WHaTeR: ***Water Harvesting Technologies Revisited***

Potentials for Innovations, Improvements and Upscaling in Sub-Saharan Africa

EC 266360 WHaTer Project

Revisiting water paradigms: green water productivity and the role of rainwater harvesting in sub-Saharan Africa

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SEVENTH FRAMEWORK PROGRAMME

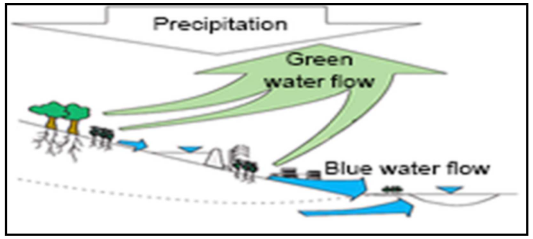
I will respond to these statements:

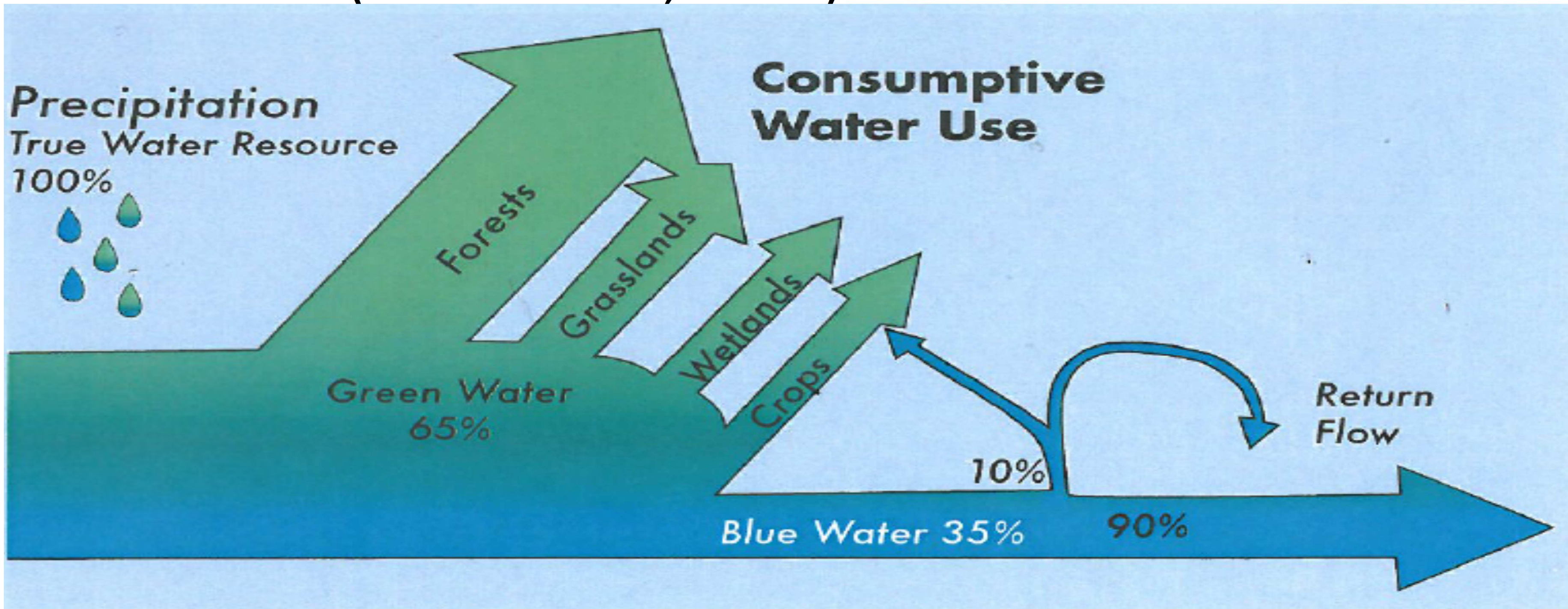
"We need not only to be aware of the strengths and limitations of the words we use, but also to consider how and why we use them".

'Revisiting Water Paradigms' -- Finding the Right Frame of Mind. James E Nickum. IWRA Update, Dec. 2014

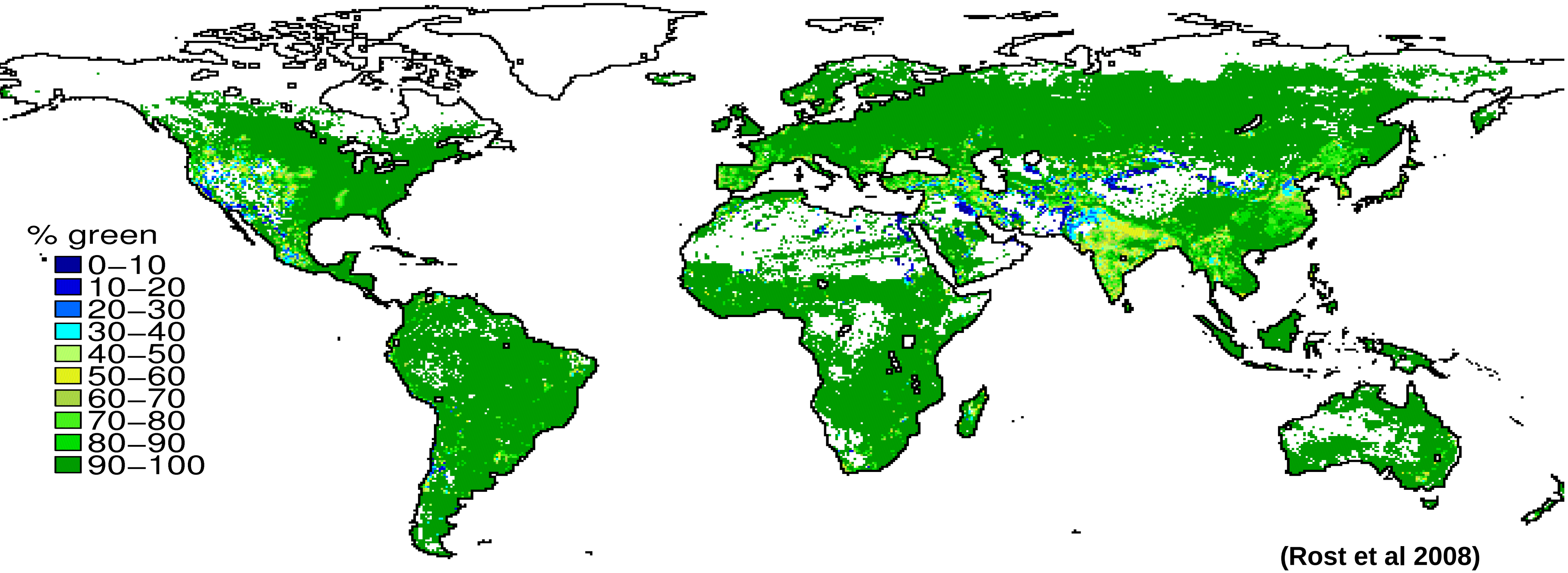
Green/Blue Water Paradigm

(Falkenmark, 1995)





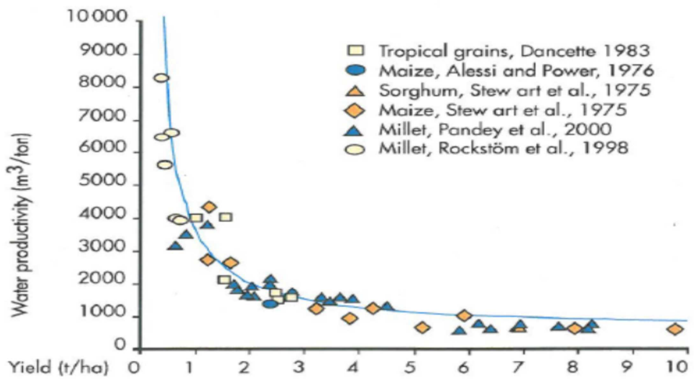
Green water flows dominate in agriculture

