

# Transboundary Water Policies: Assessment, Comparison and Enhancement

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**Abstract** Transboundary water treaties are evaluated and compared using Multiple Criteria Decision Analysis (MCDA) in order to identify the most desirable treaty and suggest how existing treaties can be improved. More specifically, a flexible MCDA technique, called the Elimination Method, is employed for analyzing and comparing three multilateral treaties and one bilateral transboundary treaty according to three main criteria, which focus on each treaty's capacity in dispute avoidance and resolution. The three multilateral agreements and one bilateral treaty which are studied consist of the 1998 Rhine Convention, 1995 Mekong River Basin Agreement, 1992 United Nations Economic Commission for Europe Convention, and the 1909 Boundary Waters Treaty between Canada and the United States, respectively. The analytical results reveal limitations of these international water policies with respect to conflict resolution, and provide directions for the possible improvement in cooperation over international water resources.

**Keywords** Transboundary water policy analysis · Multiple criterion decision making · Elimination method · Enforcement capability · Dispute settlement

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## 1 Introduction

The worldwide population explosion and the changing environment pose a continual threat to the quantity and quality of water resources. Due to the controversy between diminishing water resources and increased living, agricultural and industrial needs, water utilization conflicts have attracted attention on a global basis. By further considering the increasing importance of social and political influences on environmental decision making, conflict resolution is becoming more and more significant to environmental engineers and other decision-makers.

Among all water-related conflicts, a large portion of conflict occurs over transboundary waters. There are 261 international rivers draining a total area equal to half of the land mass in the world (Water Information Network 2001; Yoffe and Wolf 1999). Many people think that competition among nations for control of scarce water resources may cause warfare among countries in the future (Gleick 1993). To protect and conserve limited water resources and to avoid possible international conflict over transboundary water resources, an increasing number of international water policies are being put into effect (Dellapenna 2001). For example, a new Protocol on Water and Health under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes came into force on 4 August 2005 (UN ECE Protocol 2005). The book edited by Wolf (2002) contains sets of valuable articles, which provide a good summary of conflict prevention and resolution in water systems from the viewpoints of different disciplines.

Analyzing water conflicts on a global scale is attracting the interest of more and more researchers. Pioneering work in this area has been carried out by Yoffe et al. (2004). In their work, a comprehensive database is developed to connect water conflicts from historical and geographical perspectives. Then, a general analytical framework for water conflicts is proposed by utilizing political science methodologies in conjunction with the database. However, how to improve conflict resolution methodologies is still an open and challenging research topic.

International water laws define the legal rules for international water sharing among two or more countries. Currently, over 3,600 bilateral or multilateral international agreements have been signed all over the world (Vinogradov et al. 2003). Although such international water agreements significantly reduce the possibility of conflict occurring, none of them is perfect and able to resolve all conflicts. Thus, it is worthwhile to compare different international water policies, so that insights into the contents and implementation of international water policy can be obtained and worthwhile directions for the improvement of international water policy can be provided.

In this paper, policy analyses with respect to four international water policies are carried out by using the Elimination Method (MacCrimmon 1973; Radford 1989), a useful Multiple Criteria Decision Analysis (MCDA) technique which can simultaneously handle both qualitative and quantitative criteria. The selected four transboundary waters treaties are: the 1998 Convention on the Protection of the Rhine, 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin (AMRB), 1992 United Nations (UN) Economic Commission for Europe (ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (CTWIL), approved in Helsinki, and 1909 Treaty relating to Boundary Waters and Questions Arising along the Boundary between the United States and Canada (BWT). The analytical results show that the 1998 Rhine Convention performs best in both enforcement capability and treaty implementation, while the 1992 UN ECE Convention occupies the first rank with respect to the dispute resolution mechanism. For all three main evaluation criteria, the 1909 Boundary

Waters Treaty exhibits the worst performance, which shows the necessity and importance of modifying and improving this treaty. The analytical results also indicate directions for such modifications and improvements.

The remainder of this paper is outlined as follows. In Section 2, the MCDA methodology is introduced and the Elimination Method is described. In Section 3, the background to the selected transboundary waters treaties are provided and are appropriately modelled for subsequent analysis. Analyses and results are discussed within Section 4, followed by the summary in Section 5.

## 2 Multiple Criteria Decision Analysis

### 2.1 Multiple Criteria Decision Making

Most methods for water policy analysis fall under the category of decision-making technologies, which were originally developed within a field called *operational research*, or simply OR. The OR field was initiated just before and throughout World War II to solve real operational problems and has been extensively studied since the war. A wide variety of mathematical and quantitative techniques have been developed, and successfully used, for solving both well-defined problems especially at the tactical level of decision making and less well-defined strategic level problems having both quantitative and qualitative constraints. Hipel et al. (1999) provide a good overview of OR techniques as a chapter in a handbook on Systems Engineering.

To facilitate the selection of appropriate OR techniques among a large range of possibilities for a specific practical problem with given characteristics, it is informative to classify OR methods according to attributes that they can handle. Then, by knowing the key characteristics of the problem under study, suitable OR methods can be chosen such that they possess the appropriate capabilities for modelling these characteristics. There is a range of criteria that could be utilized for classifying OR methods. One possible classification is based on the criteria of how many decision-makers and how many objectives are involved in the problem (Fang et al. 1993).

