ANALYSIS OF THE PARTICIPATION OF STAKEHOLDERS IN ENVIRONMENTAL MANAGEMENT BASED ON ANP: APPLICATION TO A SPANISH NATURAL PARK

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ABSTRACT

The influence of the participation of stakeholders in environmental planning is a real problem that has not been fully tackled in the existing literature. The influences exerted in the decision making process by different stakeholders, who want to satisfy their own interests, need to be analyzed in order to make a model of the problem that is closer to reality. The aim of this paper is to analyze these influences in a specific environmental problem, namely rice straw management in the Natural Park of La Albufera, Valencia (Spain), by means of the ANP methodology. The main question we explored was how to measure the influence among stakeholders. This a complex question because it is difficult for a stakeholder to answer the direct question, "Who do you think exerts more influence on you when you have to solve a problem?" In this work, we assumed that information exchange is the tool to measure the influence among the individuals in the network. These data are used to solve the ANP model. The final aim was to prove the utility of ANP to measure the influences among stakeholders in a Social Network.

Keywords: Analytic Network Process; stakeholder analysis, participatory decision making.

1. Introduction

Due to the complexity and interrelations of the problems caused by global society (economic development, natural resource management, global warming etc.) public policy managers must conduct stakeholder analyses in order to identify and take into account the individuals, groups and organizations involved in or affected by policies (Bryson, 2004).

The present work analyzed the influences among stakeholders involved in a specific environmental problem, namely rice straw management in the Natural Park of La Albufera, Valencia (Spain). The case study included different entities that have been identified as being stakeholders for many years. The identification of stakeholders was not within the scope of our study, but rather analyzing (and quantifying) which stakeholders have more influence on the decision-making process. This case study was presented at the ISAHP 2013 in which we used Social Network Analysis (SNA) to identify and quantify the influence between the stakeholders combined with AHP to assign different weights to the stakeholders when using group AHP (García-Melón, Estruch-Guitart, Aragonés-Beltrán, & Monterde-Roca, 2013).

In this work, we used the ANP, instead of SNA, to measure the influences among the stakeholders of this network. This was not an easy task because it is difficult to directly ask the following question to each stakeholder: "Who do you think exerts more influence on you when you have to solve a problem?" Therefore, we needed to use indirect questions and chose to use the information exchange flow as a way to measure the influence among individuals of the Network. This model is a first approach to prove the utility of ANP to measure the influences between stakeholders in a Social Network.

Our case study focused on solving a participatory decision making problem in the management of the Natural Park La Albufera (Valencia, Spain). The Albufera Natural Park, with a surface area of 21,000 hectares, is located 9 km to the south of the city of Valencia (Figure1).

Figure 1. Map of La Albufera

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In this park, like in most Mediterranean wetlands, agriculture and particularly rice farming has altered (for more than two centuries) the aquatic ecosystems. The current ecosystem cannot be understood without rice farming because it is the basis of the food chain and in summer, the flooding of its 15,000 hectares has become an alternative habitat for the living fauna. At present, rice straw, which was formerly used as a crop product, has no economic value. Straw burning is the most economical disposal practice, though it affects the surrounding population. Nowadays, agri-environmental regulations prohibit this practice, except under special conditions. Different stakeholders are involved in the search for solutions which would satisfy their own interests.

2. Literature Review

Agricultural activity, as any other human activity, generates an environmental impact. Agricultural techniques that can be adopted to minimize impacts depend on how the proposed solutions affect the interests of the stakeholders and on their power or influence over other actors. The interactions between the different actors and their flow of information are critical for the adoption of sustainable and innovative practices (Isaac, 2012).

Due to the complexity and interrelations of the problems caused by global society (economic development, natural resource management, global warming, and so on) public policy managers must conduct a stakeholder analysis to identify and take account of the individuals , groups and organizations involved in or affected by policies (Bryson, 2004). The purpose of a stakeholder analysis is to understand stakeholder behavior, expectations, relationships and influences or resources they can bring to the decision-making process (Brugha & Varvasovszky, 2000).

