Workshop Summary
Integrated Ecosystem Modelling
(June 23-24, 2010)

ATREE, LUPIS, INSEE

June 23-24, 2010

Bangalore

On integrated analysis of social, economic and ecological systems

- Integration across systems often snatches rigour off the analytical tools
  - due to issues like difference in units and scale
- Thus when we have to integrate socio-economic-ecological systems, we depend on either of the two – quantitative or qualitative modes.
- This baffles us as we seem to need simultaneous consideration of both types of methods in such contexts
  - but integration of various indicators for quantitative analysis is challenging,
  - especially in an attempt to detect and understand shifts in sustainability at the grass-roots

Purpose of the work shop

Share methods on and issues in

- integrated modelling of socio ecological systems across time and /or space in developing countries

1. Gladwin Joseph, Director, Ashoka Trust for Ecology and the Environment, Bangalore, India

- Need for real world models that speak to the policy makers
- Rigor and complexity need not be compromised for ‘misplaced’ certainty
- Move from just descriptive to communicable descriptive and predictive if not prescriptive
- Land use models should depict the impact of urbanization, globalization and climate change on the poor and women

2. Kanchan Chopra (from the abstract sent), President, Indian Society for Ecological Economics

Integrated Ecosystem Modelling: Some Approaches and an Assessment

- Divergent starting points – depending on what we try to integrate and into what
  - Start from modeling a natural phenomenon (e.g. start from forest ecology and examining the links between land use and ground water)
  - Social and econ systems come in later as one examines how these natural systems augment livelihoods and consumption of different stakeholder groups
  - Start from a sectoral production or cost function and introduce an element of impact on ecosystem functioning (e.g. technology changes and loss in biodiversity)
- Macro approach - extend the economic welfare argument to define human well-being to include benefits from ecosystem services- inclusive approaches
- Durability = f (Resilience, Productivity, Organisation, State of external environment) ?
- Is ‘continued and dynamic’ resilience the overarching principle to order system states and changes in them?
  - Criticality and vulnerability for choice ordering of critical eco-systems , populations and ecological services?
  - The ordering principle is based on extending the choice sets of vulnerable people and ensures that critical Es are kept away from threshold changes in their state and functioning
  - This needs contextual treatment of issues

3. Deepak Malghan, Centre for Public Policy, Indian Institute of Management, Bangalore, India

The Relationship between Scale, Allocation, and Distribution

- Three state-variable dynamic model to illustrate the relationship between the EE concepts of scale, & traditional concerns of allocation and distribution, through both hierarchical and co-evolutionary models
- Needs to clarify the difference between normative and positive aspects of scale, allocation and distribution.
  - Normative scales work in two levels: as normative rule and benchmark- as a general normative rule
  - we require optimal scale to be less than or equal to maximum sustainable scale (in biophysical terms). However, the exact value that optimal scale assumes is contingent on contextual social, political, and cultural factors
- Scale Efficiency is the departure of measured scale from optimal scale
- Distribution Efficiency is the departure of observed distribution from optimal (just) distribution
- Allocation Efficiency measures missed trade opportunities. A simple measure of distribution efficiency can be derived from the Lorenz Curve frame work. It is the ratio of missed trade opportunities to the maximum social product that is possible when all available opportunities for trade are exhausted
- A mutually coupled model (with & without feed back loops) to simulate a decomposition equation which shows that changes in scale, allocation, and distribution can be decomposed into sum of changes due to direct policy-targeting as well as the interlinkage between scale, allocation, and distribution in the efficiency space

4. Gopal Kadekodi, Centre for Multi-disciplinary Development Research, Dharwad, India

Prospects of Reversing Biodiversity Losses of Chilika Lake in India

- DPSIR closed loop approach to model base line scenario and simulate interactive socio-ecological system for next 25 years
- Policy scenario with populations stabilization (using STELLA) showed increased agricultural area & fish prices as well as decreased forests, lake depth and salinity
- Resulted in strengthening CDA, open a new river mouth, a new regulatory bill and improved salinity

5. Rakesh Kumar Sharma and Prem Lall Sankhayan Himachal Institute of Public Administration, Shimla, India and Departments of Ecology and Natural Resource Management, Norwegian University of Life Sciences, Norway

Land use changes and forest degradation in a Himalayan watershed: Bio-System analysis with bio-economic modelling approach

- Objective function to maximise discounted gross margins from different sets of activities, namely agricultural, livestock and forestry over 20 years
- The model becomes non-linear by using variance and co-variance matrix of gross returns over five years
- The model investigates the effects of alternate policy scenarios on income levels, cropping pattern, bio mass use and growth and labour and capital requirements over next 20 years using GAMS
- Biomass growth is based on a logistic model (uses the MINOS solver, finds that diversification of crops is more for risk management than for profit maximization)

6. Narendra Nath Dalei and Yamini Gupt, University of Delhi, India

Household behaviours to Ecosystem Change

- Multinomial logistic regression model to analyse the impact of mining on local livelihoods in Orissa
- Efficient Forest Ecosystem
  Gain amount of time (+ε) from the mean collection: positive effect of ecosystems
- Degraded Forest Ecosystem
  Consumption amount of time(-ε) from total time required either for leisure or self employment: negative effect of ecosystems
- Normal Forest Ecosystems
  ε = 0: neutral effects of ecosystems

Introduce ecosystem effect following models in literature.

- Time constraints: $H = H1 + H2 + L \pm \varepsilon$ (1)

H : Given time (say 24 hours)
H1 : Time spent for earning wages and profits
H2 : Mean collection time (firewood)
L : Time spent on leisure
+ε : Gain amount of time from H2
-ε : Loss amount of time from L or part of H1

7. Indira Devi, P. Department of Agricultural Economics, College of Horticulture, Kerala Agricultural University, Trissur, India

Farmers financial rationality in Chemical Pest management

- The most efficient level of investment is estimated by equating the Marginal Value Product with the price of the pesticide and solving for the value of input use level

  ie. The optimum level of input use is given as

  bi x Y/X = Px / Py

  Solving for X, X = bi x Y x Py / Px.

