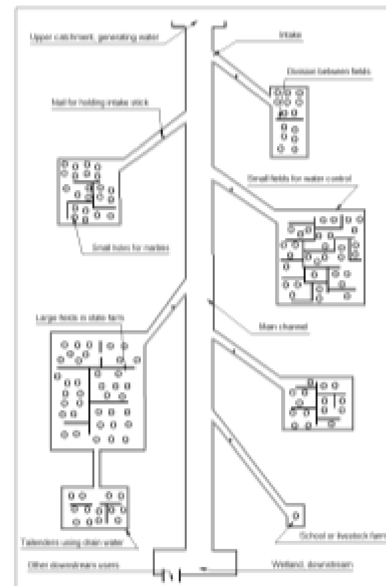
The River Basin Game: A game for discussing water use and allocation in rural contexts where irrigation is growing and consumes much water

Bruce Lankford

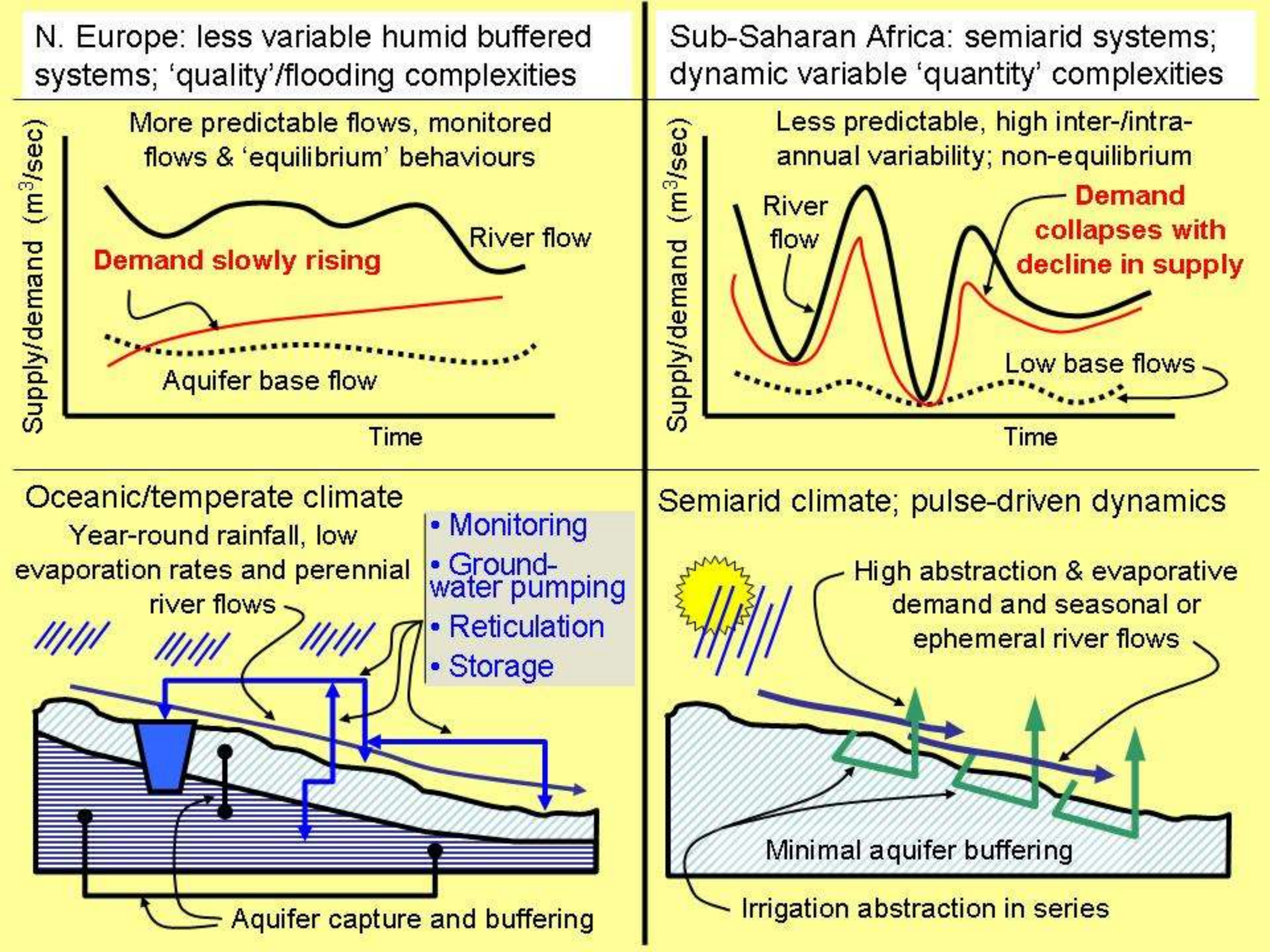


There are authors and reports (Malabo, 2018) that argue rural development in Sub-Saharan Africa simply needs more irrigation. (Irrigation brings income, food security, cash, jobs etc). But these can be illiterate & innumerate; they forget drought and dry seasons and ignore how irrigation depletes large volumes of water, harming downstream river health, communities and urban economies

Managing rural water in African River Basins

In large remote semi-arid river basins with irrigation, how do we increase local participatory ownership of water management problems so that we balance water supply between top-end and tail-end irrigators *and* between upstream irrigation and downstream needs (environment, cities, hydropower)?

"In recent years, many countries have experienced a formal shift from command-and-control and prescriptive management of natural resources towards policy making and planning processes that build on collaboration, negotiation and deliberation among policy-makers, scientists and local stakeholders". Neef, A. (2009). Transforming rural water governance: Towards deliberative and polycentric models? *Water Alternatives*, *2*(1), 53.

