Environmental management options: tradeoffs and synergies

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Key objectives

1. Highlight decision support system in environmental management options (mainly communally owned NR.) NR.)

2. Demonstrate the application of the MCA in Sustainable env. Mgt (with a case study from comm. forest mgt in Northern Ethiopia)

3. Draw implication to PES

    BESSA-PRESA Training workshop, Nairobi; **25/03/09**

Environmental management options: tradeoffs and synergies

An environmental management option chosen by decision maker (s) may exhibit one of the following: following:

I. 'Win-win' (synergies, compatibilities): Examples

(a) Soil erosion and water quality measures: both economic and and environmental advantages in terms of land productivity; improving drinking water quality (human health benefit); improved improved aquatic ecology, etc.)

(b) Decreasing the application of commercial fertilizer in agriculture without a decline in agricultural output

(c) Restoration of degraded woodland/wetland: biodiversity, wildlife, aesthetic values, recreation values, wood/wetland products (if harvested in a sustainable manner)

Environmental management options: tradeoffs and synergies

II. Tradeoffs and conflicts/ 'win-lose': Examples

(a) Trade-offs between **economic and environmental** goals: Eg. Eg. agricultural production and environmental performance
(b) Environmental objectives may conflict with one another
(c) inter-generational and inter-temporal tradeoffs/conflicts

III. 'Lose-lose' situations (worst scenario): Examples

(a) traditional agricultural practices in Ethiopian highlands: environmental degradation and productivity loss
(b) over fertilization of farm fields

(c) Overgrazing

(c) more examples (-----)

Northern Ethiopia, Tigray

Highly degraded land
(poor farming practices, overgrazing)

Managed grazing land

Crop land

vegetation regeneration

Crop land

Crop land

Environmental management options: tradeoffs and synergies

Big Policy questions:

- ❖ How to reconcile econ. and environ. objectives?
- ❖ How to manage natural/environmental resources sustainably?
- ❖ Choice of environmental management options
- ❖ Design of econ-ecol. compatible environmental policy
- ❖ Economic costs of env. management (cost min.; equity/distributional issues)
- ❖ Environmental effectiveness of alternative management management options (max.)
- ❖ etc.

Tools for analyzing tradeoffs and synergies:

1.   Conventional Economic Approach

   ➤   Evaluate the economic efficiency of preserving/restoring (eg. (eg. CBA): (a) both costs and benefits are measured in monetary units, and (b) discounting future flows (big arguments)

   ➤   Focus on commodity-based resource management (production of   food, fiber, forage)

   ➤   Does not ensure sustainability of essential ecological services

   ➤   Single objective oriented

   ➤   Methodological difficulties

Tools for analyzing tradeoffs and synergies

2. Ecosystem Approach

- Requires evaluation of broad array of ecological services

- A shift in focus to protection and restoration of ecosystems

- ***Focus on achieving and sustaining a balance between and human and ecological services*** (*such as air and water purification, mitigation of floods and drought, detoxification and and decomposition of wastes, generation and renewal of soils, soils, maintenance of biodiversity and stabilization of climate change*)

- Participatory (community-based)

- Doesn't rely on monetary value to ecological services

- **Allows consideration of multiple attributes** (compatible with MCA)

- **Incorporates multiple stakeholders/objectives** (compatible with MCA)

- In rational decision making environment, the most preferred choice is bounded by the management objectives & the constraints that limit the choices.
- Instead of having one objective/criterion, MCDM considers multiple objectives/criteria (as described below)

$$optimize\ Z_1 = f_1(x_1,\ x_2,\dots,\ x_n)$$
$$optimize\ Z_2 = f_2(x_1,\ x_2,\dots,\ x_n)$$
$$.$$
$$.$$
$$optimize\ Z_k = f_k(x_1,\ x_2,\dots,\ x_n)$$

Sub. To various constraints

where Z_1, Z_2,…, Z_k are the different criteria.

*If all the f_1, f_2,…f_k are known functions: special MCDM called **multi-obj. programming***

*If some or all of the f_i's are discrete non-functional relationships: **multiple attribute decision making** and can be treated within the framework of C& I measures.*

Tools for analyzing tradeoffs and synergies

MCA/MADM/MCDA

Is a general decision-making tool developed for decision problems involving complex multiple criteria/dimensions that that include qualitative and/or quantitative aspects.

