Arid and semi arid development through water augmentation

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Challenges for upgrading rainfed agriculture using water harvesting techniques in the Brazilian semi-arid region

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Arid and semi arid development through water augmentation

1. Introduction

2. Brazilian semi arid region

3. Water harvesting techniques

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1. Introduction

The overgrowing population (95% occurring in developing countries) and the prospective of climate change are calling for new approaches for water planning

Irrigation lands: 20% of world's cropland
75% of world's water consumption
40% of world's food production

Rainfed agriculture still plays, and will continue to do so, a critical role in food production

1. Introduction

Crop output per unit of water input must be increased in both irrigated and rainfed systems

Despite the efforts to promote water harvesting, the overall success of projects is less than expected

In Brazil there is still a window of opportunities for improvements to enable the proliferation of the use of water harvesting techniques

Arid and semi arid development through water augmentation

Brazilian semi arid region

CONCEPT	DEFINITION	CLASSIFICATION
AI, UNESCO	AI = P/ETP	Hyperarid: < 0.03 Arid: 0.03 – 0.2 Semi-arid: 0.2 – 0.5
WSI	WSI = WR/Pop	Relative sufficiency: > 1700 m^3/year/cap Water stress: 1000 m^3/year/cap – 1700 m^3/year/cap Water scarcity: < 1000 m^3/year/cap
WScI, WMO	WScI = UW/WR	Low water scarcity: < 10% Moderate water scarcity: 10% – 20% Medium to high water scarcity: 20% – 40% High water scarcity: > 40%
SWSI	SWSI = (10^4/WSI/HDI)	Relative sufficiency: 0 – 9 hab.10^4/m^3/year Water stress: 10 hab. 10^4/m^3/year – 19 hab. 10^4/m^3/year Water scarcity: > 20 hab. 10^4/m^3/year

Arid and semi arid zones in Latin America

Fonte : GWP; UNEP

América do Sul: 23% território

Semi-árido
Árido

2. Brazilian semi-arid region

Area: around 1,000,000 km^2

Mean annual precipitation: 750 mm (minimum values around 400mm); concentrated into a few months

Mean annual potential evaporation: over 2,000 mm

2. Brazilian semi-arid region

Basal rock: 70% of the area

Low hydrogeological potencial
4 m^3/h

Shallow layer of soil

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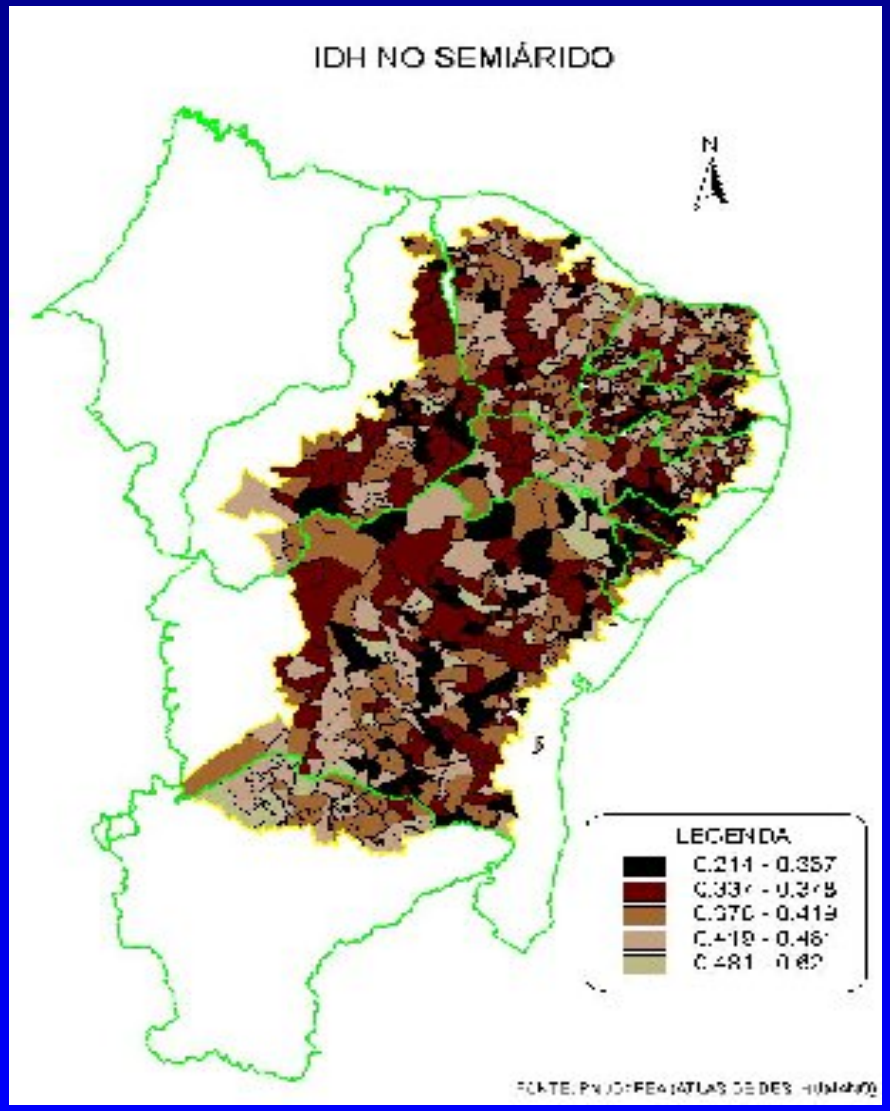
2. Brazilian semi arid region

