Public participation. Participatory Decision Making: Methods and Applications

Carlos Romero & Miguel Marchamalo
Universidad Politécnica de Madrid
miguel.marchamalo@upm.es

ecohidráulica

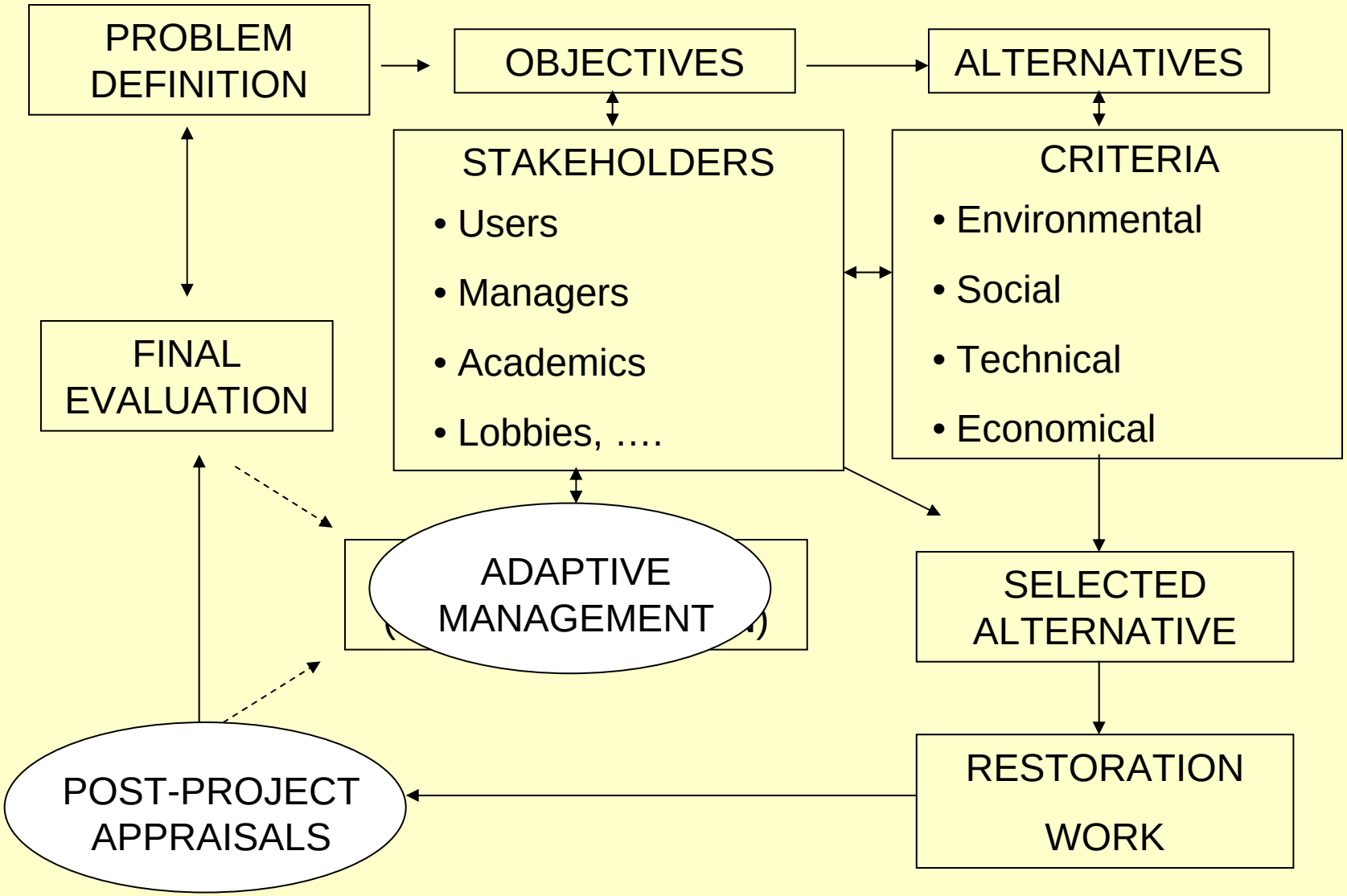
As an Index

1) PARTICIPATORY DECISION MAKING (GROUP DECISION MAKING)
   - Basic concepts
   - Application to natural resources management

2) CASE STUDIES
   - ENERGY PLANNING IN COSTA RICA.
   - LAND USE PLANNING IN A HIGH-PRIORITY ELECTRICITY PRODUCING RIVER BASIN.

Let me know any doubt or question that could arise.

RESTORATION PROJECT CYCLE



Complex decision problems

"Monocriteria" → Multicriteria

Technical problem

Economic problem

>> Complexity

The complexity is due to two main reasons:

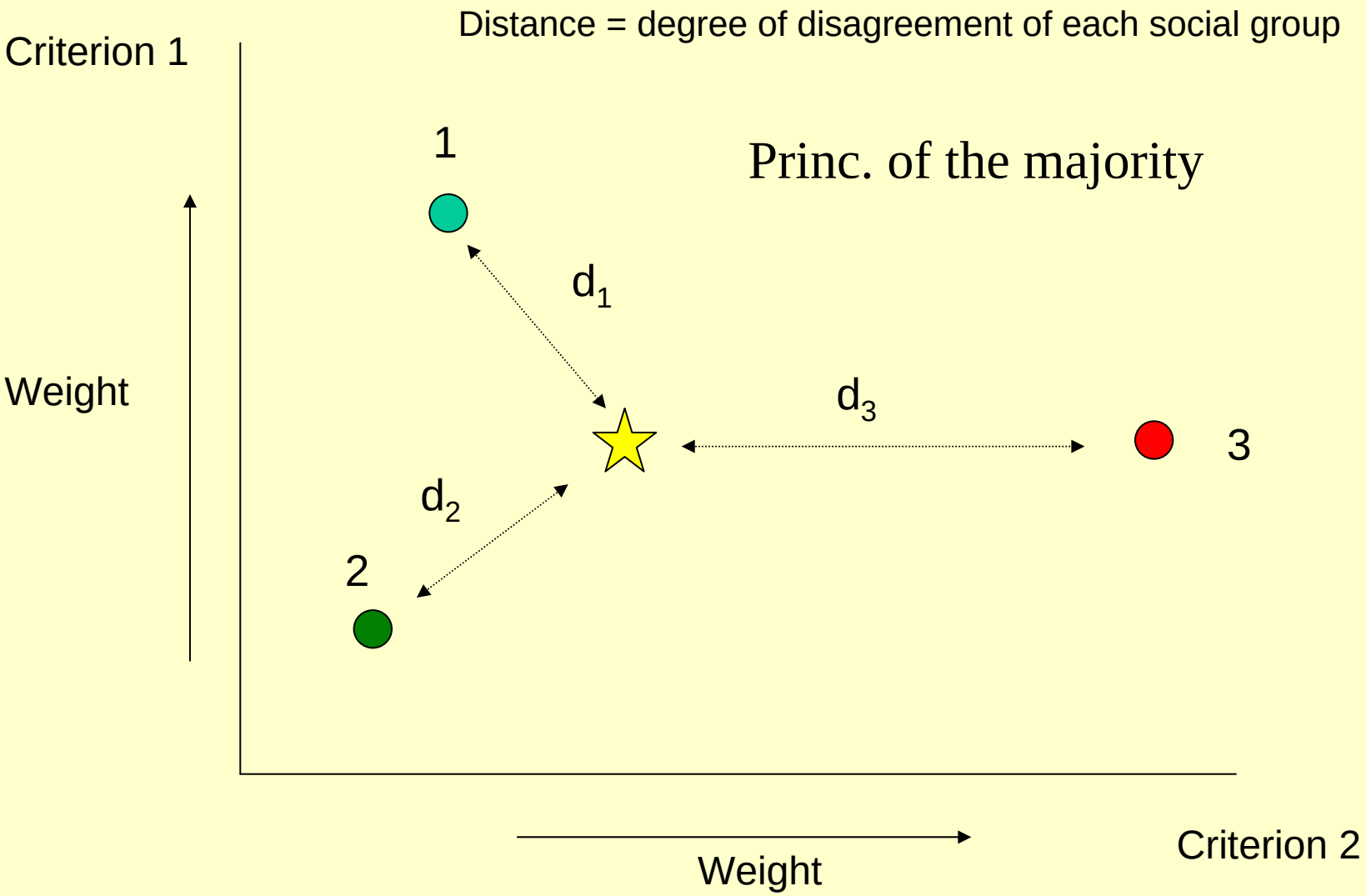
- The **multiplicity of criteria** of a very different nature (economic, environmental, social, etc) involved in the process,
- Presence of **several stakeholders (social groups)** with different views or perceptions towards these criteria (e.g., Georgopoulou, et al., 1998, Hobbs, 1995).