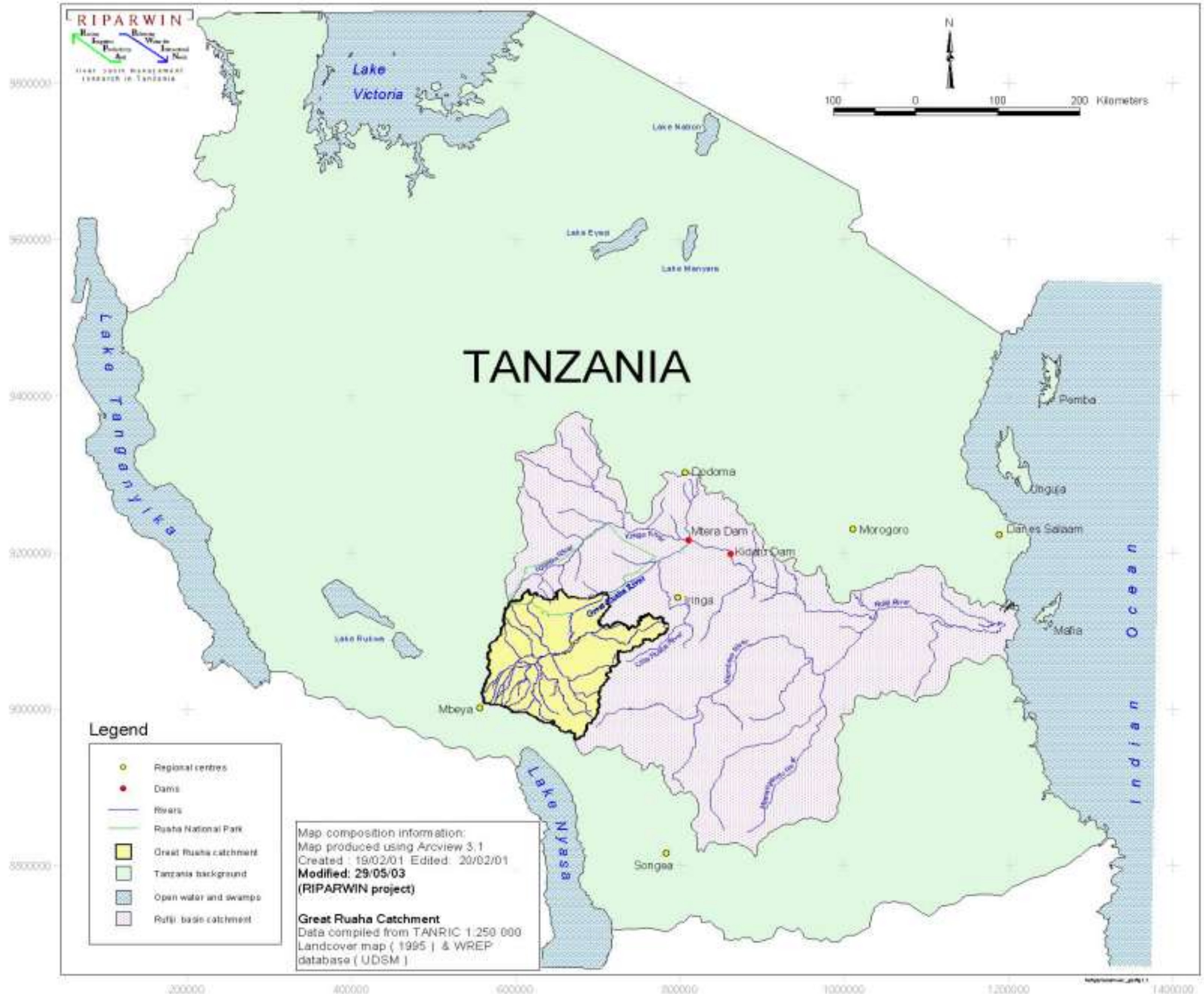


N. Europe: less variable humid buffered systems; 'quality'/flooding complexities
Sub-Saharan Africa: semiarid systems; dynamic variable 'quantity' complexities
More predictable flows, monitored flows & 'equilibrium' behaviours
Supply/demand (m3/sec)
River flow
Demand slowly rising
Aquifer base flow
Time
Less predictable, high inter-/intra-annual variability; non-equilibrium
Supply/demand (m3/sec)
River flow
Demand collapses with decline in supply
Low base flows
Time
Oceanic/temperate climate
Year-round rainfall, low evaporation rates and perennial river flows
• Monitoring
• Ground-water pumping
• Reticulation
• Storage
Aquifer capture and buffering
Semiarid climate; pulse-driven dynamics
High abstraction & evaporative demand and seasonal or ephemeral river flows
Minimal aquifer buffering
Irrigation abstraction in series

Why is river basin management and irrigation regulation required in Usangu, Tanzania?

- Hydrological change during 90's, permanent to seasonal river - seen as 'drying-up of the river'
- Animal mortality and environmental harm done in Usangu Wetland & Gt Ruaha National Park
- Hydro-electric power cuts from Mtera/Kidatu dams
- Increase in rice area irrigated and season length?
- Changes in designs of irrigation intakes?
- Climate change and less rainfall?
- Deforestation?
- Too many livestock in the wetland?

