Possibilities and constraints of rainfed agriculture in Africa:

Securing food stocks by slowing the water flow

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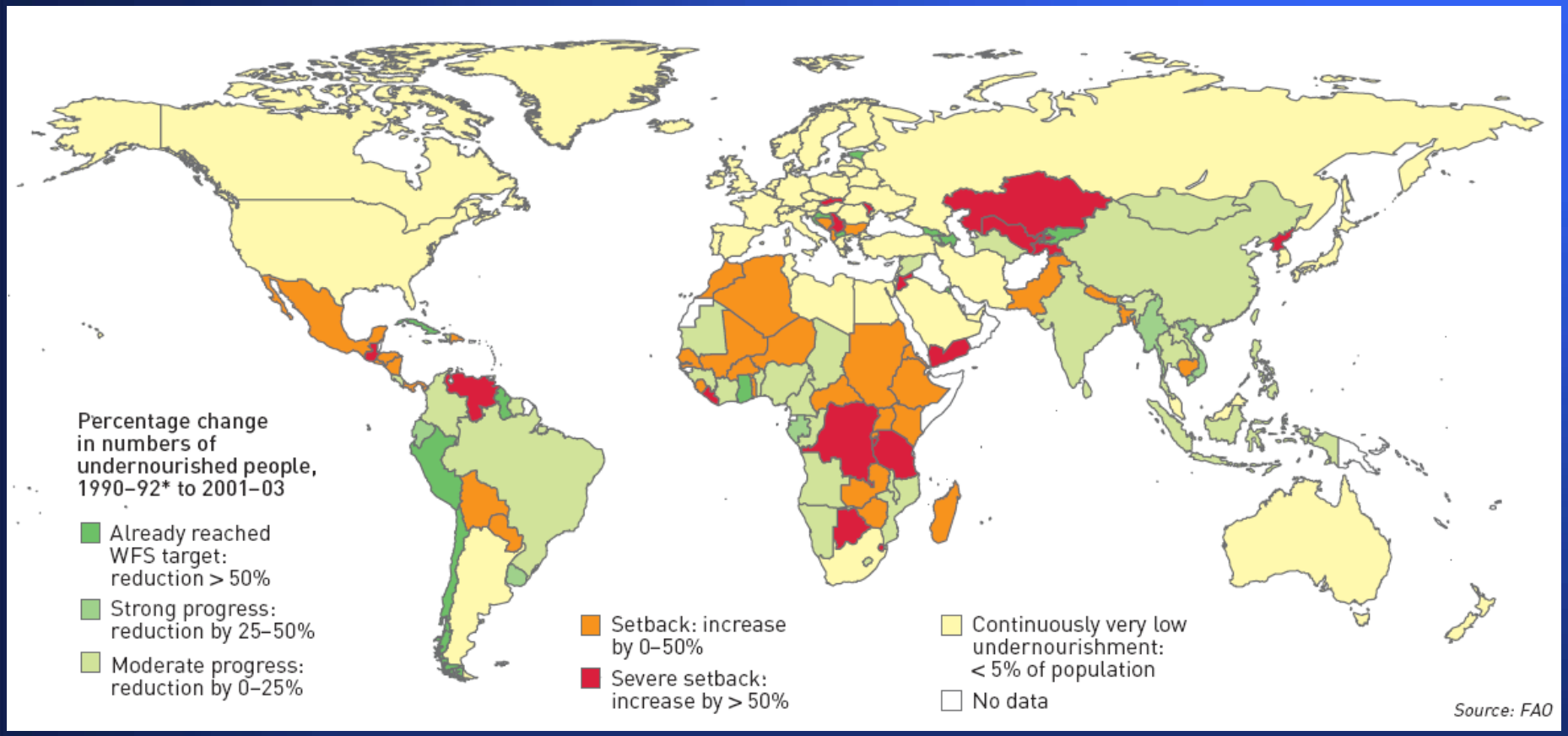
Outline

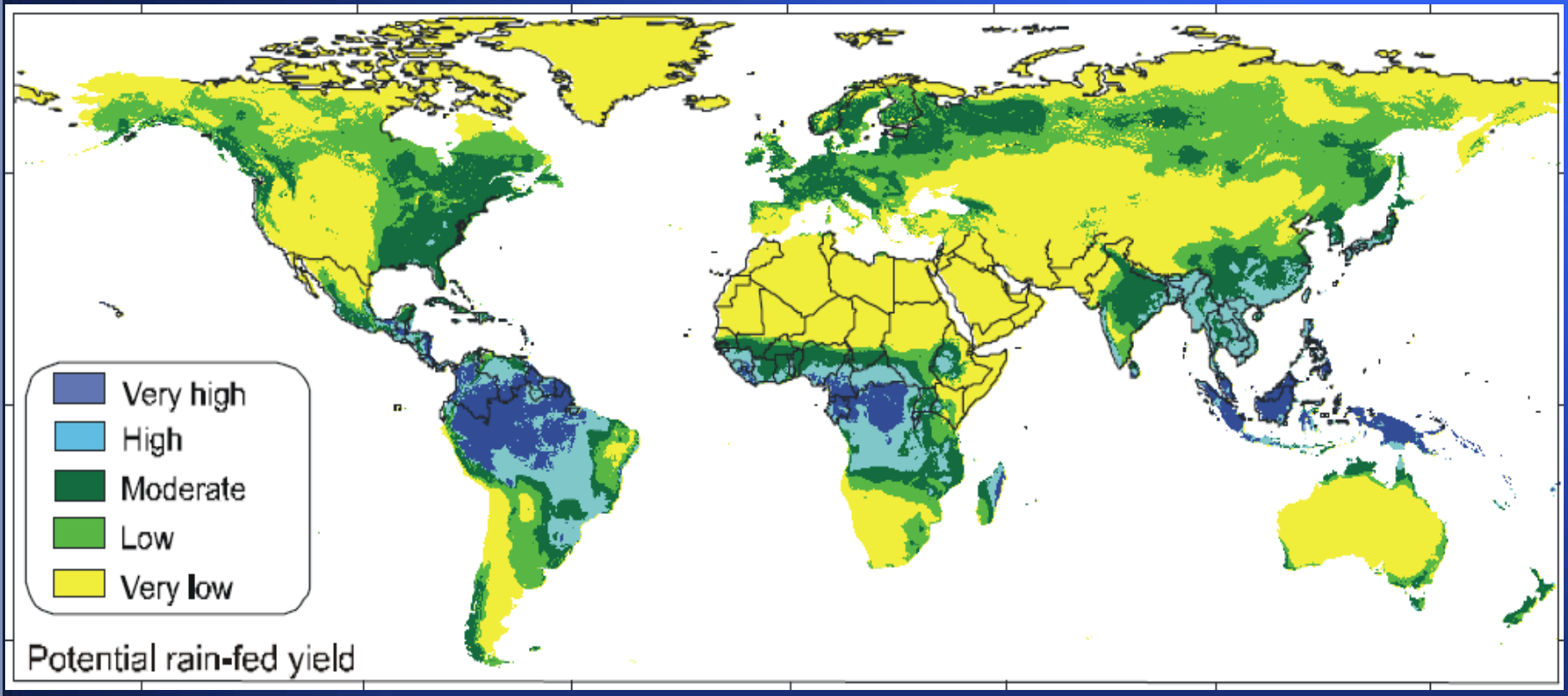
- Introduction: what is the problem?
- Water control: different approaches
- Increasing soil moisture availability
- Small-scale rainwater harvesting and water storage
- Additional strategies to secure livelihoods
- Conclusion

