UN expert group meeting on "Sustainable land management and agricultural practices in Africa:

Bridging the gap between research and farmers"

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‘Agro-bio-climatic models: Towards a generic Land Management Typology’

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Existing barriers to implementing improved SLM

- “Accumulated knowledge …has not been systematically aggregated and fed into models with predictive abilities
- We are still unable to use the prevailing conditions to assess which practices would be most successful.
- The large number and variation of agro-climatic factors affect the success of a particular practice in any specific area
- This creates the need for extensive data collection and seriously limits inference for other locations;
- Combined variation in biophysical and socioeconomic factors creates barriers to inference and replicability”.

Key questions

- **How can research be applied to scale up (or down) promising Sustainable Land Management technologies?**

- **What procedures can be used to improve inference and replicability within and between countries or Agro-Ecological Zones (AEZs)?**

Farming systems and land management typologies

- **Current typologies are largely intuitive and idiosyncratic with limited capacity for inference and replicability** (*cf*. Dickson *et al*., 2001)
- **A rule-based grammar based on standardized agro-bioclimatic criteria provides one uniform method of classification and inference**

An LMT grammar

- **Attributes and their elements are combined according to a given rule set** (hyperlink)
- **Inter-element ‘transformation costs’ are constructed based on known or estimated field conditions, literature and individual experience** (hyperlink)
- **A symetric distance matrix is constructed from the above**

Generic components for a Land Management Typology (LMT)

- Attribute classes (elements)
  - Farming system (15)
  - Area & terrain (7)
  - Growth environment (modified AEZs) (9)
  - Inputs (10)
  - Outputs (12)
- **Total 5 classes , 53 elements**

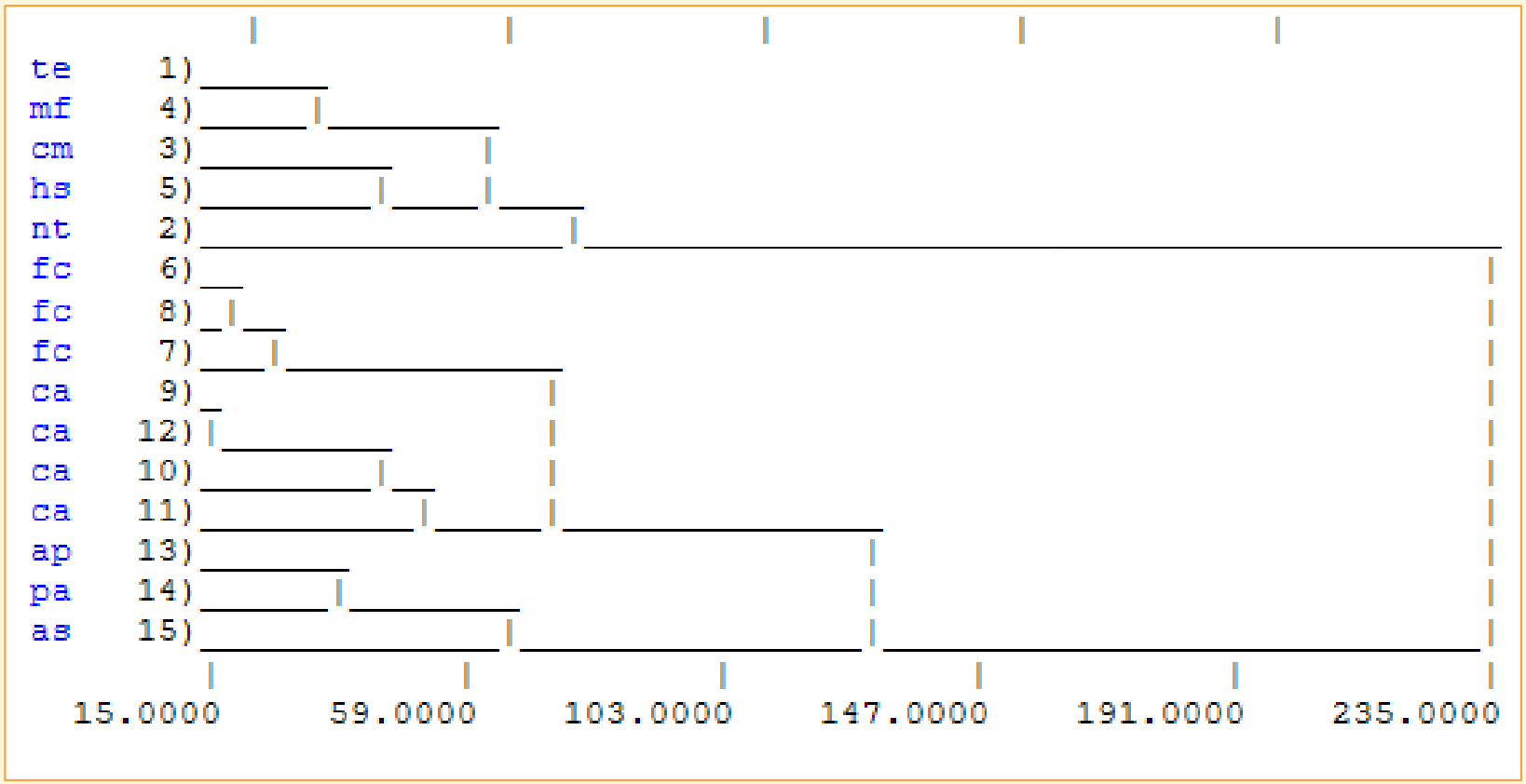
Table of elements (hyperlink)