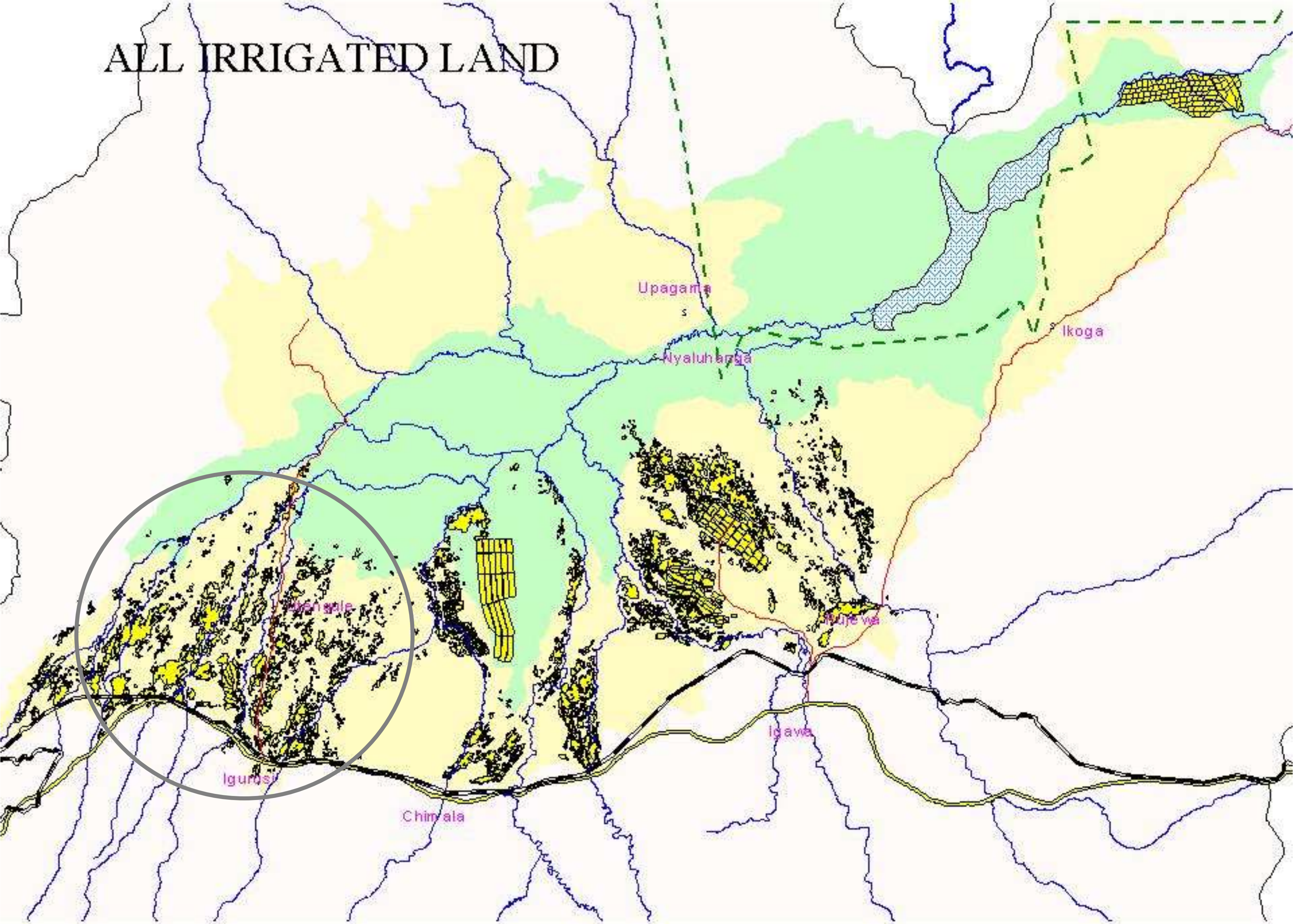
Correct and incorrect perceptions of causes of hydrological change



RIPARWIN
Lake Victoria
Lake Natron
Lake Eyasi
Lake Manyara
N
100 0 100 200 Kilometers
TANZANIA
Lake Tanganyika
Pemba
Unguja
Dar es Salaam
Mafia
Indian Ocean
Dodoma
Mtera Dam
Kidatu Dam
Morogoro
Iringa
Great Ruaha River
Lake Rukwa
Mbeya
Lake Nyasa
Songea
Legend
Regional centres
Dams
Rivers
Ruaha National Park
Great Ruaha catchment
Tanzania background
Open water and swamps
Rufiji basin catchment
Map composition information:
Map produced using Arcview 3.1
Created : 19/02/01 Edited: 20/02/01
Modified: 29/05/03
(RIPARWIN project)
Great Ruaha Catchment
Data compiled from TANRIC 1:250 000
Landcover map (1995) & WREP
database (UDSM)
200000
400000
600000
800000
1000000
1200000
1400000

