

Combating Soil Degradation and Desertification by Rehabilitation of Ecosystem Services of Soil

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The Problem

Soil Degradation, Desertification

Non-adapted land-use, aggravated by climate change



Soil Degradation, Desertification

Loss of Ecosystem Services,
result of ecosystem interactions (abiotic-biotic system)

- Soil fertility (**food**)
- Biogenic soil stabilization (**erosion control**)
- Water retention capacity of soil (**water**)
- Filter function of soil (water)
- Carbon sequestration (**climate**)
-



The Problem

Lack of research-based learning for professionalization

- Long-term student research projects in curricula
- Interdisciplinarity in teaching and research



Basic Unit

Soil science, Soil Ecology



- Bag of **degradable fabric** filled with bioactivated substrate, seed and amendments for the improvement of water and nutrient conditions.
- Initial protection against erosion.
- Scale ~ 0,5 m.

Composite Unit (any shape)

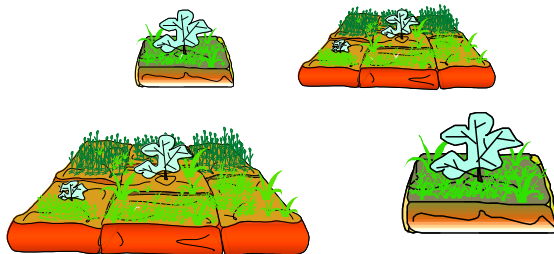
Applied Botany
Ecology



- Island of any shape composed of a number of bags with **biotic and abiotic diversity**.
- Scatter plot, water and particle collector, safe-sites for colonizers, rather autonomous unit.
- Scale ~ 1 - 5 m.

Mosaic or Contours

Monitoring, Modelling, GIS



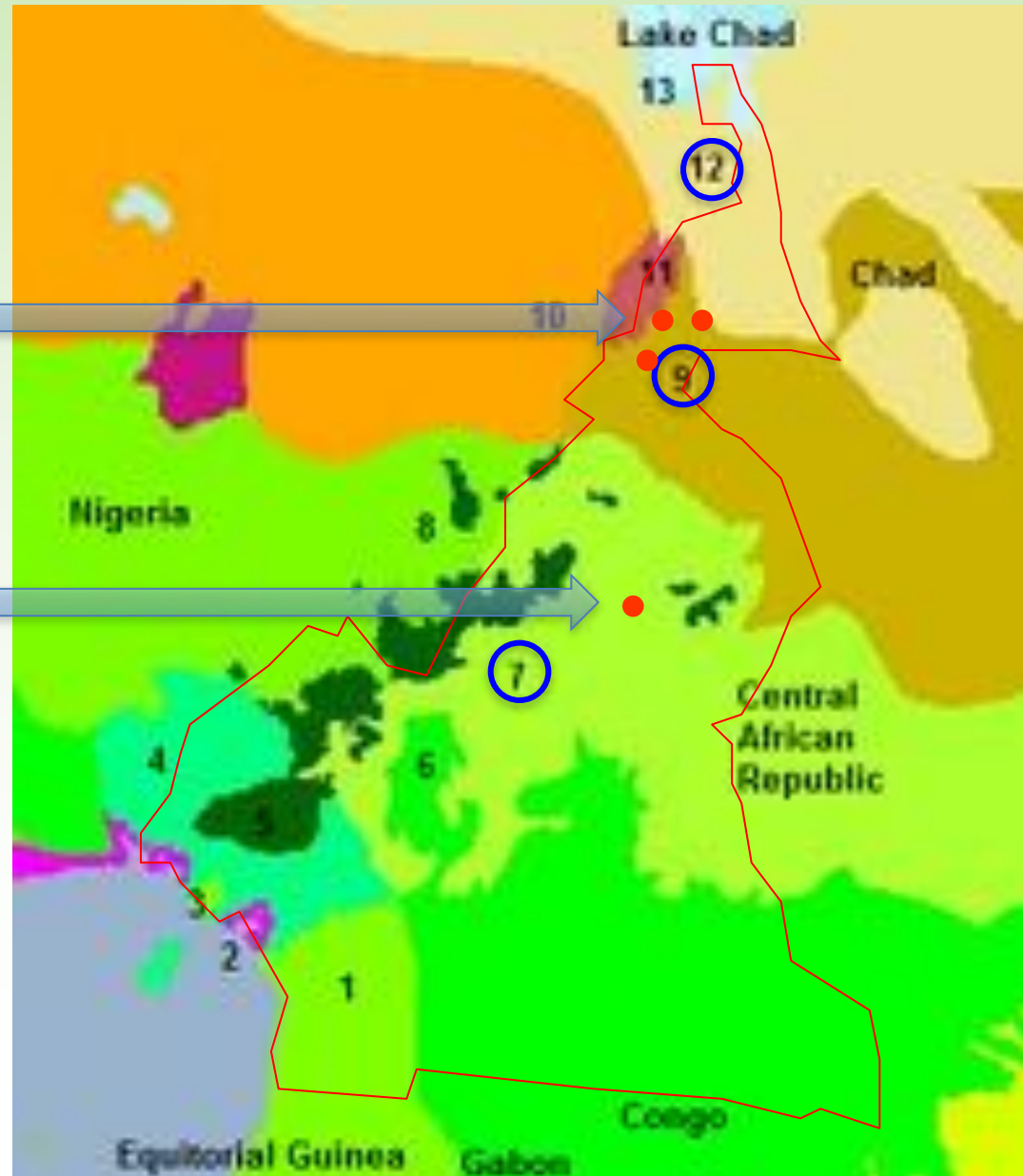
- Mosaic or other structures composed of islands and connectors.
- Development from mosaic to network.
- Scale > 20 m.

