Conjoint segmentation of policy preferences for a sustainable biofuel production in the Philippines

Dr. Lilibeth Acosta-Michlik[1,2]

Co-authors: DB Magcale-Macandog[2], KG Engay[2], MN Herrera[2], OB Nicopior[2], MI Sumilang[2], and W Lucht[1]
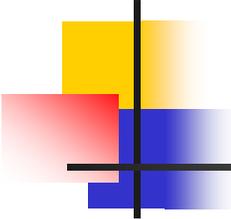
[1]Potsdam Institute for Climate Impact Research (PIK), Germany
[2]University of the Philippines at Los Banos (UPLB), Philippines

XIX International Symposium on Alcohol Fuels (ISAF)
Verona, Italy
October 10-14, 2011

Outline

1. Objectives

2. Framework

3. Methods

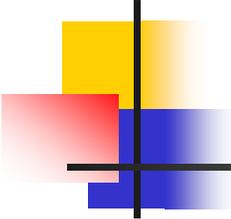   - Case study area

   - Conjoint analysis

4. Results

   - Segmentation

   - Preference weights
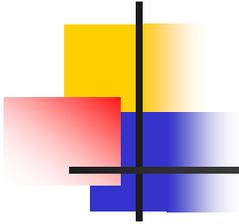
5. Utility of preference weights

Objectives

1. Contribute to an understanding of trade-off decisions on different determinants of sustainable bionergy

2. Apply conjoint analysis to elicit preferences on sustainability of bioenergy production

3. Show the utility of preference weights in integrated assessments of sustainable trade-offs and pathways

Framework

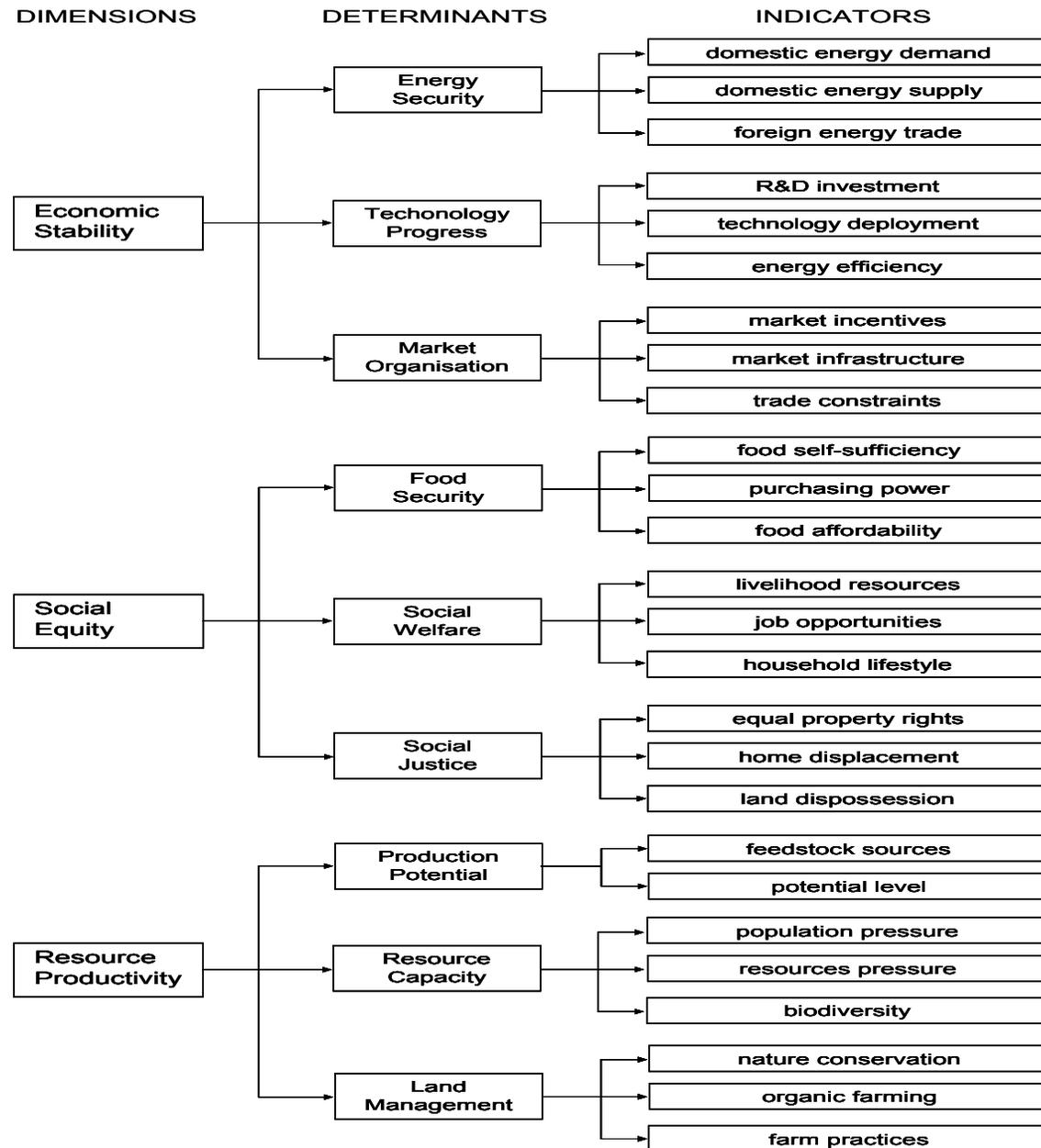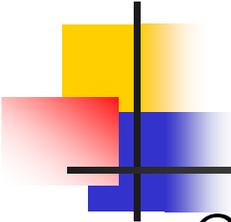Figure 1 Sustainability Concept