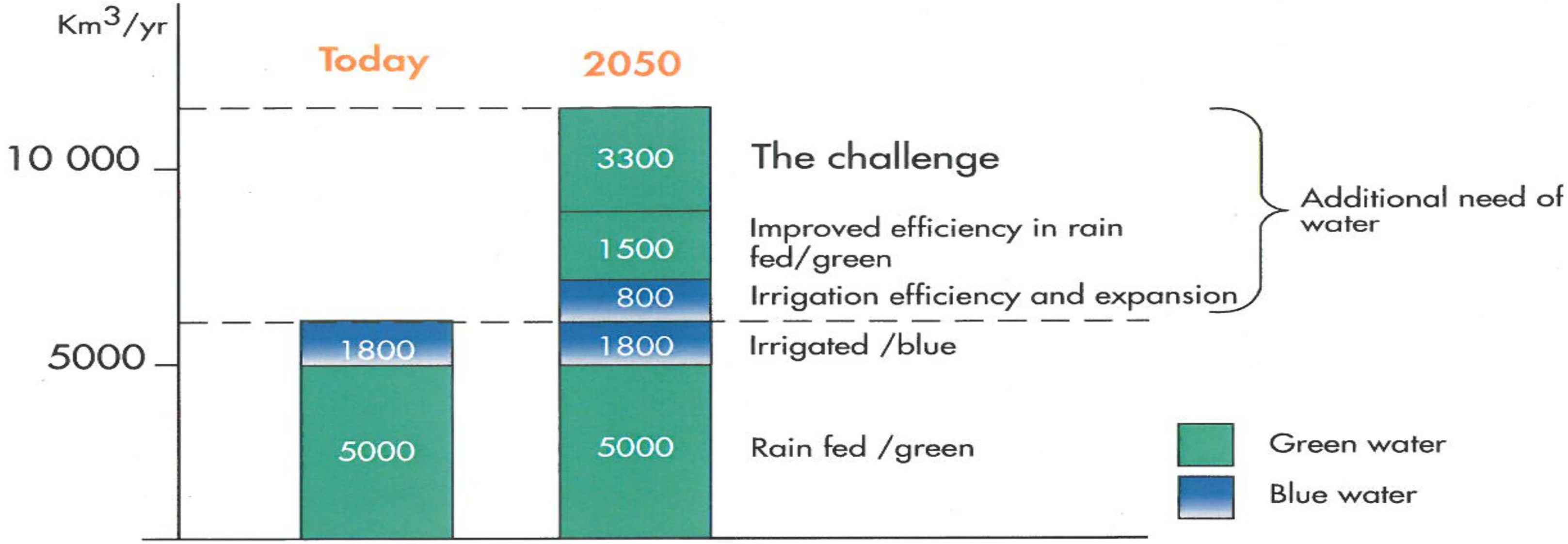


(Rost et al 2008)

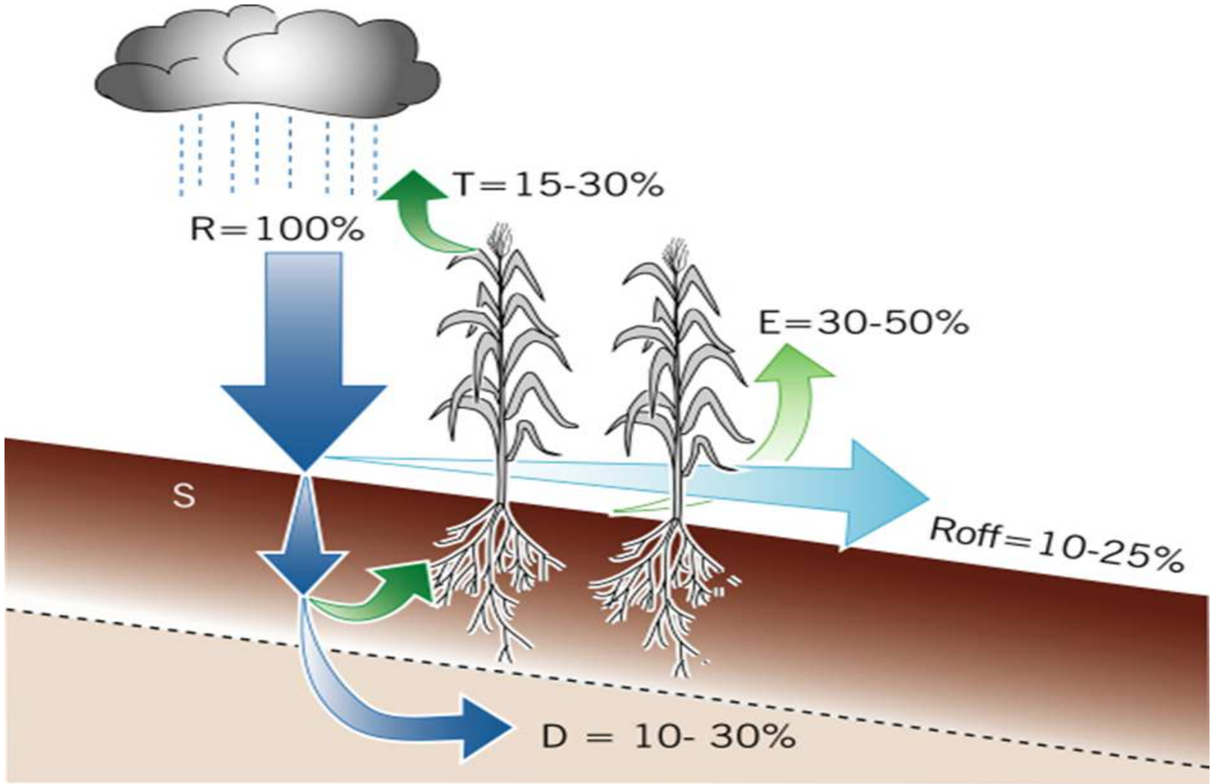
In Africa 95% of agricultural water use is green

To achieve global food security in 2050 – the biggest contribution will come from green water





Green-Blue water balance at field scale



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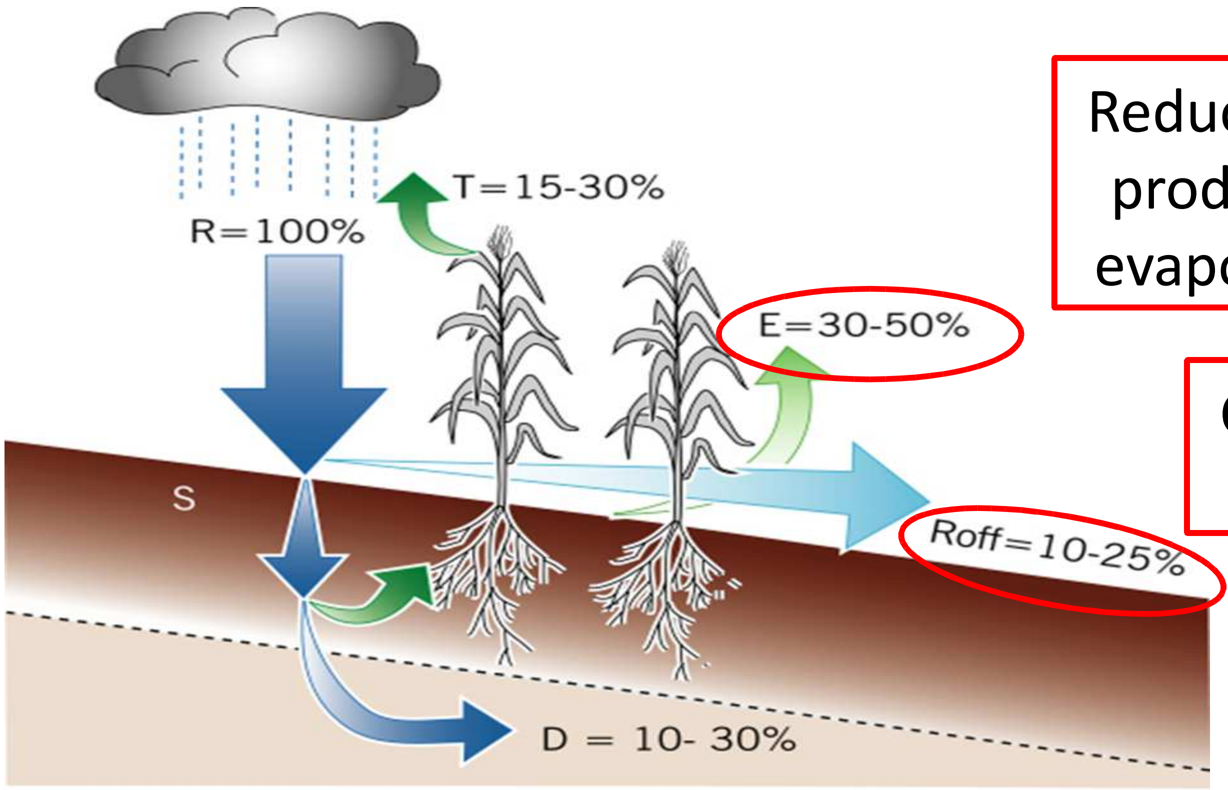
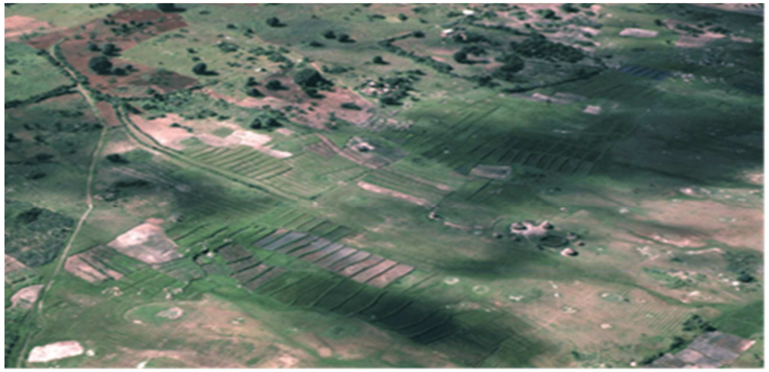