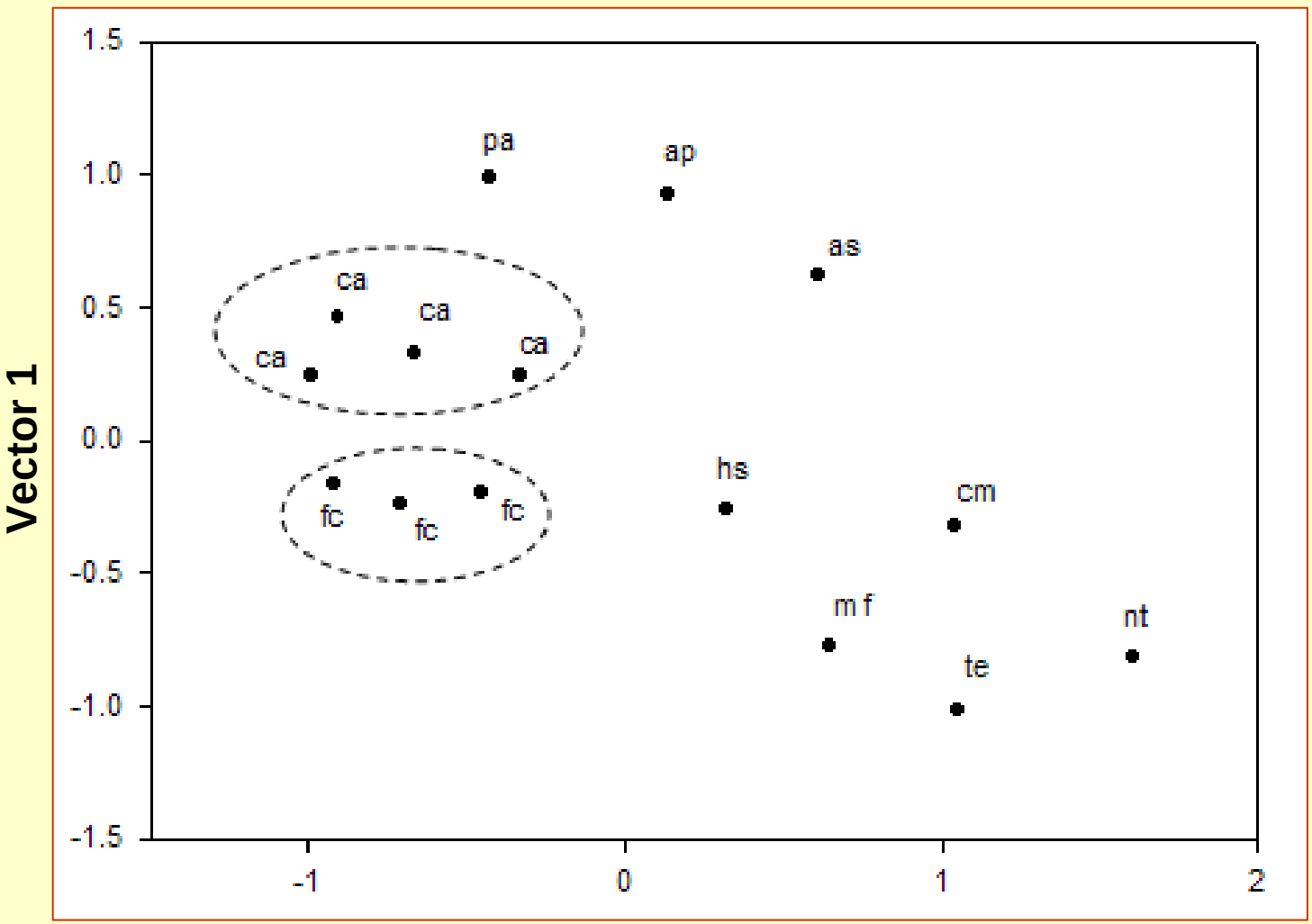
Example of a fully described LMT

Agropastoral farming system FS

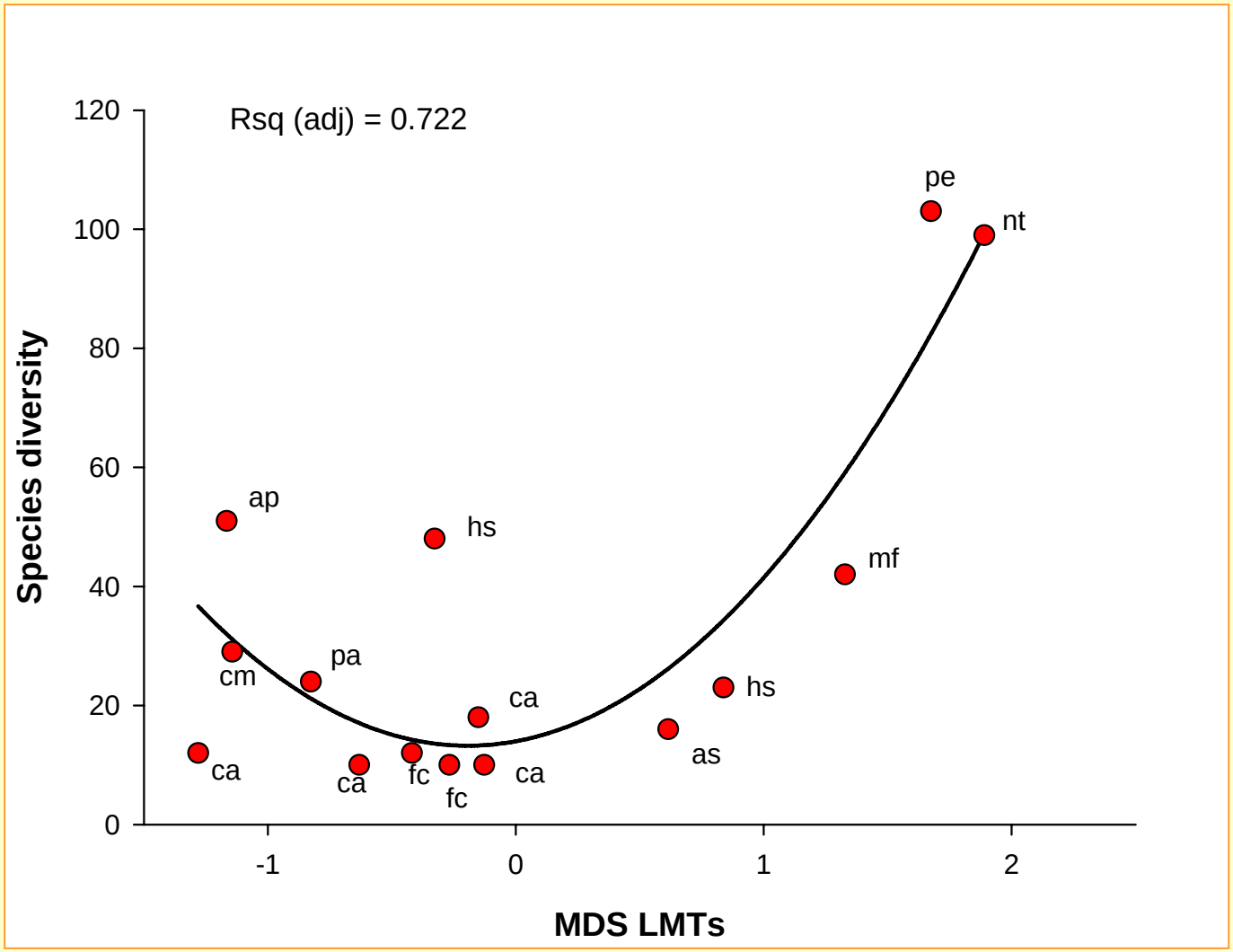
- (ap); 10-100 ha (hc); plain (pl); semi-arid (sa); megatherm (mg); rainfed (rf); INM adding (ad); INM saving (sv); organic fertilizer (or); low N stocks (lo); grain (sorghum, maize) (gr); fruit (egusi melon) (fr); vegetables (vg); meat (fo); fur & hides (wh); fertilizer (fz); other animal (oa)
- (Bafia, SubSahelian Cameroon) 51 species 37 Plant Functional Types
- [LMT = ap hc pl sa mg rf ad sv or lo gr fr vg fo wh fz oa]

Dendrogram based on similarity matrix derived from the LMT grammar





Multidimensional scaling of best two axes from similarity matrix derived from LMT grammar. Shows interpretable clustering of LMTs and provides a basis for quantitative comparison within and between types.



