

Applying Strategic Choice Approach for Decision Making of Watersheds Committees

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Abstract—Watersheds committees decisions making are usually complexes due to the need to consider many objectives and actors with different preferences. Therefore, this paper proposes a model for reducing conflicts in the watersheds committees using Strategic Choice Approach (SCA) for problem structuring and support in the decision-making process. The simulation shows that the model can be particularly useful in the face of uncertainties and environments that can minimize the conflicts in decision-making.

Keywords— *Problem Structuring, Conflicts, Watersheds Committees.*

I. INTRODUCTION

Toward a sustainable society, when a problem occurs in an organization or a group, the members of the group usually hold a discussion to decide what actions to take [1]. In order to come up with an effective solution in limited information and time, however, each member of the group possesses their own viewpoints, and their ways of thinking also differs. Therefore, it is not easy to realize a discussion with every member being assent to the consensus.

The participatory decision making processes are gaining notoriety, mainly due to the social gains that can be achieved with the society participation in public policy [2]. However, this kind of decision requires the involvement of multiple decision makers, which makes the process more complex, since different standpoints must be considered and discussed.

For [3], the making decisions about water resource management are usually complex due to the need to consider many objectives and because they involve consequences of environmental, social and economic impacts. In this process, the Watersheds Committees is a State Public Agency, which has powers and responsibilities, and the main objective is the decentralization of water resource decisions that drive the planning and have many conflicts as a result of supply and demand, increases the complexity decisions.

In that perspective, this paper proposes a model for reduce the conflicts and uncertain in the watersheds committees. In the structuring phase we used the Strategic Choice Approach (SCA) method was chosen to work with the uncertainties of the decision process.

This paper is structured as follows: Section II presents some concepts about conflicts; Section III shows some problems presents in the watersheds committee; Section IV presents the proposed model for reduce conflicts in the watersheds committees and a simulation; and Section V presents some conclusions.

II. CONFLICTS

Whenever human beings are involved in some project, or interact with one another in some way, differences of opinion inevitably arise as to what should be done. For [4], a conflict can be defined as a situation in which interdependent people express differences in goals to meet their interests and needs and still experience interference of others in achieving these goals.

Conflicts in water resources are very complex and have made a variety concepts appear at in the literature, distinct from each other, therefore, we need to take into account the context in which the conflict is being considered.

The typology of conflicts in water resources depends on the theoretical view adopted by each author. Among the more representative are those classified such conflicts: environmental changes (shortages simple, relative deprivation, absolute deprivation) [5]; the use of water (allocation of use, availability qualitative and quantitative) [6]; stage of water management (management of supply and demand, ie, equitable distribution efficient use) [7].

Conflict modeling and analysis have been investigated within many disciplines, including international relations, psychology, and law, as well as from mathematical and the perspectives of engineering [8].

The study conflicts in water resources areas have been frequent authors are developing models and tools to reduce the number of conflicts in the watersheds. [9], the negotiation support system (NSS) is designed to aid two parties of negotiations for allocation of water from a shared water resource. Another study of the same authors [10], they simulated the model in a hypothetical case of study.

For [11], sharing of waters through a negotiation game between Arabs and Israelis, through a set of optimum Pareto allocations, as well as identifying a range of negotiation. [8]

analyze a water diversion conflict in the Danjiangkou area, China and used the methodology of the Graph Model for Conflict Resolution (GMCR).

A study about the Armezian-Azerbaijain conflict in the Soviet Union was studied by [12] and they applied the Conflict Analysis Program. There are others papers that examine the conflicts on water resources [13][14].

In [3], they presented a group decision support system model to support committees responsible for water resource management; the model provides a ranking of alternatives through the combined use of the multicriteria methods PROMETHEE II and ELECTRE IV. For [15], the study describes the application of multicriteria decision aid for choosing the priority city to receive a water supply system, using the ELECTRE methodology. While [16], applies multiple criteria analysis (MCA) to six water management decision problems.

So, with these search methods that conflicts are reduced. And especially in participatory processes, besides the reduction of conflict is expected, then the consensus will be obtained.

The conflict resolution embodies the systematic study of all facets of conflict. It includes the documentation and classification of real-world disputes, as well as the development and application of methodologies and formal methods for logically modeling, analyzing, and there by better understanding conflict and how it can be resolved [17].

III. WATERSHEDS COMMITTEES DECISION MAKING PROBLEMS

The watershed committee is a legally constituted body that has as its aim the water resources decentralization decisions. The committees regulation came with Resolution No. 24 of 2002 stating that the committees were composed by the following percentages of each segment: 40% of resource users (whose uses depend on the grant), up to a maximum of 40% to representatives from the Union, Federal District and municipalities, and at least 20% of the votes of civil society representatives.