Prell et al. (2009) suggest that the increasing use of stakeholder analysis in natural resources management reflects the recognition that stakeholders can and should influence environmental decision-making processes (Prell, Hubacek, & Reed, 2009). This approach is being promoted by the EU (Directive 2003/35/EC2)(European Community, 2003); one of its objectives is to promote the participation of different actors (mainly at the level of citizenship) in the development of certain environmental action plans and programs. For the Netherlands Environmental Assessment Agency (PBL), stakeholders' participation is important in generating different forms of knowledge that support political decision-making processes (Hage, Leroy, & Petersen, 2010). In the U.S. the Environmental Protection Agency and other agencies promote citizen participation in environmental decision-making processes, and have programs that evaluate their participation (Charnley & Engelbert, 2005). This is especially important for the implementation of environmental conservation action plans in sensitive areas with conflicting land use (Mushove & Vogel, 2005). However, some studies show the difficulties and challenges of enhancing the participation of stakeholders in the management and conservation of the sites (Apostolopoulou, Drakou, & Pediaditi, 2012), (Larson, De Freitas, & Hicks, 2013), (Campo, Bousquet, & Villanueva, 2010), (Davies & White, 2012). A review of different participatory approaches for environmental management can be found in Reed (2008), and a review of the origins and justification for stakeholder analysis can be found in Reed et al. (2009).

The participation of stakeholders in environmental management planning and decision making is a real problem that has not been fully resolved, although there are different approaches and techniques which address specific problems (Janssen, Goosen, & Omtzigt, 2006) (Goosen, Janssen, & Vermaat, 2007) (Elgin & Weible, 2013), (O'Toole, Keneley, & Coffey, 2013). Several approaches have been proposed to investigate the relationships among stakeholders, like the basic stakeholder analysis technique, power versus interest grids, stakeholder influence diagrams, the participation planning matrix, interrelationship diagrams (Bryson, 2004), or actor-linkage matrices (Biggs & Matsaert, 1999). However, these techniques do not allow for determining an individual value of the influence of each actor in a decision-making process.

3. Hypotheses/objectives

The main objective of this work was "to apply ANP to analyze and measure the influences among stakeholders in a Social Network". As far as we know, ANP has never been applied to analyze the influence between stakeholders in a Social Network. This is not an easy task because different ways to model the Network can be established. The main problem we faced was how to define the concept "influence" in a specific Network. In this research we developed an easy ANP model in which 8 individuals of a Social Network were the elements of the network. As there are not many stakeholders, there are not any clusters.

4. Research design/methodology

In this paper we used the ANP methodology to analyze a particular group of stakeholders within a case study that are institutions and organizations. The relationships between the stakeholders are analyzed using the information flow among them.
The steps followed in the methodology are shown in Figure 2:

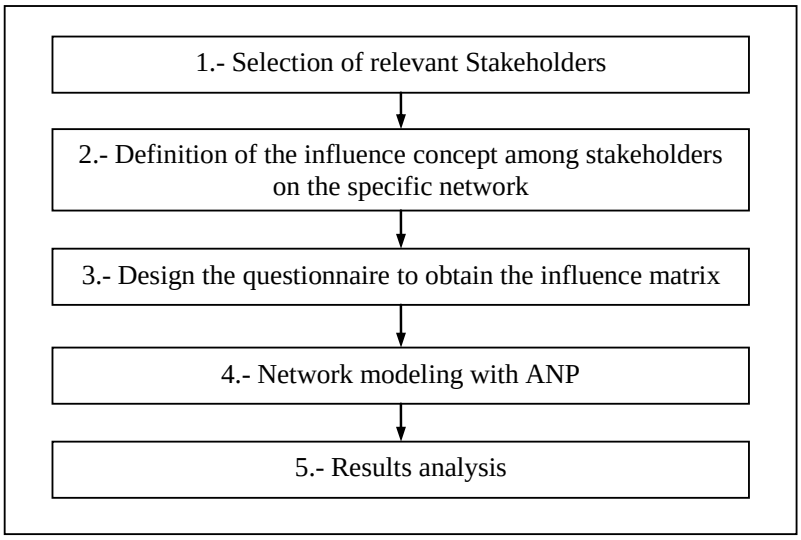

Figure 2. Methodology

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5. Data/model analysis

5.1 Step 1: Selection of relevant stakeholders

The institutions and organizations involved in the problem are identified as having responsibilities in managing the park or as interest groups. They are:

1. Technical Management Office of the Park (TMO)
2. Environment Department (Regional Ministry) (DENV)
3. Department of Agriculture (Regional Ministry) (DAGR)
4. Technical staff of Valencia City Council (VLC)
5. La Unio Farmers' Union (UNIO)
6. SEO Birdlife (SEO)
7. La Albufera Fishermen's Association (FISH)
8. Hunters Society (HUNT)

The different stakeholders involved in the problem have conflicting interests. Valencia City Council is the owner of the lake and is therefore interested in keeping it in the best possible environmental condition. Two other stakeholders are Regional Ministries: the Department of Agriculture, which is responsible for the development and management of environmental policies (and decides on which farming techniques are subsidized or banned), and the Department of Environment, who is the actual politician responsible for the park. The politician is ultimately responsible for environmental policies. The Management Office of the Park is responsible for monitoring the conditions and activities developed in the park. The interest of the Farmers' Union is to reduce farming costs as much as possible. The last two stakeholders are one representative of the Fishermen's Association, which is affected by the increasing mortality of fish due to rice-straw contamination, and a representative of SEO BirdLife, which is an association for environmental defense that is very popular in the area.

5.2 Step 2: Definition of the influence concept among stakeholders on the specific network

The definition of the influence concept among stakeholders on the specific network is a critical point of the method. The main question that arises is how to "measure" the influence that some individuals have on others in the Social Network when solving a particular problem. ANP is a method designed to solve complex decision making problems. It is a theory of relative measurement of decision maker's preferences (Saaty, 2005). In this work we tried to extend this idea to measure the influence between individuals in a network. There is usually an individual or a group acting as Decision Maker in any given decision-making problem. However, in a Social Network, the first problem is usually the identification of the most influential individuals or groups so that a group of experts or a decision making group can be created.

Therefore, in our point of view, the main difficulty we found when applying ANP to this problem was what questions to ask the members of the Network in order to determine their influence in solving a particular problem.

Following the Social Network Analysis (SNA) performed in the above mentioned study, we decided to measure influences by using the information flow among the stakeholders. The traditional question used in SNA is: *Who requests information from you regarding*

this problem? For a more robust analysis, we decided to obtain this information from the sender and the receiver of the information. We analyzed two kinds of information flows, asking the following questions:

1. Question Q1: Regarding the consequences of the different rice straw management methods, *who do you ask for information and how often? (Active)*. In this case we assumed that if the individual "A" requires information from individual "B" it is because "B" will influence "A". The main idea is that if I ask someone for information, then presumably this information will influence me. We assumed that the one asking for information is making an effort and thus he will better remember whom he asked.

2. Question Q2: Regarding the consequences of the different rice straw management methods, *who asks you for information and how often?* (*Passive*). In this case, we assume that if individual "A" provides information to individual "B" it is because "A" influences "B". In this case, the receiver of this demand for information has to make less effort than in the previous case. Therefore, he may not remember exactly who has asked for the information.

When these two questions were designed we assumed that the answers to the questions would match, because if A says he has asked B for information, it is logical to think that B will say that A has asked him for information. However, in our case study, we were surprised that in many cases the answers to both questions did not match. Namely, A said he had asked for information from B, but B did not recognize that A asked him. This was because we worked with institutions and not with individuals, and therefore the sender and receiver of information within an organization was not always the same person and it is impossible for all members of an organization to know the contacts of all other staff members. For this reason we studied the influence in both cases.

