



## **International Forum**

*Unleashing Science, Technology and Innovation for Food and Nutrition Security  
With special focus on Africa, Caribbean and the Pacific*

### **Developing a road map**

15-17 October 2014

NH Rijnhotel Arnhem, The Netherlands

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### **Forum International**

*«Libérer la Science, la Technologie et l'innovation pour promouvoir la sécurité alimentaire et nutritionnelle*

*Avec, comme axe prioritaire, l'Afrique, Les Caraïbes et le Pacifique »*

### **Élaborer une feuille de route**

15-17 Octobre 2014

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# STI for Research, Innovation & Entrepreneurship

## New Agenda for New Times



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# Overview

## Africa Rising Challenges for achieving sustainable development - Existing and Emerging

## Science, Technology, Engineering & Maths (STEM)

## Higher Education & Science in Africa New Agenda for New times - Science with a social purpose Creation of CEPHYR Ltd. Closing Thoughts

# Africa rising

# Africa on the ascendant

## Today

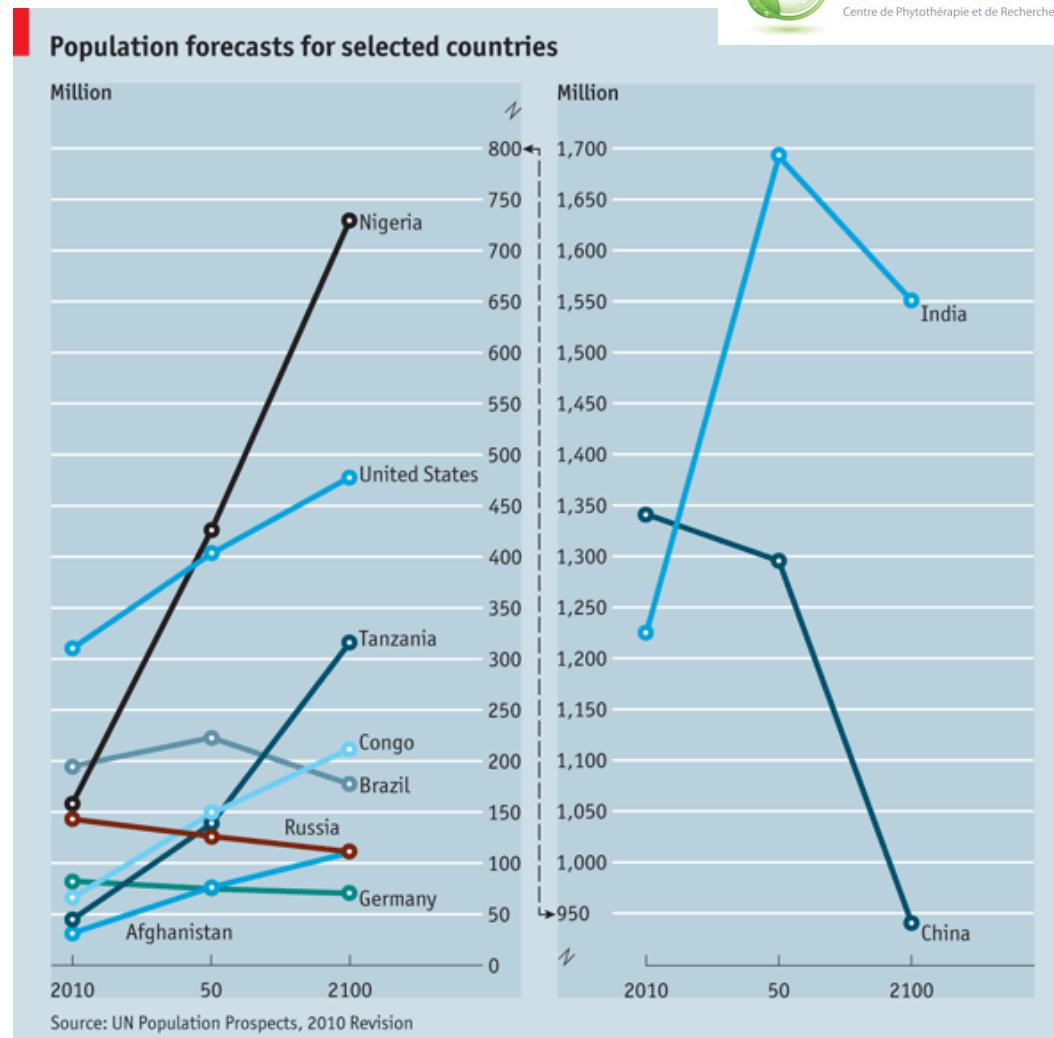
- \$1.6 trillion – Africa's collective GDP in 2008, roughly equal to Brazil or Russia
- \$860 billion, Africa's combined consumer spending in 2008
- 316 million of new mobile phone subscribers signed up in Africa since 2000
- 20 the number of African companies with revenues of at least \$3 billion
- Economic growth with GDP rising on average 4.5%/yearly

## Tomorrow

- \$2.6 trillion, Africa's collective GDP in 2020
- \$1.4 trillion, Africa's combined spending in 2020
- 1.1 billion the number of Africans of working age in 2040
- 128 million African households with discretionary income in 2020
- 50 percent the portion of Africans living in cities by 2030

# Population

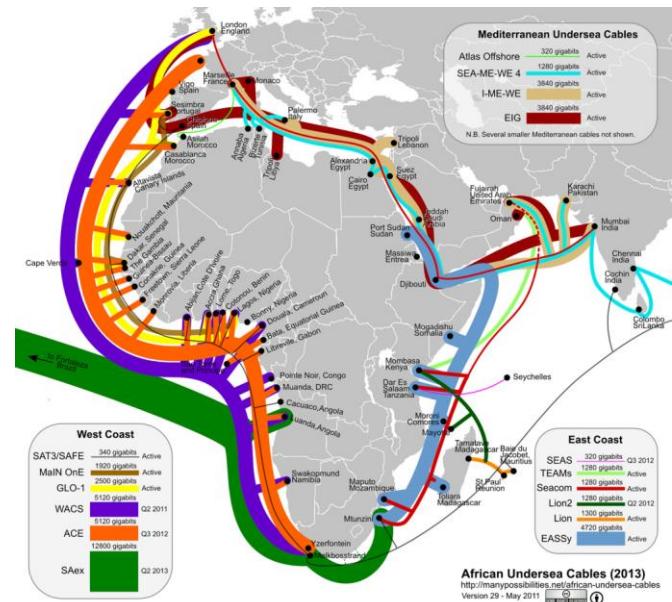
- **Africa is world's fastest-growing continent**
- **Population trends**
  - 7 billion by October 2011, not Spring 2012
  - May still be rising in 2100, past 10 billion
  - Over 50% youth under age of 25 & 11 Million to enter job market/yearly (a real demographic opportunity)
- **Sub-Saharan Africa**
  - 856 million
  - One-fifth of Asia, but could be three quarters of the size of Asia in 2100
  - Little more than Europe, could be 3 times larger by 2050



**"Youth not Oil, will be the country's most valuable resource in the 21<sup>st</sup> century"** – Nigeria: The Next Generation Report, Harvard School of Public Health, 2010

# The Ubiquity of the Internet

- Africa is world's fastest-growing telephony market
- At over 650 million subscribers and growing, Africa's mobile market is larger than United States and Europe
- Internet bandwidth has grown 20-fold
  - Over 68,000 km of submarine cable
  - 615,000 km of national backbone networks
- Spurred by the Internet, Sub-Saharan Africa stands at the cusp of a knowledge revolution



# **Challenges for achieving Sustainable Development**

# Existing & challenges &

- **Poverty &**

- Over 1.2 billion live on \$1/day'
- Human Development Index'
- Human Opportunity Index'



- **Hunger &**

- One billion people go hungry every day'



- **Environment &**

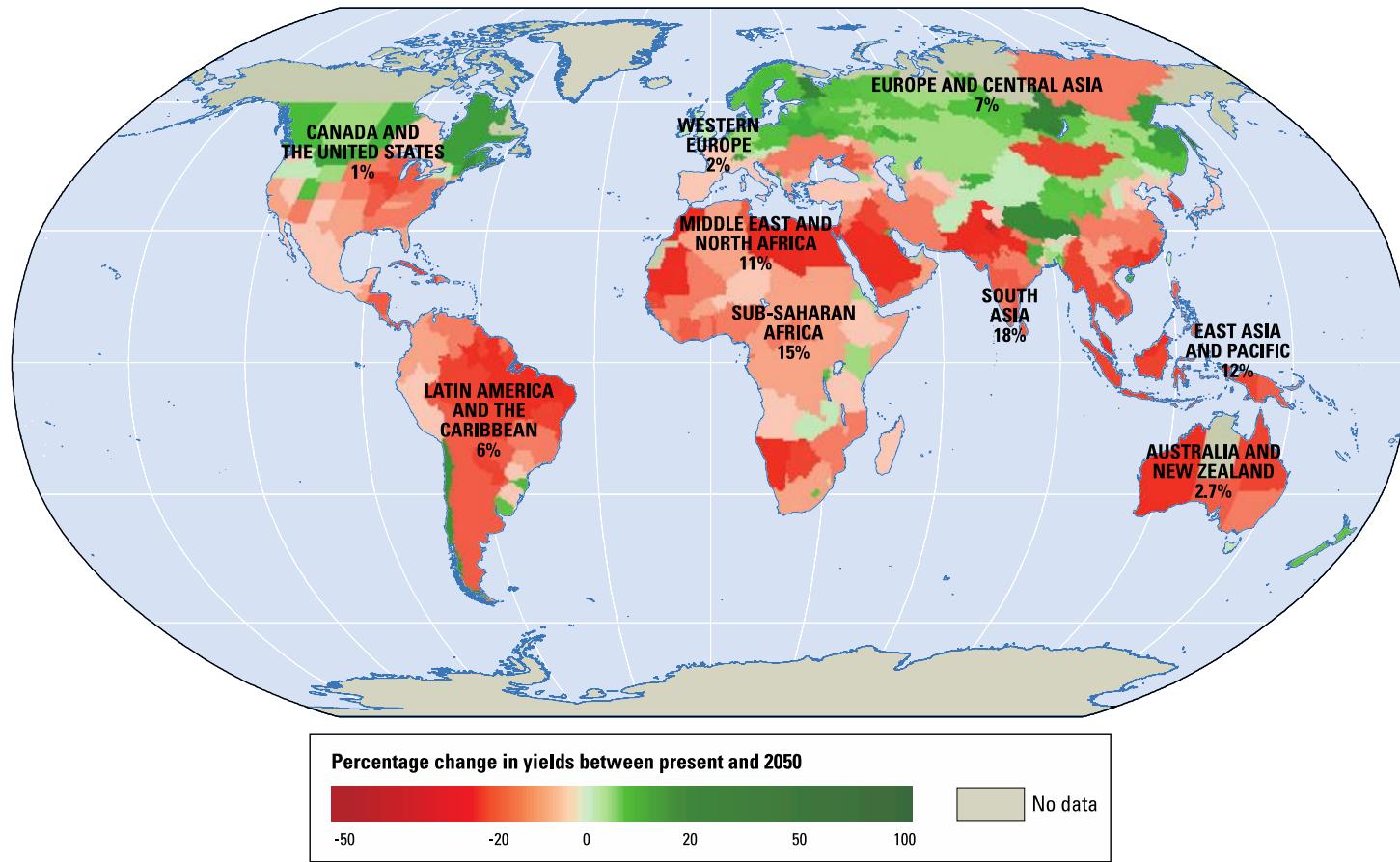
- 40% of world's cropland degraded'
- 70% of fisheries exploited, overexploited'
- One-third of forests cleared since 1960'