Development Human Index (DHI) in the Brazilian semi-arid region

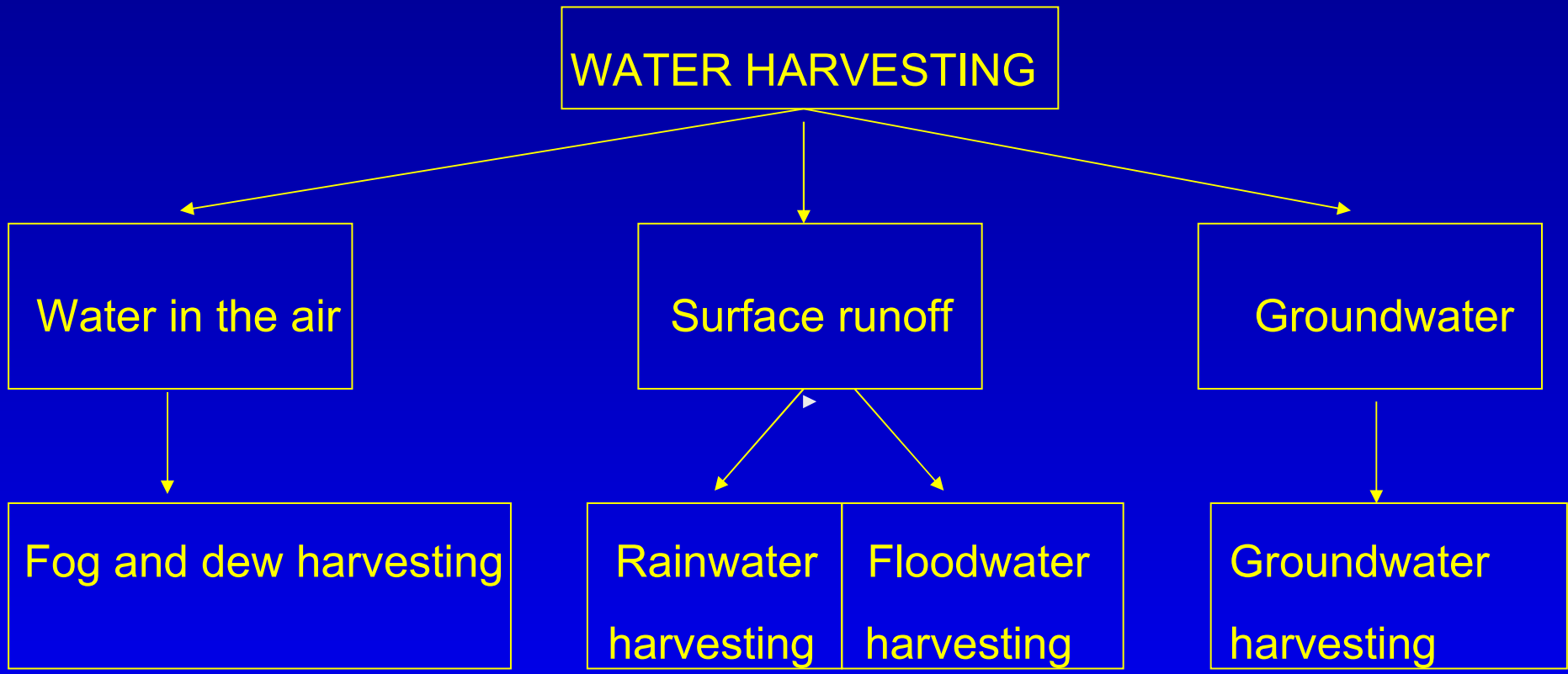
1135 municipalities

Total population: Around 21,000,000 hab.

Rural population: Around 9,000,000 hab.