Introduction: what is the problem?



Source: The state of food insecurity in the world 2006

Introduction: what is the problem?



Source: Droogers et al., 2001

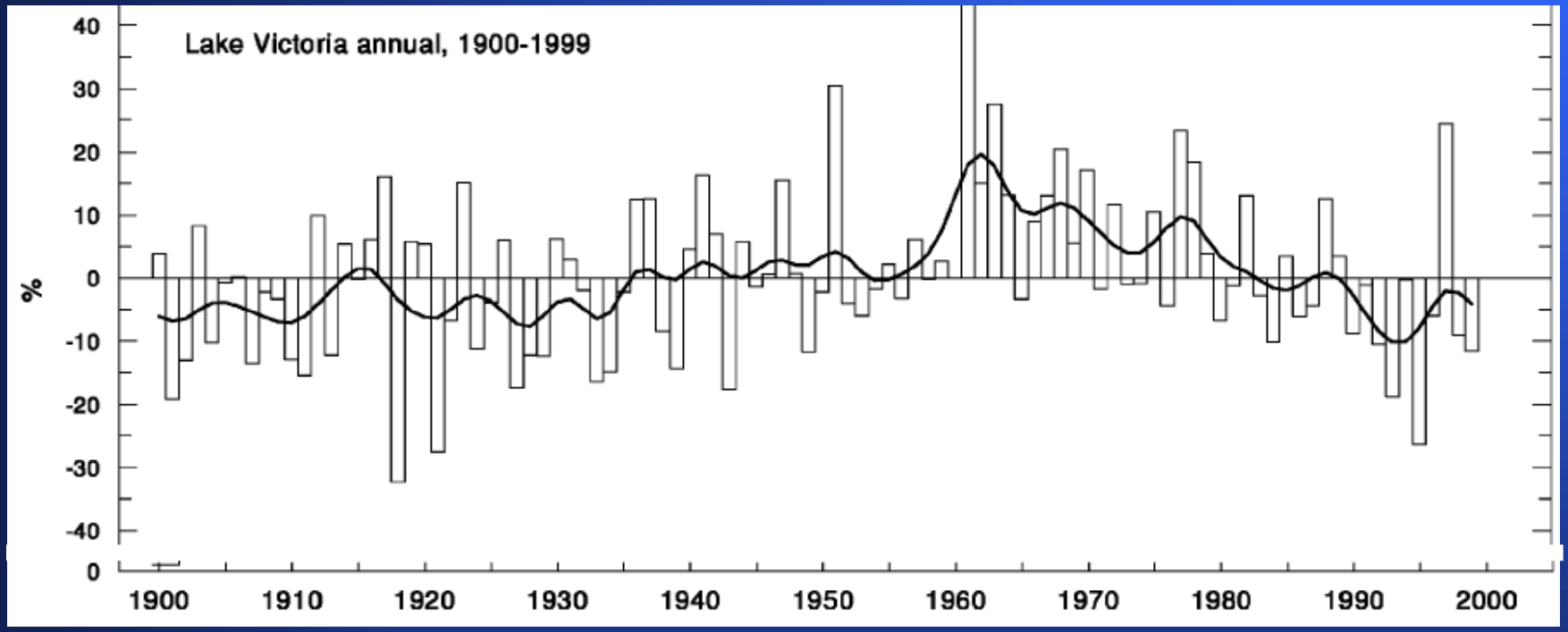
Introduction: what is the problem?

Constraining factors:

- nutrients
- water
- energy

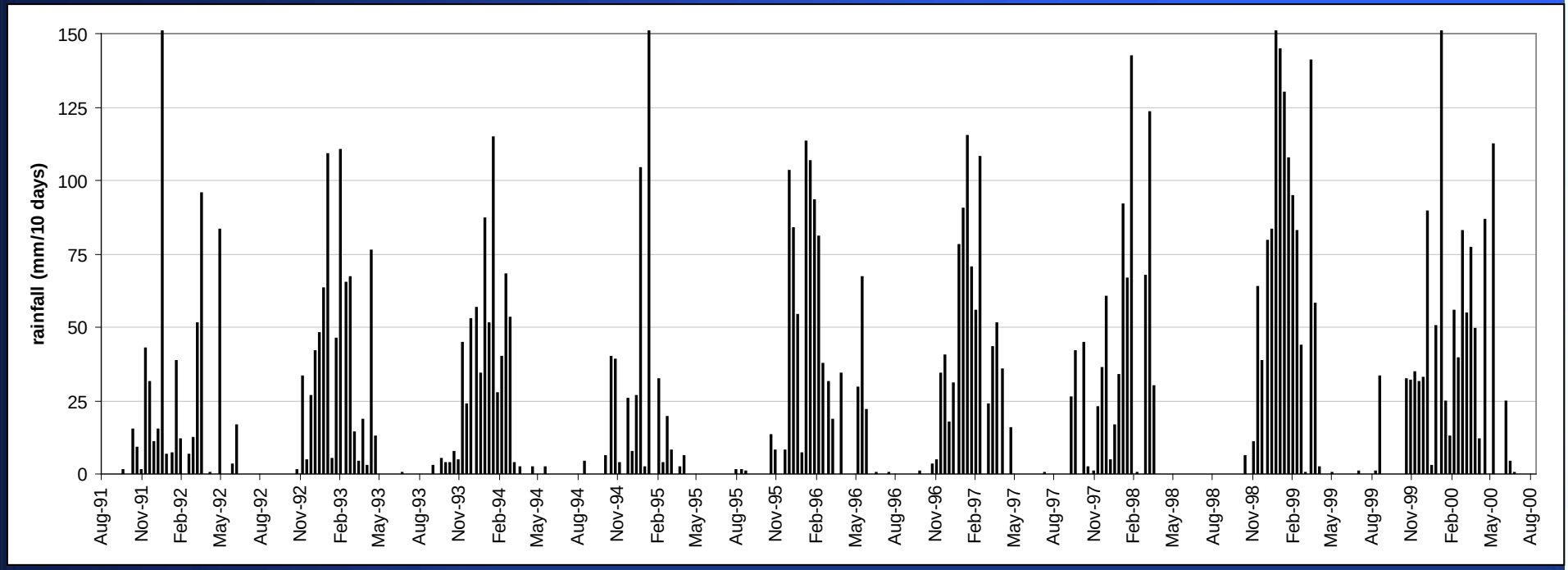
- capital
- markets

Lake Victoria catchment annual rainfall



Source: Conway, 2005

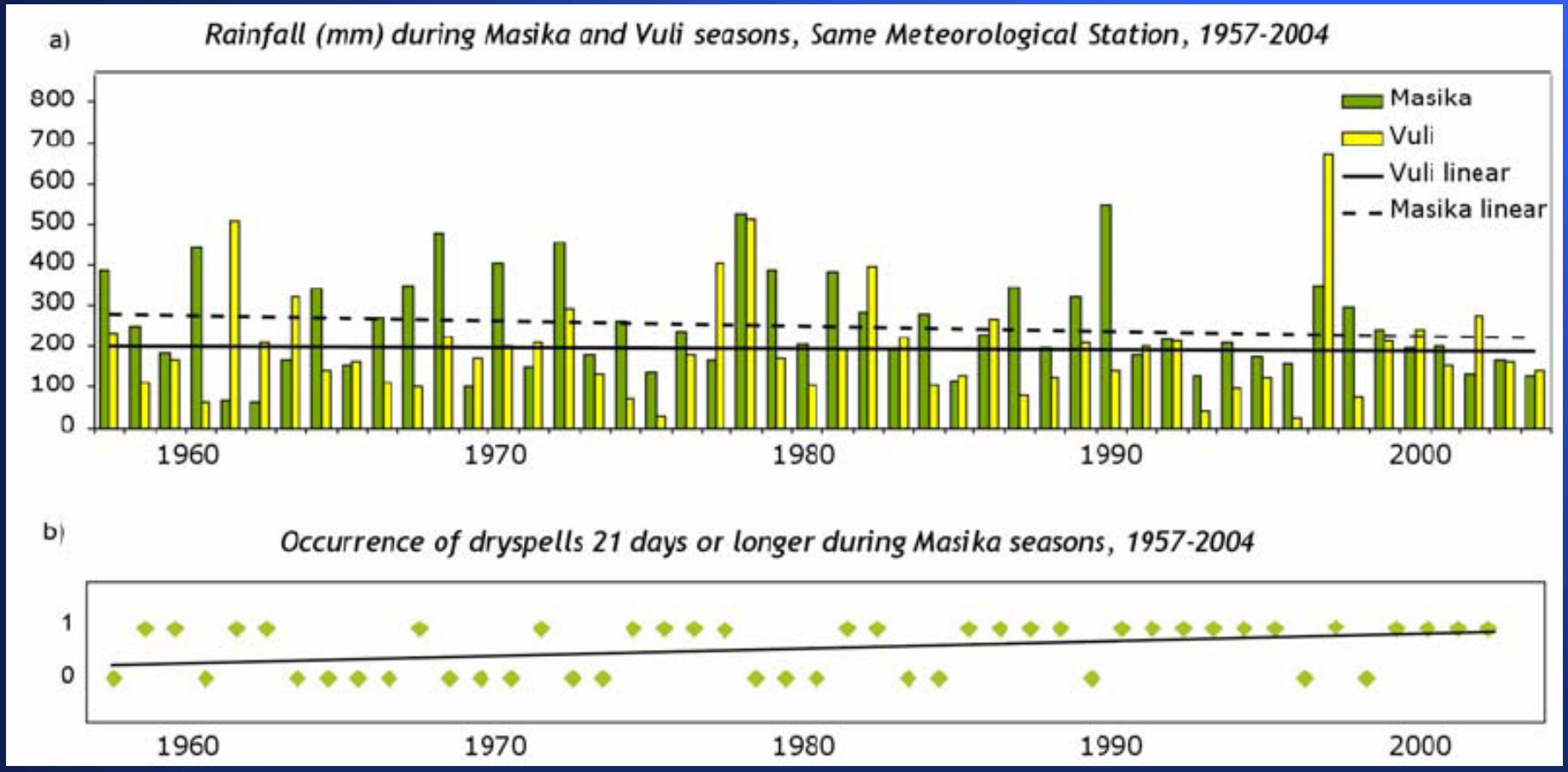
Harare 10-day rainfall



120 days 10-day rainfall (nov-feb) (mm/10 days)