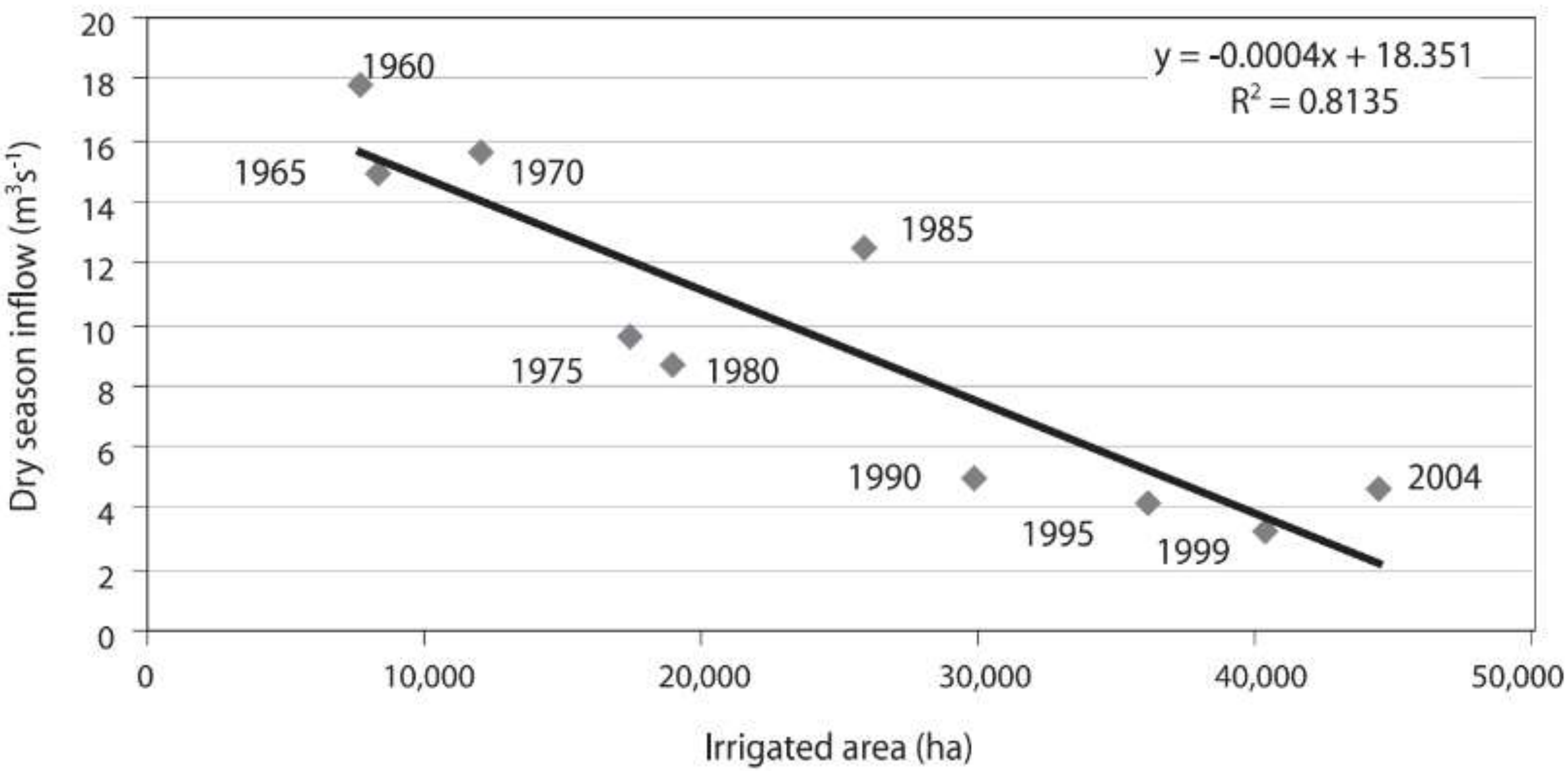

IMAGE OF 14TH AUGUST 1994
(Ihefu swamp)
Drying up river bed & shrinking wetland

ALL IRRIGATED LAND



Comparison of the Ruaha dry season inflow to the Usangu wetland and irrigated area in the Usangu catchment

- Irrigated area has grown over time from the 1960s (initial planting 1930s)
- The greater the area of irrigation, the lower the flow of the Ruaha River in dry season
- But not just area: the design of the irrigation intake also matters (next pages)



