Adapting to climate change: Policy challenges for agriculture in sub-Saharan Africa

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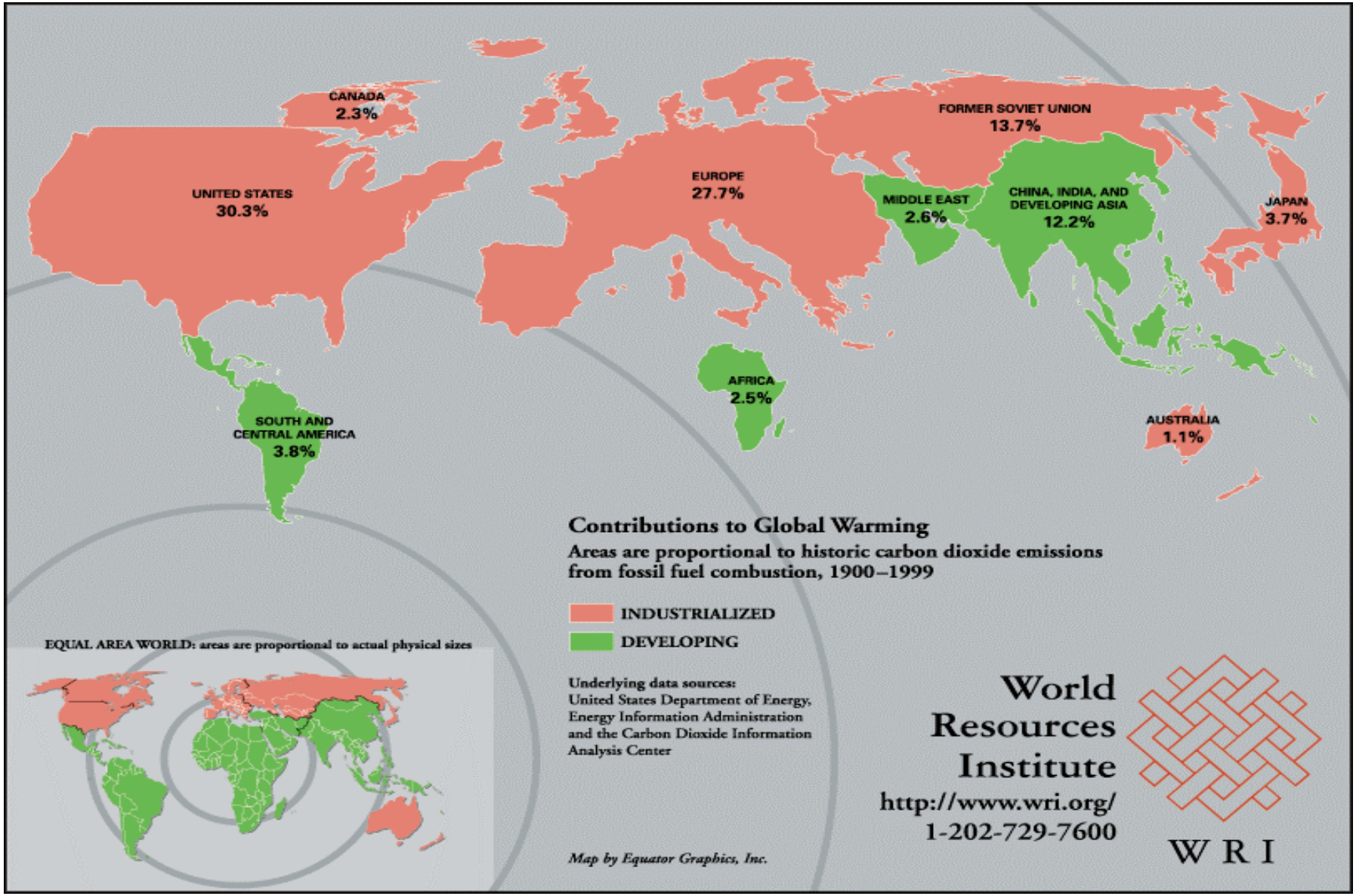
Background & motivation

- Little dispute over the realty of CC
  - Global move to action now – precautionary approach
  - Cost & risks of delayed action high (economics of mitigation)
  - Building up to COP15 – Copenhagen 2009
    - Future (post 2012) agreement on strategies and policy framework for country obligations and commitments
- Consensus on the need for mitigation and adaptation actions – both necessary
- Disagreement on responsibilities and roles
  - Relative significance and distribution among regions of the world (who should do what?)
  - Important differences between industrialized and developing countries in responsibility and abilities

- Industrialized north
  - High energy & carbon growth - historic concentration of GHG
  - Accumulation of economic & technological wealth – capacity
  - High per capita emissions – high potential gains from mitigation
  - Regions benefiting from global warming–most in temperate north
- The developing world
  - Low energy & emission levels–low potential gains from mitigation
  - Low economic and technological wealth – low ability to invest in expensive mitigation actions (need assistance)
  - High poverty – higher energy & emissions inevitable for economic growth necessary for poverty reduction
  - Already warm & vulnerable – biggest CC damages
  - Claim compensation to adapt to CC risks caused by rich north
- DCs soon to contribute more than 50% of GHG – mitigation measures are necessary – middle income

Who is responsible for global warming (historic)?



Where does SSA currently stand?

Table 1. Contribution to GHG and CO2 emissions by region and selected countries in million metric tons CO2 equivalent (CO2e) for 2000

	Total GHG emissions		**Carbon dioxide emissions**	
	Amounts	% of total	Amounts	% of total
World	33,309		23895.7	
Developed Countries	18,102	54.35	14679.5	61.43
Developing countries	15285	45.89	9268.5	38.79
Asia	11471	34.44	7837	32.80
Europe	7638	22.93	6071	25.41
North America	7599	22.81	6283.5	26.30
Central America &Caribbean	725	2.18	507.5	2.12
South America	1812	5.44	796.9	3.33
Oceania	578	1.74	369.1	1.54
Middle East & North Africa	2163	6.49	1531.5	6.41
Sub-Saharan Africa	1323	3.97	492.1	2.06
	Amounts	% in Africa	Amounts	% in Africa
Africa's biggest emitters	1323		492.1	
Congo, DRC	53	4.01	2.5	0.51
Ethiopia	59	4.46	3.6	0.73
Kenya	53	4.01	10.2	2.07
Nigeria	**163**	**12.32**	48.1	**9.77**
South Africa	**413**	**31.22**	344.6	**70.03**
Sudan	**96**	7.26	5.9	1.20
Tanzania	59	4.46	2.7	0.55
Zimbabwe	33	2.49	14.1	2.87
Source: World Resource Institute, International Energy Agency, http://earthtrends.wri.org				

Which are the dirty economic activities?

	Electricity& heat production	Other energy ind.	Manufacturing &construction	Internal transportation	Residential	Agric. & other
World	37.2	4.7	16.8	18.4	7.8	5.6
Developed Countries	41.0	4.5	15	23.6	8.6	6.1
Developing countries	37.6	6.6	24.5	16.4	7.4	5.8
Asia	41.2	4.6	24.4	13.5	6.9	6.3
Europe	40.2	4.2	16.9	19.2	12.1	6
North America	40.9	5.2	12	30.2	6.4	5.2
Central America &Caribbean	33.3	10.7	17	27	5.6	3.4
South America	14.1	9.8	26.1	35.7	7.2	5.4
Oceania	56.7	4.9	16	22.6	2	2.5
Middle East & North Africa	32.4	11	20.8	18.6	9.8	11.3
Sub-Saharan Africa	47.1	2.7	17.2	18.4	3.4	2.7
African biggest emitters						
Congo, DRC	1.1	1.1	35.4	26.3	15.4	38.3
Ethiopia	0.6	0	27.6	54.5	16.4	0
Kenya	23.1	6.5	16.7	45.5	10.9	4.1
Nigeria	12	11.5	11	41.6	9.3	0
South Africa	57.7	1.3	17.8	10.5	1.6	1.7
Sudan	20.8	1.7	15.3	53.6	2.7	4.3
Tanzania	11.2	0	15.9	56.2	13.4	3.3
Zimbabwe	53.8	0.5	15.4	15.8	1.4	12
Source: World Resource Institute, International Energy Agency, http://earthtrends.wri.org						

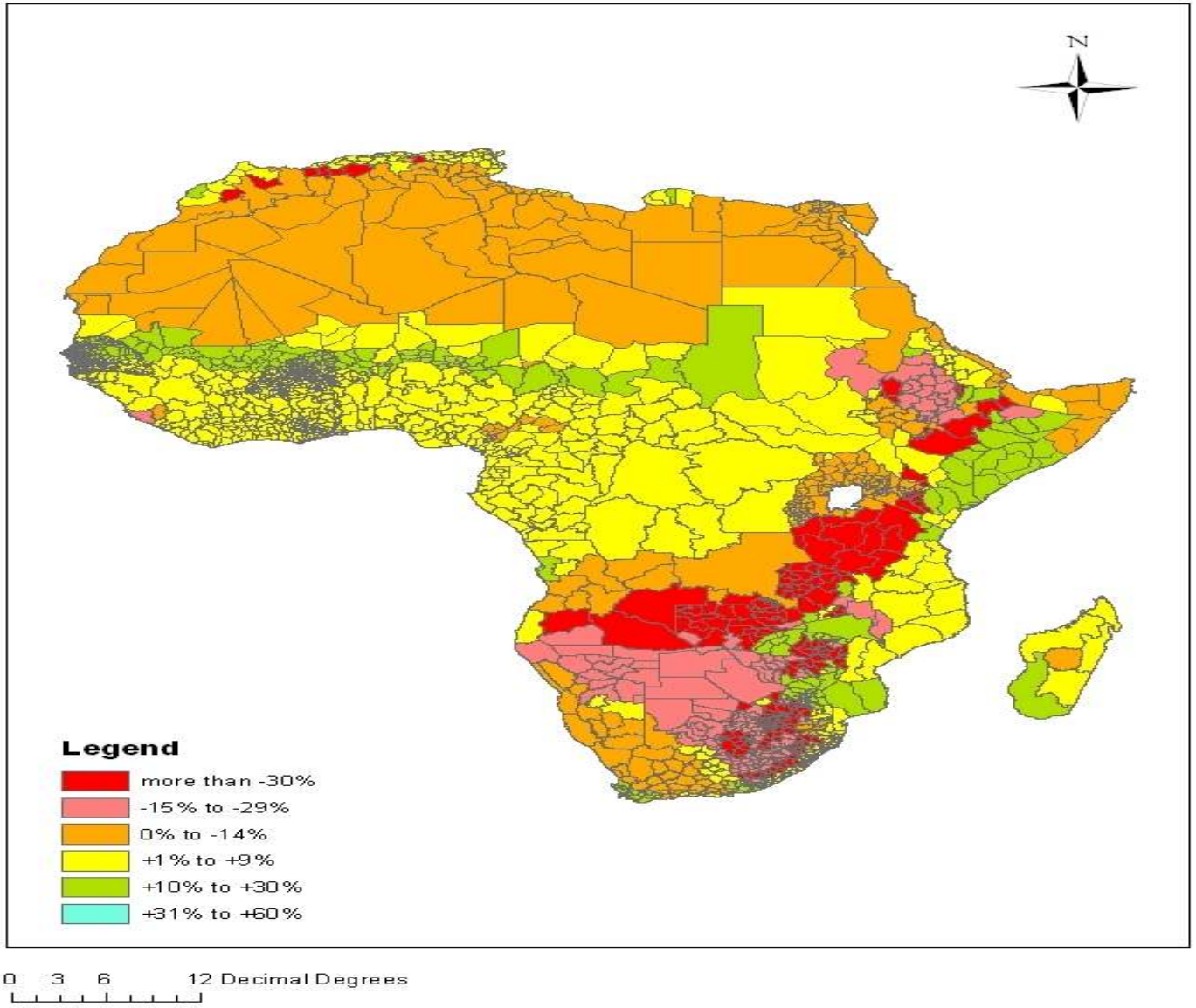
Table 2. Carbon Dioxide emissions by economic activity as percent of total (2000)

Energy consumption & economic wellbeing

Table 3. Energy consumption (million toe), GDP (1000 $) and emissions (million ton CO2e) in 2002