DIMENSIONS	DETERMINANTS	INDICATORS
Economic Stability	Energy Security	domestic energy demand
		domestic energy supply
		foreign energy trade
	Techonology Progress	R&D investment
		technology deployment
		energy efficiency
	Market Organisation	market incentives
		market infrastructure
		trade constraints
Social Equity	Food Security	food self-sufficiency
		purchasing power
		food affordability
	Social Welfare	livelihood resources
		job opportunities
		household lifestyle
	Social Justice	equal property rights
		home displacement
		land dispossession
Resource Productivity	Production Potential	feedstock sources
		potential level
	Resource Capacity	population pressure
		resources pressure
		biodiversity
	Land Management	nature conservation
		organic farming
		farm practices

Methods

Case study: Philippines

1. continuing increase in the prices of petroleum prompted consumers to utilize energy in more prudent ways

2. energy demand declined, energy supply continued to increase, albeit at a slow rate of 0.4 percent per year

3. renewable energy such as geothermal energy and biomass are important indigenous sources of energy

4. energy from biomass from forest and agriculture residues is mainly used for traditional household cooking
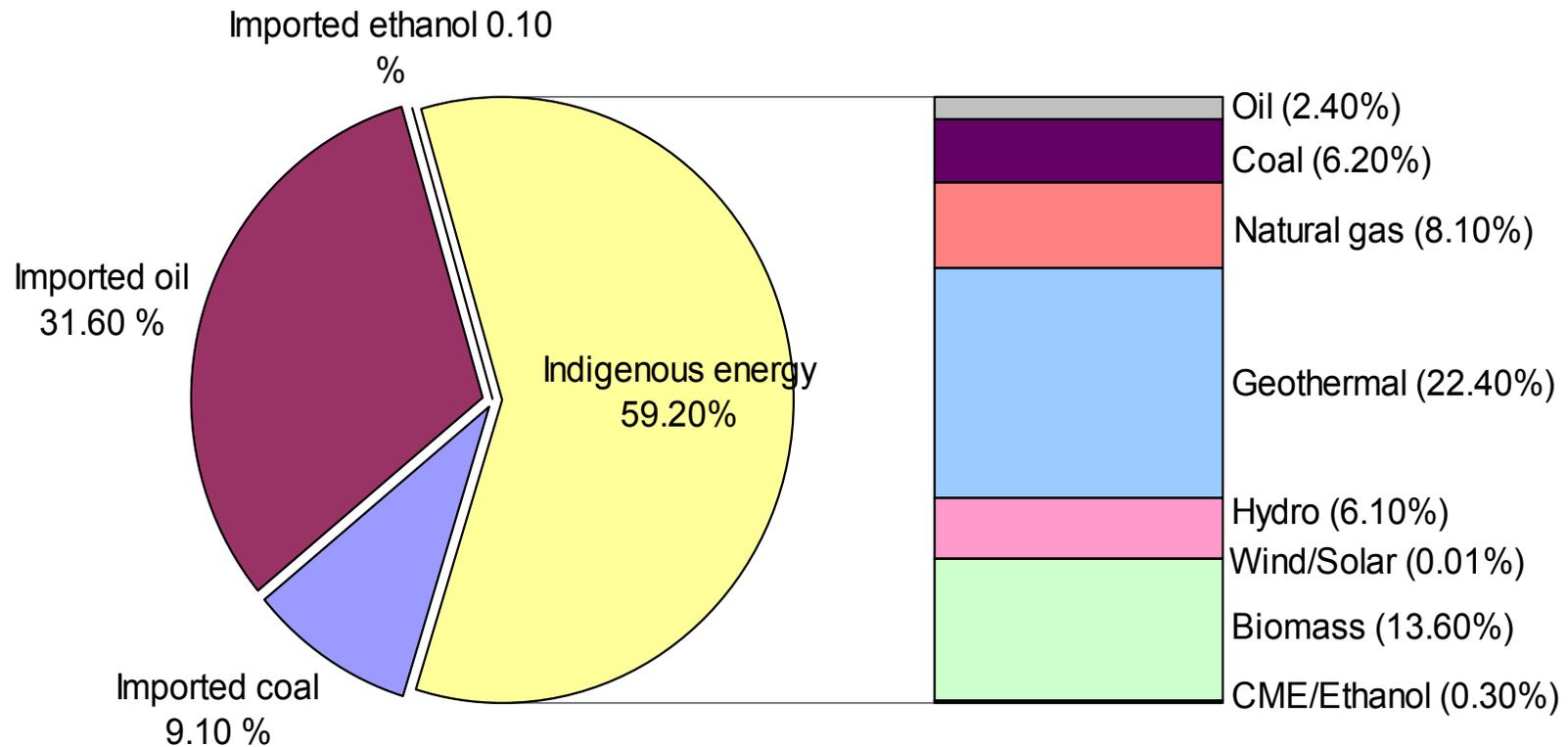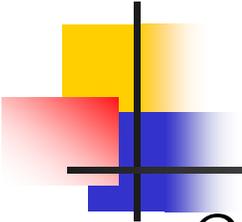
Methods

Philippines: Case study area

Figure 2 Primary energy supply mix in the Philippines, 2009

Methods

Conjoint Analysis

Also known as choice models or experiments, it is a practical technique for measuring preferences and assessing trade-off decisions.