3. Water harvesting techniques



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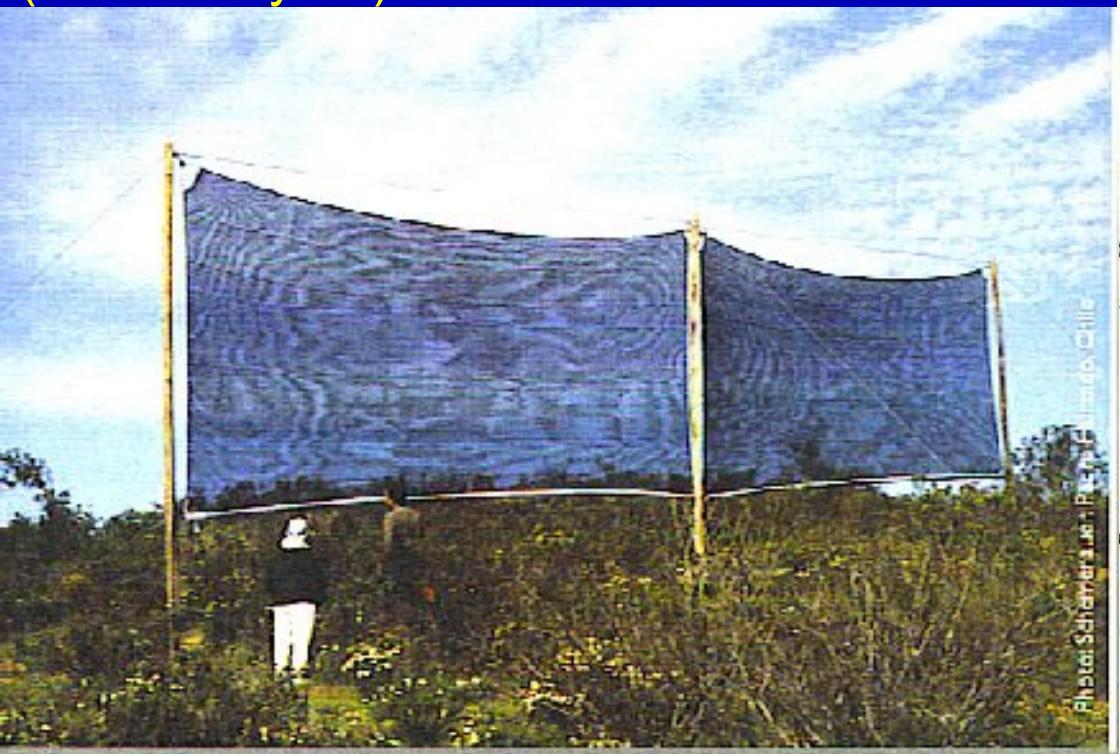
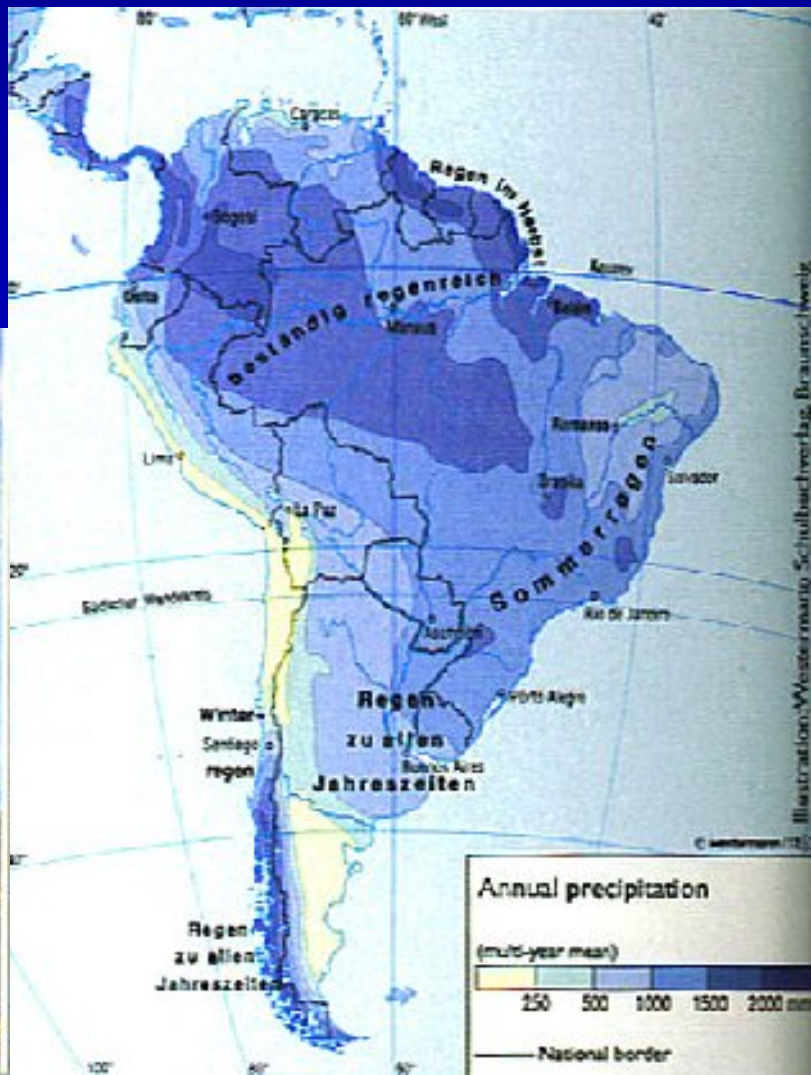
3. Water harvesting techniques

Water in the air: fog water harvesting

In Chile the collectors consist of 48m² double layer polypropylene mesh (3 litres/day/m²)





3. Water harvesting techniques

Surface runoff: rainwater harvesting (roofwater harvesting)