- **Social &**

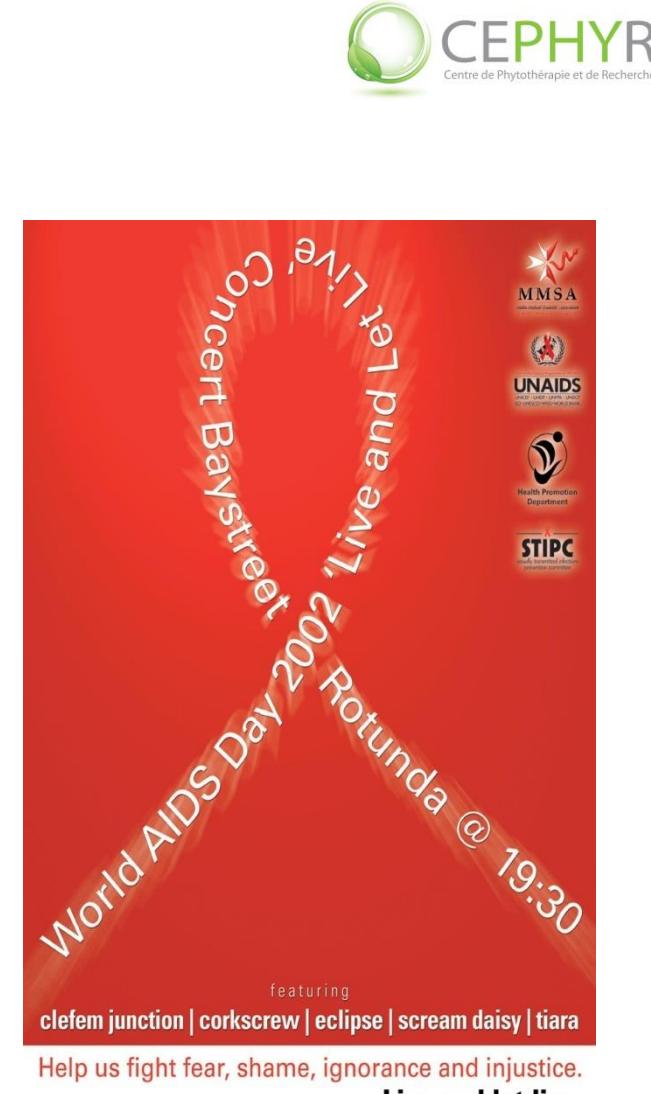
- HIV/AIDS'
- Access to health care'

# Emerging Challenge: climate change will hit food-deficit countries hardest by 2050



# HIV/AIDS

- 44 million infected, Sub-Saharan Africa worst affected
- 5 million aged 15-24
- 60% of infected are women
  - Feminization of disease
  - In Sub-Saharan Africa, 72% of infected are women
- HIV/AIDS is felling people in the prime of their lives
- Rural areas – locus of poverty and food production – are hit hardest.



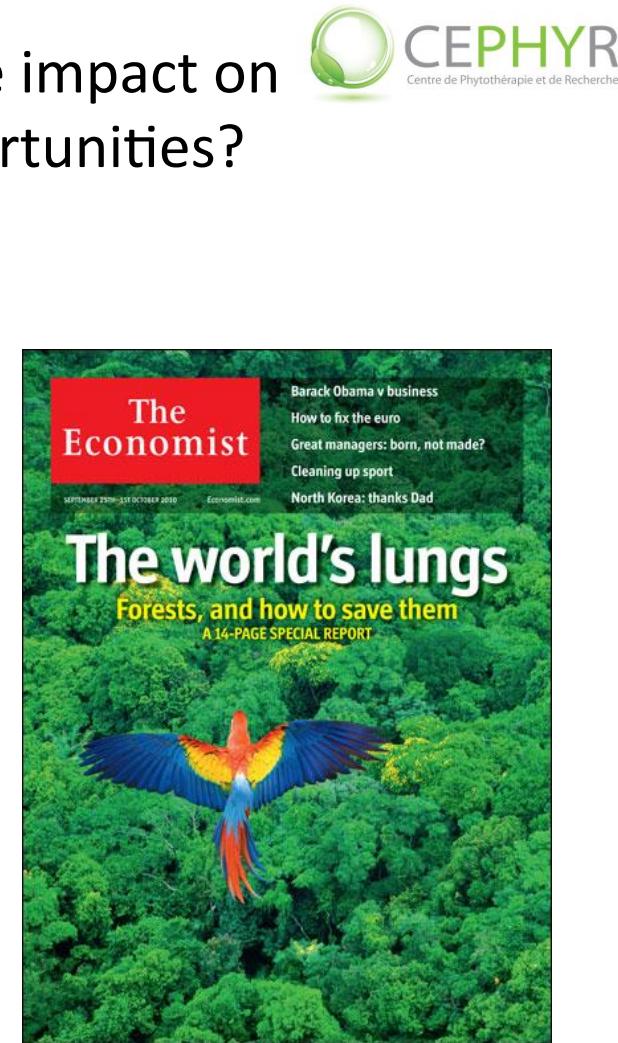
**Source:** Opportunity in Crisis,  
UNICEF 2011

# **Climate change** will have a disproportionate impact on continent – but how to turn them into opportunities?

Joint, multidisciplinary Research into:

- Coastal impacts of rising sea levels
- Drought-resistant seed varieties
- Impact on biodiversity
- Renewable energies
- Population and health
- Security (energy, food, nutrition and water)

Science needs to find solutions that are economically viable, socially relevant and environmentally benign, and for all of these, political will is needed



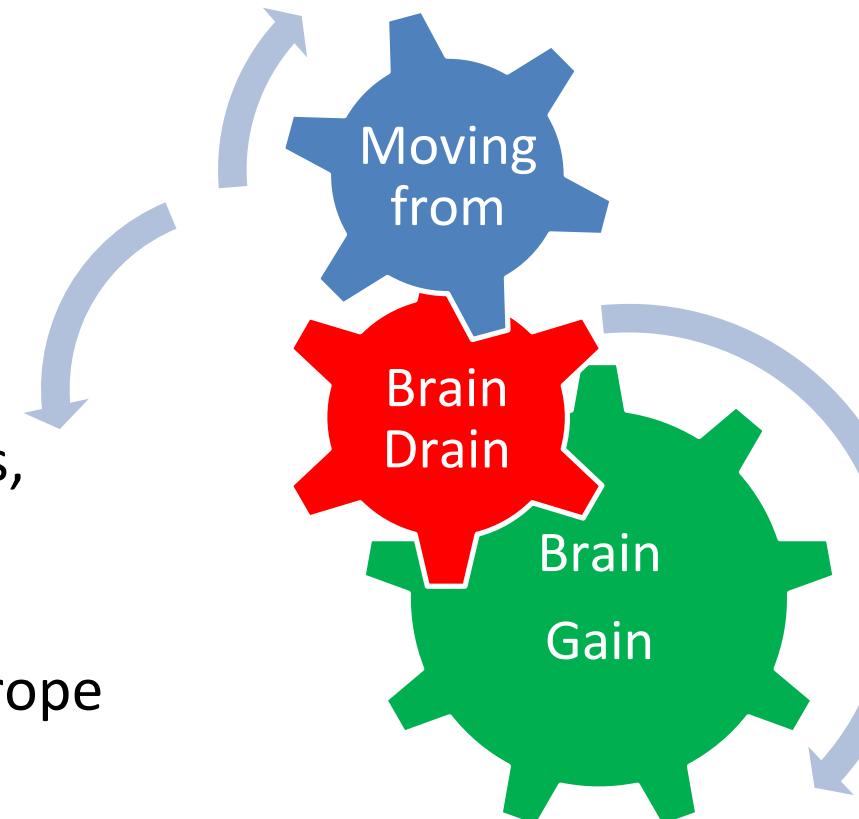
## **Collaborative work can:**

- Build scientific knowledge for local and international physicians
- Building strong institutions is critical to achieving the next major breakthroughs for diseases like HIV-AIDS
- Recent outbreak of Ebola in West Africa reinforces the need for local capacity testing, diagnosis and good laboratories
- Richness of local biodiversity and traditional practice should be put to good use to enrich the power of African therapeutic capabilities

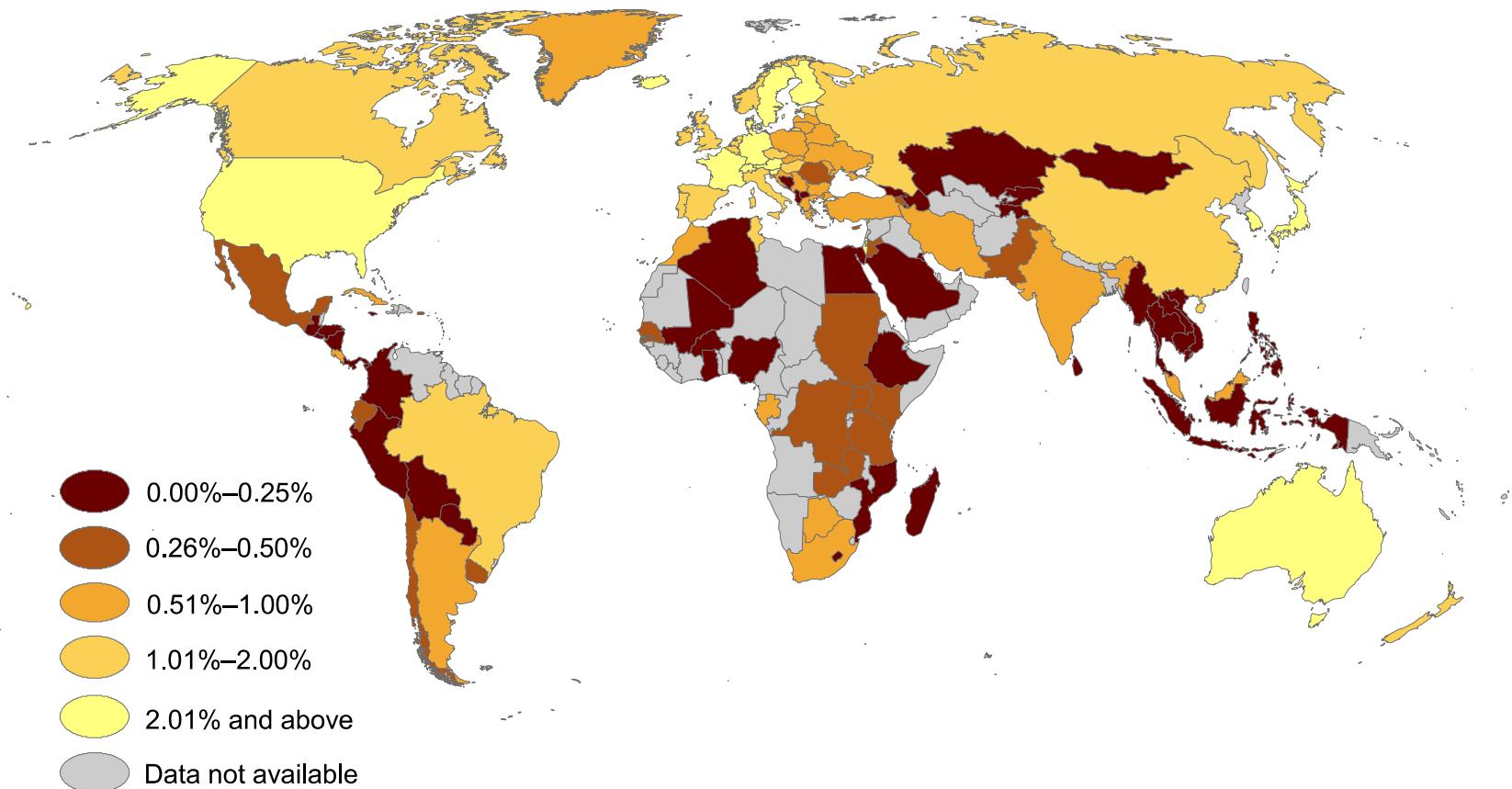
# **Science & Technology Engineering and Maths (STEM)**