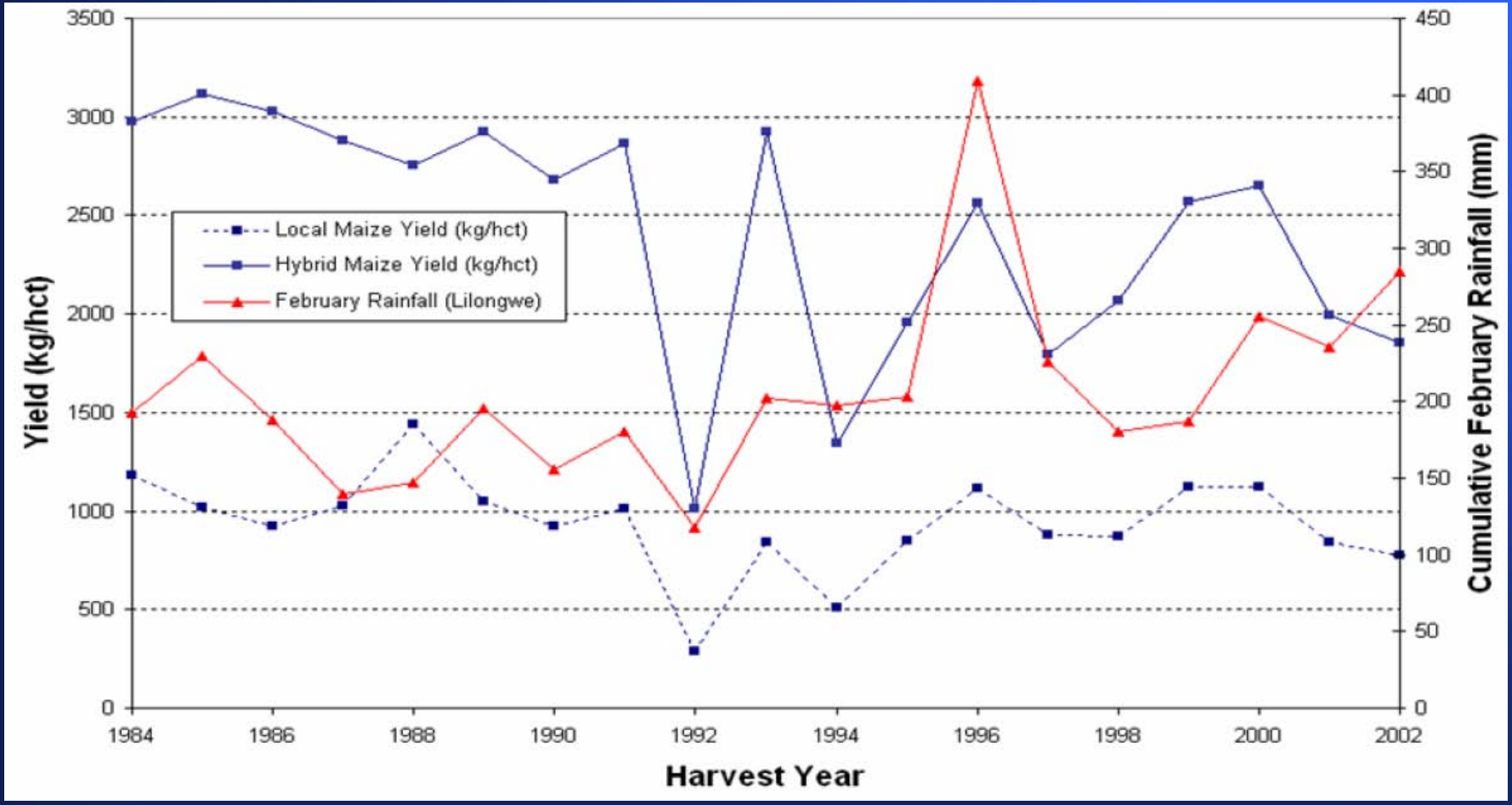
	91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99	99-00
avg	29.7	51.7	50.5	32.3	57.9	54.3	39.7	90.9	49.2
stdev	50.5	37.6	28.1	48.4	48.5	41.1	41.7	56.8	42.8
cv	1.70	0.73	0.56	1.50	0.84	0.76	1.05	0.62	0.87

North Tanzania seasonal rainfall



Source: Enfors and Gordon, 2007

Malawi annual rainfall and maize yields



Source: Hess and Syroka, 2005

Constraining factors:

- nutrients
- water
- energy

- capital
- markets

farming systems more resilient to rainfall variability

Increase buffering capacity:

- control over water
- capital goods: grain, cattle
- educate children
- financial insurance

Water control

Different approaches:

- irrigation development: primary focus on “blue” water
- rainfed agriculture: rainfall as a starting point

NEPAD’s agricultural development programme:
double irrigated area over 2002-2015; 37 billion USD

- large scale irrigation schemes: 61%
- small-scale irrigation: 21%
- investments in wetlands and valley bottoms: 6%
- soil, water and land improvements: 12%

Water control

Different approaches:

- irrigation development: primary focus on “blue” water
- rainfed agriculture: rainfall as a starting point

Many experts prioritise the latter, because:

- the large majority of farmers are rainfed who produce the bulk of all food
- conventional (government-initiated) irrigation is expensive, with disappointing results, benefiting few farmers

Water control

Meanwhile farmers have adopted, adapted and developed many small-scale water control techniques:

- these aim at securing yields from rainfed crops through slowing the water flow in the landscape:
  - capturing the rain as and when it falls,
  - improving its infiltration into the unsaturated zone, and
  - storing a relatively small part of surface runoff in tanks for use during the inevitable periods of dry spells.

Water control

Buffering rainfed systems against dry spell requires some 100 to 200 mm of additional water storage capacity:

- increase soil moisture availability
- if insufficient, add supplementary irrigation derived from rainwater harvesting and storage

Increase soil moisture availability

Increase soil moisture availability:

- increase infiltration of rainfall water
- improve the development of the root system of the crop
- decrease unproductive water losses such as soil evaporation and transpiration of weeds

Focus on:

- tillage: minimum tillage, ripping, subsoiling, mulching
- contour ridging, terracing

