WPOL D_09_00007—15/12/2009—VEERA—356783

Water Policy Uncorrected Proof (2009) 1–6

Short note: A review of state of the art on treaties in relation to management of transboundary flooding in international river basins and the Global Precipitation Measurement mission

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Received 14 January 2009; accepted in revised form 31 January 2009. Available online 15 December 2009

1. Introduction

NASA's planned Global Precipitation Measurement (GPM) mission, in collaboration with other international space partners, will represent a unique constellation of rain measuring satellites comprising passive microwave (PMW) sensors, augmented by a Tropical Rainfall Measuring Mission (TRMM)-like precipitation radar (PR) (Smith *et al.*, 2007). GPM is currently scheduled for launch in 2013 (*see* gpm.gsfc.nasa.gov). The global nature of GPM and the more accurate satellite precipitation products anticipated free of cost from it are expected to offer tremendous opportunities to improve flood monitoring in river basins, especially in those (mostly underdeveloped or remote) areas where rainfall is abundant but in situ measurement networks are inadequate. Hossain & Katiyar (2006) speculated that the absence of proper treaties for real-time rainfall data sharing among riparian nations could be the main impediment to effective flood forecasting in international river basins (IRBs), thus making GPM more justifiable.

While the general hydro-political dimension of flood prediction that will be offered by GPM seems reasonably well recognized (see also Hossain *et al.*, 2007), there has not been a comprehensive review of existing water treaties in relation to transboundary flood management for the water policy community. Using the Transboundary Freshwater Disputes Database (TFDD) maintained by Oregon State University as the primary source of information (www.transboundarywaters.orst.edu), this note took an overview of the treaties for transboundary flood management. The primary motivation for the study was to provide evidence to the legislative community that GPM will indeed be a beneficial mission for transboundary flooding on account of its global and high resolution free rainfall data that is anticipated after 2013.

2. Review of treaties for transboundary flood management

The United Nations had about 158,000 treaties on file in 2007 (UN, 2007a). However, treaties that dwell on transboundary flooding in IRBs appear to be less common. In this review, only 25 water treaties

doi: 10.2166/wp.2009.117

could be identified (on a best effort basis) from the TFDD that have explicit reference to the management of transboundary flooding. These 25 treaties primarily address problems with flood control and water allocation to downstream nations.

Most treaty information documents flood management in developed countries. The United Nations Development Programme compiles a 'Human Development Report' each year. The report ranks countries on an index ranging from zero to one using a comparative measure of life expectancy, literacy, education and standard of living. According to the values from the 2006 report, the countries involved in the treaties surveyed had an average Human Development Index of 0.872, which is considered a 'high development' value (UN, 2007b). The average value for regions not involved was 0.667, which represents moderate development. Of the treaties surveyed, 68% (17) were from European basins, 28% (7) were from North American basins, and 4% (1) was from an Asian basin (Figure 1). This could imply that 'treaties' are a fairly Western idea. Europe also has the most IRBs, which could also account for this trend.

Very few of the 25 treaties deal with sharing information, and none specifically mention a 'real-time' method of sharing information (on flooding or rainfall). One particular treaty required parties to 'exchange information concerning the level of rivers'. Another treaty mentioned the term 'forecast'; however, the usage of that term was verified as having no relevance to an actual flood forecasting system.

The review identified a few problematic basins in which there was recurring conflict. The Danube was the most common river in the treaties surveyed in relation to transboundary flooding. Seven of the 25 treaties on transboundary flooding dwelt on the Danube, with many of the agreements shared by Hungary or Russia. All of these treaties stress a need for flood control, but provide little reference to flood management. Five of the seven Danube treaties revealed that some sort of a monitoring scheme existed. However, none mentioned specifically by what method the river should be monitored or if there was a consortium involved (see Table 1).

The Rhine was another troubled basin identified in this review. Four of the 25 treaties involved the Rhine. The 'Treaty between the Swiss Confederation and the Republic of Austria for the regulation of the Rhine from the mouth of the Ill to Lake Constance' mentioned the 'Joint Committee of the Rhine'. It was not clear if the joint committee monitors the levels of the river or basically settles issues of the Rhine.

The review identified that other less problematic treaty basins have consortiums for addressing issues. In the 'Convention between the United States of America and the United Mexican States for the rectification of the Rio Grande (Rio Bravo del Norte) in the El Paso-Juarez Valley' between Mexico and the United States, a reference is found to an 'International Boundary Commission'. However, the exact purpose and functioning of the commission is not mentioned. Other treaties are equally vague. For example, the treaty 'Regulation of flow of water from Lake Memphremagog' between Canada and the United States references the 'International Lake Memphremagog Board'. The treaty 'Agreement

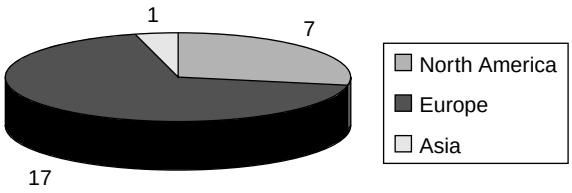

Fig. 1. Water treaties by continent that have some allusion to transboundary flooding.

Table 1. Summary of the 25 surveyed treaties on transboundary flood management.