	Total	**% of total**	**toe/capita**	**GDP/capita**	**CO2e/capita**
	Mtoe			000$	Mt CO2e
World	6,975		1.12	7.88	3.85
Developed Countries	4,184	60	3.17		11.11
Developing countries	2791	40	0.57		1.90
Asia	2175.4	31	0.62	4.68	2.24
Europe	1858.7	27	2.56	18.10	8.37
North America	1725.6	25	5.39	35.14	19.64
Central America &Caribbean	138.5	2	0.78	7.35	2.84
South America	304.5	4	0.86	7.33	2.24
Oceania	86.7	1	2.77	21.35	11.80
Middle East & North Africa	408.3	6	0.96	5.99	3.62
Sub-Saharan Africa	259.5	4	0.38	1.78	0.72
African biggest emitters		**% of SSA**			
Congo, DRC	14.28	6	4.45	0.98	0.78
Ethiopia	18.45	7	0.28	0.75	0.05
Kenya	11.04	4	0.35	1.02	0.32
Nigeria	**85.49**	**33**	0.71	0.92	0.40
South Africa	**56.43**	**22**	1.28	**10.15**	7.80
Sudan	9.08	**3**	0.28	1.94	0.18
Tanzania	12.45	5	0.34	0.06	0.07
Zimbabwe	8.27	3	0.63		1.08
Source: World Resource Institute, International Energy Agency, http://earthtrends.wri.org					

How CC damages burden SSA agriculture? Percentage change in farm net revenue with CCC 2100 Scenario



What needs to be done? Response options

- Mitigation necessary–precautionary approach
  - Atmospheric GHG concentrations stabilization (below 2.5 ^{O}C)

Stabilization targets (by 2050)	450 ppm CO2e	550 ppm CO2e
Likely associated warming (50% probability)	2 ^{o}C	4 ^{o}C
Marginal cost of mitigation (US$ per ton CO2)	> 200	50
Required annual investments (% of global GDP)	1.1% (High)	0.4% (Low)
Adaptation efforts needed	Low	High
Current world average per capita emission (ton)	7	7
Target per capita emission achieved by 2050	2	5
Required % reduction in current emission levels: North America Other OECD China at current emission of 5 ton/capita SSA & other at currently < 1 ton	 90% 80% 60% Little growth	 80% 60% Freeze at current Room for growth
Source: Adapted from IEA (2008)		

Mitigation is whose responsibility?

- Potential gain and capacity higher in rich industrialized
- At less than 1 ton no commitments expected for SS
  - Developing countries soon reach 50% global emissions
- Does this mean no mitigation for SSA?
- Mitigation opportunities include:
  - Reforming carbon trading – deforestation & land use change
  - Reward energy use efficiency in carbon intensive sectors
  - Advantage of low carbon technology transfers
  - Information and financial assistance
- Adaptation most important for SSA

SSA agric adaptation challenges

- African farmers have always coped with climate adversities
  - Never new
- Short-term coping responses of government & policy
  - Disaster relief, food assistance, droughts, floods, etc.
- Low investment in science, technology, information for long-term changes
- Weak economic infrastructure (access to markets) , poor technology, institutions, poverty, etc.
- High dependence on dryland farming (< 4% under irrigation compared to about 30% in Asia – high vulnerability to climate risk)
- Low awareness and supply & use of relevant information

Adaptation opportunities for SSA agric

- capacity to adapt is context-specific
  - Varies among countries, communities, social groups and individuals, and over time
  - Determined by a range of factors:
    - Range of available technological options,
    - Resources and their distribution
    - Structure of critical institutions
    - Stock of human capital
    - Property rights
    - Access to risk spreading processes
    - Ability of policy makers to manage information and make effective decisions
    - Public's perception of attribution

Priority areas

- Climate science – ability to predict well climate damages at regional/local scale

Model		Current averages	2020	2100
CCC	**Temperature (0C)**	23.29	24.9 (+1.6%)	29.96 (+6.7%)
PCM		23.29	23.9 (+0.6%)	25.79 (+2.5%)
CCC	**Precipitation (mm)**	79.75	78.8 (-3.7%)	65.08 (-18.4%)
PCM		79.75	89.8 (+12.5%)	83.18 (+4.3%)

- Map the distribution & rank vulnerabilities of regions, systems and communities – where is the highest risk
  - Priority targeting
- Identify & evaluate observed & potential adaptation mechanisms / options
  - Merit (economic, social & environmental goals-cost efficiency, equity, sustainability, etc.
  - Adaptation economics & policy research - evaluation

- Better communication between providers and users of climate information
  - Providers understand better needs of users
  - Make info relevant to needs of users & easy to interpret
  - Users ability to understand & interpret
  - Facilitating platforms/institutions
- Farmers education & effective extension
- Shift focus of decision making and public policy from short to long-term goals

- Observed vulnerabilities of current agricultural practices and strategies:
  - Mono-cropping
  - Specialized farming – plantations / beef & diary cattle
  - Reliance on dryland – irrigation
  - Stress tolerance (water, nutrients, heat)
- Access to markets & non-farm income and employment opportunities
- Access to energy (rural electrification)

- Mainstreaming climate sensitivity as an integral component of all agricultural & broader economic development planning & policy design
- National poverty reduction plans, adaptation action plans & general development strategies to be consistently sensitive to impacts of CC
- External assistance critical for effective implementation of adaptation mechanisms
- Developed world to channel substantial funding, information & technological assistance to reduce negative impacts on poor countries of the global environmental externality they have created

- External funding and other assistance to be tied to some new conditionality requiring reasonable commitment from recipient countries to:
  - Adaptation
  - Energy efficiency and
  - Poverty alleviation targets
- Major reforms and radical changes in existing donor funding mechanisms urgently needed to be effective in assisting development, adaptation and poverty reduction effort

  * Most critical is speeding the delivery of promised obligations
  * Assistance received by SSA in 2005 was almost the same as what reached the region in 1985
  * Currently very small percentage of total funds pledged for achieving the Millennium Development Goals have reached target countries

Adaptation to climate change in Africa

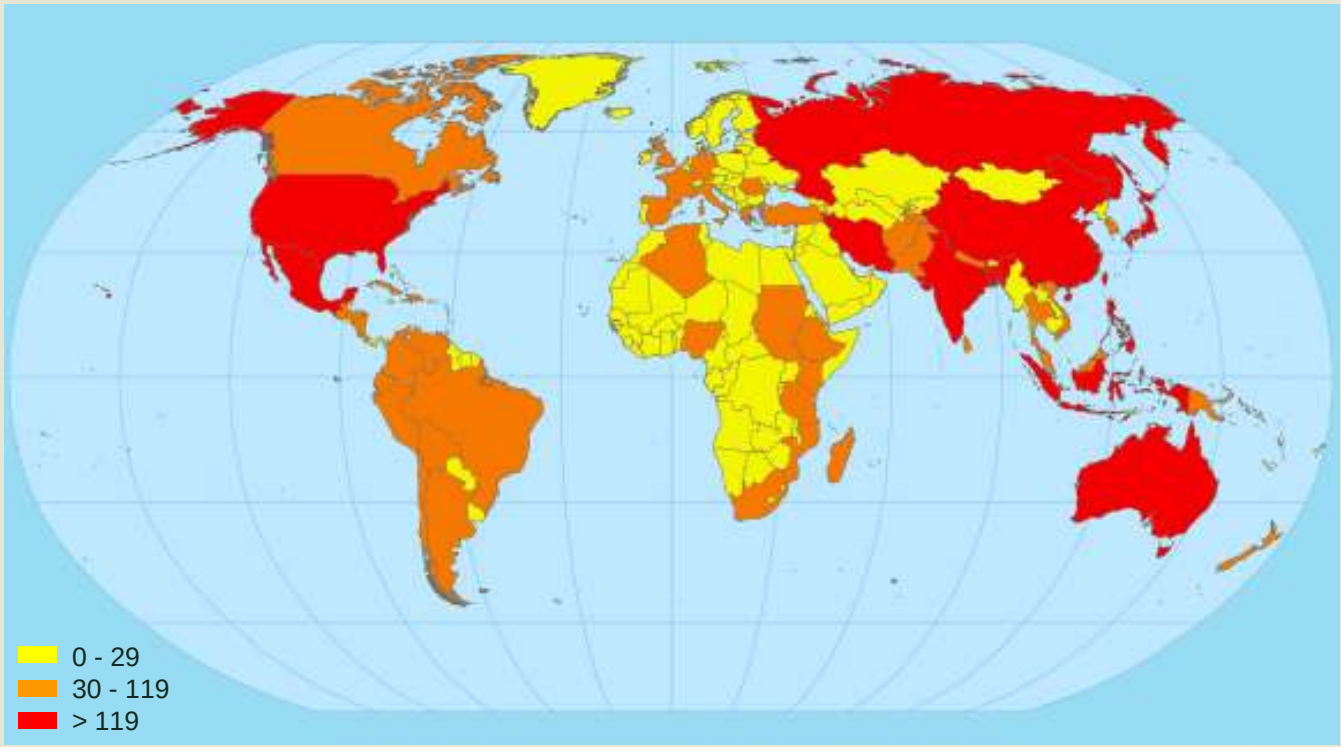
The role of microinsurance

Dirk Reinhard

Munich Re Foundation
From Knowledge to Action

November 2008

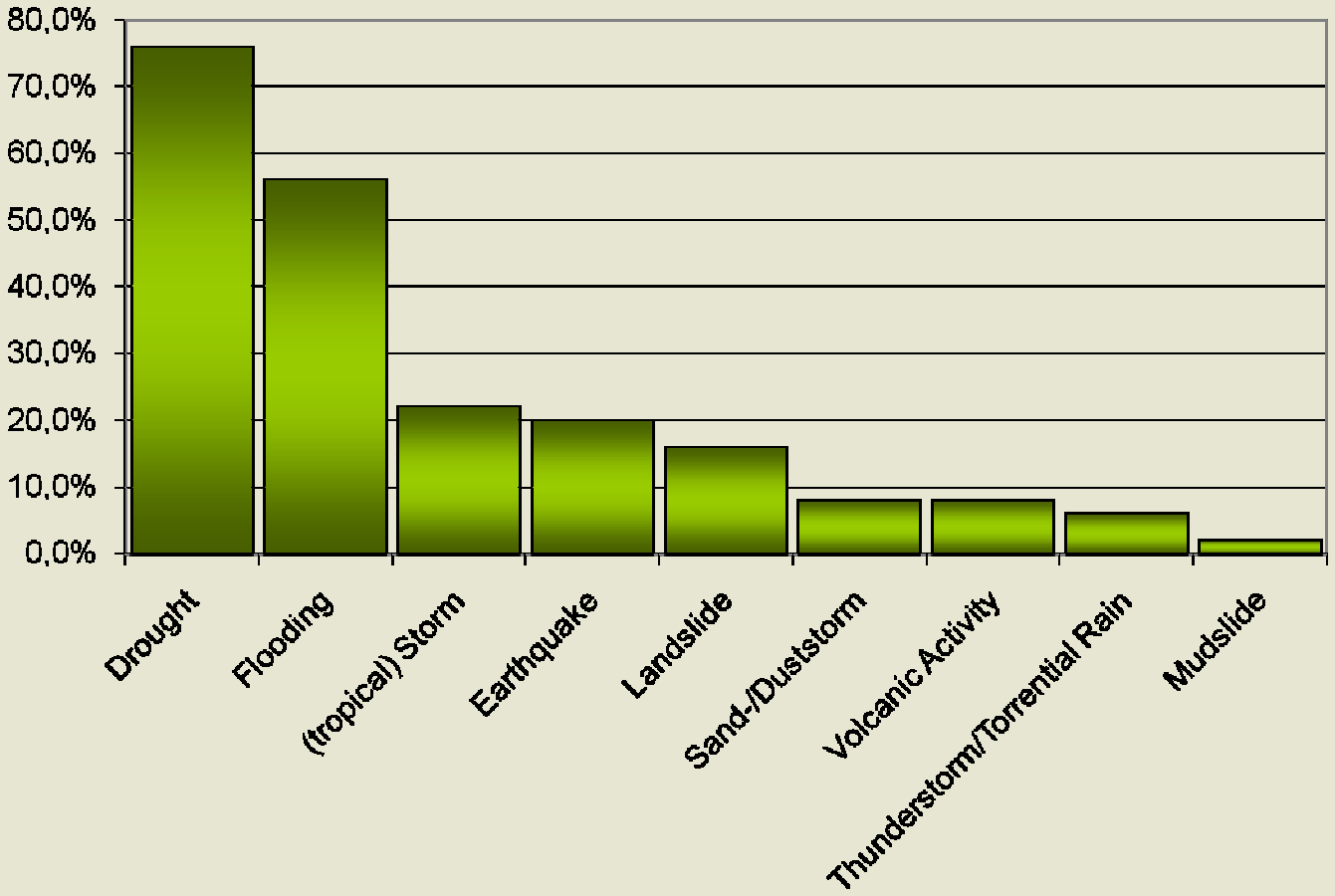
Number of natural disasters by country
1976-2005



