



WORLD
RESOURCES
INSTITUTE

**AGRICULTURAL INTENSIFICATION IN THE
SAHEL:
*REDUCING POVERTY AND ADAPTING TO
CLIMATE CHANGE***

Chris Reij

NIGER

2018 20 million inhabitants

2036 40 million inhabitants

Netherlands

2018 17 million inhabitants

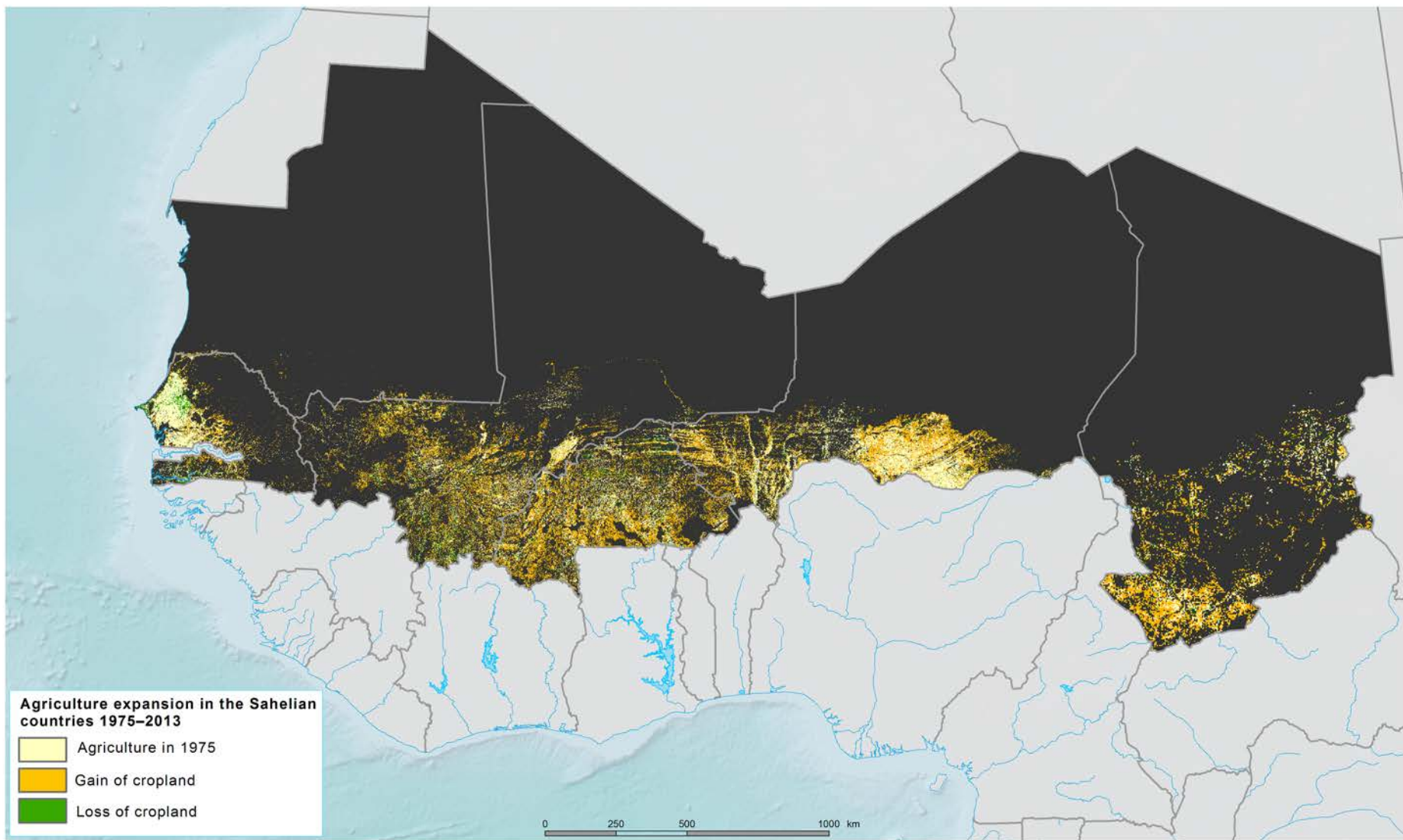
2060 20 million inhabitants

**NIGER RESTORATION PLEDGE:
3.2 million ha by 2030 (266,000 ha/year)**

**Pledge means 0.25 ha restored per
individual born between 2018 and 2036**

**Current annual rate of restoration ? But too
low.**

Scalable techniques and a scaling strategy!



INTENSIFICATION PATHWAYS

- **AGROFORESTRY**
- **AGROFORESTRY + FERTILIZERS**
- **WATER HARVESTING**
- **WATER HARVESTING + FERTILIZERS**
- **SMALL-SCALE IRRIGATION**