  Since Y in this model depicts the value terms (MVP),

  X= bi x Y / Px

- Price of pesticide is derived to include the material and application cost, for a realistic estimate

8. Saudamini Das (University of Delhi,) and Jeffrey R. Vincent

Ecosystem Services vs. Human Action: Mangroves and Storm Protection in India

- Impact of mangroves on number of human deaths
- Data and methods
  - Cross-section: 409 villages in 4 tahasils in Kendrapada District
  - Count-data models
  - 1999 Mangrove width

    Numerous environmental, socioeconomic variables
- Results
  - 1999 Mangrove width: negative, highly significant, robust impact
  - Implied no. lives saved: mangroves < early warning
  - But: protecting remaining mangroves economically justified
- $D_i = \alpha M_i + X_i\beta + \varepsilon_i$

  D = damage

  M = mangrove width

  X = other covariates

Das and Vincent Contd.

- Cross-sectional model. Endogeneity:
  - No simultaneity
  - No measurement error in *M*
  - Omitted variables (i.e., unobserved heterogeneity)
    - Many environmental, socio-economic variables in **X**
    - Increased risk of multicollinearity
    - Instrumental variables (IV)?
    - Seemingly Unrelated Estimation (suest)?
- Non-linearity in Mangrove Protection for lives

\- Quadratic Model : Model with Mangrove, Mangrove square, All have – ive sign, jointly significant, No evidence of protection effect of mangroves diminishing, Turning point at 0.40

\- Spline Model (Linear, Cubic and Restricted Cubic: Negative slope coefficient for each Spline, Linear Spline gives better result

9. Shrinivas Badiger, Ashoka Trust for Ecology and the Environment, Bangalore, India

Modelling Impacts of Cropping Systems Choices and Land Use Change on Hydrological Regimes at Sub-Basin Scales

- Hydro-sociological model
- Farmers' perception on land use conversion
- Crop mapping using farmer choices and preferences in lower catchment
- Simulated consequences of irrigation intensification and irrigation reduction
- LU-CCM Component Objectives
  - Identify hydrogicaly-relevant land-use changes
  - Develop a land use composite, representing agricultural land-use pattern (multiple cropping), more importantly map water intensive cropped areas.
  - Identify regions where communities have varying degrees of vulnerability in land-water based occupations (especially, agriculture) and regions predominantly under subsistence agriculture

10. Nandan Nawn

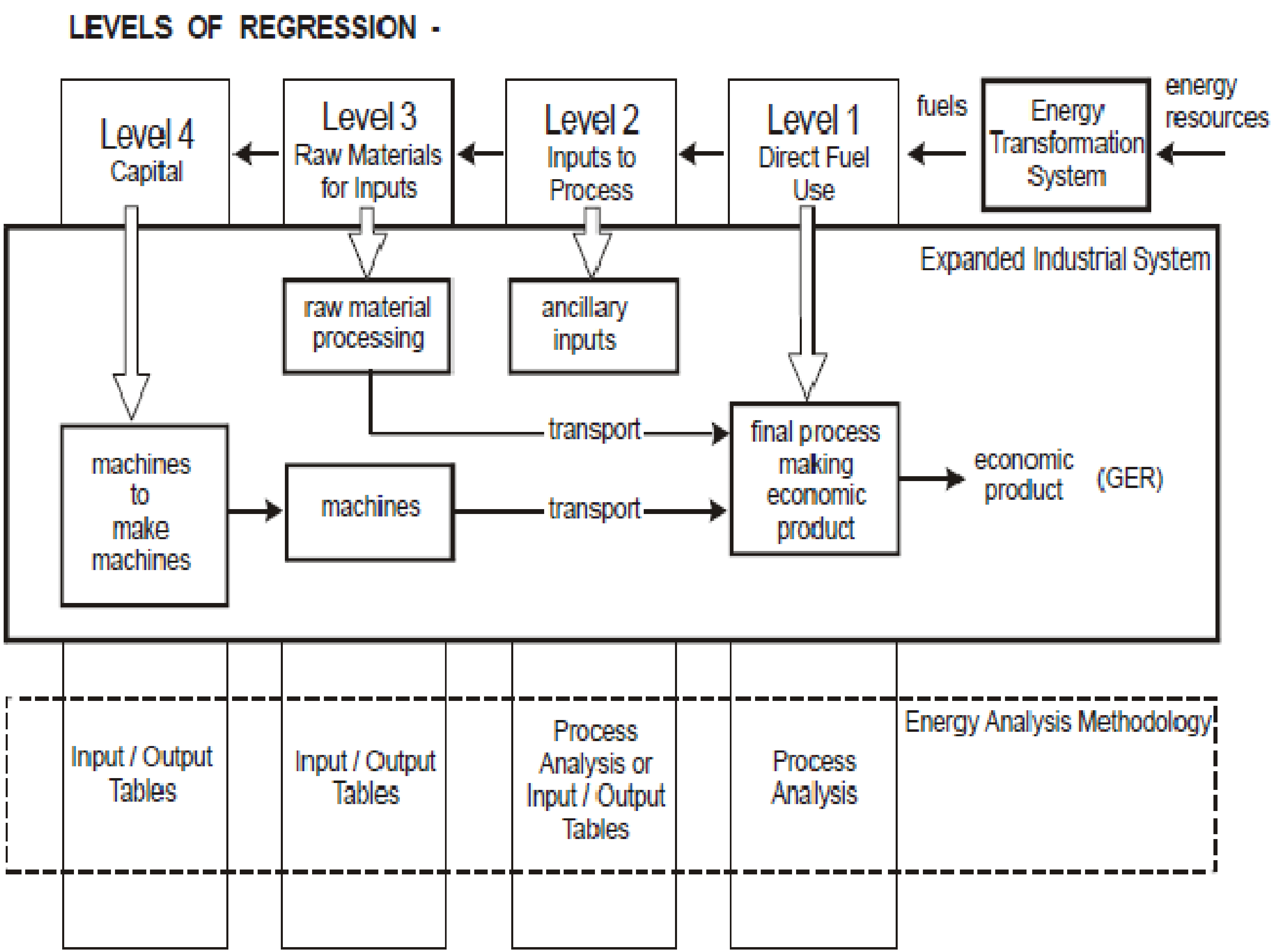
National University of Juridical Sciences, Kolkata, India

