KStream 1

Understanding human-induced degradation of dryland agricultural and natural ecosystems

‘Assessment’

The Big Questions

- What is the current spatial distribution of land degradation problems in the world's drylands?
- What are the conditions leading to desertification and how will they play out over the next 50 years?
- How can we identify ecosystems at early stages of degradation?
- What are the management principles to prevent shifts to degraded ecosystems or their rehabilitation?
- How can dryland ecosystem services be valued so that trade-offs can be evaluated and incorporated into development decision-making processes at different scales?

Departure point

Principal problem

- Policy and development plans not sufficiently based on rigorous scientific assessment

Why?

- Lack of systematic on-going data collection has lead to weak evidence-base; controversy prevents clear policy formulation; lack of measurable objectives

Overarching need:

- to develop operational measurement and analytical systems that can actively and iteratively guide policy and plans.

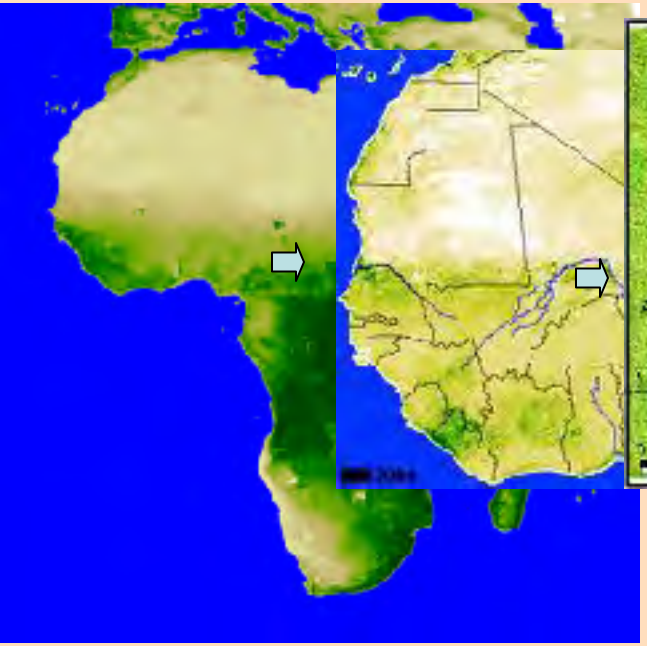
CGIAR contribution
What's new?

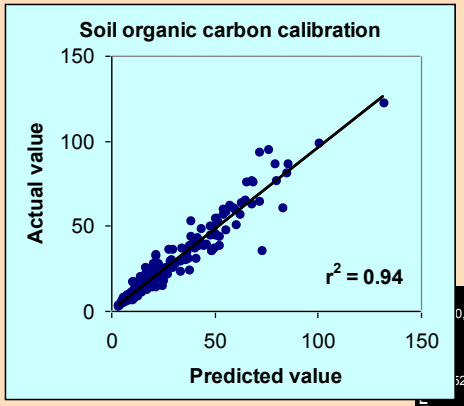
- Land health surveillance methods, which are modelled on epidemiological approaches used in the public health sector - proven
- Surveillance directly links ongoing systematic data collection to decision making - science used to inform and decisions and enable learning on consequences
- Employs new opportunities in remote sensing and hierarchical statistical methods for stochastic systems; implemented in hierarchical framework; linked to ground data; multidisciplinary
- Strong capacity building emphasis - learn by doing

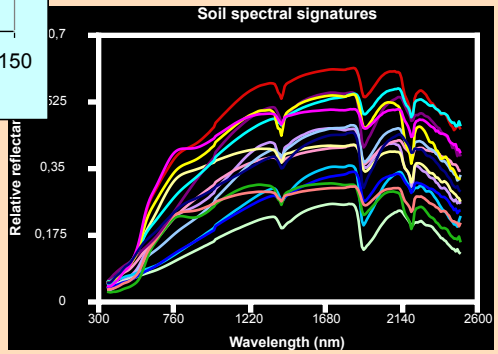
Impacts

- Resources for land health care allocated to priority areas and problems, and cost-effective solutions.
- Government can set measurable targets for sustainable land management, and monitor progress towards achieving them.
- Preventative actions implemented in time to avoid land degradation that is irreversible or expensive to reverse.
- Evaluation of outcomes of land health policies and programmes.
- Effective learning from intervention actions used to improve intervention programmes.

Land Degradation Surveillance





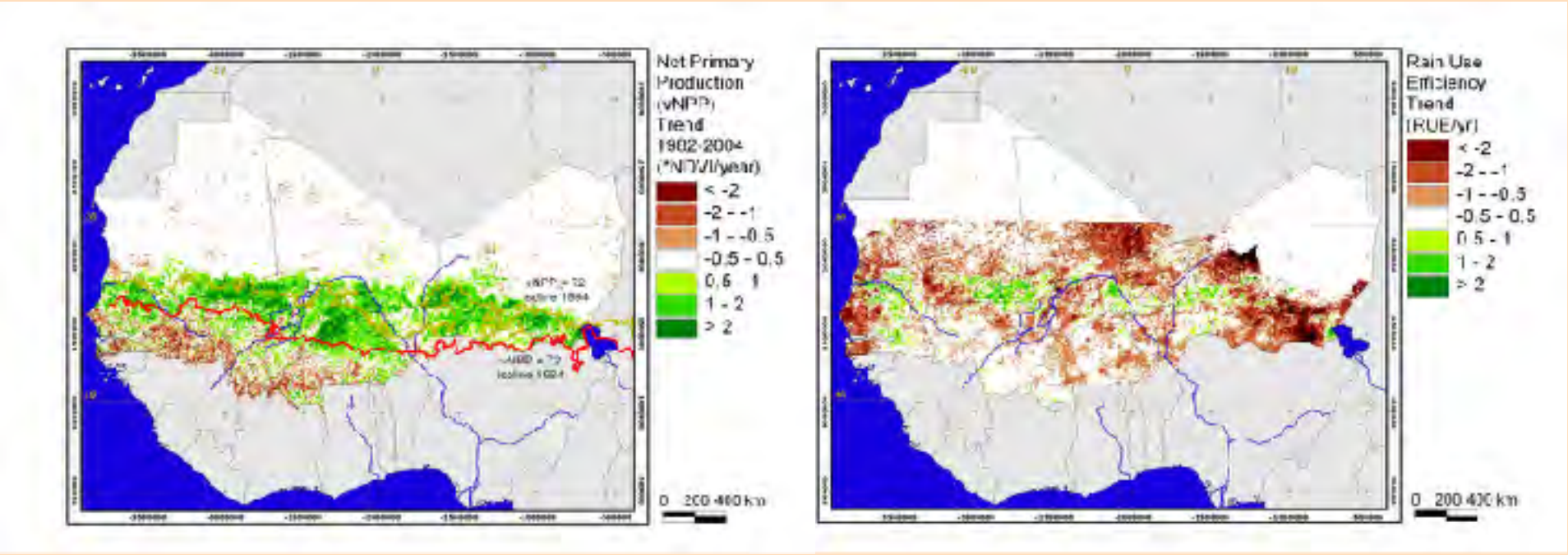


Surveillance system outputs

- Early warning of land degradation to direct preventative action
- Prevalence of different types of land degradation (what problems, where, how serious; baseline)
- Risk factors for land degradation (how much is likelihood of land degradation increased in presence of management practices, behaviours, policies)
- Assess impact of interventions (policies, projects, specific management interventions)