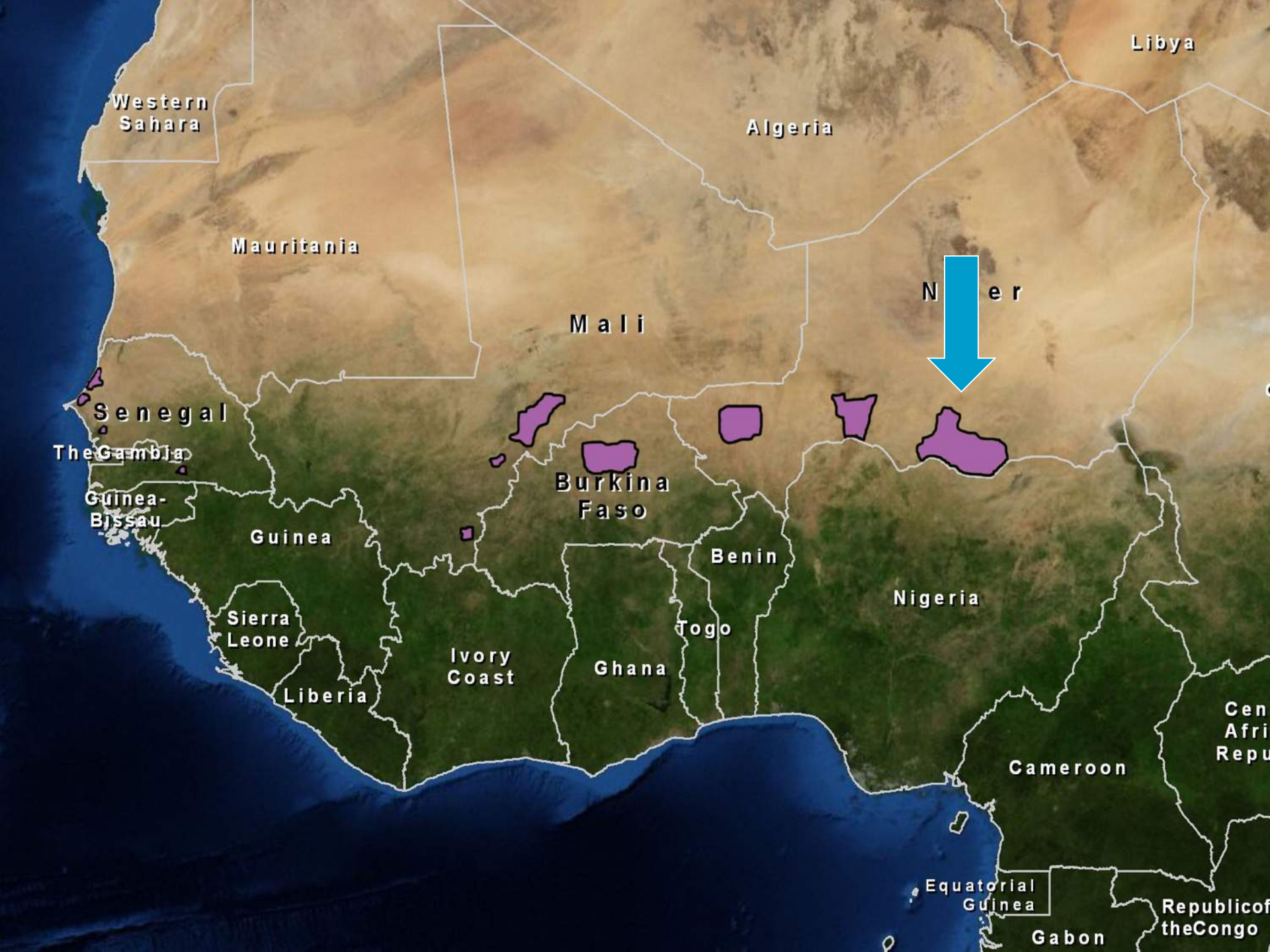
NIGER: 6 MILLION HA OF NEW AGROFORESTRY SINCE 1985



Benefits of on farm trees

- Firewood production
- Fodder for animals
- Increase in biodiversity
- Habitat for millions of migrating birds
- Fruit production
- Increase in soil fertility
- Decreased soil erosion
- Reduced wind speed
- Increased crop yields
- Poverty reduction
- Decrease in local temperature
- Increase in rainfall
- FMNR is inexpensive and easy to adopt
- Increase in biomass and carbon
- Adaptation to climate change
- Mitigation of climate change