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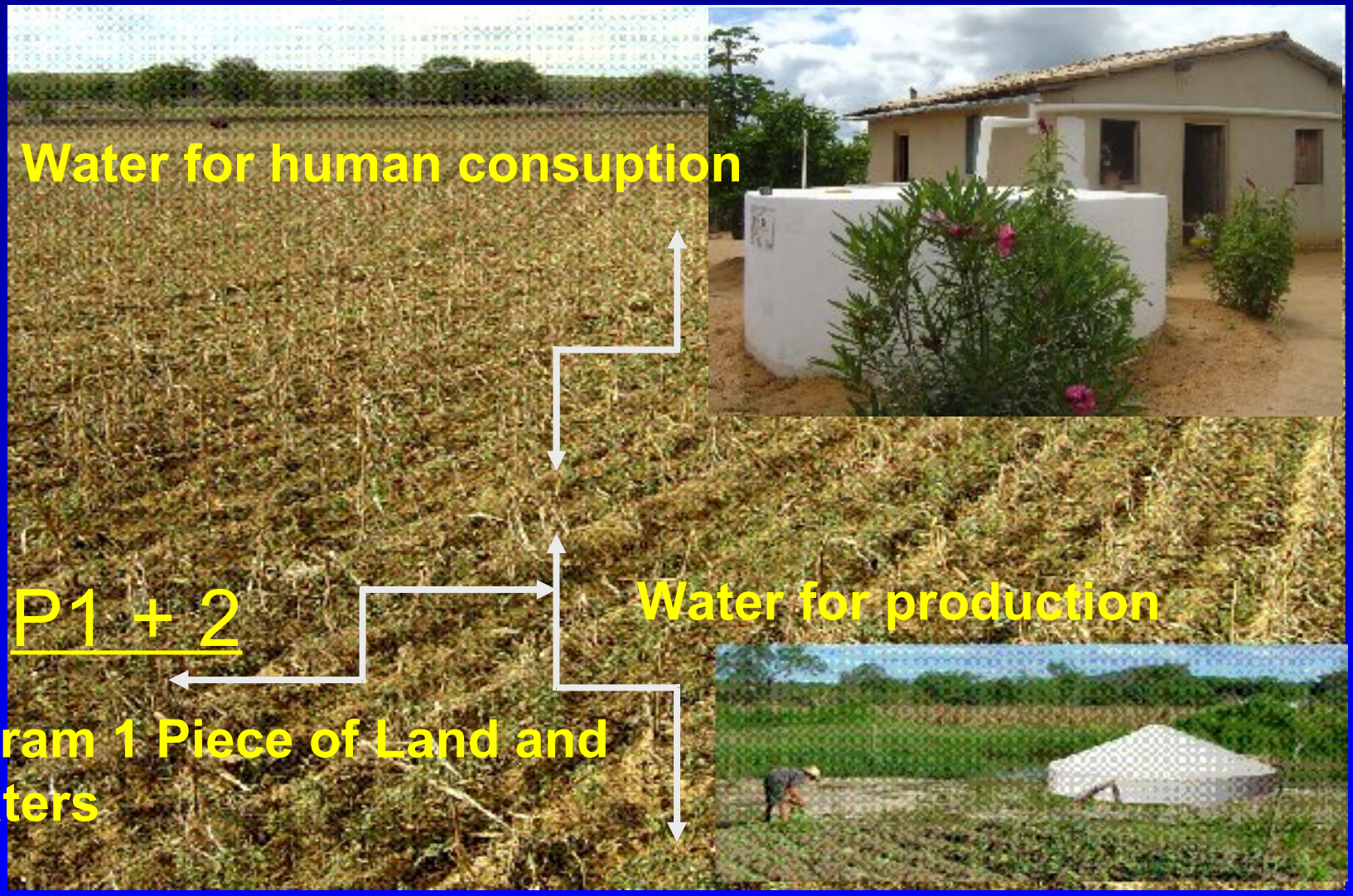
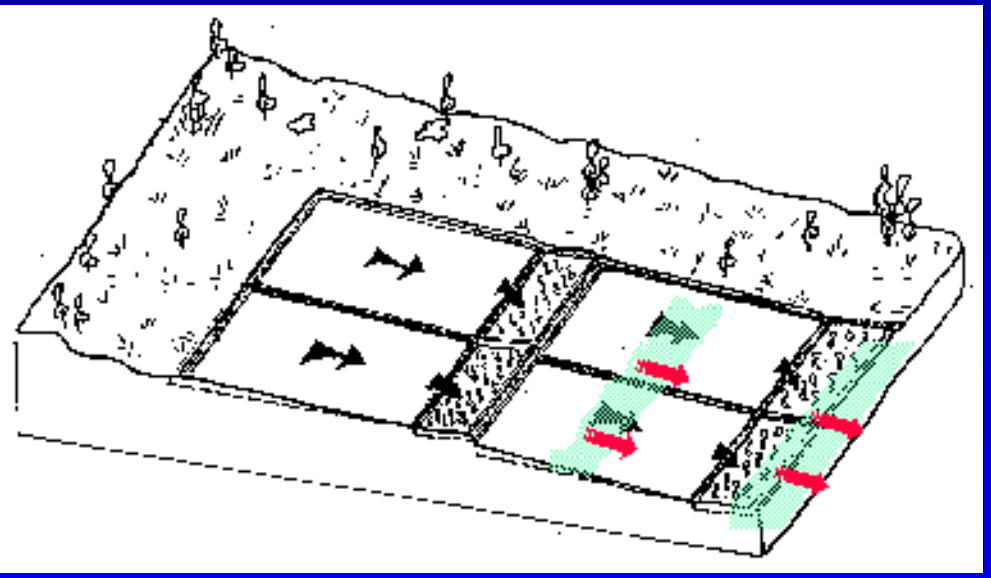
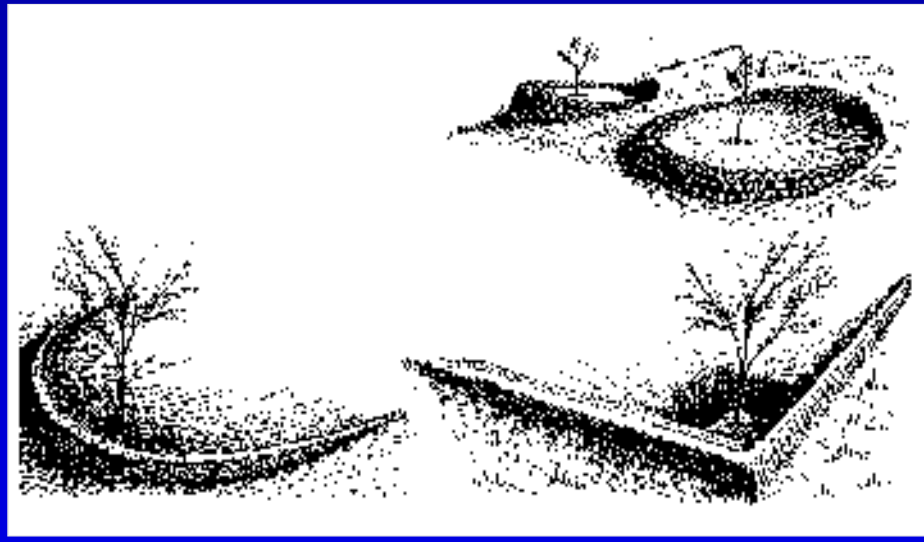
3. Water harvesting techniques