The committees were created with the goal of improving watershed and bring better living conditions for this population there. However, despite the relevance of committees it appears that in some states they come through some difficulty, especially in decision-making.

So, in this paper we focus only on the problems related to decision-making committees members and not in the selection of alternatives for improving the watersheds.

The difference between the numbers of participants, especially civil society, which has the lowest number of participants, has generated some conflict, and some members discussed whether the final decision really reflects the desire of all.

We apply a semi-structured questionnaire with 28 members

(18 public sector; 12 water resources users; 8 society), during the months April to August 2012, within two watersheds located in Alagoas, Brazil. The table 1 shows this data.

TABLE 1- Some conflicts in the committees

Alternatives	Committee's Sectors		
	Public Sector	Water resources users	Society
There are subgroups formation	50%	50%	75%
There are many conflicts in yours committee	72%	83%	87,5%
Before issuing the information you assess the implications / risks of the next meetings	78%	100%	75%

According to the data table it appears that for most of these members interviewed believe that there is formation of subgroups in committee. Members also claim that conflicts are frequent and fairly reflect these before issuing their opinions at meetings. These data show that the two committees analyzed the current decision-making process present difficulties.

It is note worthy that data collected reflect only the opinion of the members interviewed; these can not be generalized, but are relevant for further discussion.

It is observed that the process of decision making each member has the same weight, ie, all have the same relevance in the decision. Nowadays, members use the simple voting system to reach a final decision. However, for some authors a simple majority is a very poor mechanism for declaring an alternative as a winner so other forms of majority have been studied on the literature [18][19].

A. Multiple decision makers and view points

The decision process involving business, government, labor and others, is usually formed in complex environments, because it involves a set of values and judgments of everyone involved in this process [2].

The decision-making in committees involves three distinct segments that have often-conflicting preferences. A small representation of civil society, as required by law, tends to generate some conflicts with other segments, for they do not feel represented equally.

In this type of decision is prioritized the consensus, however this is hardly achieved, because of these difficulties in decision-making. The table 2 shows data obtained with the two committees analyzed and revealing what they take to cooperate.

TABLE 2- Reasons for cooperation

Alternatives	Committees Sectors		
	Public Sector	Water resources users	Society
Well committee	88,9%	100,0%	100,0%

Welfare of society	100,0%	100,0%	75,0%
Welfare Environmental	100,0%	100,0%	87,5%
Own benefit	16,7%	33,3%	25,0%
Benefit the third	38,9%	33,3%	37,5%

According to the table notes that the majority cooperates seeking the welfare committee, society and the environment. However, despite being a minority is observed that some members interviewed stated that cooperate seeking their own benefits and others

So, it appears that these multiple actors and their preferences sometimes causes a distinct series of internal conflicts, which can hinder the achievement of the solution which represents the majority.

B. Limited information

The great diversity of education is present in most committees, where they observe that some people studied until elementary school and others are doctor degree. This fact also tends to limit the discussion, because in many cases the alternative solutions to the problems are presented without any level of detail.

Board members, who in many cases tend to centralizer information, also often make the conduct of meeting. For [1], there may be situations where some people dominate the discussion, no conclusion is reached, or the resultant conclusion is not completely shared by all participants in the discussion.

So, the participation and dissemination of information is crucial for the decision is in fact democratic. The discussion to seek a solution for sustainable development should not be dominated by some and should provide each participant an opportunity to think about the problems, express an opinion and share the conclusion for solving the problems.

IV. PROPOSED MODEL

The committees currently have no method that assists in decision making, their agendas are generally prepared by board members that lead to the reunions that by a simple vote are selected alternatives for the watersheds.

Some methods have been proposed to improve this decision making process [2][3], etc., however these always were based on survey of alternatives and not focused on the reduction of conflicts and uncertainties.

For this work, the methods chosen have as a purpose to illustrate and simplify the understanding of decision-making. So, for the structuring phase, we will use the Strategic Choice Approach (SCA). The figure 1 shows the flow of the complete process.