Single axis solution score (MDS) of LMT relationship with plant species diversity (richness per 200m^2 transect)

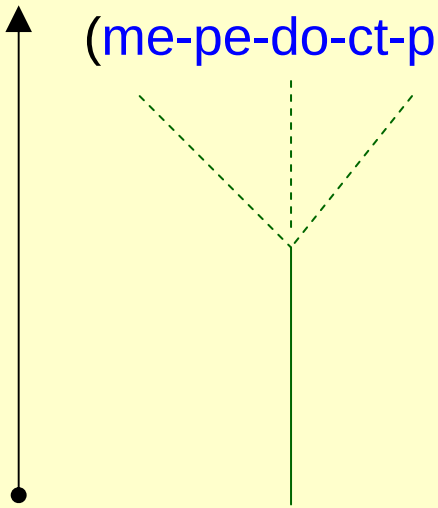
Compatibility with other grammar-based models

- Standardized baseline surveys greatly facilitate the collection, analysis and comparative assessment of LMTs
- In the same way, gradient-based, rapid resource appraisal of vegetative cover (VegClass) provides uniform comparative assessment within and between countries.
- Metric linkages between VegClass and LMT are possible

VegClass, Public domain, user-friendly software for data entry and meta-analysis; integrated with field proforma to support rapid vegetation survey

Combining functional traits to describe a single plant individual (VegClass grammar))