The Cameroon Sites

Maroua
(Salak, Boula, Gawel)

Ngaoundéré

- 7 Northern Congolian forest-savanna mosaic
- 9 East Sudanian savanna
- 12 Sahelian Acacia savanna



ReviTec Cameroon: sites, effects, sustainability

- Site preparation, substrates
- Accelerated succession, longer term development
- Productivity: Fodder
- Softening of hard surface
- Trees
- Water retention
- Soil biodiversity
- Monitoring (control of success)
- Sustainability
- FoLP-i



ReviTec Ngaoundéré: Implementation, March-April 2012



ReviTec substrates and seeds, Gawel June 2014



Loamy sand



Charcoal



Ground cow dung



EM Bokashi



Bracharia seeds



Stylosanthes seeds



Accelerated Succession

Apr 2012, 0 m



July 2012, 4 m



Nov 2013, 18 m



Nov 2014, 30 m



ReviTec Gawel



Succession ReviTec Gawel

ReviTec Gawel Far North, rainy season Aug 2014 (3 m after implementation)



ReviTec islands are greening even on hardé, unvegetated for many years

Succession ReviTec Bremen



July 2017, 7 years



Long Term Improvement: Salak



8.12.13, water run-off



3.2.15, water run-off closed:
effect of ReviTec structures

Fodder, Sept. 2012 (Salak implementation June 2012)