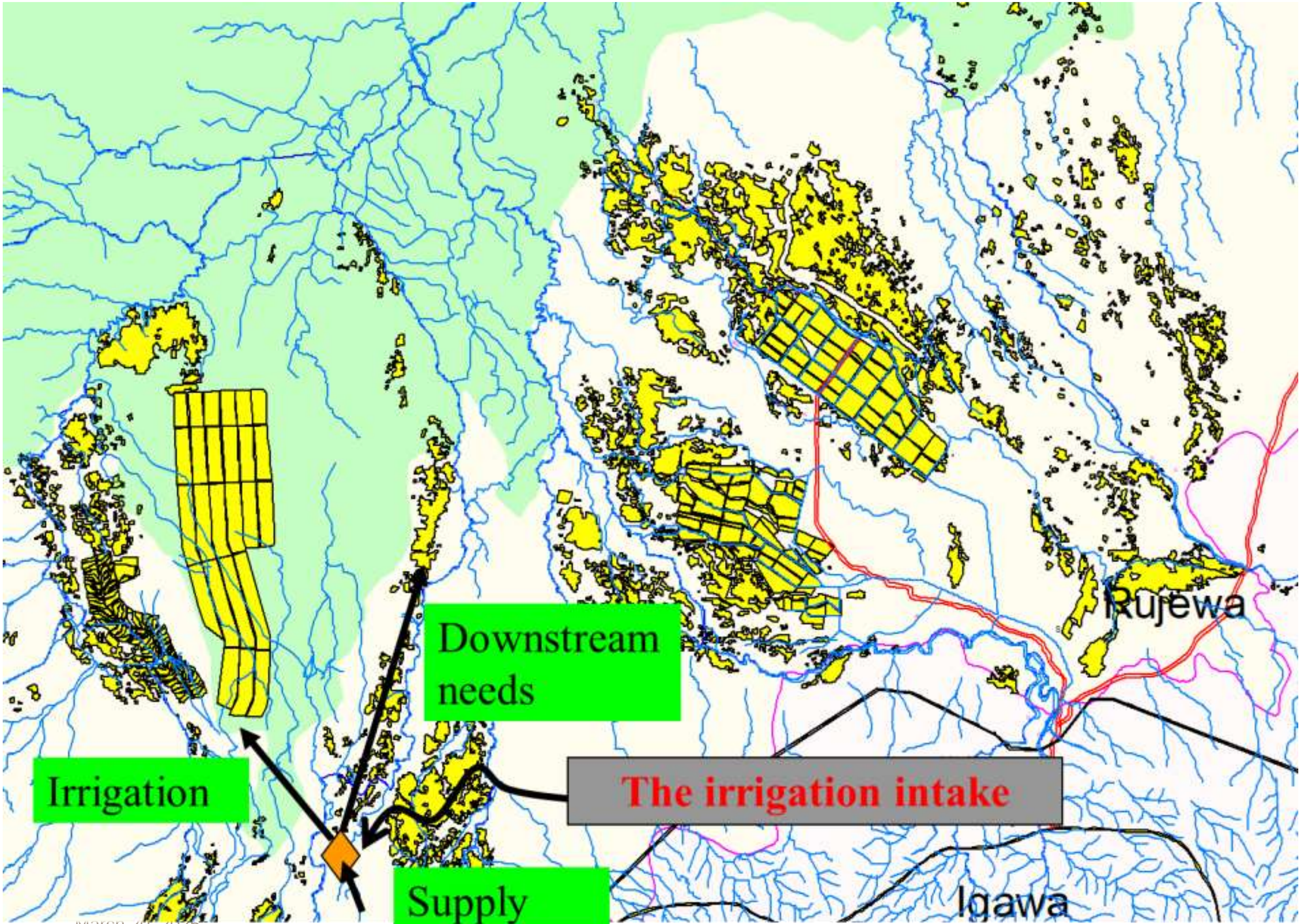
Watershed of the Usangu escarpment

Traditional irrigation intakes

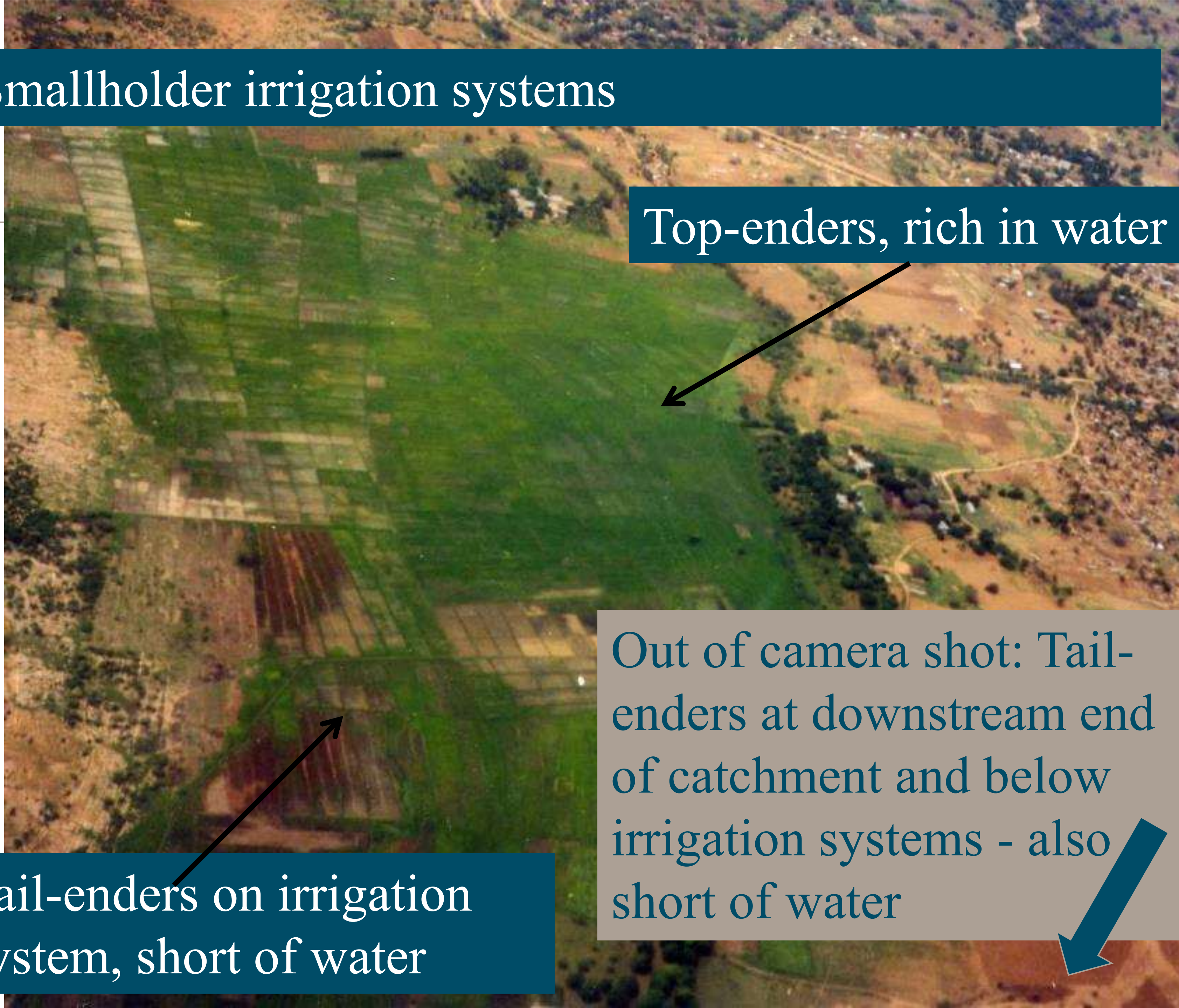
The important moment or opportunity of technological change!
From traditional to modern intakes

Improved (World Bank funded) construction of irrigation intakes on Usangu rivers to abstract water