# African solutions for Africa's challenges

- Africa's legacy of her colonial past
  - Curricula designed to produce cadres of civil servants to administer government
- Today's Africa stock of graduates have secondary and tertiary skills skewed towards Humanities and Social sciences.
  - Less than 25% have STEM skills, women under-represented
- Toward solutions
  - Leverage Africa's diaspora (Europe and North America)
  - Encourage stronger link between Universities and the Private Sector
  - Reduce the gender divide especially in the S & T

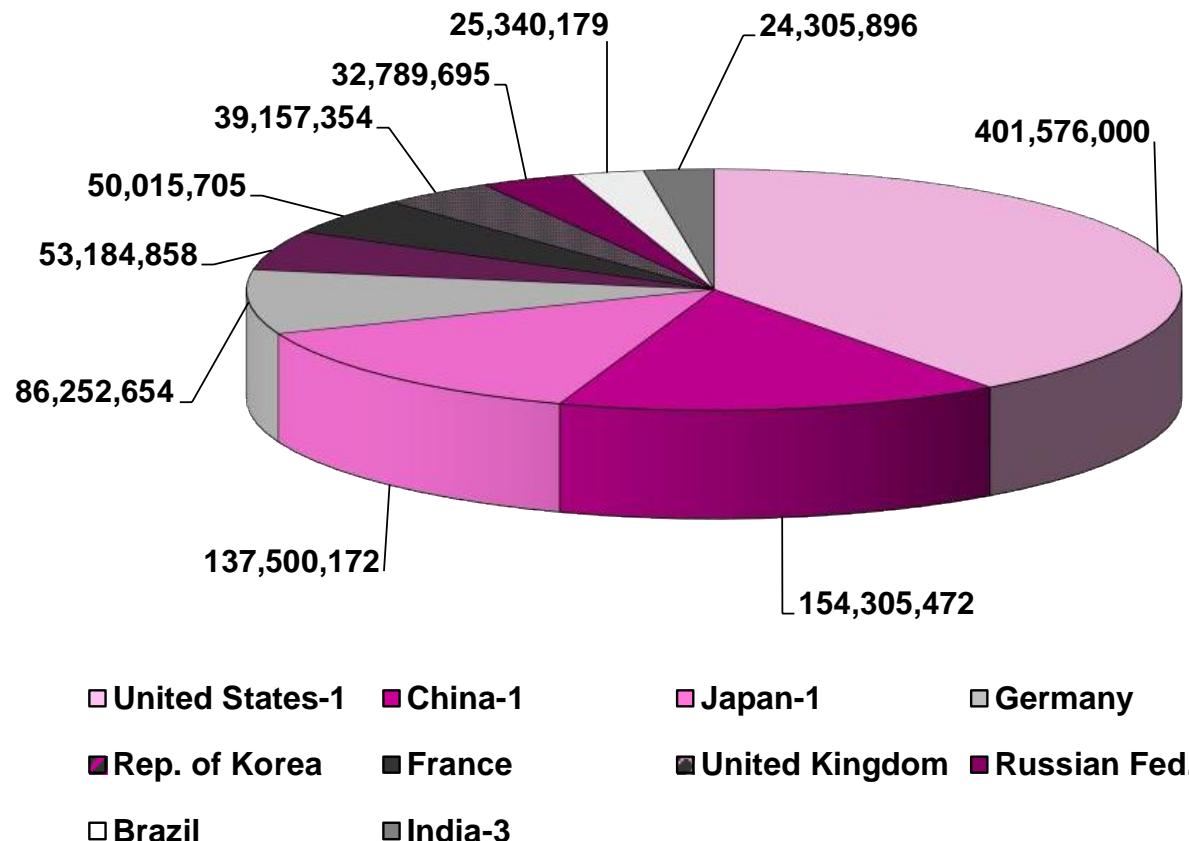


# Snapshot of R & D intensity as a percentage of GDP

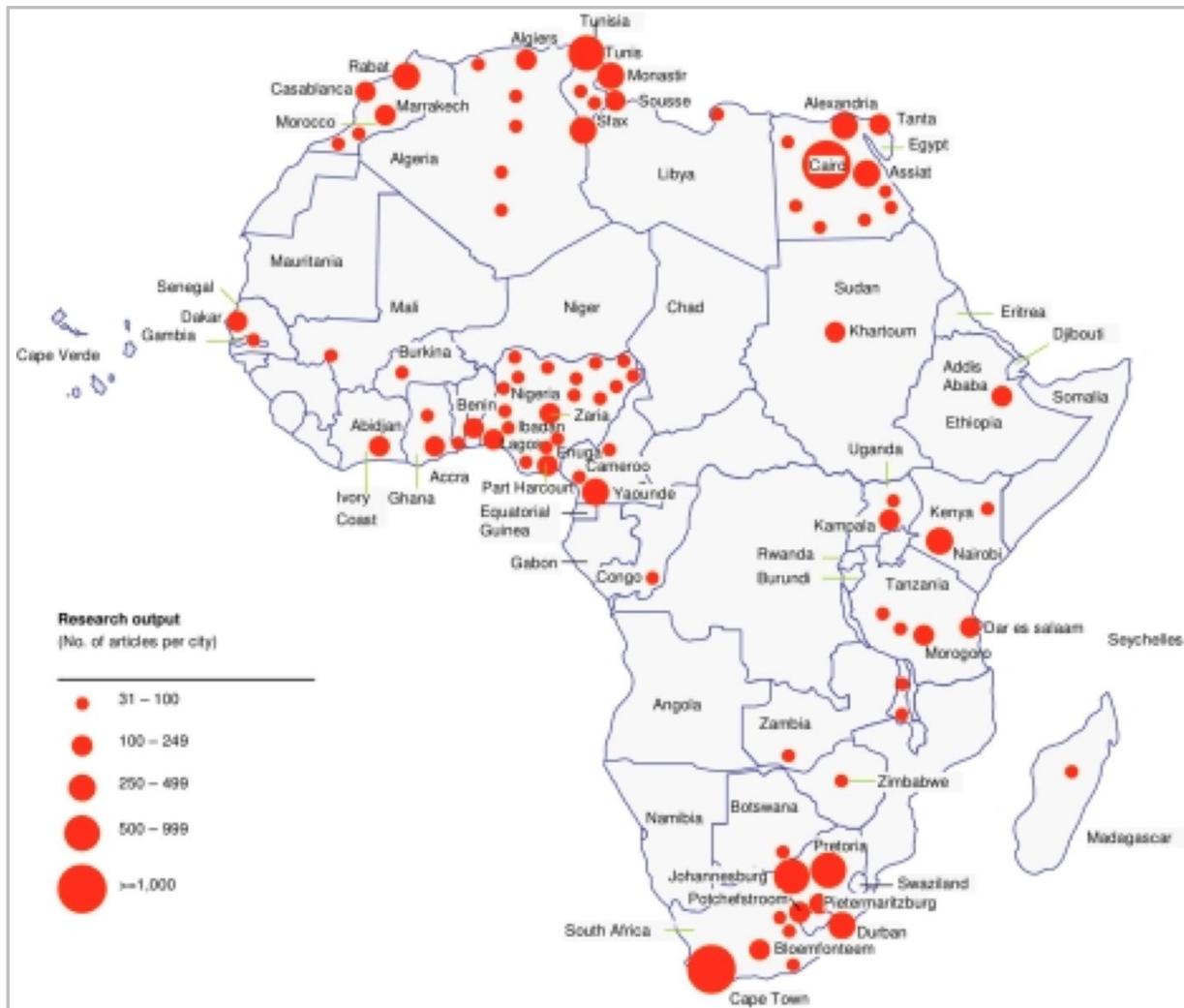


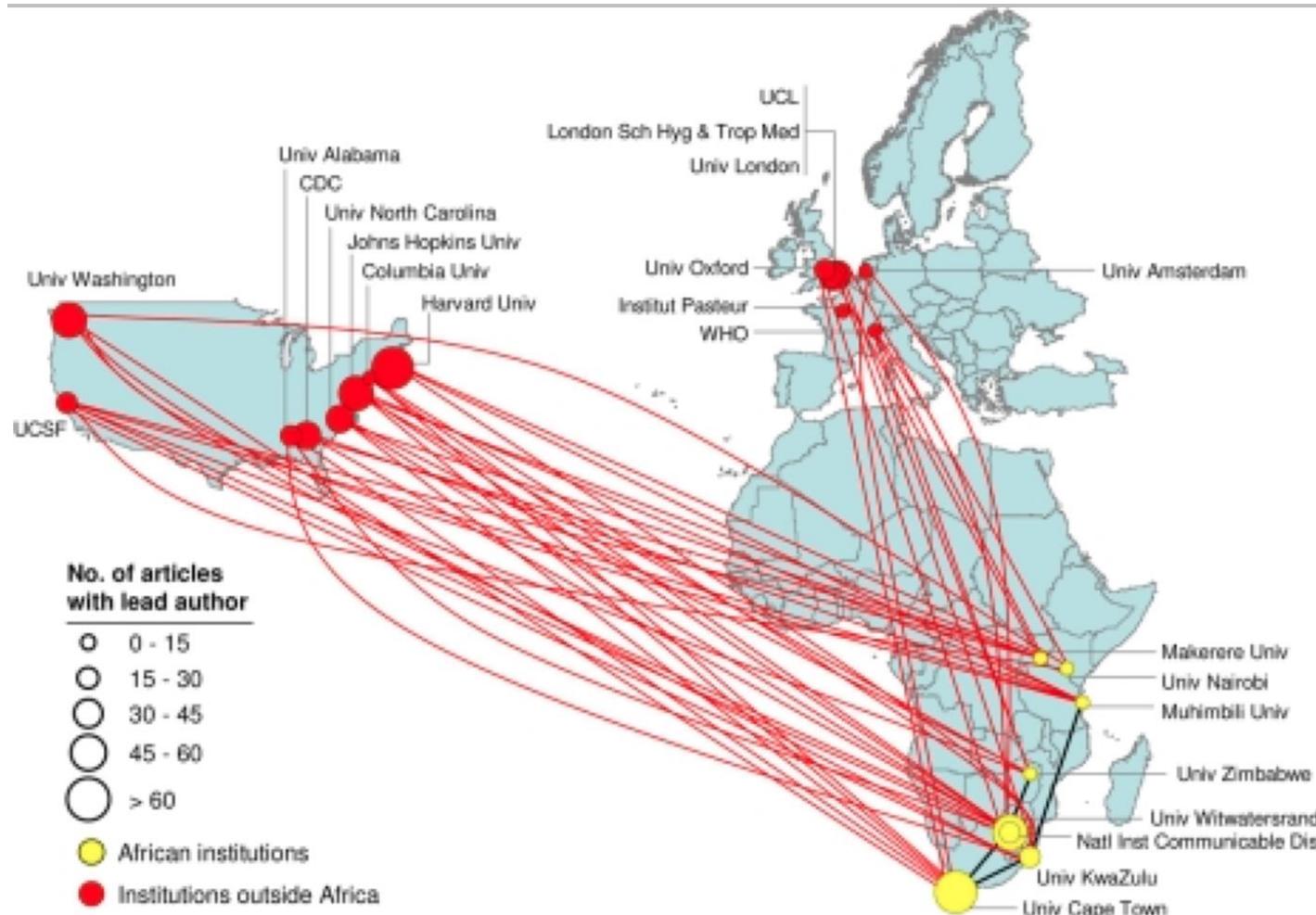
Source: UNESCO Institute for Statistics Estimates (2012)