Western Sahara

Libya

Mauritania

Algeria

Mali

Niger

Senegal

The Gambia

Guinea-Bissau

Guinea

Burkina Faso

Benin

Sierra Leone

Ivory Coast

Ghana

Togo

Nigeria

Liberia

Cameroon

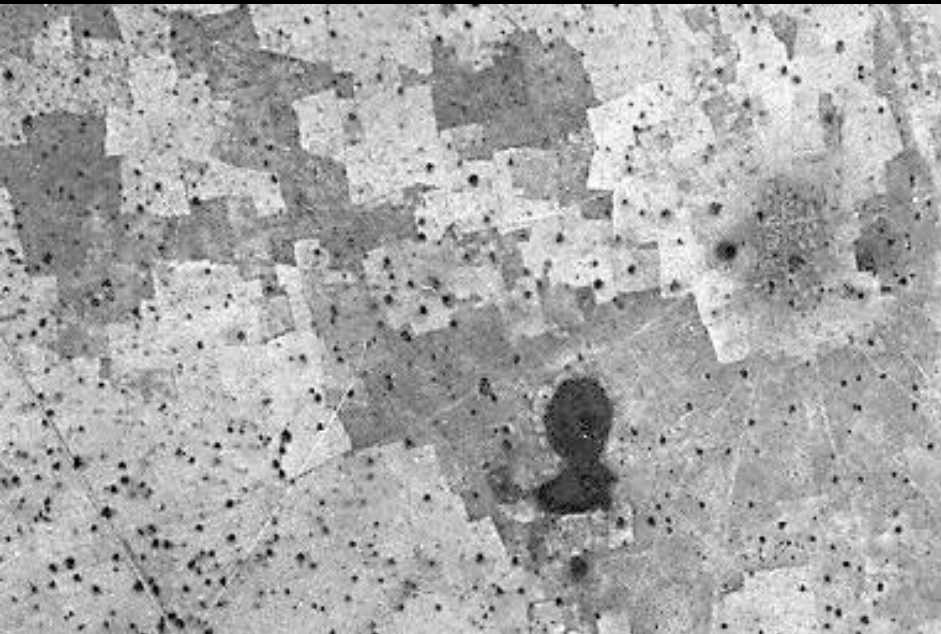
Central African Republic

Equatorial Guinea

Gabon

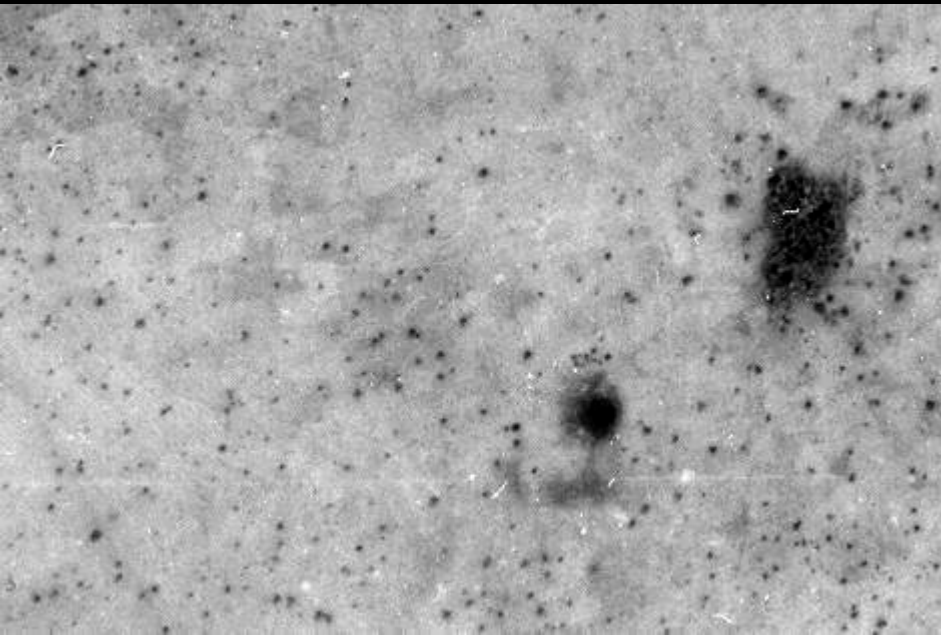
Republic of the Congo

1955

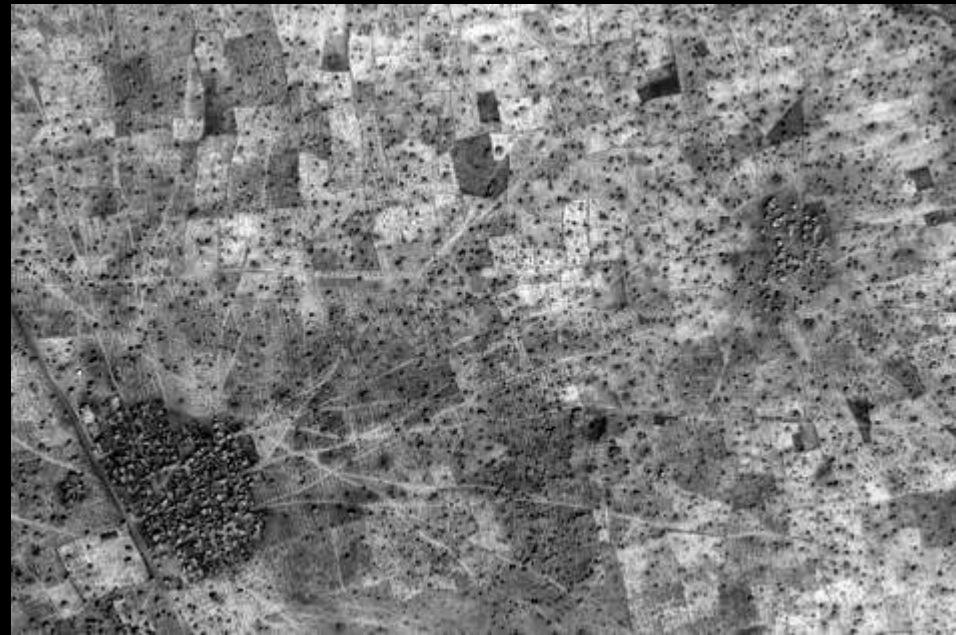


Dynamics of land use and vegetation in Southwest Zinder