One of the important categories of OR methods is called Multiple Criteria Decision Analysis (MCDA). The kinds of problems addressed under MCDA consist of one decision maker, multiple objectives and multiple candidate solutions. MCDA methods are designed for finding the more preferred alternative solutions to a problem when discrete alternatives are evaluated against criteria ranging from cost (a quantitative criterion) to aesthetics (a qualitative criterion). The evaluation of a criterion for each alternative reflects the objectives or preferences of the decision maker. For each alternative, one has a vector of multiple entries for comparing these alternatives to the others in order to determine a set of more preferred solutions. One of the advantages of MCDA methods is that they provide flexibility for carrying out sensitivity analyses by systematically varying possible entries as well as meaningfully altering the weighing schemes for the criteria. In fact, MCDA techniques constitute the most widely employed family of decision making techniques applied to water resource problems and elsewhere (Hipel 1992). A number of informative textbooks on MCDA are available such as those written by Hobbs and Meierm (2000), and Belton and Stewart (2002). Haimes (2004) also contributed to the topic of MCDA by proposing the well-received surrogate worth trade-off method described in Chapter 5 in his book.

## 2.2 Elimination Method

Decision making problems arising in international water policy analysis contain the following characteristics:

1. In international water policy analysis, the measurement of progress toward objectives (and possibly, of some of the costs and benefits) may not be expressed entirely in quantitative form;
2. There may be no direct relationship between the ways in which the degree of achievement of the various objectives is assessed;
3. There may be no numeric weighting factors available to express the preferences among the criteria or objectives. Therefore, priorities of these objectives can only be represented on an ordinal scale.

In order to be able to take into account all of these characteristics, the MCDA technique called the Elimination Method is chosen for modelling and analyzing the four transboundary water treaties considered here. The method is capable of finding the preference ranking of a number of alternatives. The basic ideas of the Elimination Method are described in the following steps (MacCrimmon 1973; Radford 1989):

- Step 1. **Criteria selection:** A set of meaningful criteria are chosen for evaluating the possible alternatives. Note that the proper selection of criteria is critical for determining the final solutions.
- Step 2. **Criteria ranking:** The selected criteria are ranked in a decreasing order of preference from most important at the top to least important at the bottom.
- Step 3. **Alternative assessment:** Each alternative is assessed with respect to each criterion chosen in step 1. Measures for assessment can be expressed quantitatively (e.g., cost related criteria) or qualitatively (e.g. "aesthetics" criterion).
- Step 4. **Threshold determination:** A threshold is defined to determine a minimum or maximum performance level for each criterion.
- Step 5. **Alternative ranking:** All possible alternatives are ranked based on the evaluation of each of them against the criteria and the priorities of all criteria. Specifically, the ordering of alternatives can be determined based on the following steps. First, the criterion with the highest priority is evaluated and the alternatives that cannot meet the required performance level are eliminated. All other alternatives survive at this point. Then, the second most important criterion is addressed and the unsatisfied alternatives are removed. A similar procedure is repeated for the remaining criteria. After checking all the criteria, a ranking of all alternatives can be obtained.
- Step 6. **Criteria update:** If the above evaluation procedure cannot produce sufficient separation between the alternatives, finer definitions of the thresholds can be considered. In addition, if appropriate, a hierarchy of conditional statements about criteria can also be employed when using the Elimination Method (Radford 1989).

## 3 Background of Selected Transboundary Waters Treaties

### 3.1 Overview

As the most important source of international water law, transboundary waters treaties are the major instruments for directing cooperation in international water utilization. One of the

earliest general transboundary waters agreements can be traced back to the 1923 treaty regarding the Geneva Convention relating to the Development of Hydraulic Power affecting more than one State and Protocol of Signature. Up to the present time, there have been more than 3,600 transboundary waters treaties around the world (Vinogradov et al. 2003; Wolf 1998; Gleick 1993).

Based on the number of Contracting Parties involved, transboundary waters treaties can be classified into the two categories of multilateral treaties and bilateral treaties. The multilateral treaties can be further categorized based on the scope covered by the treaties, such as a particular region, a river basin, or a part of a river basin. A summary of the treaty categories and typical treaty examples in each category are shown in Table 1 (Vinogradov et al. 2003). For analysis purposes, in our work, the following four important transboundary waters treaties are selected:

- The 1998 Convention on the Protection of the Rhine (CPR);
- The 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin (AMRB);
- The 1992 UN Economic Commission for Europe (ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes, agreed upon in Helsinki (CTWIL);
- The 1909 Treaty between the United States and Great Britain Relating to Boundary Waters, and Questions Arising between the United States and Canada (BWT).

### 3.2 The 1998 Convention on the Protection of the Rhine (CPR)

The 1998 Convention on the Protection of the Rhine is the descendent of the old Convention for the Protection of the Rhine and the 1963 Agreement concerning the

**Table 1** Categories of transboundary waters treaties with examples

		Particular region	River basin	Part of basin
Multilateral treaties	1992 UN Economic Commission for Europe (ECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes, drawn up at the Helsinki Convention	Y		
	1992 Agreement on Cooperation in the Area of Joint Management, Utilization and Protection of Interstate Water Resources (in Central Asia)	Y		
	1994 Convention on Cooperation for the Protection and Sustainable Use of the Danube River		Y	
	1995 and 2000 Protocol on Shared Watercourse Systems in the Southern African Development Community	Y		
	1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin			Y
	1998 Convention on the Protection of the Rhine		Y	
Bilateral treaties	1909 Boundary Waters Treaty concluded between the United States and Canada (Great Britain)			
	1956 Treaty between Hungary and Austria concerning the regulation of water economy questions in the frontier region			
	2002 Agreement between Russia and Belarus on cooperation in the field of protection and rational use of transboundary water bodies			

International Commission for the Protection of the Rhine against Pollution. The negotiations for the new convention were completed in January 1998 and the new convention was signed in April 1999 in Berne, Switzerland. The aims of the 1998 Rhine Convention are as follows (European Union 2000):

1. sustainable development of the Rhine ecosystem through:
  - (a) maintaining and improving the quality of the Rhine's waters, and its natural function;
  - (b) protecting species diversity;
  - (c) reducing contamination;
  - (d) conserving and improving natural habitats for wild fauna and flora;
  - (e) ensuring environmentally sound management of water resources;
  - (f) considering ecological requirements in developing the waterway.
2. production of drinking water;
3. improvement of sediment quality;
4. flood protection;
5. coordination with measures to protect the North Sea.