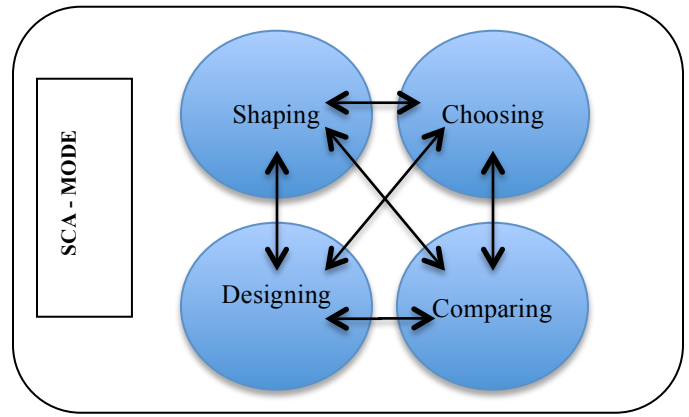


Figure 1: Model Flow

A. Model description

In the Pre-Structuring Phase, a meeting with all members should be held to clarify the methodology, reduce the differences and conflicts, and obtain more information. In this meeting, some clarification must be done about the problem to be discussed.

The SCA method chosen because it lets analyze the various interconnections in decision problems, it analyzing uncertainties and reducing conflicts.

The shaping mode phase decision-makers are addressing concerns about the structure of the set of decision problems that they now face. They may be debating in what in what ways choices should be formulated, and how far one decision should be seen as linked to another.

The designing mode phase the members be debating whether they have enough options in view, or whether there are design constraints of either a technical or a policy nature that might restrict the scope for combining options from linked areas of choice in particular ways.

The next phase, the comparing mode the decision-makers are addressing concerns about the ways in which the implications of different courses of action should be compared. The actors may be considering a variety of different criteria, and debating in what ways assessments of consequences should be made.

The final phase, the choosing mode the focus for the actors is on how to agree commitment to actions over time. So, this may mean considering not only whether there are some commitments to substantive action that could be undertaken straight away, but also in what ways the future process might be managed.

The SCA model similarities can be seen between this general model of a decision process and other more familiar models in which a sequence of a logical steps is defined, often with feedback loops to allow for possible recursion to earlier stages.

B. Model Simulation

For this simulation, we will work with major conflicts in decision-making committees listed in the questionnaire analyzed.

In the pre structuring phase the facilitator along with all committee members explains the methodology that will be used and performs the dissemination of information relevant to the problem being discussed.

At the start of phase mode shaping the facilitator asks for members to raise the most important issues and resolve conflicts that may exist, so the following topics were raised:

- Higher frequency of meetings;
- Clarification of alternatives;
- Guidelines drawn up by all;
- Match the number of participants per segment;
- Financial support for the activities of the committees;
- Commitment;
- Communication;
- Democratizing the meetings;
- Transmitting knowledge;
- Overview of the problem.

Then makers define the area of decision being studied all the alternatives, collected through the different opinions of the members. So, we arrived the following decision areas in the table 3:

TABLE 3- An initial set of decision areas for Committees

Decision Area	Label
Democratic decisions	Demo_decision?
Dissemination of information	Disse_information?
Commitment of segments	Cmt_segments?

With these decision areas identified well and knowing the options that each of these areas has, it is possible to identify areas of uncertainty:

- Difference in the educational level of the members;
- Motivation of members;
- Continuity of the shares;
- Lack of financial support.

Based on the uncertainties defined the members selection criteria that will be important in the evaluation of each alternatives. With these criteria estimating the effect and implication of each decision may have called areas of comparing and can be measured quantitatively and qualitatively, the table 4 shows these areas.

TABLE 4- Comparing areas

Order of importance	Comparing areas	Label
1°	Reduce in complaints	Complaints
2°	Reduce conflicts number	Conflicts
3°	Greater interaction of members at meetings	Interaction

4°	Meeting more efficient	Efficient
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The Figure 3 shows the graph of decisions of the links and the links do not exist between the various decision areas through lines (connection decision) that link them. Each of these bonds indicates that the pair of connecting areas decision is directly interrelated so that this pair can be considered an option joint instead of two separate options.

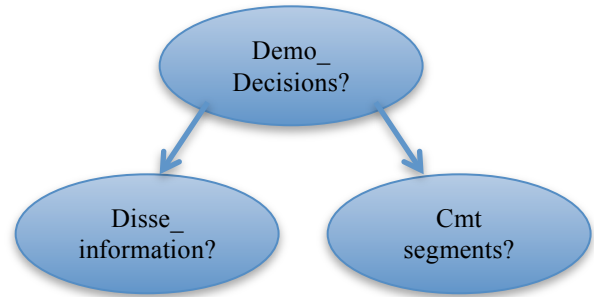


Figure 3: A decision graph for Watersheds Committees

The designing mode phase each decision area receiving decision options to be mutually exclusive. The table 5 shows the options considered for the decision areas.