Source: EM-DAT: The EFA/CRED International Disaster Database

Natural hazards in Africa

Percentage of selected types of natural hazards



Quelle: http://www.unisdrafrica.org/ - as of January 2005 / own chart, based on 50 countries

The 10 most expensive natural catastrophe events for the African economy 1990-2007

Period	Event	Affected Area	Losses (US$m, original values)		Deaths
			Overall losses	Insured losses	
28.11.2005	Tropical storm Delta	REGION EUROPE, AND REGION AFRICA, Spain, Canary Islands. Morocco	380,00	10,00	20
24.-26.2.2004	Earthquakes	Morocco: N, Al Hoceima, Ait Kamara	400,00	0,00	640
21.5.2003, 28.5.2003	Earthquakes, Tsunamis	Algeria: N, near Algiers, Thenia, Rouiba, Boumerdes, Zemmouri, Reghaia	5.000,00	0,00	2.200
9.-13.11.2001	Floods	Algeria: N, Algiers, Bab el Oued	300,00	0,00	750
March 2000	Drought	Morocco	900,00	0,00	
Feb.-March 2000	Floods	REGION AFRICA, South Africa. Mozambique. Botswana. Swaziland. Zimbabwe. Malawi. Zambia	715,00	50,00	1.000
1.1.-30.6.1995	Drought	REGION AFRICA, Lesotho. Malawi. Botswana. Zambia. Swaziland. Zimbabwe. Mosambique. Angola. Namibia. South Africa. Tanzania	600,00	0,00	
12.10.1992	Earthquake	Egypt: N, esp. Cairo, Minia, Suez, Ismailia, Alexandria, Port Said, Fayum, , El-Giza, Luxor	1.200,00	0,00	561
Jan. - March 1992	Drought	REGION AFRICA, C, E, South Africa: Natal, Orange Free State. Namibia. Swaziland. Zimbabwe. Sambia. Mozambique. Zambia	1.000,00	0,00	
20.3.1990	Tornado	South Africa: C, Orange Free State, Welkom	380,00	115,00	2

The 10 natural catastrophe events in Africa with the highest death toll 1990-2007

Period	Event	Affected Area	Losses (US$m, original values)		Deaths
			Overall losses	Insured losses	
August-September 2006	Floods	Ethiopia: S, E, NE, W, Dire Dawa, Mi'aso Woreda, Gewane, Omo, Amhara, Oromia, Gondar, Dembia, Haraghe, Somali, Mustahil, Hargele	0,00	0,00	1.000
24.-26.2.2004	Earthquakes	Morocco: N, Al Hoceima, Ait Kamara	400,00	0,00	640
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Feb.-March 2000	Floods	REGION AFRICA, South Africa. Mozambique. Botswana. Swaziland. Zimbabwe. Malawi. Zambia	715,00	50,00	1.000
Oct. - Dec. 1997	Floods	Somalia: C, E, S, Belet Huen, Tiyeglow, Bardera, Bay, El Wak, Buale, Jamaame, Magere, Jilib, Fagan, Luuq, Gedo, Garbahare, Afmadou, Hagar, Kismayo, Marerey, Dole, Billis Kokani, Badhade, Ras Kiamboni, Kolbio, Kuda, Baidoa, Gedo	0,00	0,00	2.000
2.-6.11.1994	Floods	Egypt: C, N, Durunka, Asyut, Sohag, Quena, Luxor, Sinai	140,00	0,00	580
12.10.1992	Earthquake	Egypt: N, esp. Cairo, Minia, Suez, Ismailia, Alexandria, Port Said, Fayum, , El-Giza, Luxor	1.200,00	0,00	561
10.-15.3.1991	Floods	Malawi: SE, Mulanje district	0,00	0,00	500
1990	Drought	Angola: C, S, Huila, Namibe, Kwanza Sul, Benguela	0,00	0,00	10.000

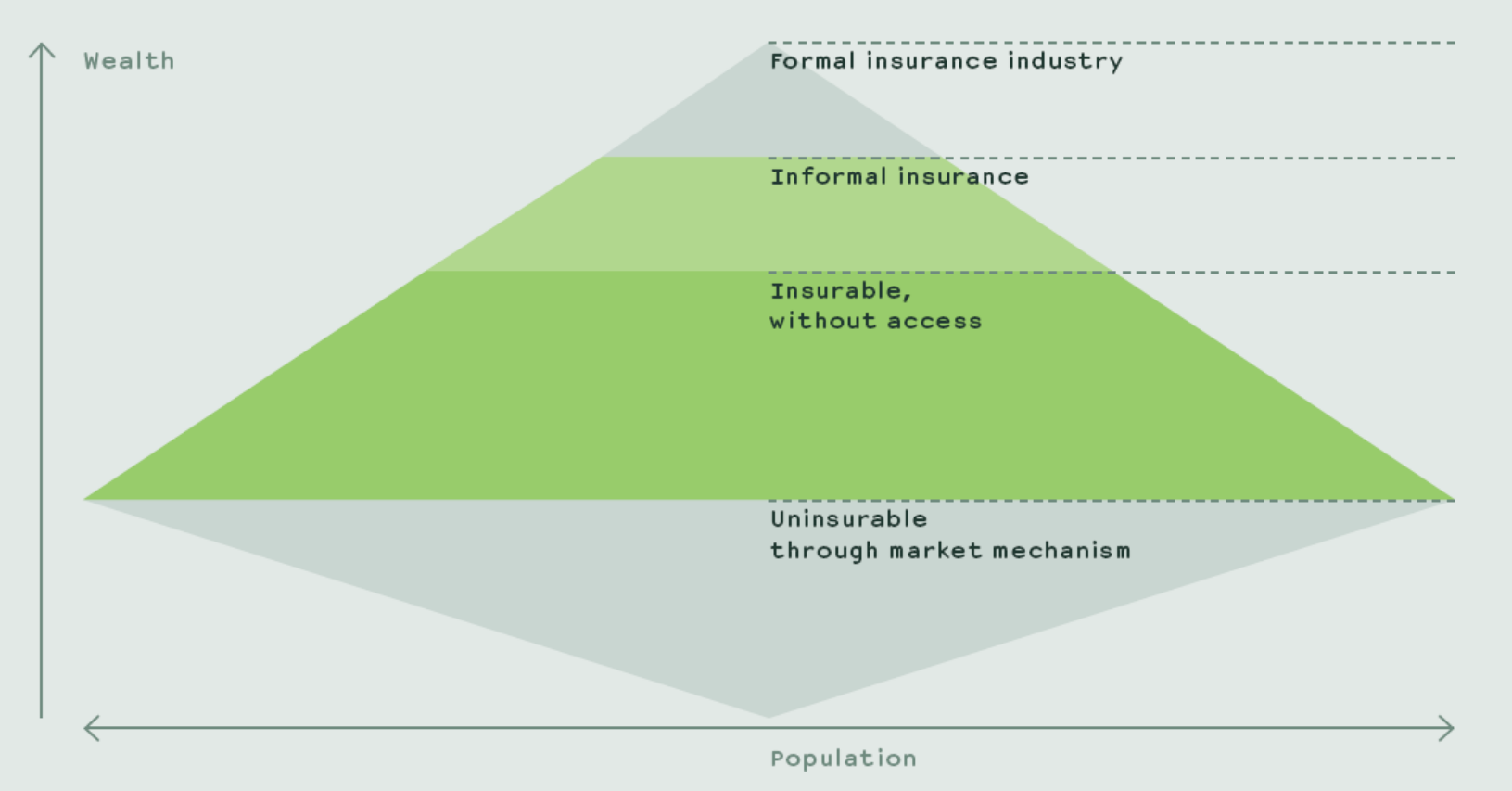
Definition and demand

Demand for Microinsurance

Microinsurance is the provision of insurance to low-income households that otherwise do not have access to insurance.

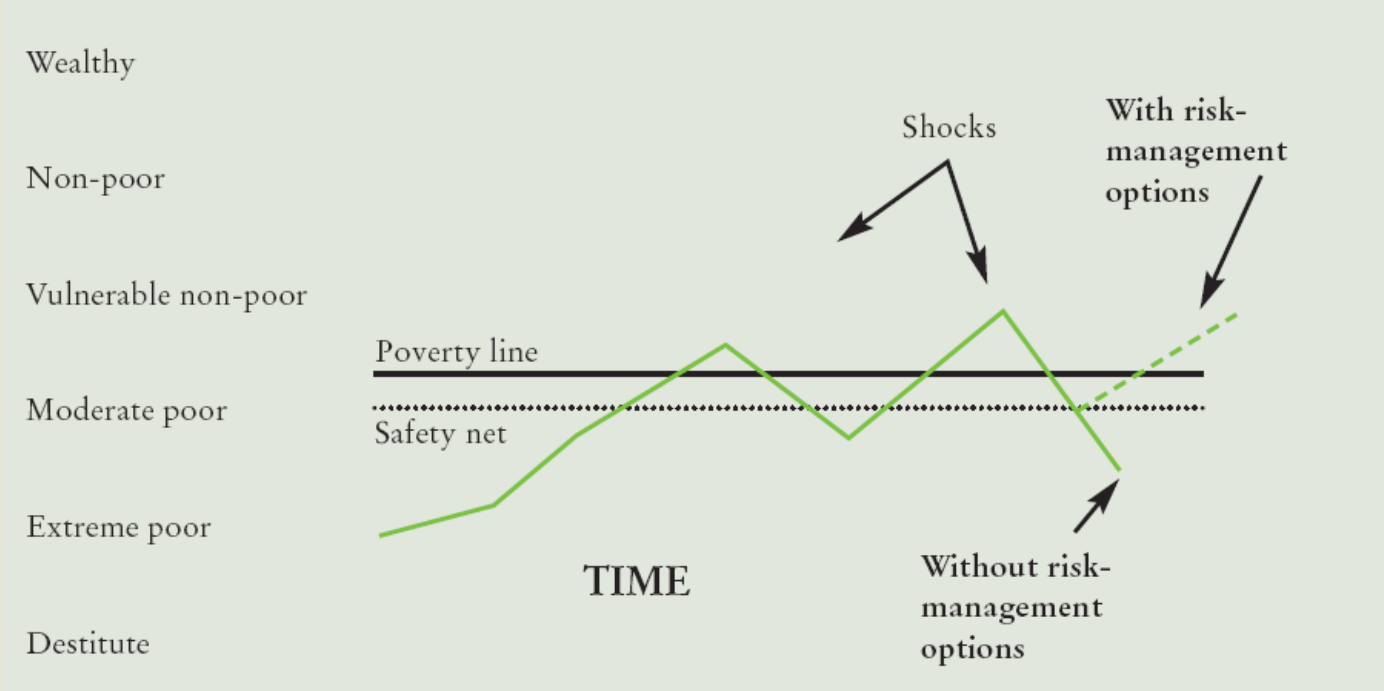
Poor households are especially vulnerable to risk, both in the form of natural calamities as well as more regular occurrences of illness and accidents.

The bottom of the access to insurance



Source: Churchill, Craig. Presentation ‘An introduction to microinsurance’. Microinsurance Conference 2007.

Role of Microinsurance: Impacts of shocks on household income and assets



Source: Protecting the poor – A mircoinsurance compendium, edited by Craig Churchill, Munich, Geneva, 2006, page 25

Priority risks in selected countries

Country	*Priority risk*
Uganda	Illness, death, disability, property loss, risk of loan
Malawi	Fear of death, especially in relation to HIV/AIDS, food insecurity, illness, education
Philippines	Death, old age, illness
Viet Nam	Illness, natural disaster, accidents, illness/death of livestock
Indonesia	Illness, children's education, poor harvest
Lao P.D.R.	Illness, livestock disease, death
Georgia	Illness, business losses, theft, death of family member, retirement income
Ukraine	Illness, disability, theft
Bolivia	Illness, death, property loss including crop loss in rural areas

Source: Protecting the poor – A mircoinsurance compendium, edited by Craig Churchill, Munich, Geneva, 2006, page 27

Landscaping Study – MicroInsurance Centre

Microinsurance offered in the 100 poorest countries

78 million people in the 100 poorest countries were found to have microinsurance cover.