This is **not a single method**. It comprises group of methods. Several MCDM have been developed. MCA, as as applied to natural resource management, includes **multiple stakeholders' interests and views** of **both qualitative and quantitative** nature and hence provides an appropriate tool for addressing the methodological challenges involved in NRM assessment

Illustration: AHP-MCA

Tools for analyzing tradeoffs and synergies

MCA/MADM/MCDA

Analytic Hierarchy Process (AHP): is a method based on the **priority theory**. It is capable of breaking down a complex unstructured situation into its component parts. Arranging these these parts in an hierarchical order and assigning numerical values based on subjective judgments and the relative importance on a numerical scale of (usually from1 – 9), the judgments are synthesized to evaluate the <u>relative importance of importance of criteria</u>, <u>performance of resource management management scheme</u>, and <u>determine the overall priority of alternative resource management scenarios</u> (Source: Mandoza and and prabhu,1999; 2000; 2003)

AHP-MCA: IS BASED ON DEVELOPING HIERARCHICAL STRUCTURE OF **C&I** ELEMENTS FOR RESOURCE/ENVIRONMENTAL MANAGEMENT

Broad objectives/Principles

Criteria

Indicators

Verifiers
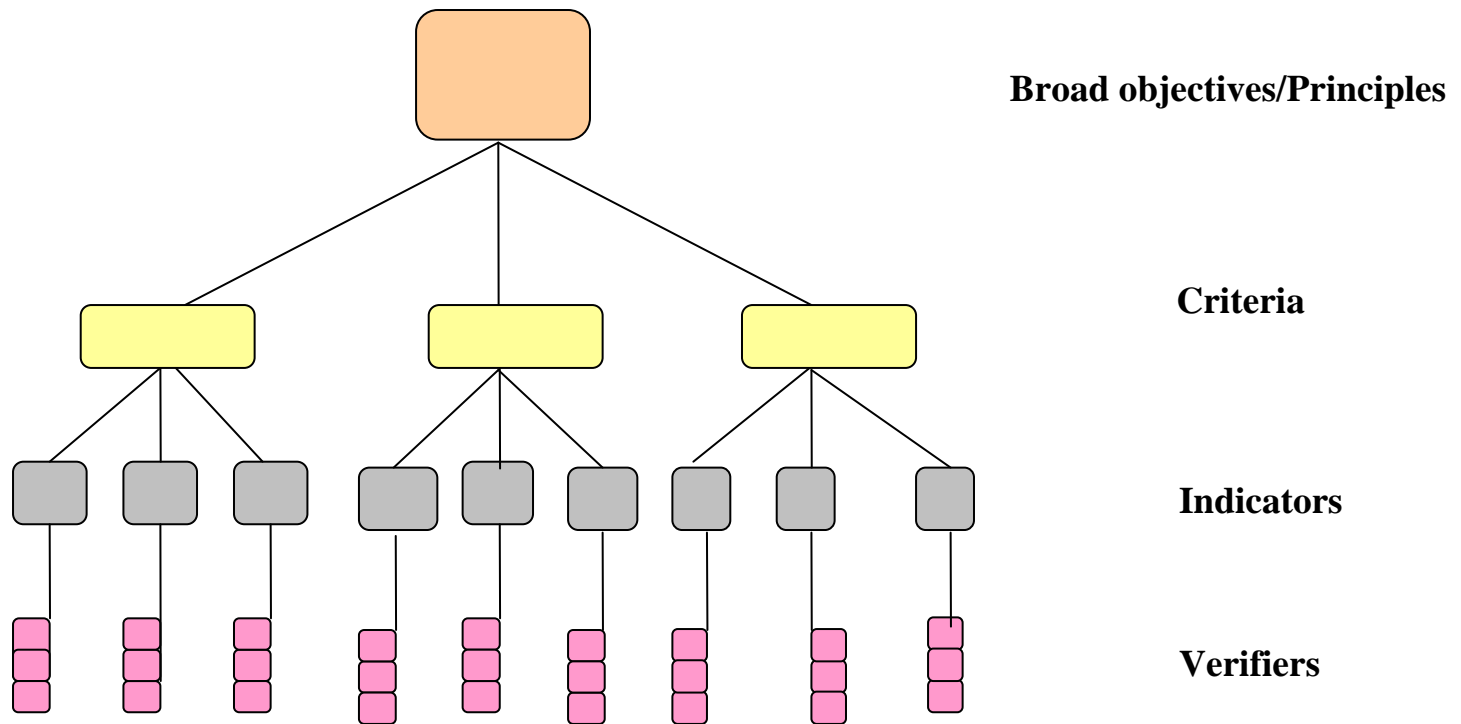
AHP-MCA Approach

- **AHP-MCA methods:** (Ranking; pair-wise comp. (PWC); and Scoring) of the C&I elements.

- **Ranking**: assigning a 'rank' to each C&I element

  (9-point scale was used: **1=weakly important; 3= less important; 5= moderately important; 7= more important; 9= extremely important. 2, 4, 6, and 8 are intermediate assessments)**

- **PWC**: one-on-one comparison between each C&I elements

  (9-point numerical scale was used: 1=equal importance; 3= moderately more important; 5= strongly more important; 7= very strongly more important; 9=extremely more important.

  2, 4, 6, and 8 are intermediate assessments)

- **Scoring**: judge the **_current condition_** of each C&I element relative to **_desired condition_**

  (1= poor/unfavourable; 3= fair but below average; 5= average and acceptable; 7= good condition; 9= excellent/outstanding performance; and 2, 4, 6, and 8 are intermediate judgments)

Practical implementation: AHP-MCA

- Identify the multiple objectives of the resource system (**management objectives**): Obj.$_1$; Obj.$_2$; … ; Obj.n

- Develop C&I sets (identify C&I sets; and evaluate them: (ranking, (ranking, rating, PWC…); involves multiple stakeholders

