Numerical indexing of risks of conflicts
Around the transboundary water resources

Remote Sensing, Cooperative Modelling & Simulation

MENANI Mohamed Redha, Earth Sciences Department, Batna University, Batna, Algeria
Fax : 00 213 (0)33 85 32 98 - Email: menani_redha@univ-Batna.dz

Abstract

The world-wide crisis of water will see the transboundary water resources becoming the object of tensions and litigations increasingly marked. Also, the transboundary conflicts on fresh water intended to the categories of traditional uses are subjected to a growing attention on behalf of national and international organizations. Each case of conflict has its proper characteristic and to appreciate its relative importance, it is necessary to consult a broad documentation based on reports of commissions, organizations or groups of research. According to criteria's and data's taken into account, the situation is some times appreciated differently.

This note proposes a numerical indexing method of the risk of conflict around the transboundary water resources by taking into account indicators having weights proportional to their relative importance. These indicators include:
- the degree of dependence to the transboundary water resources of the concerned countries;
- the state of satisfaction of the needs of each country;
- the geopolitical context of the zone of conflict;
- the geographical position in relation to the resources;
- the water governance by parts in conflict.

However, these indicators take different values in rating intervals which depend of the local conditions.

The combination of the fixed weight and of the reached rate by each indicator in a given region leads to a partial index of the risk concerning this indicator and the sum of the partial indices provides the global index of the risk of conflict around the transboundary water resources.

This indexing approach is inspired by the DRASTIC method established by the NWWA (Aller and al, 1987) with the aim of numerically evaluating the vulnerability to pollution of the groundwater. This method was inspired in its turn by the approach of Hutchinson and Hoffman (1983) which was elaborated in the same objective.

The rating intervals proposed here are based on criteria's and standards which take into account results of research works carried out through actions at world scale which target not only the quantitative and qualitative aspects of the resources, but also a broader vision which integrates the economic, social, educational and political aspects.

Each indicator varies in a rating field according to well defined criteria's which take different values according to local conditions, thus providing a partial index of risk (multiplication of weight by rate) and the sum of these partial indices gives the global index of risk of conflict for a given region.

Based on indicators relatively easy to identify, this approach allows:
- a standardized qualification of the risk of conflict around the transboundary water resources;
- a fast comparison between different regions of the world exposed at this risk;
- a cartography of the zones at risk according to same indices.

Indicators of risk:

Indicators of risk have weights fixed which take into account their relative importance. The indicators proposed are summarized in table 1

Table 1. Risk Indicators and their respective weights

Indicators	Weights
The degree of dependence to the transboundary water resources	5
The satisfaction degree of the water needs	4
Geopolitical context of the zone of conflict	3
The geographical position in relation to the water resources	2
The water governance by parts in conflict	2

The relative weights assigned to the proposed indicators can lend to discussion, nevertheless the following remarks guided this choice. The various factors, which in certain situations can be redundant, are evaluated separately and in an independent way, because it is question of evaluating their intrinsic influences:

- The dependence degree of a country to the transboundary water resources for the satisfaction of its various needs is a decisive factor of conflict even if the other indicators have rates of weak risk. Even if a country has trumps of good governance or of effective governance according to the terminology of the GWP (2003), if it has normal relations with the concerned country or countries, if the geostrategic problems do not arise, the transboundary water resources are perceived like a vital energy resource on which one has a right of ownership and about which one does not make any concession.

- The satisfaction of the needs: if the various potentialities of provisioning of a country do not satisfy its traditional needs, or if for example the pressing need for a greater capacity of electric power becomes essential (hydroelectric stations), temptation to benefit from the transbordoundary water resources is increasing, by non consensual adjustments, derivations of river, excessive pumping… i.e. as many arguments of conflicts, this even if the other indicators have rates of weak risk, i.e. even if countries in question have normal diplomatic relations and efficient systems of water governance;

- The geopolitical context of a region is a critical factor. In the case of a political or armed conflict between countries, the management of the transboundary water resources endures the direct consequences. The cooperative committees of dialogue have then great difficulties in their operation if they are not straightforwardly blocked. However, in regions marked by normal political relations, the risk of conflict decreases very appreciably. One perceives better now the difference between the relative importance of the geopolitical context and the risk related to the degree of dependence to the water resources which is more important relatively, even in the case of good relations between the concerned countries.

