Soil as a water resource for food security in African drylands

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African drylands

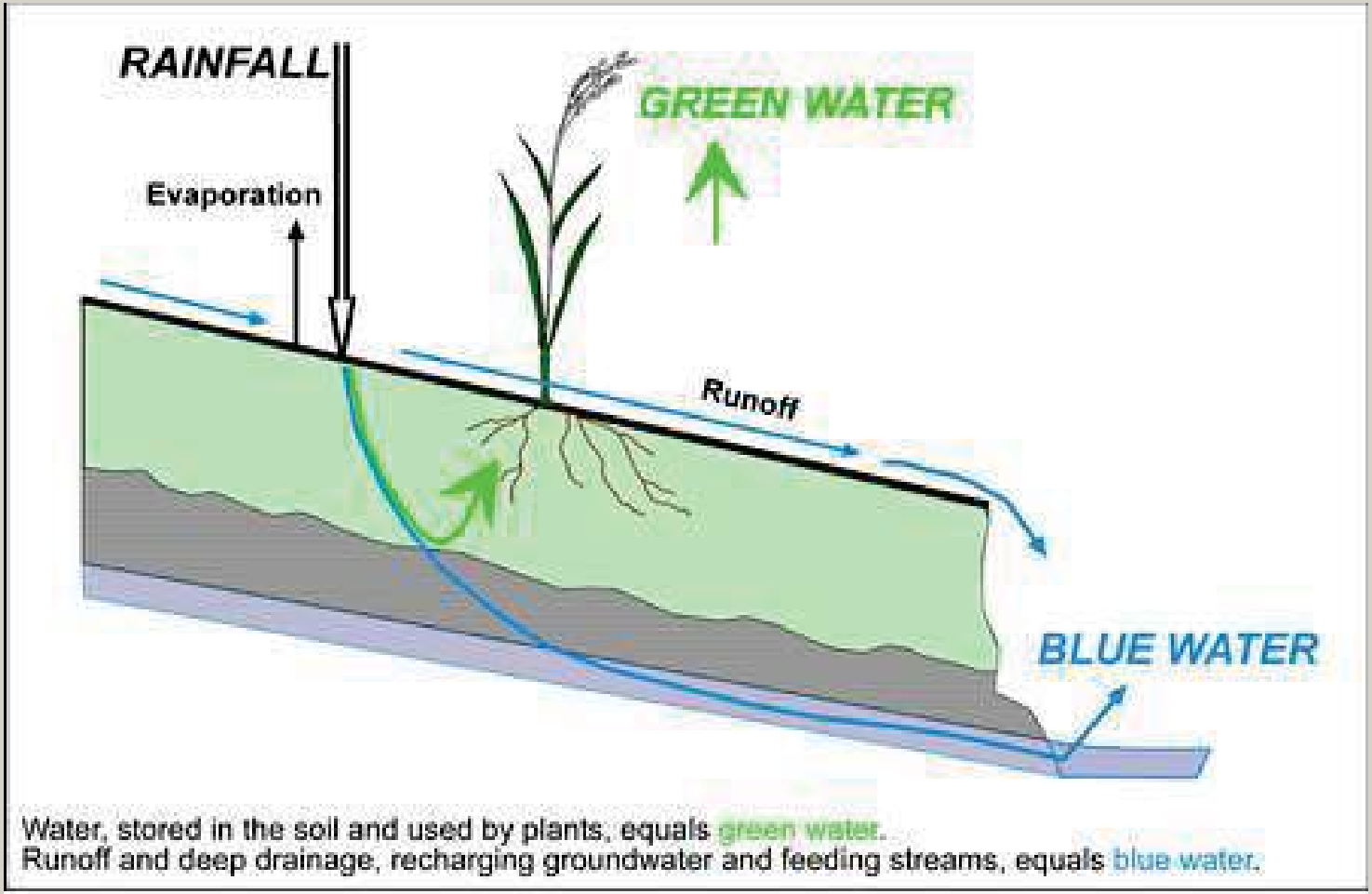
What has food security to do with soil water?

Food production needs a lot of water

- Maize / Millet: 1 kg of biomass: 200 kg of water

- 1 edible kcal = 1 kg of water
- ♂ 2500 kcal d^{-1} = 2500 kg of water

Water for food = green water



(After Rockström, 1997)

Is there enough green water ?