Sustainability of Agriculture and Energy Analysis

- Calculated percentage per acre distribution of input-output in Aman paddy in physical terms and also in terms of energy using different levels of regression

- The model is also used for projection of farm level energy efficiency into the future

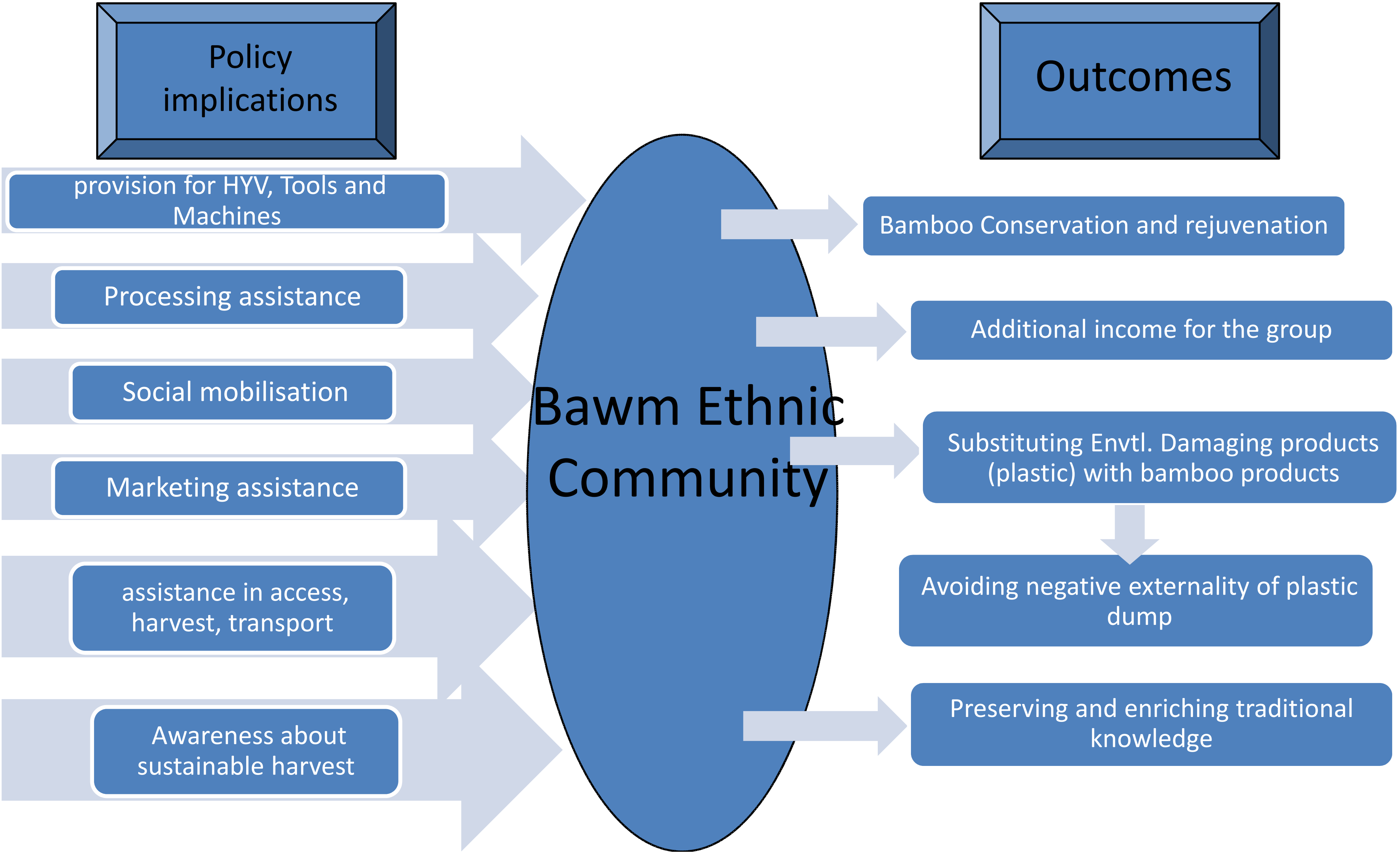
Nandan Nawn Contd.