- 357 microinsurance products (separate from social security schemes)
- 116 social security schemes
- 246 microinsurers (separate from government providers of social security)

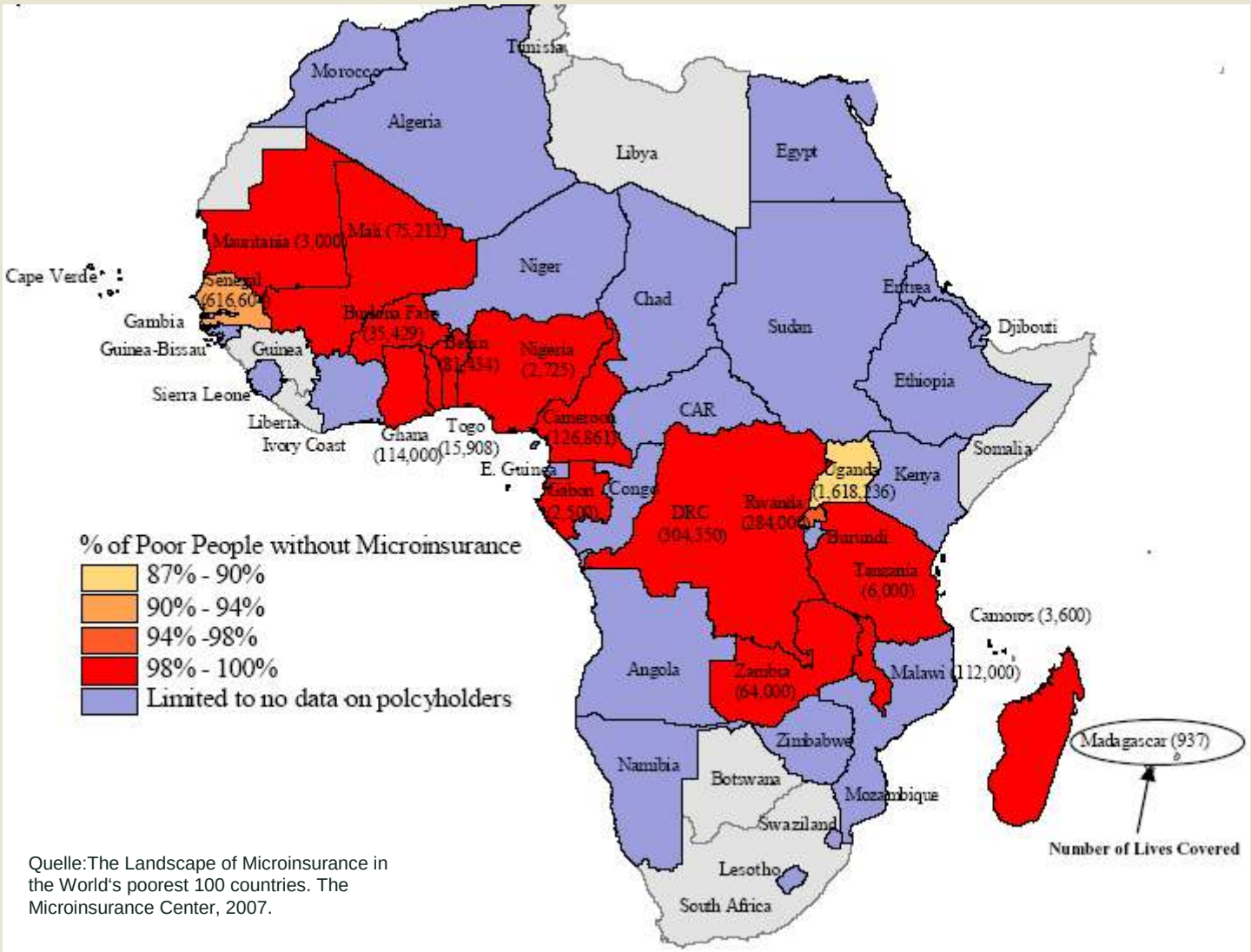
Landscaping Study – MicroInsurance Centre
Growth potential

– Microinsurance for the world's poor is growing fast, with most of its recent growth coming from the private sector.

– The microinsurers surveyed were positive about the future, predicting at least 10% growth over the following year and 100% growth over five years.

– It could be argued that this is relatively easy, given the low volume base of microinsurance currently, but it does also mean that microinsurers are realistically optimistic about the prospects of growth in a huge unserved market.

Microinsurance in Africa



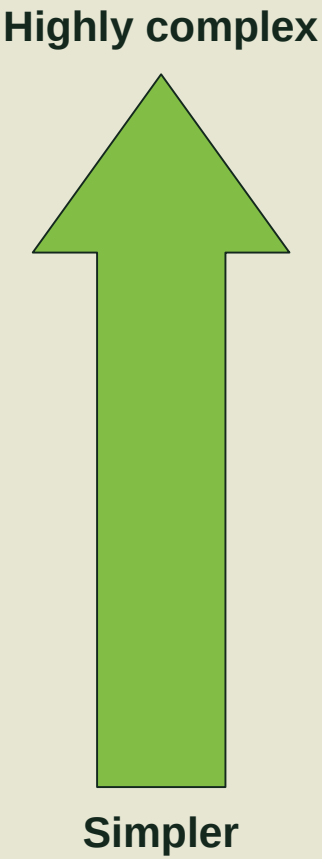
Quelle:The Landscape of Microinsurance in the World's poorest 100 countries. The Microinsurance Center, 2007.

Covered lives by product and region

Region	Life	Health	Accident & Disability	Property & Index
Americas	7,545,057	445,876	105,000	600
Africa	2,036,141	3,053,778	1,603,000	1,600,000
Asia	54,158,332	31,697,038	39,180,508	34,557,434
Total	**63,739,530**	**35,196,692**	**40,888,508**	**36,158,034**

Source: The Landscape of Microinsurance in the World's poorest 100 countries. The Microinsurance Center, 2007

Complexity of different insurance products



- Crop insurance
- Health and disability insurance
- Annuities and endowment (retirement provision)
- Property insurance
- Term life insurance (payment to beneficiaries on death)

Key challenges

- Low premium and high transaction costs per client
- Lack of infrastructure
- Lack of insurance knowledge
- Insurance illiteracy: significant investment in customer-education is necessary
- Low and irregular income: volume is a basis for returns on investment
- Lack of data

Lessons learned

- There is a **huge untapped market**
- Need for action: **as weather-related natural disasters increase, so does the vulnerability** of the poor
- **Don‘t listen to your heart, listen to you calculator!**

Water storage and rain water harvesting revisited:

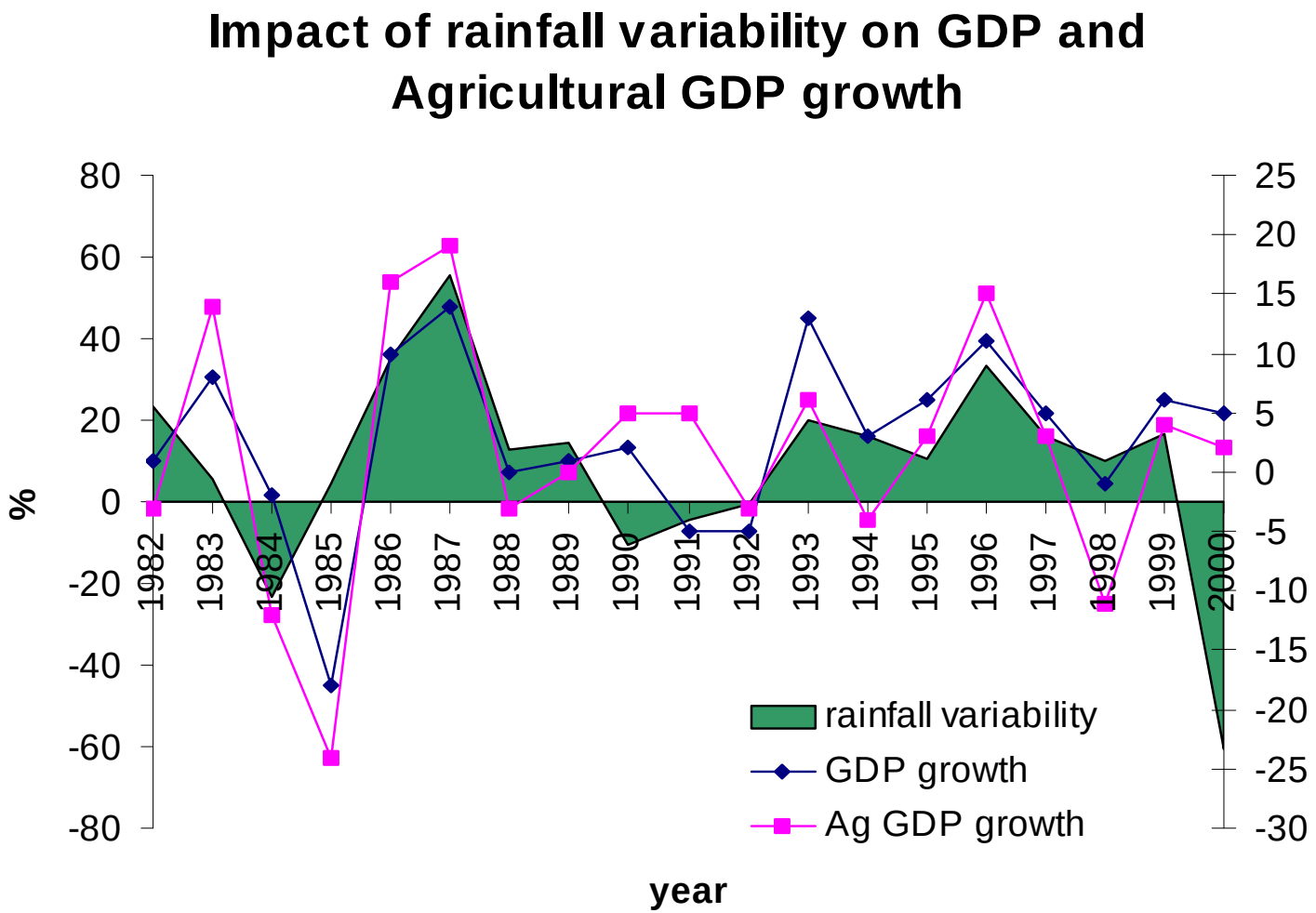
Past experiences and potential as an adaptation practice in the arid and semi-arid lands of Africa

Akiça Bahri, Regassa Namara, Boubacar Barry
and Pay Drechsel

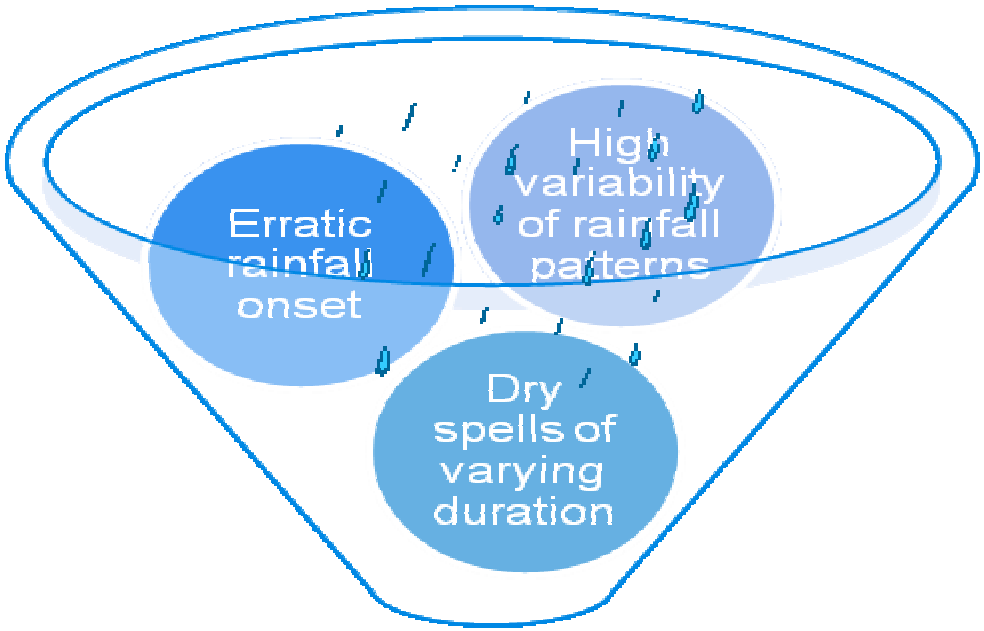
Content

1. RWH & storage: Options from the past and present
2. Challenges at different scales with examples of research
3. Key criteria for analyzing storage and RWH in view of climate change