Prolongation of Period of Greening

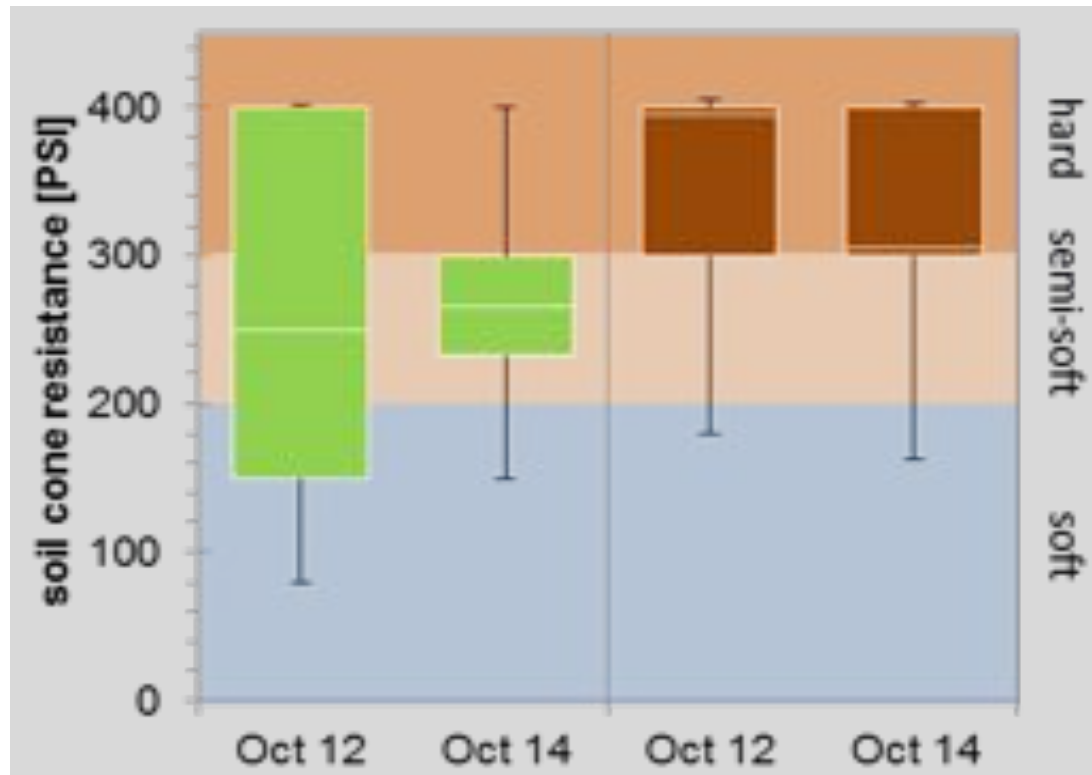


Salak, Dec 4, 2012, beginning of dry season

Softening Hardé Surface

Softened soil crust under
ReviTec structures

High resistance of
untreated soil



Boula Mokong 2012, 2014

Spiralling root from first contact with hard soil surface



Mahamat Alifa, MSc thesis 2014: Ability of Revitec structures to soften the hardness in selected “hardé” vertisol of North Cameroon

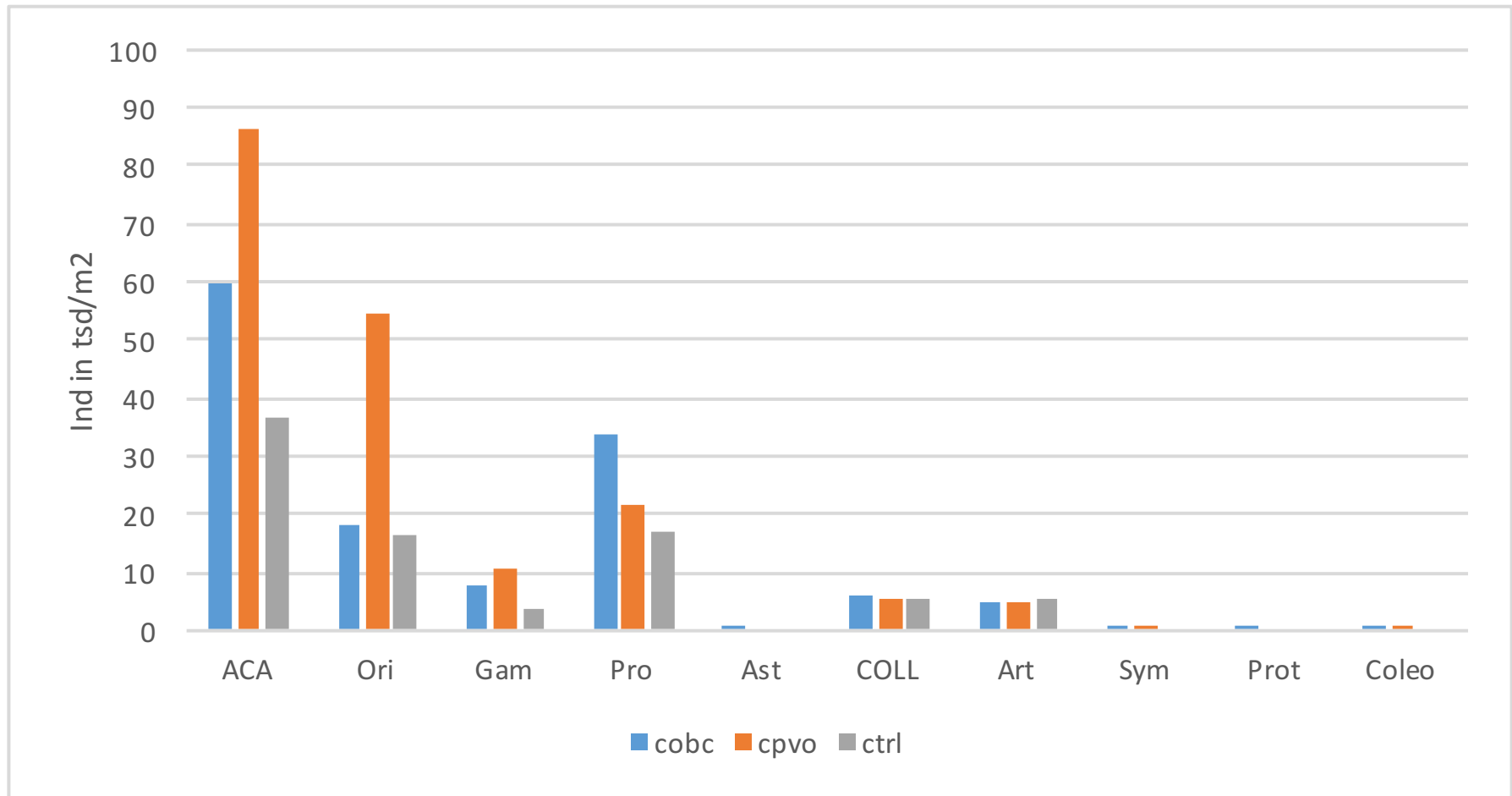
Tree Growth 2 years (Gawel June 2016)