Respondents' choices were analysed using a Hierarchical Bayes Choice-based Conjoint (HCBC) model to capture (1) preferences of individuals and (2) groups of individuals.

$$(1)\ \ Y_i = X_i\beta_i + \varepsilon_i \qquad\qquad (2)\ \ \beta_i = \Theta z_i + \delta_i$$

Where
Y_i is a vector of the responses from the choice tasks
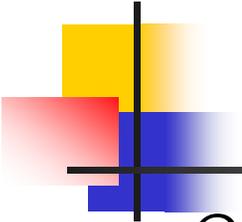X_i is a matrix of the attribute levels
β_i is the p-dimensional vector of regression coefficients or utilities
ε_i is a p-dimensional vector of random error terms
Θ is a p by q matrix of regression coefficients (i.e. utilities)
z_i is a q-dimensional vector of covariates or segmentation units
δ_i is a p-dimensional vector of random error terms

Methods

Conjoint Analysis

From the segmented conjoint utilities Θ generated from equation (2), the preference weights (ω) of the various attributes (R) were computed as follows:

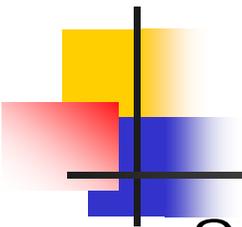$$(3) \qquad \omega_{ij} = \left(R_{ij} / \sum_{i=1}^{n} R_j \right) * 100$$

$$(4) \qquad R_{ij} = \Theta_{ij}^{\max} - \Theta_{ij}^{\min}$$

Where
i refers to attribute levels
j refers to the segments
ω_{ij} are preference weights measure the relative importance of the attributes

Methods

Survey design/administration

- Conducted from April to June 2011; Sent out 312 WEB-surveys and carried out 53 CAPI-surveys* with a response rate of 57% (208 survey)

- Segmentation: (1) government officials and employees, (2) academic and research professionals, (3) private company managers and workers, (4) farm owners and workers, and (5) "others" (e.g. students, residents, etc.)