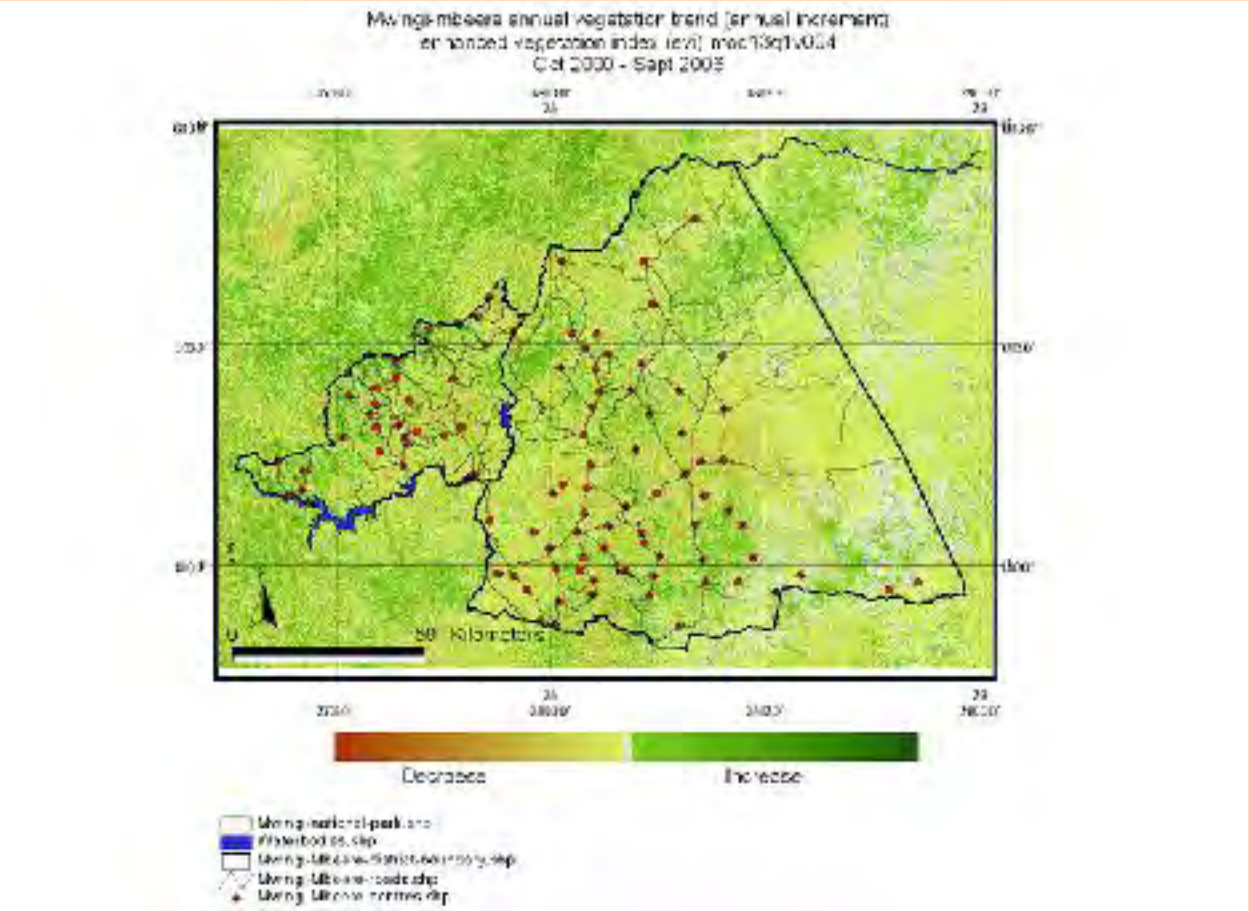
Hierarchical multiscale assessment

Regional analysis of vegetation and rainfall trends in the Sahel 1982 -2004

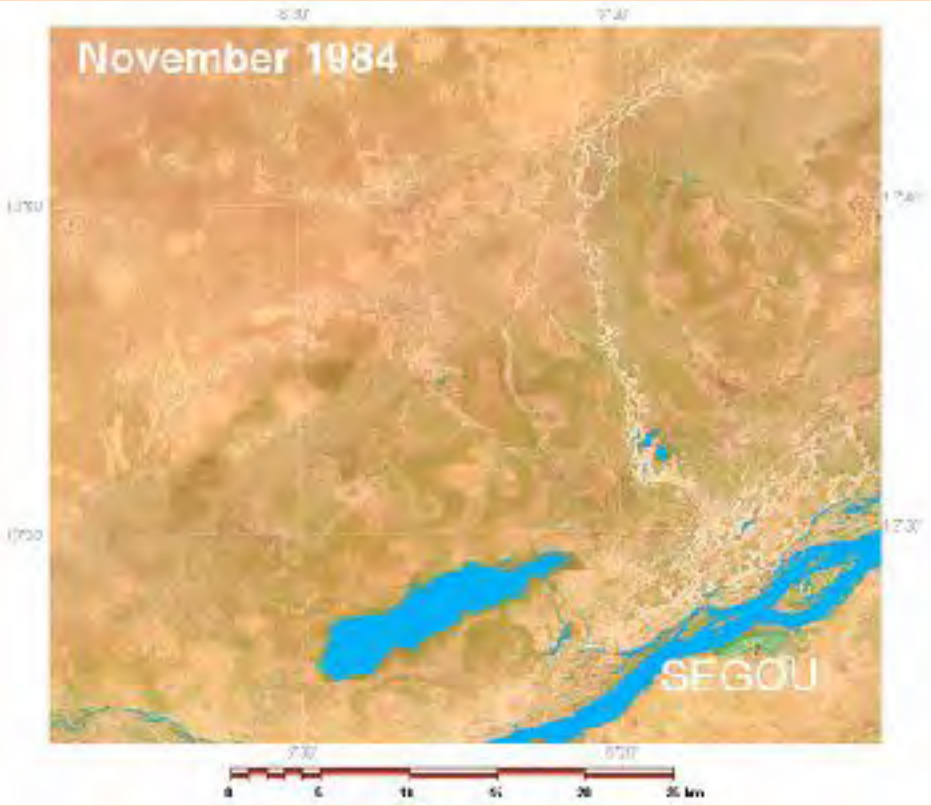


Hierarchical multiscale assessment

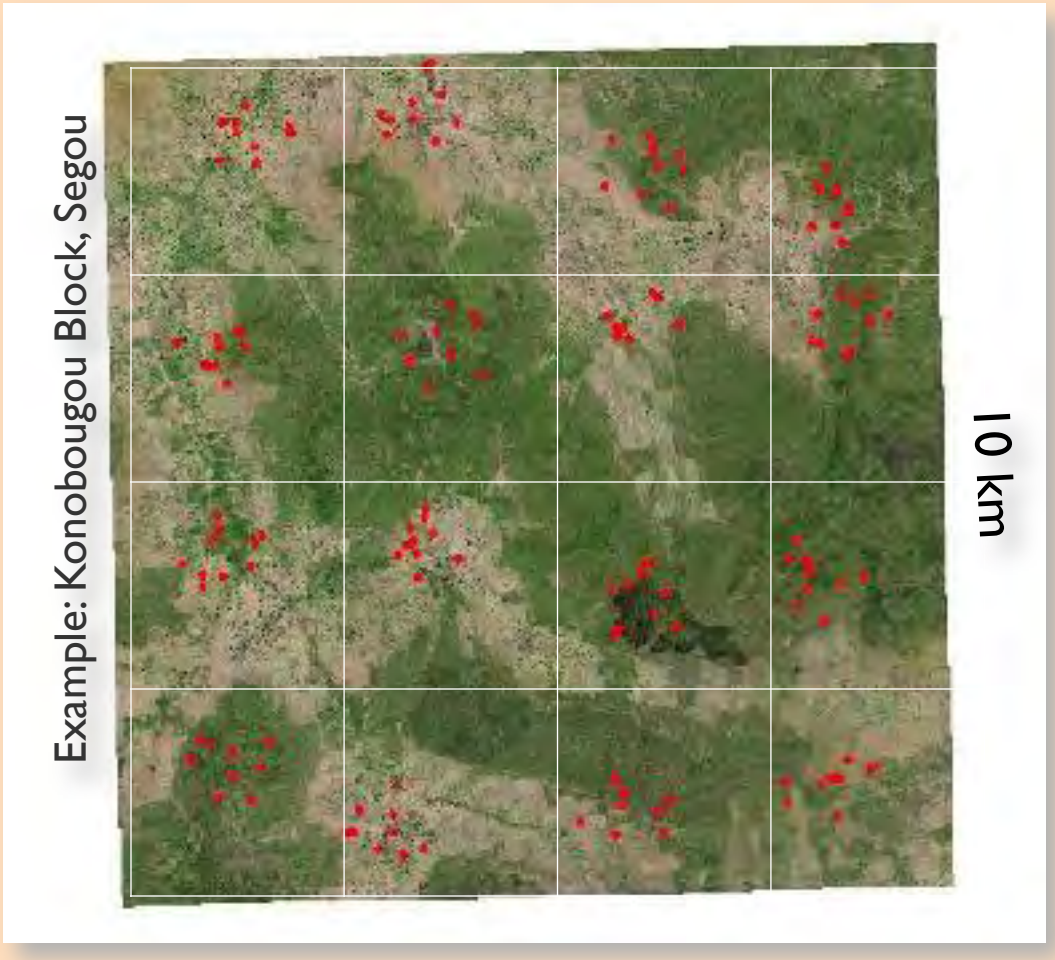
District level analysis of vegetation trends in Kenya 2000 –2006 (MODIS EVI)