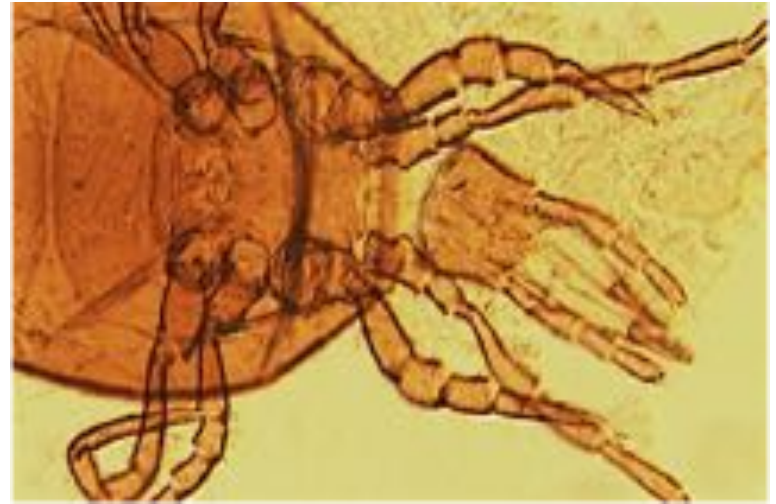
Surface Water Harvesting, Strong Growth (Fodder)



Unexpected Soil Biodiversity (interactions for ecosystem services)



New Species: Gamasina



PhD Dieudonné Danra Djackba, Lea Rosine Djoussi Ndé

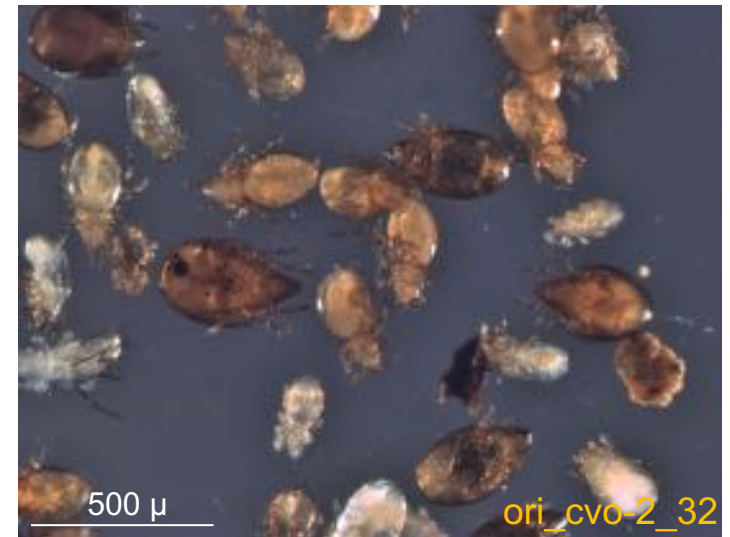
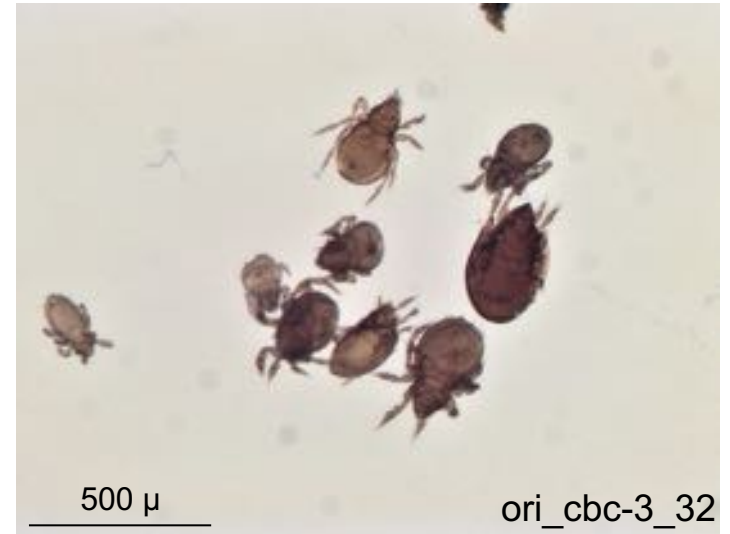