5.3 Step 3: Design the questionnaire to obtain the influence matrix

Each stakeholder answered the two questions presented in Section 5.2.

Table 1
Information questionnaire active search: Question 1

Q1. Regarding the consequences of the different rice straw management methods, who do you ask for information? How often?	
○ *Once a year*	○ *Monthly*
○ *Once every six months*	○ *Weekly*
○ *Once every three months*	○ *Daily*

Table 2
Information questionnaire passive search: Question 2

Q2. Regarding the consequences of the different rice straw management methods, who asks you for information? How often?	
○ *Once a year*	○ *Monthly*
○ *Once every six months*	○ *Weekly*
○ *Once every three months*	○ *Daily*

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5.4 Steps 4 & 5: Network modeling with ANP and analysis of results

With the information collected from the Stakeholders, we designed two similar ANP models, one for each question. Each model is a Network with a single cluster whose elements are each of the stakeholders.

5.4.1 First Question Model

The relations between the elements of this Network were established from the answers given by the stakeholders to the first question. Question 1 asked, "Who do you ask for information (active)". Table 3 is built by columns. For example, VLC asked TMO, DAGR, UNIO, FISH and HUNTER for information, so we consider these stakeholders exert influence on VLC. In the column VLC we show the frequency (weekly, monthly etc.) this stakeholder reported that he has requested information from the other stakeholders.

In order to quantify the intensity of the influence on a particular stakeholder, for example VLC, a pairwise comparison matrix was constructed among the stakeholders that influence him (TMO, DAGR, UNIO, FISH and HUNTER), analyzing the flow of information (yearly, every six months, monthly, and so on) that each stakeholder provides regarding the other. Figure 3 shows the judgments and influences calculated for the VLC node using SuperDecisions software. Table 3 shows the unweighted supermatrix that was obtained.

Table 3
Influence matrix Question 1, "Who do you ask for information?"

	1. TMO	2. DENV	3. DAGR	4.VLC	5. UNIO	6. SEO	7. FISH	8. HUNT
1. TMO	0	MONTHLY	YEAR	MONTHLY	YEAR	MONTHLY	MONTHLY	6 MONTH
2. DENV	WEEKLY	0	YEAR	0	6 MONTH	MONTHLY	YEAR	0
3. DAGR	WEEKLY	MONTHLY	0	YEAR	4 MONTH	MONTHLY	YEAR	0
4.VLC	WEEKLY	MONTHLY	0	0	0	YEAR	MONTHLY	MONTHLY
5. UNIO	WEEKLY	WEEKLY	MONTHLY	6 MONTH	0	MONTHLY	0	0
6. SEO	MONTHLY	0	0	MONTHLY	MONTHLY	0	YEAR	0
7. FISH	MONTHLY	YEAR	YEAR	YEAR	0	YEAR	0	6 MONTH
8. HUNT	0	YEAR	YEAR	0	YEAR	0	YEAR	0

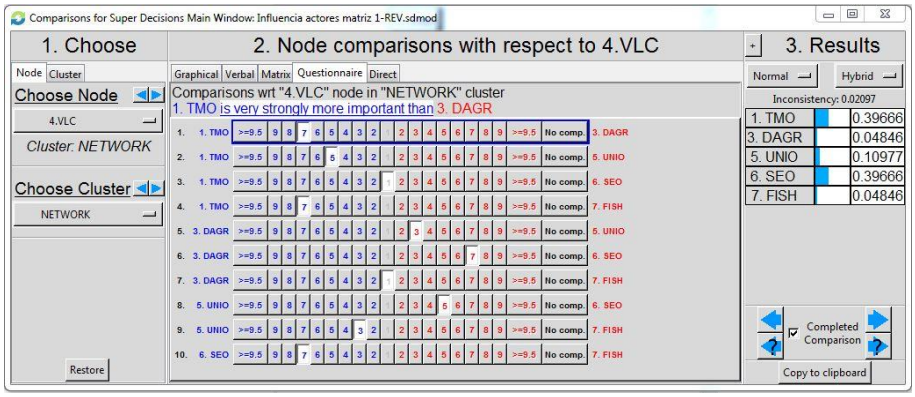

Figure 3. Influence of stakeholders on VLC (model Q1)