11. Zulfiquer Islam: Department of Sociology, University of Rajshahi, Bangladesh

Sustainable Livelihoods for Bawm community

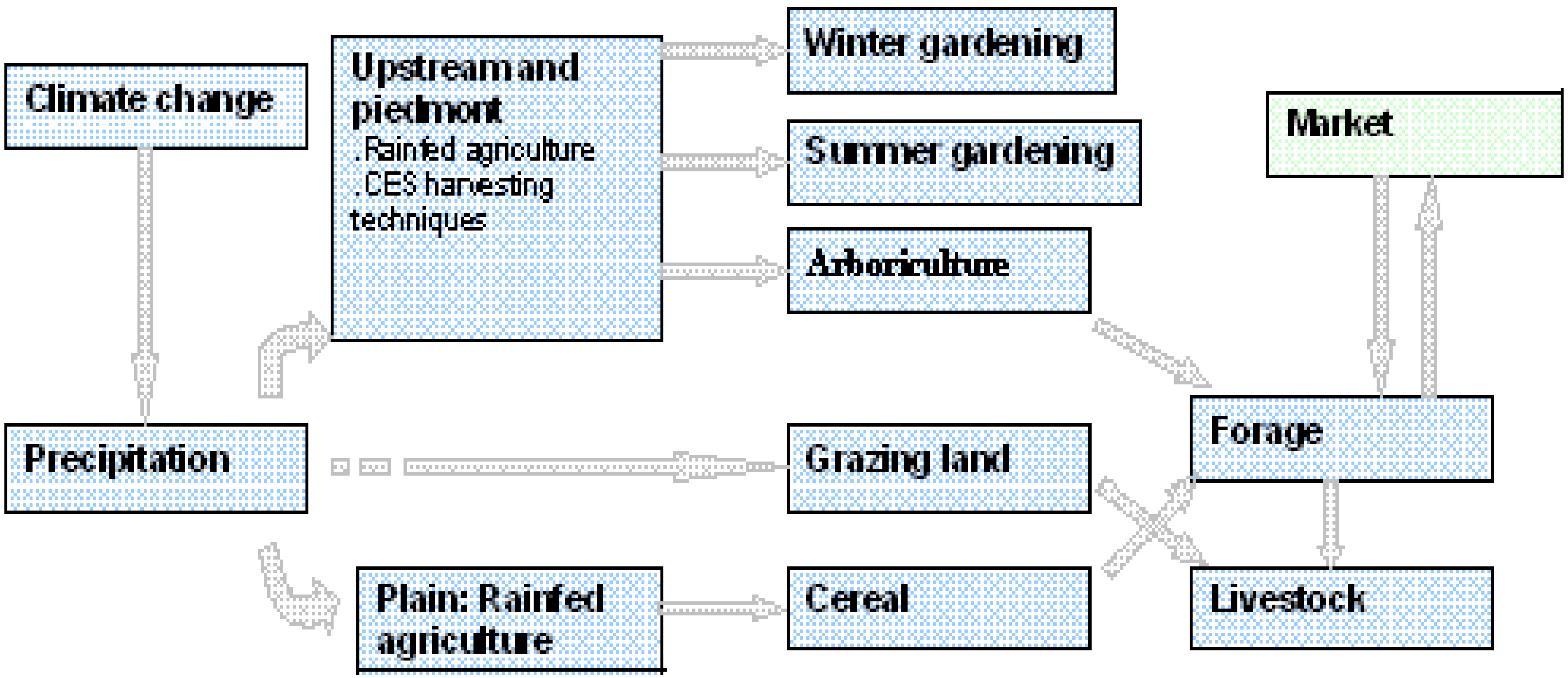
Bawm Livelihood Model



12. Sghaier Mongi *et al.*, Institute of Arid Regions, Laboratory of Economic and Rural Societies , Tunisia

Climate change impacts assessment on the Sustainable development "Application of Multi-criteria analysis in the Oum Zessar Watershed Tunisia southern East"

climate change and ecosystem interaction



Mongi *et al.*, Contd.

Simple Multi-Attribute Rating Technique (SMART) application was used to identify the more appropriate climate change adaptation strategy that guaranties the economic, environmental and social sustainable development

13. Mohamed Abdeladhim *et al*., Institut des Regions Arides, Tunisia

Regional Impact of Water Policy Reform in Tunisia: A Computable General Equilibrium Approach

- Used A regional CGE model to examine the assess the impact of inter-sectoral water allocation policy on regional sustainable development in Médenine governorate in Tunisia
- CGE model is a system of simultaneous equations that describe the circular flow of income and expenditure in an economy
- Calibrated to a consistent set of data for a given year
- Can be defined for a village, region, nation or the world
- Can be static or dynamic in nature
- The data needed are organized in a Social Accounting Matrix

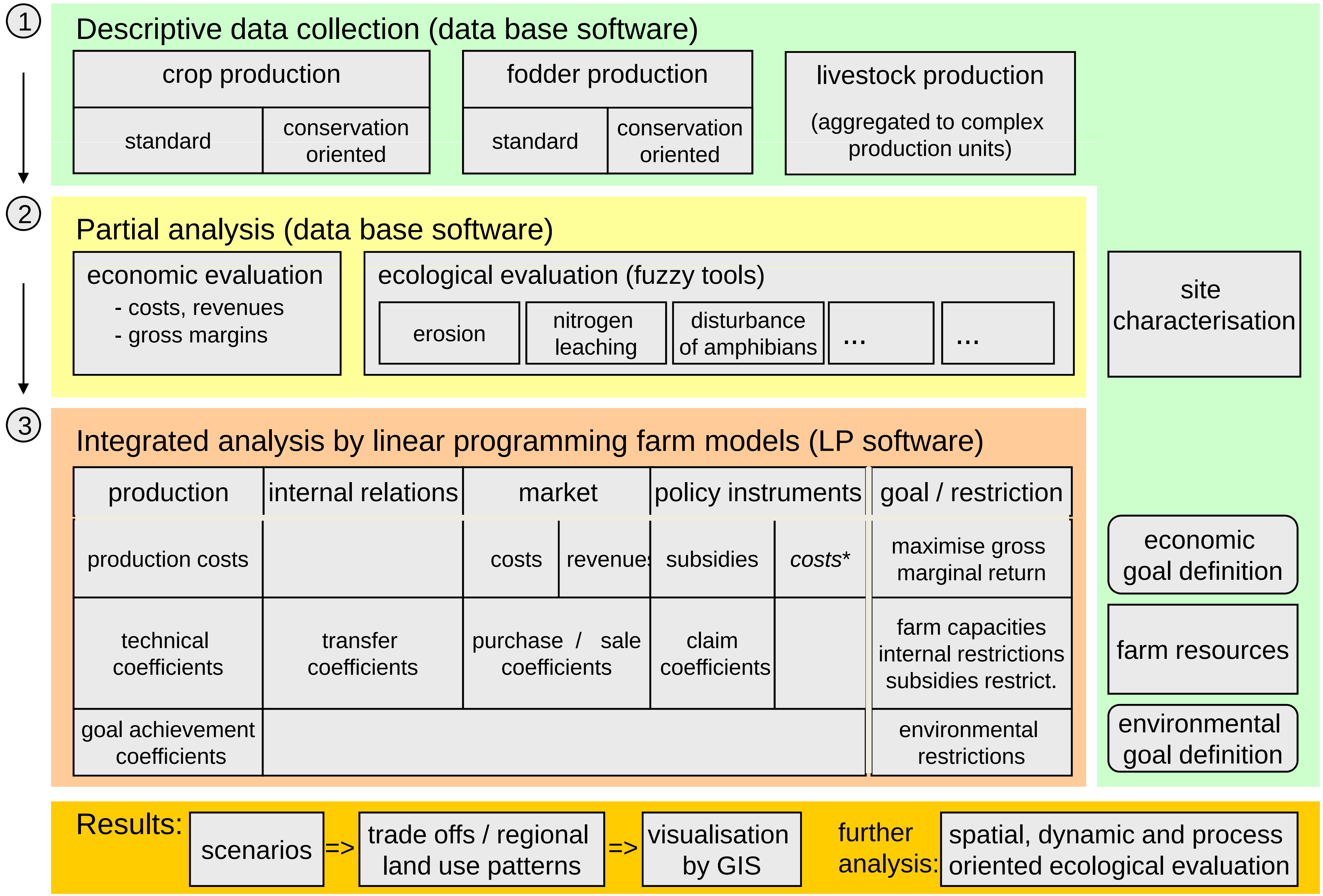
14. Peter Zander *et al.*, Leibniz Centre for Agricultural Landscape Research, Germany