Tillage

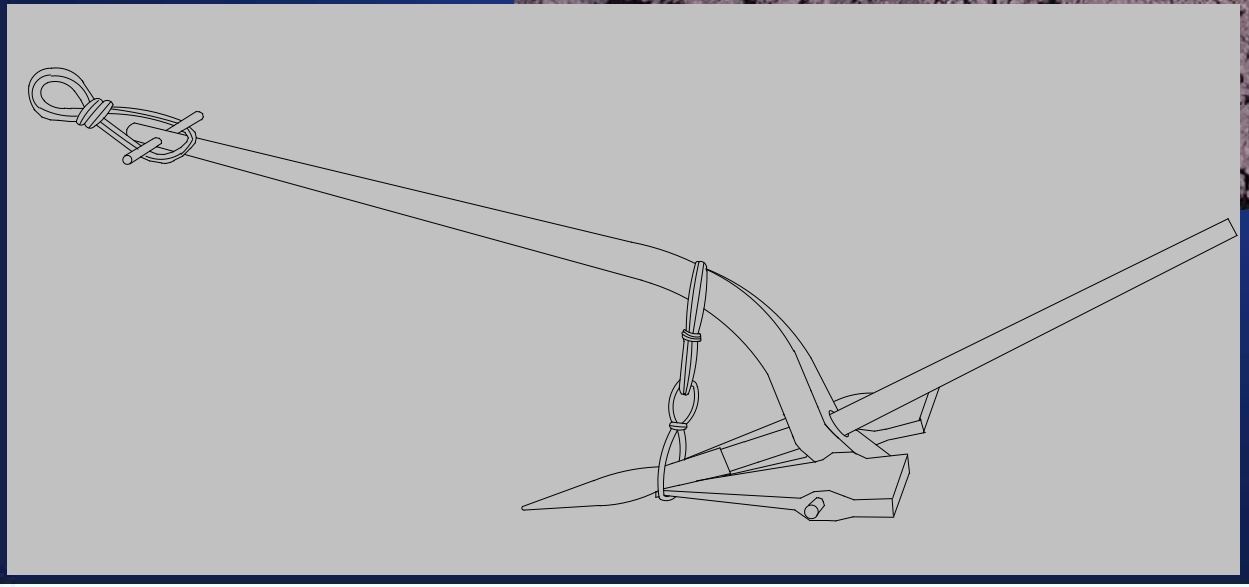
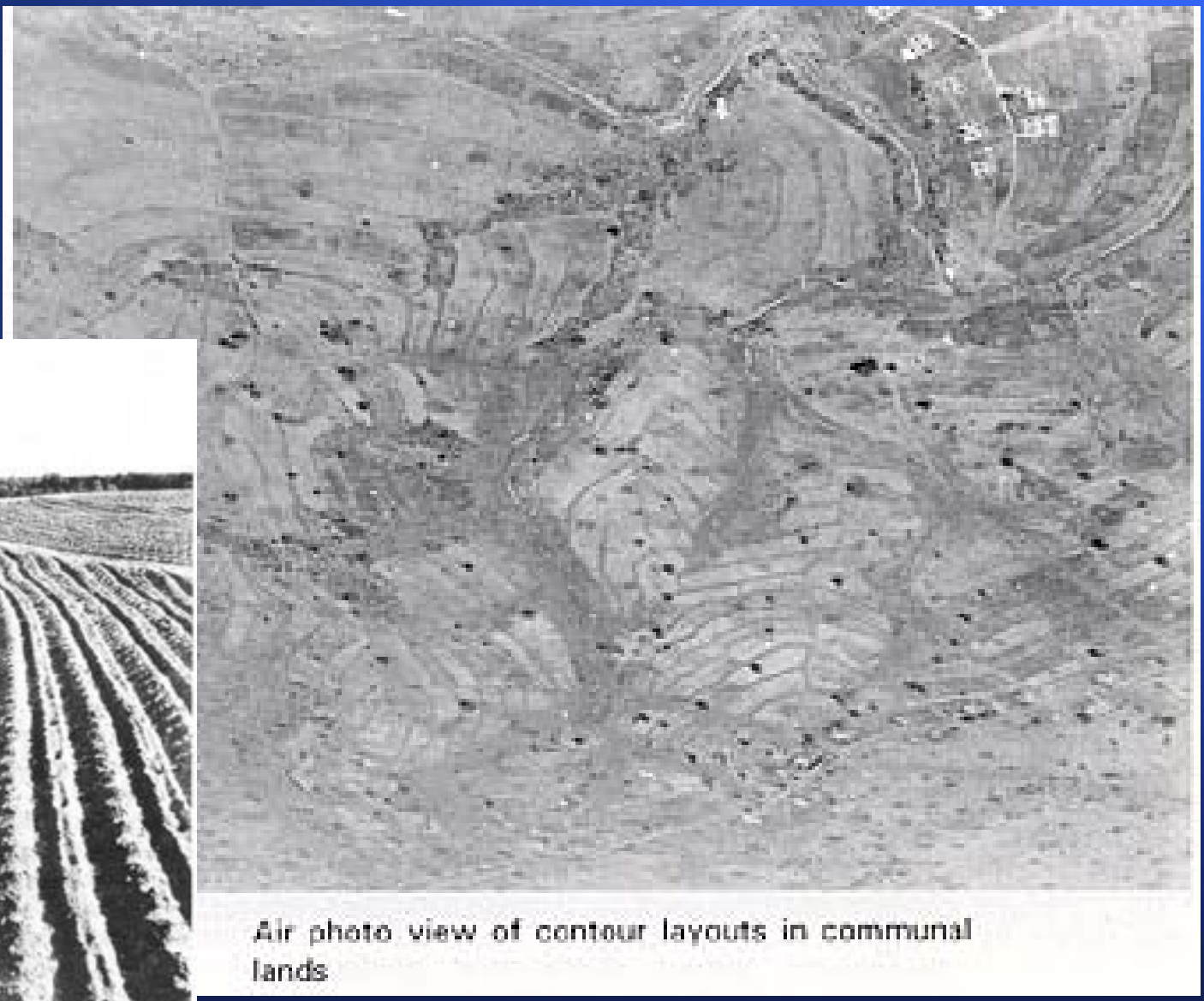