Name	Date	Basin	Countries	Monitored	Committee
Agreement between the governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on joint and complex use of water and energy resources of the Naryn Syr Darya cascade reservoirs	3/17/1998	Aral Sea	Kazakstan, Kyrgz Republic, and Uzbekistan	N	N
Minute No. 291 of the International Boundary and Water Commission, USA and Mexico, concerning improvements to the conveying capacity of the international boundary segment of the Colorado River	7/16/1994	Colorado	United States, Mexico	N	Y
Exchange of notes concerning a special operating program for the Duncan and Arrow storages on the Columbia River System	4/1/1968	Columbia	Canada, United States	Y	N
Exchange of notes constituting an agreement between Canada and the United States of America concerning the treaty relating to cooperative development of the water resources of the Columbia River Basin	1/22/1964	Columbia	Canada, United States	Y	N
Treaty between Czechoslovakia and Hungary concerning the regime of state frontiers	10/13/1956	Danube	Czechoslovakia, Hungary	N	N
Agreement between Yugoslavia and Hungary together with the statute of the Yugoslav-Hungarian water economy commission	8/8/1955	Danube	Hungary, Yugoslavia	Y	N
Agreement between Czechoslovakia and Hungary concerning the settlement of technical and economic questions relating to frontier water	4/16/1954	Danube	Hungary, Czechoslovakia	Y	N
Convention between the USSR and Hungary concerning measures to prevent floods and to regulate the water regime in the area of the frontier river Tisza	6/9/1950	Danube	Hungary, USSR	Y	N
Treaty between the government of the Union of Soviet Socialist Republics and the government of the Romanian People's Republic concerning the regime of the Soviet-Romanian state frontier and final protocol	11/25/1949	Danube	Romanian People's Republic, USSR	N	N
Treaty between the government of the Union of Soviet Socialist Republics and the government of the Hungarian People's Republic concerning the regime of the Soviet-Hungarian state frontier and final protocol	2/24/1950	Danube	Hungarian People's Republic, USSR	Y	N

Continued

WPOL D_09_00007—15/12/2009—VEERA—356783

Table 1. (*continued*)

Name	Date	Basin	Countries	Monitored	Committee
Convention between the government of the Union of Soviet Socialist Republics and the government of the Romanian People's Republics concerning measures to prevent floods and to regulate the water regime of the River Prut	12/25/1952	Danube	Romanian People's Republic. USSR	Y	N
Convention between the German Reich and the Lithuanian Republic regarding the maintenance and administration of the frontier waterways	1/29/1928	Lielupe	Germany, Lithuania	Y	N
Exchange of notes between the government of Canada and the government of the United States of America constituting an agreement concerning the construction of a joint ring levee	8/30/1988	Nelson-Saskatchewan	Canada, United States of America	N	N
Convention between Italy and Switzerland on the subject of regulation of Lake Lugano and additional protocol	9/17/1955	Po	Italy, Switzerland	Y	N
Exchange of letters of 15 June 1970 between Switzerland and Italy concerning the management of works on the watercourse of the Breggia on the Italian-Swiss border	6/15/1970	Po	Italy, Switzerland	N	N
Convention between the Swiss Confederation and the Italian Republic concerning the correction of the Roggia Molinara (towns of Chiasso and of Come), concluded at Chiasso	4/15/1951	Po	Italy, Switzerland	N	N
Treaty between Switzerland and Austria-Hungary for the straightening of the Rhine from the mouth of the Ill until Lake Constance	12/30/1892	Rhine	Austria-Hungary, Switzerland	N	N
Treaty between the Swiss Confederation and the Republic of Austria for the regulation of the Rhine from the mouth of the Ill to Lake Constance	4/10/1954	Rhine	Austria-Hungary, Switzerland	Y	Joint Committee of the Rhine
Exchange of notes constituting an agreement concerning the execution of improvement works on the River Gander at Mondorff (France) and at Mondorf-les-Bains (Luxembourg), Paris, 3 and 23 June 1986	6/23/1986	Rhine	France, Luxembourg	N	N
Agreement between the government of the French Republic, the government of the Federal Republic of Germany, and the government of the Grand Duchy of Luxembourg on flood warning for the catchment basin of the Moselle	10/1/1987	Rhine	France, Germany, Luxembourg	Y	N
Convention between Switzerland and France concerning the correction of the Hermance	12/3/1959	Rhone	France, Switzerland	N	N
Convention between the United States of America and the United Mexican States for the rectification of the Rio Grande (Rio Bravo del Norte) in the El Paso-Juarez Valley	2/1/1933	Rio Bravo/Rio Grande	Mexico, United States of America	N	International Boundary Commission

Regulation of flow of water from Lake Memphremagog	11/6/1935	St. Lawrence	Canada, United States of America	Y	International Lake Mempremagog Board
Agreement between the United States of America and Canada to regulate the level of Lake of the Woods and accompanying protocol	2/24/1925	St. Lawrence	Great Britain, United States of America	Y	International Joint Commission
Agreement between the government of the Polish People's Republic and the government of the Union of Soviet Socialist Republics concerning the use of water resources in frontier waters	7/17/1964	Vistula/Wista	Polish People's Republic, USSR	Y	N

between the United States of America and Canada to regulate the level of Lake of the Woods and accompanying protocol' between Great Britain and the United States references an 'International Joint Commission'. The exact purpose of these commissions or consortiums is not adequately described.

3. Conclusion

The review of 25 flood-related treaties (from a larger set available at TFDD) provides a basic insight in to the issue of international river basins and flood control. Because the information identified in relation to transboundary flood management represents only a very small portion of all treaties, it is fair to say that treaties are currently an inadequate means of addressing water related issues like real-time flood forecasting. Also, because the information identified from the review addressed primarily developed nations and without any reference to a 'real-time' method of data sharing for flood forecasting, it can also be confidently assumed that GPM will indeed have a positive impact on the hydro-politics of transboundary flood management in IRBs.

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