Participatory decision processes

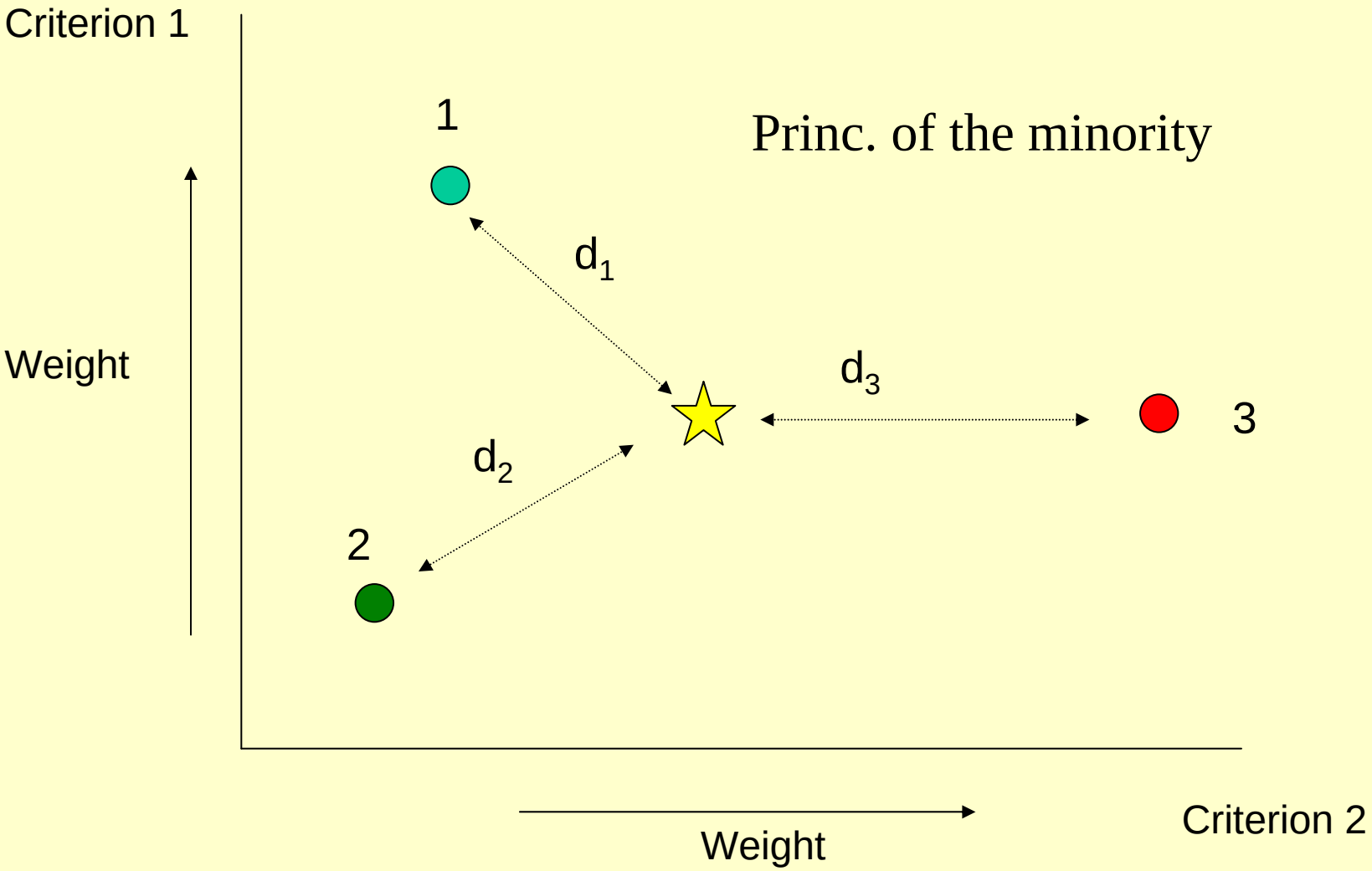
Participatory decision process (Applied Sc.) / **Social choice** (Ec.) / **Group decision making** (Oper. Res.)

1. Identify **criteria/ attributes and stakeholders**
2. Evaluate the **weight** assigned to each criteria per stakeholder
3. Aggregate preferences: **group preferences** (G.P.)
4. Social consensus: Different ways: (G.P.)
   - Principle of the majority MAX (aggregate agreement)
   - Principle of the minority MIN (maximum disagreement)

Distance based framework



Distance based framework (2)



For detailed methodology:

Linares, P. and C. Romero. 2002. Aggregation of preferences in an environmental economics context: a goal-programming approach. *Omega* 30 (2002) 89-95

González-Pachón, J. and C. Romero (2007). Inferring Consensus Weights from Pairwise Comparison Matrices. *Annals of Operations Research* **154**: 123-132.

Applications

a) analysis of the opinion of relevant stakeholders in the formulation of projects, plans or laws that imply a certain degree of social conflict;

b) resource allocation among different policies;

c) useful tool for the negotiation process between stakeholders at any level (international, national, regional, local)

CASE STUDIES

1) ENERGY PLANNING IN COSTA RICA (NATIONAL LEVEL).

- Costa Rican energy profile and land use planning
- Social preferences for energy planning in Costa Rica.

2) RESTORATION PROJECT IN A HIGH-PRIORITY ELECTRICITY PRODUCING RIVER BASIN.

- The problem.
- Social preferences
- Resource allocation for river basin restoration.

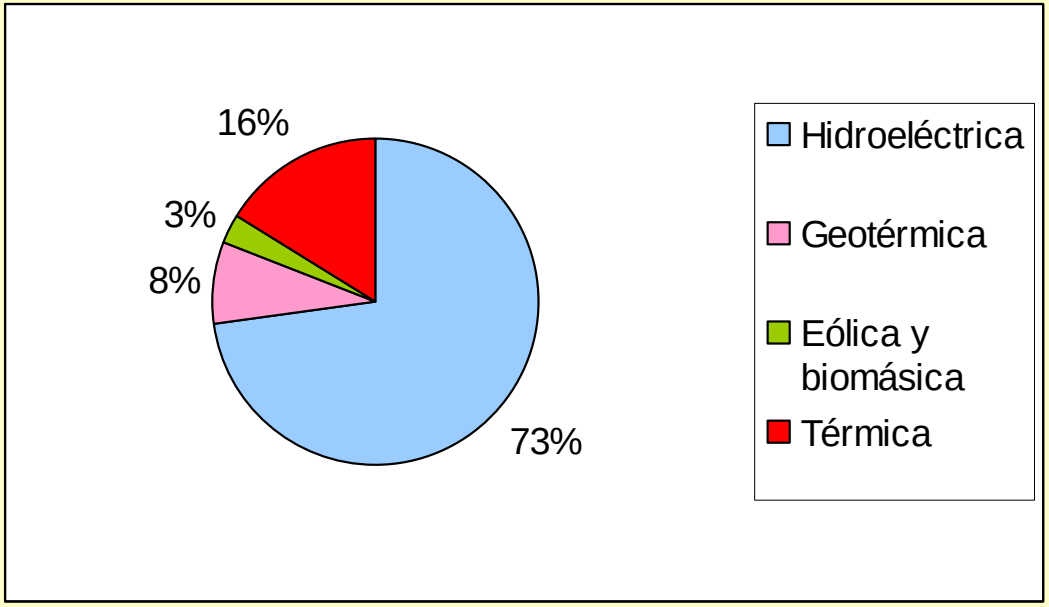
Marchamalo, M. and C. Romero. (2007). Participatory decision-making in land use planning: An application in Costa Rica. *Environmental Economics 63: 740-748*