Reduce non-productive evaporation

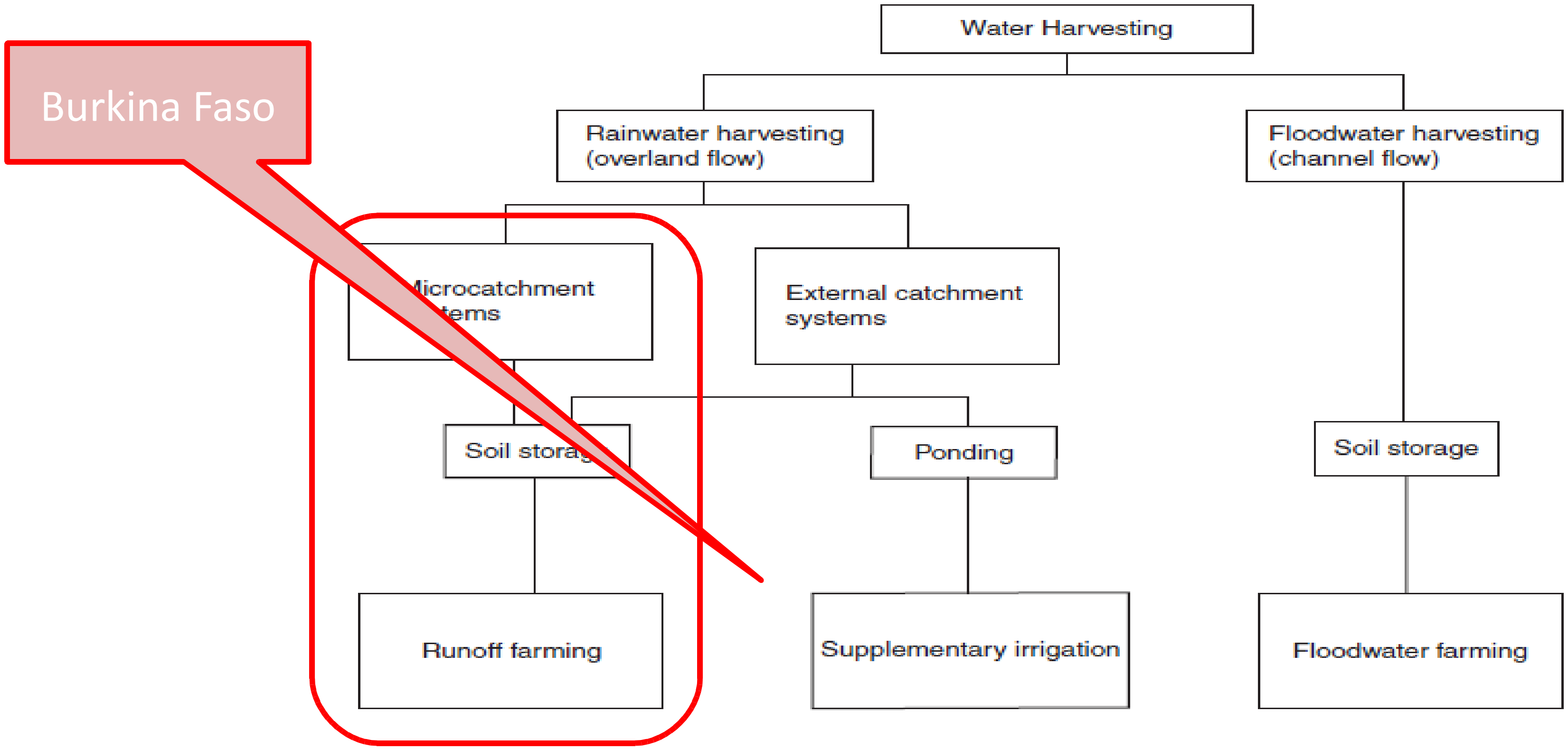
Control runoff



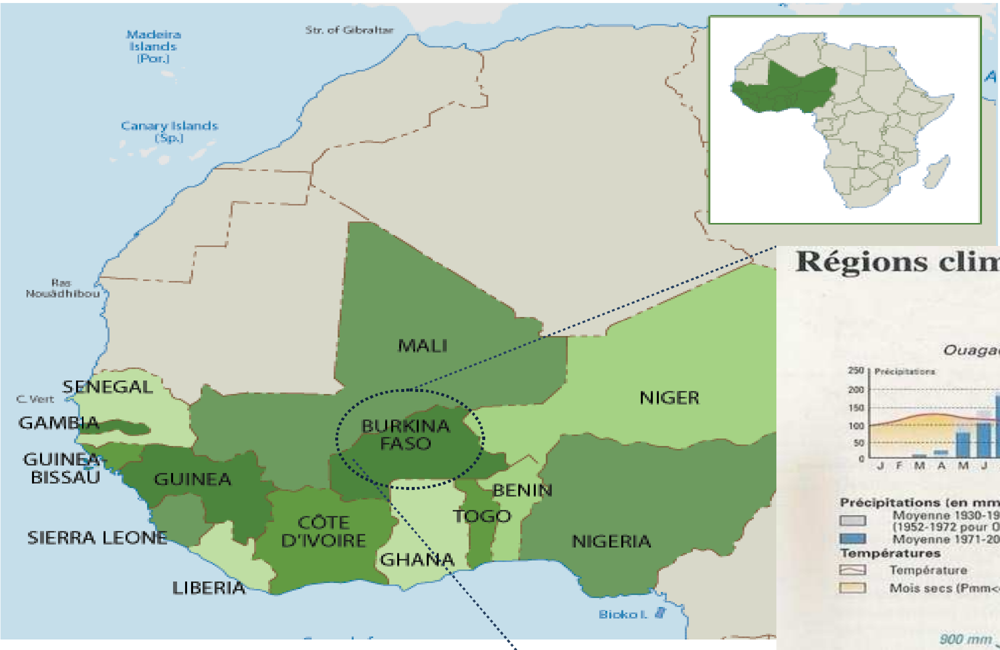


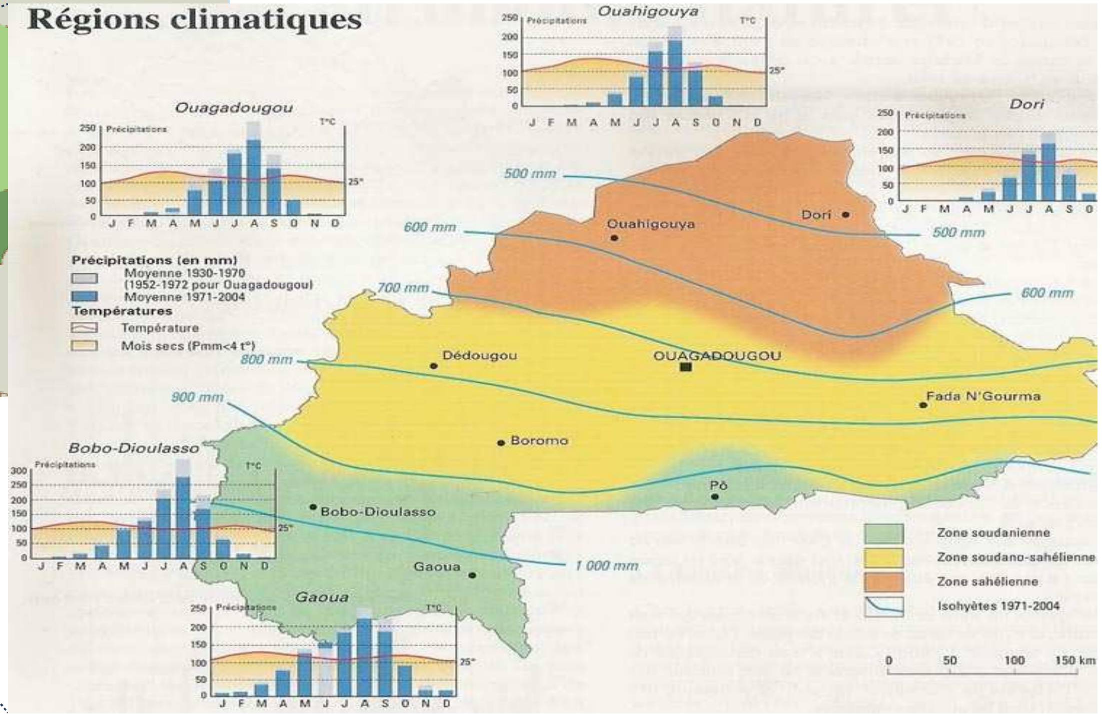

Water harvesting is: "The collection and concentration of rainfall runoff, or floodwaters, for plant production".