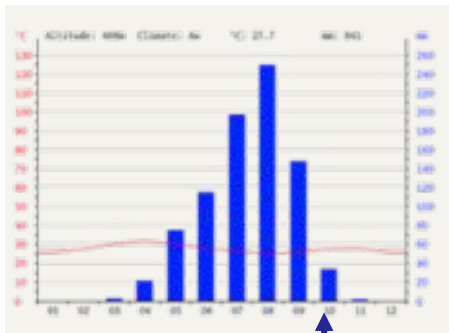
New Species: Oribatids

New data on oribatid mites (Acari, Oribatida) of Cameroon: results of the Joint German-Cameroonian scientific research (April 2016)
Ermilov & Koehler, 2018

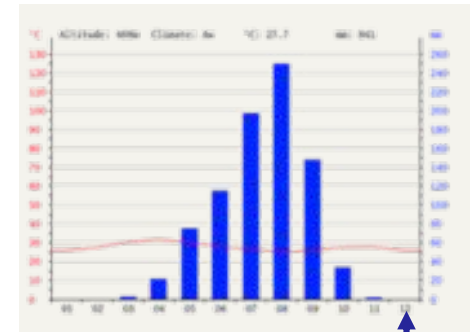
Monitoring, bioindication involvement of Universities, rural communities



Monitoring, remote sensing (google earth)



Gawel 18.10.2007



Gawel 06.12.2016



Monitoring wireless underground sensor networks

Monitoring Revitec Sites



- Soil moisture
- Temperature
- Rain quantity
- Remote areas
- ...

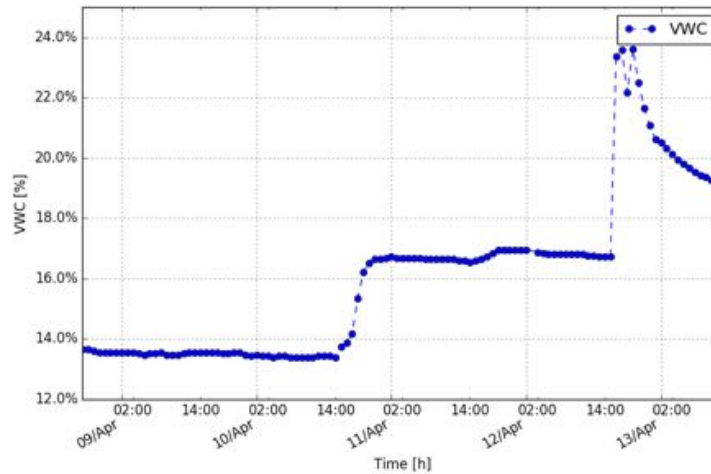


New sensing hardware

- Wireless communication
- Buried underground
- Autonomous and robust
- Long lifetime (5+ years expected)

Monitoring wireless underground sensor networks

Field Test in Ngaoundéré, April 2016



Economy

Social system

Sustainable **ReviTec**[®]