Photo and drawing:
Melesse Temesgen

Tillage

Photo: Melesse Temesgen

Contour ridges



Air photo view of contour layouts in communal lands

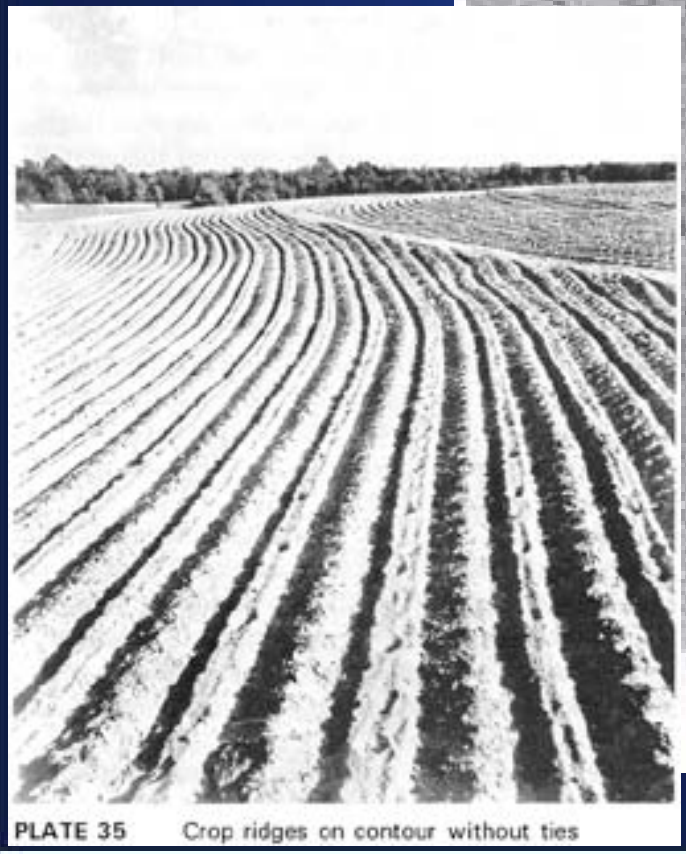
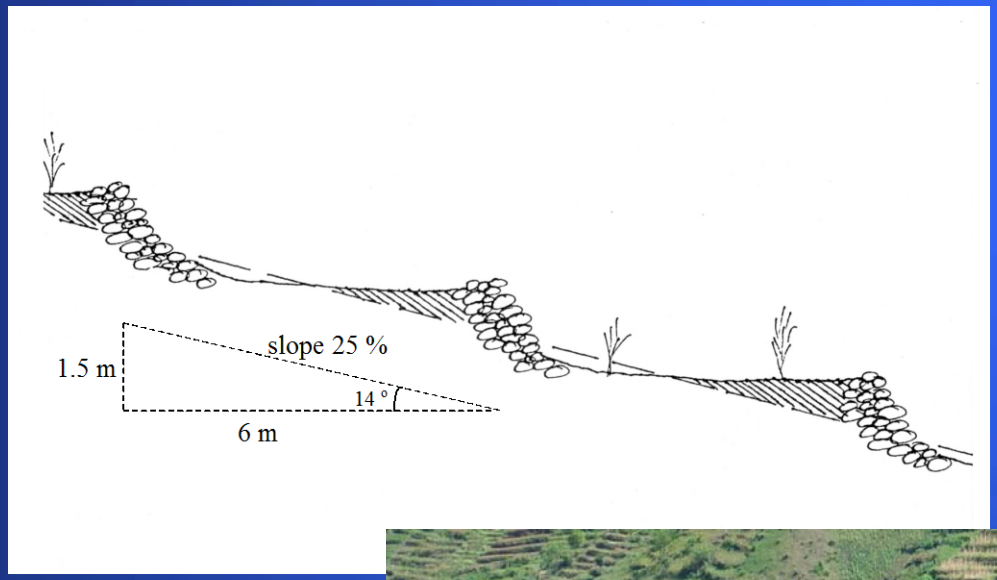


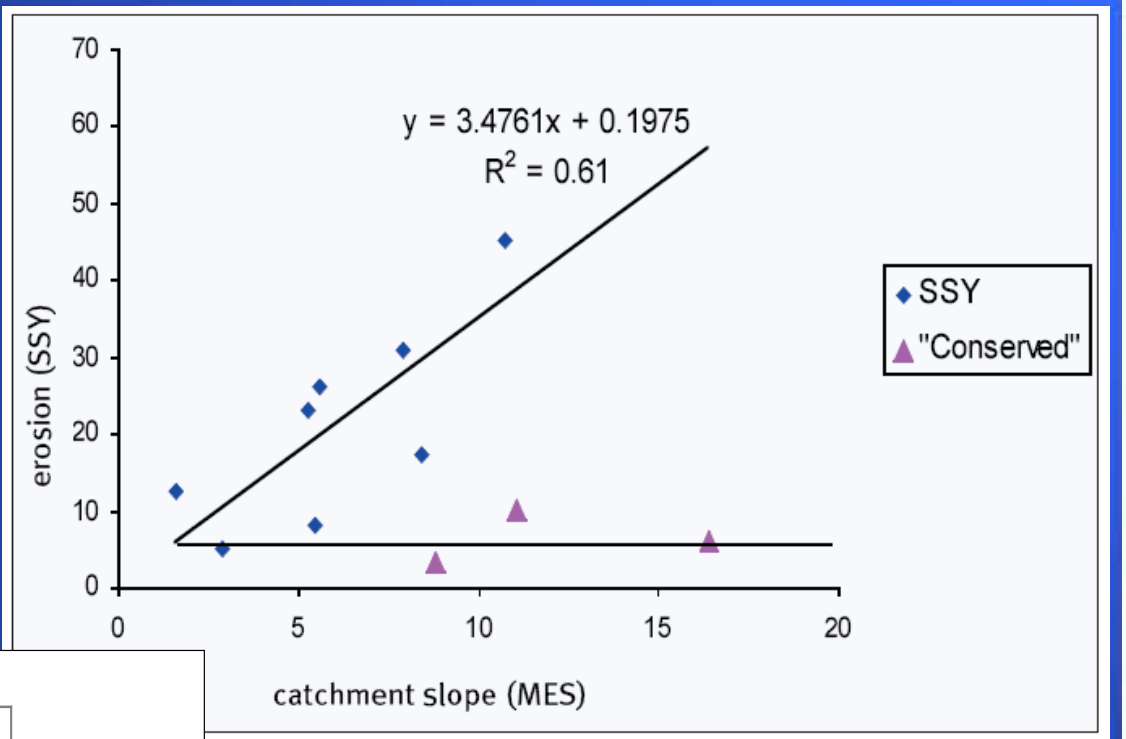
PLATE 35 Crop ridges on contour without ties