Energy and land use planning

- ✓ Land use and electricity planning are complex decision problems due to the multiplicity of implied criteria, of very different nature (economic, environmental, social...) and by the way that the different social groups perceive these criteria.
- ✓ Nowadays electricity planning is considered a decision-making problem with several criteria and different decision makers (social group) involved (Linares and Romero, 2002).
- ✓ The search of a solution for these problems implies the development of participatory decision processes involving all the relevant social groups

Energy and land use planning in Costa Rica (I)

- ✓ The generation component is mainly hydroelectric in a 73%, 11% of the electricity comes from geothermal and aeolian sources, whereas the percentage of nonrenewable energy, thermal in this case, it is only of 16% (ICE, 2000).
- ✓ In the country there is no nuclear electricity generation nor is it sought in the short term.



Constraints and critical factors

- ✓ The hydroelectric potential of the country would not manage to cover the internal demand as of year 2026 if the construction of dams in the Protected Areas (National Parks and Protective Zones) nor in the Indigenous Reserves is not allowed (Portilla, 2002).
- ✓ The increasing resistance raised by indigenous and nonindigenous communities to the construction of new dams raises numerous questions for the future power development of Costa Rica.
- ✓ Critical factors in the future next will be: a) the satisfaction of the increasing power demand, b) the fulfillment of the international power commitments subscribed by Costa Rica (at regional level –SIEPAC, and international level-Protocol of Kyoto), c) the increase of the generation of renewable energy of the country, d) the viability of the future hydroelectric projects, e) the conservation of wild areas and f) the budget available for the expansion.

Two main strategies of electricity planning

Criteria (policies)

1. **Criterion COST** (Maintenance of the low cost and discharge accessibility of the electrical energy in the country).

2. **Criterion PERCENTAGE OF RENEWABLE ENERGY.**

3. **Criterion CONSERVATION OF WILD AREAS** (National Parks, Biological and Indigenous Reserves)

4. **Criterion STABILITY OF the POWER SELF-SUFFICIENCY** (as future power model of the country).

Methods

1) Identification of involved social groups (stakeholders) (expert choice, existing information and reports)
2) Individual preferences (paiwise comparisons of criteria) (Questionary Analytic Hierarchy Process (Saaty, 1980) (3 individuals / social group)
3) Aggregation of Group preferences (Goal Programming, principle of the majority, MAX (aggregate agreement))
4) Aggregation of social preferences (Goal Programming)
5) Social evaluation of alternatives:
    1) Consensus
    2) Analysis of disagreement
    3) Intra-group heterogeneity

Problem, criteria and social groups

PROBLEM	CRITERIA	SOCIAL GROUPS
ENERGY PLANNING IN COSTA RICA	**Cost**	**Generators**
	Percentage of renewable energy	**Academics**
	Conservation of wild areas	**Environmentalists**
	Stability of energetic self-suficienciency	—
NUMBER	**4**	**3**

4 criteria x 3 social groups

Individual preferences (Questionary)

Pairwise comparison matrix (Saaty, 1980)

Criterion	Criterion #1	Criterion #2	Criterion #3	Criterion #4
Criterion #1	**1**	**?**	**?**	**?**
Criterion #2	–	**1**	**?**	**?**
Criterion #3	–	–	**1**	**?**
Criterion #4	–	–	–	**1**

Number of criteria (n)

n(n-1)/2 verbal judgements (semantic, non-numeric)

6 comparisons in this case

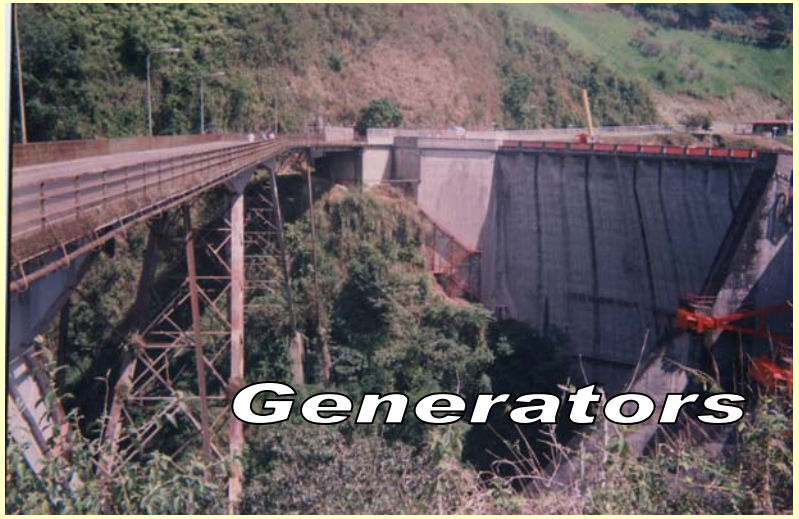
Individual preferences (Questionary)

Pairwise comparison scale (Saaty, 1980)

Intensity of importance	Definition	Explanation
1	**Equal importance**	**Two activities contribute equally to the objective**
3	**Moderate importance**	**Experience and judgement slightly favor one activity over another**
5	**Strong importance**	**Experience and judgement strongly favor one activity over another**
7	**Very strong or demonstrated importance**	**An activity is favoraed very strongly over another, its dominance demosntrated in practice**
9	**Extreme importance**	**The evidence favoring one activity over anogher is of the highest possible order of affirmation.**

Do you consider that (CRITERION i) is of Equal / Moderate / Strong / Very Strong / Extrem Importance with respect to (CRITERION j)?

Academics



Individual preferences

Generator #1	Cost	Conservation	Renewable	Self-suficiency
Cost	1,00	1	1/5	1/5
Conservation		1,00	1/7	1/5
Renewable			1,00	1
Autosuficiency				1,00

Individual preferences

ENCUESTADOS	CRITERIOS				IR	SUMA
	Coste	Conservación	Renovable	Autosuficiencia		
Generador nº 1	0,081	0,074	0,441	0,404	0,01	1
Generador nº 2	0,599	0,098	0,044	0,259	0,04	1
Generador nº 3	0,661	0,038	0,155	0,146	0,10	1
Académico nº 1	0,115	0,049	0,380	0,456	0,13	1
Académico nº 2	0,074	0,284	0,321	0,321	0,01	1
Académico nº 3	0,344	0,311	0,278	0,067	0,03	1
Ambientalista nº 1	0,059	0,444	0,444	0,053	0,00	1
Ambientalista nº 2	0,078	0,635	0,200	0,087	0,05	1
Ambientalista nº 3	0,036	0,607	0,255	0,102	0,17	1

Results

Group preferences

GRUPOS SOCIALES	CRITERIOS				SUMA
	Coste	Conservación	Renovable	Autosuficiencia	
GENERADORES	0,599	0,038	0,104	0,259	1,00
ACADÉMICOS	0,115	0,284	0,280	0,321	1,00
AMBIENTALISTAS	0,059	0,607	0,247	0,087	1,00
SOCIAL	**0,148**	**0,284**	**0,247**	**0,321**	**1,00**

$$MIN \sum_{i=1}^{q} \sum_{k=1}^{N_j} (n_{ik} + p_{ik})^{\pi}$$

s.t.