The executive institute under the 1998 Rhine Convention is the International Commission for the Protection of the Rhine (ICPR). The ICPR is made up of representatives from all Contracting States, which include the Federal Republic of Germany, French Republic, Grand Duchy of Luxembourg, Kingdom of the Netherlands, Swiss Confederation, and European Union. It is chaired by all Contracting States in turn. Decisions are taken unanimously and are communicated to the Contracting Parties. Each year, the ICPR will submit an activity report to the Contracting Parties while the Contracting Parties should regularly report to the ICPR on the legislative, regulatory and other measures they have taken in implementing the Convention and the results of those measures. The tasks of the ICPR are as follows (European Union 2000):

1. prepare studies and programs on the Rhine ecosystem;
2. make proposals for actions to be taken;
3. evaluate the effectiveness of the actions carried out;
4. coordinate warnings and alerts;
5. inform the public as to the state of the Rhine and the results of its work.

### 3.3 The 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin (AMRB)

Gooch (2005) provides a good description of the Mekong River Basin Agreement. As mentioned in his thesis, the objective of the Agreement on Cooperation for the Sustainable Development of the Mekong River Basin is to achieve optimum use and prevention of waste of the waters in accordance with the aim of improving the livelihood of the people living within the Lower Mekong River Basin. The history of the Mekong Agreement consists of three phases. In the first phase, Cambodia, Lao People's Democratic Republic (Lao PDR), Thailand and South Vietnam agreed on the Mekong Development Project under the leadership of the first Mekong Committee for the Coordination of Investigations of the Lower Mekong Basin in 1957. The first phase focused on extensive hydropower cascades in the river. However, the plans were never actually realized. The second phase referred to the Interim Mekong Committee from 1978 to 1995. The Committee included a united Vietnam but without Cambodia which was ravaged by war. The second phase was

aimed at national irrigation projects as well as hydropower. In 1995, the current Mekong River Commission (MRC) was established based on the 1995 Mekong River Basin Agreement. The MRC consists of the four Lower Mekong River countries, Cambodia, Lao PDR, Thailand and Vietnam. The 1995 Mekong Agreement has been considered as a broader, more modern perspective of integrated sustainable ecosystem development.

The aim of the MRC is to promote and co-ordinate sustainable management and development of water and related resources for the countries' mutual benefit and the people's well being. The MRC has a three level hierarchical structure comprised of the Council, Joint Committee (JC), and the Secretariat. The Council is at the highest level. Its responsibilities include:

- political decisions on the implementation of the Agreement;
- approval of projects and other implementation steps;
- the resolution of issues, differences and disputes.

The JC is responsible for the implementation of the Council's policies and decisions, the preparation of the Basin Development Plan, the collection of information, the execution of studies and assessments, and the supervision of the Secretariat.

### 3.4 The 1992 UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes, adopted in Helsinki (CTWIL)

The UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UN ECE Convention) was adopted on March 17, 1992 in Helsinki and came into force on October 6, 1996. By September 16, 2003, the Convention consisted of 34 member Parties, including the members of the European Union (EU). The objectives of the 1992 UN ECE Helsinki Convention are (Greenyearbook 2005):

1. to strengthen the protection and management of transboundary waters through national and international actions;
2. to prevent, control, and reduce pollution;
3. to promote public information and publication in decision-making processes.

Based on the definitions of the 1992 UN ECE Helsinki Convention, the meeting of the Parties is the supreme decision-making body. The functions of the Parties' meetings are to continuously view the implementation of the Convention and to consider and adopt proposals for further development or amendments to the Convention. The meeting of the Parties is required to be held at least every 3 years. Between the regular meetings of the Parties, the Bureau (a chairperson and two vice-chairpersons elected by the Meeting of the Parties and the Chairpersons of Working Groups), with the assistance of the Secretariat, shall carry out the tasks entrusted to it by the Meeting of the Parties. The implementation of the program of activities is supported by working groups on water management; legal and administrative aspects; monitoring and assessment; and water and health, as well as by an expert group on water and industrial accidents.

### 3.5 The 1909 Treaty Between the United States and Great Britain Relating to Boundary Waters, and Questions Arising Between the United States and Canada (BWT)

At the beginning of the twentieth century, there was great interest in finding ways to resolve disputes over transboundary waters shared by Canada and the United States.



Moreover, both countries wished to remain as good neighbors and prevent potential conflicts which may occur in future water resources developments. On January 11, 1909, the treaty between the United States and Great Britain relating to boundary waters, and questions arising between the United States and Canada (the 1909 Boundary Waters Treaty) was signed by the United States and Great Britain (on behalf of the Dominion of Canada). The 1909 Boundary Waters Treaty is composed of a preliminary article, 14 articles, and the detailed rules of procedure. The key objectives of the treaty are (Boundary Waters Treaty 1909):

1. “to prevent disputes regarding the use of boundary waters and to settle all questions which are now pending between the United States and Canada;”
2. “to make provision for the adjustment and settlement of all such questions as may hereafter arise.”

The International Joint Commission (IJC) is the institutional means for implementing the 1909 Boundary Waters Treaty. The IJC is required to give all interested parties a “convenient opportunity to be heard” on matters under consideration (Boundary Waters Treaty 1909). Over the past nearly 100 years, the IJC has helped to solve many disputes that have arisen between the United States and Canada.

## 4 Policy Analysis

### 4.1 Overview

There exists a large number of criteria which could be used to evaluate the transboundary waters policies. Some typical examples of such criteria include scope, substantive rules, procedural rules, institutional mechanisms, dispute avoidance and settlement, treaty implementation and compliance (Vinogradov et al. 2003). Since great importance is placed on the effectiveness of the selected transboundary waters treaties in dispute avoidance and settlement in our work, the evaluation of the selected four important transboundary waters treaties will focus on the following three major aspects:

- Enforcement capability;
- Treaty implementation;
- Dispute settlement mechanism.