- Evaluate the relative importance of C&I elements

- Evaluate the performance of the existing resource management management system

- Design alternative mgt options; Evaluate the various management options; Ranking different management options

- Choice of management decision (change existing management management system or introduce improvement…)

- **Relevance to PES/RES:**

- Inducing the uptake of new management options entails compensation

i) **Focus group discussions** with 18 selected groups (in 12 villages) (6 women, 6 men, 6 local leaders) to elicit views views and perceptions of the local people

ii) **Stakeholder workshop on C&I**: (socio-economists; local extension workers; community leaders, local admin. leaders; local religious leaders; guards of comm. forests; forests; SWC experts, & *woreda* agriculture office; foresters

iii) **Interviews with key informants** (agri. Bureau-Mekelle & H/selam; REST-H/Selam)

iv) **Experts**: for identifying alternative forest mgt. scenarios and scoring

- The local C&I sets:

  Two broad objectives (principles) :ecol. & econ.); **six criterion** (vegetation regeneration, SWC, econ. benefits, enabling institutions, local awareness, & buffer zones); and **43 indicators** were identified.

- The analysis was based on the six criteria and the 43 indicators. The set of criteria & indicators were synthesised to assess forest sustainability (Mendoza & Prabhu,2000a,b).

- Relative importance of <u>Criteria</u> (on the basis basis of stakeholders' preferences) :

1st local awareness;

2nd vegetation regeneration;

3rd econ. benefits;

4th enabling institution.

– – – ➤

Criteria	Ave.wt*.	SD	Rel. wt.(%)
• C1. Natural regeneration of vegetation or forests should be enhanced	7.54	1.56	17.44
• C2. The soil and water conservation effect of exclosures should be enhanced.	7.31	1.44	16.90
• C3. Management of exclosures should maintain/ enhance the flow of economic benefit	7.38	1.19	17.08
• C4. Enabling institutional conditions should be put in place	7.38	1.39	17.08
• **C5. Adequate knowledge and awareness**	**8.46**	**0.98**	**19.57**
• C6. Functioning buffer zone should exist.	5.15	1.67	11.92

- Performance evaluation: Does the existing mgt. perform well w.r.to the criteria **(on the basis of the C&I sets)?**

 (Ans.): In a 9-point performance score, except the 'SWC criteria', all other sustainability criteria are performing below the average performance level.