3. Water harvesting techniques

Surface runoff: rainwater harvesting (microcatchment water harvesting)

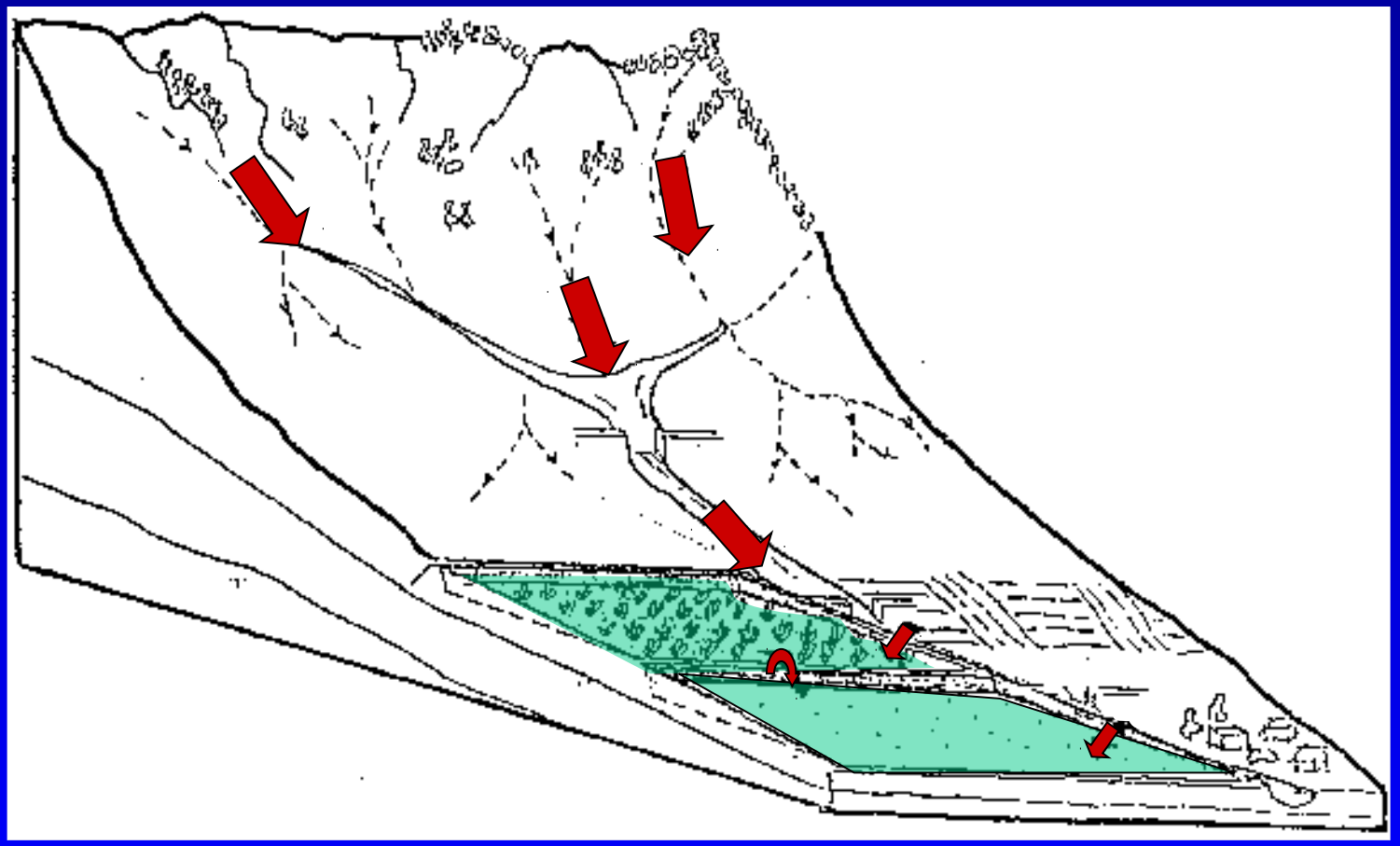




Three types of microcatchment water harvesting

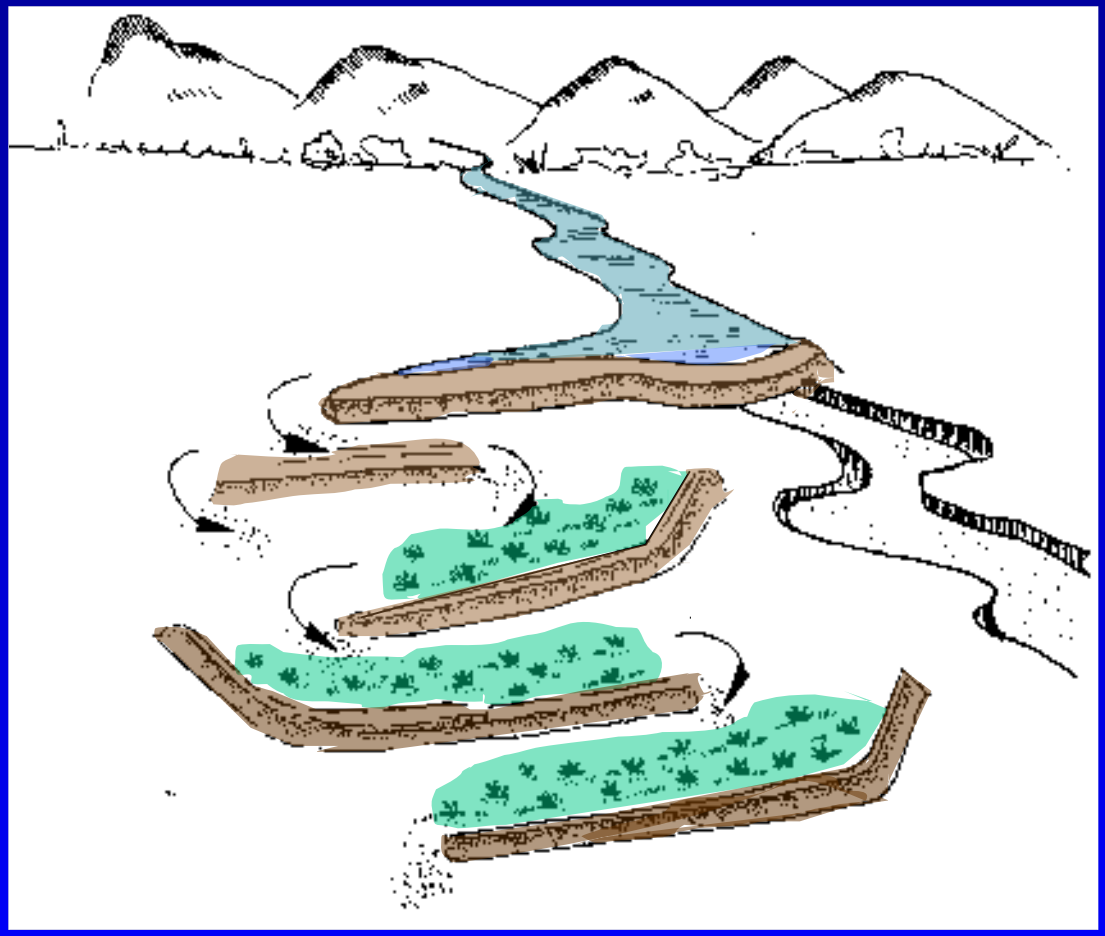
3. Water harvesting techniques

Surface runoff: rainwater harvesting (macrocatchment water harvesting)