### 4.2 Enforcement Capability

Enforcement capability reflects the ability of a treaty to have its rules followed. It includes whether the treaty contains compulsory capability on dispute resolution, whether decisions made from the treaty have power on its Contracting Parties, whether the treaty provides monitoring and consultant mechanisms on decision implementation, and whether the treaty can impose penalties for non-compliance by a Party. To evaluate the enforcement capability of the selected transboundary waters treaties, we set forth the following criteria:

1. Seek arbitration and judicial settlement;
2. Legally binding capability;



3. Decisions are to be implemented by the Contracting Parties within a certain time limit;
4. Parties report the reasons for unimplemented decisions and ask for consultations.

In the following, the four treaties are evaluated based on the criteria mentioned above.

#### 4.2.1 *The 1998 Convention on the Protection of the Rhine*

In the 1998 Rhine Convention, the dispute settlement consists of two stages. In the first stage, the disputes are solved by means of negotiations among Contracting Parties or any other possibility of arbitration acceptable to them. If the first stage is not able to settle the dispute, arbitration proceedings, which are defined as part of the Convention, are initiated in the second stage upon the demand of one of the parties to the dispute. This shows that the 1998 Rhine Convention contains the capability for seeking arbitration and judicial settlement.

Arbitration decisions are made by the court of arbitration. The court consists of three members. Two of them are appointed by each Party involved in the dispute, and the other one is designated by the former two arbitrators and will act as the chairman of the court. To avoid situations where the arbitration court cannot be established in a timely fashion, the International Court of Justice (ICJ) will intervene in the arbitrator selection. Any decisions made by the court will be based on the rules of international law and particularly the rules of the Convention. The decisions have a legally binding capacity.

All decisions to the disputes are required to be implemented within a certain time limit by the associated Contracting Parties. If a Contracting Party cannot implement the decision or can only partly implement it, the Convention requires the Party to report the reasons to the Commission and all other Contracting Parties. Further consultations can be carried out. Based on the reports of the Contracting Parties or the results of consultations, the Commission may decide on measures supporting the implementation of decisions.

Details about the enforcement capability of the 1998 Rhine Convention can be found in the Articles of the treaty (Rhine River Convention 1998). The associated Article numbers are listed in Table 2.

#### 4.2.2 *The 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin*

In the 1995 Agreement of the Mekong River Basin, the Council and the Joint Committee of the Mekong River Commission (MRC) are first required to make every effort to solve any disputes covered by the Agreement. If the MRC cannot reach a decision, the disputes will be referred to the Governments, which negotiate through diplomatic channels. Only when Governments consider it necessary, they *may* request the assistance of mediation. This process indicates that the MRC is less willing to seek arbitration or judicial settlement.

There is no explicit expression on the legal enforcement of the Commission's decisions in the Agreement. However, because the Council of the MRC is composed of members who would be empowered in each country to make policy decisions (Mekong River Basin Agreement 1995), it can be expected that the decisions made by the Council of MRC may have a legally binding capacity.

Since the 1995 Agreement does not define any measures on the implementation of decisions, both criteria "Decisions are to be implemented by the Contracting Parties within a certain time limit" and "Report the reason of unimplemented decisions" are represented as "Not available", as shown in Table 2.

**Table 2** Treaties' contents related to enforcement capacity

	1998 Rhine Convention	1995 Mekong River Basin Agreement	1992 UN ECE Helsinki Convention	1909 Boundary Waters Treaty
Seek arbitration and judicial settlement	Article 16-2; Annex 1	Article 34; Article 35	Annex IV-12; Article 22-2-b	Article VIII; Article X
Legally binding capability	Article 16-2; Annex 1; Annex 2; Annex 6; Annex 7	Article 18-b; Article 15	Article 22-1-2-3; Annex IV 2; Annex IV 17	Article IX
Decisions are to be implemented by the contracting parties within a certain time limit	Article 11-2-a	Not available	Not available	Not available
Report the reasons for unimplemented decisions	Article 11-4	Not available	Not available	Not available

#### 4.2.3 *The 1992 UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes, adopted in Helsinki*

In the 1992 UN Economic Commission for Europe (ECE) Convention, both arbitration and judicial settlement by the International Court of Justice (ICJ) are explicitly defined as two compulsory dispute resolution methods. When a dispute is submitted for arbitration, an arbitral tribunal shall be established. The arbitral tribunal consists of three arbitrators. Two of them are appointed by the claimant party or parties and the defendant party or parties, and the third one, who will be the president of the arbitral tribunal, is designated based on the common agreement of the former two arbitrators. In order to guarantee unbiased decisions, the president of the arbitral tribunal should not (UN ECE Helsinki Convention 1992):

1. “be a national of one of the parties to the dispute”;
2. “have his or her usual place of residence in the territory of one of these parties”;
3. “be employed by any of them”;
4. “have dealt with the case in any other capacity”.

Furthermore, in order to avoid the possibility that one of the parties in the dispute refuses to attend the arbitration through postponing its arbitrator assignment, the Convention first defines the time limitation on the arbitrator assignment and then, if possible, requests the participation of the Executive Secretary of the Economic Commission for Europe. If one of the parties to the dispute does not appear before the arbitral tribunal or fails to defend its case, the tribunal is able to continue the arbitration proceedings to render its final decision based on the other Party's request. “Absence of a party or failure of a party to defend its case shall not constitute a bar to the proceedings.” (UN ECE Helsinki Convention 1992). The decision of the arbitral tribunal is final and binding upon all parties to the dispute.