# World's Top Leaders in R & D Investment



# Research Output & Country wise &

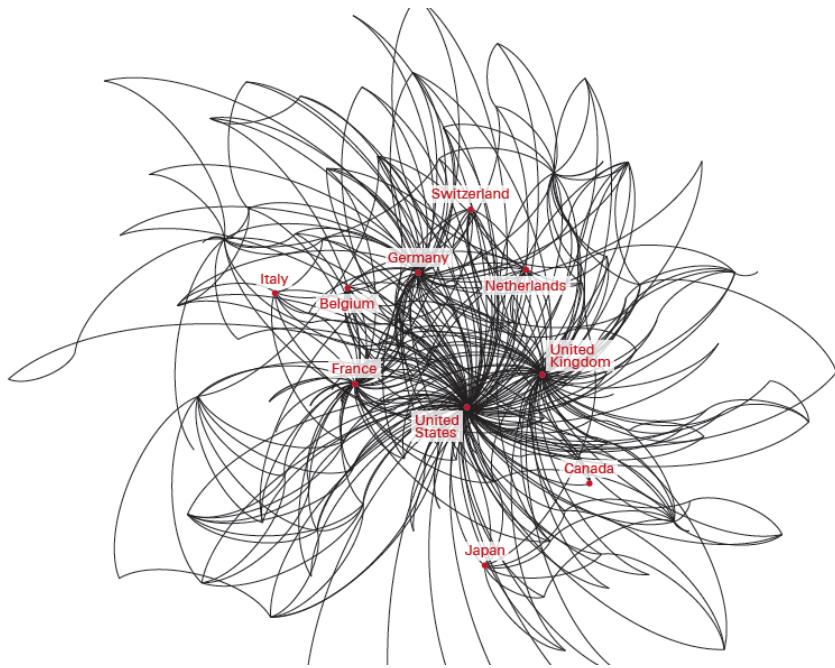




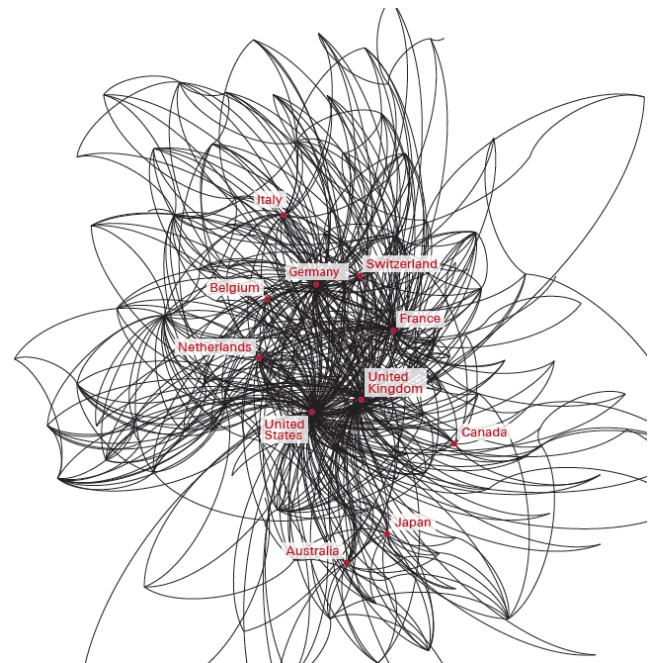
# World's top 20 publishing cities: Africa conspicuous by its absence



## Collaboration:'NorthXNorth' 1996X2000'



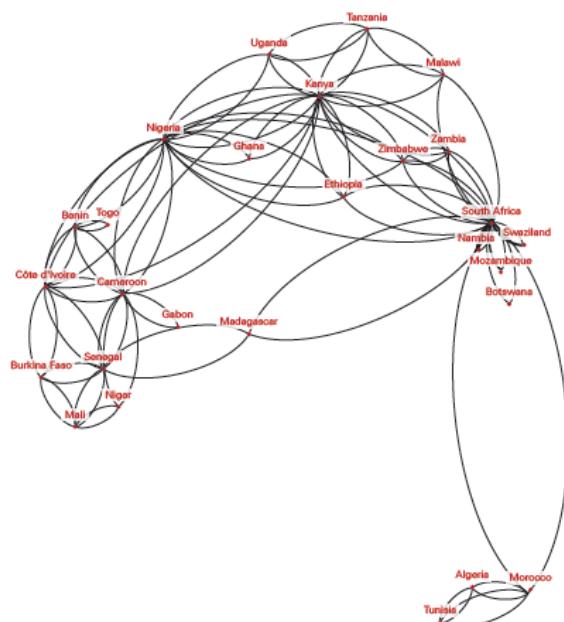
## Collaboration:'NorthXNorth,' 2004X2008'



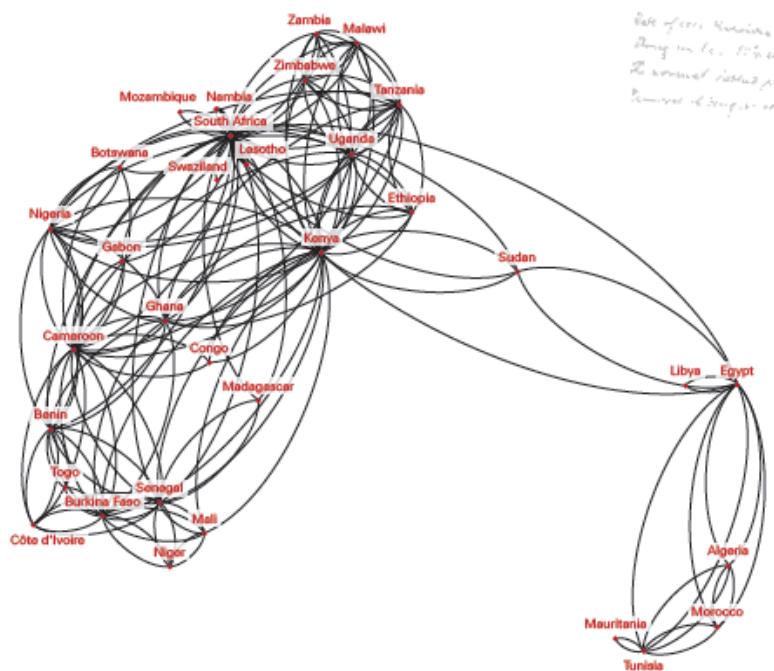
Source:"Knowledge,'networks'and'na7ons:'Global'scien7fic'collabora7on'in'the'21st' century,'The'Royal'Society,'2011,'p.'50"[www.royalsociety.org/](http://www.royalsociety.org/)

Science is an international enterprise where collaboration is an important & driver for success. International collaboration results in higher citation & impacts &

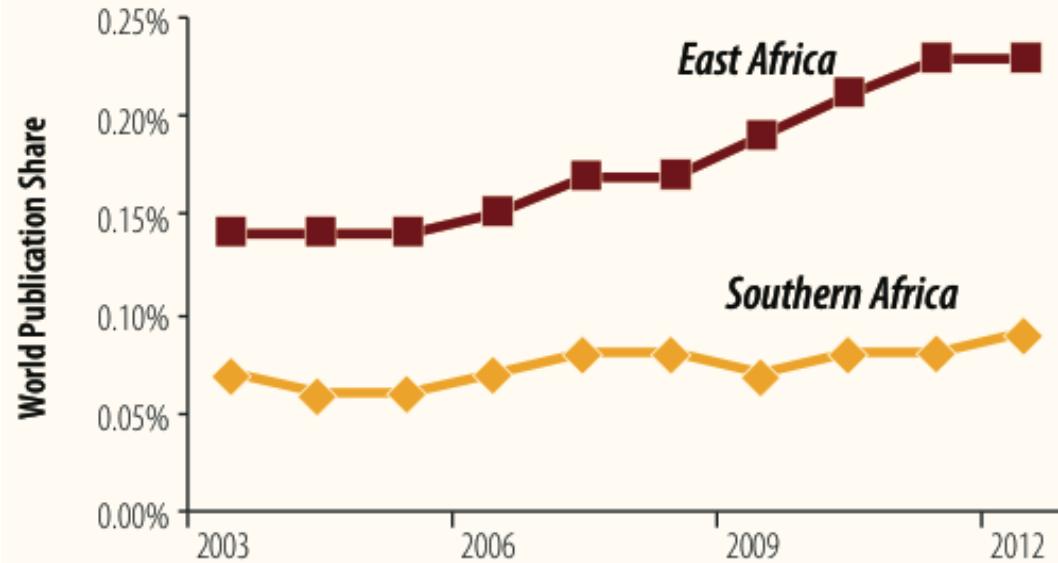
## Collaboration: 'Africa,' 1996X2000'