Example: Millet in the Sahel

Grain	500	kg DM ha^{-1}
Straw	1000	kg DM ha^{-1}
Roots	1000	kg DM ha^{-1}
Total	2500	kg DM ha^{-1}

Water use = 2500 * 200 = 500 000 kg water ha^{-1}

1 mm rainwater = 10 000 kg per ha

A Millet crop uses only 50 mm for transpiration !

The field water balance in Saria (Savannah zone in Burkina Faso)

$$P = R + E + T + (\Delta S + D)$$

P= Precipitation	780 mm
R= Runoff	45 %
E= Evaporation	26 %
T= Transpiration	13 %
$\Delta S + D$ =	15 %

Green Water Use Efficiency

$$\frac{\text{mm transpiration}}{\text{mm of rain}}$$

GWU: Africa =10-30 %

Great plains, USA > 55 %

What has soil water to do with soil ?

The field water balance

$$P = R + E + T + \Delta S + D$$

P = Precipitation

R = Runoff

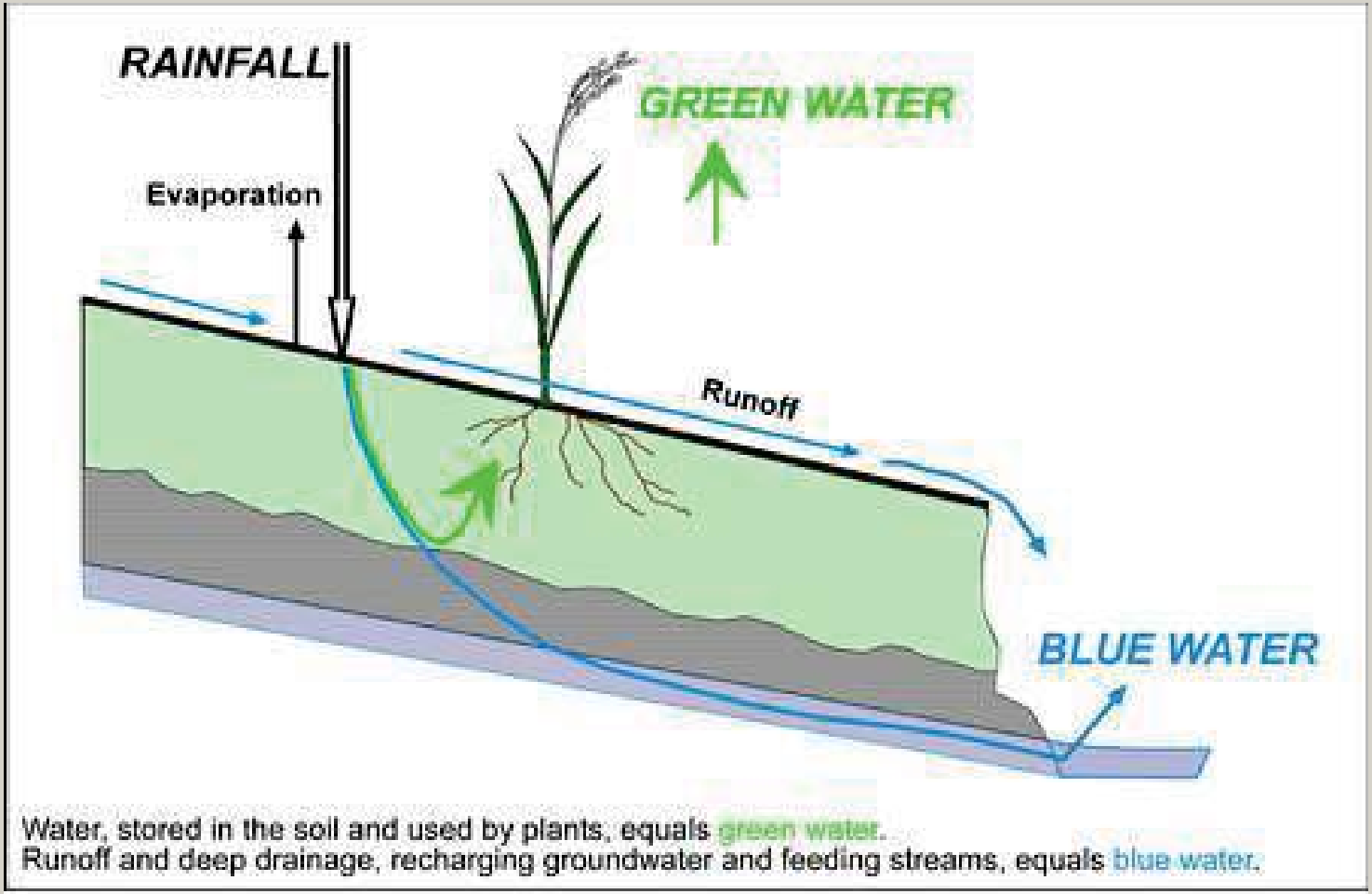
E = Evaporation

T = Transpiration

ΔS = Change in stock of A-water in the root zone

D = Drainage below the root zone

Water for food = green water



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Stock of Available-water

Available-water determines survival during a dry spell

Max S (of A-w) = RD * (FC - WP)

RD= rooting depth

FC= field capacity

WP= wilting point

Farmers complain about drought

Drought = dry spells

The cause = desertification

(Land degradation in drylands)

What is the role of desertification?

Structural crust

Deteriorating physical/hydrological processes

Runoff ⇑

Evaporation ⇑

Drainage below root zone ⇑

Max S ⇓

Transpiration ⇓

Degradation effect on dry spell

Max S good soil: 80 cm * 0.10 = 80 mm

Dry spell = 80 mm/4 = 20 days

Max S degraded soil: 60 cm * 0.08 = 48 mm

Dry spell = 48 mm/4 = 12 days

NOT a change in rainfall BUT a change in the soil !

How to increase food security?

With water conservation

- Decrease losses (of rain)
- Improve storage capacity (of soil)
- Improve water use (by any plant)

Desire for greener land

Options for Sustainable Land Management in Drylands

"Desire for greener land" compiles options for Sustainable Land Management (SLM) in drylands. It is a result of the integrated research project DESIRE (Desertification Mitigation and Remediation of Land - A Global Approach for Local Solutions). Lasting five years (2007–2012) and funded within the EU's Sixth Framework Programme, DESIRE brought together the expertise of 26 international research institutes and non-governmental organisations. The DESIRE project aimed to establish promising alternative land use and management strategies in 17 degradation and desertification hotspots around the world, relying on close collaboration between scientists and local stakeholder groups. The study sites provided a global laboratory