Both criteria “Decisions are to be implemented by the Contracting Parties within a certain time limit” and “Report the reason of unimplemented decisions” are also not available for the 1992 UN ECE Helsinki Convention due to the lack of definitions on measures for decision implementation.

#### 4.2.4 *The 1909 Treaty between the United States and Great Britain Relating to Boundary Waters, and Questions Arising between the United States and Canada*

The decisions made by the IJC of the 1909 Boundary Waters Treaty are based on the majority vote among Commission members. If the votes from the Commission are equally divided, then separate reports will be submitted to their own governments and the governments will negotiate for possible adjustment on the disputes. In this dispute settlement stage, the disputes may be further referred to an umpire, who is chosen based on the fourth, fifth and sixth paragraphs of Article XLV of the Hague Convention for the specific settlement of international disputes, dated October 18, 1907 (Boundary Waters Treaty 1909). Such an umpire shall have power to make the final decisions on disputes referred to him or her. However, Article IX of the Treaty explicitly indicates that the reports of the Commission “shall not be regarded as decisions of the questions or matters” either on the facts or the law, and “shall in no way have the character of an arbitral award”. Therefore, referring to an umpire cannot be considered as seeking arbitration or judicial settlement and any decisions made by the Commission have no legally binding capacity.

Both criteria “Decisions are to be implemented by the Contracting Parties within a certain time limit” and “Report the reason of unimplemented decisions” are also not available for the 1909 Boundary Waters Treaty.

Related contents of treaties on enforcement capacity are summarized in Table 2.

### 4.3 Treaty Implementation

In this study, the treaty implementation is evaluated based on the following criteria:

1. The Contracting Parties regularly submit reports to the Commission;
2. The relationship between the implementation of commission decisions and the national law of contracting Parties;
3. Monitoring programs.

#### 4.3.1 *The 1998 Convention on the Protection of the Rhine*

According to Article 11-3 of the 1998 Rhine Convention, the Contracting Parties are required to regularly submit reports to the Commission. The contents of the reports include the legislative, regulatory or other measures taken for implementing the rules of the Convention and the decisions of the Commission, and the results and possible problems resulting from the implementation of such measures.

Any planned measures should be carried out based on the Contracting Parties’ national law.

Establishing monitoring programs is both the Commission’s tasks and Contracting Parties’ obligations. The Commission has the power to establish international monitoring programs on Convention implementation and to assess the monitoring results with the cooperation of other scientific institutions. The monitoring results are used to measure the effectiveness of the decision implementation. Furthermore, each Contracting Party is requested to establish its own monitoring programs and analysis on the Rhine ecosystem and to report the results to the Commission.

#### 4.3.2 *The 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin*

The 1995 Mekong River Basin Agreement defines two kinds of reports. One is called “Notification” and the other is called “Prior consultation”. “Notification” means that a riparian provides information to the Commission on its proposed use of water. The situations under “Notification” include intra-basin uses and inter-basin diversions on tributaries of the Mekong River, and intra-basin uses of the mainstream of the Mekong River during the wet season. “Prior consultation” means that a riparian provides information plus additional data to the Commission such that other member riparians are able to discuss and evaluate the impact of such proposed water use. “Prior consultation” involves inter-basin diversion on the mainstream of the Mekong River during the wet season, and both intra-basin use and inter-basin diversion on the mainstream of the Mekong River during the dry season.

Different from all other transboundary treaties, in the Mekong River Basin, each party has a National Mekong Committee (NMC). Functions of NMC include assistance to MRC, national focal points for the MRC, review of MRC’s annual work programs to ensure that national priorities are reflected in the programs, and so on. Although NMCs play very prominent roles in the implementation of MRC activities, they have no legal basis in the Agreement. In addition, there is no clear and defined relationship between the MRC and the NMCs in the Agreement.

The Joint Committee of the Commission is requested by the Agreement to set up monitoring programs on the locations and levels of the flows. In addition, the Joint Committee is required to prepare proposals for mechanisms used to monitor intra-basin water use and inter-basin diversion from the mainstream.

#### 4.3.3 *The 1992 UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes, adopted in Helsinki*

The 1992 UN ECE Helsinki Convention requires that all defined provisions to each Contracting Party cannot affect each member country’s national laws and each member country should exchange its national regulations with other member countries.

The 1992 UN ECE Helsinki Convention explicitly defines provisions to each Party on establishing monitoring programs as follows (UN ECE Helsinki Convention 1992):

1. All Parties should establish programs to regularly monitor the quality of the transboundary waters, including floods and ice drifts, as well as transboundary impacts.
2. All Parties should agree upon pollution measurement parameters and monitor pollution discharged into the transboundary waters.
3. All Parties should regularly carry out assessment on transboundary water conditions and the measures that are applied to protect and preserve the transboundary waters.
4. During Parties’ meetings, all Parties should continuously review the implementation of the Convention.

However, no regular reports from all Parties to the Commission are mentioned in the 1992 UN ECE Helsinki Convention.

#### 4.3.4 *The 1909 Treaty between the United States and Great Britain Relating to Boundary Waters, and Questions Arising between the United States and Canada*

Because of the consultation properties of the Commission decisions, in the 1909 Boundary Waters Treaty, no definitions are provided on regular reports from the Parties, the relationships with respect to the national laws of Contracting Parties, and the establishment of monitoring programs. Therefore, all three criteria are not available for the 1909 Boundary Waters Treaty.

Treaties' contents related to treaty implementation are summarized in Table 3.

