















Who shall pay for the provision of ecosystem services – An Analytic Network Process approach

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Introducing

- even though we know who are the providers and the beneficiaries, we don't know who are the buyers, i.e. the ones willing to pay for ecosystem services they make use of;
- In Romania the protection functions forest owners are restricted to harvesting, but in the same time they must to pay for administration fees and taxes for their forest;
- In this way is required a compensation for the revenue the forest owners' give up in order to provide whatever ecosystem services;
- This compensation should be paid by "someone"
- Who is/are this "someone"? and How much they shall to pay?

Aim and objectives

to assess the extent to which certain organizations, authorities and business entities benefiting from forest ecosystem services.

OBJECTIVES

- To identify the most relevant social subjects;
- To establish some causal relationship between ecosystem services and the stability and quality of social subjects activities;
- To evaluate the intensity of causal relationship, and to find some priorities assign to beneficiaries of ecosystem services.

 Data was collected from stakeholders meetings within the SOLIDARON Project

- Participatory with stakeholders were set the beneficiaries and the forest ecosystem services

Beneficiaries analysis according to ecosystem services that benefit

No.	Forest ecosystem services beneficiaries	Forest ecosystem services	No.	Forest ecosystem services beneficiaries	Forest ecosystem services
1.	Residens, local communities	Flood protection Hydrological regulation Erosion control Aesthetic framework Wood and non- wood resources Pharmacology resources	8.	Educational and Research Institutions	Pharmacology resources
2.	National Company of Roads	Flood protection Erosion control	9.	Tourism Sector	Aesthetic framework Habitat and refuge
3.	Insurance Companies	Flood protection	10.	Hunting Associations	Aesthetic framework Habitat and refuge Wood and non-wood resources Genetic resources
4.	Energy Sector – hidroelectric energy production	Hydrological regulation	11.	Wood and non-wood Products Companies	Wood and non-wood resources Genetic resources
5.	Water bottling Companies	Hydrological regulation	12.	Beekeeper Associations	Habitat and refuge Wood and non-wood resources Genetic resources
6.	Water Distributors	Hydrological regulation	13.	Pharmaceutical Companies	Non-wood resources Pharmacology resources
7.	Agricultural Exploitations	Flood protection Erosion control			

All calculations have been done with SuperDecisions software, that implements the theory of AHP, by Thomas Saaty

Flowchart of nodes, clusters and links between nodes

	Alternatives atte
1.	Residens, local administration 2. National Company of Re
3.	Ensurance Company 5. Energetic Sector
6,	Water bottling Companies 7. Water Distributors
8,	Agricultural Exploitations 9. Educational and Research Ins
10). Tourism Sector 11. Hunters Associations
12	2. Wood and non-wood Products Companies
13	Beekeepers Associations 14. Pharmaceutical Companies
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- First of all, we have reffered to the beneficiaries as alternatives (we have 14 nodes in beneficiaries cluster), and in the second we have considered a cluster of ecosystem services (8 nodes).
- Each node has to be compared with each other node to the same link, using the standardized evaluation scale:
- 1 equally as important as,
- 3 moderately more important than,
- 5 strongly more important than,
- 7 very strongly more important than,
- 9 extremely more important than.

Intermediate marks 2, 4, 6, 8 can also be used, when needed.

At pairwise comparisons between nodes we establish the marks in participatory with the stakeholders at workshops within the SOLIDARON Project



- In an analytical network there is no difference between the goal, criteria and alternatives, and all nodes can be connected in a logical way, not necessarily organized în a hierarchical order.
- Dependencies, reciprocal or not, are established by the person who modelling the problem in a manner as possible and logical.