Goals:

$$W_i^j + n_{ik} - p_{ik} = a_i^{kj} \qquad i \in \{1,...,q\}, k \in \{1,...,N_j\}$$

$$MIN \sum_{i=1}^{q} \sum_{j=1}^{m} (\overline{n}_{ik} + \overline{p}_{ik})^{\pi}$$

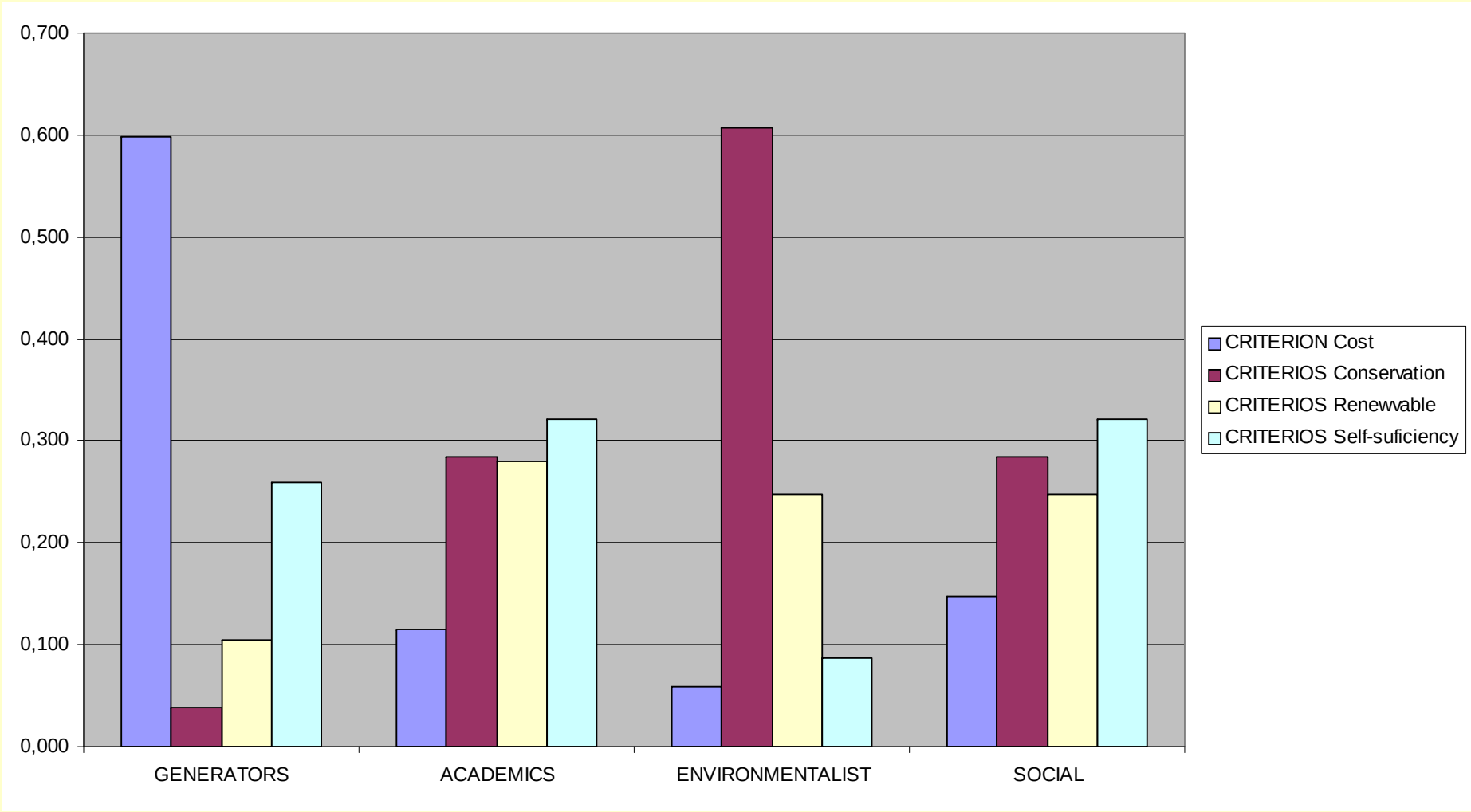
s.t.

Metas

$$W_i^S + \overline{n}_{ik} - \overline{p}_{ik} = W_i^j \qquad i \in \{1,...,q\},\ j \in \{1,...,m\}$$

