows?

- Keep ‘rough’ gravel bed intact with floods flow (more roughness bed)– be careful not to remove too much gravel
- Consider low weirs/ bed stabilizers to slow down the flow
- Avoid excessive siltation in main recharge section of the river bed
- Do not block the subsurface flow through cut-off weirs or bed stabilizers!!

Not a good idea:

Wadi Siham weir in Yemen completely blocked subsurface flow and caused a dramatic drop in water levels in downstream wells

Not a good idea:

The same happened with this bed-stabilizer: it blocked the subsurface flow – causing the recharge of downstream wells to stop

Good idea:

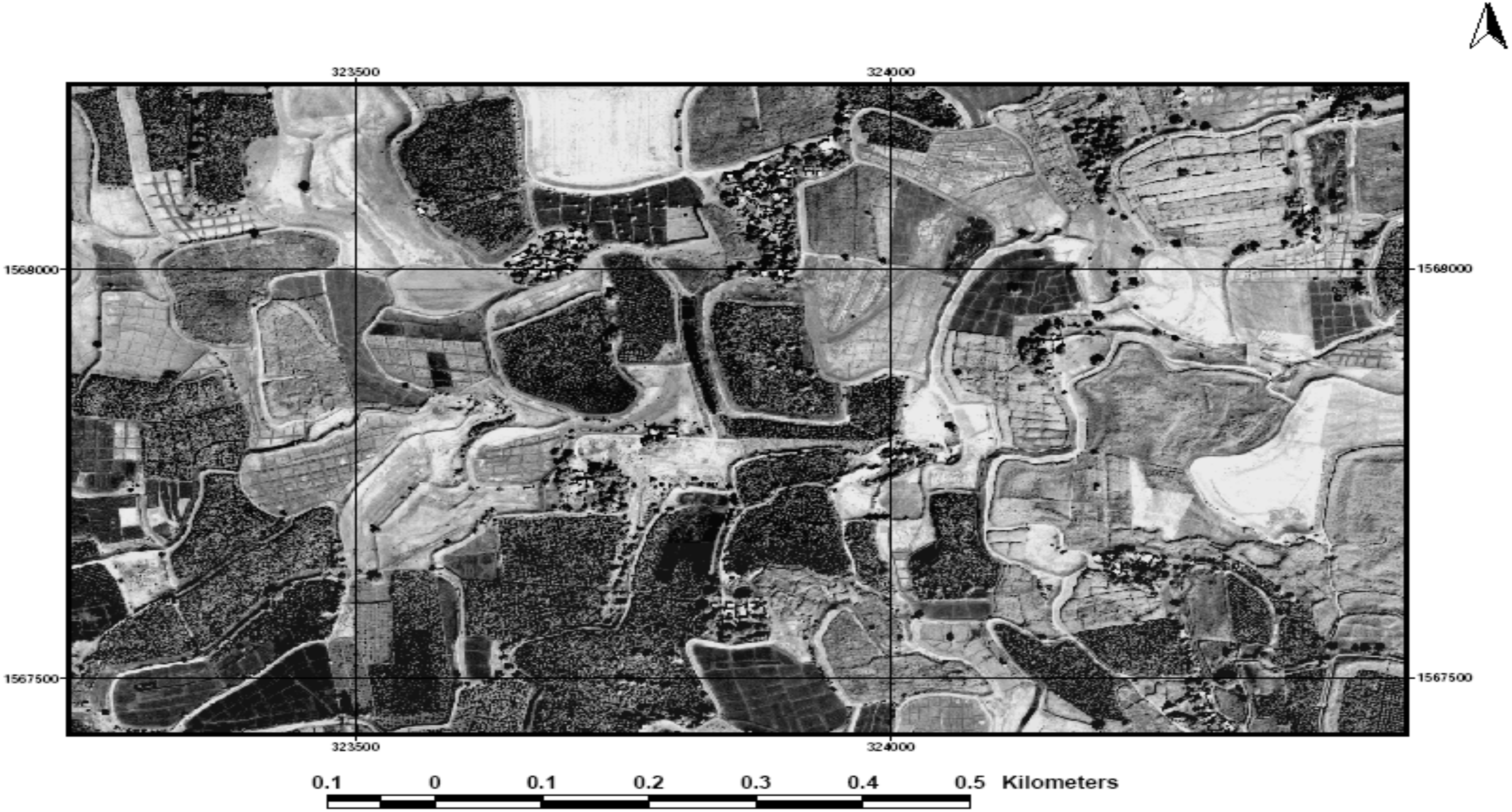
Farmers in this downstream area argued for a change in the traditional water distribution – with more chance of a flood going downstream

It was no so much the irrigation from the spate they were looking – instead they were interested in having their wells recharged

Good idea:

LOW RECHARGE WEIR
TO SLOW DOWN AND SPREAD FLOODS

FIELD WATER DISTRIBUTION

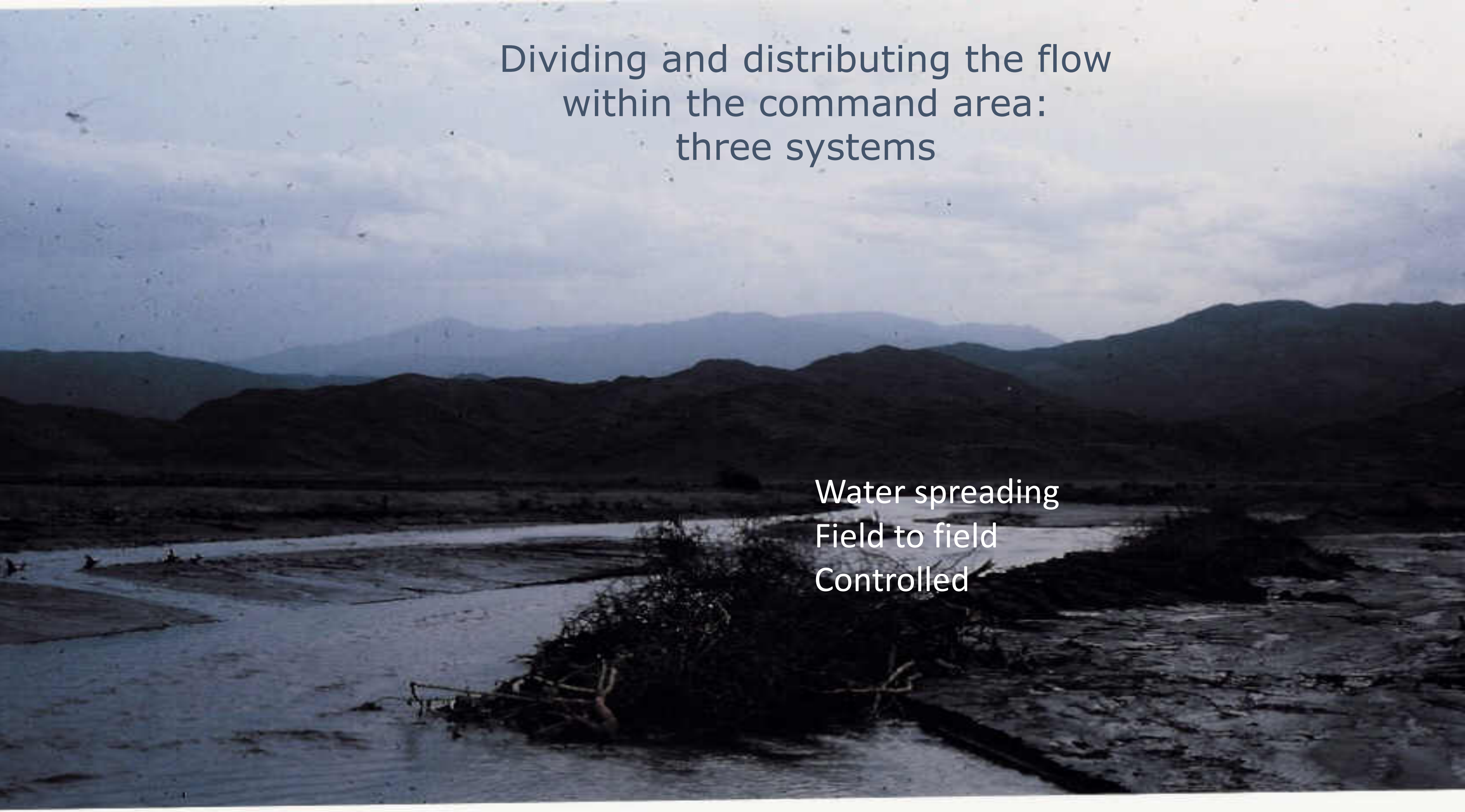


Field Water Management – General Principles

What is important

- Dividing and distributing the flows in manageable proportions
- Preventing spate water rapidly disappearing in low-lying areas – spreading the water around
- Ensuring large enough water volumes to reach the downstream areas