Classification of water harvesting systems



Burkina Faso



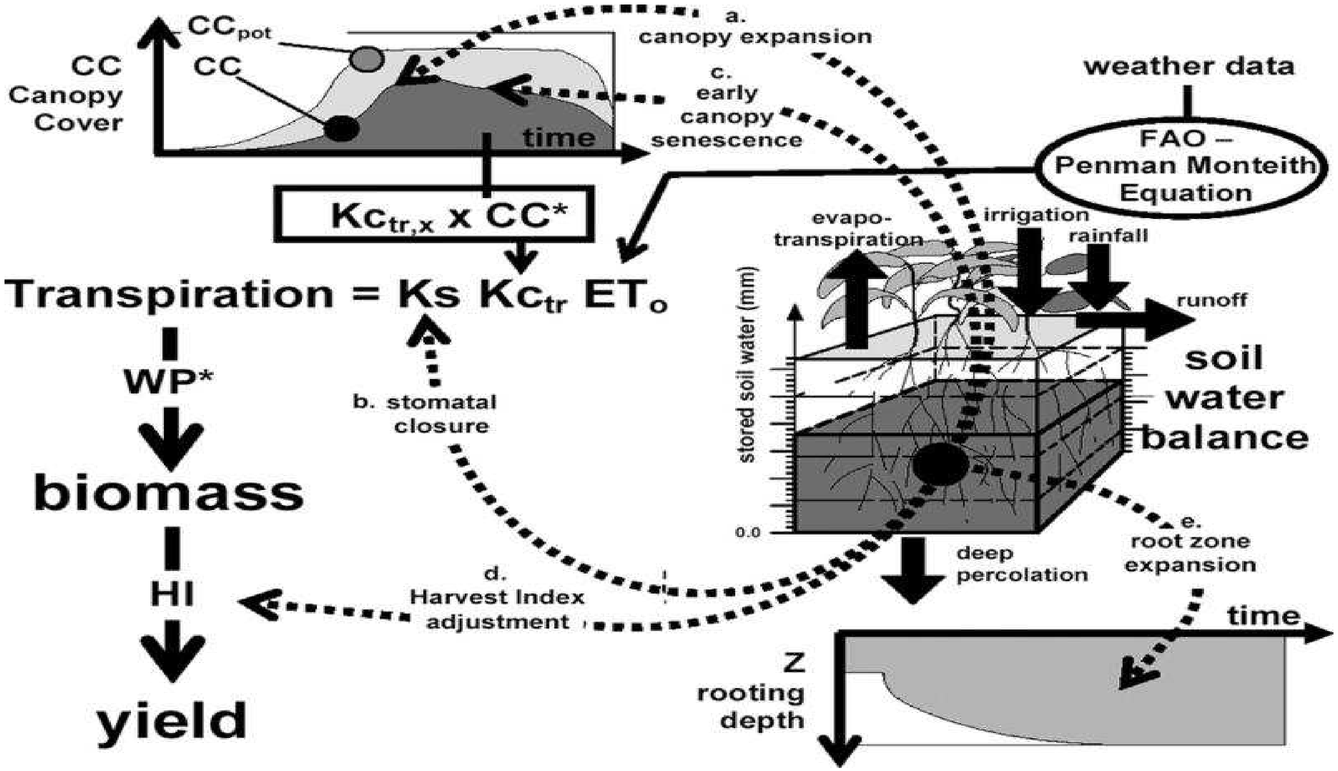


Dry spells

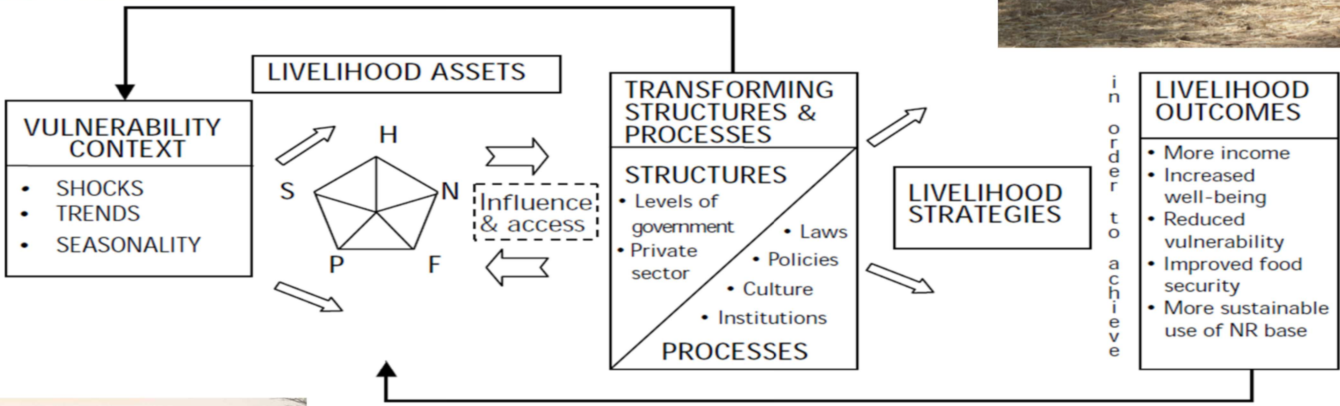
Rainfall variability

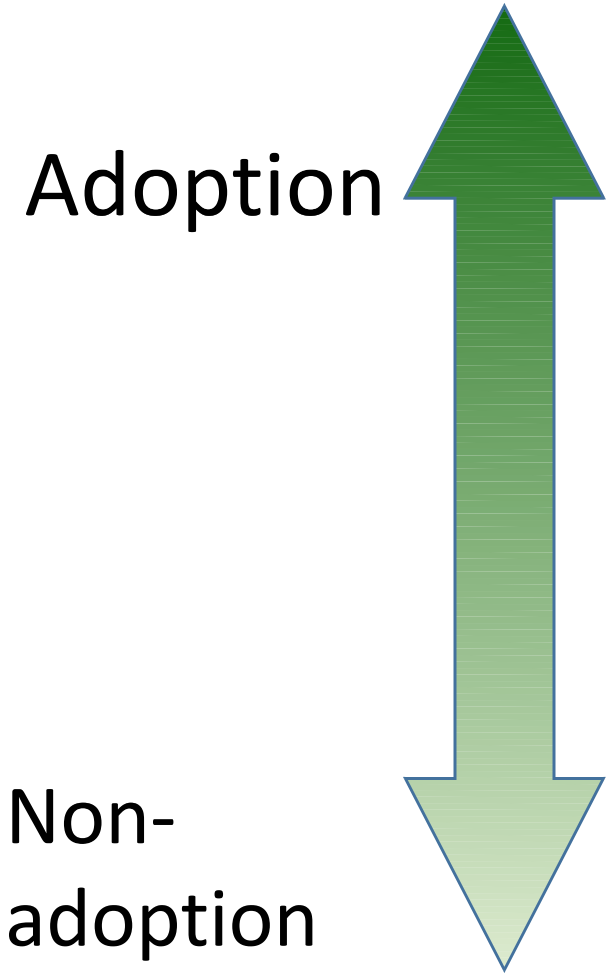
Short growing season

Modelling influence of WHT on risk with AQUACROP



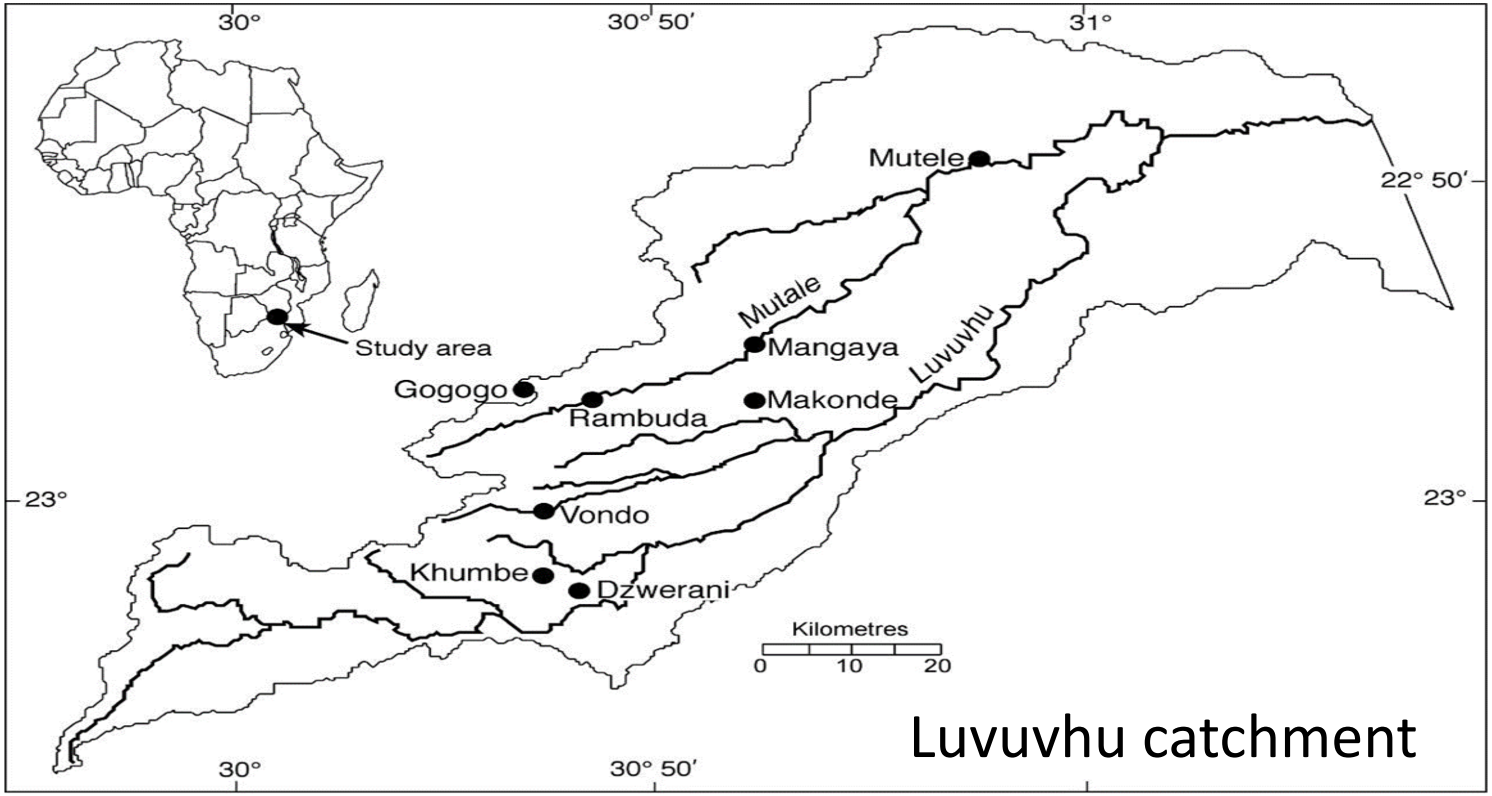
Investigated adoption of water harvesting



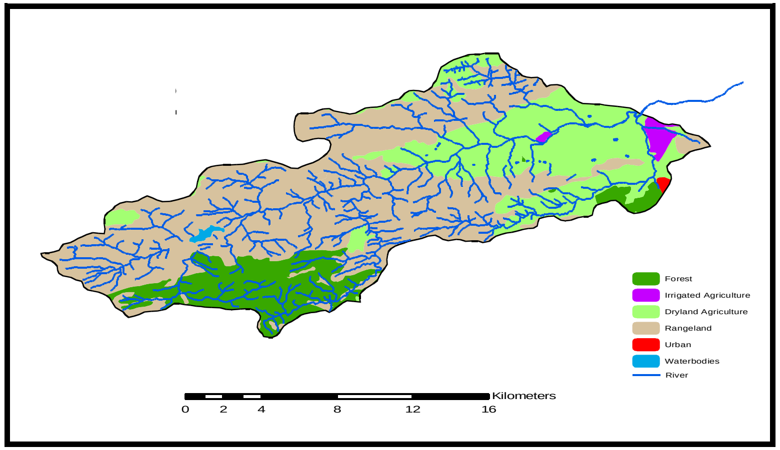


Innovators	Similar to Investors, but are combining technologies, particularly stone lines and zaï. They experiment with new technologies not traditionally used in their village/region with little external support and confidence. They have the ability to expand use of WHTs without external support.
Investors	Extensively adopted WHTs and are expanding the technologies after having previously used them and gained success, mostly zaï but not necessarily. Expansion of WHT and/or use of zaï seems mainly driven by a desire to gain additional income/improve the land for the future as an investment (legacy).
Augmenters	A significant area of their land covered with stone lines and earth bunds. WHTs were adopted and expanded through numerous projects or with a mixture of self-adoption and projects. In most cases farmers used projects to install stone lines in areas with worst runoff and then augmented this with earth bunds installed themselves or with projects. These farmers may also use small areas of zaï on the most degraded areas of land.