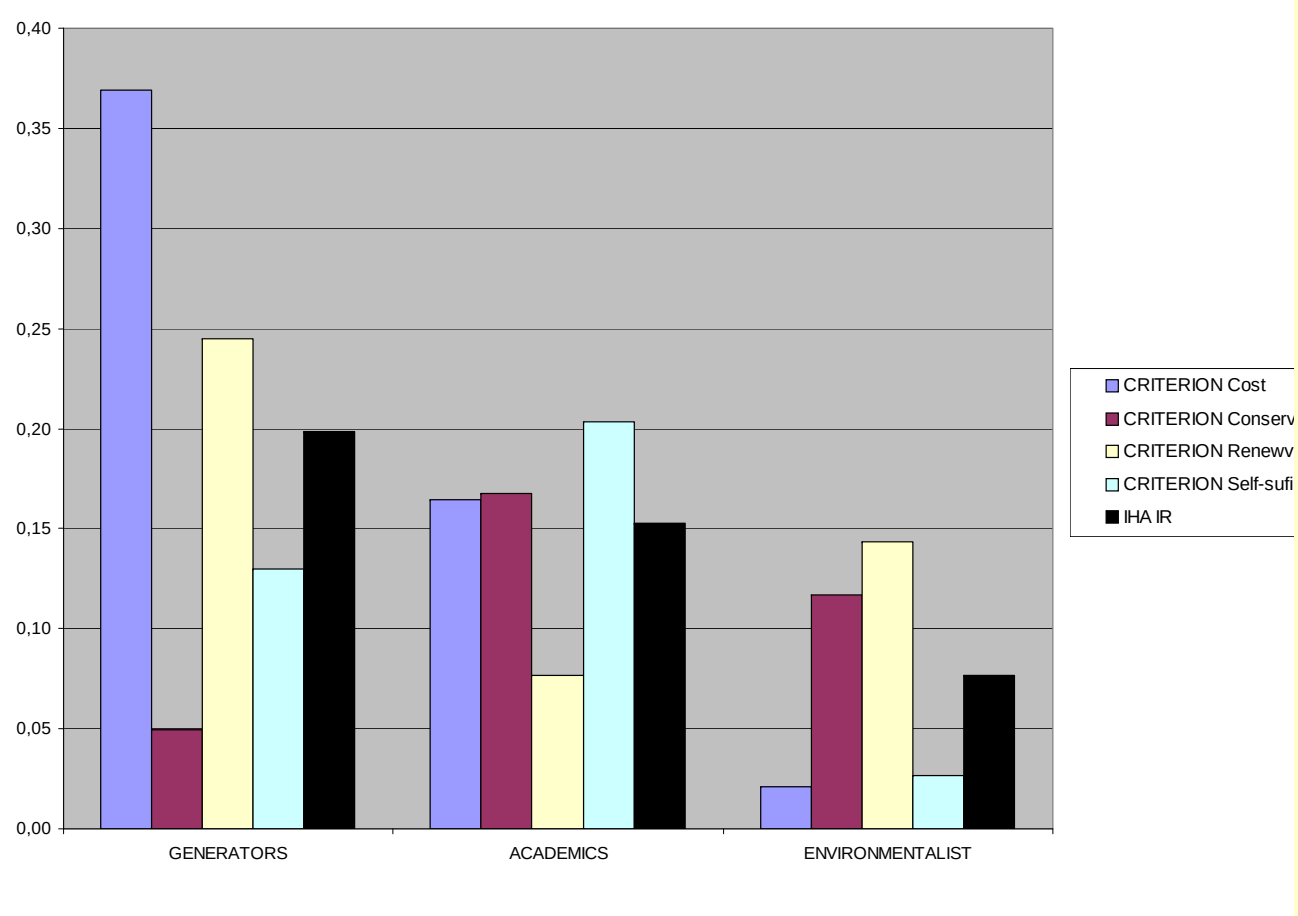
Results

Group preferences



Results

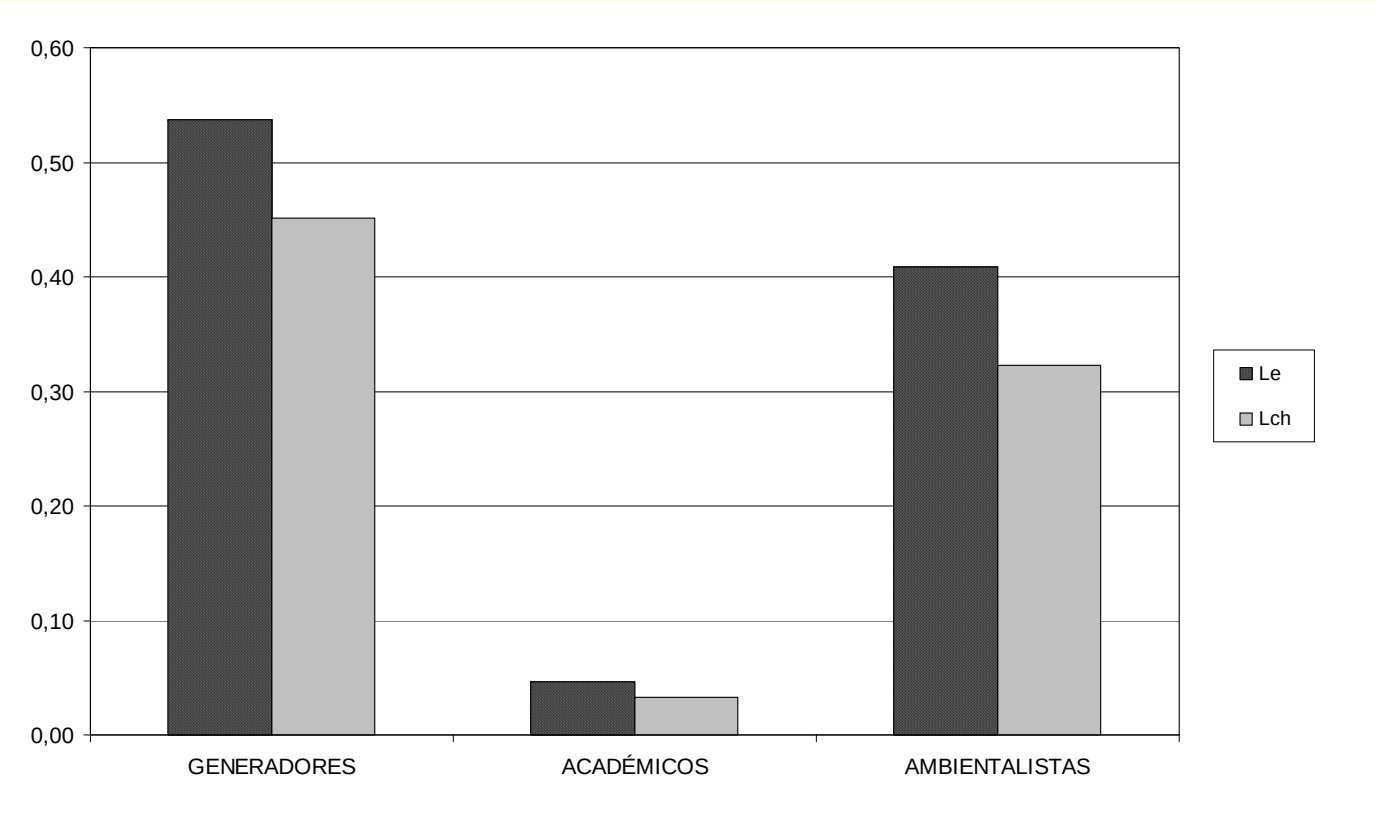
Intra-group heterogeneity (per Criterion and total)



$$IH_i^j = \sqrt{\frac{\sum_{k=1}^{N_j} (a_i^{kj} - W_i^j)^2}{N_j - 1}} \qquad i \in \{1,...,q\}, k \in \{1,...,N_j\}, j \in \{1,...,m\}$$

Results

Disagreement (Euclidean and Chebisev distance)



$$Le_j = \sqrt{\sum_{i=1}^{q} (W_i^j - W_i^S)^2} \qquad i \in \{1,...,q\}$$

$$Lch_j = Max\left(\left|(W_i^j - W_i^S)\right|\right) \qquad i \in \{1,...,q\}$$

Conclusions

1. Social consensus (maximizing aggregate agreement) was very close to academics judgement, whose disconformity was minimum.

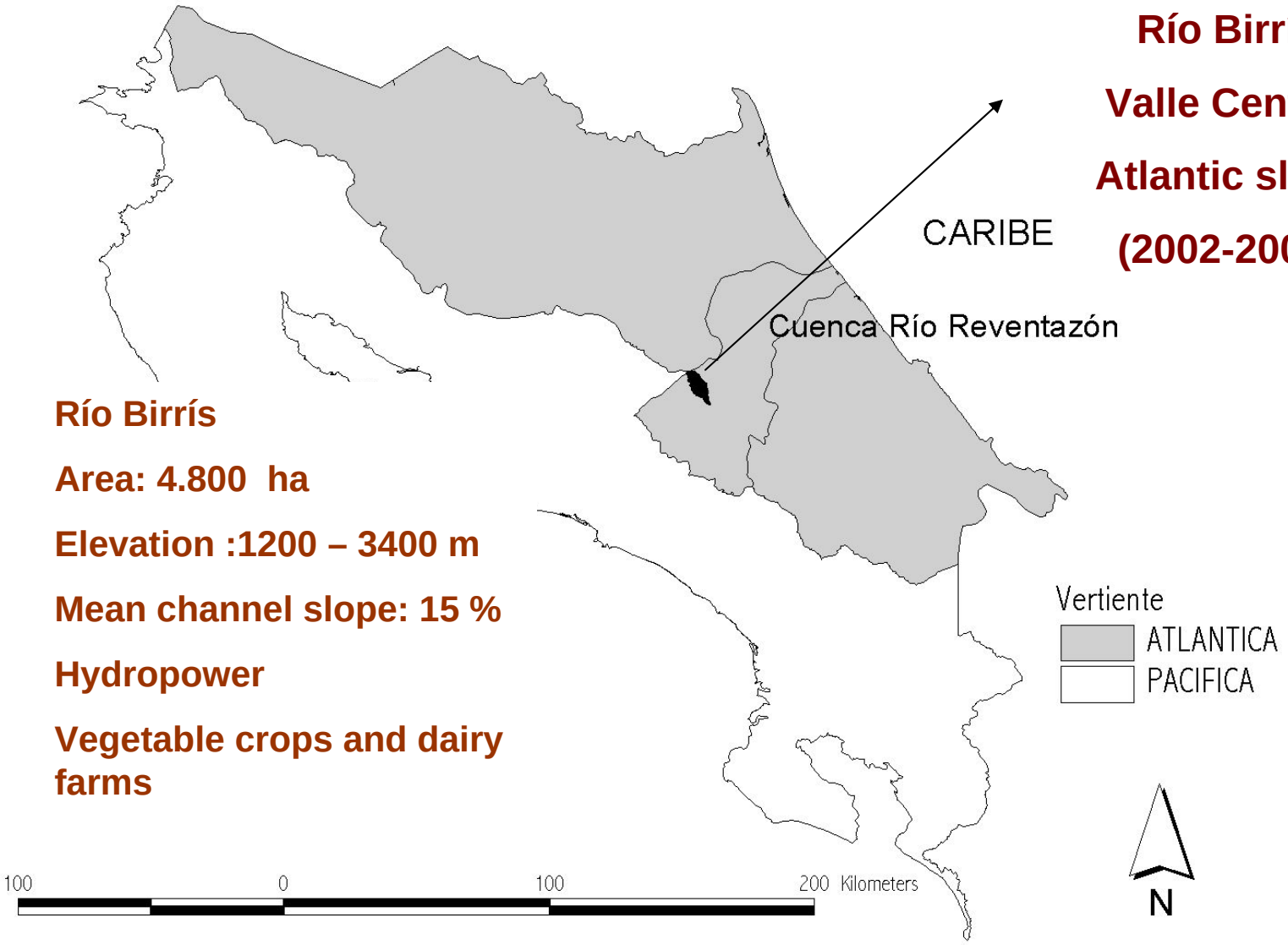
2. Generators and environmentalist showed jugdements more far from consensus, prioritizing cost (generators) and conservations (environmentalists).