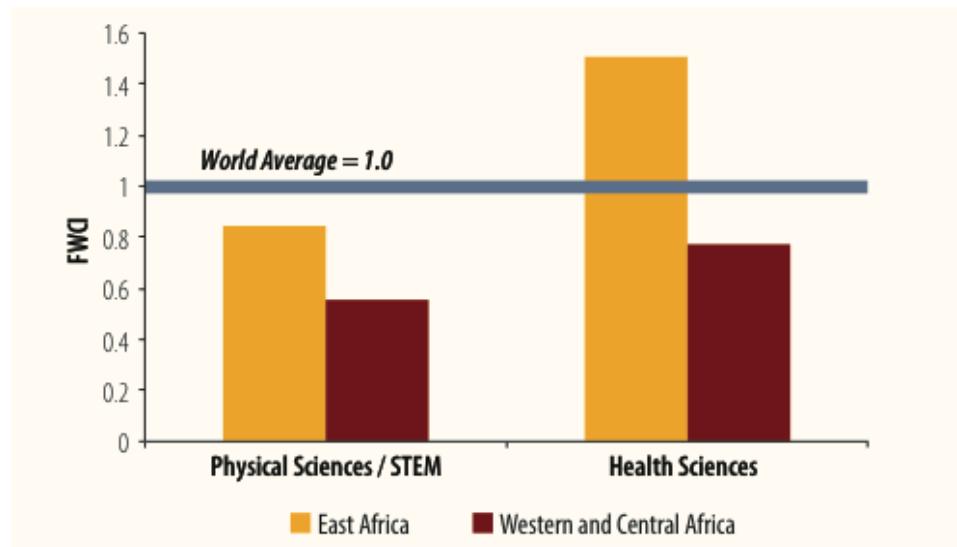
## Collaboration: 'Africa,' 2004X2008'



Source: Knowledge, networks and nations: Global scientific collaboration in the 21<sup>st</sup> century, The Royal Society, 2011, p. 53 [www.royalsociety.org](http://www.royalsociety.org)



### Growth in East & Southern Africa's world publication (2003-2012)



**Field-weighted Citation Impact for EAfrica and W& CAfrica in Health Sciences & STEM/Physical Sciences (2012) – Source: Scopus**

# Way forward

## Increased collaboration:

Regional: Political support from EU and AU

- Emerging regional ties of countries like

SA, Cameroon, Nigeria, Morocco etc..

- NEPAD and EU have formulated the S & T Consolidated Action Plan

- Setting up Centre of Excellence e.g in the BioSciences, Water and Technology
- CAADP promotes use of S & T to boost agricultural productivity

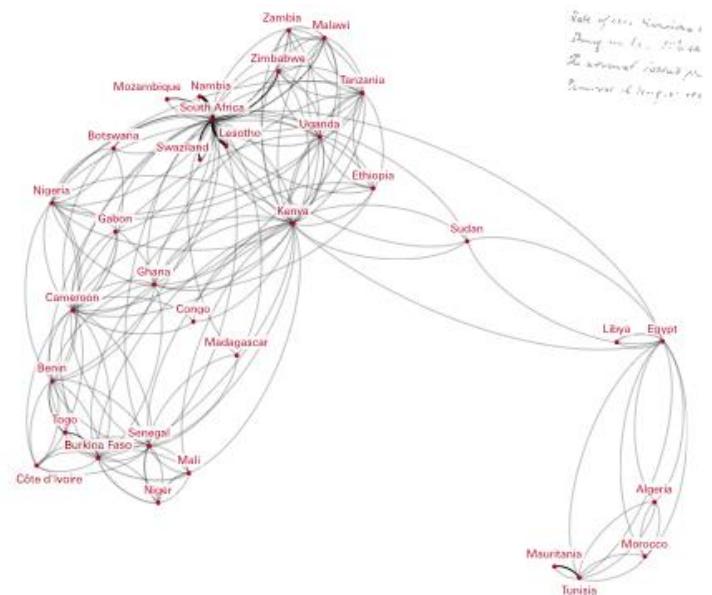
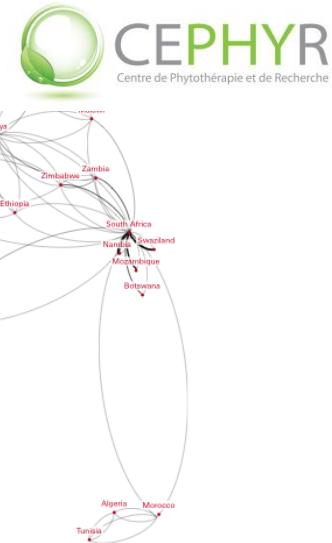
## South Africa: & inchpin & of & cien5fic & collabora5on & in Africa &

- With Senegal, Cameroon, Nigeria, Uganda and Morocco among others

## Egypt &

- Emerging powerhouse
- Boosted investments in science (US\$911 million in 2007, up from only \$403 m in 1996)
- Egypt and Sudan have emerged as bridges to Sub-Saharan Africa
- Has recently set up the Zewail City of Science: US2Bn budget

Figure 2.4. Collaboration between African countries  
Fig a. 1996-2000



# New agenda for new times

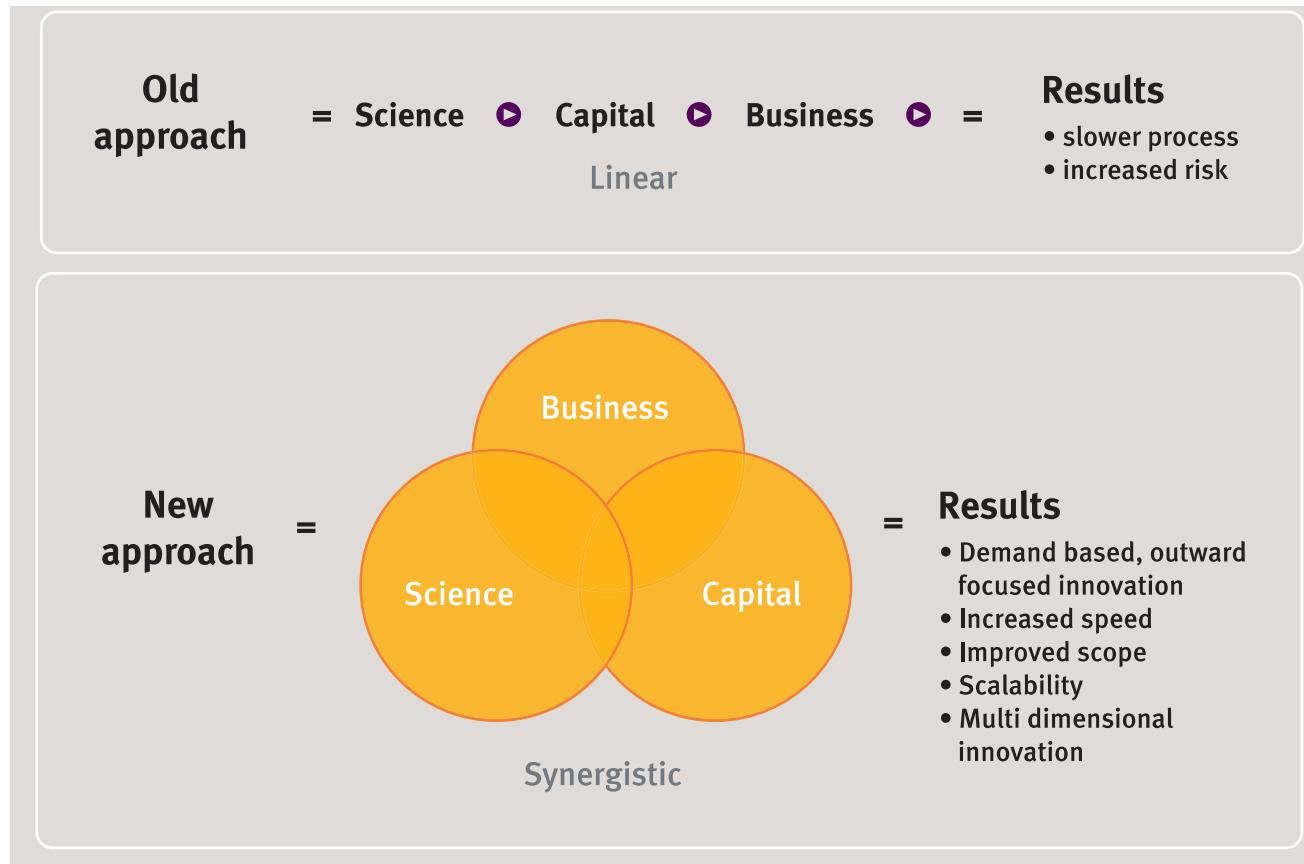
# Role for Socially Relevant Science &

- Climate & change &
  - Marshal evidence to convince 'skeptics'
  - Focus on both adaptation and mitigation'
- HIV/AIDS &
  - Transcend disciplinary boundaries,' work with social and behavioral' scientists'
  - Recognize role of culture'
- Knowledge & divide &
  - Foster collaboration, increase trust'
  - Improve communication of science'



# Commercialization of African Research

Adoption of '**Convergence innovation**': overcoming the problem of missing links between Science, Business & Capital and providing specific focus on Product development



- **Access to Venture Capital** (has led to the development of companies like Genentech, Amgen, Genzyme etc.)
- IFC had identified Health Innovations as an investment opportunity
  - Development of Nibima from traditional herbal medicine *Cryptolepis sanguinolenta* from Mampong, Ghana
  - Malaria dipstick from Uni. Ghana
- **The East African example** (Bridgeworks Africa) at ICIPE (failed because of weak institutional framework, regulatory inefficiencies etc..)
- Yet ICIPE has several patents that have not given any scalable business models and profits insignificant
- Even with success with **Niprisan** (anti-sickling remedy), Nigeria did not have the capacity to sustain institution-specific funds to make large investments
- Although **Africa Enterprise Challenge Fund** is making VC, yet more clout needed through partnership with international agencies to make development happen.
- There is a need for a '**Africa VC Fund**' to be structured as to mitigate risks and attract for-profit Private Sector Funds

## Ghana

Schistosomiasis: Chronic diseases; impairing growth and development in children. 2<sup>nd</sup> devastating disease after malaria in Africa.