Savvy adapters	Adopted principles of WHTs to reduce runoff in areas where it is strongest in fields.
Passive adopters	Adopted stone lines with a project, or used the technology their father did (e.g. zaï) but have not expanded area of application. Women in this group adopted stone lines using leftover materials from projects in family fields. In most cases WHTs are just use where needed (i..e. where runoff is strong and damages plants, or where land is severely degraded in the case of zaï). Extent of adoption is relatively low compared to Augmenters.
Receivers	Cultivating with WHTs only in gifted or renting fields which already had the technologies in place.
Leavers	Adopted and used WHTs in the past but do not use in current fields (i.e. those that have dis-adopted). Generally WHTs have not been re-adopted as farmers do not have the assets to install them and/or no longer see a need to.
Non-users	Knowledge of WHTs and how to construct them, but has never adopted (in fields they manage) as do not have the tools, materials and other assets required to install them, or do not consider it necessary to put them in any of their fields. (Women within MHHs in this category may work with WHTs in family fields, but not in their own fields.)
Unaware	No knowledge of WHTs or how to construct them

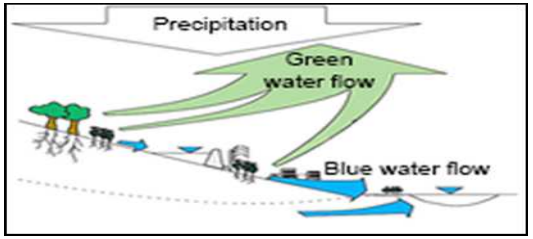
South Africa: Streamflow reduction activity



- limit commercial forestry
- reduce green water flow
- release blue water flow for small-scale irrigated agriculture



Green/Blue water paradigm: is it useful?