3. Social consensus supports a self-suficient strategy, prioritizing the supply of national demand.

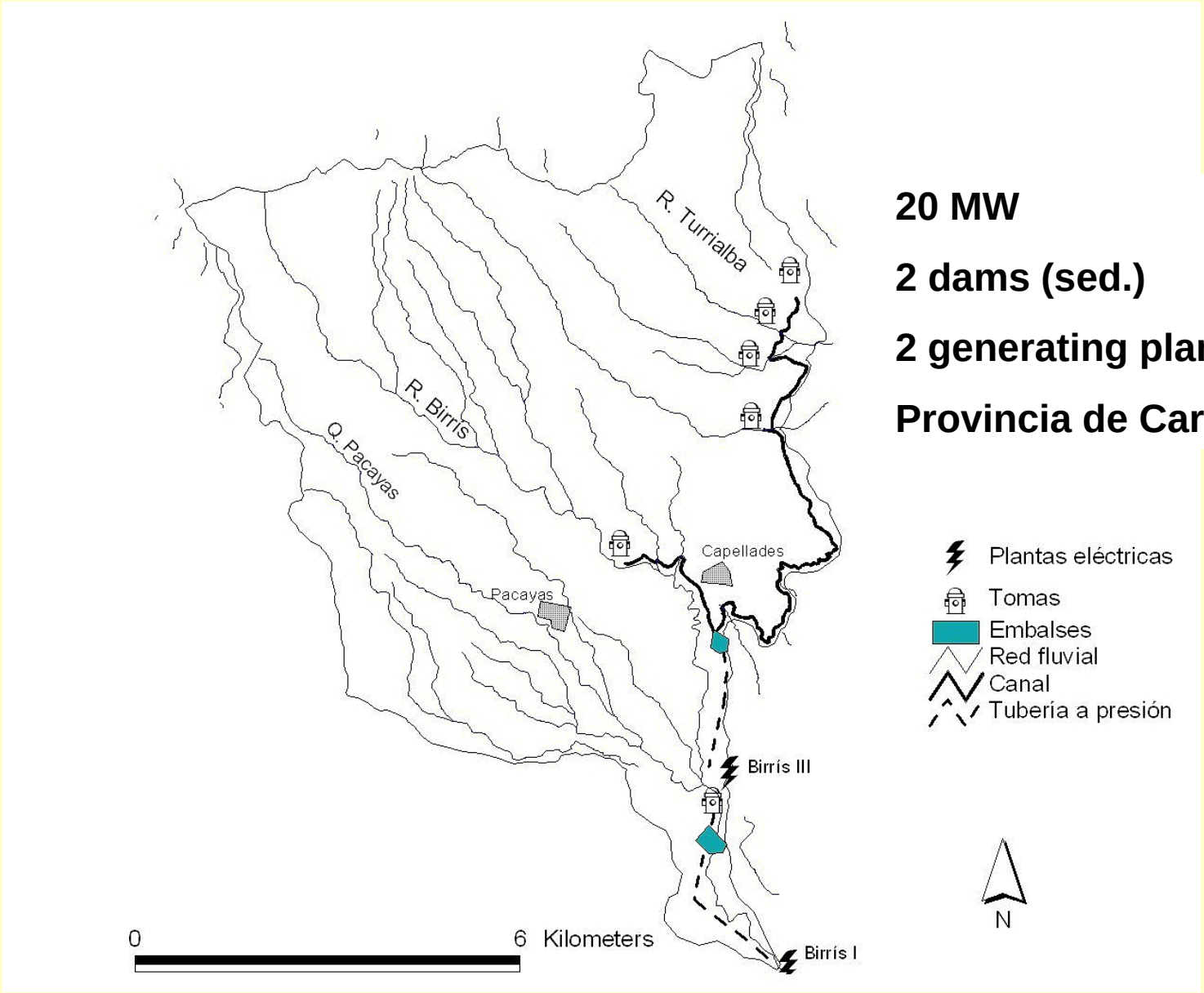
4. Generators conformed the most heterogeneus group, followed by academics and environmentalists. This last group showed high homogeneity in their judgements.


RESTORATION PROJECT IN A HIGH-PRIORITY
ELECTRICITY PRODUCING RIVER BASIN

Río Birrís


Río Birrís
Valle Central
Atlantic slope
(2002-2003)
CARIBE
Cuenca Río Reventazón
Río Birrís
Area: 4.800 ha
Elevation :1200 – 3400 m
Mean channel slope: 15 %
Hydropower
Vegetable crops and dairy farms
Vertiente
ATLANTICA
PACIFICA
100
0
100
200 Kilometers
N

HYDROELECTRIC BIRRÍS SYSTEM- SHB (JASEC)



20 MW

2 dams (sed.)

2 generating plants

Provincia de Cartago

Land use pattern in Rio Birrís Basin, Costa Rica

Soil erosion

R. Birrís

Q. Pacayas

Methods

1) Identification of involved social groups (stakeholders) (expert choice)
2) Individual preferences (paiwise comparisons of criteria) (Questionary Analytic Hierarchy Process (Saaty, 1980) (3 individuals / social group)
3) Aggregation of Group preferences (Goal Programming, principle of the majority, MAX (aggregate agreement))
4) Aggregation of social preferences (Goal Programming)
5) Social evaluation of alternatives:
    1) Consensus
    2) Analysis of disagreement
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Problem, criteria and social groups

PROBLEM	Criteria	SOCIAL GROUPS
EVALUATION OF ALTERNATIVES FOR LAND USE PLANNING OF BIRRÍS RIVER BASIN	**Farmer's income**	**Generators**
	Quantity and continuity of water resource	**Land use planners**
	Physical quality of water resource. Erosion-sedimentation.	**Farmers**
	Chemical and biological quality of available water resource.	**Academics**
	---	**Environmentalists**
NUMBER	4	5