in which researchers could apply, test, and identify new and innovative approaches to combatting desertification. The resulting SLM strategies are local- to regional-scale interventions designed to increase productivity, preserve natural resource bases, and improve people's livelihoods. These were documented and mapped using the internationally recognised WOCAT (World Overview of Conservation Approaches and Technologies) methodological framework, which formed an integral part of the DESIRE project.

The book describes the DESIRE approach and WOCAT methodology for a range of audiences, from local agricultural advisors to scientists and policymakers. Links are provided to manuals and online materials, enabling application of the various tools and methods in similar projects. The book also includes an analysis of the current context of degradation and SLM in the study sites, in addition to analysis of the SLM technologies and approaches trialled in the DESIRE project. Thirty SLM technologies, eight SLM approaches, and several degradation and SLM maps from all the DESIRE study sites are compiled in a concise and well-illustrated format, following the style of this volume's forerunner 'where the land is greener' (WOCAT 2007). Finally, conclusions and policy points are presented on behalf of decision makers, the private sector, civil society, donors, and the research community. These are intended to support people's efforts to invest wisely in the sustainable management of land – enabling greener land to become a reality, not just a desire.

DESIRE

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Desire for greener land

Options for Sustainable Land Management in Drylands

WOCAT

World Overview of Co

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Stone rows in Burkina Faso

Compost making

Parkland

Can it be done?

Water conservation

Focus more on water conservation

and less on soil conservation

Prospect?

There is a large gap between actual and attainable food production in SSA

It is easier to go from 500 to 1000 kg ha^{-1} yr^{-1} in Africa than going from 6000 to 8000 kg ha^{-1} yr^{-1} in Asia

It could well be that in 2030 an agricultural active Africa helps alleviate global shortages of cereal production

Fresh water

- Soil is excellent storage medium (sand dams)
- Soil act as filter

Soil & water are linked!

Every soil management decision

is a water management decision

Warning: Food production is often not only limited by water availability but also by nutrient shortage: we need to aim at synergy!

Thanks for your attention

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