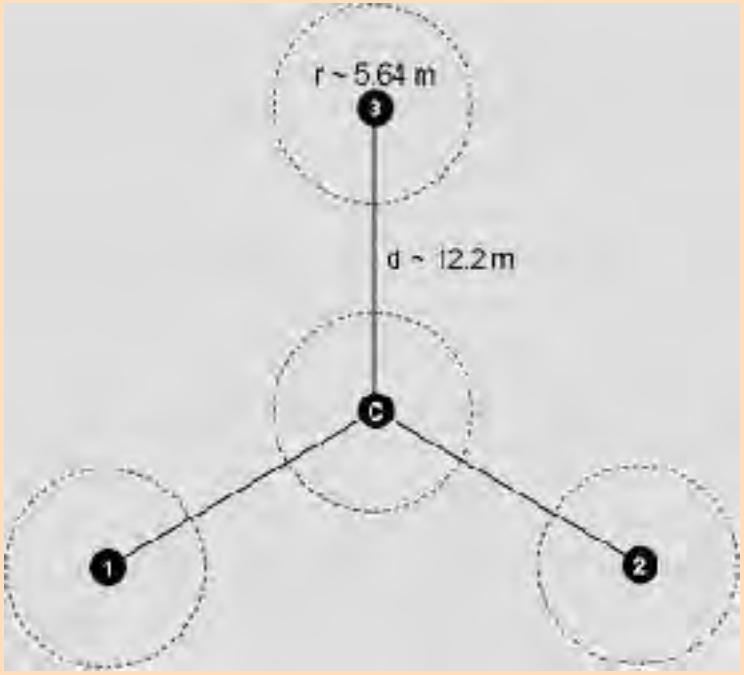
Landsat time series



Sentinel site of 10 x 10 km with ground sampling points

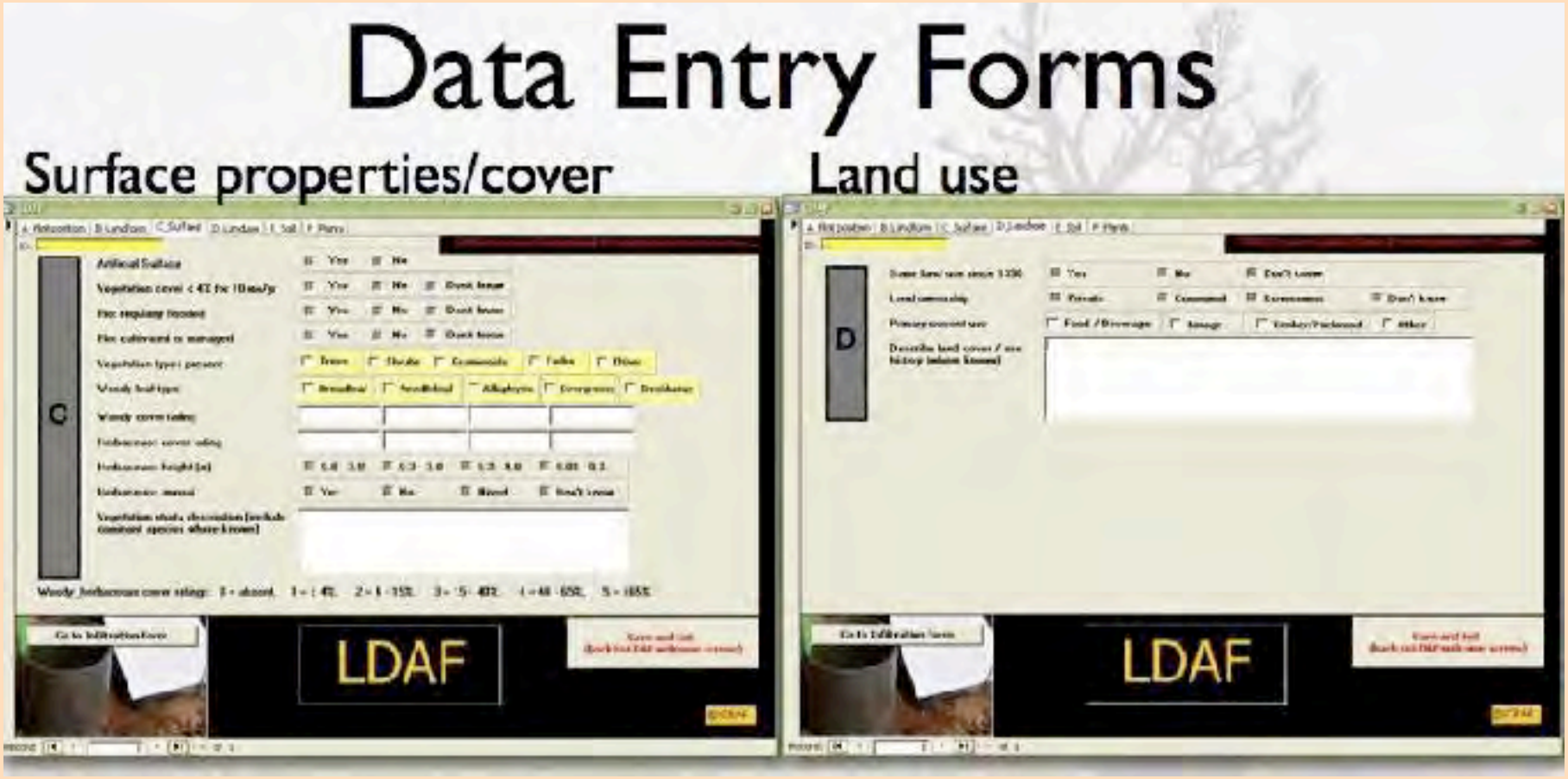


Vegetation and soil characterization



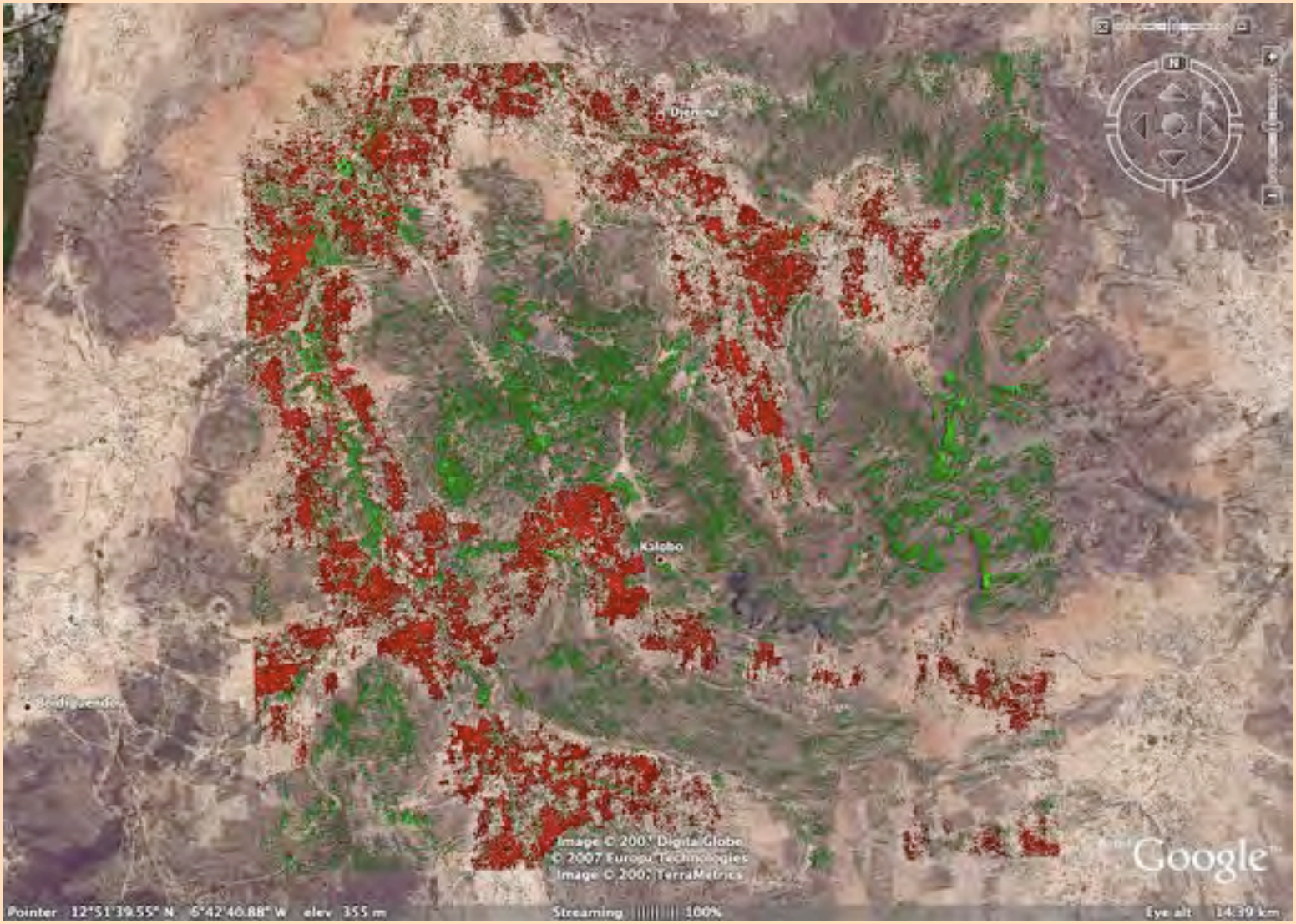
