

Development of cooperative research on assessment of climate change impacts on water resources of Vietnam-China transboundary river basins

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Abstract. Vietnam-Chinese transboundary river basins play an important role in socio-economic development for both Vietnam and China. The cooperative research on assessment of climate change impact on water resources is necessary in order to maintain and develop water resources, exploit and consume effectively, protect environment and prevent disasters on transboundary river basins. The problems have been paid the attention by scientists and agencies of both countries. This report presents the expressions of climate change impacts on water resources on Vietnam-China transboundary river basins and suggest cooperative content and methodology of the research.

Keywords: climate change, Vietnam-China transboundary river basins.

1. Introduction

Along Vietnam-China border, the river flowing into Vietnam is Hong River, with 81.200 km² upstream area located in China and 1.100 km² area in Laos, the river flowing out is Ky Cung –Bang Giang River, with 10.532 km² upstream area located in Vietnam, flowing into Ta Giang River in Guangxi, China. According to the recent research [1], total discharge volume of Red River, resulting from foreign territory is 48,7 km³ per year, equivalent to 38.2% of total water amount of Hong River. The both river systems are important for socio-

economic development of Vietnam and China. The main upstream rivers of Hong River system, include: Ly Tien (upstream of Da River), Nguyen River (upstream of Thao river) and Ban Long river (upstream of Lo river) located in the South of China has more abundant water resources and hydropower potential than the **similar** ones in the North. Ky Cung- Bang Giang river system, having amount of 9-10 km³ per year, flowing into China territory, is also vital for socio-economic development on downstream area of Ta Giang river basin. Thus, protection and maintenance of water resources aimed to exploit and utilise resources effectively, preserve environment and prevent disasters is crucial and paid the

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attention by scientists and agencies of both countries [2, 3].

2. The expressions of climate change impacts on water resources of Hong River basin

Climate change due to the earth warming causes the change of the processes, such as ocean-atmosphere interaction, ocean circulation over continents, hydrological cycle, also may lead to changes in distribution of water resources in space and time. Results of national and international research show that climate change impacts may increase the uncertainty of hydro-meteorological parameters, leading to more frequent occurrence of extreme hydrological characteristics. Natural disasters related to flood and drought occurring

frequently over the world and the region in recent year is the sign of the above statements.

Meanwhile, due to socio-economic development and population growth, demand of water resources on upstream area of Hong River system is highly growing, especially many reservoirs have been build for the purposes of hydropower, irrigation and others. Based on data of Power Engineering Consulting Joint Stock Company 1 [4], Ly Tien river in China territory has 11 reservoirs with nine of them in operation, Ban Long river in China territory has 8 hydropower reservoirs under planning with many of them in operation, Nguyen river has 1 operating plant. Some hydropower plants on Ly Tien river, upstream of Da river taken from satellite is shown in Figure 1.