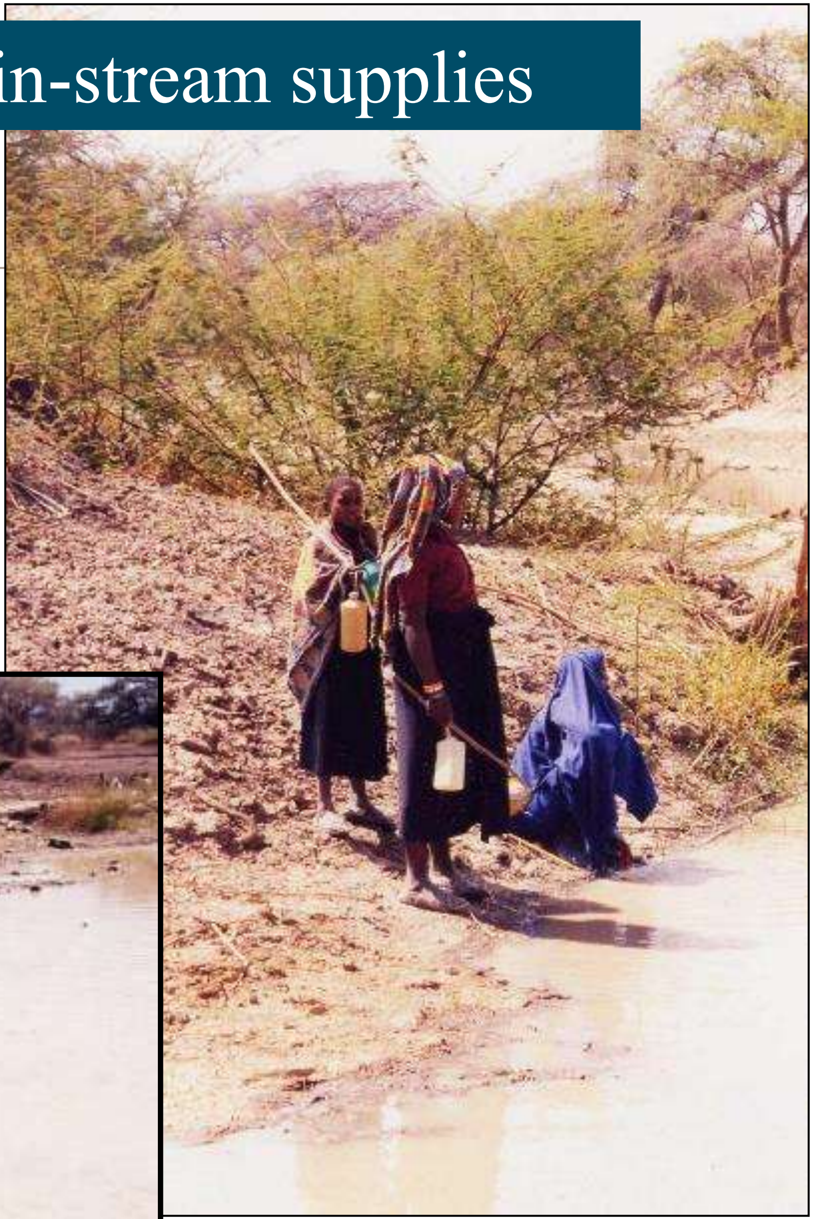
Modern irrigation intakes


Downstream
needs
Irrigation
The irrigation intake
Rujewa
Supply
Igawa

Smallholder irrigation systems



Accessing domestic water from in-stream supplies



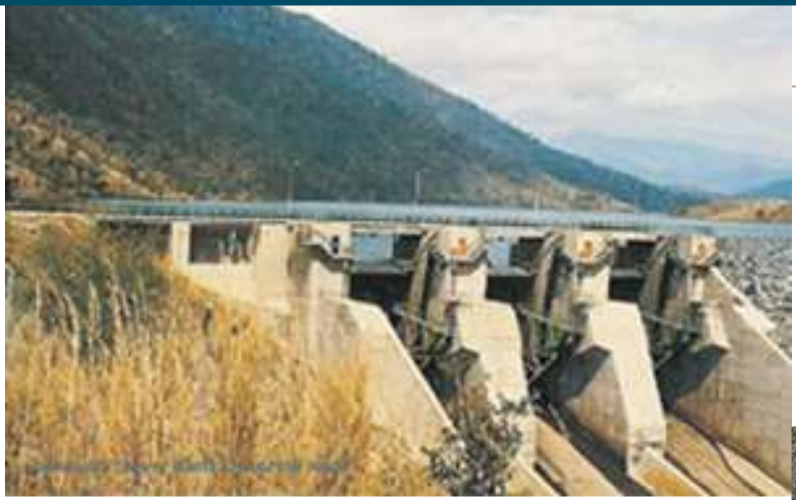
Livestock reliant on in-stream water & grazing

Fisher people reliant on in-stream and ponded water

Ecosystems & livelihoods in Ihefu wetland in Usangu

Ecosystems in the Ruaha National Park

Hydropower for urban/rural Tanzania: Kidatu dam



Electricity to Dar es Salaam

Approach participatory water management via river basin game?

Playing the game: four phases

University of East Anglia

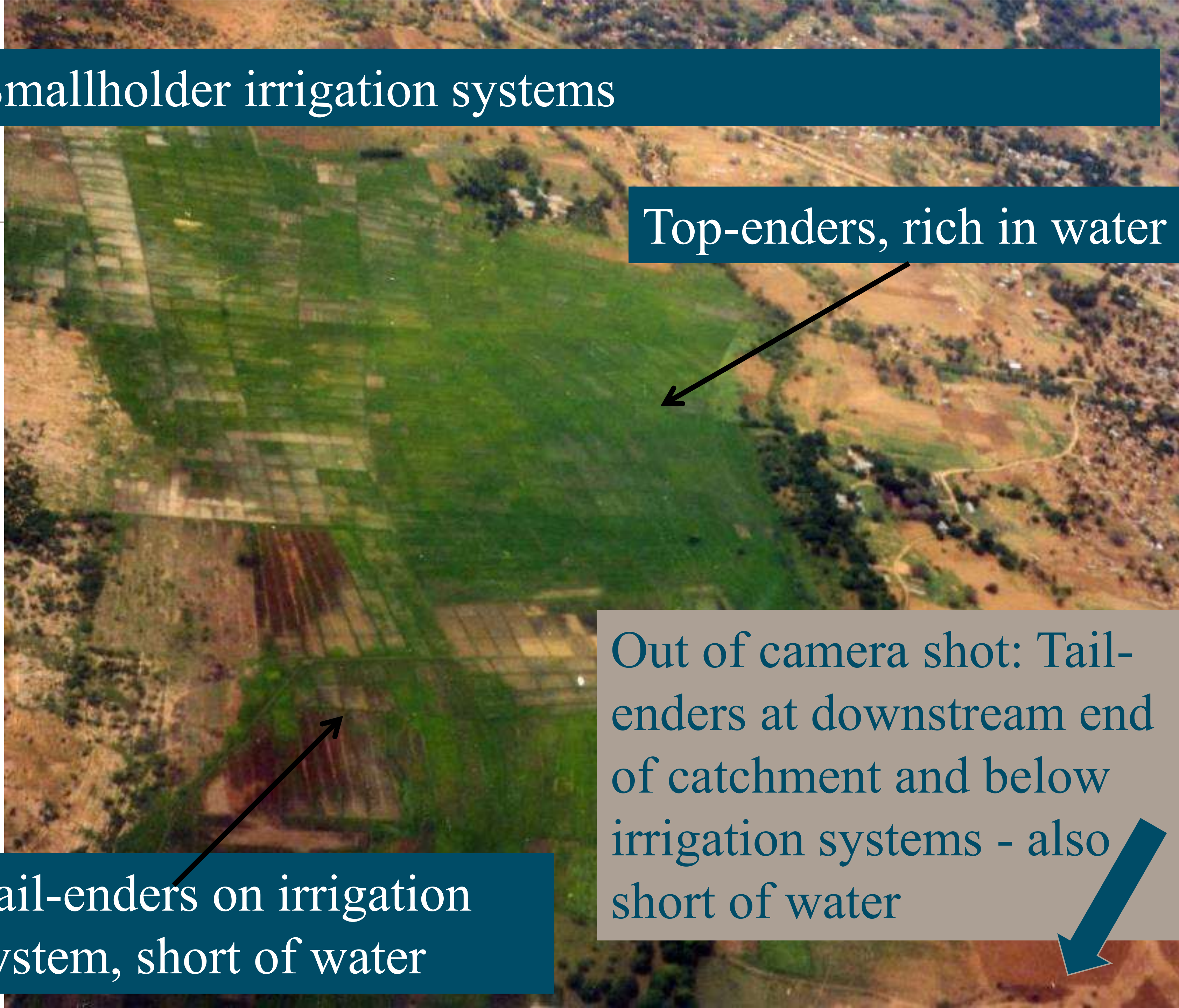
1st phase = demonstration (wet & dry seasons, increasing number of intakes, change in intake design and change in capacity)