- SSIWeb Sawtooth software was used to analyse the responses of the respondents (i.e. compute utilities and preference weights) and to construct the choice tasks and prepare the conjoint questionnaire

*Computer Aided Personal Interview

Methods

Survey design/administration

In this part of the survey, we provide you different imaginary economic conditions to develop bioenergy production. Given these conditions, which type of biomass would you choose to produce bioenergy in order to support economic development in your country?

Please choose one option:

TYPES OF BIOMASS	Sugar-rich crops	Oil crops	Fast-growing trees
1. Energy security	Low domestic energy demand	High domestic energy demand	Low domestic energy supply
2. Technology progress	High R&D investment	Low R&D investment	High technology deployment
3. Market structure	High market incentives	Low market incentives	Good market infrastructure
	○	○	○

In this part of the survey, we provide you different imaginary social conditions that will result from bioenergy production. Given these conditions, which type of biomass would you choose to produce bioenergy in order to support social well-being in your country?

...se choose one option

...ES OF BIOMASS	Starch-rich crops	Agriculture/Forest residues	Perennial grasses
...ood security	Increase food self-sufficiency	Increase purchasing power	Increase affordability of food
2. Social welfare	Increase livelihood sources	Increase job opportunities	Improve household lifestyle
3. Social justice	Hinder equal property rights	Cause home displacement	Cause land dispossession
	○	○	○

In this part of the survey, we provide you different imaginary environmental conditions to develop bioenergy production. Given these conditions, which type of biomass would you choose to produce bioenergy in order to protect the environment in your country?

Please choose one option

TYPES OF BIOMASS	Oil-rich crops	Fast-growing trees	Sugar-rich crops
1. Production potential	Very high potential	Moderate potential	Very low potential
2. Resource capacity	Potential affected by population pressure	Put more pressure on natural resources	Improve landscape and species diversity
3. Land management	Support nature conservation	Compatible with organic farming	Available good farming practices
	○	○	○