#### 4.4 Dispute Settlement Mechanism

Although the treaties can normally be implemented without serious controversies, it does not mean that all possible disputes have been avoided. In fact, disputes inevitably exist among the Contracting Parties, especially on the applications and the interpretation of the treaty provisions. Therefore, dispute settlement mechanism becomes one of the important components of transboundary waters treaties. In this study, the following criteria are considered to evaluate the treaties' capability in dispute settlement:

1. Organization;
2. Plenary sessions;
3. The procedure of accepting the request;
4. Decision making process.

##### 4.4.1 *The 1998 Convention on the Protection of the Rhine*

The complete manuscript for the Convention on the Protection of the Rhine (Rhine River Convention 1998) can be accessed online. The organization defined by the 1998 Rhine Convention is the International Commission on the Protection of the Rhine (ICPR). Although the Commission has broad power in, for example, establishing monitoring programs, it does not have a formal mandate to resolve disputes. All disputes are first

**Table 3** Treaties' contents related to treaty implementation

	1998 Rhine Convention	1995 Mekong River Basin Agreement	1992 UN ECE Helsinki Convention	1909 Boundary Waters Treaty
The contracting parties regularly report to the commission	Article 11-3-a,b,c	Article 24-c; Article 5	Not available	Not available
The relationship between the implementation of commission decisions and the national law	Article 11-1	Not available	Article 8; Article 13-2	Not available
Monitoring programs	Article 8-1-a; Article 8-1-d; Article 5-2	Article 6; Article 26-4,5	Article 4; Article 11; Article 17-2	Not available

solved by negotiation and then, if possible, by compulsory arbitration (Vinogradov et al. 2003).

The ICPR has one plenary session in each year. Extraordinary plenary sessions can be called by the President on his initiative or on the demand of at least two delegations.

When disputes arise and cannot be handled by negotiation, any one of the Parties to the disputes can request arbitration.

The decisions of the ICPR are taken unanimously. Each member has one vote. Abstention of not more than one delegation is considered as unanimity, except for the European Community. Absence of a delegation is considered as abstention. If measures to be carried out fall under the purview of the European Community, the European Community can vote with the number of votes corresponding to the number of the member states signatory to the Convention. The European Community does not vote if the member states vote and vice versa.

#### *4.4.2 The 1995 Agreement on Cooperation for the Sustainable Development of the Mekong River Basin*

The text for the Agreement on Cooperation for the Sustainable Development of the Mekong River Basin (Mekong River Basin Agreement 1995) can be accessed online. The institutional framework for cooperation in the Mekong River Basin under the 1995 Mekong River Basin Agreement is called the Mekong River Commission (MRC). The MRC consists of three permanent bodies: Council, Joint Committee, and Secretariat.

The Council is composed of one member from each participating riparian State at the Ministerial and Cabinet level (no less than Vice-Minister level), who would be empowered to make policy decisions on behalf of his or her government. The Council convenes at least one regular session every year and may hold special sessions whenever necessary or at the request of a member state. Decisions of the Council are based on a unanimous vote.

The Joint Commission consists of one member from each participating riparian State at no less than Head of Department level. The Joint Commission convenes at least two regular sessions every year and may convene special sessions whenever necessary or based on requests from a member state. The Joint Committee attempts to resolve the disputes between the regular sessions of the Council. Decisions of the Joint Commission are also based on a unanimous vote.

Any dispute can be referred to the Council by any Council member, the Joint Committee, or any member State, or to the Joint Committee by any Joint Committee member or member state. If necessary, the Joint Committee can further refer the disputes to the Council.

#### *4.4.3 The 1992 UN Economic Commission for Europe Convention on the Protection and Use of Transboundary Watercourses and International Lakes, done at Helsinki*

There is no specific institutional mechanism defined by the 1992 UN ECE Helsinki Convention, except that the Executive Secretary of the Economic Commission for Europe may be involved in some cases on the Convention implementation. However, the implementation of the 1992 UN ECE Helsinki Convention stimulates the institution-building process of transboundary waters treaties in Europe (Vinogradov et al. 2003).

All Contracting Parties hold an ordinary meeting every 3 years. Extraordinary meetings can be evoked if the Parties deem them necessary, or by the written request of any Party,

which should be approved by at least one third of the Parties within six months. Each Party to the Convention has one vote.

When disputes are raised, the involved Parties try to seek a solution by negotiation or by any other means of dispute settlement acceptable to the parties in the dispute. If such procedures are not successful, one of the following compulsory means will be carried out for dispute settlement:

1. Submission of the dispute to the International Court of Justice (ICJ);
2. Arbitration.

If arbitration is sought, an arbitral tribunal shall be established. The arbitral tribunal consists of three arbitrators, two of whom are assigned by the involved Parties and the other is designated by these two arbitrators. The decisions of the arbitral tribunal are taken by a majority vote of its members.

#### *4.4.4 The 1909 Treaty between the United States and Great Britain Relating to Boundary Waters, and Questions Arising between the United States and Canada*

The implementation institution of the 1909 Boundary Waters Treaty is called the International Joint Commission (IJC). The IJC is composed of six commissioners. Three of them come from Canada and the other three come from the United States to guarantee unbiased recommendations. Regular Commission meetings are held each year in the United States in April and in Canada in October. Extraordinary meetings can be held with respect to a special call or direction by the two Governments.

From time to time when disputes arise along the common frontier between Canada and the United States, either the Canadian government or the United States government can jointly or on its own initiative submit the requests to the IJC. Although the Treaty allows either Government to initiate such a request individually, in practice, unilateral requests will not be accepted by the IJC since the other Government may ignore the decision from the IJC.

After receiving the requests, the IJC is authorized to investigate and report upon the facts and circumstances of the questions and matters referred, and make appropriate conclusions and recommendations. The IJC is able to set up study boards to investigate a problem using the best American and Canadian experts. The majority of the Commissioners shall have power to render a decision. However, if the Commission is divided equally or unable to render a decision, questions or matters can be referred to an umpire chosen in accordance with the procedure prescribed in the fourth, fifth and sixth paragraphs of Article XLV of the Hague Convention for the specific settlement of international disputes, dated October 18, 1907.

The contents of four treaties related to dispute resolution mechanism are summarized in Table 4.