  The **most preferred criterion** in terms of importance for the SFM i.e.('local awareness') shows the **least performance score** at existing forest mgt.

Implication: existing management of community forestry in the case study area appears to be poor and not sustainable.

Indicators	average scores	SD. of scores	Relative weights		indicators	average scores	SD. of scores	Relative weights	
			RM[a]	PWC[b]				RM[a]	PWC[b]
Criterion (1)									
I1.1	3.23	1.96	23.78(1)▲	27.33(1)	I4.3	4.38	2.10	11.81(1)	17.98(1)
I1.2	3.31	2.53	16.44	7.97	I4.4	4.00	2.08	9.53	8.22
I1.3	3.69	1.97	20.67(2)	20.57(3)	I4.5	3.85	2.19	10.73(3)	9.41
I1.4	3.69	2.06	19.78(3)	19.06	I4.6	4.15	1.82	10.18	10.59
I1.5	2.38	2.22	19.33	25.07(2)	I4.7	3.54	1.66	10.62	11.96(3)
Criterion(2)					I4.8	3.15	1.14	9.86	9.55
I2.1	5.77	1.92	20.61(1)	35.92(1)	I4.9	3.46	1.20	9.32	8.85
I2.2	4.54	1.39	16.27	12.94	I4.10	1.50	1.96	5.96	*
I2.3	4.38	1.19	17.54(3)	19.34(2)	**Criterion (5)**				
I2.4	4.54	1.71	15.73	13.34	I5.1	3.15	1.68	15.13(1)	26.46(1)
I2.5	5.54	2.07	18.08(2)	18.46(3)	I5.2	1.92	1.61	13.03(2)	16.88
I2.6	3.42	1.98	11.75	*	I5.3	1.46	1.13	11.71	14.01
Criterion (3)					I5.4	2.15	1.72	12.11	16.90(3)
I3.1	4.00	1.63	13.68(1)	25.45(1)	I5.5	3.00	1.78	12.63(3)	25.75(2)
I3.2	5.85	2.79	12.11(2)	13.86	I5.6	2.69	1.44	11.97	*
I3.3	2.92	1.55	11.71	12.65	I5.7	2.62	1.45	11.84	*
I3.4	1.69	1.32	10.53	11.55	I5.8	2.77	1.92	11.58	*
I3.5	2.77	2.24	11.71	20.06(2)	**Criterion (6)**				
I3.6	4.15	2.44	11.97(3)	16.43(3)	I6.1	0.85	1.14	14.21	8.16
I3.7	5.23	2.74	12.11(2)	*	I6.2	3.00	1.87	20.37(1)	26.80(1)
I3.8	4.77	2.09	9.21	*	I6.3	3.77	1.74	16.07	12.07
Criterion (4)					I6.4	4.23	2.01	17.01(2)	13.74
I4.1	5.31	2.21	11.27(2)	13.26(2)	I6.5	1.92	1.80	16.45(3)	16.34(3)
I4.2	3.00	2.35	10.73(3)	10.18	I6.6	3.15	2.48	15.89	22.90(2)

- Analysis of alternative mgt. scenarios:

✓ **Six** forest management scenarios were identified:

A1:existing mgt system (partial grazing; partial cut-and-carry system)