100 m² sub-plots
within 1000 m² plots

Standardized Field Protocol



Includes socio-economic data

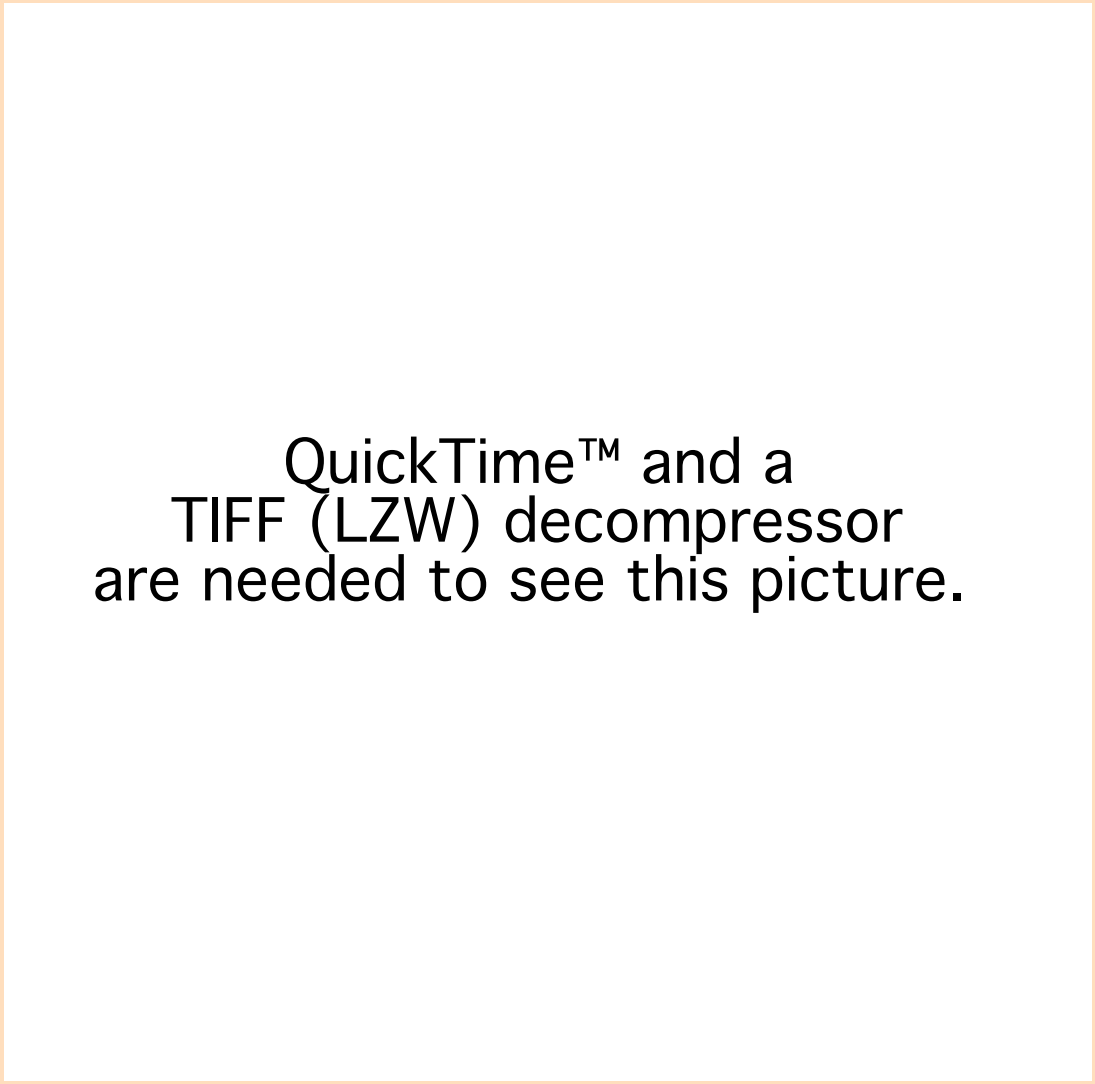
Hot spot mapping of dense woody cover and poor soil fertility at a 10 x 10 km sentinel site