- More than science communication tool
- Shift from IWRM to ILWRM
- Focus on improving rainfed agriculture
- Limited blue water availability for irrigation
- Rainfed agriculture can deliver food security

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http://whater.eu

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Project partners

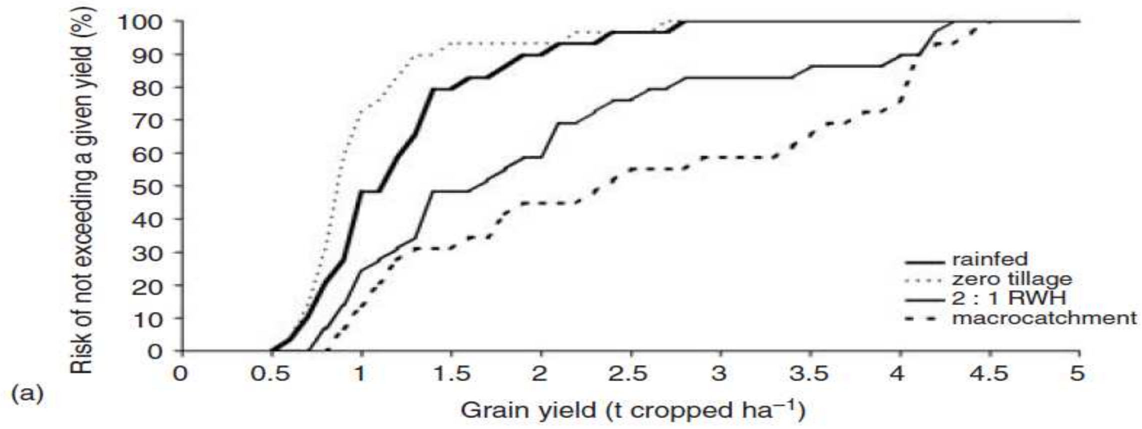
Definition of paradigm:

- A typical example or pattern of something; a pattern or model:

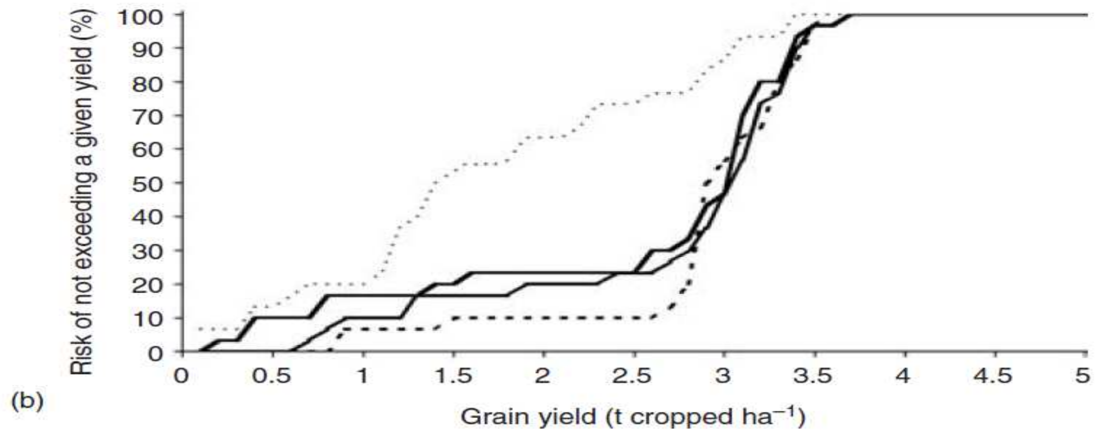
  'society's paradigm of the 'ideal woman''
- A world view underlying the theories and methodology of a particular scientific subject:

  'the discovery of universal gravitation became the paradigm of successful science'

Vuli season



Masika season



30 year simulated performance for maize in Tanzania

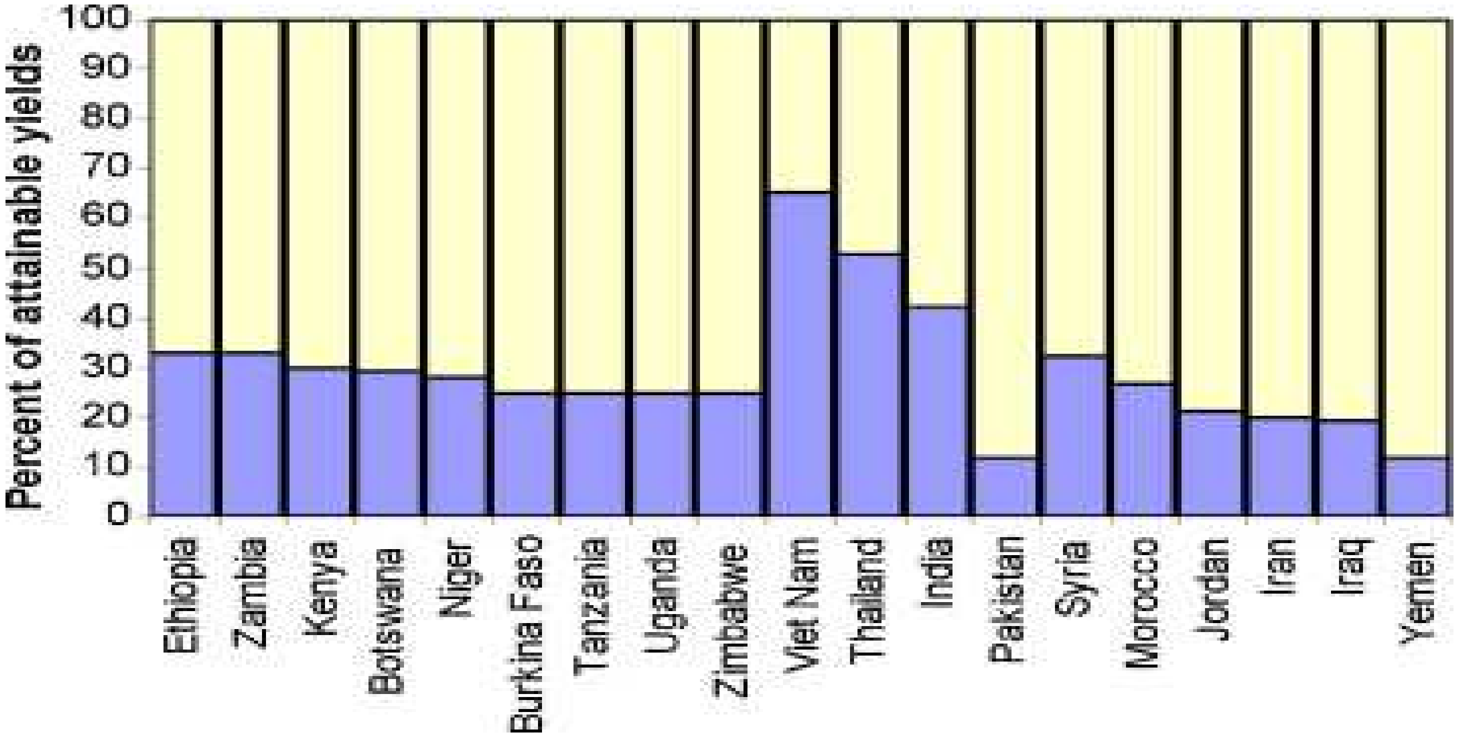
Table 1. Simulated 30-year mean maize grain yields of the four treatments.

Treatment	Vuli grain yield ($t\ ha^{-1}$)	Masika grain yield ($t\ ha^{-1}$)	Vuli benefit over control (%)	Masika benefit over control (%)
Rainfed control	1.22	2.53	0	0
Zero tillage	1.01	1.68	−17	−33
Microcatchment RWH	1.94	2.70	60	7
Macrocatchment RWH	2.52	2.85	108	13

Table 2. Simulated mean maize grain yields for the rainfed and 2 : 1 microcatchment RWH treatments divided into five-year (pentade) periods.

Season	Pentade	Rainfed grain yield ($t\ ha^{-1}$)	2 : 1 RWH grain yield ($t\ ha^{-1}$)	Benefit over rainfed (%)
Vuli	1	1.14	1.81	58
	2	1.50	2.44	62
	3	1.10	1.37	25
	4	1.50	3.13	109
	5	1.12	1.53	36
	6	0.69	0.97	41
	All	1.22	1.94	60