- Althought the conectors were drawn between nodes, and not between clusters, pairwise comparisons was made between node against another node for all ecosystem services,
- All nodes from ecosystem services cluster gets different weights for different beneficiaries

- All marks are plugged into asquare matrix, which has unit values along the main diagonal
- All mathematics behind this models is explained in detail by Thomas Saaty in his publications.
- Basically 3 types of matrices are generated, on the basis of pairwise comparisons between nodes and clusters

1. Unweighted Super Matrix

contains the local priorities derived from the pairwise comparisons throughout the network

- A component in a supermatrix is the block defined by a cluster name at the left and a cluster name at the top.

Super Decisions Main Window: Parc MM paduri.sdmod: Unweighted Super Matrix — 🛛 🔍 🗙											
		2. Servicii ecosistemice									
Cluster Node Labels		1. Flood protection	2. Hydrological regulation	3. Erosion control	4. Aesthetic framework	5. Habitat and refuge	6. Wood and non-wood resources	7. Genetic resources	8. Pharmacology resources		
	1. Residens, local administration	0.559586	0.636986	0.428571	0.148815	0.000000	0.574712	0.000000	0.148815		
	2. National Company of Roads	0.249487	0.000000	0.428571	0.000000	0.000000	0.000000	0.000000	0.000000		
	3. Ensurance Company	0.095464	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		
Alternati	5. Energetic Sector	0.000000	0.104729	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		
Alternati r ves	6. Water bottling Companies	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		
	7. Water Distributors	0.000000	0.258285	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000		
	8. Agricultural Exploitations	0.095464	0.000000	0.142857	0.000000	0.000000	0.000000	0.000000	0.000000		
	9. Educational and Research Institutions	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.065794		

2. Weighted Super Matrix is obtained by multiplying all the elements in a component of the unweighted supermatrix by the corresponding cluster weight.

😵 Super Decisions Main Window: Parc MM paduri.sdmod: Weighted Super Matrix - 🛛 🕹										
		2. Servicii ecosistemice								
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	9. Educational and Research Institutions	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.065794	

3. Limit Super Matrix which is the supermatrix produced in step 2 raised at powers of 2 until all elements converge to unique values

😵 Super Decisions Main Window: Parc MM paduri.sdmod: Limit Matrix —									
	2. Servicii ecosistemice								
Cluster Node Labels	1. Flood protection	2. Hydrological regulation	3. Erosion control	4. Aesthetic framework	5. Habitat and refuge	6. Wood and non-wood resources	7. Genetic resources	8. Pharmacology resources	
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6. Water bottling Companies	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	
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- the Normals column shows the results normalized for each component
- the main beneficiaries who shall pay for ecosystem services that benefit are:
- local administration and residens
- hunters associations
- pharmaceutical companies
- tourism sector
- National Company of Roads and Railways
-and so on

Priorities assigned to the beneficiaries of ecosystem services

Name	Graphic	Ideals	Normals	Raw
1. Residens, local administration		1.000000	0.312186	0.312186
2. National Company of Roads		0.271496	0.084757	0.084757
3. Ensurance Company		0.038224	0.011933	0.011933
5. Energetic Sector		0.041934	0.013091	0.013091
6. Water bottling Companies		0.000000	0.000000	0.000000
7. Water Distributors		0.103418	0.032286	0.032286
8. Agricultural Exploitations		0.095424	0.029790	0.029790
9. Educational and Research Institutions	1	0.026344	0.008224	0.008224
10. Tourism Sector		0.354658	0.110719	0.110719
11. Hunters Associations		0.596227	0.186133	0.186134
12. Wood and non-wood Products Companies	•	0.083619	0.026105	0.026105
13. Beekeepers Associations		0.218419	0.068187	0.068187
14. Pharmaceutical		0.373458	0.116588	0.116588

Discussion&Conclusions

- Although the method itself has been presented as a sort of blackbox in this short communication – much more details about mathematic are presented in SuperDecision software help;
- The AHP open many opportunities to analyze, from the basic decision making processes related to silvicultural sistems (eg. different aspects of forest management) to the most complex ones like forest or communication strategies.

Acknowledgements

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Thank you for attention!