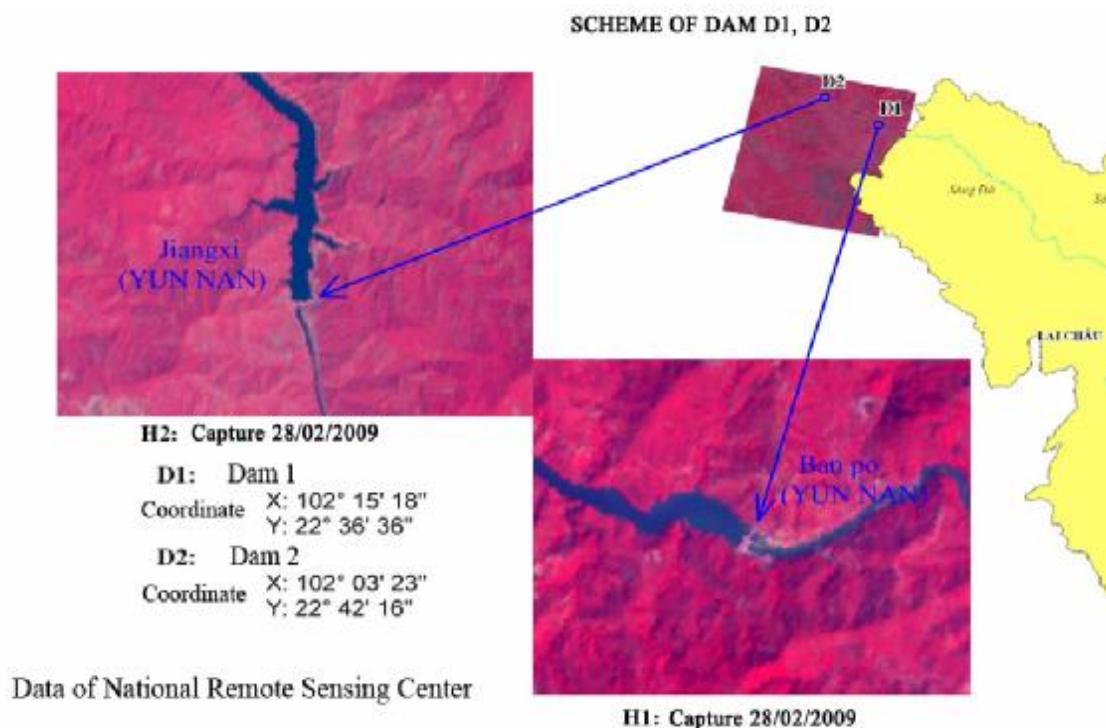


Figure 1. Hydropower plants on Ly Tien river.

Unstable water inflowing from China territory due to operation of hydropower plants at upstream results in large daily water level fluctuation which is contrast to natural law: daily water fluctuation is around 1.5-2.0m on Da river at Muong Te, 0.5-1.0m at Nam Giang, 1.0-1.3m on Lo river at Ha Giang and 0.5-0.8m on Gam river at Bao Lac. Regulation activities of reservoirs in China make the tendency of drought flow a month faster. Discharge in the first months of November-December of dry

season decreases quicker than the previous periods. Flow regulation of reservoirs at Ly Tien Do station, upstream of Da river (basin area of 17.155 km²) far about 52 km from Vietnam-China Border is shown in Figures 2 and 3. The instability of flow from China disturbs the operation of structures in exploitation and utilisation of water as well as usual status of ecosystem, downstream of Hong river system.

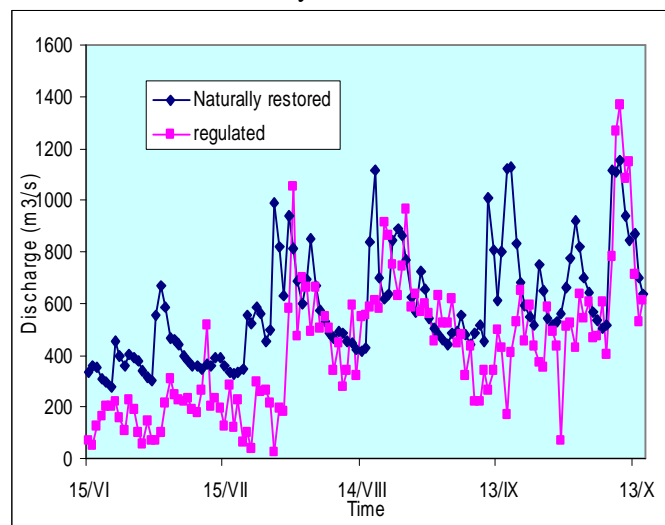


Figure 2. Naturally restored daily flow and regulated flow at Ly Tien Do station in 2010.

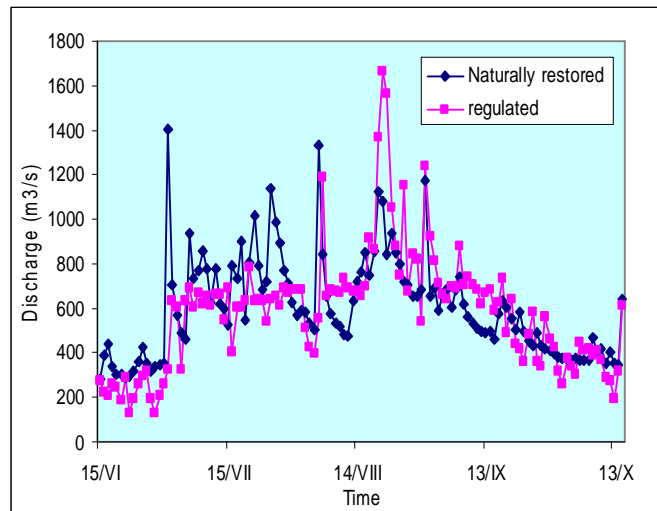


Figure 3. Naturally restored daily flow and regulated flow at Ly Tien Do station in 2009.

One significant expressions of climate change impacts on water resource in upstream of Hong river is occurrence of the annual maximum flood in October which is the last month of flood season when the storage capacity of reservoirs are nearly full. Statistical data in Table 1 shows that the annual maximum flood on Ly Tien river and Nguyen river often

occurs in August (taking more than 50%). In recent years, two the annual maximum flood occurred in October 2006 and October 2010. Consequently, artificial floods appeared on 11th October 2006 with flood peak nearly twice than natural one (Table 2), this made flood magnitude suddenly 10m higher on 8th-12th October 2006 at Muong Te station.

