SWOT ANALYSIS TECHNIQUE AS A QUANTITATIVE TOOL FOR ADAPTIVE MANAGEMENT ON TRANSBOUNDARY RIVER BASINS

Christina Mitsiani,
George Tsakiris

Lab. of Reclamation Works and Water Resources Management, School of Rural and Surveying Eng., National Technical University of Athens, Greece

mitsiani@mail.ntua.gr

Most conflicts between countries, originate from issues regarding the quantity and quality of shared water resources. During the last decades, many tools and models for river basin management have been developed according to the international and European law, conventions and other agreements. The proposed methodology is a quantitative outlook of the popular SWOT analysis. The technique suggested in this article has been empirically tested and contributes in strengthening the present highly subjective technique. This method, inspired by marketing management, has been shaped to be used for measuring Strength, Weakness, Opportunity and Threat in a transboundary river system and can be a useful tool for cooperation between the countries that share a river, in the framework of an adaptive management.

Water resources act as a complex system that learns and evolves. Adaptive river management is the continually improving management, with strategies and policies which continuously change and adapt to external human interventions and natural changes, by learning from the outcomes of the implemented management [3].

The main definitions of the four concepts, as outlined in the literature [1,2], but here transformed to the transboundary system, are ***Strenght***: Internal advantage to the system, ***Weakness:*** Internal disadvantage to the system, ***Opportunity***: External advantage to the system, ***Threat***: External disadvantage to the system. Therefore, strength and opportunity are considered to be positive factors, while weakness and threat are negative factors.

The classical SWOT analysis uses the above definitions as a mean to classify the various management issues using a structured format (Table 1). The researcher is simply required to identify the status of the system by putting a tick on the list. Once the listing is complete it is used to assess the status of strength, weakness, opportunity and threat based on the value for each of the definition. By the classical SWOT analysis, systems are evaluated based on a highly subjective technique, which fails to quantify the level of importance given to each of the four concepts and individual variables listed under each of the system elements. In addition, it cannot be derived from the analysis the short-term versus the long-term impact of each of the variable. The technique proposed will aid, showing empirically a) the overall status of a river system, b) the degree of various concepts and c) the short- and long-term status of the river systems and be used as a tool on adaptive river management.

Table 1 SWOT analysis of basic river system elements

	Sj	Sn	N	Wn	Wj	Hi	Md	Lo
Cooperation								
C1 to C3								
Environment								
E1 to E5								
Economy								
O1 to O4								
System adaptive Behaviour								
S1 to S4								

Column variables:
Sj = Major strength, Sj = Minor strength, N= Neutral, Wn = Minor weakness, Wj = Major weakness, Hi = High, Md = Medium, Lo= Low
Row variables, for a transboundary river system:
C1: Cooperation between the two governments (sharing data, auditing mechanisms, common policies)
C2: Cooperation and coordination between water institutions
C3: Following the bilateral agreements
E1: Ecosystem maintenance
E2: State of water quality
E3: Existence of Waste water treatment plans
E4: Availability of treated wastewater for irrigation use
O1: Productivity of energy
O2: Use of river water in agriculture
O3: Potable use and recreation (river as a social good)
O4: Gross Domestic Product (PPP) (2007 est, source: CIA The World Factbook)
O5: Availability of water during the dry periods, for the above uses
S1: Regional development plans that adapt to several environmental political and economic changes
S2: Following the existing guidelines for transboundary management
S3: Taking advantage of EU and International Funding Opportunities for water resources management
S4: Satisfaction of the citizens (by government policies) and public participation
(Source: Modified form, Kotler, Philip. Marketing Management, The millennium edition, 1999)

The analysis presented in this article is based on a hypothetical case, on a transboundary river system shared by two countries and can either focus on the whole river system or on every co-riparian basin separately. Initially, the four concepts need to be further classified, as it follows:
S_S = Internal Strength for the short-term period
S_L = Internal Strength for the long-term period
W_S = Internal Weakness for the short-term period
W_L = Internal Weakness for the long-term period
O_S = External Opportunity for the short-term period
O_L = External Opportunity for the long-term period
T_S = External Threat for the short-term period
T_L = External Threat for the long-term period

It is well accepted that any variable can be measured quantitatively if the units of measurement are appropriate. This article centers on various river management functions, such as Cooperation, Environment, Economy and System Adaptive Behavior. The various units of measurement for the variables (C_{1-3}, E_{1-4}, O_{1-5}, S_{1-4}) can be obtained from secondary information or from empirical survey, using an attitude scale (e.g. 7-point interval scale, from low to high) or percentage.