Degradation risk factors guide interventions

- Cultivated land has 80% prevalence of severe nutrient deficiency: Phosphorus deficiency a basic constraint to crop production; coupled with low organic matter. Huge threat to sustainable food production.
- Semi-natural areas have high prevalence of soil depth limitations. Not suitable for cultivation. Limited possibility for extension of cropping area. Marginal areas require restoration of woody vegetation cover for sustainable ecosystem management (run-off management); discourage cultivation.
- Cultivated areas with low tree density should be targeted for enrichment planting. Grafted high value Parkland trees protected with live fencing a promising option.

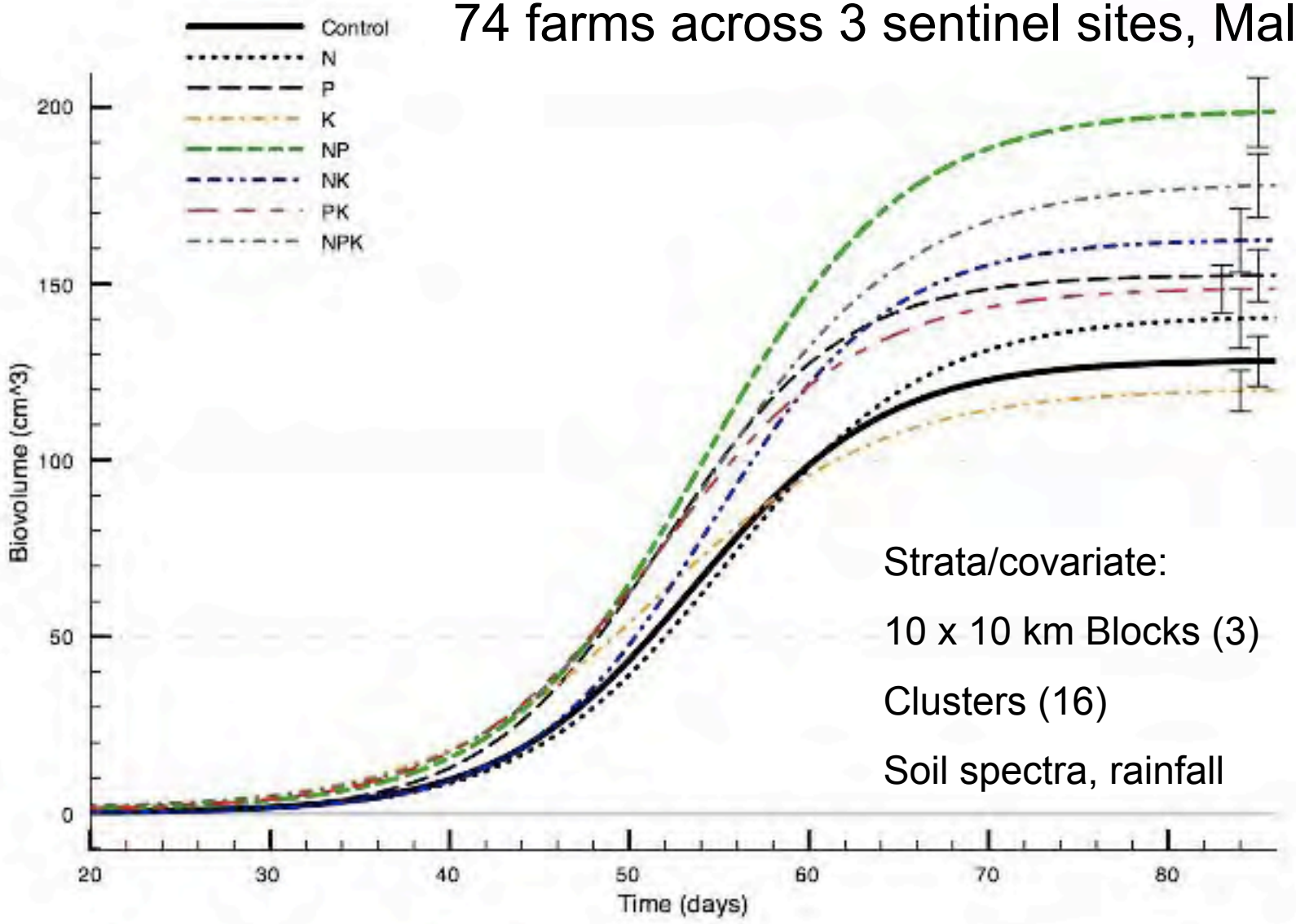
Targeting interventions



Green = dense woody vegetation Orange = sparse or absent woody cover

Systematic Intervention Testing at Sentinel Sites
Millet crop growth response to fertiliser