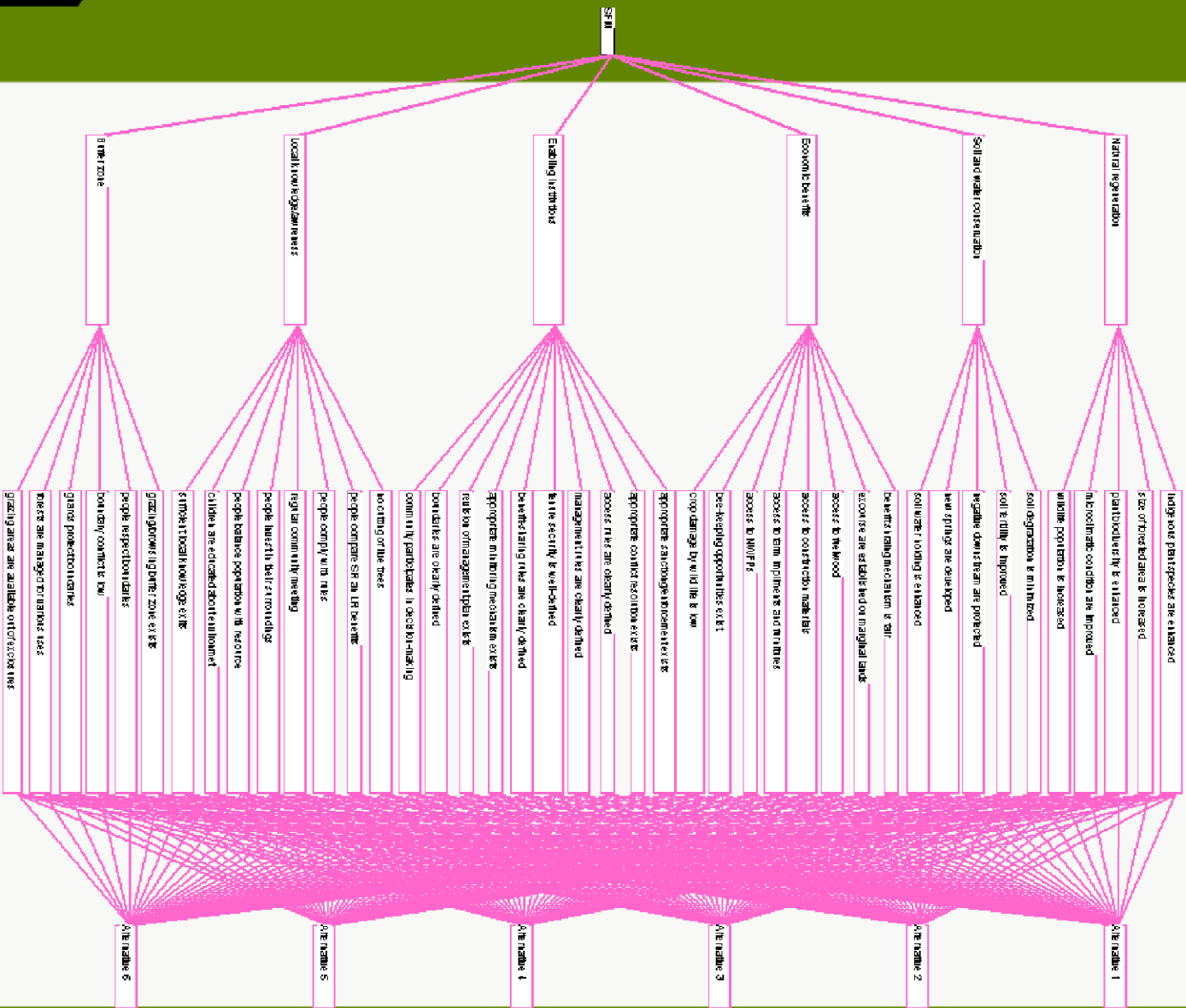**A2:** reference scenario (open access scenario)