### 4.5 Overview of the Evaluation of Transboundary Waters Policies

Following the discussion presented in the previous subsections, we can summarize the characteristics of each transboundary waters policy in a matrix form, as shown in Table 5. In Table 5, each transboundary waters policy with respect to different criteria is evaluated as “Good (G)”, “Moderate (M)”, and “Not available (N/A)”. The evaluation results are based on the critical review of all transboundary waters treaties. For practical implementation, the evaluation could be obtained from a panel of experts or by carrying out surveys.



**Table 4** Treaties' contents related to dispute settlement mechanism

	1998 Rhine Convention	1995 Mekong River Basin Agreement	1992 UN ECE Helsinki Convention	1909 Boundary Waters Treaty
Decision making process	Article 10-1; Article 10-3; Article 10-4	Article 20; Article 27	Annex IV-6; Annex IV-7	Article VIII
Organization	The International Commission on the Protection of the Rhine (ICPR)	Mekong River Commission (MRC)	Not available	International Joint commission (IJC)
Plenary sessions	Article 9-1; Article 9-2	Article 17	Article 17-1	Rules of procedure 5-1
Procedure of accept the request	Article 16-2	Article 18-c; Article 24-f	Article 22-2	Article IX

#### 4.6 Results for the Enforcement Capacity

From Table 6, it can be observed that, with respect to the Enforcement Capacity, the 1998 Rhine Convention exhibits the best performance. It defines both the power and the implementation monitoring procedures for the Commission's decisions. The second best transboundary waters treaty is the 1992 UN ECE Helsinki Convention, which misses the measures on the decision implementation. Both the 1995 Mekong River Basin Agreement and the 1909 Boundary Waters Treaty do not work satisfactorily on enforcement capacity.

#### 4.7 Findings for the Treaty Implementation

For the Implementation of Commission Decisions, Table 6 shows that only the 1998 Rhine Convention passes all three thresholds of the criteria and the 1998 Rhine Convention is still

**Table 5** Evaluation matrix for each criterion

Themes	Criteria	CPR	AMRB	CTWIL	BWT
Enforcement capability	Seek arbitration and judicial settlement	G	M	G	N/A
	Legally binding capability	G	M	G	N/A
	Decisions are to be implemented by the Contracting Parties within a certain time limit	G	N/A	N/A	N/A
	Report the reason for unimplemented decisions	G	N/A	N/A	N/A
Treaty implementation	The Contracting Parties regularly report to the Commission	G	M	N/A	N/A
	The relationship between the implementation of commission decisions and the national law	G	N/A	G	N/A
Dispute resolution mechanism	Monitoring programs	G	G	G	N/A
	Decision making process	M	M	G	G
	Organization	G	G	G	G
	Plenary sessions	G	G	G	G
	The procedure of accept the request	G	G	G	M

G: good, M: moderate, N/A: not available.

**Table 6** Analysis matrix for four transboundary waters policies

Themes	Criteria	CPR	AMRB	CTWIL	BWT
Enforcement capability	Legally binding capability		X		X
	Seek arbitration and judicial settlement		X		X
	Decisions are to be implemented by the Contracting Parties within a certain time limit		X	X	X
	Report the reason for unimplemented decisions		X	X	X
Treaty implementation	Monitoring programs				X
	The Contracting Parties regularly report to the commission		X	X	X
	The relationship between the implementation of commission decisions and the national law		X		X
Dispute resolution mechanism	Organization				
	The procedure of accept the request				X
	Decision making process	X	X		
	Plenary sessions				

Each “X” symbol denotes failing performance.

the best transboundary waters treaty among all four candidates. The 1992 UN ECE Helsinki Convention performs a little better than the 1995 Mekong River Basin Agreement on the relationship between the Commission decisions and national law. The 1909 Boundary Waters Treaty still reveals the worst performance. The reason is that the IJC in the 1909 Boundary Waters Treaty acts as more of a consultant in the dispute and there are no measures on the treaty implementation.

#### 4.8 Results for the Dispute Settlement Mechanism

The 1992 UN ECE Helsinki Convention has the best performance on dispute resolution mechanism because of its single Party request acceptance condition, majority vote decision making, regular Parties’ meetings, and stimulation on establishing institutional mechanisms.

The 1998 Rhine Convention and the 1995 Mekong River Basin Agreement exhibit a similar performance in terms of dispute acceptance conditions and both score on the second rank. Both treaties use a unanimous vote in decision making, which may cause problems if one of the Parties always votes negatively.

The 1909 Boundary Waters Treaty still ranks at the bottom. Since, in practice, the IJC only accepts the joint reference request from both the governments of Canada and the United States simultaneously, the effectiveness of the IJC in dispute resolution is significantly degraded and many conflicts cannot be solved in a timely fashion.

#### 4.9 Recommendations on Improving the 1909 Boundary Waters Treaty

Analytical results in the previous subsections clearly demonstrate the drawbacks and low efficiency of the currently used 1909 Boundary Waters treaty between Canada and the United States, although such a treaty is considered to have worked very well during the past almost 100 years. All these facts show that the currently used treaty cannot fully satisfy the

requirements of transboundary waters management. Hence, modifications or improvements to the current treaty become increasingly more important.

Based on the comparisons with other transboundary waters policies, the policy analysis indicates the following possible improvements to the current Treaty:

1. The most important enhancement is to endorse the decisions of the IJC as legally binding. Any decisions made by the IJC should be final and must be implemented by both Contracting Parties.
2. The IJC must be able to be involved in the dispute resolution process based on the request from either Contracting Party. In addition, the IJC should define detailed rules to avoid the possibility that one Party avoids its obligations.
3. If no decision can be made by the IJC, an arbitration system should be invoked. An arbitration system is a guarantee to making final decisions with respect to the dispute resolution since the transboundary waters conflicts must be resolved on time. Otherwise, the water will be polluted or wasted, and such negative effects may be irreversible.
4. Measures to monitor and evaluate the implementation of the decisions should be explicitly defined in the treaty. The resolution of the dispute ultimately depends on how the decisions are carried out. In some cases, the implementation of the decisions may encounter difficulties due to, for instance, the lack of financial support. If this happens, the treaty should have rules to handle such situations.