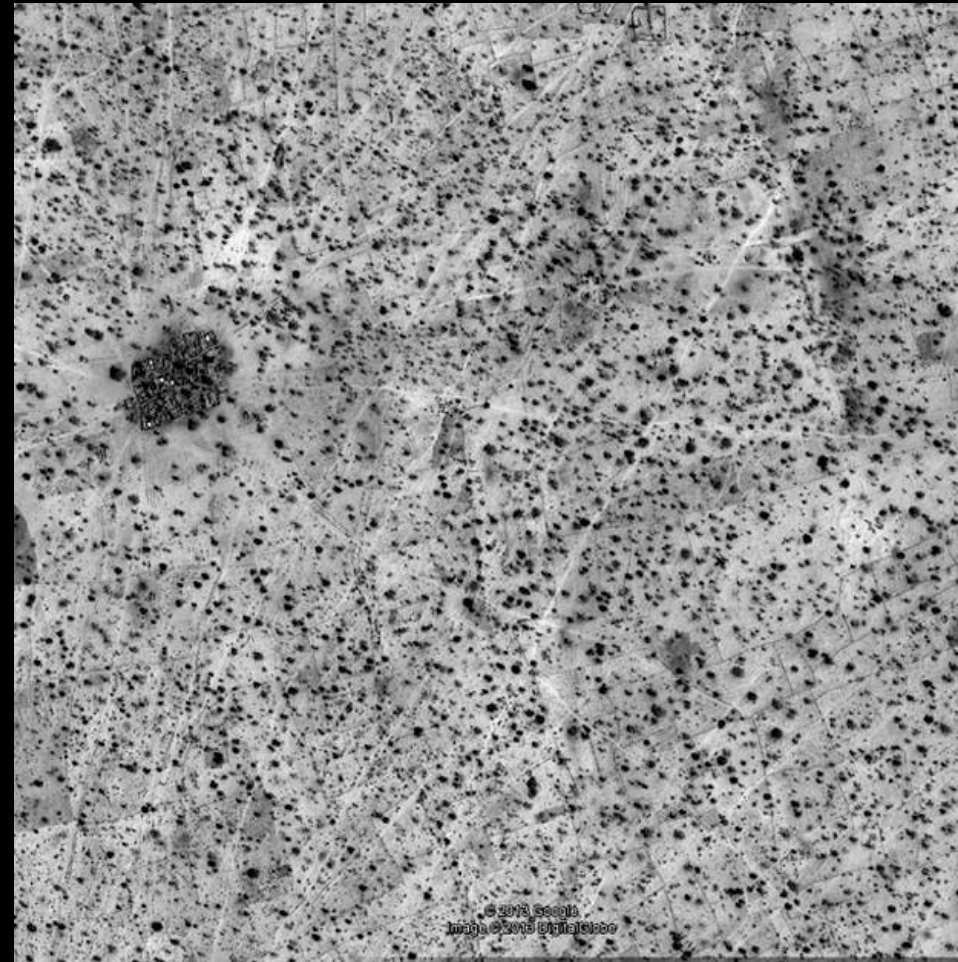
1975



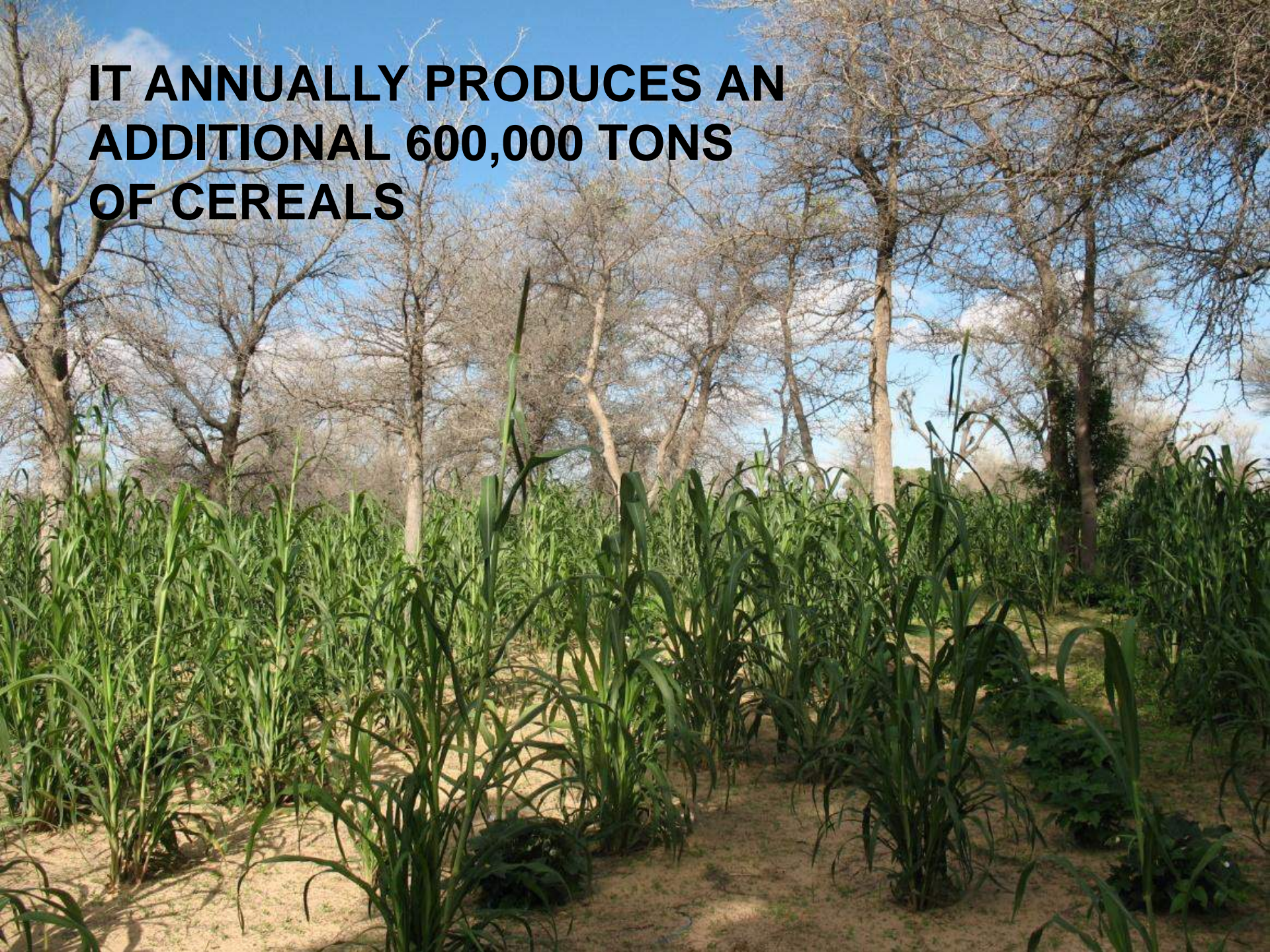
2005



October 2005 and February 2012



**IT ANNUALLY PRODUCES AN
ADDITIONAL 600,000 TONS
OF CEREALS**



FOOD DEFICIT IN NIGER IN 2011 -2012:

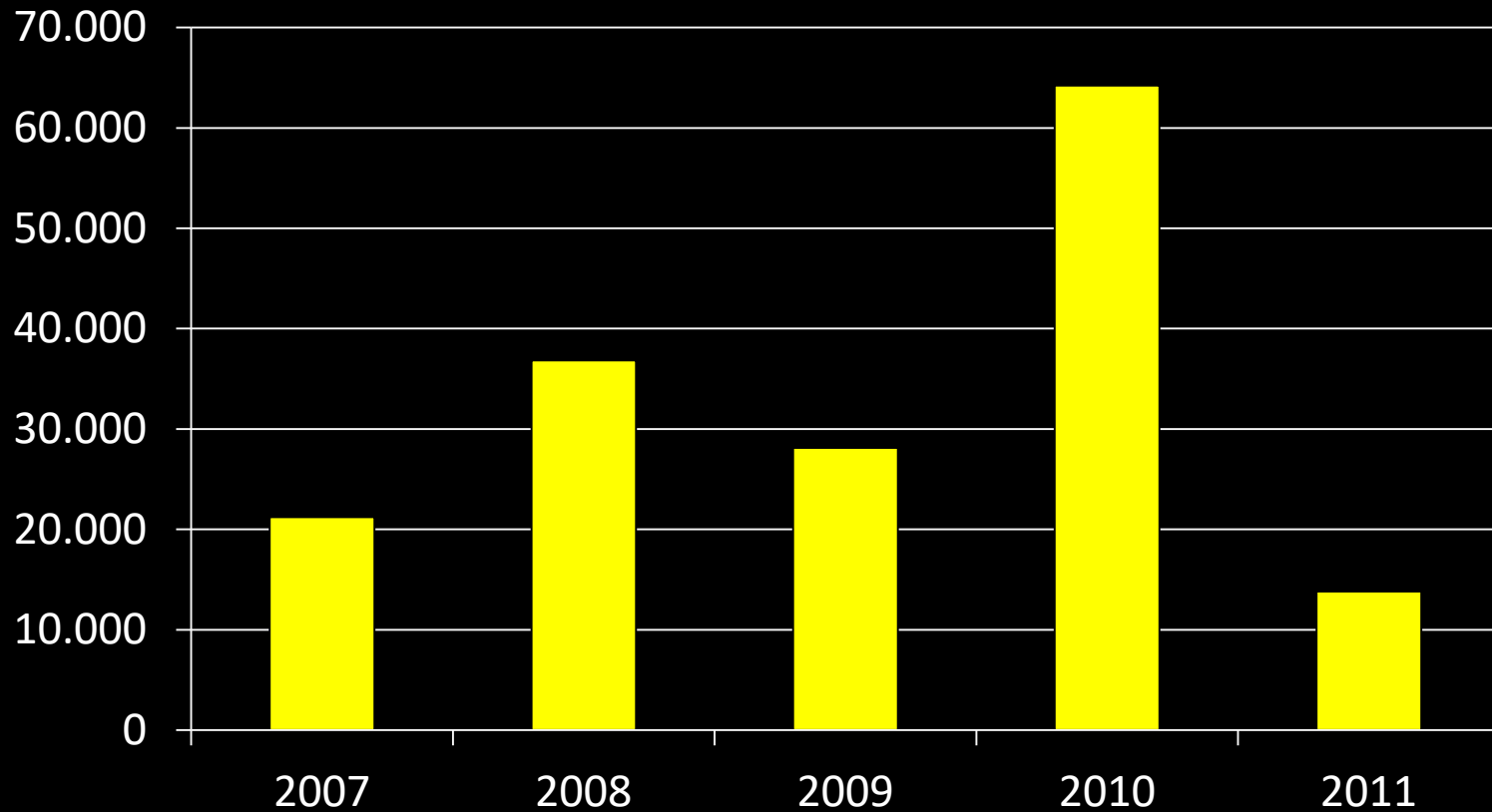
600,000 TONS



Benefits of agroforestry: Grain surpluses (Niger)

Annual grain surplus in Kantché department (Zinder, Niger)