Plant Functional Type



Plant Functional Elements

Example of PFE combination

me = mesophyll leaf size class

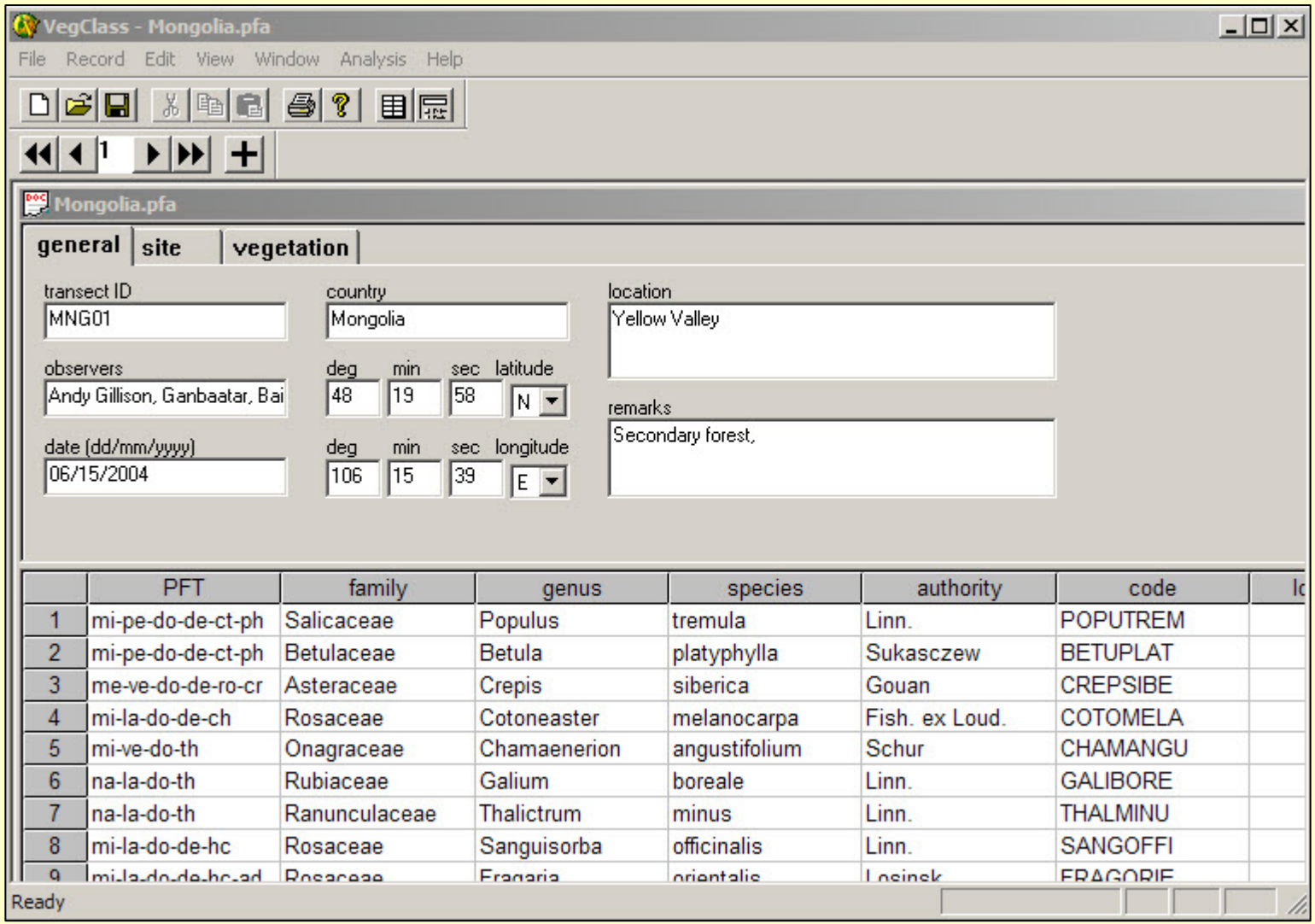
pe = pendulous leaf inclination

do = dorsiventral leaf

ct = green cortex (photosynthetic stem)

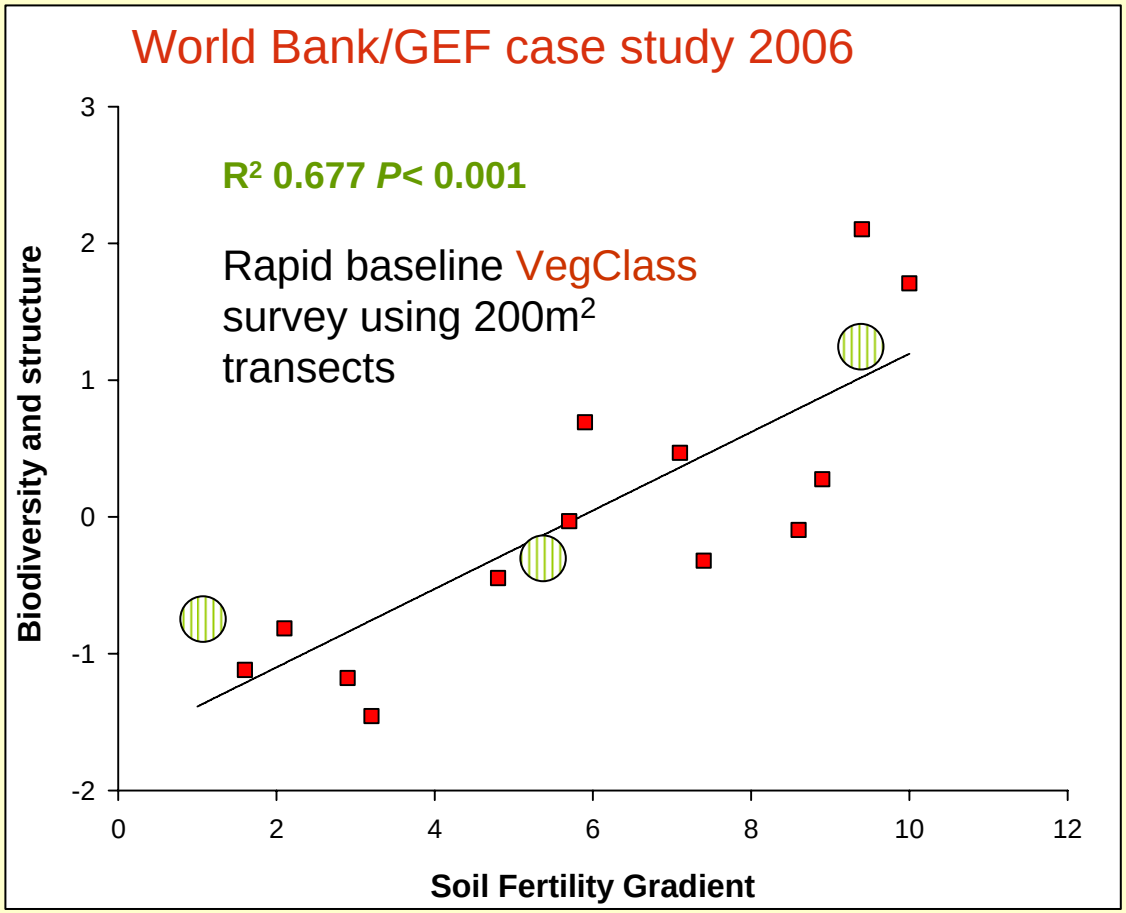
ph = phanerophyte (perennial woody plant > 2m tall)