Team at Ngochu have developed a prototype test (dipstick test) for the disease developed but did not go further as not enough Technology Transfer Capacity nor Support for product development, field trials or market assessment

## Tanzania

*Artemisia annua* grown locally. Farmers dry ad export to Kenya where extraction takes place, then shipped to Switzerland where Novartis processes it into Coartem ®

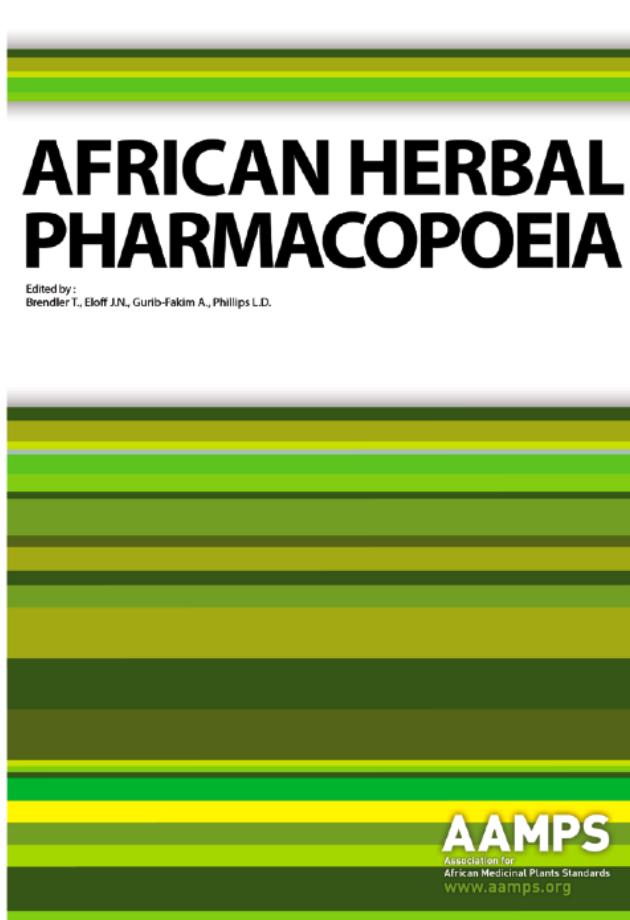
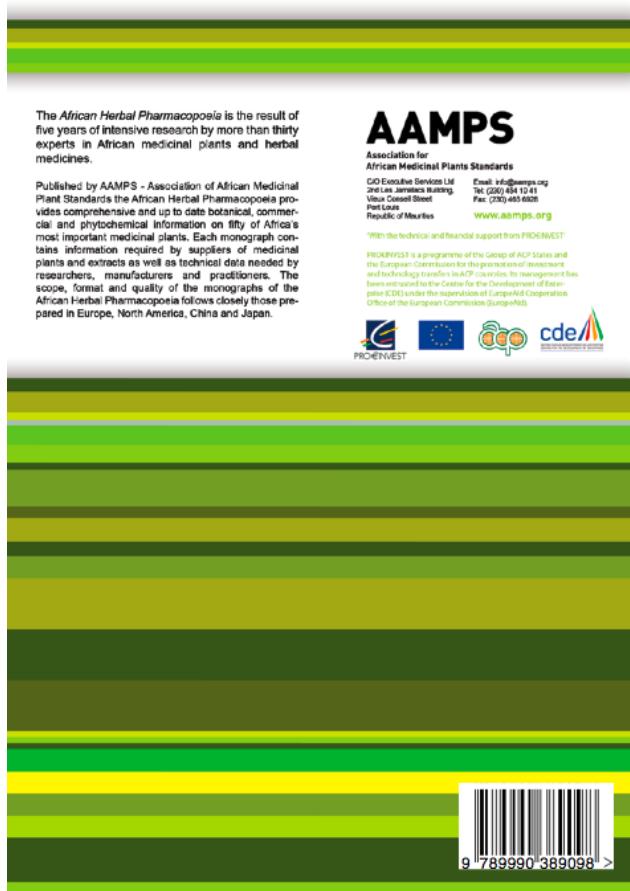
At National Institute for Medical Research have developed a technique to enhance production locally but this innovation not applied and hence no commercial value captured locally

## Rwanda

1. Fertilizer formulated at the Institute of Research into S & T was not processed further due to lack of awareness of the Innovation process and support structure to protect innovation. Hence potential of this discovery remains untapped.

2. Seed varieties developed by Rwanda's Institute of Agricultural & Scientific Research being marketed in Malawi but no royalties flowing back to Institute – hence no local value being captured

# African Herbal Pharmacopoeia



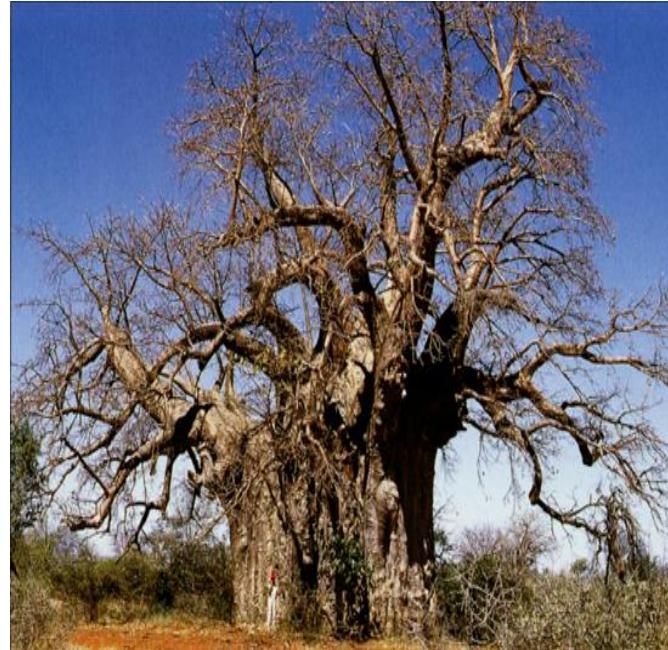
Brendler T, Eloff JN, Gurib-Fakim A, Philipps, D (2010)

Cited by the '**Medicines Control Council of South Africa for Complementary Medicines**' as an accepted Reference (South Africa, Department of Health – November (2013))



## *Adansonia digitata* (Baobab)

- Highly appreciated by the Neutraceutical sector
- Growing interest by cosmetic companies.



**Cold pressed seeds:** high quality oil used in cosmetic creams & milk – after sun care  
Baobab Co. produces extracts from fruit for nourishing the epidermis & shampoo

## Pelargonium sidoides DC.

### GENERAL DESCRIPTION

**Scientific Name:** *Pelargonium sidoides* DC.

**Synonyms:** None.

**Family:** Geraniaceae

**Vernacular Names:** *Pelargonium sidoides* (English); *Pelargonium sidoides* (French); Umckaloabo (German); *Pelargonium sidoides* (Van der Walt 1977, Van Wyk & Wink 2004).



*Pelargonium sidoides* flowers (© Plantaphile)

**Possible Alternative Source Species:** none

### ETHNOBOTANICAL INFORMATION

**Major Ethnopharmacological Uses:** The traditional medicinal uses of *Pelargonium sidoides* are poorly recorded. The plant is traditionally used by Zulu people to treat gonorrhoea, diarrhoea and dysentery. A large number of *Pelargonium* species with tuberous rhizomes are used in traditional medicine against diarrhoea and dysentery, and only this use is well documented (Watt & Breyer-Brandwijk 1962, Forbes 1986, Hutchings et al., 1996, Van Wyk et al., 1997).

**Other Relevant Uses:** none

### CHEMICAL CONSTITUENTS

**Compounds:** The dried rhizomes contain at least eight different coumarins, of which umckalin and 5,6,7-methoxycoumarin are considered to be useful marker compounds (Kaysor & Kolodziej, 1994, 1995, 1997; Kolodziej & Kaysor, 1998, Kaysor et al., 2001) The herb also contains gallic acids and methyl esters of gallic acids, as well as flavonoids (quercetin), flavan-3-ols (catechin, gallocatechin) and phytosterols (sitosterol-3-glucoside). Above-

**Botanical Description:** A small perennial herb with tuberous rhizomes, rounded to heart-shaped and slightly silvery leaves on long petioles, and small tubular flowers that are dark maroon red to almost black. The closely related *P. reniforme* is morphologically very similar but has pink flowers (Van der Walt 1977, Van Wyk & Wink 2004).

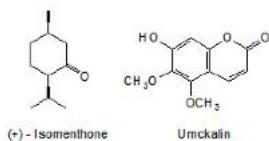
**Origin and Distribution:** Eastern parts of southern Africa (Eastern Cape Province, Kwazulu-Natal and Lesotho).

**Plant Part Used:** Dried tuberous rhizomes.



*Pelargonium sidoides* root, dried and cut (© Plantaphile)

ground parts contain a wider diversity of phenolic compounds but no coumarins. Monoterpeneoids such as isomenthone (common in *Pelargonium* species) appear to be absent. A comprehensive study of all the chemical constituents of both underground and aerial parts of *P. sidoides* and *P. reniforme* has been carried out by Kolodziej (2007).



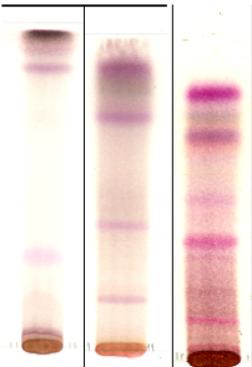
### QUALITY CONTROL

**TLC / HPLC / GC:** Extractability of dried material water, ethanol and acetone concentration in mg/ml from 1 g of plant material:

extractant	water	ethanol	acetone
mg/g	86	72	40
% extracted	8.6	7.2	4.0

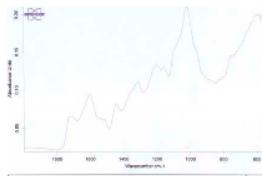
© AAMPS - 1

General TLC systems for coumarins can be used. No specialised systems for HPLC analysis appear to have been published.



Solvent systems from left to right EMW, CEF, BEA. This separates polar compounds, intermediate polarity compounds and non-polar compounds. Detection reagent: vanillin sulphuric acid.

### NIR Spectroscopy



**Adulterants and Adulterations:** The dried product may be adulterated with the very similar-looking *P. reniforme*. Morphological distinction of the dried product is extremely difficult, so that chemical analysis is the only reliable method. Whereas *P. sidoides* contains umckalin and its 7-O-methyl ether (=5,6,7-trimethoxycoumarin) as major constituents, these are characteristically low or absent in *P. reniforme*.

**Standard Preparations:** EPs® 7630.

African Herbal Pharmacopoeia (2008) - *Pelargonium sidoides*

### Standard specifications (WHO, 1998)

#### Microbiology:

*Salmonella* spp. – negative  
*Escherichia coli* – negative  
Aerobic bacteria – not more than 105/g or ml  
Fungi – not more than 104/g or ml  
Enterobacteria and Gram-negative bacteria – not more than 103/g or ml

Total ash: Not more than 5%  
Acid-insoluble ash: Not more than 1%  
Water-soluble extractive: Not less than 20%  
Foreign matter: Not more than 2%  
Pesticide residues: In accordance with national requirements. Aldrin and dieldrin – not more than 0.05 mg/kg.  
Aflatoxins (B2, G1, G2, and B1): 4 ppb  
Heavy metals: Lead in final dosage form – not more than 5 ppm, cadmium in final dosage form – not more than 0.3 mg/kg.

### PHARMACOLOGICAL PROPERTIES

Evidence for immune stimulation (Kaysor et al., 2001), NO induction (and anti-bacterial effects of the proprietary substance Umckaloabo have been published (Kaysor & Kolodziej, 1997, Kolodziej et al., 2003). Recent studies showed significant effects on nasal epithelial cells (Neugebauer et al., 2005) and against mycobacteria (Seidel & Taylor, 2004). The antibacterial and antiviral effects are attributed to gallic acids and other phenolic compounds, whereas the immunomodulatory activity is considered to be due to a combination of phenolic compounds and the numerous coumarins (umckalin and derivatives). For a comprehensive review of the known biological activities of *P. sidoides* see Bredler and Van Wyk (2008).