74 farms across 3 sentinel sites, Mali



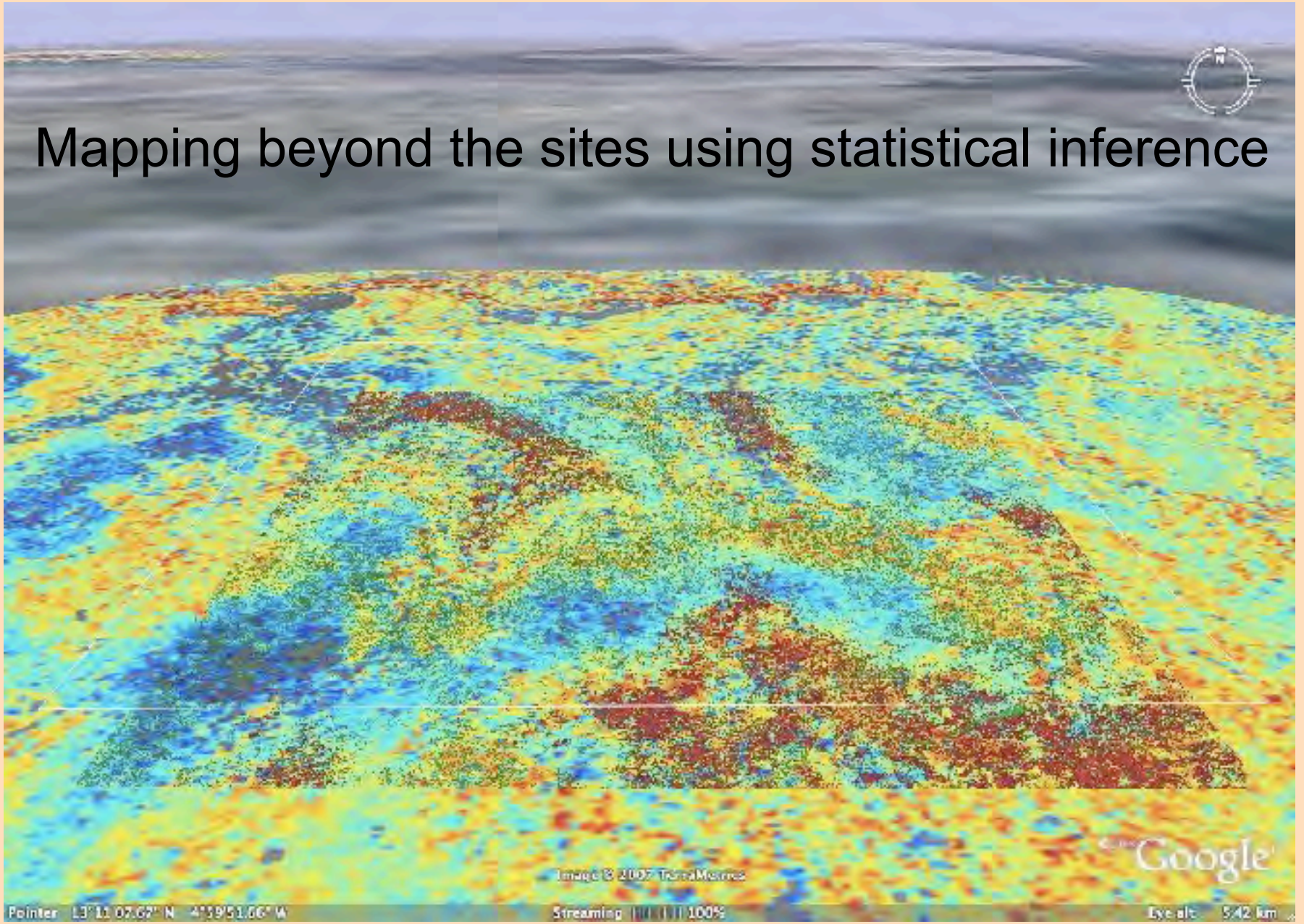
Strata/covariate:

10 x 10 km Blocks (3)

Clusters (16)