Photos: H.A. Elwell; FAO website

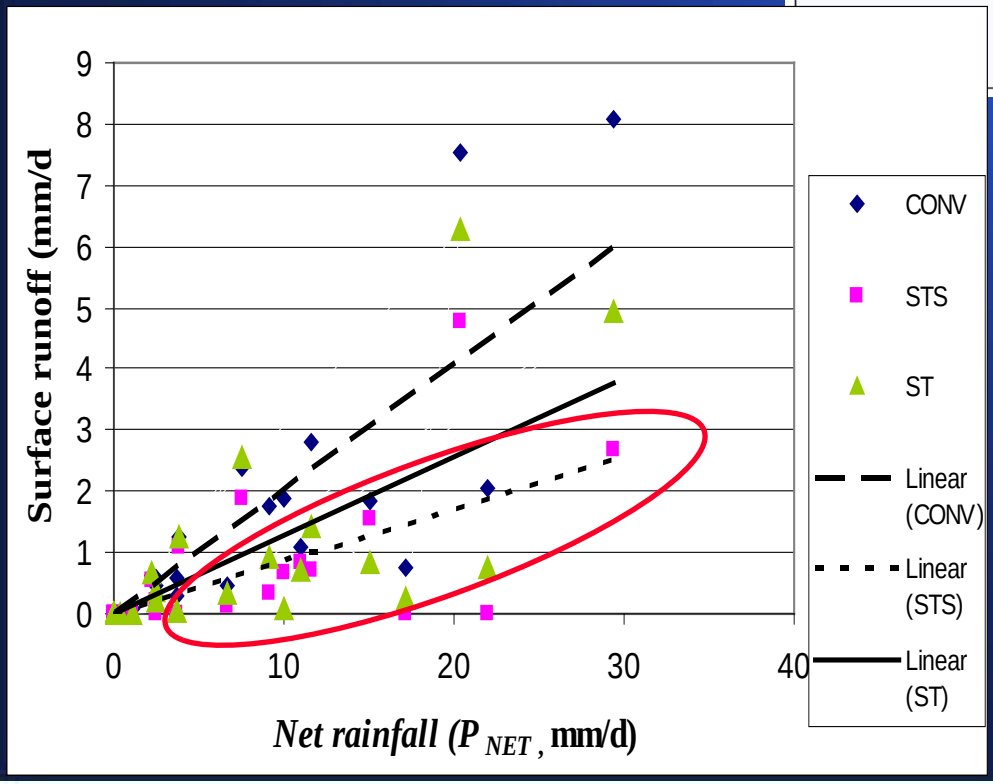
Terraces



SSI project



Source: Vlek, 2005



Source: Temesgen, 2007

Rainwater harvesting and storage

Enlarge the catchment area for a crop:

- plant scale: reduce planting densities, *matengo* pits in Tanzania, *tassa* pits and half moon basins in Niger, and *zaï* pits in Mali (Reij et al., 1996)
- plot scale: “harvest” surface runoff from adjacent plots or roads,
  - apply it instantaneously onto the field
  - store it temporarily

SSI project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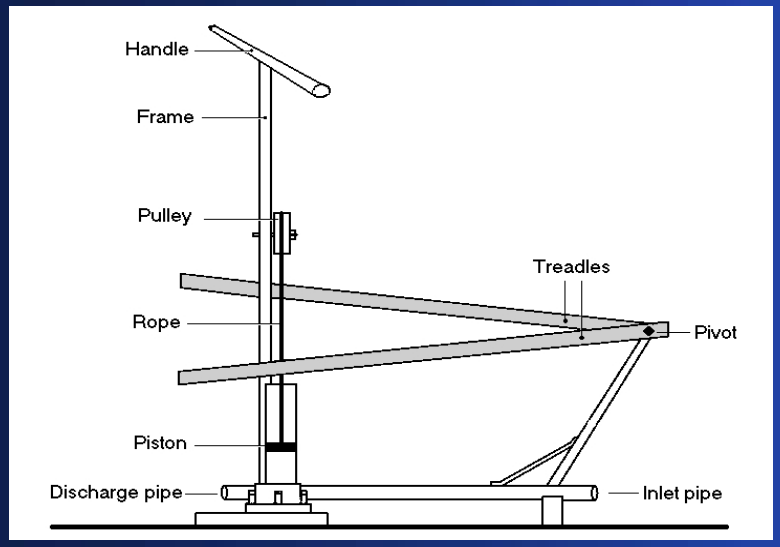
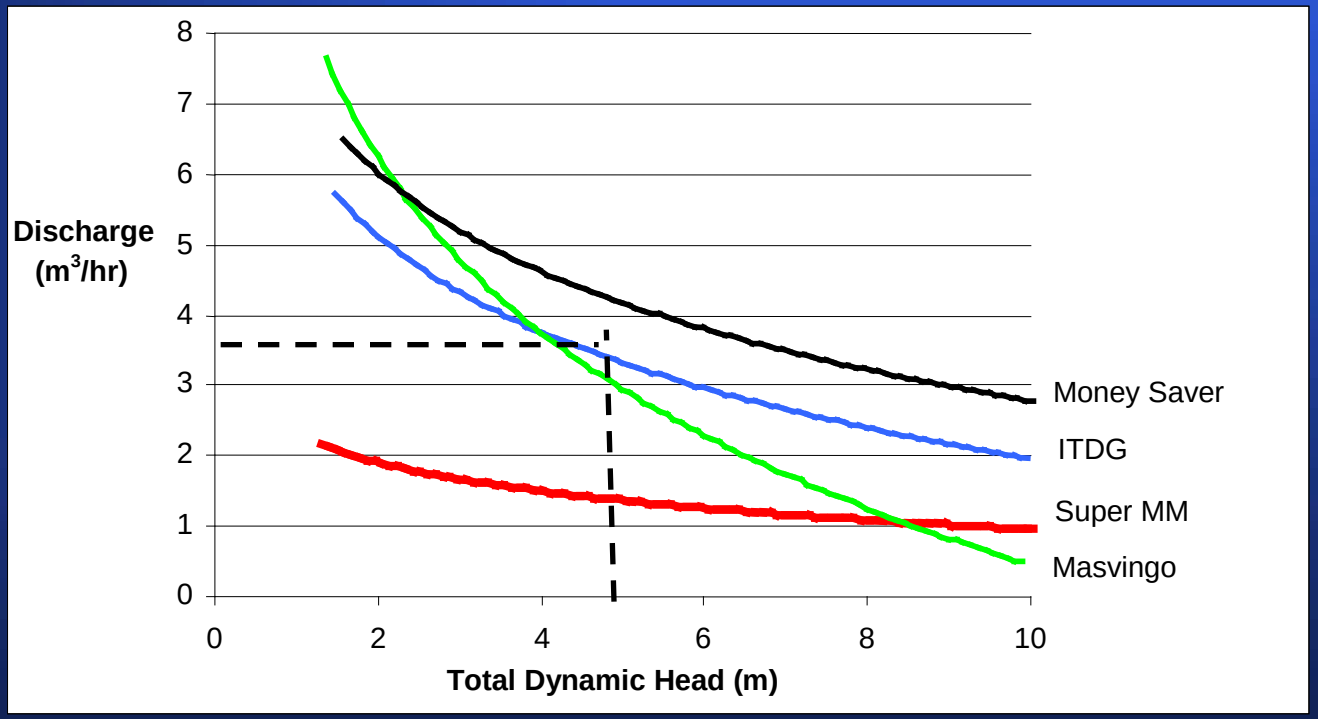
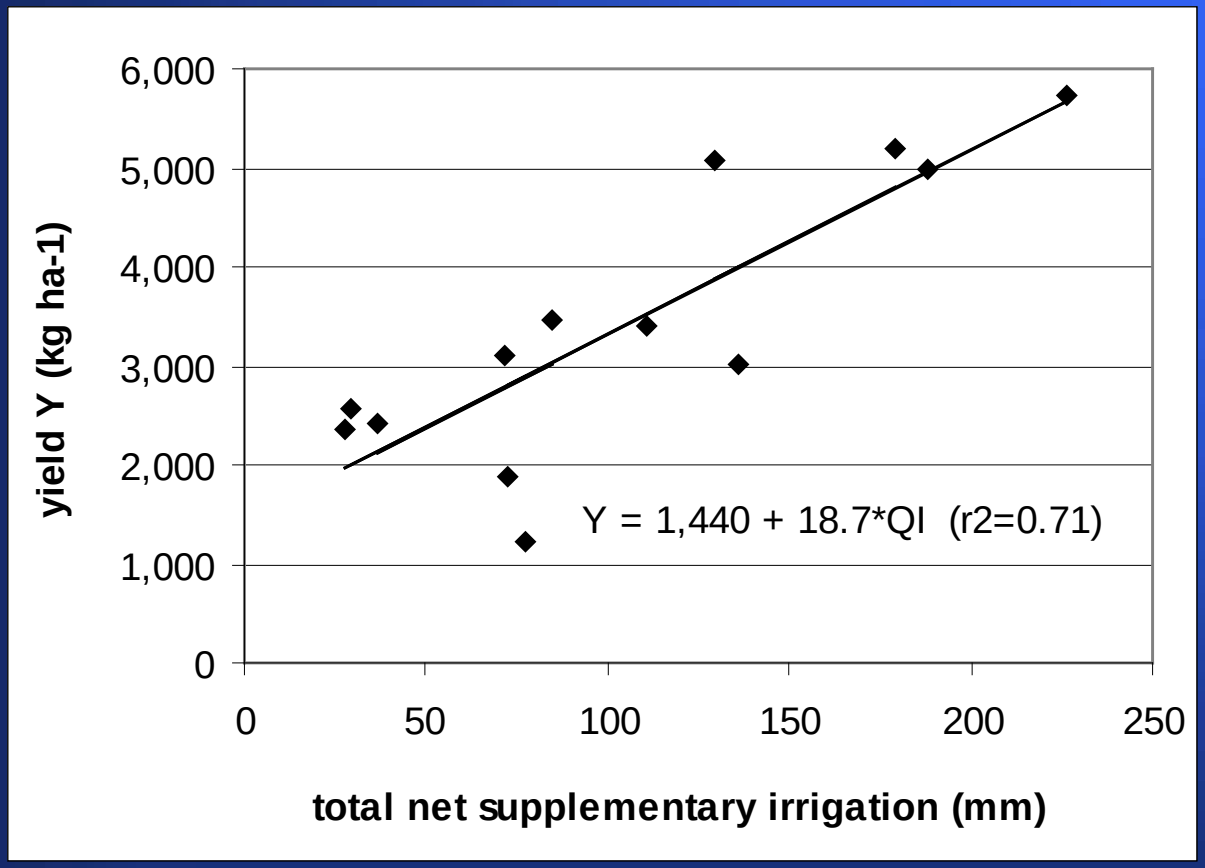