Adaptive PFTs are constructed from 36 generic PFEs according to a specific rule set. This system can be applied to all terrestrial vegetation



Sample page from VegClass showing PFT and species listings

Biodiversity and vegetation structure can be readily used to estimate soil fertility in the lower Zambezi basin, Mozambique – Potential linkages here with LMT grammar



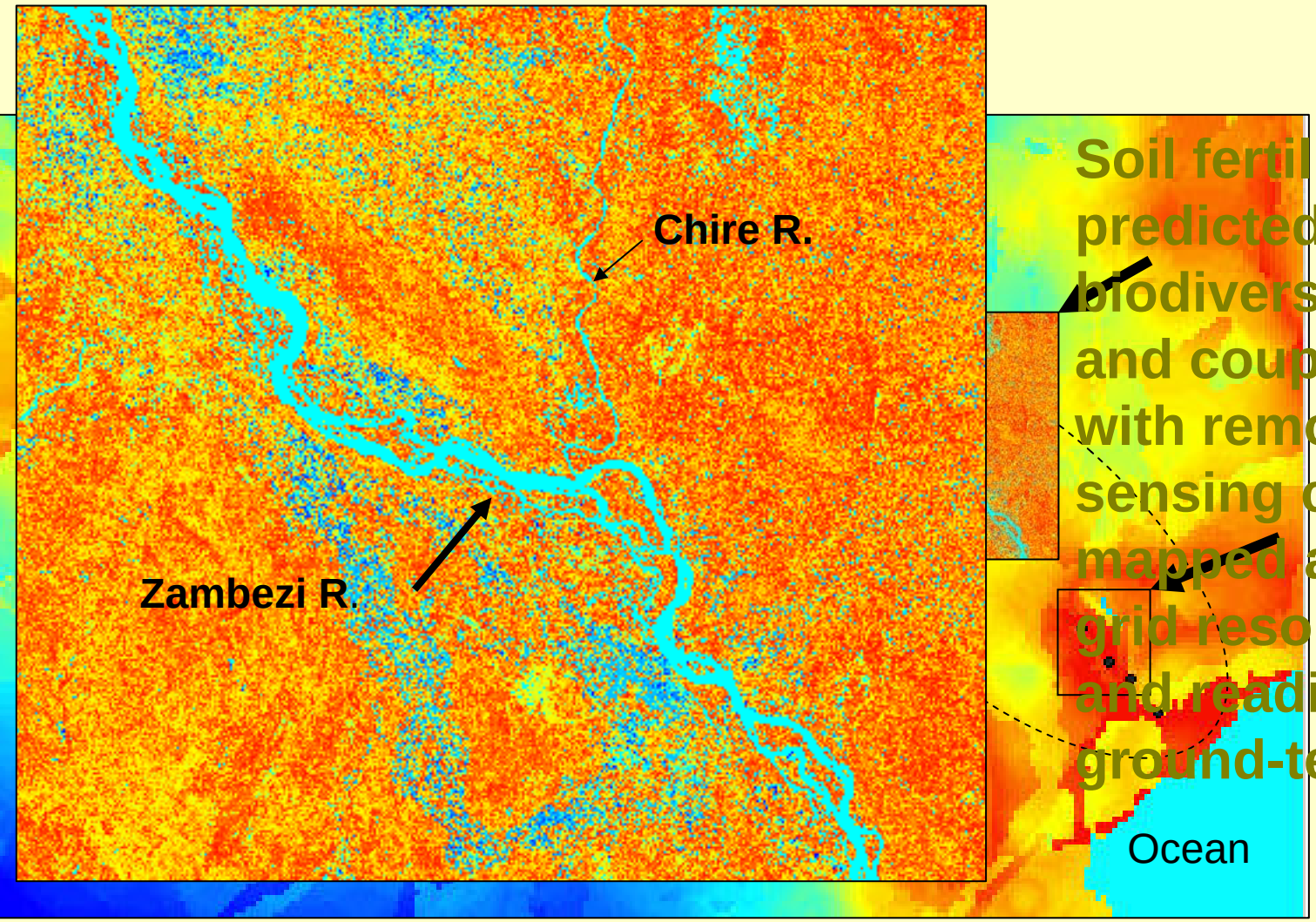
Potential agric. productivity

High (SFG8.9)