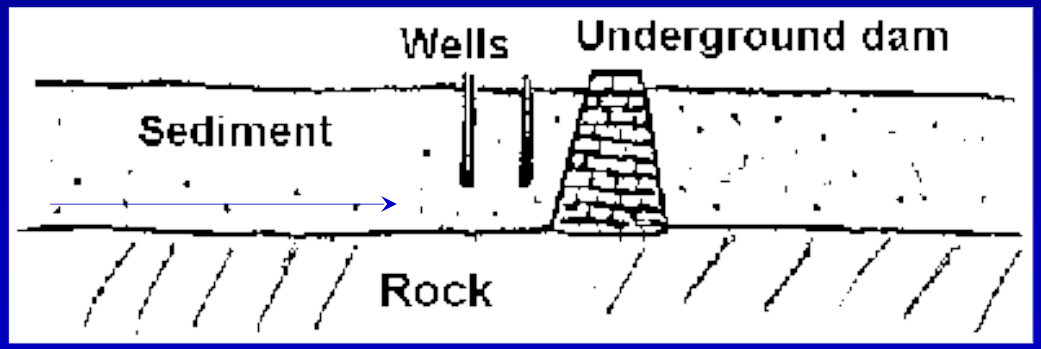
3. Water harvesting techniques

Surface runoff: floodwater harvesting



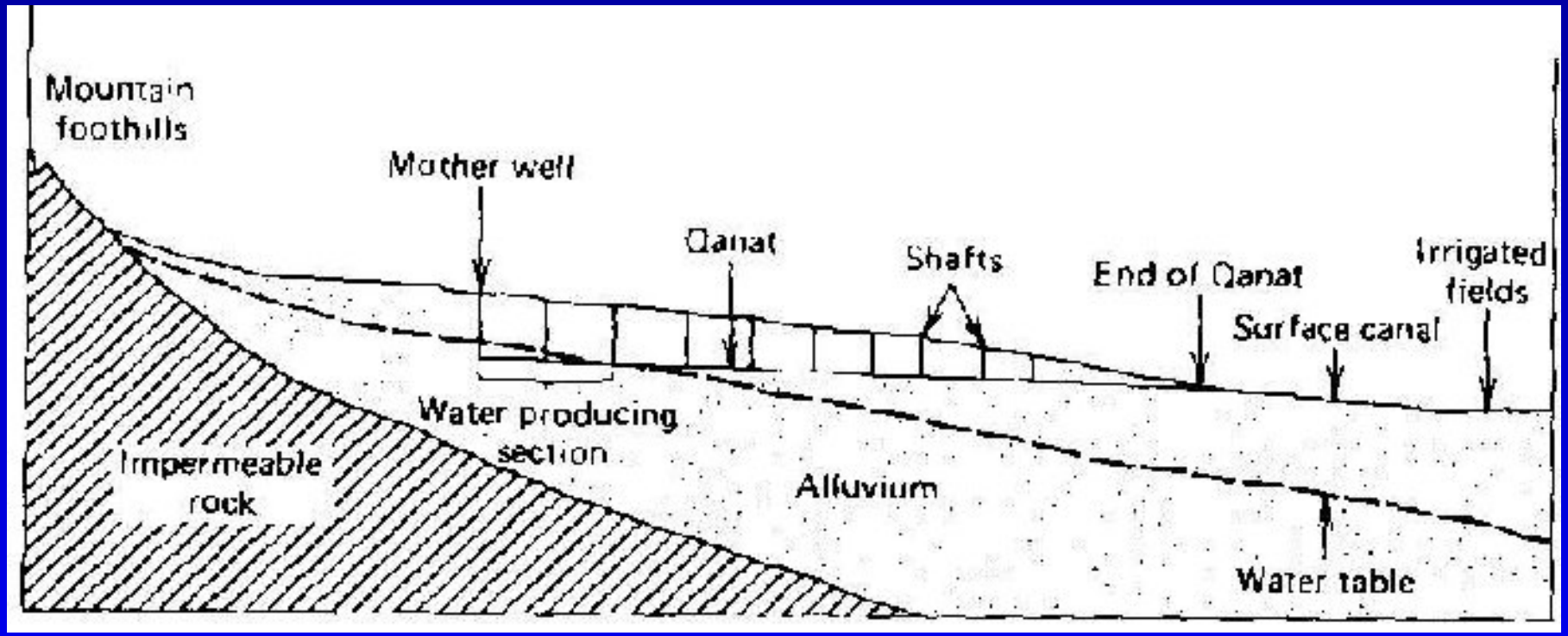
3. Water harvesting techniques

Groundwater: groundwater harvesting (underground dams)



3. Water harvesting techniques

Groundwater: groundwater harvesting (Qanat)



3. Water harvesting techniques

- Economics of water harvesting for agricultural production

It is difficult to give exact figures on the world present total area under the various forms of water harvesting and its contribution to improve food production and food security at local and regional

Data on water harvesting for upgrading of rainfed agriculture in semi-arid regions are more common

Falkenmark et al. (2001): field studies suggest that the prospect of doubling yields, or even quadrupling, is realistic by producing more crop per drop of rain

3. Water harvesting techniques