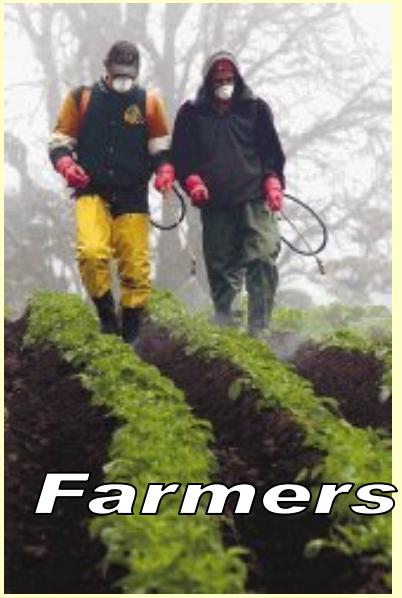
4 criteria x 5 social groups


Land-use planners


Generators


Academics

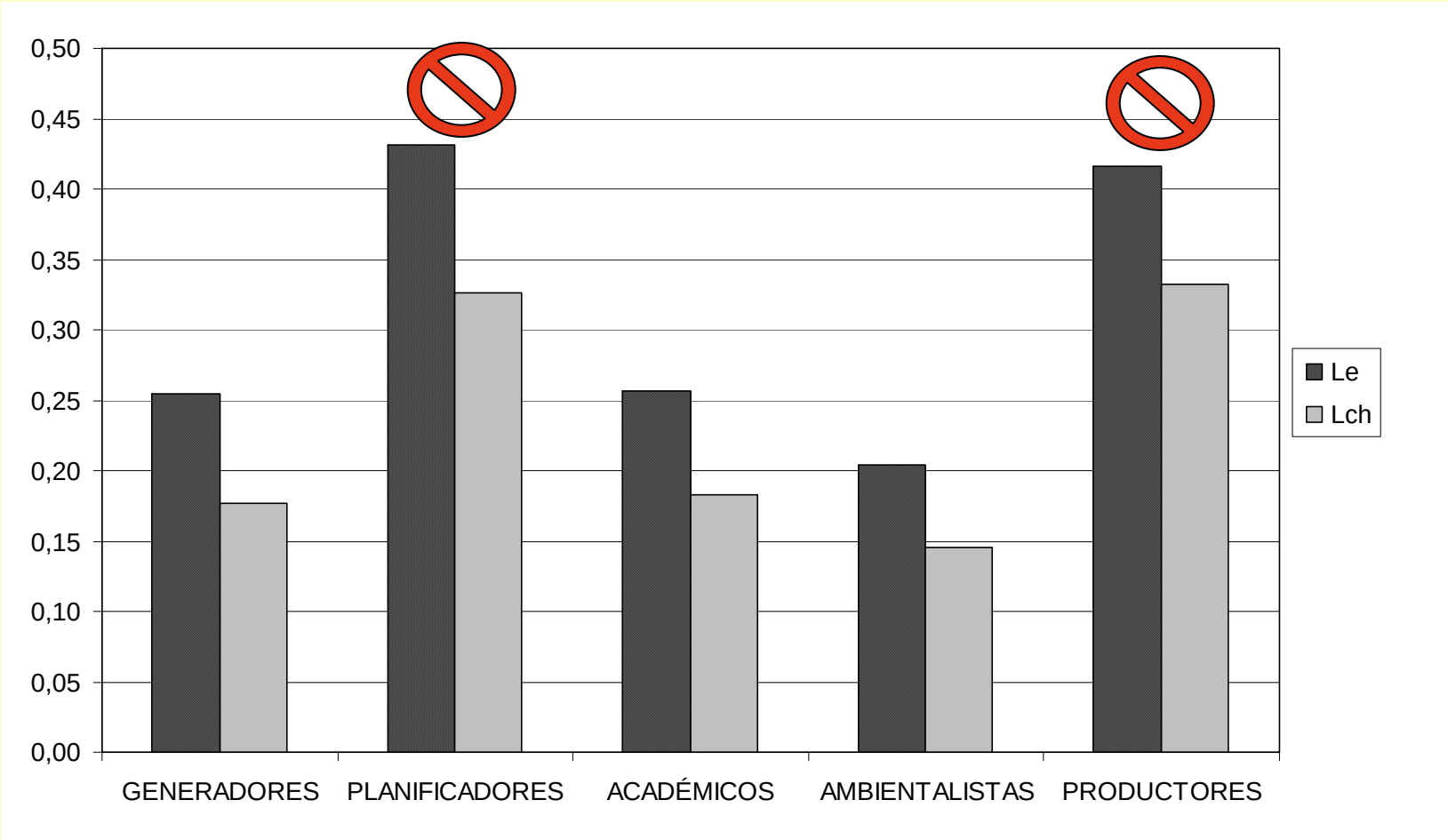

Environmentalists


Farmers

Group and Social Preferences

GRUPOS SOCIALES	CRITERIOS				SUMA
	Ingreso	Cantidad	Erosión	Calidad	
GENERADORES	0,043	0,429	0,427	0,101	1,00
PLANIFICADORES	0,085	0,111	0,576	0,228	1,00
ACADÉMICOS	0,082	0,210	0,250	0,458	1,00
AMBIENTALISTAS	0,087	0,533	0,105	0,275	1,00
PRODUCTORES	0,417	0,161	0,250	0,172	1,00
SOCIAL	**0,085**	**0,390**	**0,250**	**0,275**	**1,00**

Disagreement




Resource allocation for river basin restoration

Land-use scenarios (I)

- A - Status quo (no investment)
- B – Augmentation of forest cover (forest conservation ESP, 69 $/ha/año + reforestation)
- C – Promotion of sustainable farming (Investments in agroecological farms + forest ESP 43 $/ha/año)
- D - Balanced (Balanced allocation; ESP, 43 $/ha/año)

- Prospection period: 10 years
- Closed budget (internalization of environmental costs in the price of electricity)

Scenarios- Hypotheses (II)