The above indicates that since the units of measure used are not likely the same, it is essential to standardize the outcome. In doing so, it can be made comparison with an ideal river system (if we examine the whole transboundary river as a unit) or with the other co- riparian river system (if we examine the part of the river basin of every country separately). The "standardized score" is actually the relative position of the river system (RS) under study with respect either to an ideal river system or to the other coriparian river system (Competitive - CS). The standardized score can be derived using (1).
Standardized Score = (RS)/(CS) (1)

Once the standardized scores are calculated, the researcher based on expert opinion or an empirical survey, can identify the level of importance of the factors measured a scale (using e.g. again a 7-point interval

scale. The level of importance acts as a weight, which indicates how important the corresponding variable is. Thus the analysis of a hypothetical transboundary river system, compared to an ideal situation, is shown in Table 2.

After the classification is complete, the technique calculates the score to assess the status of concepts, for the various elements of the river system under study. Table 3 shows the calculation required to arrive at the score for each of the concept (S_S to T_L).

Table 2 Standardized and Rated Score

Variables	1*	2*	3*	4*	5*
C1					
. . .					
S4					

* 1= Actual score of the river system (RS), 2= Score of ideal or coriparian system (CS), 3= Standardized score (1/2), 4= Level of importance, 5= Rated score (3/4)

Table 3 Status of various Concepts (random use of scores)

Concept	Variables	5*	6*	7*
S_S	C_1	4	7	19.9
	C_2	3		
	Ei	2.3	2.3	
	O_2	6.5	10.6	
	O_5	4.1		
S_L				
O_S				
. . .				
T_L				

* 5= from table 2 (7-point interval scale) , 6= sub-set score of functional area, 7= Concept score

In addition, the data also helps to calculate the "river system Position" (Φ_S) and the "river system Attractiveness" (Φ_L). The "position" means the present status of the transboundary river system and the "attractiveness" determines the future prospects.

To calculate the "position" of the river system, the short-term concepts are considered using:

$$\Phi_S = (S_S - W_S) + (O_S - T_S) \quad (2)$$

For calculating the river system "attractiveness", it is used the long term concepts, in the equation:

$$\Phi_L = (S_L - W_L) + (O_L - T_L) \quad (3)$$

The results for these two indicators can be derived from the data of Table 3. Positive value indicates that the river system examined is relatively better compared to the other one (of the coriparian country), while negative value indicates a vulnerable status.

One more dimension, the "comparative advantage" Φ, uses both the short term and long term results of the river system and it is the sum of "system Position" and "system Attractiveness".

$$\Phi = \Phi_S + \Phi_L \quad (4)$$

SWOT analysis is a useful tool for the planning and decision making and has been widely applied to environmental planning and water resources management. This technique, when it is used for comparing the transboundary river systems of each country, it can have remarkable results, as it can detect the vulnerable and strong elements of the river system or management. Easy and user friendly, it has many advantages and can be used by governments or stakeholders, for improving their policies in the framework of an adaptive management.

References

1. EU (2003) Evaluating Socio Economic Development, SOURCEBOOK 2: Techniques and Tools - SWOT analysis www.evalsed.info, http://ec.europa.eu/regional_policy
2. Kotler P (1999) Marketing Management. The millennium edition, Prentice Hall of India, New Delhi
3. Pahl-Wostl C, Downing T; Kabat P; Magnuszewski P; Meigh J; Schuter M; Sendzimir J; Werners S (2005) Transition to adaptive water management: The NeWater project. Institute of Environmental Systems Research, University of Osnabruck.

Ms Ch. Mitsiani is honored by a 3-year sholarship of the Greek State Scholarship Foundation