Li & Gong (2002); China; corn

Tian et al. (2003); China; potato

Fox & Rockström (2003); Burkina Faso; sorghum

Fooladmand & Sepaskhah (2004); Iran; grape

Barron & Okwach (2005); Kenya; maize

Fleskens et al. (2005); Tunisia; olive

Xiao et al. (2007); China; wheat

Wang et al. (2009); China; sorghum

4. Results from an experiment with trees

Although micro-catchment water harvesting techniques have been recommended as an alternative to allow tree cultivation, normally the most appropriate one is not specified for specific conditions

As there are some constraints in transferring water harvesting systems from one region to another there is a need to emulate techniques developed at experimental stations to further application on a larger scale of a field situation

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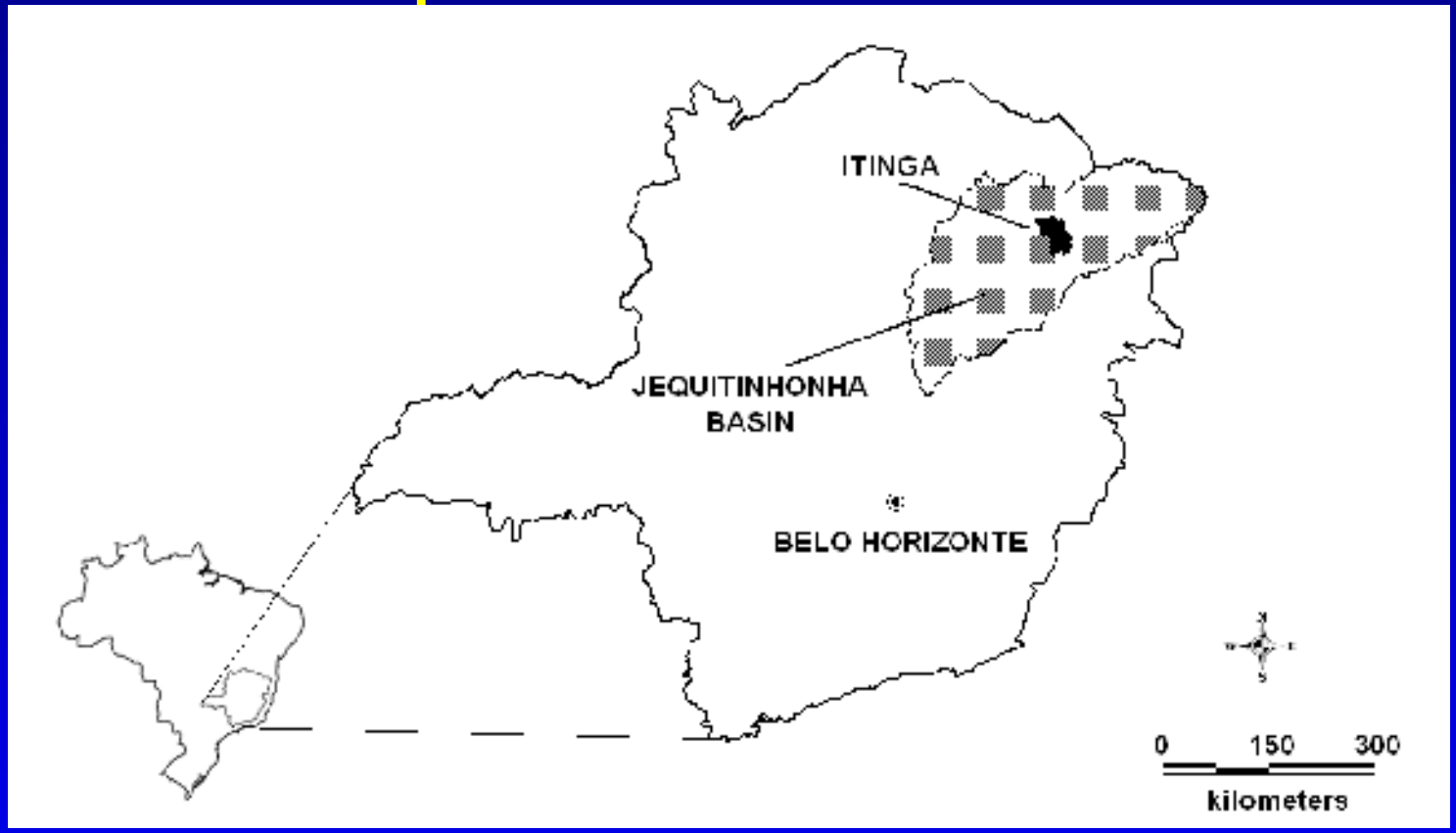
4. Results from an experiment with trees