Dividing and distributing the flow within the command area: three systems



- Water spreading
- Field to field
- Controlled

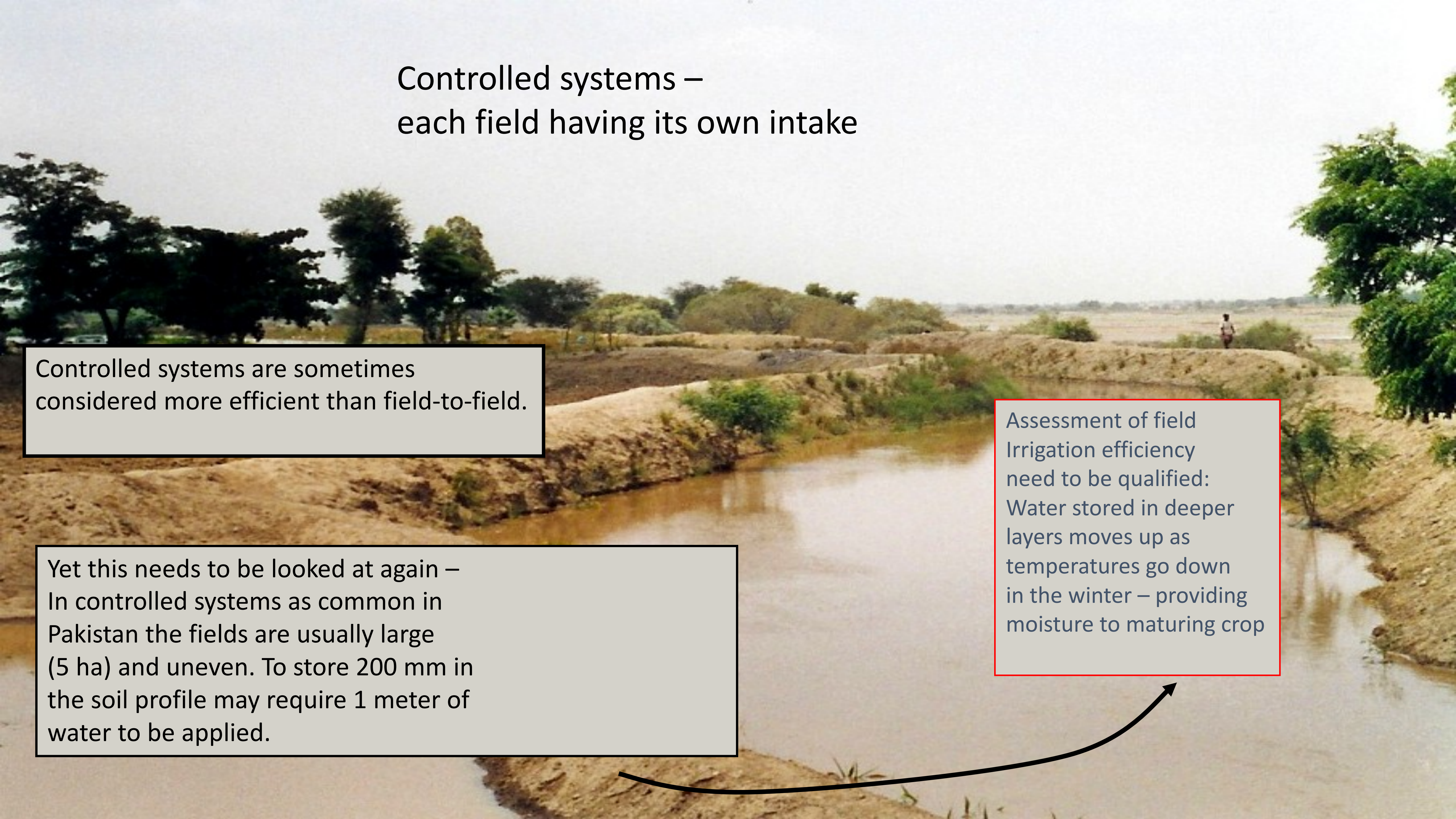
Water spreading through guide bunds


Field to field irrigation

To avoid erosion in field to field systems…

Field gates:
-controlled flow
-relatively costly

Irrigating the Rod-Kohi Field
Katcha Nacca


Controlled systems –
each field having its own intake
Controlled systems are sometimes considered more efficient than field-to-field.
Yet this needs to be looked at again – In controlled systems as common in Pakistan the fields are usually large (5 ha) and uneven. To store 200 mm in the soil profile may require 1 meter of water to be applied.
Assessment of field Irrigation efficiency need to be qualified: Water stored in deeper layers moves up as temperatures go down in the winter – providing moisture to maturing crop

Comparing field to field and controlled systems

Field to field systems	**Controlled systems**
No land for canals, but possible damage to crops in 2nd irrigation	Land required for canals – but these may be cultivated
Smaller floods later in season not diverted because of u/s cultivation	Smaller floods may no irrigate entire field, if plots are big
In-field scour due to breaching, though this will also remove sediment from command area	Gated structures will give full control over water diversion
Smaller floods not reaching tails	In large plots irrigation may be uneven
Time of breaching can be source of conflicts	
Damage to upstream field bunds will jeopardize new irrigation to lower areas	Sedimentation in canals may affect command

Priority:
Preventing spate water from quickly disappearing to low-lying areas before it has spread all over the command area

Importance of gully plugging

Plugging this gully (that developed after a major flood) avoided that floods quickly disappeared from this area and that soils dried out quickly