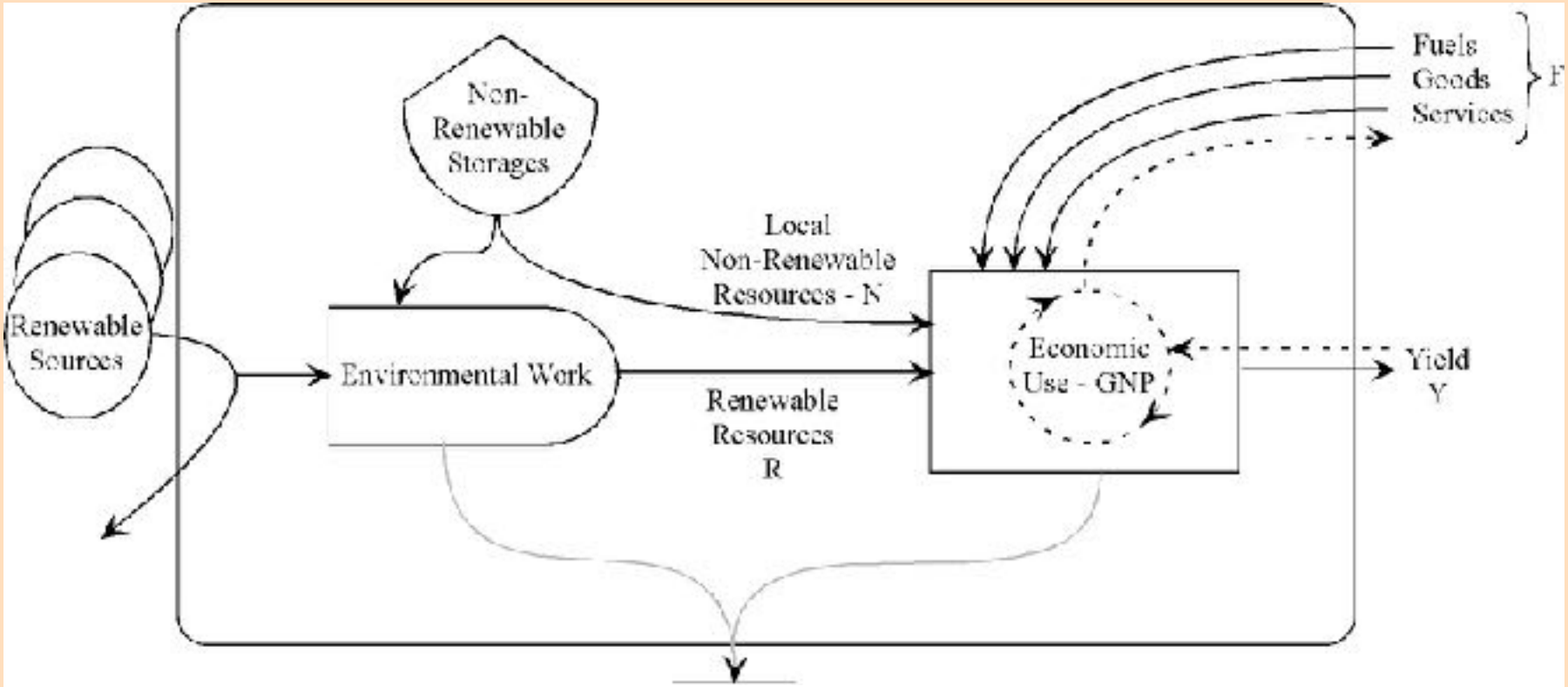
Soil spectra, rainfall

Mapping beyond the sites using statistical inference



Environmental accounting – National scale

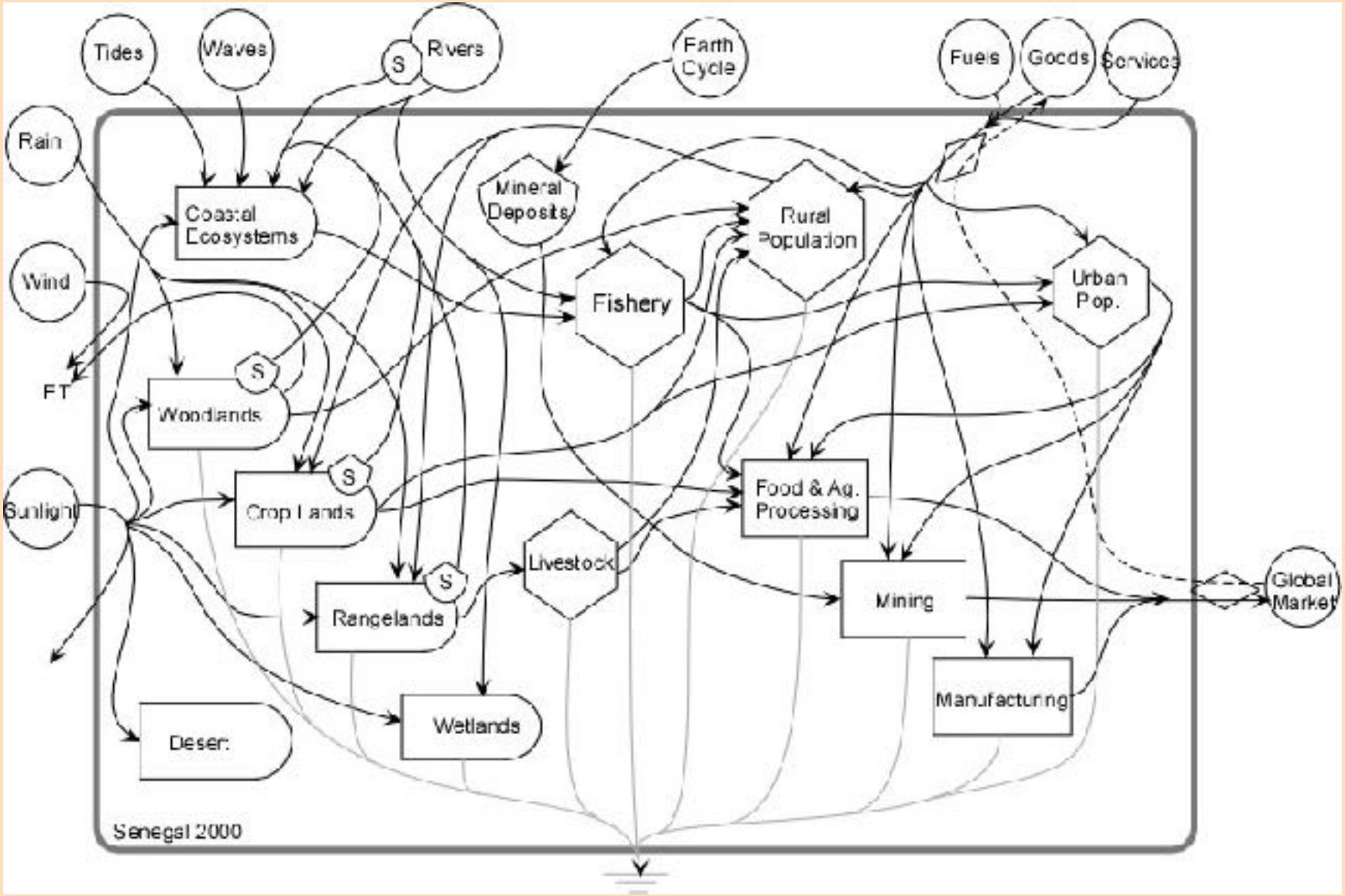
EMERGY – the work required to generate a product or service



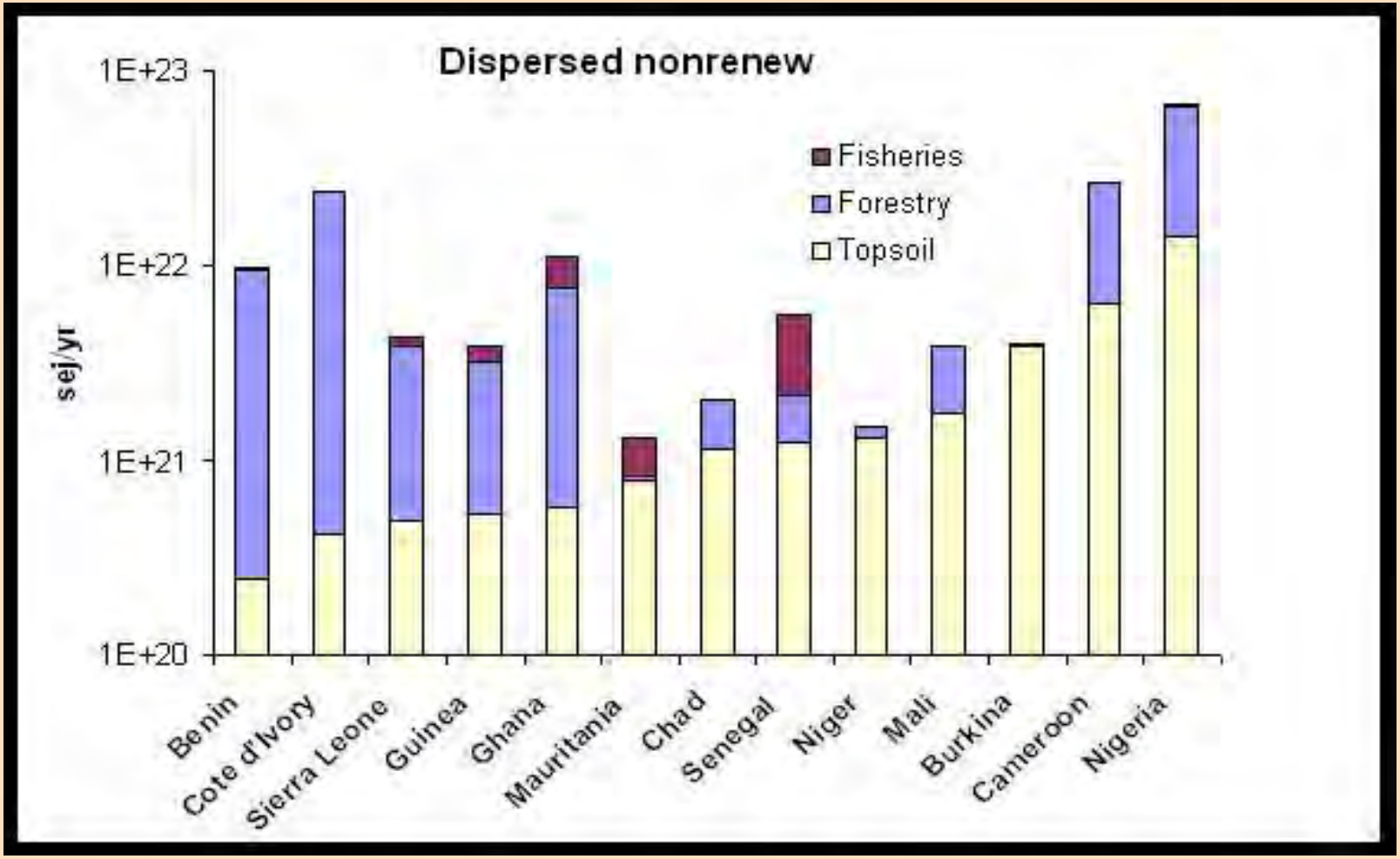
Sustainability indices

Percent renewable = Renewable/ (Renewable + Non-renewable + Fuels,Goods,Services)