CO_2 Balances and Bio-economic Modelling for Rural Development in India- A proposal

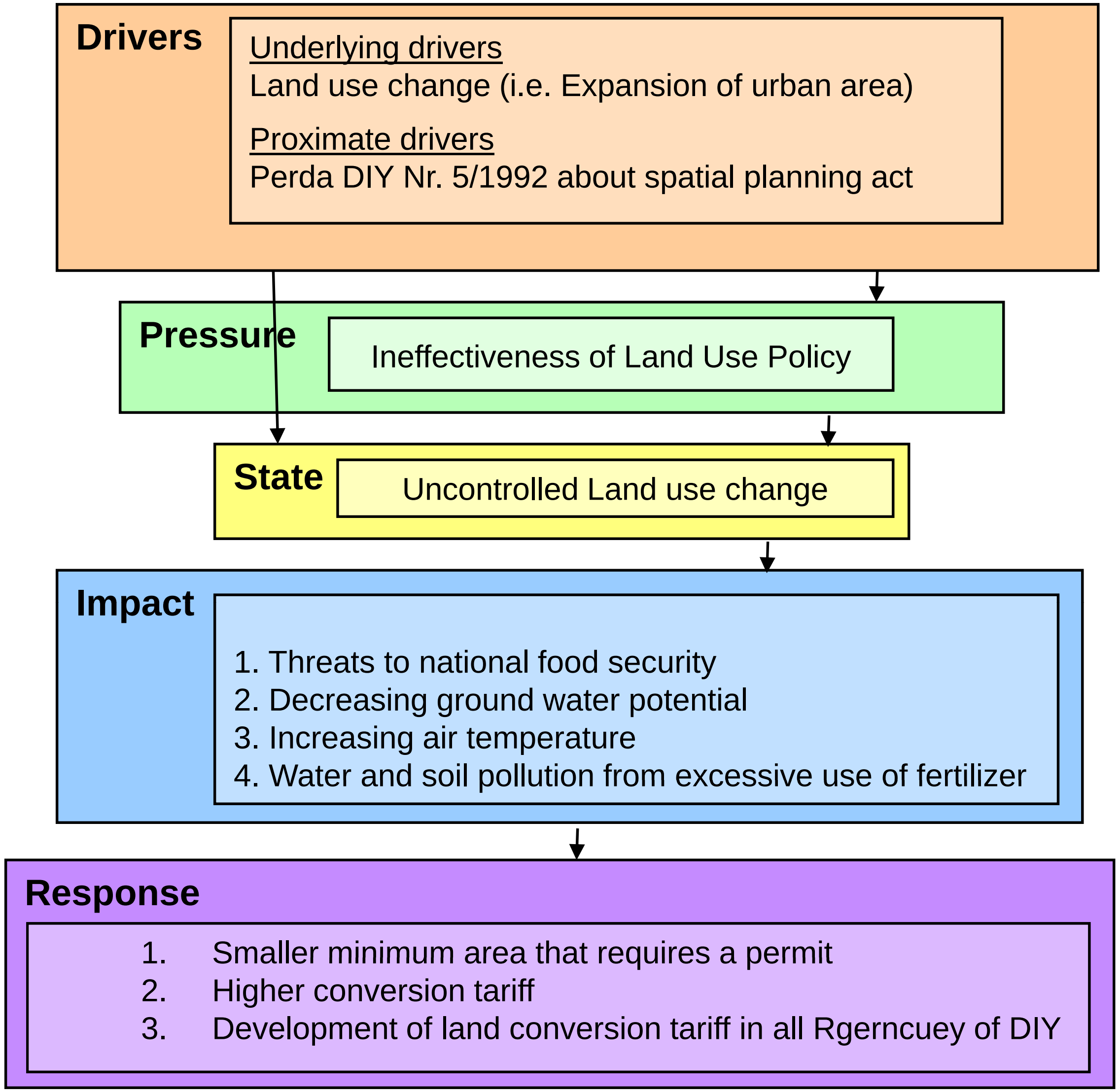
Multi Objective Decission Support System for Agro-Eco System Modelling (MODAM) recommended to be applied in Karnataka

Zander *et al.*, Contd.