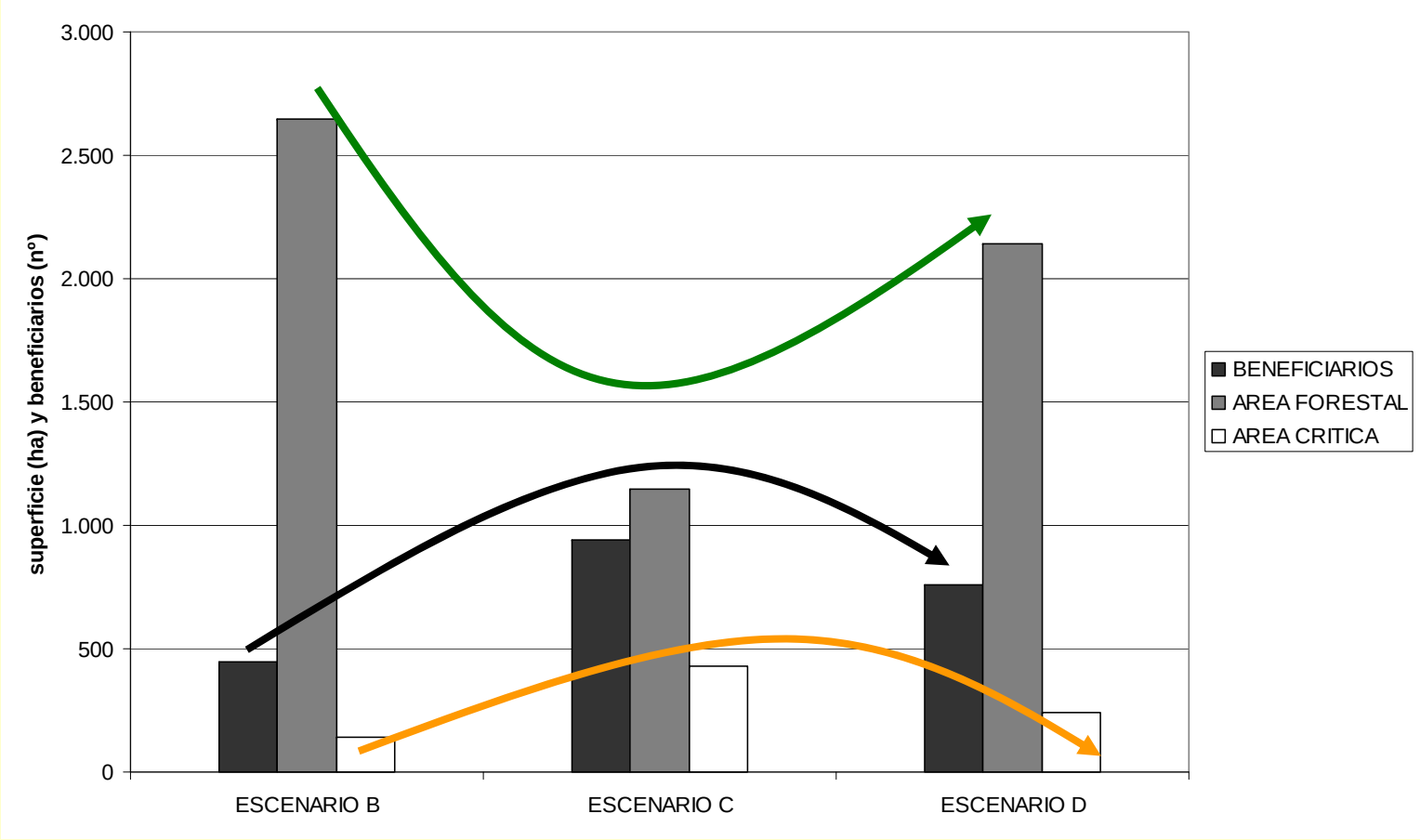
a) Same investment in environmental education and coordination
b) Erosion control as a transversal measure.
c) Continuity of demographic patterns and markets.
d) Continuity of the interest on electricity production.
e) Evaluation in actual economic units.
f) There is a linear relationship between employment and aggregate agricultural cash-flow.
g) Allocation: 1 ha agroecological pilot projects per farmer

Scenarios (III)

Investment allocation per programs in four scenarios of land use planning in River Birrís Basin

PROGRAMA	ESCENARIO A	ESCENARIO B	ESCENARIO C	ESCENARIO D
Calidad de agua	--	11%	11%	18%
Proyectos productivos	--	16%	49%	28%
Cobertura vegetal	--	49%	16%	30%
Educación y coordinación	--	24%	24%	24%
		Rf	**Ag**	**Eq**

Scenarios (IV)



Inversión en área forestal, área crítica y beneficiarios de los escenarios propuestos para la ordenación de la cuenca del río Birrís

Evaluation – Social Preferences

	ESCENARIO A	ESCENARIO B	ESCENARIO C	ESCENARIO D
GENERADORES	--	0,36	0,28	0,32
PLANIFICADORES	--	0,35	0,34	0,36
ACADÉMICOS	--	0,23	0,21	0,24
AMBIENTALISTAS	--	0,25	0,16	0,21
PRODUCTORES	--	0,23	0,29	0,26
SOCIAL	--	0,28	0,21	0,25
		Rf	**Ag**	**Eq**

Social evaluation of land use scenarios

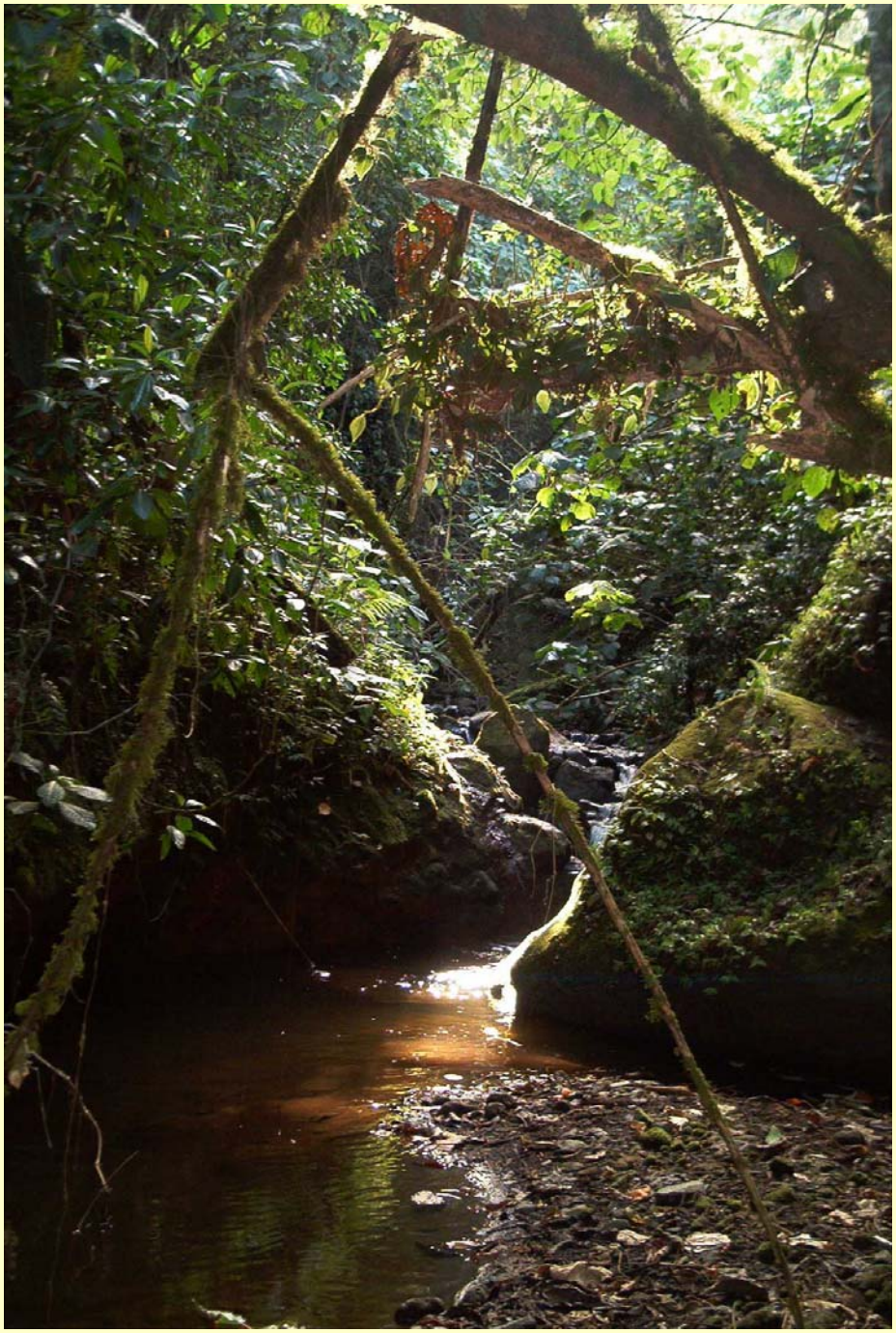
Conclusions Preferences

• Analysis of preferences is a **helpful tool in natural resources planning, as river basin restoration**. It helps to **identify points of conflict and coincidence** between different social groups and can lead to a **negociation process** to achieve real consensus.

• We have **sucessfully characterised the structure of preferences** of various social groups involved in complex decision problems in natural resources planning.

• **Calculation procedures are simple**, implying the solution of a discrete number of lineal programs.

• We have obtained **social consensus solutions** applying the principle of majority. Other alternatives include the minimization of maximum disagreement (principle of the minority) and the asignement of weighted coefficients to each group, dependind, i.e., on their political influence.



Acknowledgements:

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Thank you!

miguel.marchamalo@upm.es

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