Rainfall and Economy



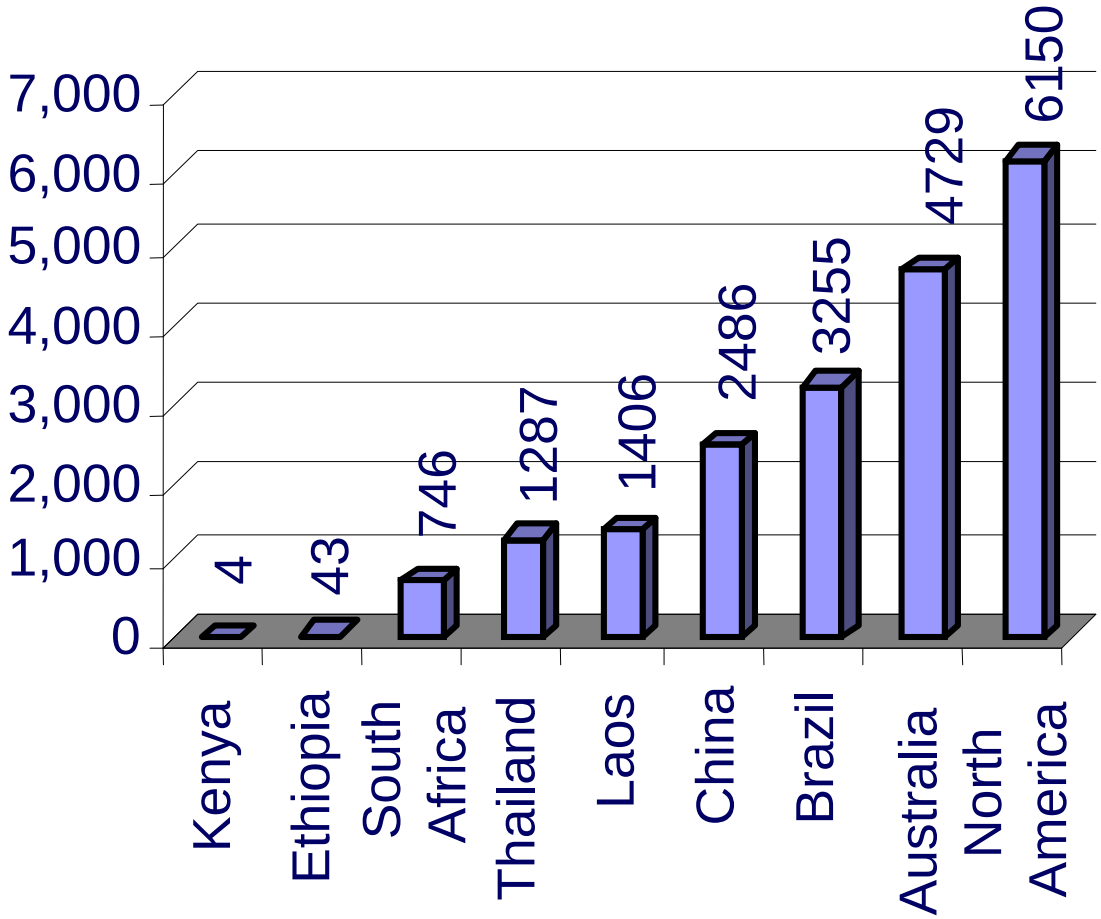
Ethiopia



Fluctuations in food production

Water storage mitigates variability

Per capita storage (m^3/capita)



World Bank (2003)

Very little water storage has been built in Africa.

Increased storage could reduce Africa's vulnerability to climate change and variability.

1. RWH & storage: Options from the past and present

Domestic rainwater harvesting and storage in Carthage

4th and 2rd centuries BC (today: Tunisia)

In Carthage, water was supplied either from wells or from cisterns in individual dwellings which collected rain water. These were often at least two meters deep and could hold several thousand liters of water.

Community based water transfer and storage

ROMAN AQUEDUCT AND CISTERNS OF CARTHAGE

On farm

Stone lines in Burkina Faso to retain sediment and runoff

Newly prepared half-moon at the inception of rain …

…. and with millet crop

5. Half-moon basins rehabilitate degraded land and support a crop of millet, Niger.

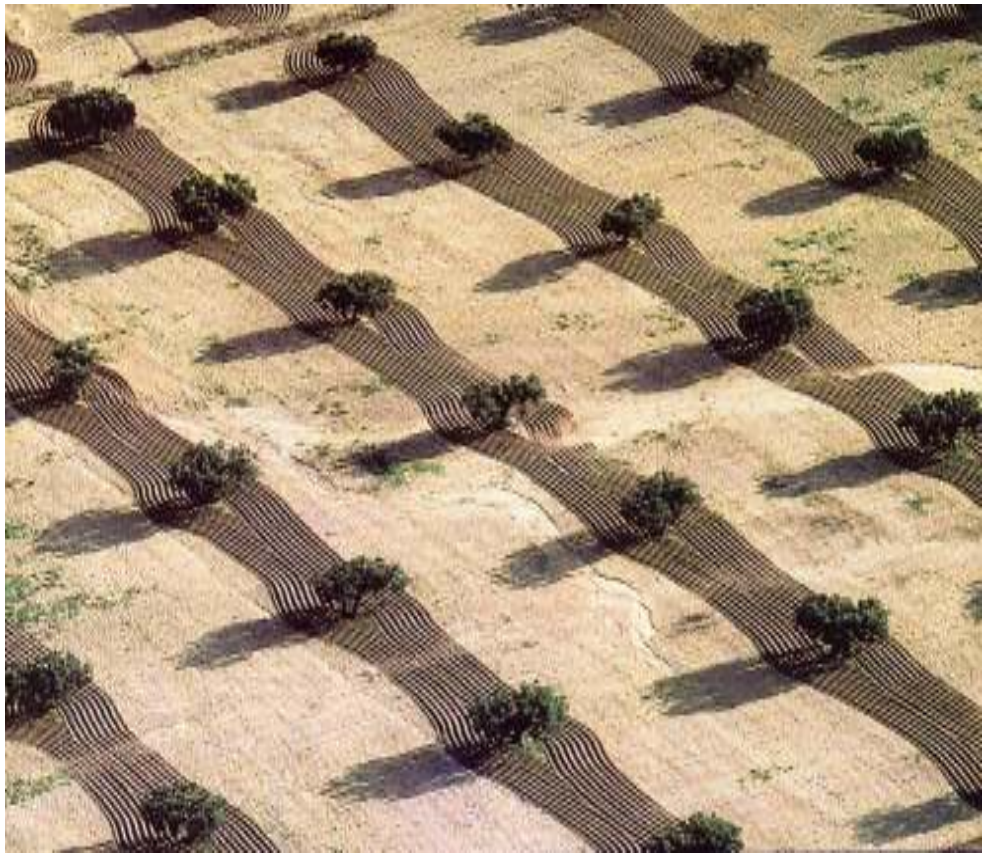
Tied-ridges

Water conservation (storage) in the soil

Mulching

Cover crops

Contour lines

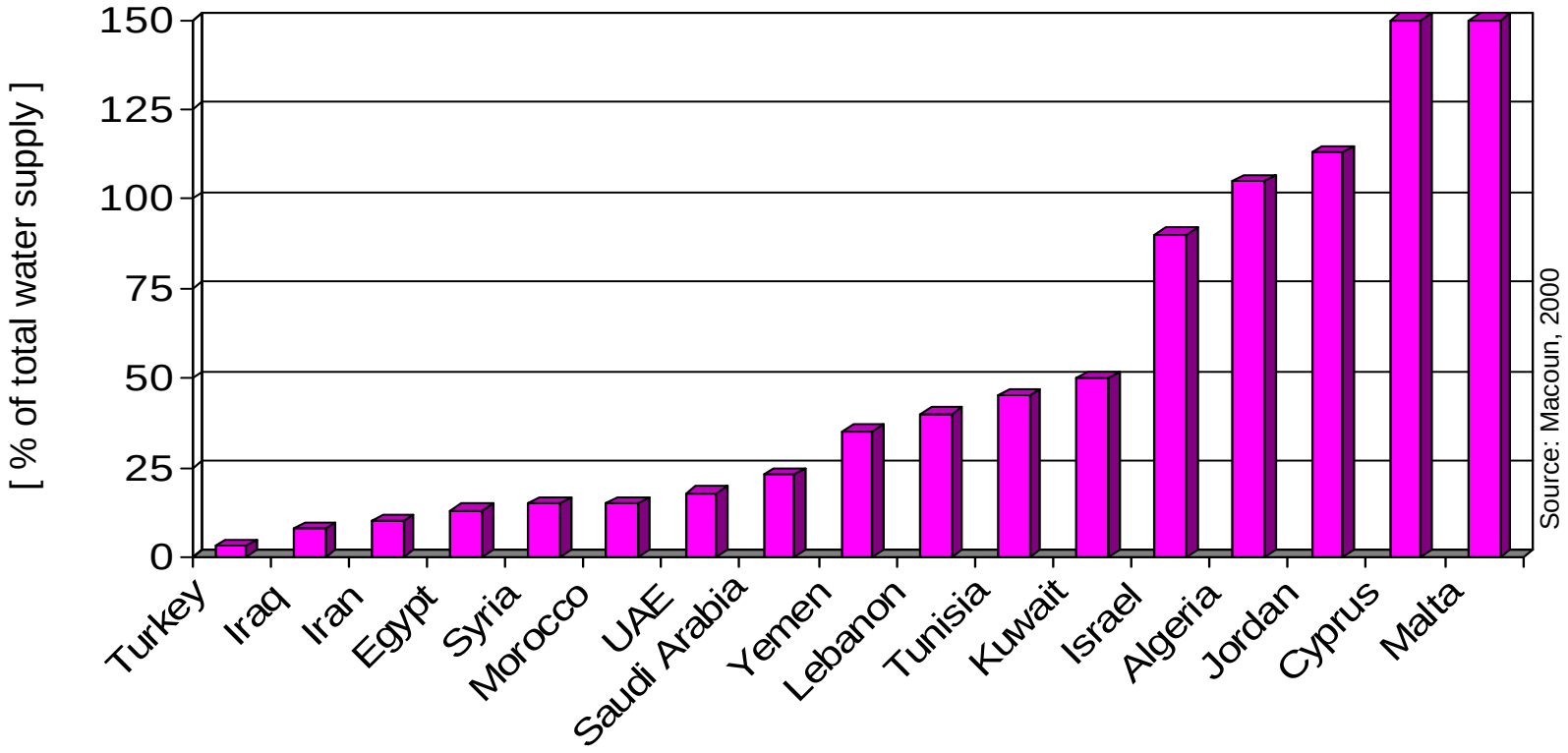


Small reservoirs

Volta Lake, Ghana

Harvesting water abroad:

Import of virtual water with food



→ A large variety of options

→ A large variety of possible challenges

→ No easy choice: What fits where?

2. Challenges at different scales illustrated with examples from research

Challenges at different scales

1. **Farm scale:** Adopting technologies
2. **Community scale:** Governance of storage
3. **Basin scale:** Upscaling storage

1. Adopting RWH technologies

RWH Systems	**Occurrence (examples)**
Stone rows	West Africa
Sand storage dam; Conservation Tillage, Fanya juu, Chololo pits, Tera; Haffirs	East Africa
Vallerani system	West and Northern Africa
Demi-Lune/ half moon, Earthen dams; Road-run-off	West and East Africa
Fanya chini	Eastern and Southern Africa
Zai/Tassa (micro-catchments)	East, West and North Africa

What prevents uptake?