Metric tons



Improved soil fertility and an increase in fodder production





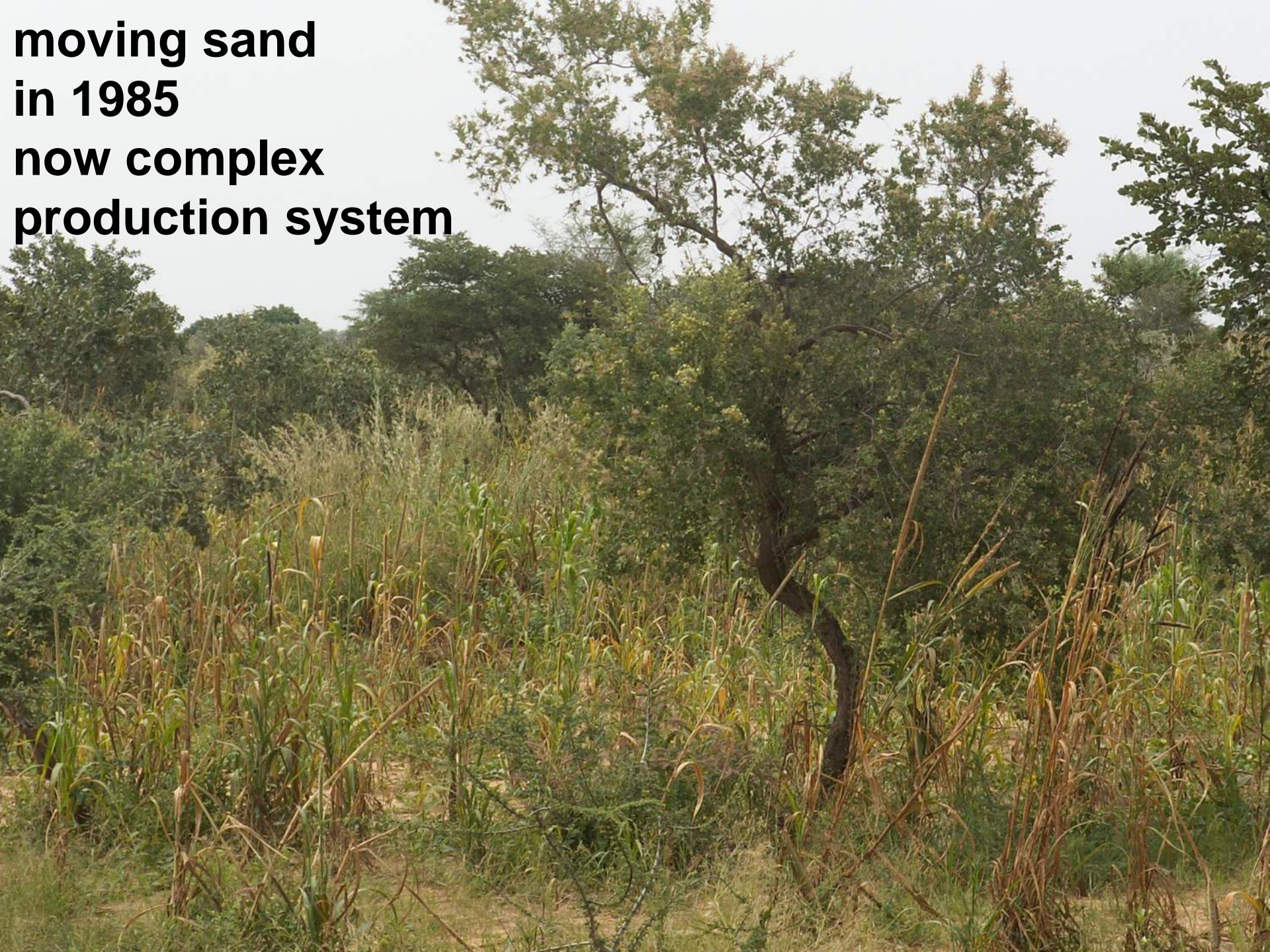
**FODDER IS LESS A
CONSTRAINT AND LIVESTOCK
DEPENDS 6 MONTHS/YEAR ON
TREES**

AVERAGE ANNUAL HOUSEHOLD INCOME FROM NEW AGROFORESTRY PARKLAND (US \$)

Village Degree of vulnerability	Kouka Samou	Doukoum Doukoum	Kirou Haussa	Zedrawa	Daré
Least vulnerable	200	40	140	125	135
Medium Vulnerable	110	37	120	70	63
Very vulnerable	80	83	26	40	100
Extremely Vulnerable	104	50	116	80	45

Source: Yamba and Sambo (2012)

**moving sand
in 1985
now complex
production system**



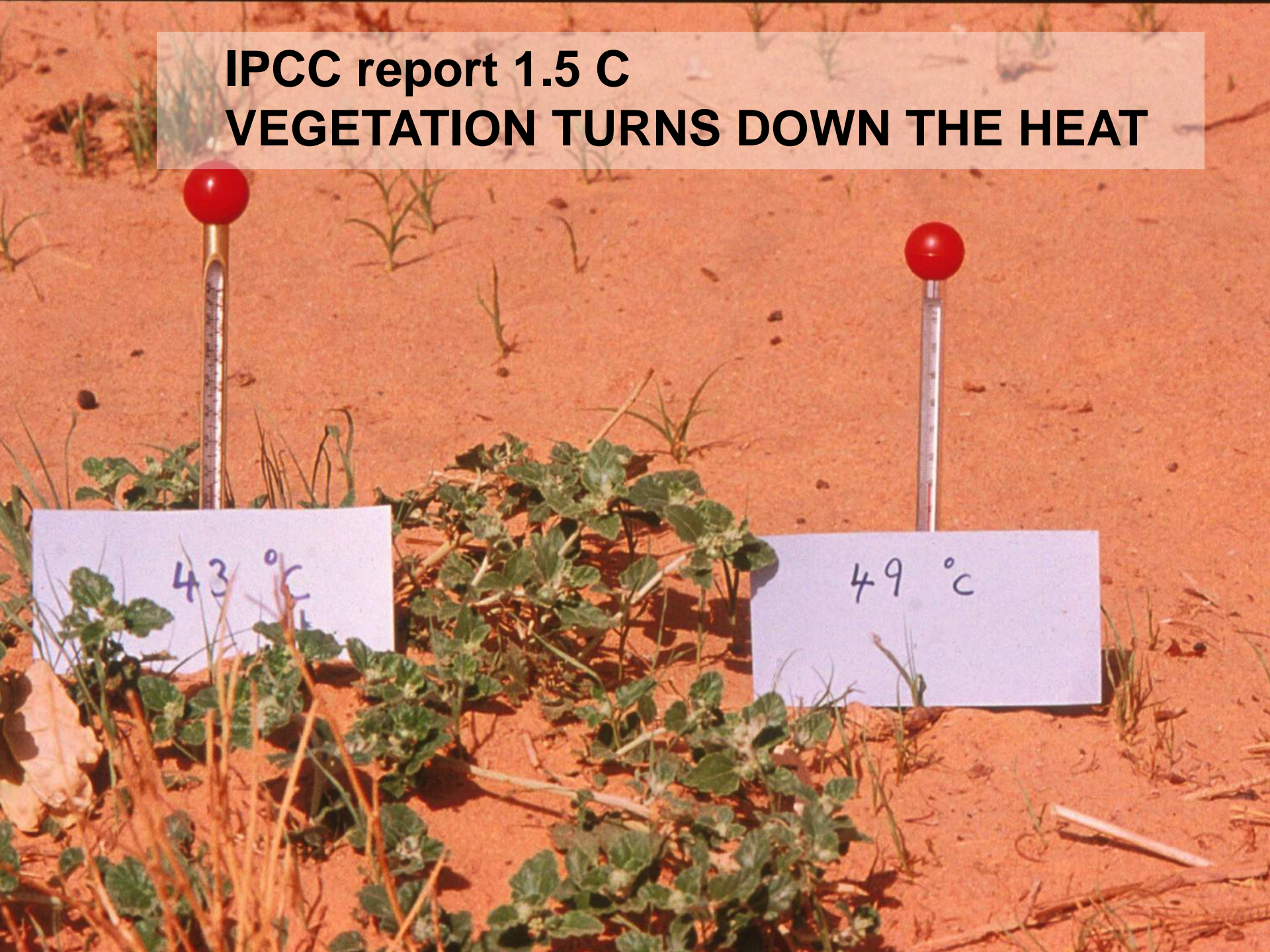
**IPCC report 1.5 C
VEGETATION TURNS DOWN THE HEAT**