Science

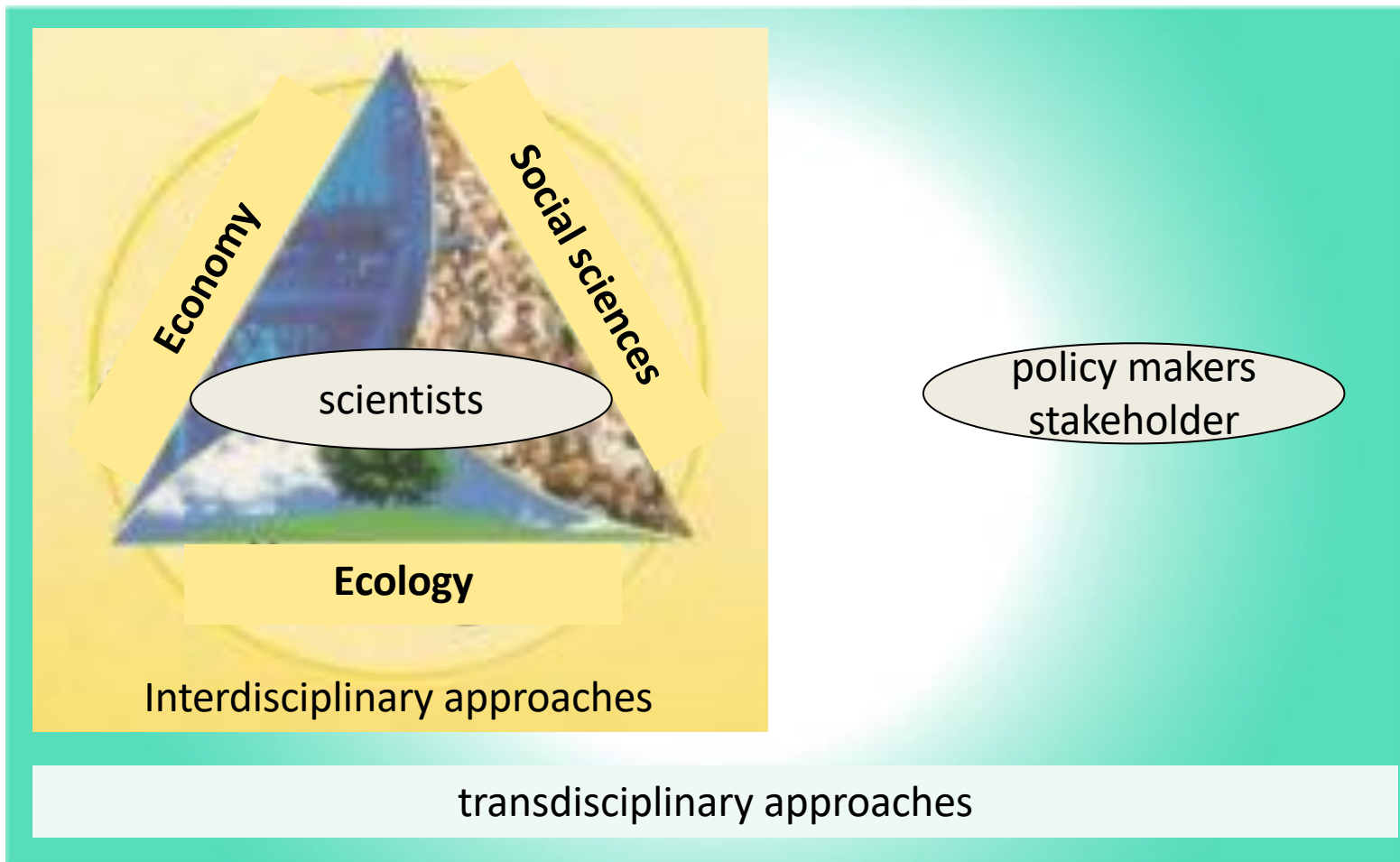
Relations



ReviTec[®] interdisciplinarity



ReviTec[®] transdisciplinarity



Economy

Tableau 2 : Récapitulatif du coût en pourcentage/ha		
	FCFA	(%)
Matériaux	Coût total	Pourcentage
Sacs de jute biodégradables	5.890.000	15,5%
Matrice minérale (sable riche en terreau) 20 kg par sac	620.000	1,6%
Composte (EM-BC bokashi) 5 kg par sac	5.000.000	13,1%
Biochar (0,7 kg par sac) (kg)	1.085.000	2,9%
Mycorrhiza, 0,5 kg par sac (kg)	775.000	2,0%
Semences, 150 g par sac (kg)	930.000	2,4%
Plants inoculés aux mycorrhyses et transport	3.487.500	9,2%
Transport	2.015.000	5,3%
Clôtures (km)	7.250.000	19,1%
Préparation du site par ha (substrat, trouaison, plantage)	7.750.000	20,4%
Sécurité du site (3 années)	3.240.000	8,5%
Total général	38.042.500	100,0%
Total en Euro	57.992 €	
Coût par ha	1.871 €	



Economy: cost vs benefits

tree survival & production, fodder, water harvesting



Economy: income incentives

Carbon sequestration, compost, biochar, soil amendments, tree nursery (mycorrhiza!), bags, monitoring, firewood, rural development ...



Enterprise creation

FoLPI: Forests, Landscapes and People International (FoLPI), Yaoundé