Medium (SFG5.6)

Low (SFG1.0)

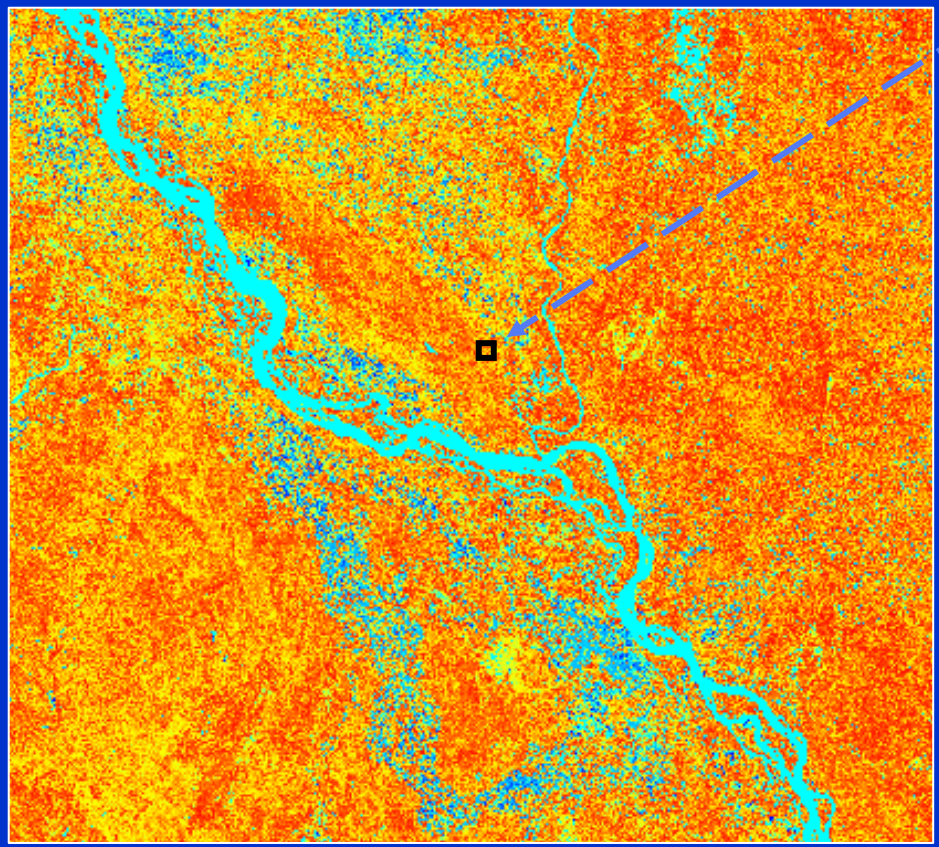
Soil fertility can be linked with biodiversity, LMT and remote sensing



Soil fertility predicted from biodiversity and coupled with remote sensing can be mapped at 30m grid resolution and readily ground-tested

Fertility high → → → → Low

Information on soil fertility, plant biodiversity, remotely sensed and other site values can be extracted from spatially-referenced data layers (also LMT)



Cell at 17.262S, 34.999E elevn 34m

Attribute	Value
Photosynthetic reflectance	605
Non-photosyn. reflectance	266
Bare ground reflectance	93
Soil fertility index	8.6
Plant species richness	19
Plant functional type richness	16
Plant functional complexity	116
Mean canopy height (m)	5
Basal area (m^2 ha^{-1})	1
Litter depth (cm)	0.2

Transect # 14 (40x5m) maize, rice

LMT: fc ha pl ar mg ud rf nl or lo gr fr fz

So…What?