Adoption barriers

- Only 10 % of the RWH technologies had relatively low labour requirements
- About 50 % require secured land tenure
- Although all technologies claim yield improvements, the time frame for this to happen does vary significantly
- Supplementary irrigation via RWH is not supporting yields over a longer time without adding fertilizers!

www.iwmi.cgiar.org/africa/West/projects/Adoption%20Technology/Technology_Adoption.htm

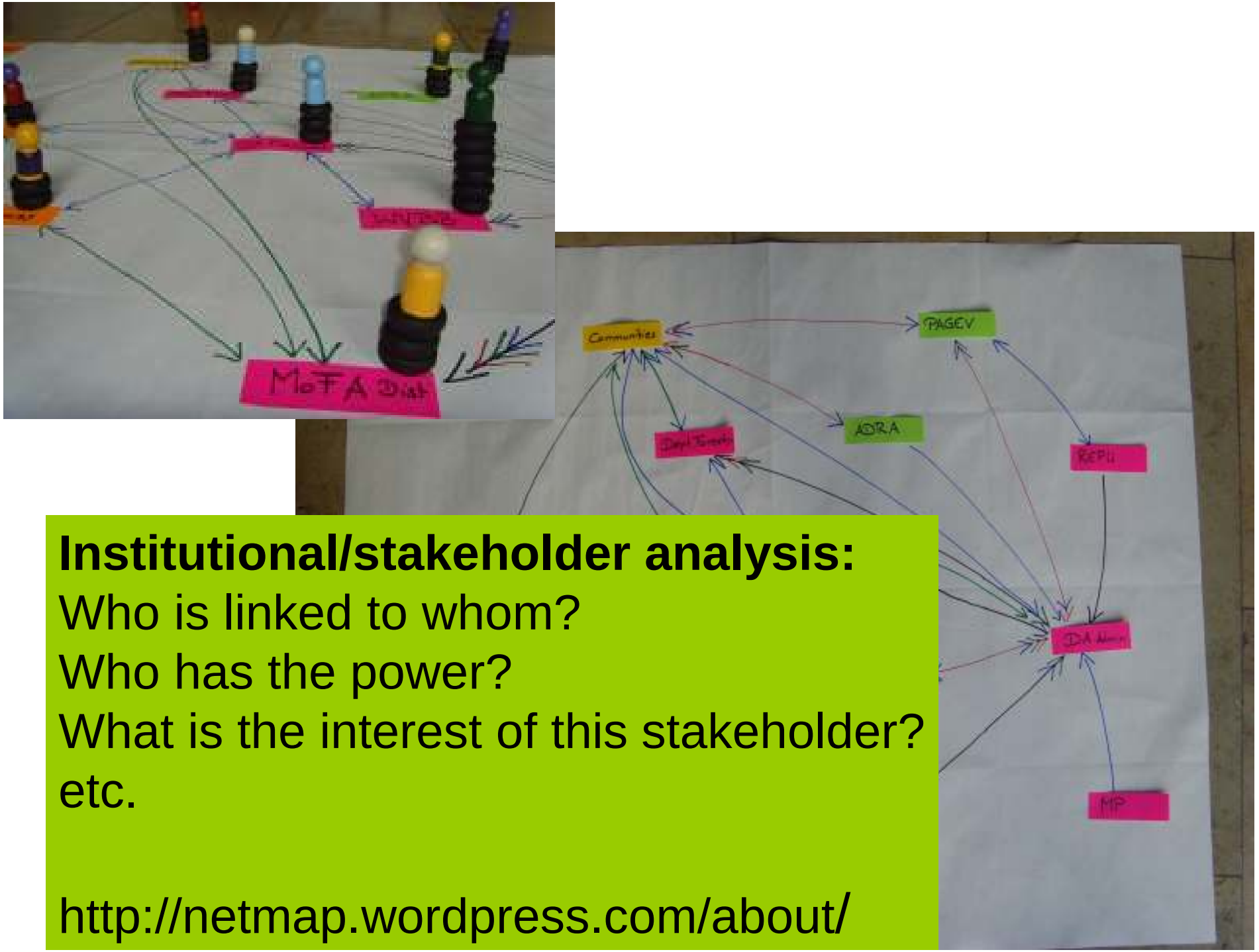
2. Governance of storage: the challenge of ownership and maintenance

Maintenance

- Who is in charge?
- What is the perceptions of problems and solutions?
- What is needed to do a good job?
- How to enhance ‘ownership’?

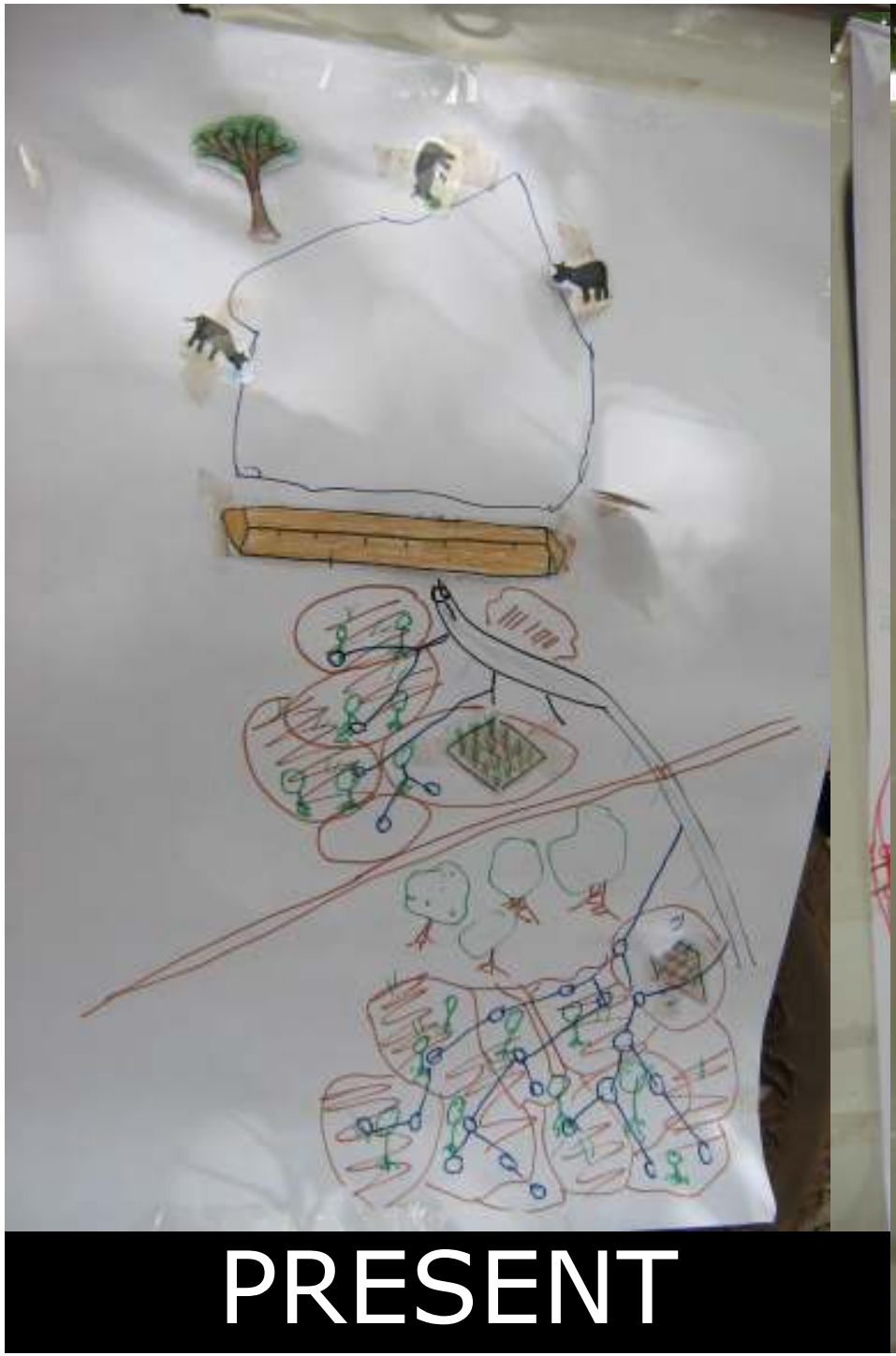
  → How was the reservoir set-up financed?
- Will artificial “Water User Associations” work?

  → traditional power structures vs. participatory governance



Institutional/stakeholder analysis:
Who is linked to whom?
Who has the power?
What is the interest of this stakeholder?
etc.

http://netmap.wordpress.com/about/



PRESENT

FUTURE

www.smallreservoirs.org

TU Delft
Delft University of Technology

3. Upscaling storage

- How to deal with ensembles of storage options?

- What is the impact of many small reservoirs on a big reservoir?

→ Hydrological modeling

→ Applying a basin perspective

→ Transboundary implications

Daily Graphic

WEDNESDAY, NOVEMBER 17, 2004

Norpalm workers

MORE than 500 workers of the National ... Palm Limited (NOPL), now Norpalm Lim... ed, near Ewusiejo in the Ahanta West D... trict of the Western Region who were wron... fully dismissed are to be compensated in d...

Picture: EBOW HANS...

• Mr Amadou Bocoum (second right), the Country Director of Plan Ghana, and Mr Salifu Waah (right), the DCE for Sissa... signing the contract for irrigation projects for Sissala in the Upper West Region. Looking on is Mr Moses Dani-Baah (se... ed left), the Deputy Minister of Health and Member of Parliament for Sissala.

Plan Ghana to construct 13 dams in Sissala District

Story: Fiifi Mensah

PLAN Ghana, a child-centred community development organisation, has planned to construct 13 dams in the Sissala District of the Upper West Region.

Work on the dams will be undertaken over the next three years and the dams will help improve the food security in the area, as well as help to alleviate the endemic poverty there.

Mr Amadou Bocoum, the Country Director of Plan Ghana, stated this at the signing ceremony in Accra between Plan, the Sissala District Assembly and the contractors for work on four of the dams to start.

He mentioned the four communities that will initially benefit from the dams as Busfi, Nimoro, Kupulima and Zini and said 30 hectares of land would be irrigated all-year round and 1,000 animals would have access to water every day, while 3,000 people from the four communities would benefit from it.

Mr Bocoum said work on the four dams ... in the district to achieve their ... potential and help them to acquire quali... education, which is a strategic objective ... Plan Ghana.

He said the organisation had, with ... support of the Sissala District Assembly, ... developed 58 community projects, ensur... that the implementation of those pr... grammes were on schedule.

Mr Moses Dani-Baah, the Deputy Min... ister of Health, said since Plan Ghana ... started its operations in the district in ... 2002, its impact had been tremendous.

He said that the organisation had init... ated school projects and provided furn... ture and books to a number of schools ... the district.

It had also helped to train pupil teach... ers to help man the various schools.