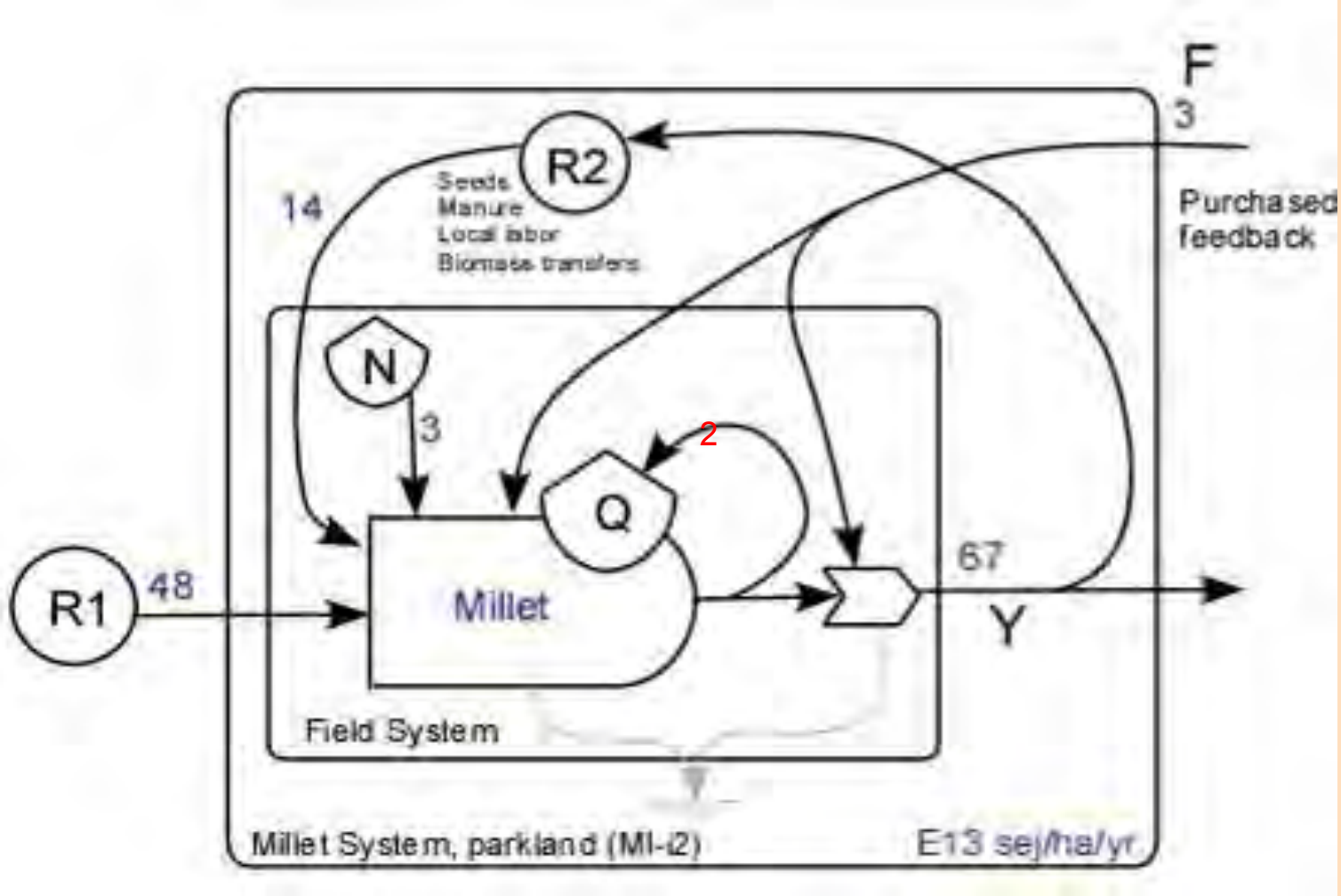
Systems Diagram of Senegal



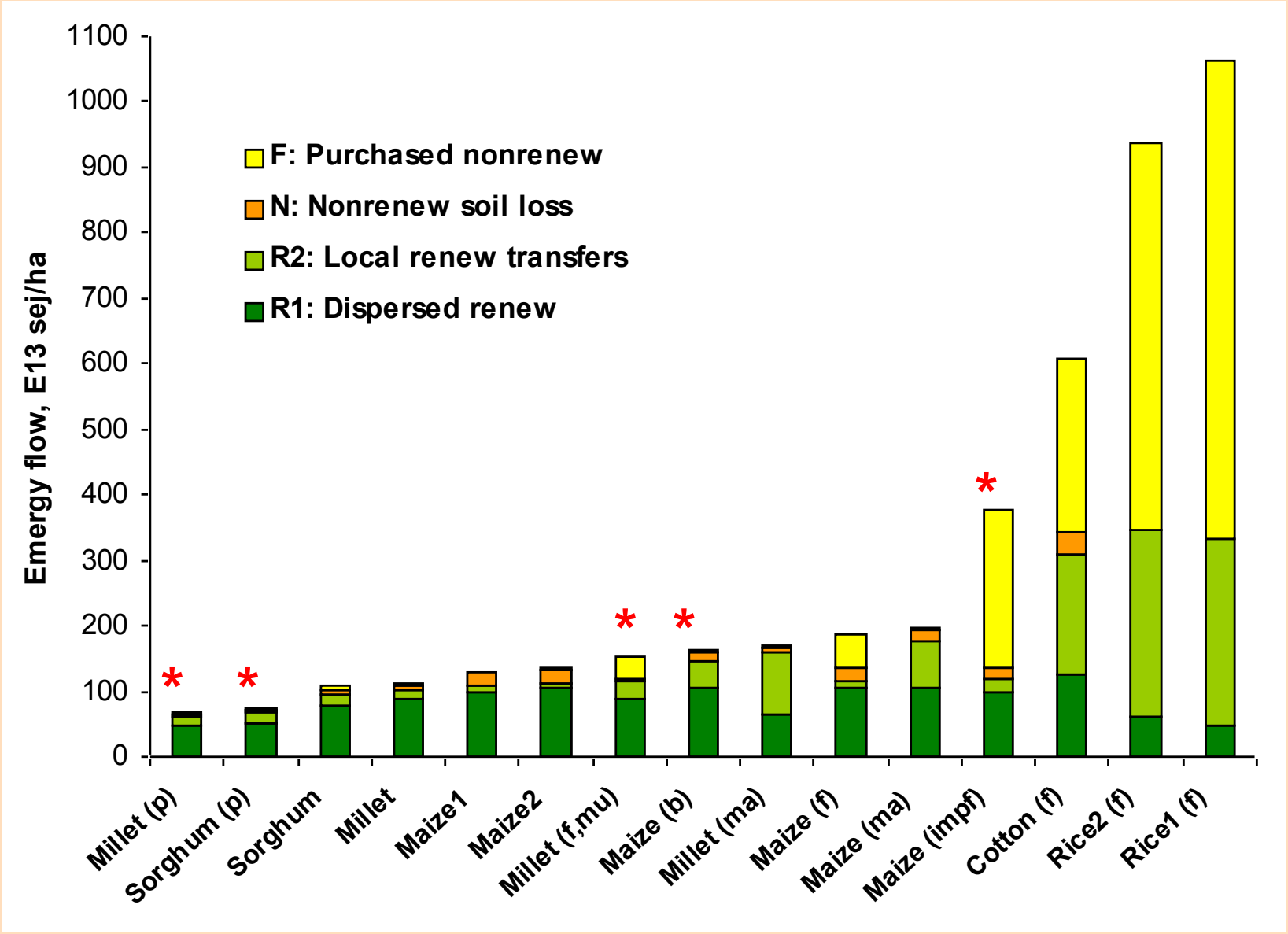
Natural Capital Depletion



Local Scale Analysis
Parkland Agriculture



Sahelian Agricultural Resource Basis



Key partners

- CGIAR centres: regional assessments, network of sentinel sites for intervention testing.
- UNEP (Environmental assessment; West Africa pilot; Environmental accounting with University of Florida)
- Earth Institute at Columbia University (global and regional analyses; Africa soil health surveillance; cyberinfrastructure
- Bioforsk, Norway (remote sensing, soil science)
- National programmes through CGIAR collaborative programmes (including China)

At the end of the day

- National capacity in land health surveillance
- Policies, programmes and projects at national to local scale
  - Prioritized and designed on the basis of solid evidence of problems
  - Use early warning to avert problems
  - Set measurable objectives
  - Monitor progress towards objectives
  - Reliably assess intervention outcomes
- Then we can say assessment has been successful