Results
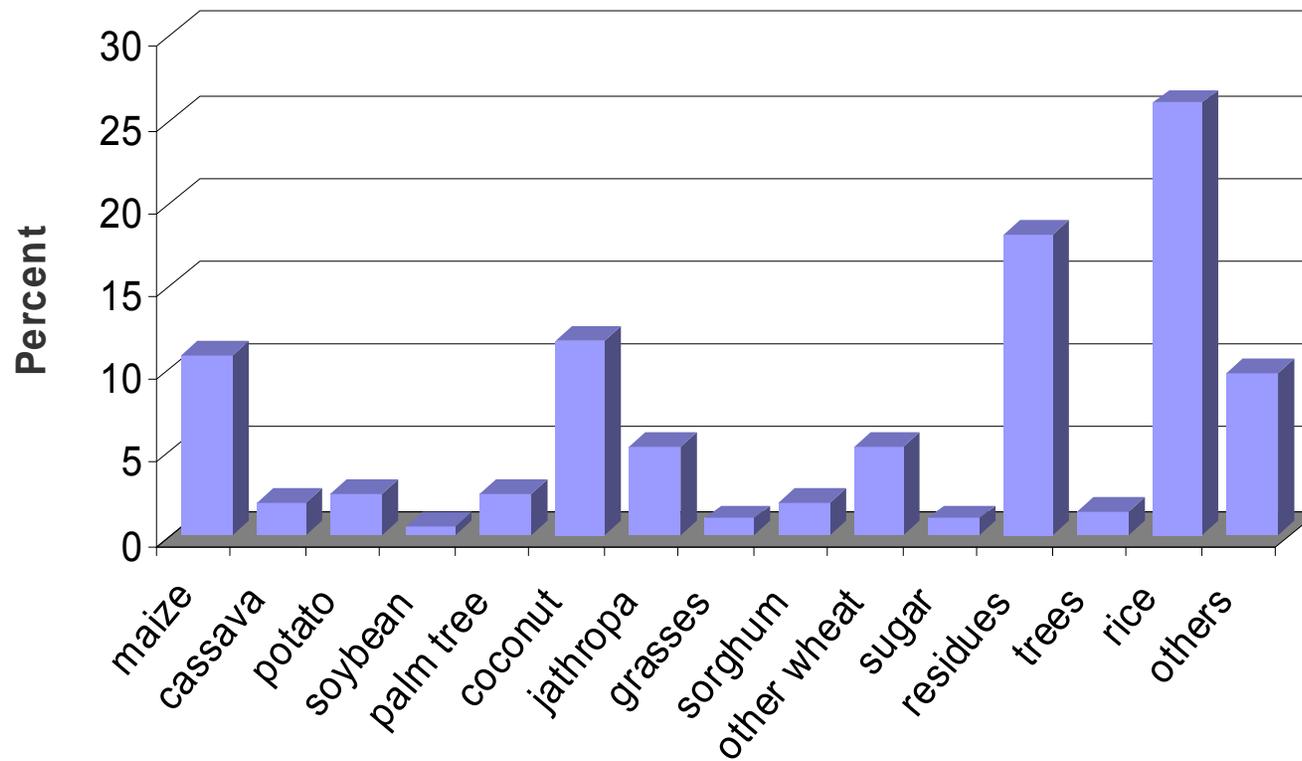
Production profile

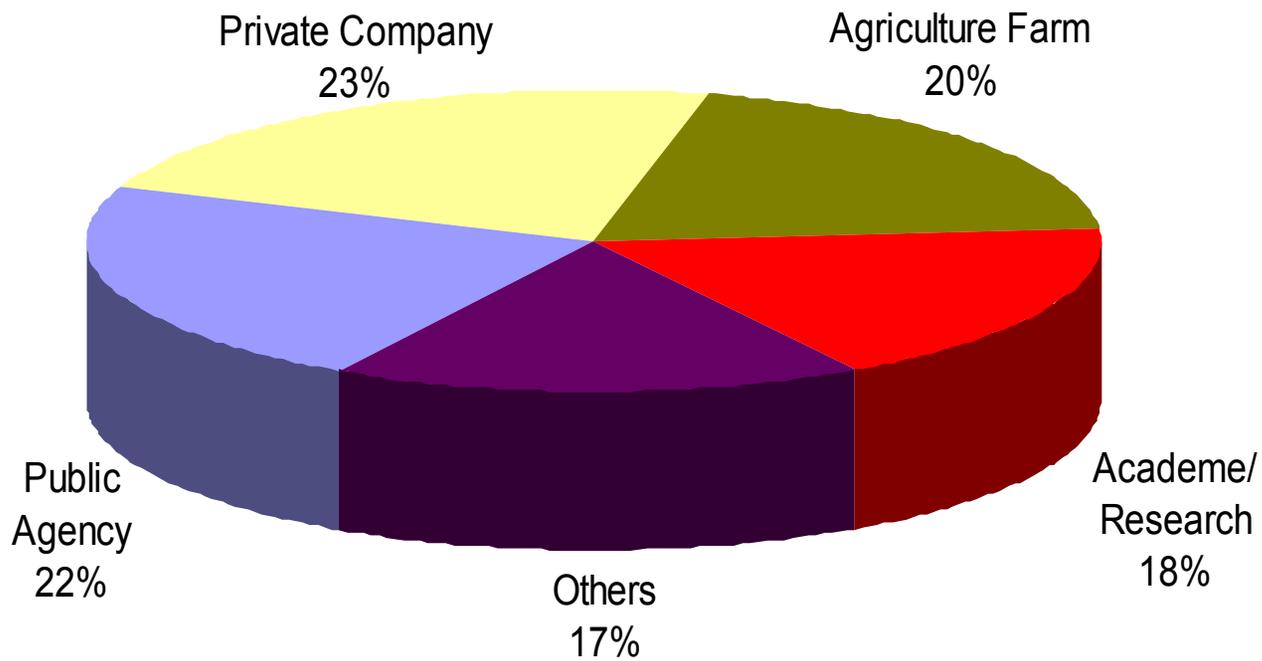Figure 4 Crops related to the work of the respondents