Source: Chigerwe et al., 2004



Source: Pazvakawambwa and Van der Zaag, 2000

Marginal productivity of supplementary irrigation is high (in the order of 1.5-2 kg maize per m^3)

- tanks + pumping device may “lift” people out of the poverty trap
- hence such investments have a high social value

But

- reservoirs + pumps are relatively expensive
- requires targeted subsidies
  - South Africa: the “water for food movement” and the “war on hunger” programme
  - this is the type of *distributed* access to increased water storage that Africa needs (cf. Grey & Sadoff 2006)

Impact

Soil conservation with rainwater harvesting

- improve the development of the root system of the crop
- improve infiltration rates and soil moisture availability
- increase crop yields
- reduce storm runoff and soil loss

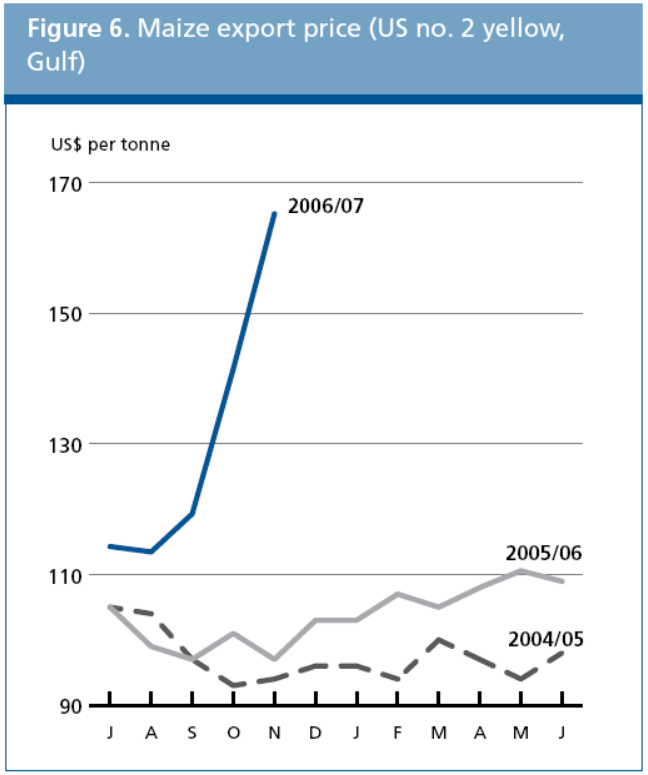
Impacts at the larger (spatial and temporal) scale

- increases the water value in the catchment
- positive externalities are likely, but difficult to quantify
  → on-going research
- “green water credits” suggested by ISRIC & SEI as a form of payment for environmental services

Additional strategies to secure livelihoods

Once the stochastic variable has been “tamed”, farmers may afford to invest in fertilizer; however

- high response rates are not high enough
- I/O ratio (kg grain required to buy 1 kg fertilizer) is too high:
  - increase farm gate price of grain
  - re-subsidise fertilizer



Source: FAO Food Outlook Dec 2006

Conclusion

- Farmers are not only the food makers but also the custodians of rainfall and watershed managers
- By combining rainfall and runoff water farmers question the sharp distinction between rainfed and irrigated agriculture

  → "green" the water depts., and "blue" the agric depts.
- Farmers have a major role in achieving the MDGs; governments should create "farmer friendly" conditions:
  - farm-gate prices of crops should be fair
  - subsidise investments in soil conservation
  - subsidise investments in distributed water storage
  - re-introduce subsidies on fertilizers (rather than invest in large-scale irrigation schemes)
- Research the watershed & catchment-wide externalities

“If water is running make it walk,
if water is walking make it stand,
if water is standing make it sit,
if water is sitting make it sleep.”

Upanishad
(cited in Vishnudas, 2006)