2nd phase = water-seeking strategies (individual water focus and consequences)

3rd phase = money-seeking strategies (livelihoods focus and consequences)

4th phase = community-based resolutions (common property agreements/consequences)

Smallholder irrigation systems



Top-enders, rich in water

Tail-enders, short of water

Differences in water consumed and yields obtained between water-short smallholders and water-rich parastatal upstream schemes

Rice irrigation in Southern Tanzania	Unit	Tailender Smallholder	Top-end large farms
No. days water in field		145	220
Seepage rate	mm/day	2	2
Av evaporation rate		5.57	5.57
Presaturation	mm	120	650
Water layer	mm	50	200
Seepage loss	mm	290	440
Crop water evap	mm	808	1225
Field water req	mm	1098	1665
Effective rainfall	mm	480	480
Average rice yields		2.7 to 4.5 t/ha	2.0 to 4.0 t/ha
System water depleted	mm	927	2544

Reflecting and discussing

Sharing ideas on how to more carefully manage water

Re-designing intakes?

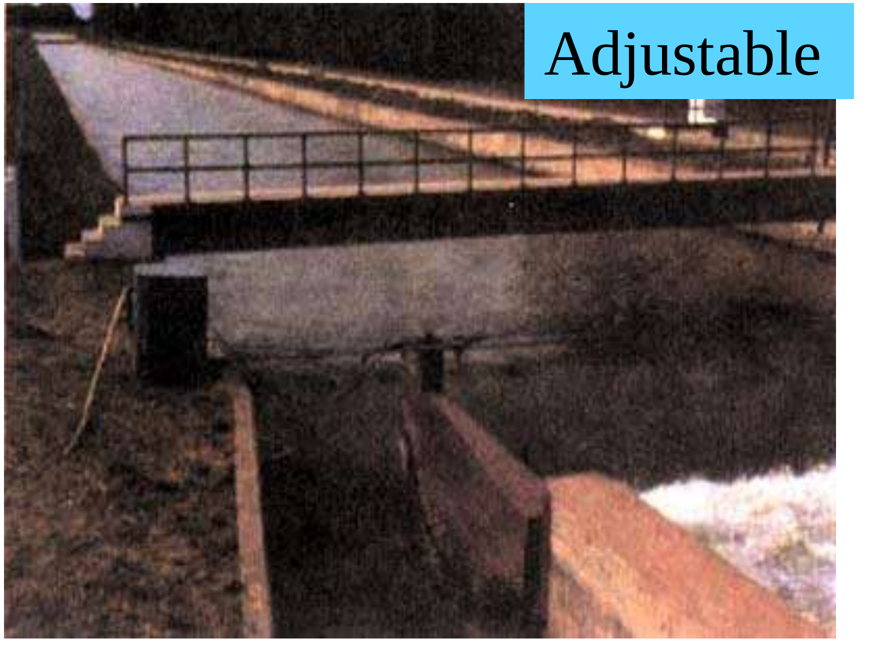
In addition to reforming water institutions, how do we design irrigation intakes that meet

- irrigation and downstream requirements,
- dry & wet seasons and climate change
- complex changing circumstances,
- formal and informal/customary water rights
- river basin management objectives?

Move away from full crest weirs and undershot orifice gates?

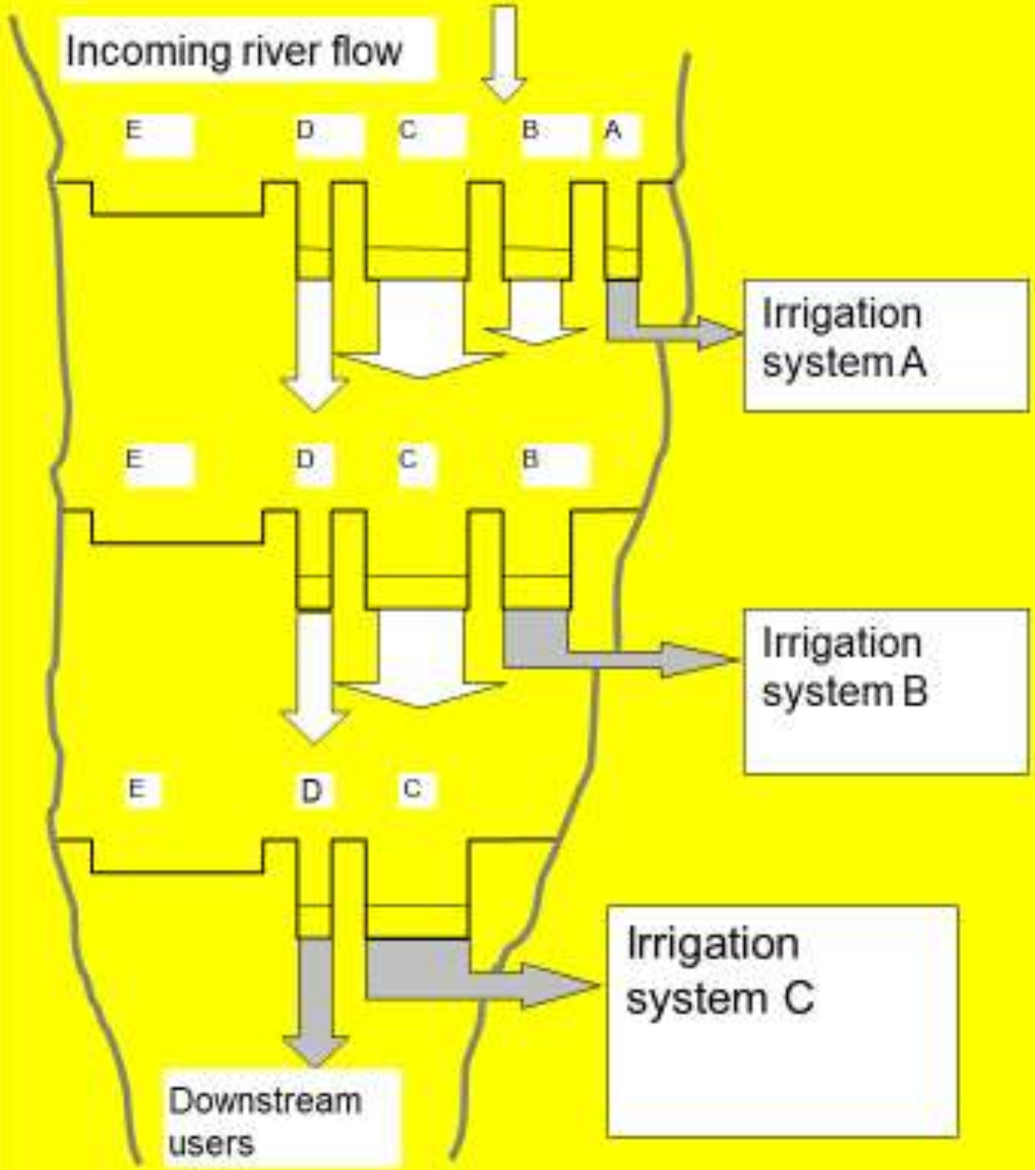
More appropriate to use concrete or metal proportional dividers?