German team

Support of enterprise creation, project acquisition and implementation

FoLPI

- Enterprise creation & organisation
- Project acquisition & implementation
- Dissemination

KeKo

- Provide scientific knowledge, capacity building
- Share expertise and experience

greendesert

Support Cameroonain team:

- Propose enterprise structure
- Support with business plan and financial plan
- Marketing

Effective Cooperation

University Partnership Bremen-Ngaoundéré

DAAD-SRP, DAAD-DIES, BMBF

ReviTec sites for demonstration, research and capacity building

Ngaoundéré, Maroua

Uni. Ngaoundéré, GIZ Yaoundé / Maroua

Memorandum of Cooperation

GIZ-Maroua, IRAD

Materials

UTAMTSI – GIC-Sondason (Fondjomekwet), Prof. Ngakou

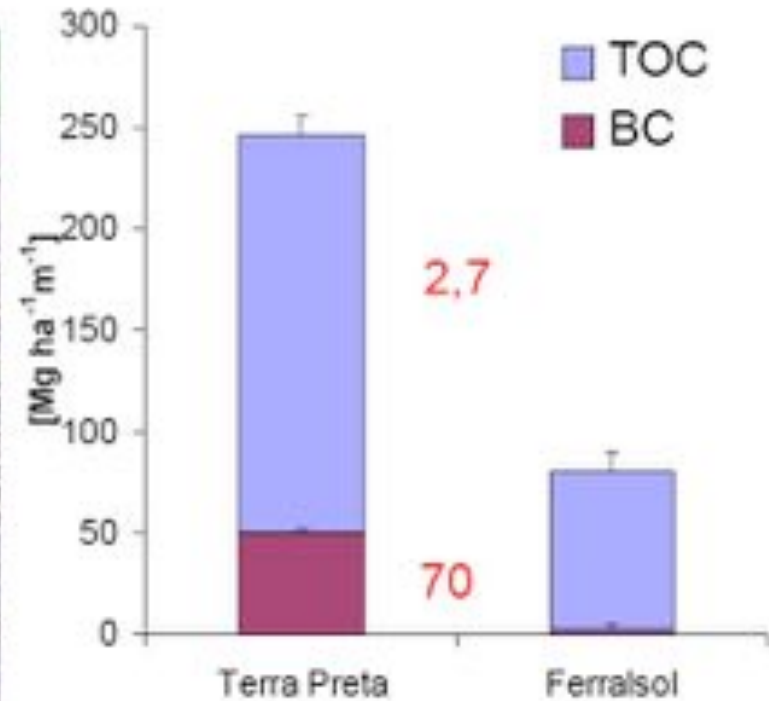
Prof. Dr. Albert Ngakou, Prof. Dr. Elias Nukenine, Okenye Mambo, Enviroprotect Maroua,

Prof. Dr. Anna Föster, Raimund Kesel, Dr. Thomas Buse, Senckenberg Museum für

Naturkunde Görlitz; MSc, PhD students BRE, NGA



The mystery of Terra Preta



- ⇒ *Bio-Char*
- ⇒ *Organische Abfälle*
- ⇒ *Knochen*
- ⇒ *Exkremente*

Glaser et al. (2001)

Soil Mesofauna Extraction



Tullgren-Extraktor, Neuentwicklung in Kamerun