Table 4
Weighted supermatrix for Question 1

	1. TMO	2. DENV	3. DAGR	4.VLC	5. UNIO	6. SEO	7. FISH	8. HUNT
1. TMO	0,000	0,284	0,091	0,397	0,055	0,233	0,389	0,143
2. DENV	0,214	0,000	0,091	0,000	0,130	0,233	0,056	0,000
3. DAGR	0,214	0,284	0,000	0,048	0,246	0,233	0,056	0,000
4.VLC	0,214	0,284	0,000	0,000	0,000	0,033	0,389	0,714
5. UNIO	0,214	0,076	0,636	0,110	0,000	0,233	0,000	0,000
6. SEO	0,071	0,000	0,000	0,397	0,502	0,000	0,056	0,000
7. FISH	0,071	0,036	0,091	0,048	0,000	0,033	0,000	0,143
8. HUNT	0,000	0,036	0,091	0,000	0,067	0,000	0,056	0,000

From the weighted matrix the results shown in Figure 4 were obtained.

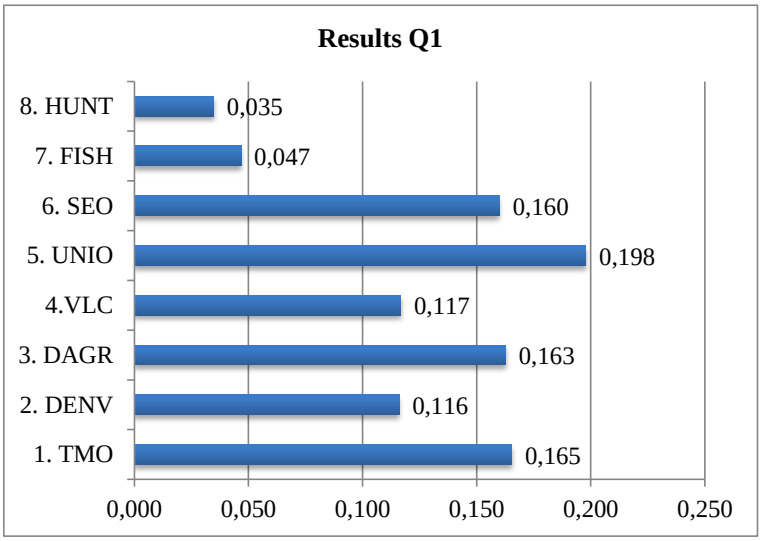

Figure 4. Results Question 1

These results show that the most influential stakeholders in this model are: UNIO (19,8%), TMO (16,5), DAGR (16,3%) and SEO (16,0 %). These stakeholders were reported to be the most frequently consulted about the problem.

5.4.2 Second question model

The relations between the elements of this Network were established from the answers of the stakeholders to the second question. Question 2 asked, "Who asks information from you and how often? (Passive)". Table 5 is built by rows being aij = (Frequency) if the element in the column has requested information from the element in the row, and aij =0 otherwise. For example, VLC is asked for information from TMO, DAGR, UNIO, SEO and FISH, so we consider VLC exerts influence on these stakeholders.

Table 5
Influence matrix Question 2, "Who asks information from you?