**Clinical Studies:** A total of 18 clinical trials have thus far been conducted, several of which were randomised, double-blind and placebo-controlled. EPs® 7630, an extract of *P. sidoides*, has been shown to effectively shorten the severity and duration of acute bronchitis and tonsillitis, most notably in children. Several other randomised, double-blind, placebo-controlled studies of special extracts on children and adults have followed (Bereznoy et al., 2003, Haidvogl et al., 1996, Mathys et al., 2003). For a review of the clinical evidence see Agabbiaka et al (2008) and Bredler and Van Wyk (2008).

**Pharmacokinetic Properties:** not investigated.

### SAFETY DATA

**Single Dose Toxicity:** Overall safety and a very low incidence of side effects have been confirmed (Conrad et al., 2007). An unpublished brine shrimp test indicated complete safety. The observational study mentioned above (Haidvogl et al., 1996) also

indicates safety (very low incidence of side effects – only eight out of 742 patients).

**Clinical Safety Data:** Safety has been investigated in numerous clinical trials (see Clinical Studies) and was found safe for muse in adults and children with a minimum number of adverse effects reported.

### KEY USAGE

**Therapeutic Indications:** Acute bronchitis in children and adults.

**Dosage, Method and Duration of Administration:** Ethanolic extracts are used in a proprietary herbal tincture known as Umckaloabo. The recommended dose of EPs® 7630, a root extract from *P. sidoides*, for adults and children over the age of 12 years, is 30 drops (1.5 ml) three times per day for 7 days. Children aged 6-12 years may take 20 drops (1.0 ml) three times per day. Infusions or decoctions are traditionally used, but dosage information on the crude herb is not available.

**Contraindications:** A theoretical risk of interactions with anticoagulants and antiplatelet drugs could not be confirmed.

**Special Warnings and Precautions for Use:** Can be safely consumed when used appropriately. A total of 34 case reports of allergic (hypersensitivity) reactions have been recorded through the WHO's pharmacovigilance programme, which may be associated with the use of *Pelargonium* extract, all originating from Germany (De Boer et al., 2008).

**Pregnancy and Lactation:** The extract of *P. sidoides* root (EPs® 7630) is contraindicated during pregnancy and lactation, as no specific data on effect on pregnant or lactating women are available.

**Evaluation of Efficacy:** Acute bronchitis in children and adults: efficacy clinically proven (Special extract) (Bredler & van Wyk, 2008).

### TRADE INFORMATION

**Nature of plant material:** Conservation status: not listed. Origin: Eastern Cape Province. Most of the material is still wild crafted, but crop development has progressed to a point where significant quantities of raw material will soon be produced from cultivated plants. The plant flowers over a long period during the summer months. Harvesting usually takes place after the end of the growing season.

**Processing and storage:** The tuberous rhizomes are simply sliced and dried. Rapid kiln drying

African Herbal Pharmacopoeia (2008) - *Pelargonium sidoides*

yields a better-quality product. Stability of product: Unknown.

### REGULATORY INFORMATION

**Pharmacopoeias / Monographs:** *Pelargonium Root*. European Pharmacopoeia 6.0 2008, 01/2008:2264 corrected 6.0, 2625.

**Regulatory / Registration Status:** Licensed as a herbal medicine with full drug status in Germany, as traditional herbal medicine in the UK.

**Patents:** Proprietary extracts of *Pelargonium sidoides* and their preparations are to date protected by a total of seven patents in various countries (WO2003028746, WO2006002837, EP1684775 - 2006, WO2006002918, EP1829548 - 2007, WO2007009446, EP1878434 - 2008).

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# Medicinal plants of Mauritius & Indian Ocean Islands commonly used against diabetes

*Momordica charantia* (Bitter Gourd)- Exotic

*Artocarpus heterophyllus* (Jack Fruit) - Exotic

*Aegle marmelos* (Bael)- Exotic

*Antidesma madagascarensis* (Bois Ronde) - Indigenous

*Faujasiopsis flexuosa* (Bois Cassante) - Indigenous

*Pittosporum senacia* (Bois Pomme)- Endemic

*Ocimum sanctum* (Tulsi) (Sacred basil) – Exotique

*Vangueria madagascariensis* (Vavangue)– Exotic

*Azadirachta indica* (Neem) – Exotic

*Eriobotrya japonica* (Bibace) – Exotic

*Syzygium cumini* (Jamblon) – Exotic

# Validation of the Herbal Remedies

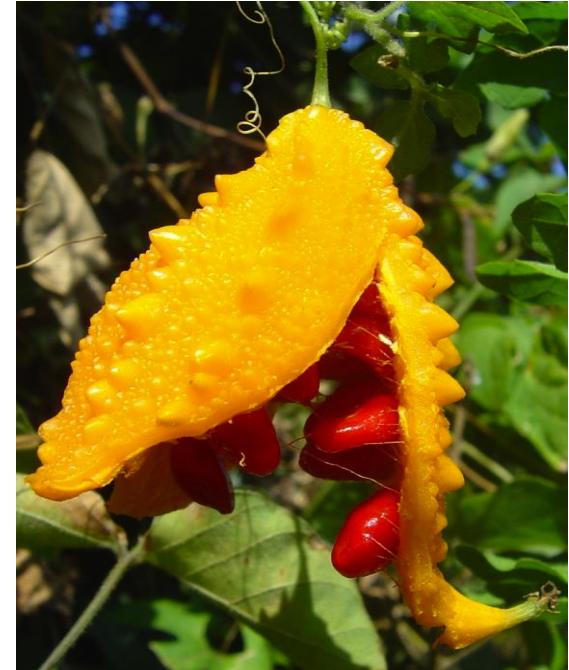
## Exotic plant: *Momordica charantia* (Cucurbitaceae)

**Traditional uses:** Food plant & decoction of plant used against diabetes management (Gurib-Fakim et al, 1995)

### Validation of the anti-diabetic potential:

**In vitro:** inhibit the uptake of glucose and the amino acid, tyrosine across rat everted gut sacs (Gurib-Fakim et al, 2003)

- Potent **antioxydant & anti-glycating** properties (equivalent to standard drug aminoguanidine), moderate **anti-lipoxygenase** activity (Mahomoodally et al, 2012)



**Gurib-Fakim, A et al (2003),** “*Momordica charantia* extracts inhibit uptake of monosaccharide and amino acid across rat everted gut sacs in-vitro”, Biological and Pharmaceutical Bulletin  
**Mahomoodally F, Gurib-Fakim A (2012).** BMC Complementary & Alternative Medicine. 12, 165

**Indigenous plant: 'Bois bigaignon'**  
***Antidesma madagascariensis***  
(Euphorbiaceae)

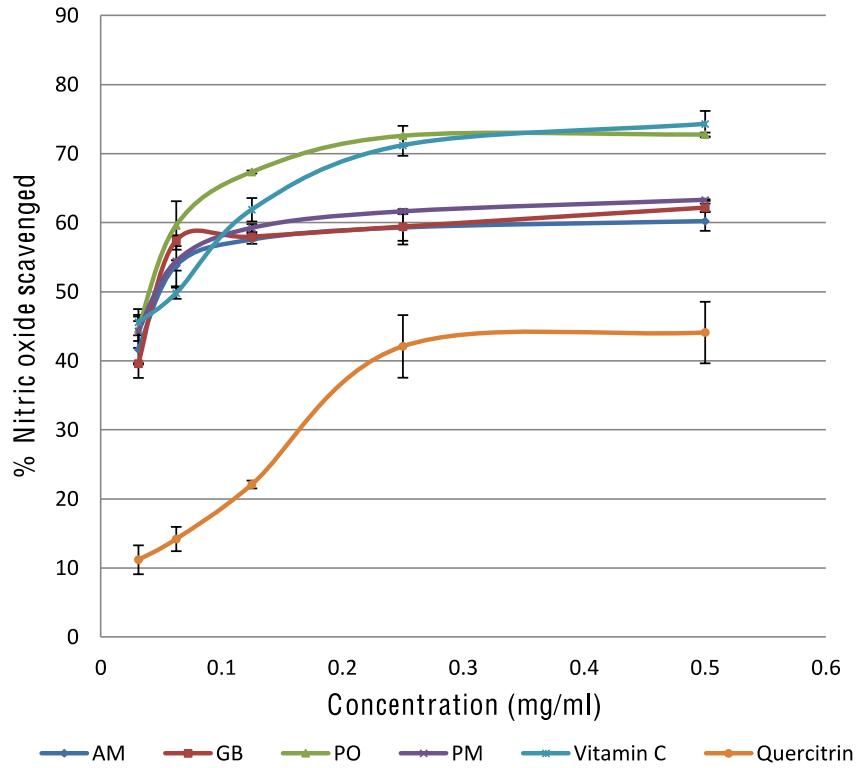
**Traditional uses:** Leaves: infectious diseases (skin infections), diabetes (Gurib-Fakim *et al*, 1996)

Validation of the traditional uses against diabetes (*in vitro*):

Significantly stimulated the mucosal disappearance and serosal appearance of glucose & strongly inhibited key carbohydrate hydrolysing enzymes -  $\alpha$ -amylase and  $\alpha$ -glucosidase (Gurib-Fakim *et al*, 2006)

- Inhibits glucose uptake at the brush border of small intestine (Gurib-Fakim *et al*, 2010)

- Strong antioxydant activity



Gurib-Fakim A *et al* (2006). Stimulatory effects of *Antidesma madagascariensis* on D-Glucose, L-Tyrosine, fluid and electrolyte transport across rat everted intestine, comparable to insulin *in vitro*. *British Journal of Biomedical Sciences*, **63**, 12-17.