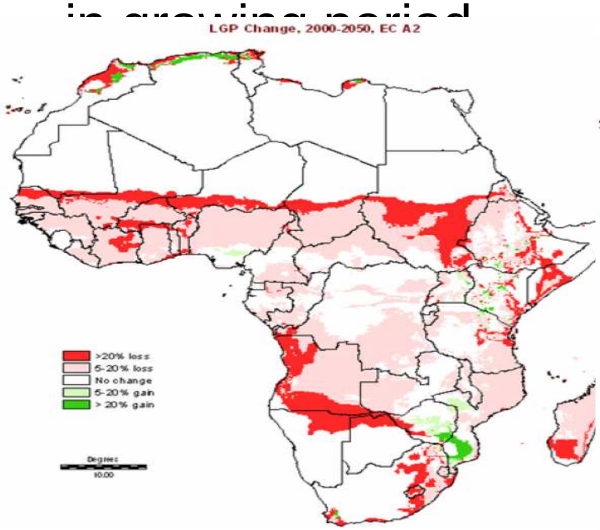
Yield gap



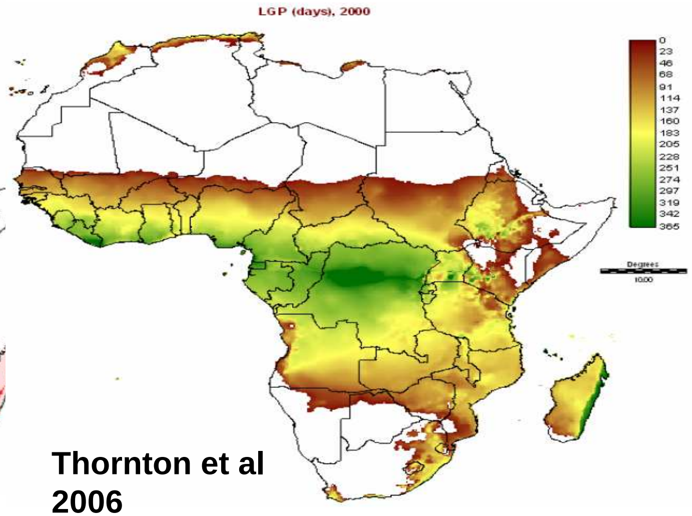
Agricultural Water Management, Volume 97, Issue 4, 2010, 543 - 550

Hotspots: highly vulnerable to climate change

projected change
in growing period

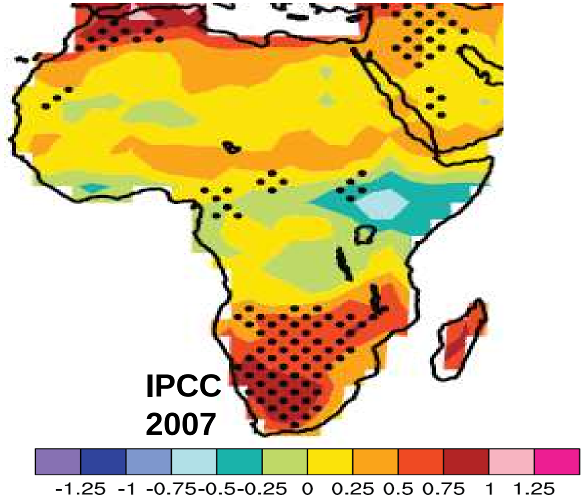


current length
of growing period



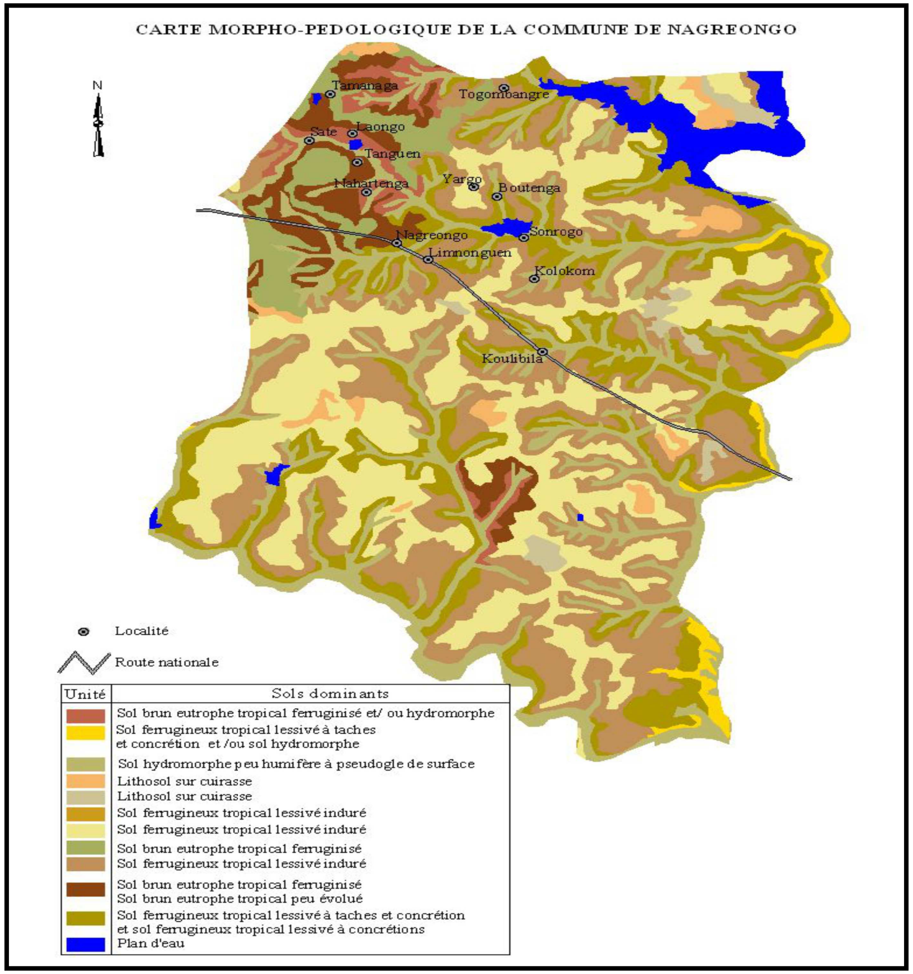
Thornton et al 2006

projected increase
in variability



IPCC 2007

change in # of consecutive dry days,
21st century, A1B, 9 GCMs, normalized

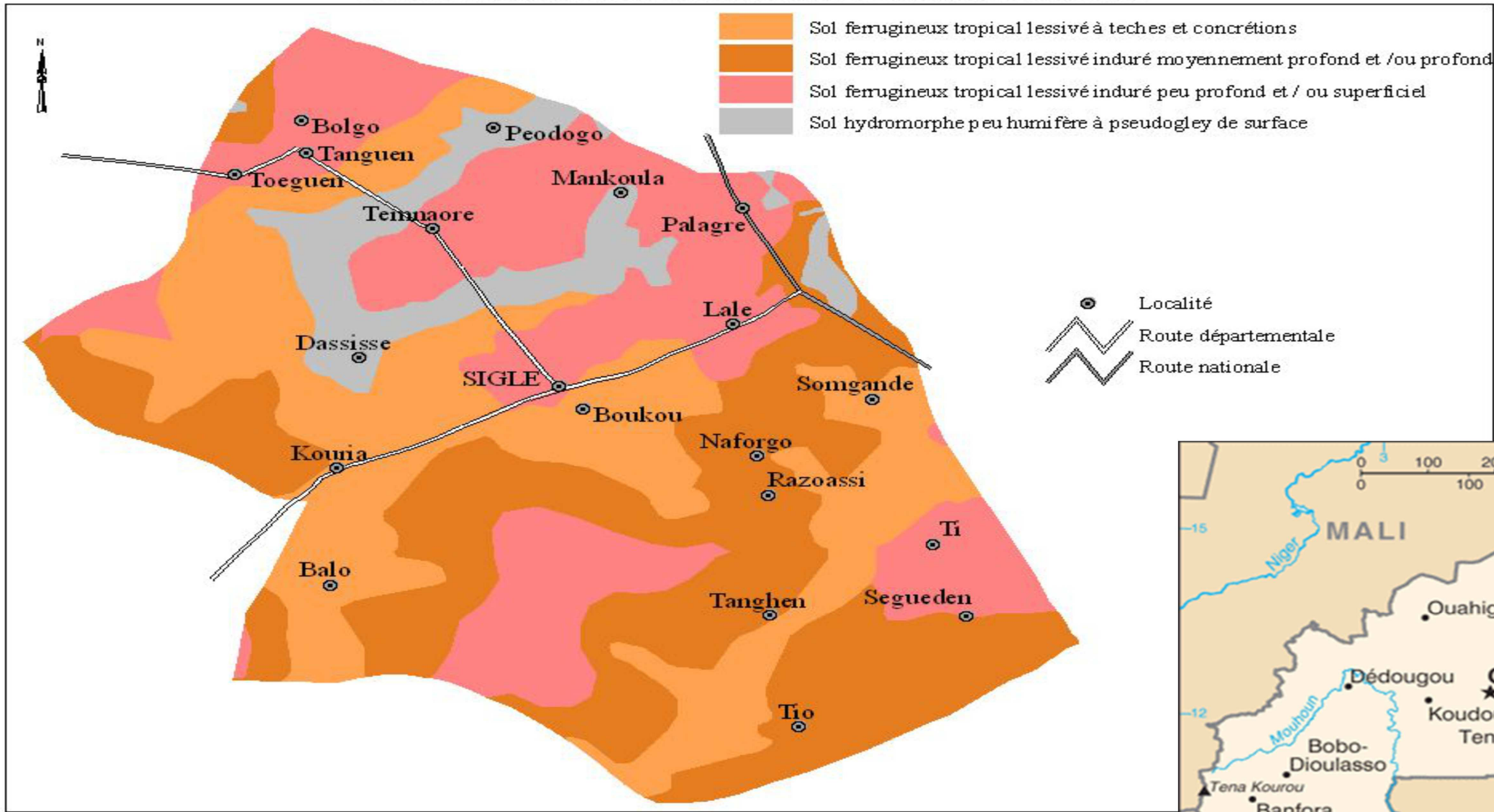


Soil type is Ferric Lixisol

Sandy loam / Clay

AWC = 100 to 150 mm

in top 1m depth



Predominant soil type is Ferric Lixisol

Not seen in Burkina Faso
These examples are from Ethiopia

System design now requires optimising pond storage volume.