A3: no access scenario

A4:cut-and-carry, controlled pruning and controlled thinning thinning
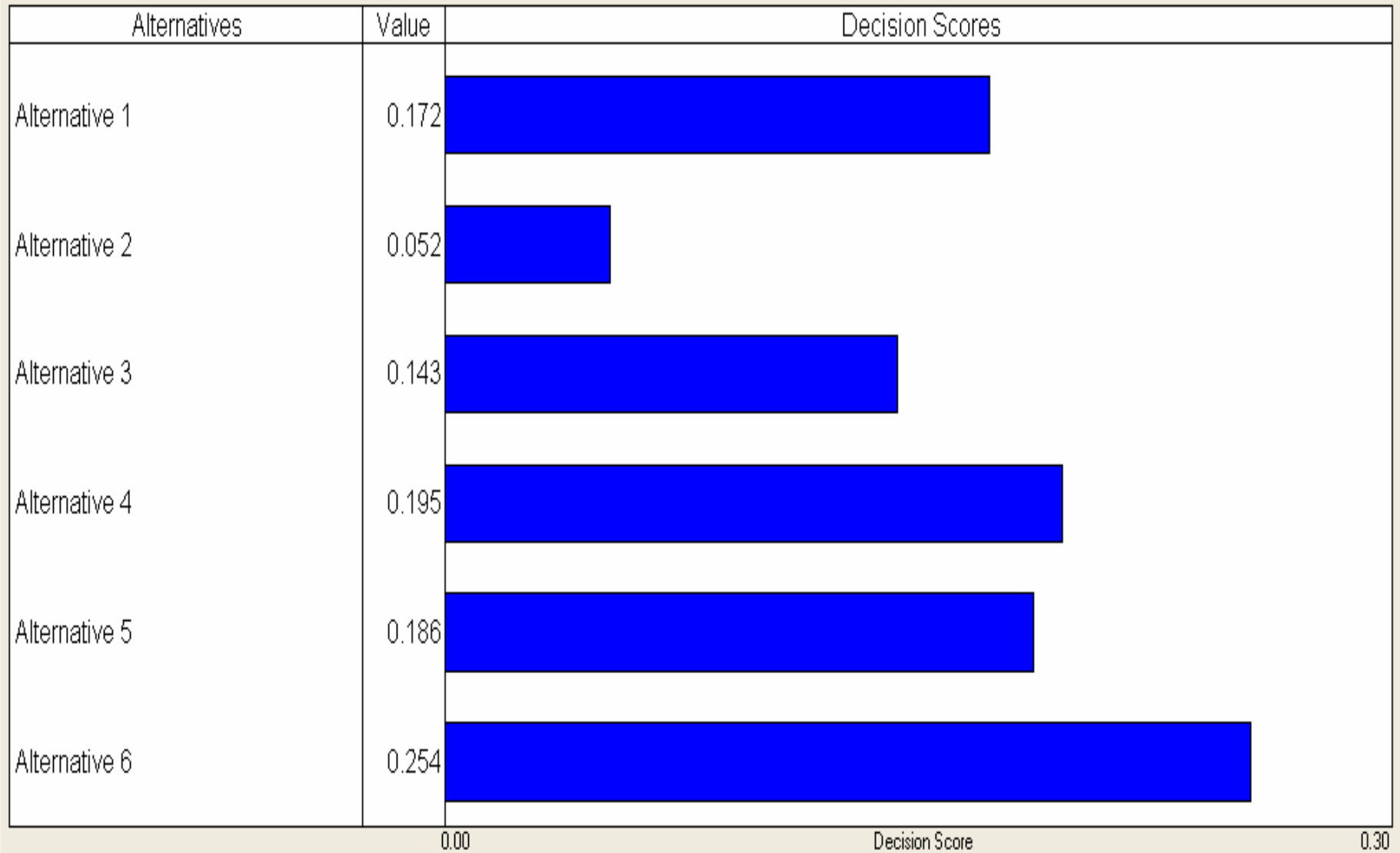
A5: A4+controlled grazing

A6:A4+enrichment plantation

✓ the six criteria and 43 indicators were analyzed (with the the help of **MCA-AHP**) & compared to choose the most most preferred alternative/scenario.

Decision: SFM

Alternatives	Value	Decision Scores
Alternative 1	0.172	
Alternative 2	0.052	
Alternative 3	0.143	
Alternative 4	0.195	
Alternative 5	0.186	
Alternative 6	0.254	

Decision Score   0.00 — 0.30

- Both economic and environmental objectives must be harmonized by carefully identifying and evaluating locally relevant set of C&I of sustainability for CPR mgt.

- Any environmental intervention, resource use and management plan, and design of rules and regulations should be holistic and take into account the prioritized preferences of key stakeholders.

- the poor performance of most of the C&I elements of sustainability under the current management scenario send signals to re-think and introduce appropriate management options

- How this is linked to PES? **compensation schemes are needed for those who forgone ,for example, the economic benefits as a result of new management option.**

Discussion

Any:

- Ideas
- Thoughts
- Experiences
- Lessons learnt
- Practical issues
- Policy issues
- Specific cases
- etc.