43 °C



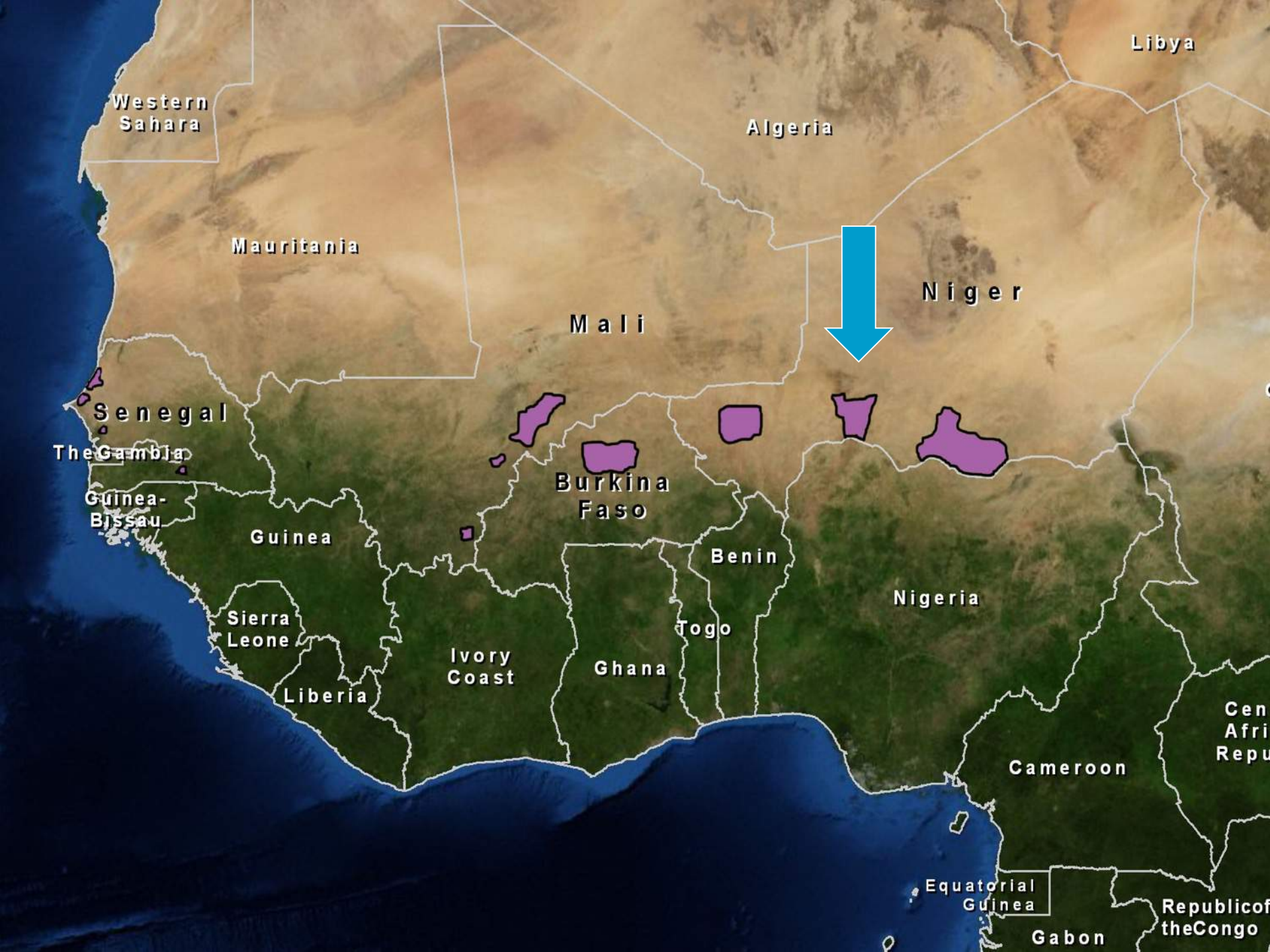
49 °C



“Day-time temperatures in Oursi village on 12 November 1989; time air temperature in the shade and temperature on the bare ground in full sun without any shade.

	<i>tree shade</i>	<i>bare ground</i>
<i>06.45 hours</i>	<i>25 C</i>	<i>23 C</i>
<i>10.30 hours</i>	<i>33 C</i>	<i>54 C</i>
<i>13.25 hours</i>	<i>36 C</i>	<i>71 C</i>

Important micro-organisms in the top soil will die if exposed to temperatures of 55 C and over for more than 1 hour at a time.