Management optimisation: when to irrigate and how much?

Economic analysis show benefit only if labour cost is set at zero; lifting water is very laborious.

Classification of water harvesting systems

Variables:

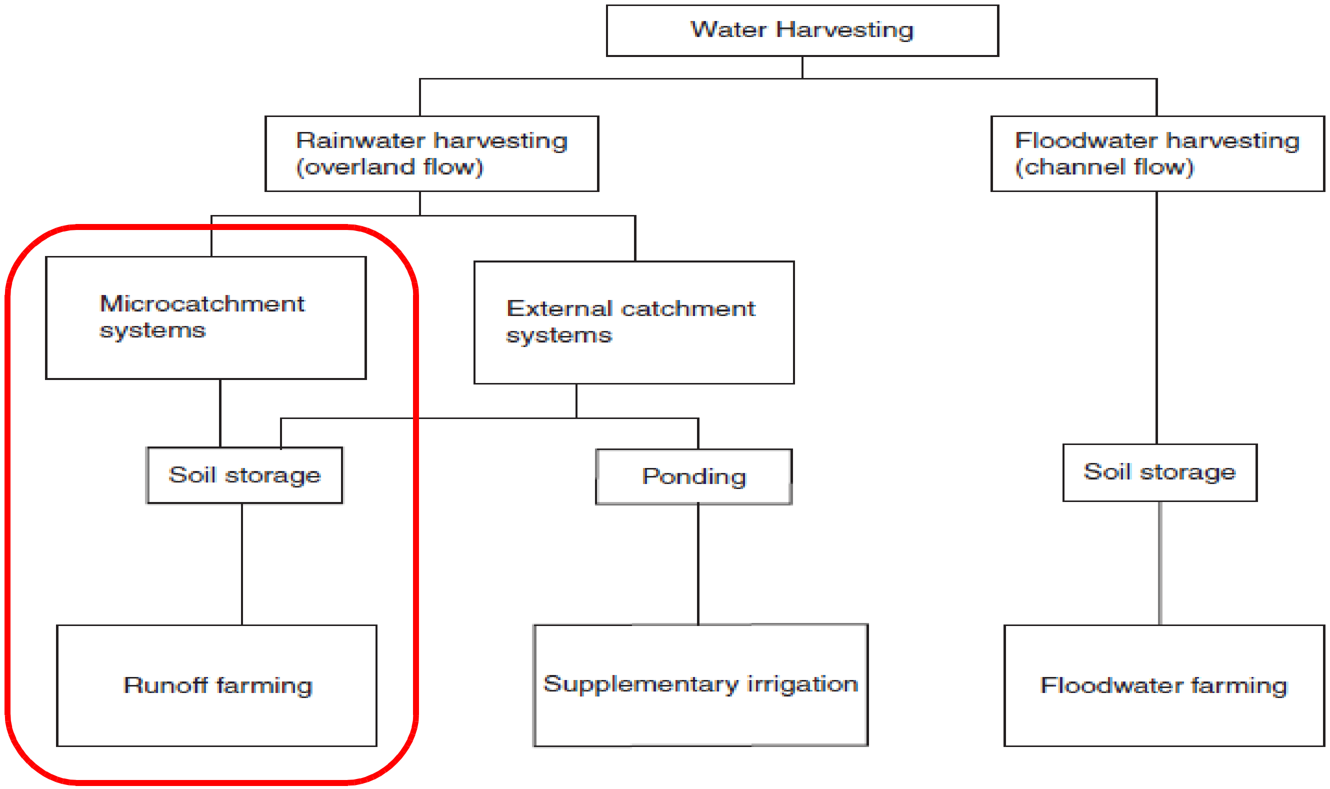
Catchment location & size

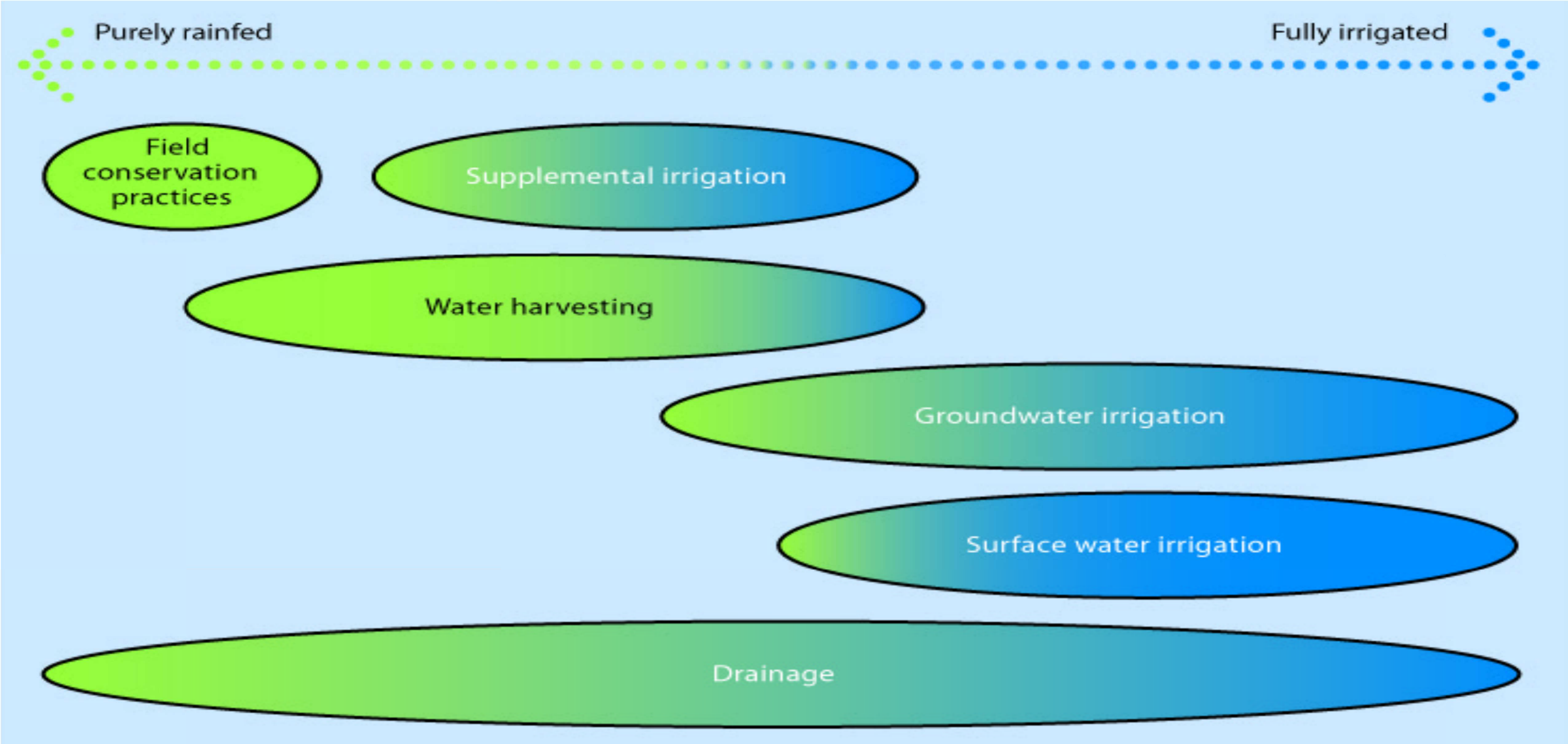
Runoff coefficient

Transfer distance

Water storage

Social organization





Opportunities for sustainable intensification are found in water management practices along the continuum from rainfed to partially and fully irrigated farming systems