Multi Objective Decission Support System for Agro-Eco System Modelling

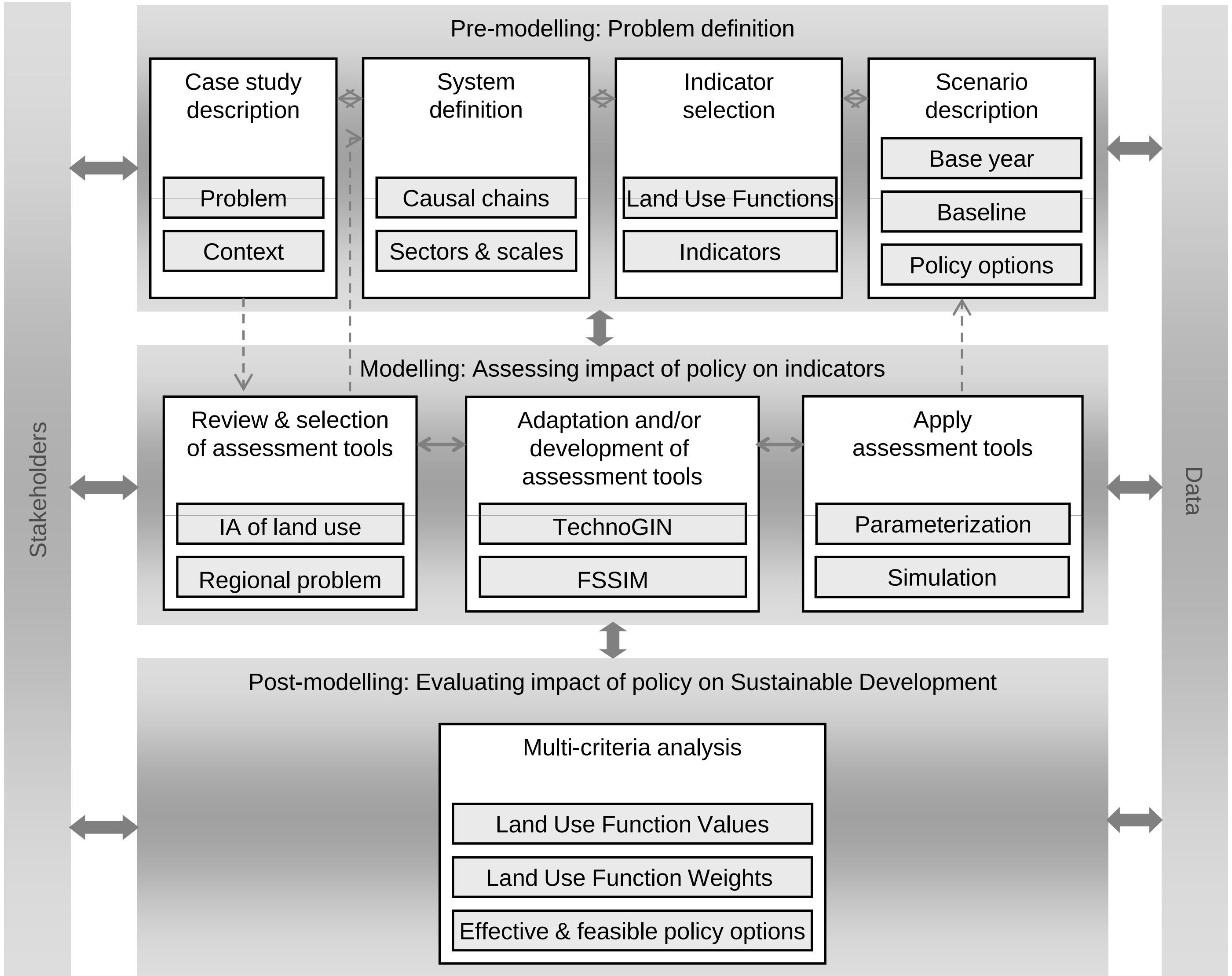


15. Nina Novira and Syarifah Aini Dalimunthe, Gadjah Mada University Yogyakarta, Indonesia : *DPSIR for a particiaptory spatial analysis to assess Land Conversion Tariff policy in Jogyakarta*

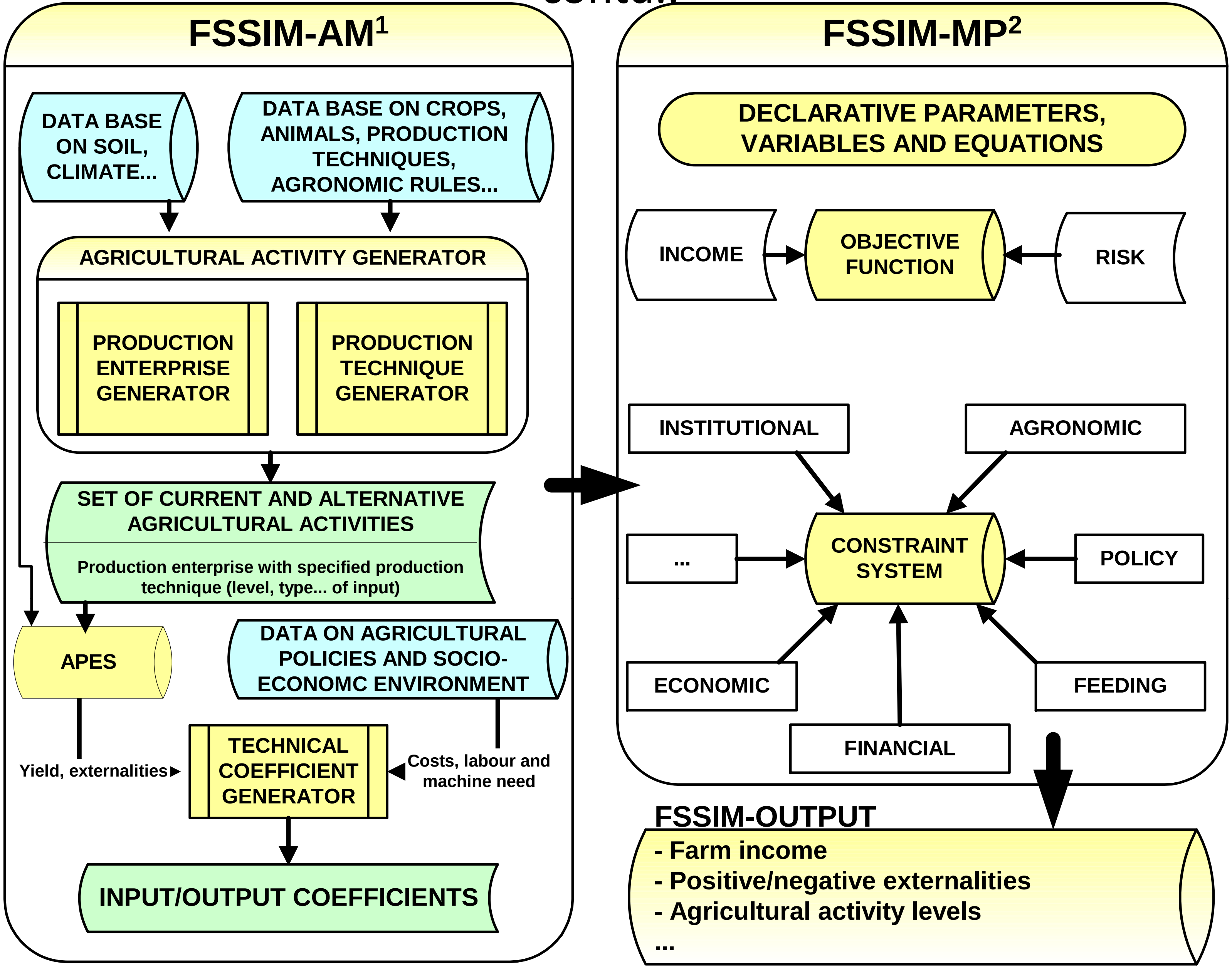


16. Pytrik Reidsma *et al.*, (Wageningen University, Nanjing Agricultural university)

Integrated assessment of agricultural land use policies reducing nutrient pollution in Taihu Basin, China