	1. TMO	2. DENV	3. DAGR	4.VLC	5. UNIO	6. SEO	7. FISH	8. HUNT
1. TMO	0	WEEKLY	MONTHLY	MONTHLY	WEEKLY	MONTHLY	WEEKLY	2 WEEKS
2. DENV	MONTHLY	0	MONTHLY	MONTHLY	WEEKLY	WEEKLY	YEAR	YEAR
3. DAGR	YEAR	YEAR	0	0	MONTHLY	0	YEAR	YEAR
4.VLC	6 MONTH	0	YEAR	0	6 MONTH	6 MONTH	YEAR	0
5. UNIO	0	YEAR	4 MONTH	0	0	WEEKLY	0	YEAR
6. SEO	MONTHLY	MONTHLY	MONTHLY	YEAR	MONTHLY	0	YEAR	0
7. FISH	4 MONTH	YEAR	YEAR	2 MONTH	0	YEAR	0	YEAR
8. HUNT	0	0	0	YEAR	0	0	YEAR	0

Figure 5 shows the Influence of stakeholders on VLC with this model Q2. The weighted supermatrix was obtained in the same way as with the Question 1 (Table 6).

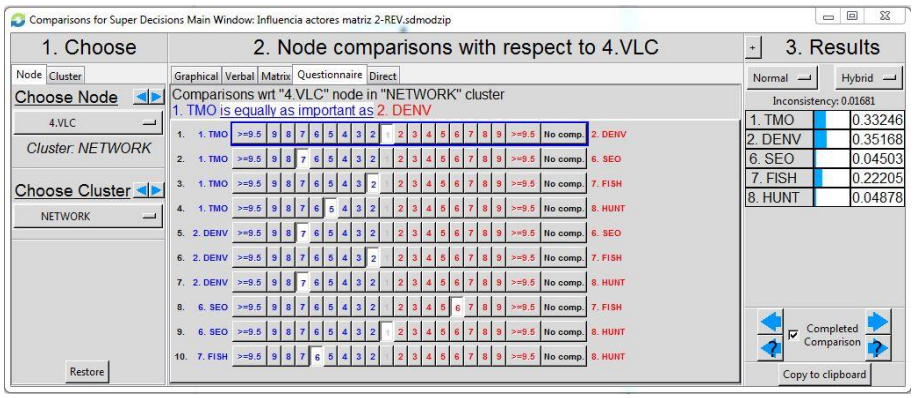

Figure 5. Influence of stakeholders on VLC (model Q2)

Table 6
Weighted supermatrix for Question 2

	1. TMO	2. DENV	3. DAGR	4.VLC	5. UNIO	6. SEO	7. FISH	8. HUNT
1. TMO	0,000	0,550	0,271	0,332	0,273	0,124	0,643	0,667
2. DENV	0,362	0,000	0,271	0,352	0,273	0,281	0,071	0,083
3. DAGR	0,039	0,050	0,000	0,000	0,091	0,000	0,071	0,083
4.VLC	0,076	0,000	0,034	0,000	0,273	0,281	0,071	0,000
5. UNIO	0,000	0,050	0,120	0,000	0,000	0,281	0,000	0,083
6. SEO	0,362	0,301	0,271	0,045	0,091	0,000	0,071	0,000
7. FISH	0,161	0,050	0,034	0,222	0,000	0,033	0,000	0,083
8. HUNT	0,000	0,000	0,000	0,049	0,000	0,000	0,071	0,000

From the weighted matrix the results shown in Figure 6 were obtained.