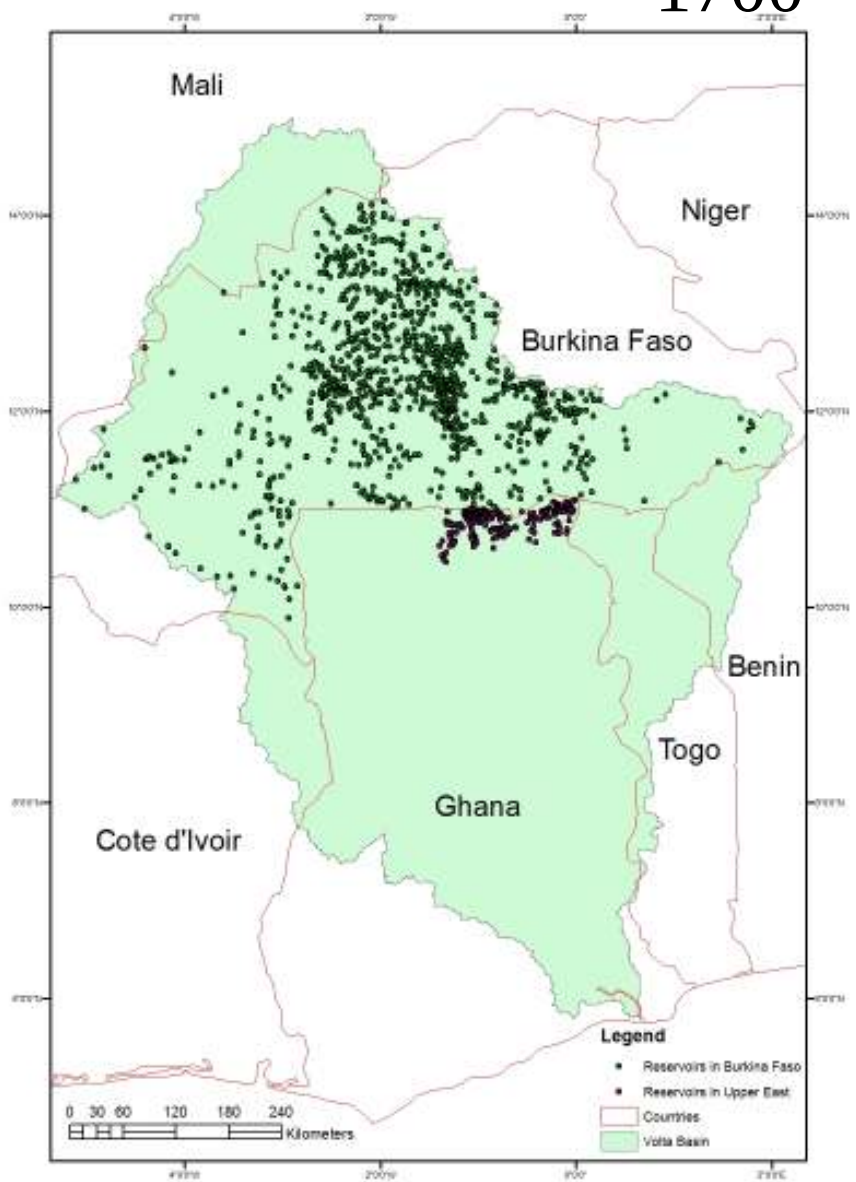
Mr Dani-Baah said the small-scale ... dams would go a long way to help in effor... at increasing food yield and reducing ... poverty in the area.

Mr Salifu Waah, the District Chief ... Executive, said the assembly had committed ... itself to co-operate with Plan Ghana to ... enable the organisation to implement ...

INTERNAL REVENUE SERVICE

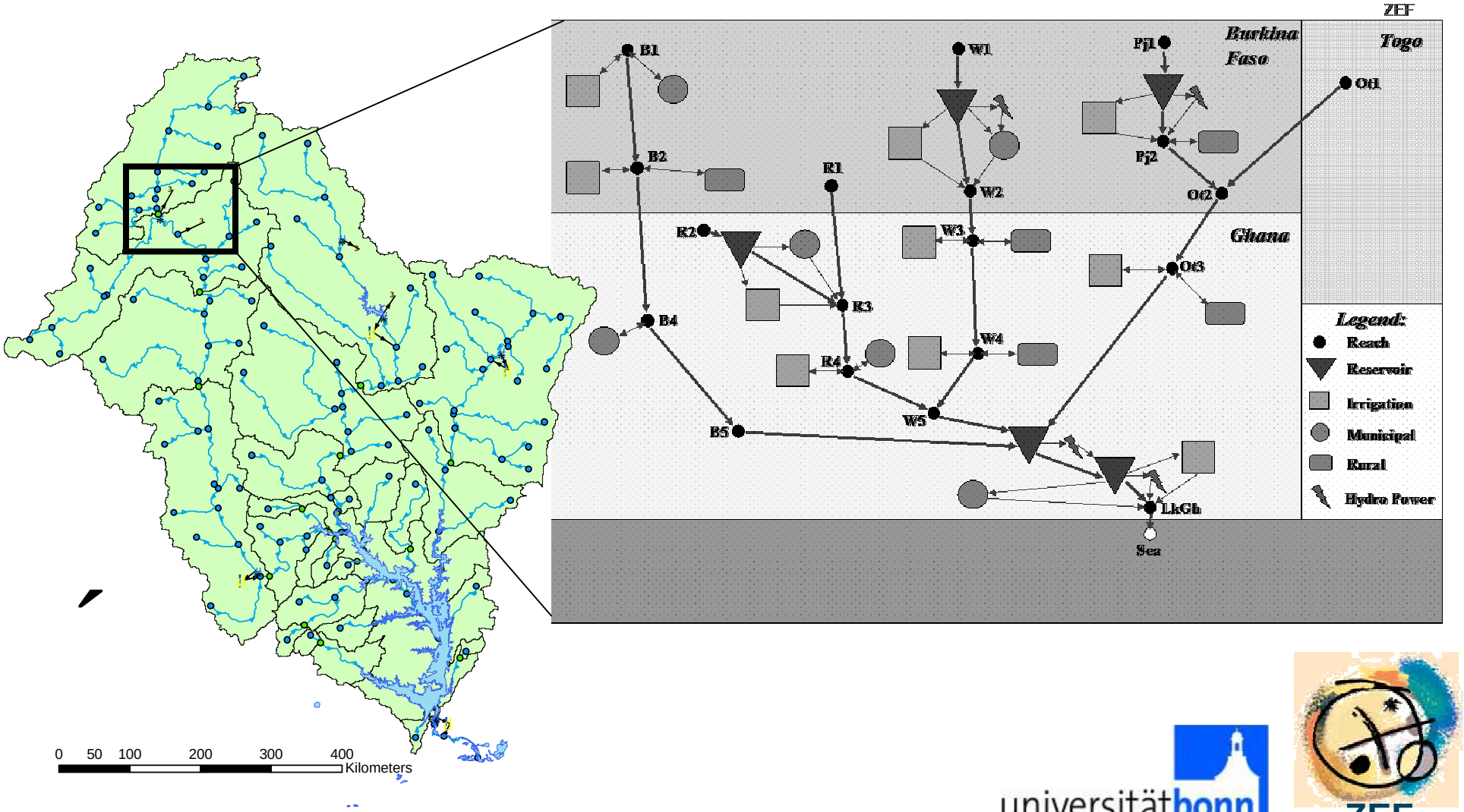
SETTLEMENT OF INCOME TAX ARREARS

The Commissioner of Internal Revenue wishes to remind ALL TAX-PAYERS who have not paid their taxes up to date that they MUST endeavour to settle all such arrears on or before 31st December, 2004.



Case of small reservoirs in the upper Volta Basin

Interconnections to be considered !



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ZEF

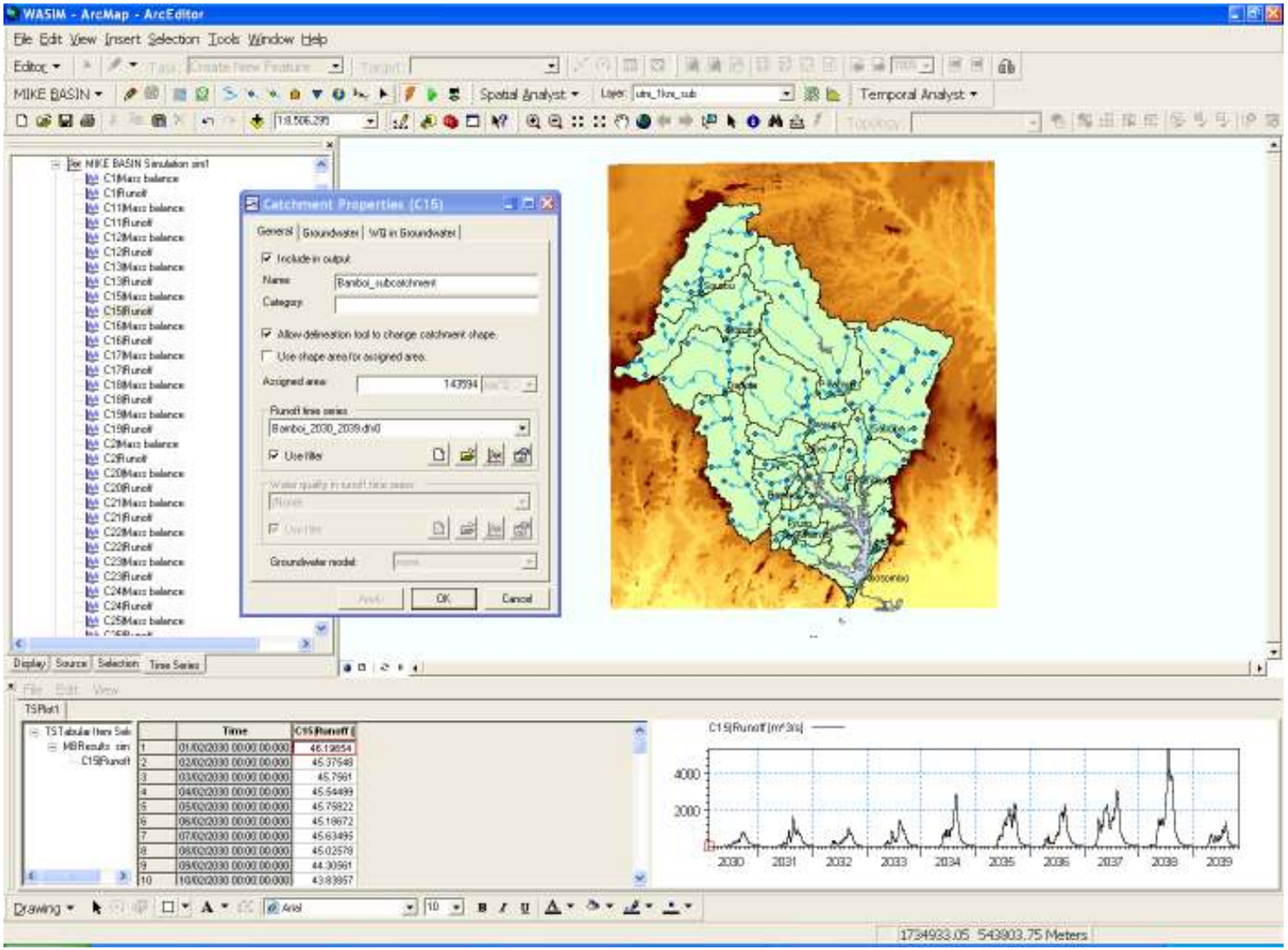
Small Reservoirs Project (IWMI, ZEF, et al.)

"Tool Kit" for design and evaluation of reservoir ensembles:

- Methods using satellite imagery to assess the number and storage capacity of small reservoirs
- Hydrological models to evaluate the availability of water for small reservoirs in ensembles
- Models to evaluate the impact of water allocation among competing uses
- Methods to assess the impact of human activities on the quality of reservoir water
- Methods to assess the impact of reservoirs on the health of rural people
- Information for the management, operation, and maintenance of reservoirs