Results

Segmentation

Figure 3 Distribution of survey response by group of respondents

Results

Preference weights

Attributes	Respondent groups				
	Public Agency	Private Company	Agriculture/ Farm	Academe/ Research	Others
Economic Stability					
Type of biomass	33.46	30.21	32.36	28.77	28.10
Energy security	20.06	21.36	21.68	21.84	20.77
Technology progress	18.76	18.91	19.77	19.35	19.66
Market structure	27.72	29.53	26.19	30.04	31.47
Social Equity					
Type of biomass	23.27	20.42	29.77	20.21	20.97
Food security	22.93	23.10	23.10	22.89	23.94
Social welfare	29.49	31.97	26.15	31.61	31.17
Social justice	24.31	24.51	20.98	25.29	23.92
Resource productivity					
Type of biomass	19.41	17.83	25.83	17.32	18.19
Production potential	25.57	26.00	22.67	27.19	26.11
Resource capacity	26.50	25.83	25.84	25.97	25.75
Land management	28.53	30.33	25.66	29.52	29.95

Note: The preference weights (ω_{ij}) are in percent and the numbers in parenthesis are its standard deviation.

Table 6 Average preference weights of the different sustainability attributes, by respondents
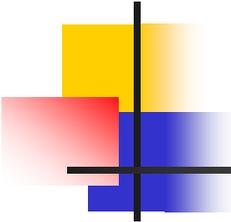
Results

1. sustainability of bioenergy production depends on the choice of biomass feedstock and these choices depend on people's perceptions, which are influenced by profession and experience

2. flow of knowledge between policy and business, either through work relations or media contributes to a common perception and thus awareness of the sustainability problem

3. farmers remain disconnected from this information network due to their lack of interactions with policy, science and business

4. farmers give most importance to type of biomass because they make direct decisions on land use; organic farming is also an important indicator for resource productivity