Western Sahara

Libya

Mauritania

Algeria

Mali

Niger

Senegal

The Gambia

Guinea-Bissau

Guinea

Burkina Faso

Benin

Sierra Leone

Ivory Coast

Ghana

Togo

Nigeria

Liberia

Cameroon

Central African Republic

Equatorial Guinea

Gabon

Republic of the Congo

**ILLELA DISTRICT, TAHOUA
MARCH 1984**

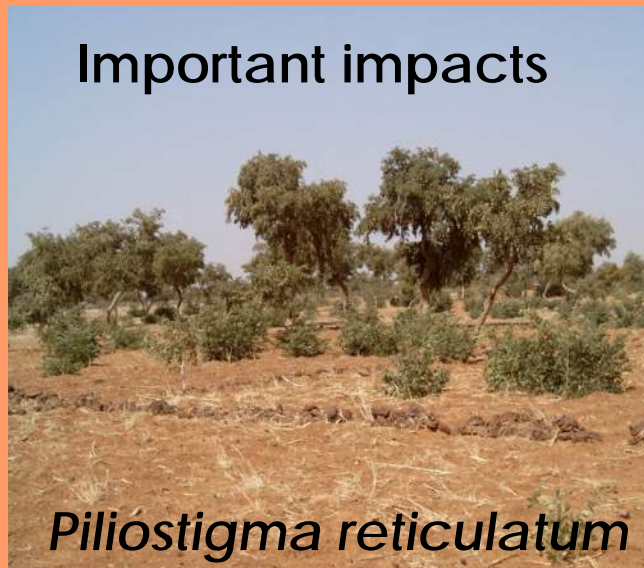


WATER HARVESTING AND AGROFORESTRY



Zai

Half moons



MAY 4, 2018



Rainfall, WH techniques and cereal yields in Niger (1991 – 1996)

Rainfall	1991	1992	1993	1994	1995	1996	Average 1991 – 1996
Badagui- chiri	726 mm	423 mm	369 mm	613 mm	415 mm	439 mm	
Illéla	581 mm	440 mm	233 mm	581 mm	404 mm	440 mm	
Zai							
T0	----	125	144	296	50	11	125
T1	520	297	393	969	347	553	513
T2	764	494	659	1486	534	653	765
Half moons							
T0	----	86	77	206	28	164	112
T1	655	293	416	912	424	511	535
T2	1183	538	641	1531	615	632	857
Average Illéla district	386	241	270	362	267	282	301

**T0 = adjacent fields; T1 WH technique + manure
T2 WH technique + manure + urea**

**DABNOU, ILLELA (TAHOUA)
OCTOBER 1992**



**DABNOU, ILLELA (TAHOUA)
SEPTEMBER 2006**



**Batodi: water levels in wells increased by 14 m
in 10 years (1994 – 2004) (Nov. 2004)**



Batodi: water levels still at – 4 m in January 2012
number of gardens increased from:
0 in 1994
4 in 2004
10 in 2012 and 11 in 2018



**Batodi: the gardens are cultivated 365 days/year
(May 2012)**



Batodi: the same garden
July 19, 2018







**BADAGUICHIRI VALLEY WAS
VERY DEGRADED IN 1984**









PROJET DE PROMOTION DES EXPORTATIONS AGRO-PASTORALES
(P.P.E.A.P.) COOPERATIVE NIYA

Seuil d'épandage d'ADOUNA (amont)

Maitre d'œuvres : **SA A E R A / TA** Réalisation: PDRT Coût: 31.870.410 FCFA

Financement: **(P.P.E.A.P.) 80%** **COOPERATIVE NIYA 20%**

Caractéristique de l'Ouvrage: • longueur totale maçonnerie... 525m • longueur deversoir... 400m • longueur ailes... 125m
• Digue Protection en laterite... 600m • Hauteur + Fondation... 1.70 à 1.90m

Objectifs à atteindre: • Plus de 45 ha de Superficie d'épandage en amont • 300 ha de Superficie à protéger en aval contre l'ensablement
• Rendre l'accès possible en toutes Saisons afin d'écouler les produits agricoles • 10 Villages