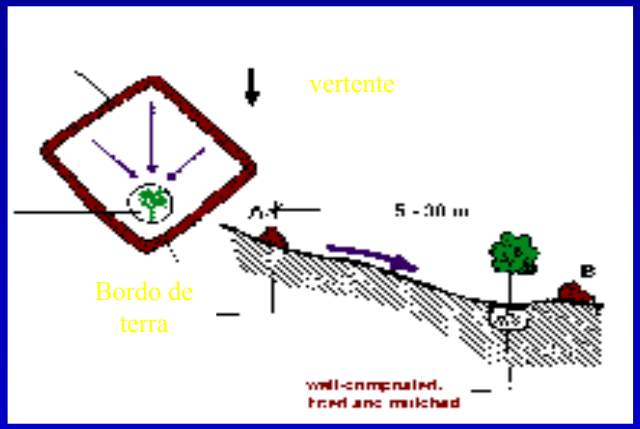
Jequitinhonha Basin; “Valley of the misery” (ONU, 1974)

Mean precipitation: 800mm/year (90% from October to March)

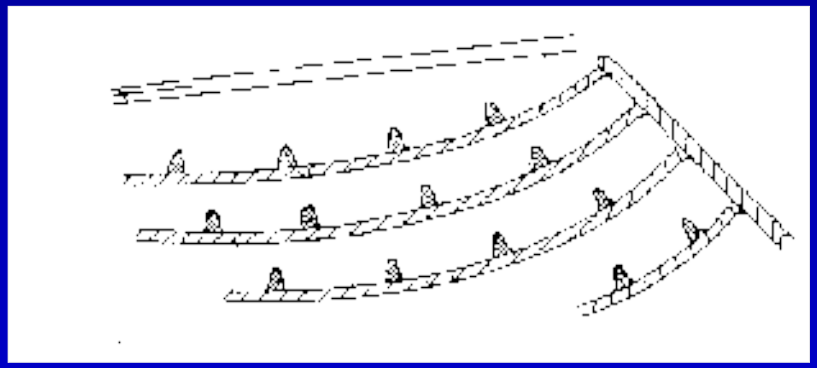
Arid and semi arid development through water augmentation

4. Results from an experiment with trees

Negarin

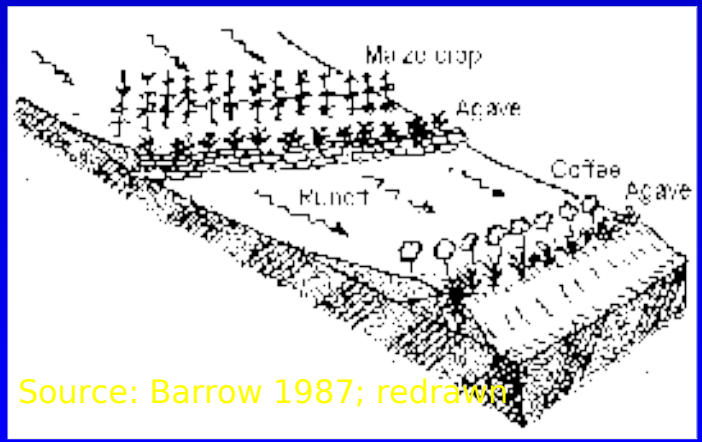


Contour bunds



Semicircular bunds

Contour ridges



Source: Barrow 1987; redrawn

4. Results from an experiment with trees

- two 1000 m^2 experimetal plots were selected (EA1 e EA2)

- in each, 200 m^2 to the control area and each of the four runoff farming techniques

-slope: 5% to 7%

- clayey sand soils

- 180 trees were planted in mid 2005 in the EA1 and EA2 areas; 80 of mango (*Manguifera indica*) and 80 of guava (*Psidium guajava*)

4. Results from an experiment with trees

The systems performance were based on monitoring of:

- soil moisture (at 20cm and at 40cm depth)

- infiltration tests

- canopy development (mean height and mean number of leaves)

The contour ridge technique showed to be the most effective in enhancing the plant production and growth; it was also the best technique to retain soil moisture which allowed the plants to continue growing in spite of the high evaporation rates during the dry season

5. Concluding remarks

The analysis of the potential of upscaling of water harvesting from a field scale to a watershed scale is still a big challenge that must be overcome in order to convince decision-makers about the cost benefits of the water harvesting techniques

In assessing the potential contribution of water harvesting techniques to improving the water and food supply Rosegrant (1997) states that "… given the limited areas where such methods appear feasible and the small amounts of water that can be captured, water harvesting techniques are unlikely to have a significant impact on global food production and water scarcity."

5. Concluding remarks

In a sense this is still verified in spite of the positive experiences carried out in the last decade on increasing crop yield associated with water harvesting adoption

However, it must be remembered that socioeconomic and environmental benefits of the extensive use of the water harvesting techniques are far more important than increasing agricultural water productivity

GRACIAS

THANK YOU

OBRIGADO