Results

Preference weights

Economic Stability

Social Equity
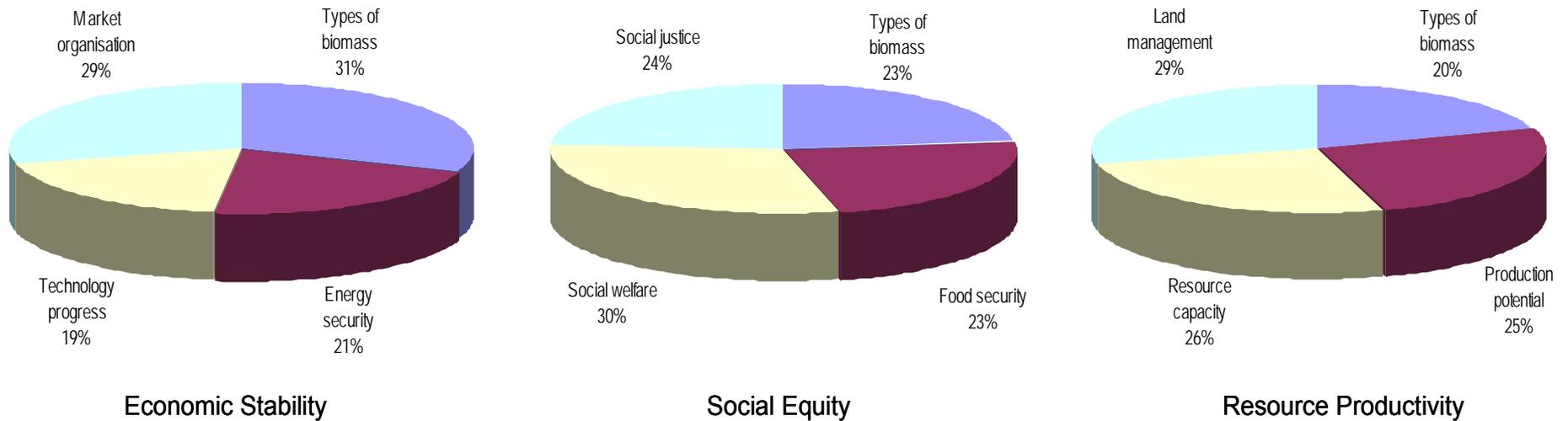
Resource Productivity

Figure 6 Distribution of preference weights among the different sustainability attributes
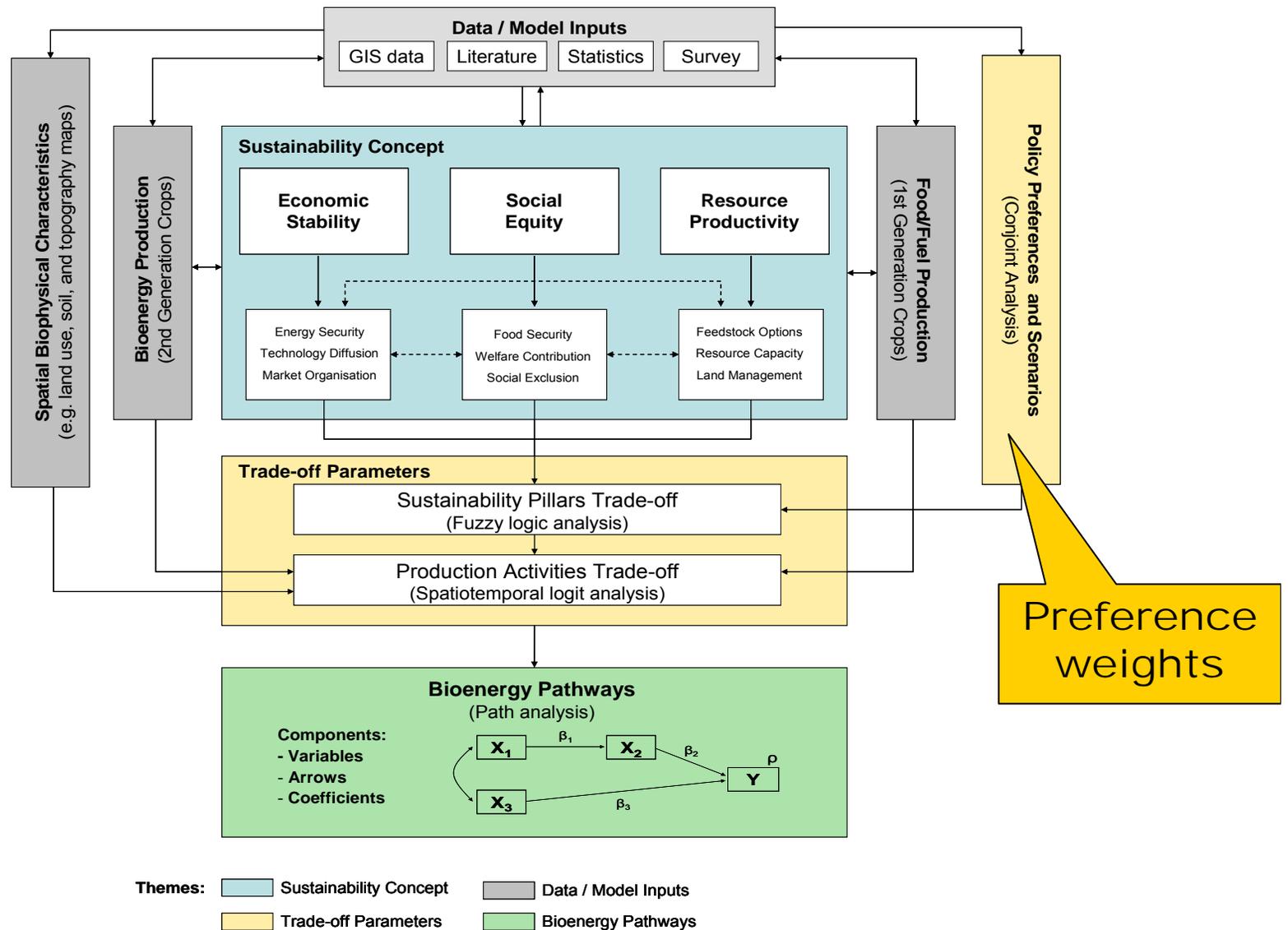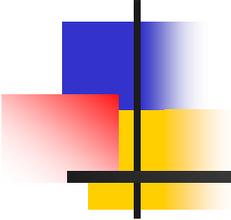
Utility of preference weights

Figure 4 Thematic and methodical framework of the hybrid approach STRAP

Thanks for your attention!