TABLE 5 – Decision areas with their decision options

Decision Area	Decision options	Label
How Democratic Decisions?	Consensus Majority	Demo_decision?
Who Dissemination of information?	All members Only board members	Disse_information?
Who Commitment of segments?	All members Some members Only board members	Cmt_segments?

Based on the areas of decision and decision options was possible to build the decision tree. In this tree, all alternatives are shown to have resulted from combinations between each area and decision option.

So, the tree shows for decision makers all combinations of possible alternatives to reduce conflict, presenting an overview of the possibilities facilitating the process of social negotiation.

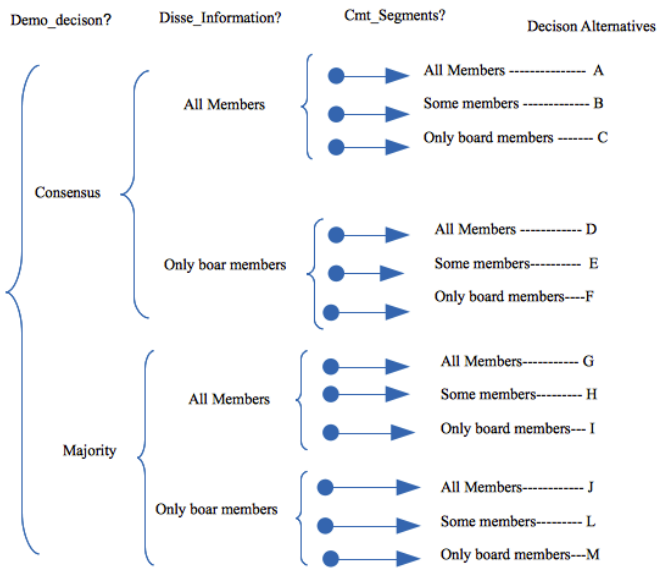


Figure 4: Decision Tree

In the comparing mode phase, with comparing area defined in the table 4 the alternatives were evaluated separately to receiving a score. The criterion for scoring was a scale created by symbols for the comparison areas, being used an ordinal scale for pairwise comparison. The table 6 shows the scale used in the case.

TABLE 6 – Scale for comparing between decision options

Decisions Options	Comparing areas			
	Complaints	Conflicts	Interaction	Efficient
Consensus	+++	NA	###	***
Majority	++	@@	##	**
All members dissemination the information	+++	@@@	###	***
Only board members dissemination the information	++	@@	##	**
All members are commitment	+++	@@@	###	***
Some members are commitment	++	@@	##	**
Only board members are commitment	+	@	#	*

NA – not applicable

The score of the alternatives is shown in Table 7. For each alternative the scores of the four areas were totaled for comparison according to the decision options thereby obtaining the score of an alternative.

TABLE 7 –Score of alternatives for comparison

Alternatives	Comparing areas			
	Complaints	Conflicts	Interaction	Efficient

A	+++++++ +	@@@ @@@ @@	##### #	***** ***
B	+++++++	@@@ @@	#####	***** **
C	+++++++	@@@ @	#####	***** **
D	+++++++	@@@ @@	#####	***** **
E	+++++++	@@@ @	#####	***** **
F	+++++++	@@@	#####	***** *
G	+++++++	@@@ @@@ @@	#####	***** **
H	+++++++	@@@ @@@ @	#####	***** **
I	+++++	@@@ @@@	#####	***** *
J	+++++	@@@ @@@ @	#####	***** **
K	+++++	@@@ @@@	#####	***** *
L	++++	@@@ @@	#####	*****

Evaluating the comparison areas and the criteria it was found that the best alternative to the members of the committee would be alternatives A and G.

In the last phase, choosing mode, checks in accordance with the table 8 that search committees should disseminate information and this should be a task for all members and not just a group as it is currently. The committee should also seek and encourage involvement of all committee members.

TABLE 8 – Alternative endings to choose

Alternative	Demo_decision?	Disse_information?	Cmt_segments?
A	Consensus	All members	All members
G	Majority	All members	All members

The alternative to resolve conflicts among members it would be seeking consensus at meetings

V. CONCLUSION

Broad public participation is essential for sustainable watershed management, which is recognized in a wide range of policy statements, academic papers, and activist programmes world-wide and activist [20].

This paper shows a proposal model for the decision-making in the watersheds committees. In this model, the developed methodology helps the actors at the reducing conflicts and increasing cooperation levels.