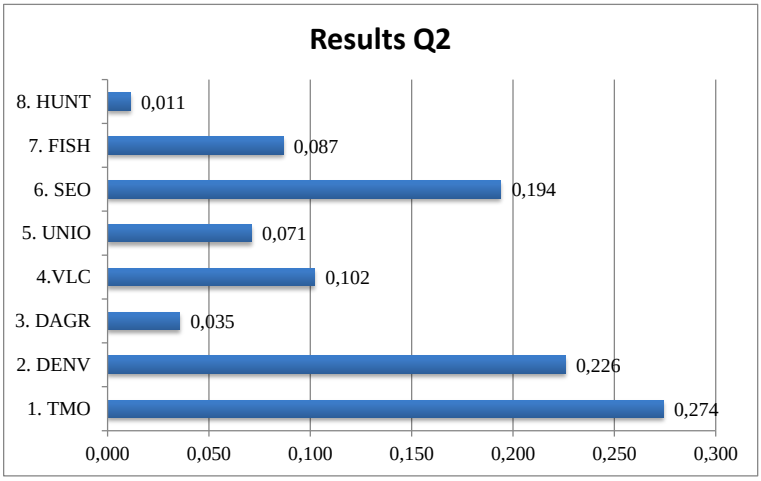

Figure 6. Results from Question 2

These results show that the most influential stakeholders in this model are: TMO (27,4%), DENV (22,6%) and SEO (19,4%). These stakeholders are the most frequently consulted about the problem.

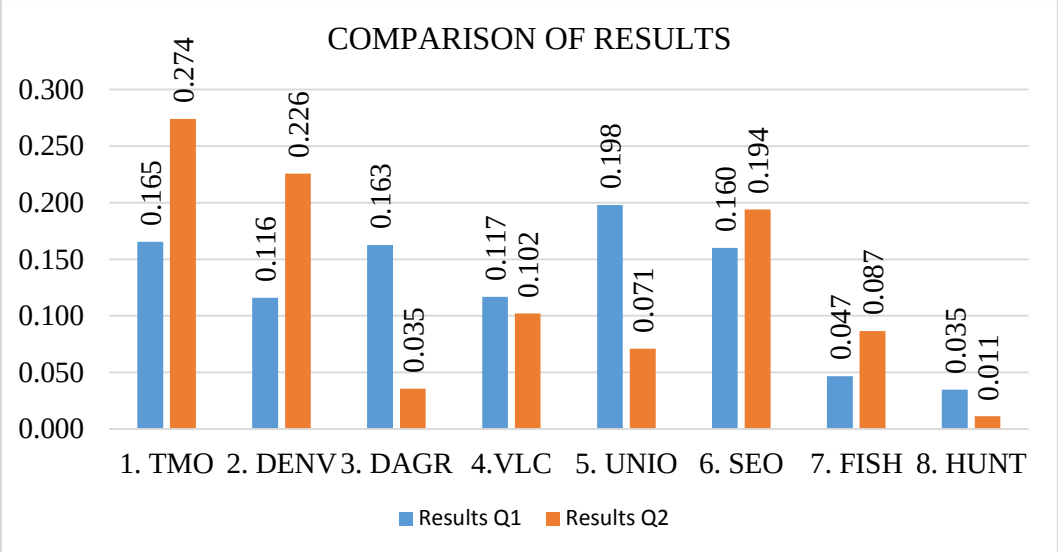

Figure 7. Comparison of results

6. Limitations

The most important limitation in this study was the need to use indirect questions to measure the influences among stakeholders

7. Conclusions

The main conclusion obtained in this work is that it is possible to use ANP to analyze the influence among stakeholders in a Social Network. Nevertheless, this is not an easy task. The main problem is defining the concept of "influence" when the stakeholders face a problem. Social Network Analysis is based on the study of flows of information. For this reason and as a first approach to the problem, we considered the information exchange as a way to measure the influence among the individuals of a Social Network.

The Social Network that was studied is small, and the problem we addressed is one of many that exist in the management of the park. This particular problem arises once a year and not every year, however it is source of many conflicts among stakeholders.

The results show different influence intensities depending on how the questions about the exchange of information are formulated. In our opinion, the main reasons for these differences are the following:

- In this case we worked with institutions, and even though the questionnaire was passed out to certain people, it is very possible that when an individual has requested information from an institution, the person who replied to him was not the same person who filled out the questionnaire.

- For an individual, it is easier to remember whom he has asked for information, than who has asked him. Asking for information requires effort, and is therefore more memorable, because usually such information is needed to solve the problem.

These conclusions were reached after discussions with the stakeholders.

This work is a first step for the use of ANP. However, in order to effectively use this model, it is essential to analyze the concept of "influence" and to carefully prepare the proper question(s) presented to the stakeholders

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