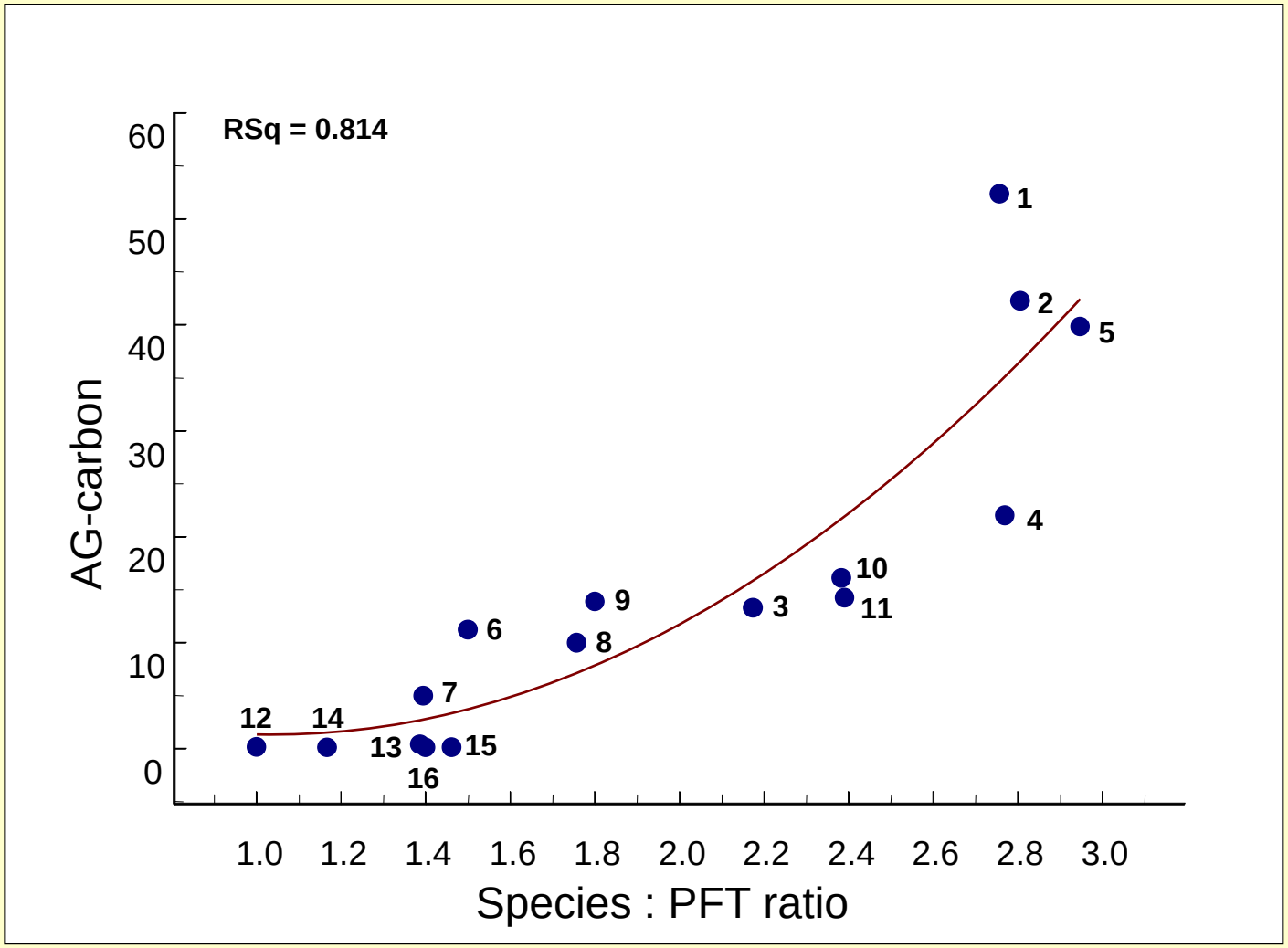
- **Socioeconomic (household valuations) in SE Asia indicate close ties with biodiversity and vegetation structure (NPV, return to land, labour etc.)…**unpublished.
- **Rapid field assessment of agricultural productivity in the lower Zambezi basin also indicates statistically significant connections with soil fertility and biodiversity**
- **An LMT grammar may provide a user-friendly metric for constructing predictive linkages with sociometric indices.**

Conclusions

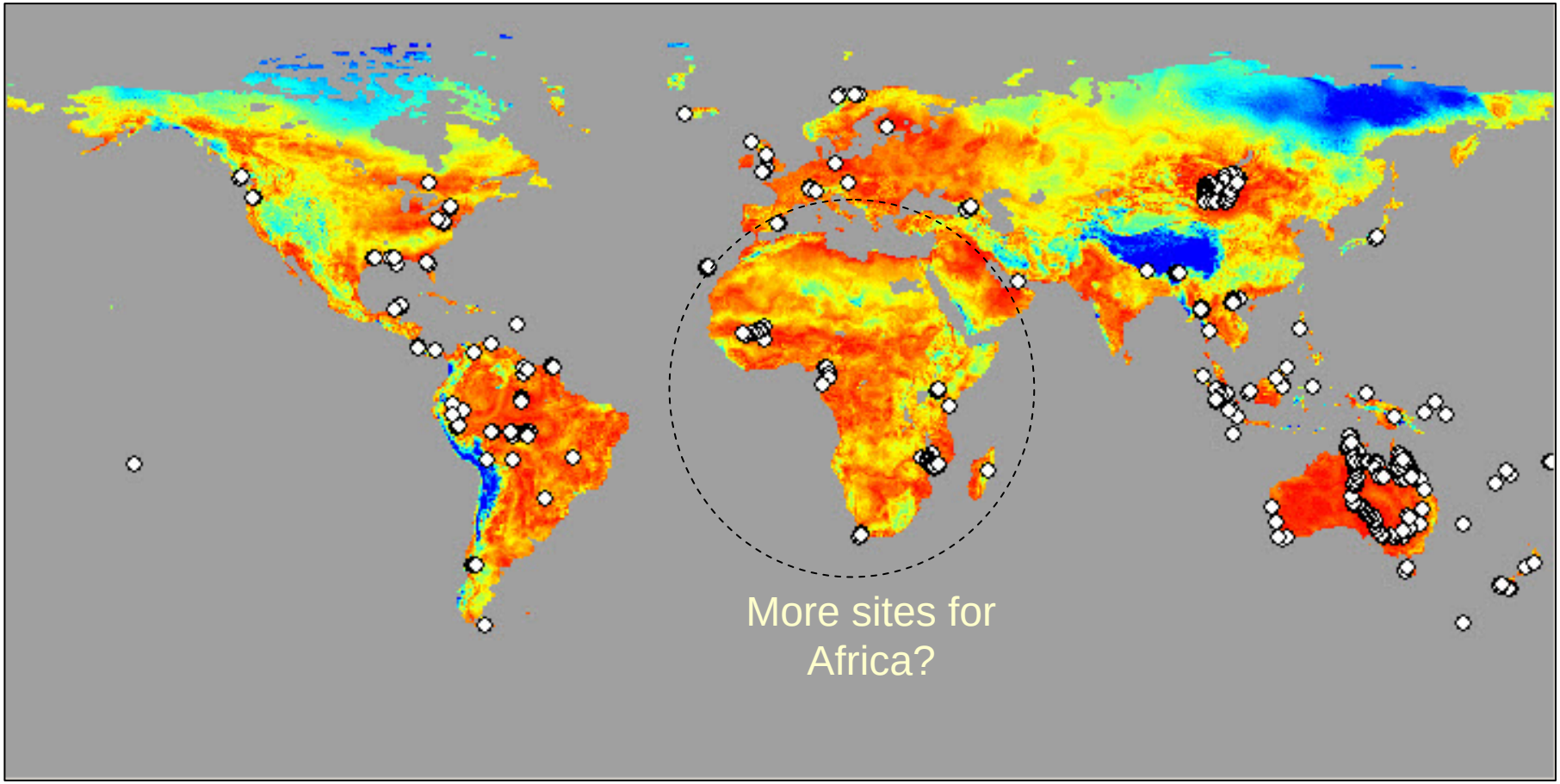
- A generic approach to land management typology can facilitate uniform, comparative assessment of farming systems and sustainable management practices within and between countries and AEZs
- When combined with other geospatial baseline data (e.g. biodiversity, soil nutrients) a generic LMT may be used to model (map and test) outcomes for planning and adaptive management
- The methodology has potential for integrated, rapid natural resource appraisal
- Promising socioeconomic links with LMT remain to be tested