The model is composed of two phases the pre-structuring and the structuring where we use the SCA method. In the simulation we observe that the best alternative to reduce conflict in the committees is the alternative A, ie, have consensus in decision-making. For [21] stated that the discussion participants need to understand other opinions or views before reaching a sustainable conclusion.

So, we hope that the proposed model can assist members in reducing conflicts and uncertainties of the decision process, thereby improving the watersheds and a society.

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REFERENCES

- [1] Kyoko, I. Problem Solving Discussion Support System Based On Hypothesis Thinking, In: International Conference on Systems, Man, and Cybernetics, 2010, Istanbul, Turkey.
- [2] Natallya, A. L.; Danielle, C. M. Participatory Multicriteria Decision Making Model in Hydrographic Basin Committee. In: International Conference on Systems, Man, and Cybernetics, 2012, Seoul, Korea.
- [3] Vanessa, B. S. S.; Danielle, C. M. Supporting water resource management committees by using multicriteria analysis. In: International Conference on Systems, Man, and Cybernetics, 2010, Istanbul, Turkey.
- [4] DONOHUE, W. A. e KOLT, R. Managing Interpersonal Conflict, Sage Publications, 1992.
- [5] Helga, Haftendorn. Water and International Conflict. Third World Quarterly, Vol. 21, No. 1, (Feb., 2000), pp. 51-68.
- [6] LANNA, A. E. Introdução. In: Técnicas quantitativas para o gerenciamento de recursos hídricos. Porto Alegre: Editora da Universidade/UFRGS/IPH, 1997. 345p.
- [7] OHLSSON, L. The turning of a screw – Social adaptation to water scarcity. In: New Dimensions in water security (Part 3). Rome: FAO/AGLW, 2000.
- [8] Shawei, He; Keith, W. Hipel, D. Marc, Kilgour. Water Diversion Conflict in Danjiangkou, China. In: International Conference on Systems, Man, and Cybernetics, 2012, Seoul, Korea.
- [9] Lea, Kronaveter; Uri, Shamir. Negotiation Support for Cooperative Allocation of a Shared Water Resource: Methodology. JOURNAL OF WATER RESOURCES PLANNING AND MANAGEMENT, 2009.
- [10] Lea, Kronaveter; Uri, Shamir. Negotiation Support for Cooperative Allocation of a Shared Water Resource: Application. JOURNAL OF WATER RESOURCES PLANNING AND MANAGEMENT, 2009.
- [11] M, Atwi. J. Sanchez, Chóliz. A NEGOTIATED SOLUTION FOR THE JORDAN BASIN. Journal of the Operational Research Society 62, 81-91, (January 2011).
- [12] Niall, M. F. Keith, W. H. Jonh, J. Ralph, Z. A conflict analysis of the Armenian-Azerbaijani Dispute. The Journal of Conflict Resolution, Vol. 34, No. 4. (Dec., 1990), pp. 652-677.
- [13] Hipel, K.W., Fang, L., and Kilgour, D.M., 2008. "Decision support systems in water resources and environmental management," *Journal of Hydrologic Engineering*, 13(9), 761-770.
- [14] Hipel, K.W., Obeidi, A., Fang, L., and Kilgour, D.M., 2008. "Adaptive systems thinking in integrated water resources management with insights into conflicts over water exports," *INFOR*, 46(1), 51-69.
- [15] Danielle. C. M.; Adiel, T. A. "Water supply system decision making using multicriteria analysis," *Water SA*, vol. 32, pp. 229-235, 2006.
- [16] S. Hajkowicz S and K. Collins, "A review of multiple criteria analysis for water resources planning and management," *Water Resources Management*, vol. 21, pp. 1553-1566, 2007.
- [17] Hipel, K.W. (Editor). (2009a). *Conflict Resolution, Volume 1*. Eolss Publishers, Oxford, United Kingdom (ISBN-978-1-84826-120-4 (Adobe e-Book), ISBN-978-1-84826-570-7, Library Edition (Hard Copy).
- [18] D. Tjosvold, R. Field, "Effects of Social Context on Consensus and Majority Vote Decision Making," *Academy of Management Journal*, vol. 26, no. 3, pp. 500-506, Sep. 1983.
- [19] S. Brams, A. Taylor, "Fair Division. From Cake-Cutting to Dispute Resolution," New York: Cambridge University Press, 1996.
- [20] PERKINS, P. Public participation in watershed management: international practices for inclusiveness. *Physics and Chemistry of the Earth* 36: 204-212, 2011.
- [21] S. Kaner, L. Lind, C. Toldi, S. Fisk, and D. Berger, *Facilitator's Guide to Participatory Decision-Making*, New Society Publishers, 2005.