16. Structure of Farming Systems Simulator (FSSIM) for China contd..

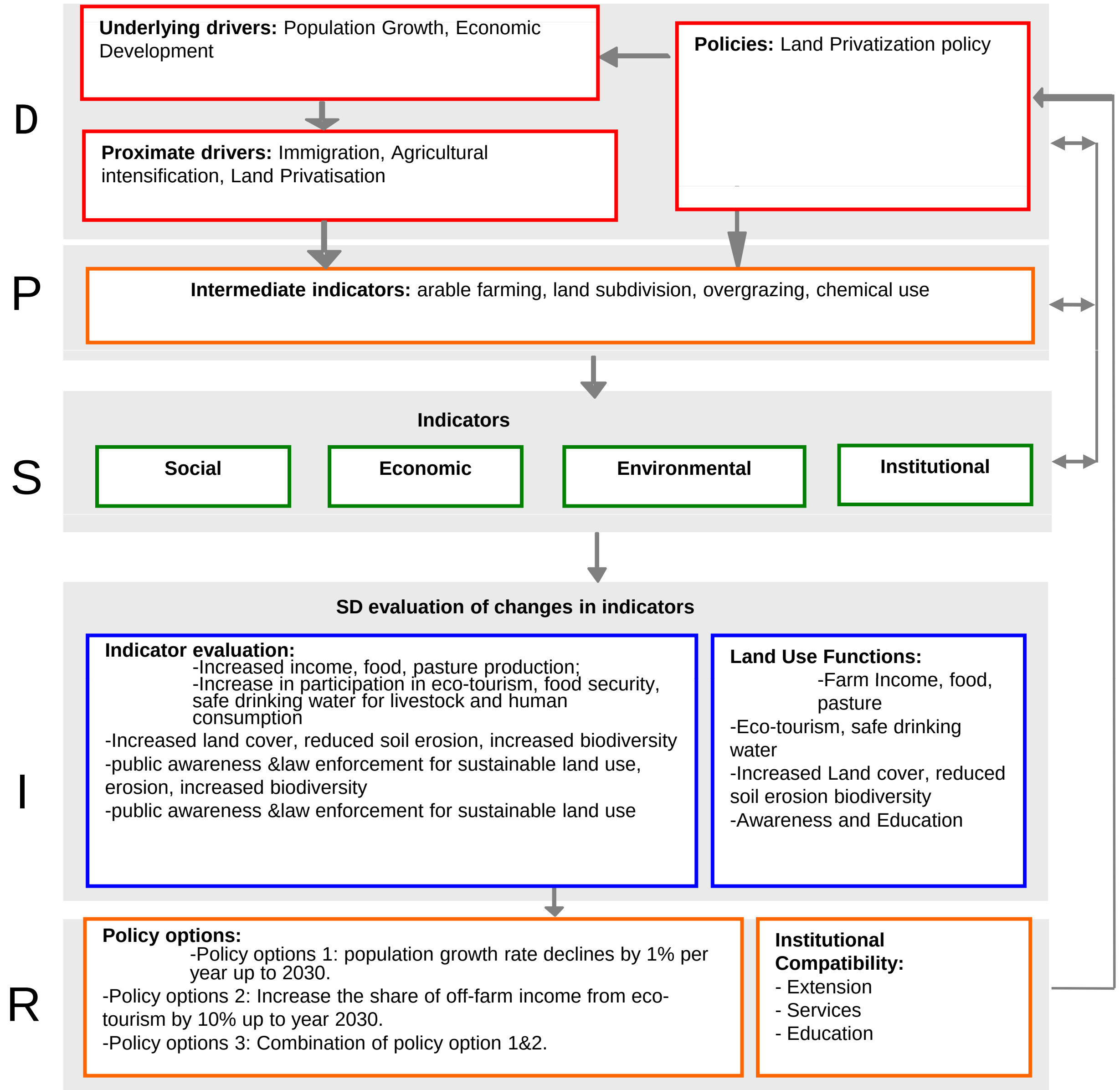


17. Stella Makokha and Le Chen, Kenyan Agricultural Research Institute, Nairobi, Kenya

Land Use Policies and Land Degradation in Narok District, Kenya

- Used DPSIR framework to assess impact of policies on land degradation in Kenya.
- Regression Analysis
- Environmental indicators for land degradation as dependent variables are:
    - Share of land under natural vegetation (including natural forests)
    - Amount of soil lost (Erosion)
    - Soil Erosion (Number of Rills and Gulleys)
    - Soil nutrient balance
    - Water quality
- Economic indicator
    - Household Income
- Social Indicator- Food security:
    - Average staple food consumption/farm household/year

Makokha and Chen Contd.