Thankyou

Above-ground carbon and species:PFT ratio along a gradient of Land Use Types, Sumatra, Indonesia



Gillison (unpubl.)



DOMAIN similarity levels

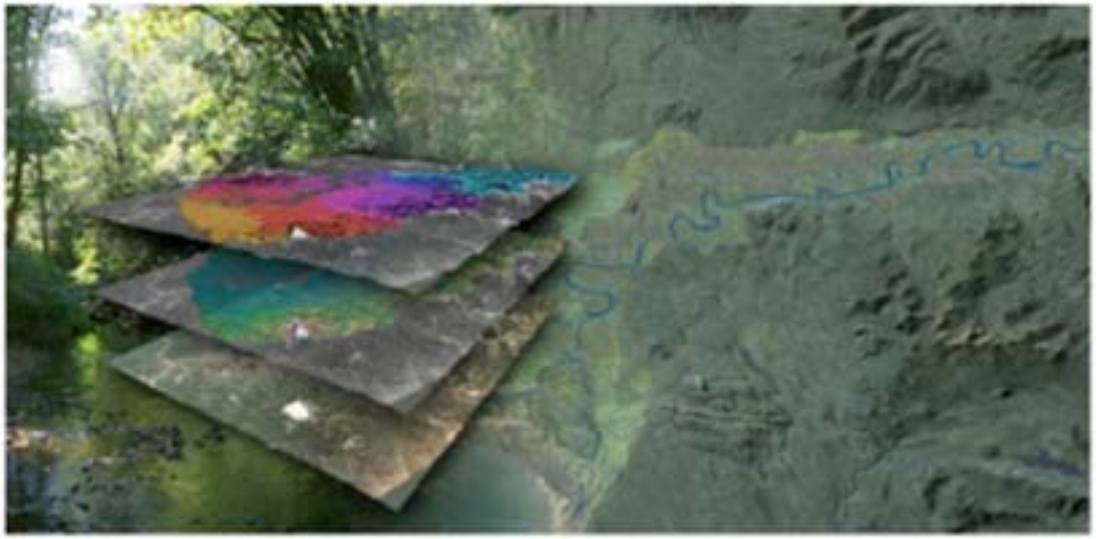
- > 99%
- 95-9
- 92-94
- 88-92
- < 88
- no value

Comparing African biophysical data at global scale.

Uniform methods of data collection provide ready comparison between global sites. DOMAIN similarity mapping of global subset of 1031 VegClass transect sites based on Elevation, Total annual precipitation, Minimum temperature of coldest month, Annual total actual evapotranspiration. (Approx. 1800 transects recorded as at 25 Jan 2009)

DrukDIF Version 0

TOP STORY



Bhutan Today and Tomorrow

Chiog ***Geog*** ***Watershed*** ***Country*** ***Region***

MISSION

...to provide an integrating, cross-sector platform for the resources of Bhutan

NEWS & ANNOUNCEMENTS

QUICK LINKS

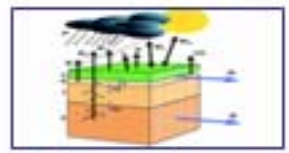
Physical Template
- Topography
- Soils
- River Networks

Landcover
- Classes
- Seasonality
- Attributes
- Change

Landuse
- Agriculture
- Forestry
- Infrastructure
- Ecotourism

Biodiversity
- Fauna
- Flora
- Ecosystem

Water Resources
- Climate
- Hydrology
- Flood Warning
- Hydropower
- Water Quality



Scenarios
- Water Distributions
- Climate Change
- Sediments
- Agric. Production
- Species Distributions