**Adouna valley:
smallholder irrigation along 20 km
onion production 20 - 30 tons/ha**



+



+



**Water
harvesting**

Agroforestry

Micro-dosing

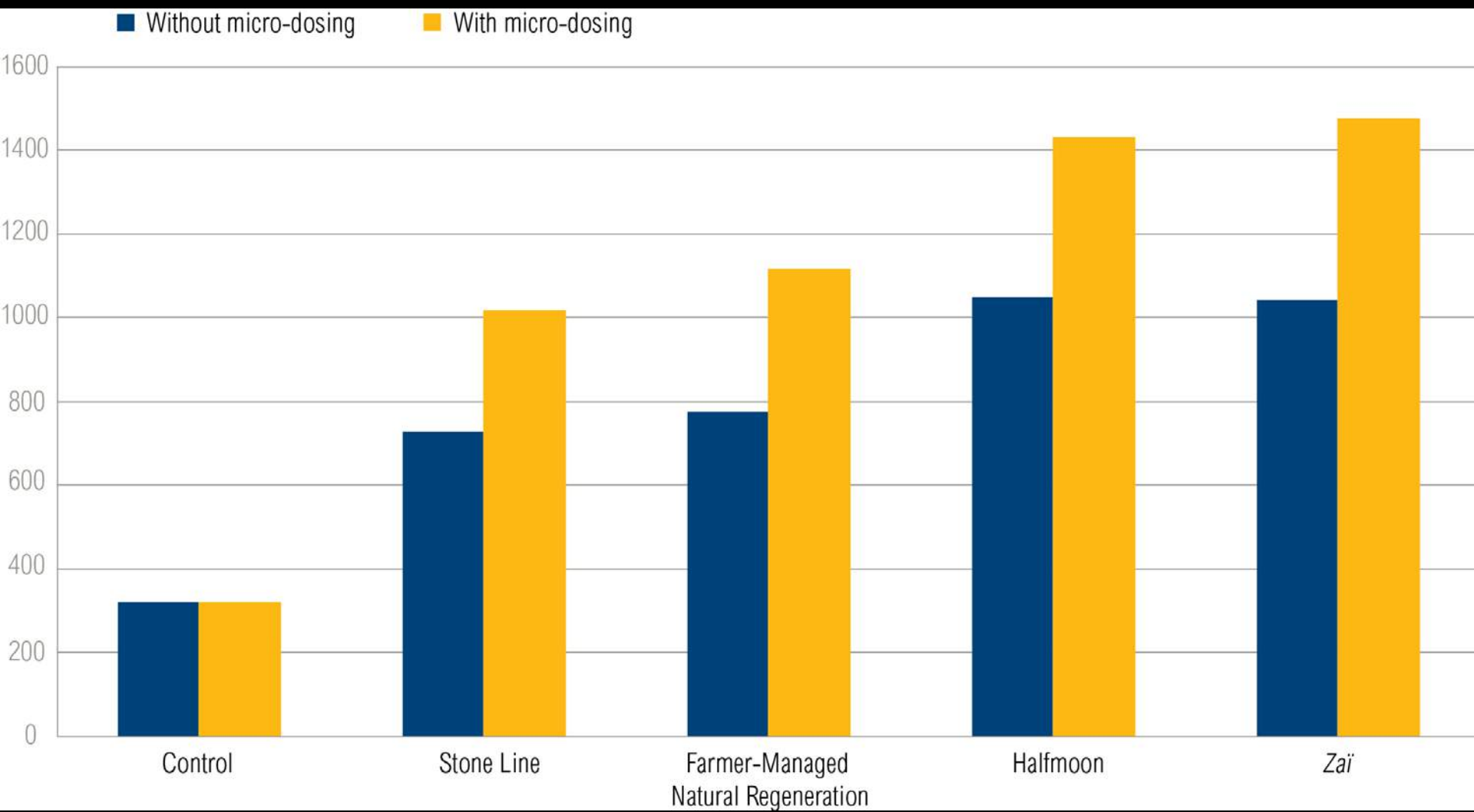
Agroforestry Niger 500 – 800 kg/ha

Agroforestry + micro-dosing 900 – 1300 kg/ha

Without water harvesting 0 kg/ha

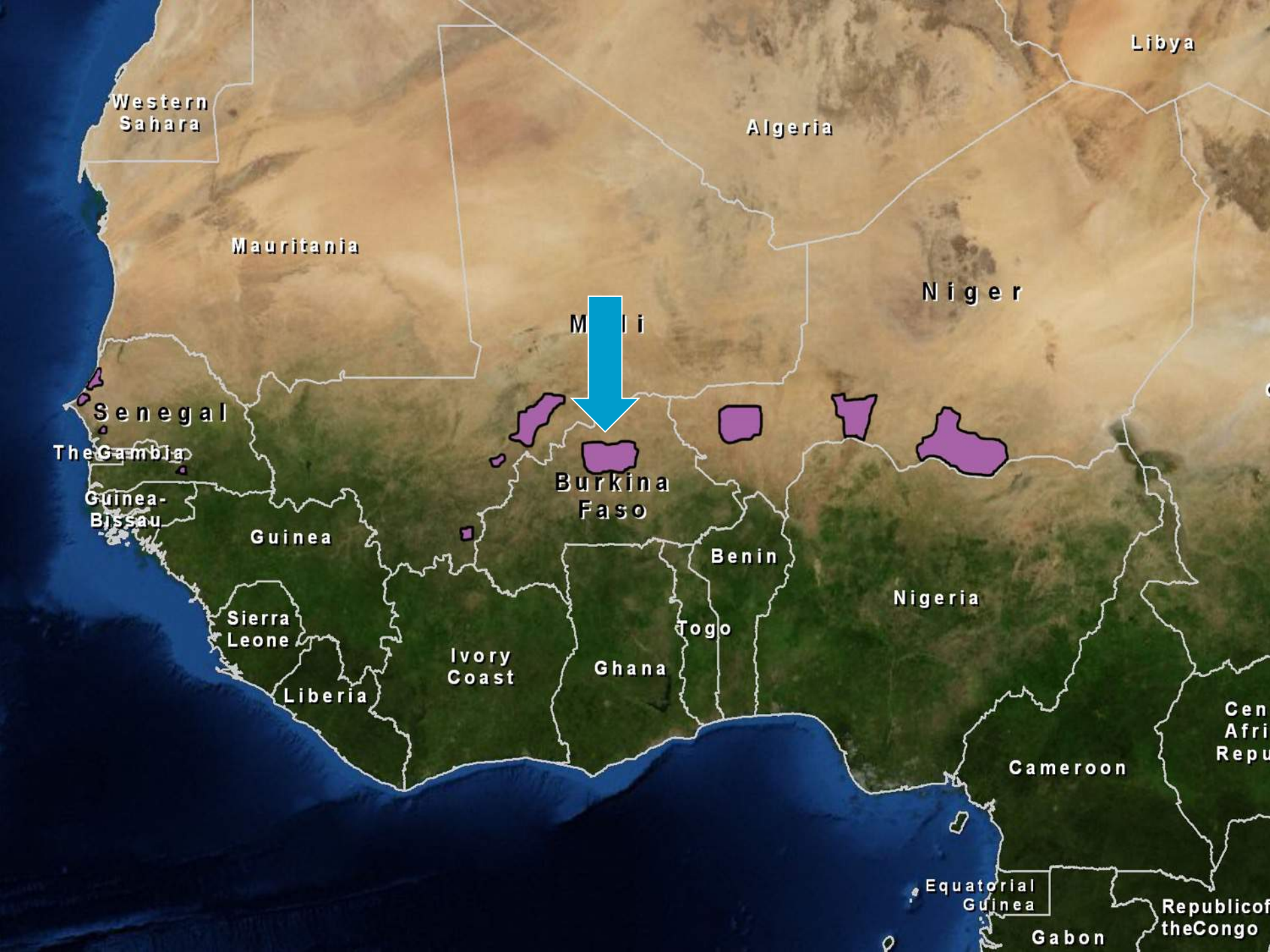
Water harvesting 500 kg/ha

Water harvesting + microdosing 800 – 1500 kg/ha



**The resource cake has grown :
significant reduction in conflicts
between herders and farmers**





Libya

Western Sahara

Algeria

Mauritania

Niger

Mali

Senegal

The Gambia

Guinea-Bissau

Guinea

Burkina Faso

Benin

Sierra Leone

Ivory Coast

Ghana

Togo

Nigeria

Liberia

Cameroon

Central African Republic

Equatorial Guinea

Gabon

Republic of the Congo



**Yacouba Sawadogo:
« The man who stopped the desert »**

**ZAI HELP CROPS GET THROUGH
DRY SPELLS**





RIGHT LIVELIHOODS AWARD 2018

October 1988 (water harvesting techniques introduced on barren land in 1985)



OCTOBER 2008 (COUNTERFACTUAL 0 kg/ha)



AGROFORESTRY IS A LOW COST FOUNDATIONAL PRACTICE TO INCREASE PRODUCTIVITY AND SET THE STAGE FOR FURTHER INTENSIFICATION.....



A SCALING STRATEGY: SIX STEPS

- 1. IDENTIFY AND ANALYZE RE-GREENING SUCCESSES IN DRYLANDS**
- 2. WORKING AT THE GRASSROOTS**
- 3. CREATE ENABLING POLICIES AND LEGISLATION**
- 4. DEVELOP A COMMUNICATION STRATEGY**
- 5. DEVELOP AGROFORESTRY VALUE CHAINS**
- 6. DEVELOP RESEARCH TO FILL GAPS IN KNOWLEDGE**