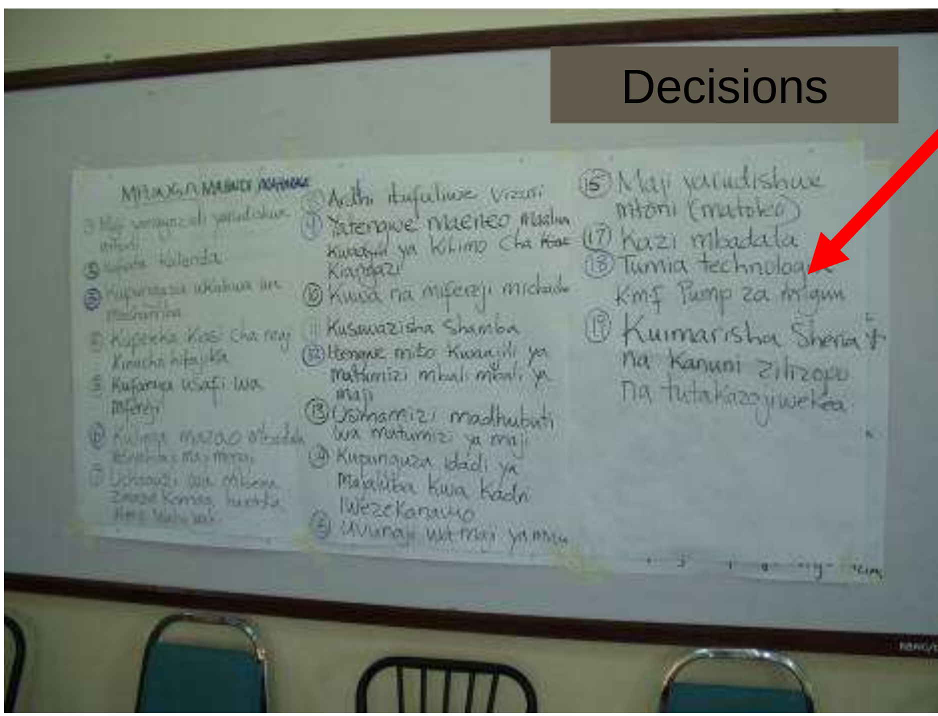
To intakes designed to expect variable supplies and demand and that use visible proportional division



Adjustable shutter-type proportional dividers

Castellated weirs for proportional distribution of water





Here is a decision aid model – the river basin game

Vital that decisions and discussions are in the local vernacular and are not ‘expert-language-driven’. Ask non-leading questions such as ‘what does good water management look like, where can this be found, and who is an example to follow?’

The Cathedral and the Bazaar

Lankford, B., & Hepworth, N. (2010). **The Cathedral and the Bazaar:** Monocentric and Polycentric River Basin Management. *Water Alternatives*, *3*(1).

Ostrom, E. (2010). Polycentric systems for coping with collective action and global environmental change. *Global environmental change*, *20*(4), 550-557. https://doi.org/DOI: 10.1016/j.gloenvcha.2010.07.004

In Tanzania, high level decision-makers are trained on a decision-aid to determine allocations of water in a basin.

In northern Nigeria and Tanzania, local resource users and decision makers used the river basin game to collectively consider incremental changes to water allocations

Engaging with irrigators

Replacing this type of supply-side training

"Farmers must be trained on soil and water technologies to enhance crop production and food security"

ASARECA. 2006 Maputo Workshop statement
www.asareca.org/swmnet

With this kind of support thinking:

What training needs arise when we bring farmers from top- and tail-end systems together while handing them responsibility to allocate water between systems and to downstream users?

And other forms of support?

Seeing farmers as researchers
Helping them to identify & strengthen:

- Group not individual problems
- Their own water experts "Waterists"
- Their own technical solutions esp from the tailend parts of irrigation systems
- Their own institutional agreements to bring those about solutions
- Institutional roles of various support agencies to assist them
- Their own research needs and gaps

Irrigators may have limited dynamic, cross-scale system knowledge and may lack confidence – hence a marriage between external and bottom-up approaches to solicit their ideas. Plus experts can bring in fresh solutions and answers to group & system problems that farmers are facilitated to express

Researchers helping farmers

Research about irrigation is needed to answer farmer questions about who is using most water and why they see water delays & shortages

Photo of Bruce Lankford measuring canal flows in Kapunga irrigation scheme in Tanzania in about 2002.
I determined wetting up of the field was 300 mm depth, as compared to 120 mm depth under smallholder small-plot to small-plot wetting up

Conclusions: The river basin game

- RBG assists programmes that balance water allocation between irrigation and other sectors, and builds equity within irrigation systems
- Game provides a safe place for players to compare water management approaches. ‘Trust-building’ (Huntjens et al., 2012)
- Promotes local poly-centric ownership of problems
- Creates demand for services & solutions including hardware (i.e. intakes)
- ‘Sustainability’ concerns if not followed up and may not work well beyond the local scale
- Changes the way scientists and engineers work with their knowledge and with society: ‘Post-normal’ science. (Funtowicz & Ravetz, 1993); Socialising engineers

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