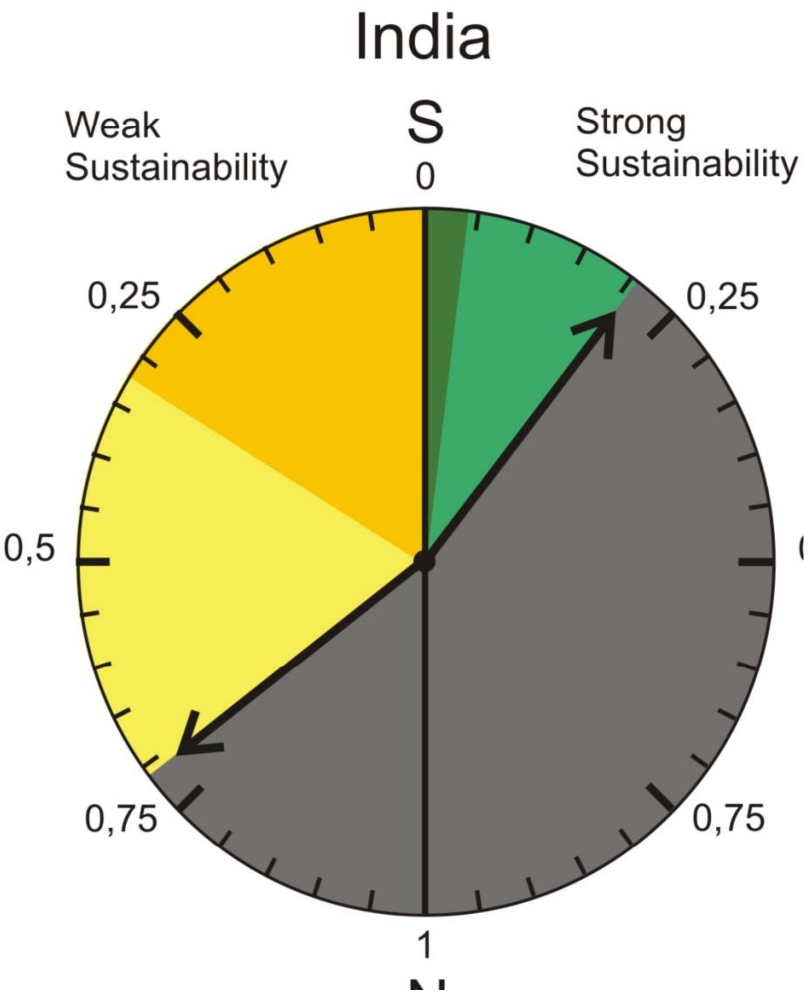
18. Ierene Francis *et al.*, Ashoka Trust for Research in Ecology and the Environment, Bangalore, India

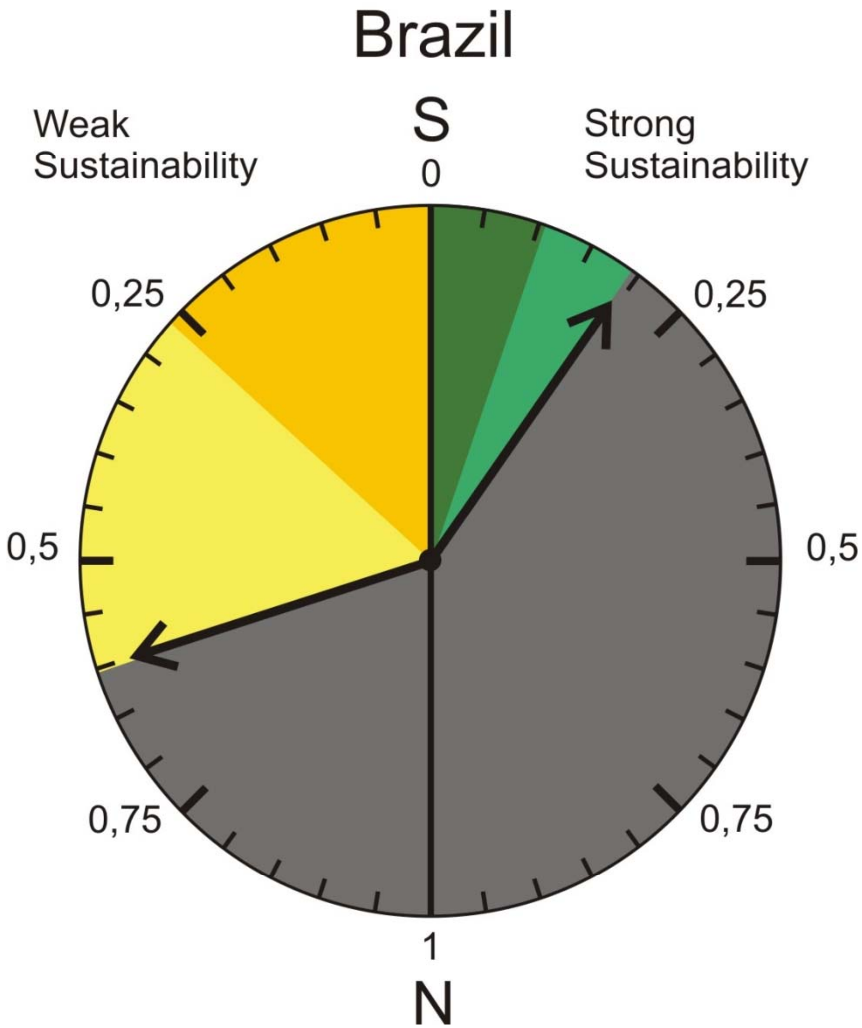
Comparing two farming practices in Karnataka: for efficiency and sustainability

Methods in sequence	
MRA of indicator values of SD dimensions	Causalities of spatial and temporal variation
	Quantum of changes attributable to each explanatory factor
SEM	Solve a concurrent set of non-linear variations in explanatory factors for the future
TechnoGIN	Input-Output coefficients for different cropping patterns and rotations
Institutional Analysis	Under what institutional conditions will the selected policy can have intended impact
MCA	The relative pros and cons of different policy/ practice with respect to different dimensions of sustainability.
GIS maps	Pattern and distribution of change in crops
FoPIA	Co evolution of potential scenarios, indicators and responses with farmers

19. Saulo Rodrigues-Filho *et al.*, University of Brasília

CompasSus – Compass of Sustainability





Discussions:

1. Nature and dimensions of SD in different scales - under weak sust.. and strong sust.. at local and global scale ; scale conflicts across time, space.

2. How best to bring in ethnic values and cultural sovereignty into models

3. For risk management strategies, Cobb-Douglas production function may not hold good

4. Participatory research methods (especially sustainability impact assessments) may lead to immediate responses than long term solutions as offered by non-inclusive research methods

5. Food security may need local scales of analysis in a sustainability assessment framework

6. Role of sharing data and tools for sustainability research