- The influence of the geographical position or dominant position (natural or provoked) is related to the fact that a country which is located at upstream of a river or nearest the alimentation border of the transboundary aquifers has more benefits by this situation that the country located downstream, either naturally, or by a provoked way (non consensual installations and river derivations, discharge of polluted water, etc…). This indicator which is also a source of conflict has however a weight weaker than those enumerated previously.

- The water governance by the parts in conflict, which according to the GWP (2003) is the source of the world-wide crisis of water, is not only an indicator of conflict, but also an indicator of a social, economic, and political development. According to Rogers and Hall (2003), the water governance of a country can be evaluated according to basic principles and criteria's of performance. Poor governance of water in a boundary region is an undeniable source of local conflicts with a possibility of incidence on the transboundary resources. For example, losses in distribution networks generate necessarily the recourse to an additional water supply, or the absence of sanitation networks and the inexistence of purification of the discharged water which lead to pollution of the surface water and groundwater. Conversely, an efficient system which has recourse to other forms of resources to satisfy its needs (purification, treatment, desalination…) will decrease the need for recourse to the transboundary resources. The incidence of the water governance on the risks of conflicts around the transboundary water resources is necessarily of relative weight weaker than the degree of dependence to this resource and than the geopolitical and geographical contexts of the area which are basically different indicators and intrinsically more incisive. Nevertheless, the degree of satisfaction of the water needs is improved by effective governance, all the more if it presents criteria of performance.

- The factors "dialogues and cooperation" are taken into account in the water governance indicator, through the heading untitled "existence of structures which treat the regulation aspect of territorial or use conflicts and the respect of the ethics of the use of water".

Rating intervals of the indicators of risk:

According to local conditions, the indicators of risk take values varying between 1 and 10; the greatest dimensions indicate a high risk of tension and conversely.

It is obvious that these ratings must be established for each country concerned by the transboundary water resources.

The partial index of risk is obtained by multiplying the fixed weight of an indicator by the rate reached in the studied case (IPR = I_{iw}. I_{ic})

IPR: partial index of risk
Iiw: indicator fixed weight
Iic: indicator rate (variable)

Example of the degree of dependence to the transboundary water resources
The degree of dependence to the transboundary water resource can be appreciated by the quotation indicated in table 2.

Table 2. Ratings intervals of the dependence degree to the transboundary water resources

Variation intervals	Rate
Total dependence	10
Partial dependence with difficulties of satisfaction of the needs by other resources (natural and technical difficulties)	8
Partial with possibilities of supplying by other resources but with a high capital cost	6
Partial with possibilities of supplying by other resources with an advantageous capital cost	3
Partial to weak with an effective supply by other resources	2

Partial index of minimum risk (PIR $_{min}$) = fixed weight. Minimum rate = 5. 2 = 10
Partial index of maximum risk (PIR $_{max}$) = fixed weight. Maximum Rate = 5. 10 = 50

The very weak dependence to the transboundary water resources cannot exist because no country can forsake its quota.

The natural difficulties are related for example to the rainfall deficit which influences negatively the filling of a dam even if enormous investments were made in this direction. The technical difficulties are for example those which can block projects of hydraulic transfers.

When an investment on other forms of resources becomes profitable, the tension on the transboundary water resources decreases appreciably.

The total index of risk:
It is the sum of the partial indexes:

$$GIR = \sum PIR = \sum I_{iw} * I_{ic}$$

With GIR: global index of risk of conflict around transboundary water resources

According to this procedure, the global index of minimum risk of conflict is 25, whereas the maximum index is 152.

We note generally that two countries or more which are involved in a transboundary water conflict do not present the same global index of risk because conditions which prevail in each one of these countries are different. For the entire zone, it east can be preferable to affect the highest GIR obtained for the concerned countries, because it is which reflects the real tension which prevails around the transboundary water resources.

Conclusion
On the basis of impact of 5 fundamental indicators characterized by fixed weights and variable rates which translate the local conditions of these indicators, the combination of weights and rates lead to the numerical expression of the risk of conflict around the transboundary water resources. It is obvious that this approach can not be applied, at least with difficulty, to all situations because conditions are much diversified, but it allows an approach of the most common situations.

The databases of various organizations working in fields which are on relation with this context facilitate the acquisition of the majority of the data necessary for calculation of the various indices. These indices can be updated like the databases making it possible to follow the evolution of the global index of risk.

If the definition of certain ratings intervals can lend to discussion, the relative order of classification seems correct and the global index of risk of conflict around the transboundary water resources allows a classification of the zones relating to this risk and its cartography.