## 5 Conclusions

In this paper, international water policies are analyzed by using the Elimination Method, a flexible type of MCDA technique. The analysis focuses on four transboundary waters treaties: the 1998 Rhine Convention, the 1995 Mekong River Basin Agreement, the 1992 UN ECE Helsinki Convention, and the 1909 Boundary Waters Treaty. In the foregoing critical review, all four treaties are evaluated with respect to enforcement capability, treaty implementation, and dispute settlement mechanism. A total of eleven criteria are actually used in the performance assessment. The analytical results show that the 1998 Rhine Convention performs best in both enforcement capability and treaty implementation, while the 1992 UN ECE Helsinki Convention ranks highest with respect to the dispute settlement mechanism. For all three evaluation aspects, the 1909 Boundary Waters Treaty exhibits the worst performance, which shows the need to modify and improve the treaty. The analytical results also indicate the directions for such modification and improvement. Although our discussion is focused on the 1909 Boundary Waters Treaty, in fact, the problems inherent to this treaty exist widely in many currently used transboundary waters treaties.

The UN Convention is a very important transboundary water treaty, even though it is not intended for use with a specific case. Since it is a guideline for the preparation of water treaties, the UN Convention can be considered as a general representative of a group of specific treaties. In addition, from the analysis in this paper, the UN Convention does not always perform best compared to the other three treaties. This means that even for the guidelines, some enhancements should also be considered. Finally, the authors would like to emphasize that the general analysis procedure presented in this paper can be applied to any set of water treaties that may be of interest to decision makers.

## References

- Belton V, Stewart TJ (2002) Multiple criteria decision analysis: an integrated approach. Kluwer, Dordrecht
- Boundary Waters Treaty (1909) Treaty between the United States and Great Britain relating to boundary waters, and questions arising between the United States and Canada. Available from <http://www.ijc.org/rel/agree/water.html>. Cited 1 March 2005
- Dellapenna JW (2001) The customary international law of transboundary fresh waters. *International Journal of Global Environmental Issues* 1(3/4):264–305
- European Union (2000) Convention for the protection of the Rhine. Available from <http://europa.eu.int/scadplus/leg/en/lvb/l28115.htm>. Cited 1 March 2005
- Fang L, Hipel KW, Kilgour DM (1993) Interactive decision making: the graph model for conflict resolution. Wiley, New York
- Gleick PH (1993) Water and conflict: fresh water resources and international security. *Int Secur* 18:79–112
- Gooch J (2005) The Mekong Agreement in light of international principles relating to sustainable use of transboundary watercourses. Dissertation, University of Lund, Lund, Sweden
- Greenyearbook (2005) Convention on the protection and use of transboundary watercourses and international lakes (ECE Water Convention). Available from <http://www.greenyearbook.org/agree/t-fresh/cputwil.htm>. Cited 1 March 2005
- Halmes YY (2004) Risk modeling, assessment and management, 2nd edn. Wiley, Hoboken, New Jersey
- Hipel KW (1992) Multiple objective decision making in water resources. *J Am Water Resour Assoc* 28:3–12
- Hipel KW, Kilgour DM, Rajabi S (1999) Chapter 27 – operations research and refinement of courses of action. In: Sage AP, Rouse WB (eds) *Handbook of systems engineering and management*. Wiley, New York, pp 1077–1118
- Hobbs BF, Meierm P (2000) Energy decision and the environment: a guide to the use of multicriteria methods. Kluwer, Massachusetts
- MacCrimmon KR (1973) An overview of multi-objective decision making. In: Cochrane RL, Zeleny M (eds) *Multiple criteria decision making*. University of South Carolina Press, Columbia, South Carolina, pp 18–46
- Mekong River Basin Agreement (1995) Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin. Available from <http://www.internationalwaterlaw.org>. Cited 1 March 2005
- Radford KJ (1989) Individual and small group decisions. Springer, New York
- Rhine-River Convention (1998) Convention on the protection of the Rhine. Available from [http://www.internationalwaterlaw.org/RegionalDocs/Rhine\\_River.htm](http://www.internationalwaterlaw.org/RegionalDocs/Rhine_River.htm). Cited 1 March 2005
- UN ECE Helsinki Convention (1992) Convention on the protection and use of transboundary watercourses and international lakes. Available from <http://www.unece.org/env/water/text/text.htm>. Cited 17 July 2005
- UUN ECE Protocol (2005) Convention on the protection and use of transboundary watercourses and international lakes. Available from <http://www.unece.org/env/water/welcome.html>. Cited 17 December 2005
- Vinogradov S, Wouters P, Jones P (2003) Transforming potential conflict into cooperation potential: the role of international water law. UNESCO, Paris
- Water Information Network (2001) Fair allocation criterion: core of international water conflict (a). Available from <http://www.hwcc.com.cn/newsdisplay/newsdisplay.asp?Id=1024>. Cited 10 July 2005
- Wolf TA (1998) Conflict and cooperation along international waterways. *Water Policy* 1:251–265
- Wolf TA (2002) Conflict prevention and resolution in water systems. Edward Elgar, Cheltenham, United Kingdom
- Yoffe SB, Wolf AT (1999) Water, conflict and co-operation: geographical perspectives. *Camb Rev Int Aff* 12:197–213
- Yoffe SB, Fiske G, Giordano M, Giordano M, Larson K, Stahl K, Wolf AT (2004) Geography of international water conflict and cooperation: data sets and applications. *Water Resour Res* 40:W05S04