www.smallreservoirs.org

Interlinked small and large reservoirs



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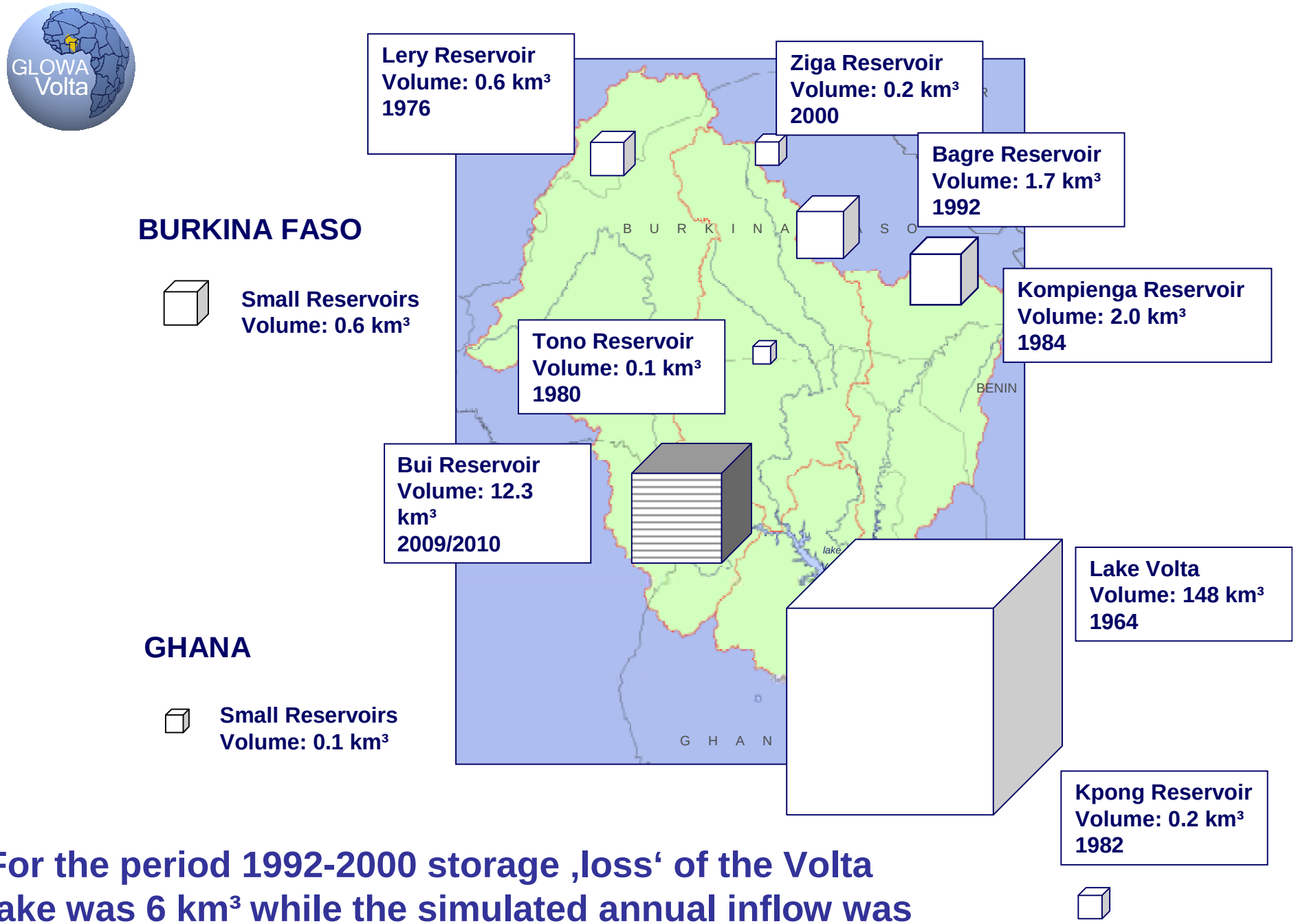
www.glowa-volta.de

ZEF



For the period 1992-2000 storage ‚loss' of the Volta lake was 6 km³ while the simulated annual inflow was highly variable (11 – 59 km³).

3. Key criteria for analyzing storage and RWH in view of climate change

A research framework for evaluating appropriate RWH/storage options should be based on:

- Social, economic, biophysical, health and environmental impacts of proposed options (up- and downstream)
- Governance and maintenance
- Resilience to climate change of individual and/or combined technical options

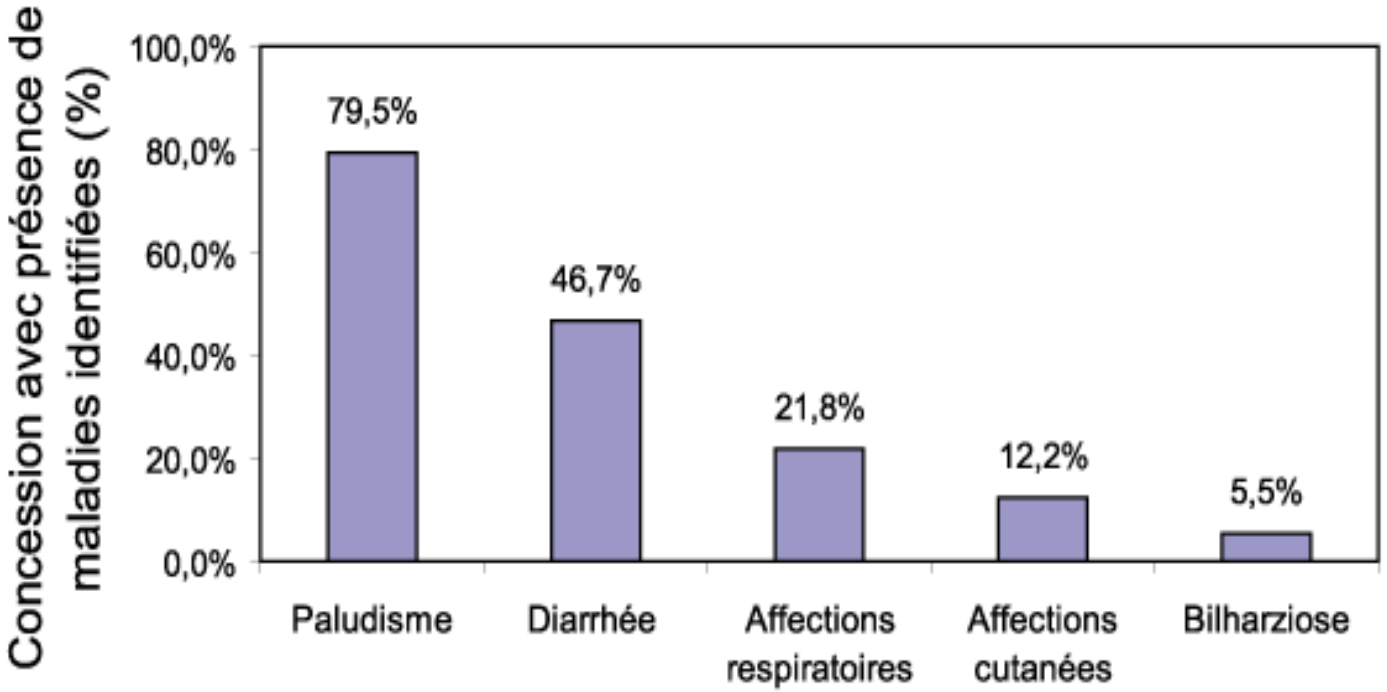
New BMZ funded IWMI project “Rethinking Storage” (Ghana and Ethiopia)

Conclusions

- RWH and storage will play an important role in enhancing the resilience of rural poor vulnerable to climate change.
- Each type of RWH and storage has its own niche in terms of technical feasibility, socioeconomic suitability, impact on health and environment and institutional requirements.
- It requires careful analysis to decide which options fit in a particular physical and socio-economic context.

Thank you!

Small Reservoirs and health:
Results to be compared with background data



Burkina Faso *(Yonkeu, S. 2002)*

Labour productivity in sorghum fields (Burkina Faso)

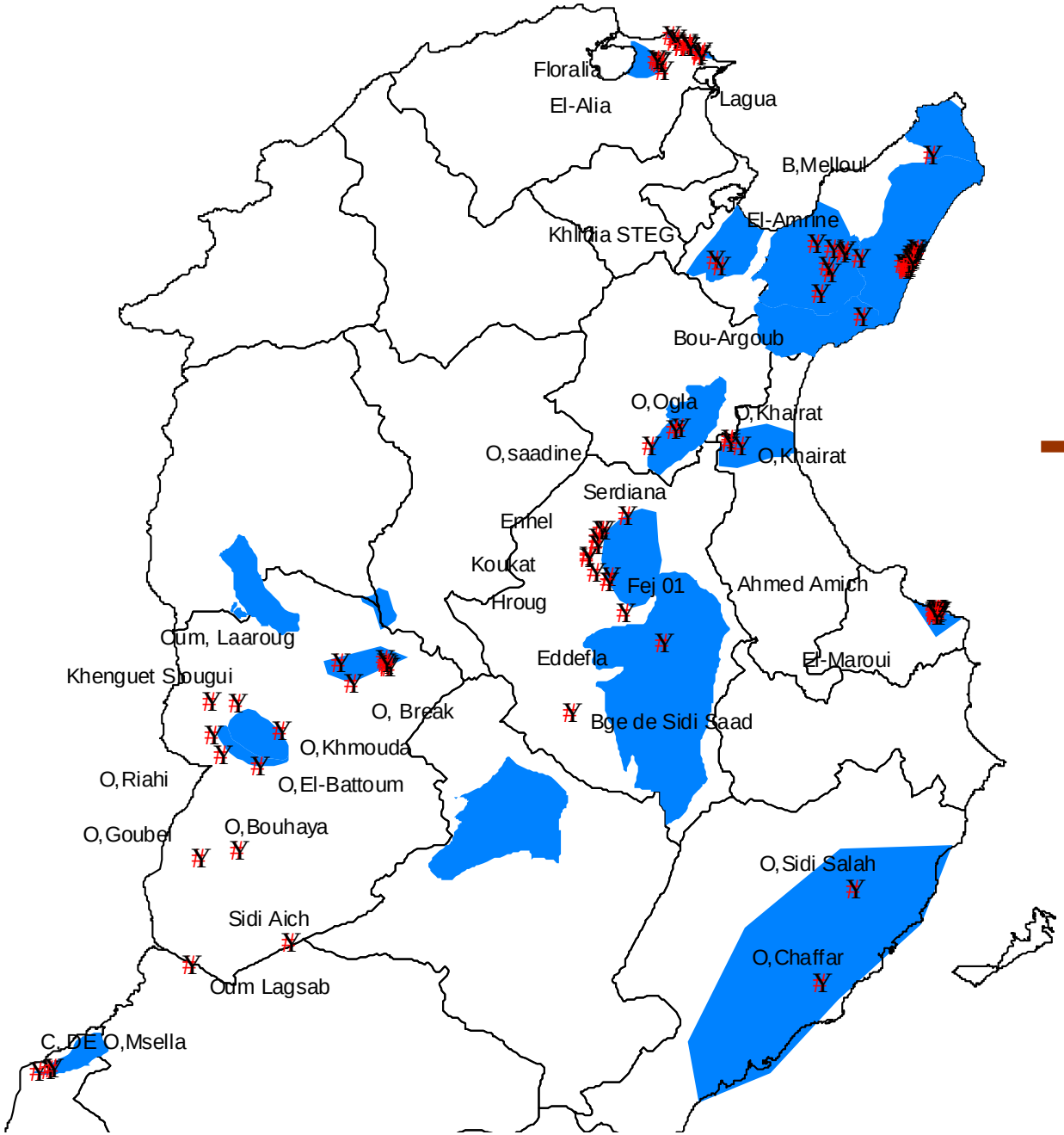
	Yield Kg/ha	Total Sale (return to land) *FCFA/ha	Labour required Hours	Labour productivity (return to labour) FCFA/day
Family fields				
With RWH	547	30,060	1101	220
Without RWH	330	18,150	713	200

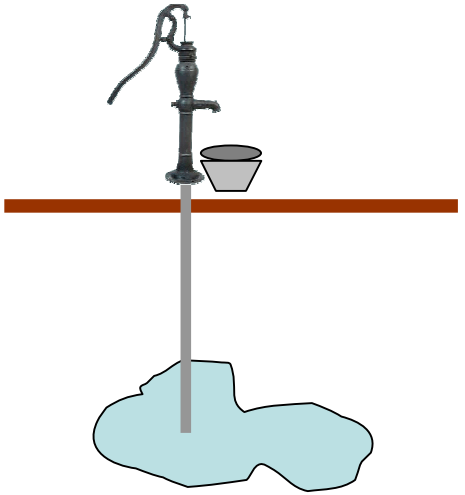
RWH increases sales by 66 %, however, this was based on a 55 % increase in family labour input with only a 10 % higher return on the invested time than without the new technology.

Criteria

	Groundwater storage	Small surface water reservoirs	Large dam reservoirs
Advantages	•Little evaporation loss •Ubiquitous distribution •Operational efficiency •Available on demand	•Ease of operation •Responsive to rainfall •Multiple use •Groundwater recharge	•Large, reliable yield •Carryover capacity •Low cost per m3 water stored •Multipurpose •Flood control and hydropower •Groundwater recharge
Limitations	•Slow recharge rate •Groundwater contamination •Cost of extraction	•High evaporation loss fraction •Relatively high unit cost •Absence of over-year storage	•Complexity of operations •Siting •High initial investment cost •Time needed to plan and construct
Key Issues	•Declining water levels •Rising water levels •Management of access and use •Groundwater salinization •Groundwater pollution	•Sedimentation •Dam safety •Environmental impacts •Ownership/Maintenance •Malaria, schisto?	•Social and environmental impacts •Sedimentation •Dam safety

Supporting groundwater recharge





Tunisia

GRAND MOSQUE OF KAIROUAN

The courtyard was designed for RWH. A central drainage hole delivers the collected rainwater into the 9th-century cisterns below. The entry decorations were designed to filter sand and dust from the water.