Gurib-Fakim A *et al* (2012). Inhibitory effects of a traditional antidiabetic medicinal fruit extract.. *J. Food Biochemistry*, 107-114

# *Antidesma madagascariensis* – Anti-diabetic potential (in vivo)

## *In vivo* testing (Mice)

- Significant concentration dependent inhibition of amylase in mice (activity measured against standard drug Acarbose)
- EtoAc extract more potent; reduced level of glucose (-59.4%) as compared to (-55.1%) for positive control

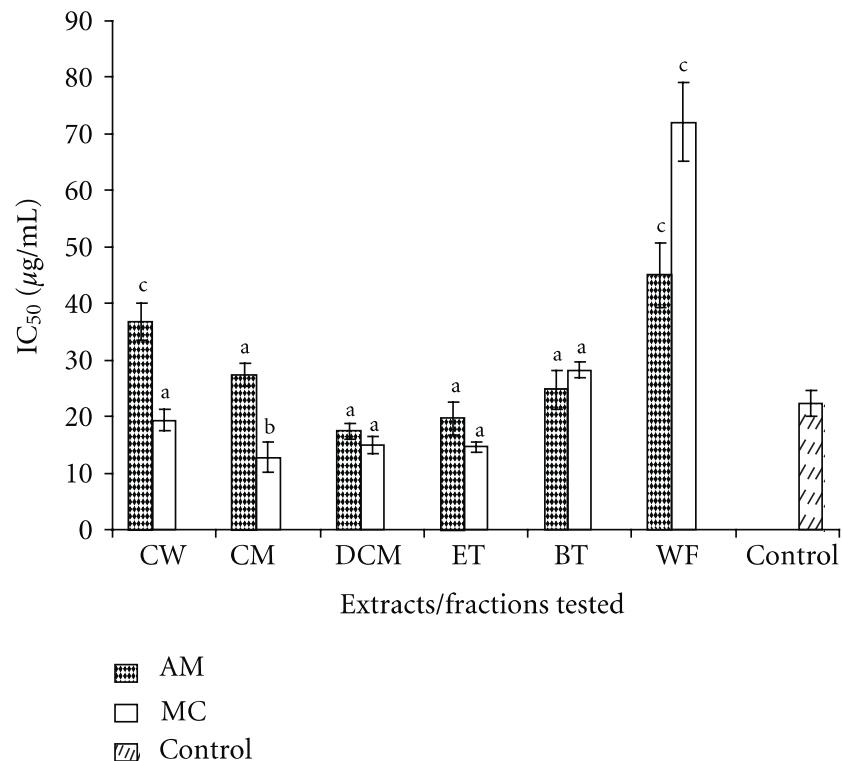


FIGURE 3: Summary of  $\text{IC}_{50}$  values ( $\mu\text{g/mL}$ ) for the active extracts/fractions of AM and MC against  $\alpha$ -glucosidase activity. CW: crude water; CM: crude methanol; DCM: dichloromethane; ET: ethylacetate; BT: *n*-butanol; WF: water fraction. Positive control: 1-Deoxynojirimycin. <sup>a</sup>Values comparable to positive control (1-Deoxynojirimycin). <sup>b</sup>Values significantly lower ( $P < 0.05$ ) from positive control. <sup>c</sup>Values significantly higher ( $P < 0.05$ ) compared to positive control.

# Antidesma madagascariensis – Anti-infective potential

Strains tested	<i>A. madagascariense</i> (31.2 g) <sup>b</sup>			
	DCM <sup>c</sup> (5.67 g)	<i>n</i> -BuOH <sup>d</sup> (4.74 g)	H <sub>2</sub> O <sup>e</sup> (5.67 g)	Tanin-less extract
<i>E. faecalis</i>	0.43	0.33	0.16	2.50
<i>S. aureus</i>	3.48	0.16*	0.16*	2.50
MRSA	0.87*	0.33*	0.66*	1.00*
<i>E. coli</i>	3.48*	0.66*	0.66*	0.63*
<i>P. aeruginosa</i>	1.74*	1.32*	0.16*	1.25*
<i>C. albicans</i> <sup>*1</sup>	0.43*	0.33*	0.33*	0.63
<i>A. niger</i>	0.87*	1.32*	-	ND
<i>Penicillium</i> spp.	1.74	0.66*	-	ND
<i>T. rubrum</i>	0.87	1.32	-	ND

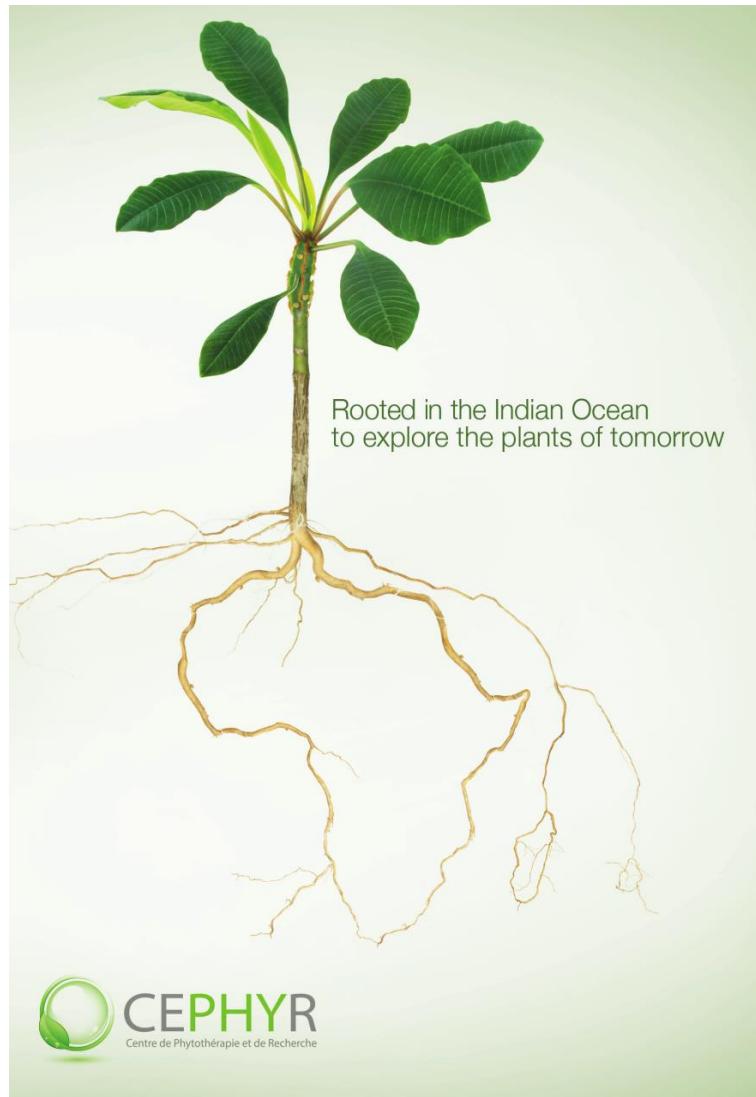


Bioautography with inoculum of *S. aureus*

Activity attributed to the presence of:  
alkaloids, flavonoids, tannins, phenols,  
saponins and leucoanthocyanins

- Isolation of actives being carried out

# Creation of CEPHYR ([www.cephyr-recherche.com](http://www.cephyr-recherche.com))



- ❖ Access to a unique and lesser-known Biodiversity (>5.000 medicinal plants on the African continent)
- ❖ **Trained graduates**  
(Multidisciplinary team of Chemists, botanists, Pharmacologists)
- ❖ **Recognised expertise in research**
- ❖ **Fully accredited Laboratories**
- ❖ One large database of bioactive extracts
- ❖ **Strategic partnership in 3 continents**
- ❖ Partnership with the other arm of the Holding **CIDP** : Expertise in clinical trials in the fields of Cosmetics, Foods and Pharmaceutical products

## Our Service offering will also include:

### ***Tests and Security evaluation on cosmetic ingredients and finished products***

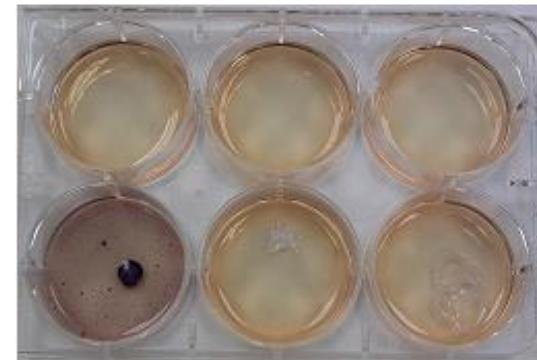
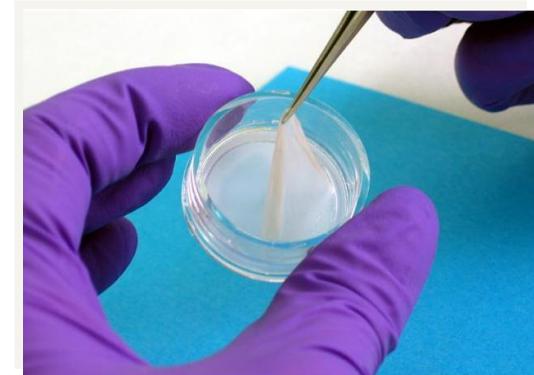
- **Safety evaluation of cosmetic ingredients**

- Cytotoxicity (direct Cell Contact & agar Overlay Assay)
- Dermal Toxicity (*In vitro* Dermal Irritation EpiSkin, *In vitro* 3T3 NRU photo toxicity test, dermal Absorption – Freund's Diffusion Method)
- Ocular Toxicity (Bovine Corneal Opacity and Permeability)
- Genotoxicity (DPRA (direct peptide reactivity assay, MUSST assay (dendritic cell activation), Bacterial Reverse Mutation Test)

- **Preclinical safety tests for finished cosmetic products**
- Eye irritation tests: (Cell diffusion on agarose gel, Eye Irritation on HET CAM +/-)

# Pre-Clinical In-vitro Cell and Tissue Culture Laboratory

- International drivers behind the development of alternative methods – Amendment of EU Cosmetic Directive
- Provide *in vitro* models that address
  - Skin Sensitization
  - Dermal irritation, corrosion
  - Ocular toxicity
- Use of Validated Methods (OCDE Guidelines)



University of Pretoria

Nestle

Universiti Teknologi  
Malaysia

Symrise



L'ORÉAL



Bristol-Myers Squibb



URIAGE



YVES ROCHER



# **Closing thoughts**

# Elements of the new agenda

- Capitalize on momentum gained in the global environmental and conservation movements
  - Recognize all actions are local

Emphasize maintenance and sustainable use of “natural capital”

- Recognize important role of local communities

Mobilize cutting-edge knowledge

- Recognize value of indigenous knowledge and cultural traditions

Forge partnerships anchored in the common good for the benefit of all.

-Become the voice of change.

## **Science & Society:**

-STEM-related research output and impact are related to a region's long-run economic development

## **Facilitate interaction:**

-Sustainable development is about developing solutions drawing on multiple disciplines  
-Promote STEM which has remained stagnant

## **Promote the participation of all scientists:**

-Go beyond traditional North-South exchanges and engage emerging players as equal partners

## **Provide independent, authoritative advice and stimulate dialogue between stakeholders (Public, Private and Civil Society):**

-Work to improve public trust in science  
-Mobilize science for social purpose, anchored in ethical approaches to the conduct of science

- Africa must become a producer of knowledge, not just a consumer
- Africans must be activists - not pacifists - in generating ideas, spurring research, mobilizing scientific knowledge for socially-relevant developmental purposes
- Success of CAADP can be replicated in STEM
  - 17 countries have met or surpassed target of 6 percent agricultural growth
  - 40 countries have received support to advance CAADP goals
  - CAADP has enabled systems for African leadership, collective action and peer review.
- In all of these areas, women can and must become the drivers of change!
- Development takes time and we cannot afford to fail one more generation!

*"The application of science and technology is fundamental, and indeed indispensable, to the social and economic transformation of our countries... We in Africa must either begin to build up our scientific and technological training capabilities or remain an impoverished appendage to the global economy. There is no reason to believe that Africa cannot achieve what others have achieved in these fields."*

XH.E.'Paul'Kagame,'President'of' Rwanda"