Table 1. The appearance of annual flood peak at October, period of recharge of reservoirs in recent years in upstream of Da and Thao rivers in China territory.

No.	Year	Ly Tien Do station on Ly Tien river		Man Hao station on Nguyen river	
		Peak flow rate (m ³ /s)	Date/ Month	Peak flow rate (m ³ /s)	Date/Month
1	1973	2434	27 July	2265	28 July
2	1974	3720	5 August	3415	6 August
3	1975	2605	16 June	1855	17 June
4	1976	2145	15 August	1860	22 August
5	1977	1730	5 July	1400	1 August
6	1978	1860	7 August	1660	1 June
7	2001	2217	1 August	2944	14 July
8	2002	2870	10 August	3370	15 August
9	2003	2030	20 July	1370	28 July
10	2004	1380	8 September	1560	9 August
11	2005	2030	20 July	1070	25 August
12	2006	6920	11 October	4250	11 October
13	2007	3880	4 August	2920	4 August
14	2008	1770	19 July	1590	10 August
15	2009	2300	19 August	1150	18 August
16	2010	1770	10 October	1060	11 October

Table 2. Artificial flood occurred in October 2006 at Ly Tien Do station on Ly Tien river (upstream of Da river).

Flood	Rainfall (mm)			Flood peak (m ³ /s)	
	Trung Ai Kieu	Tho Kha Ha	Muong Te	Ly Tien Do	Muong Te
1-4 August 2007	163	152	120,6	3880	5359
8-11 October 2006	162	158	131,8	6920	6505

Another expression related to climate change impacts on water resource is that although in recent years, water resource in Hong river system tended to decrease but extreme flood occurring in Hong River system had tendency of increasing in frequency. Statistics in Table 3 shows that extreme floods

used to occurred once every 8-10 years in the last period. From 2001 up to now, extreme floods occurred on Da river in 2002 and 2006, on Thao river in 2005 and 2008 and on Lo river in 2001 and 2008. It is noteworthy for flood prevention for Hong river delta.

Table 3. The increasing frequency of great flood occurrence on river branches of Hong river system

<i>Da river (Hoa Binh station)</i>		<i>Thao river (Yen Bai station)</i>		<i>Lo river (Genh Ga station)</i>	
Annual flood peak exceeds 15000m ³ /s		Annual flood peak exceeds 7000 m ³ /s		Annual flood peak exceeds 7000 m ³ /s	
Year		Year		Year	
Period of 1960-1990					
1964	17200	1968	10100	1969	8100
1969	15800	1971	9860	1971	11700
1971	16200	1979	7450	1986	8720
		1986	7510		
Period of 1991-2000					
1996	22640	1996	7010	1995	7380
				1996	7930
Period of 2001-2010					
2002	15100	2005	7450	2001	8200
2006	15200	2008	10800	2008	7050

Floods on 6-7 January 2003 with the peak flood of 1320 m³/s at Lao Cai station on Thao river (annual peak flood of 1860 m³/s on 16 August) is the unprecedented abnormalities that may related to climate change impacts.

The increasing uncertainty of hydrological characteristics due to climate change impacts reduces reliability of hydrological engineering calculation as well as accuracy of forecast and warning, leading to reduce operation efficiency of water regulation structures and raise natural and manmade disaster risk.

The risks related to climate change impacts on water resources on Vietnam-Chinese transboundary river basins can be reduced based on promoting information exchange, scientific research and management cooperation. Currently, the trend of cooperation on climate change study, integrated water resources management in the region and the world create the opportunities to develop cooperation on the basis of equitable and reasonable utilization of water resources, and obligation not to cause significant harm on river basins, crossing the border of two countries.

3. Cooperative research on climate change impacts to enhance sustainable development of water resources on Vietnam-Chinese transboundary river basins

According to the research of international experts [5], cooperation should be started with information exchange, cooperative research and development of general principles of integrated management of international river basins. Cooperative research and rational use of transboundary water would turn risks and challenges into cooperative opportunities.

The objectives

- Exchange results of hydrological and water resources research on rivers acrossing the border, including: Da river, Thao river, Lo river, Ky Cung river and Bang Giang river;
- Assess rainfall and surface water of transboundary river basins in space and time;
- Assess the water demand in space and time;
- Tendency of rainfall and surface water in recent years;
- Develop climate change scenarios of the region;

- Assess impacts of climate change scenarios on rainfall-runoff process, water balance on the river basins which take an account of socio-economic development on transboundary river basins;

- Propose to respond climate change and mitigate adverse impacts of water exploitation on rivers crossing Vietnam-China border.

Cooperative research

Information and data exchange on the basis of authorisation; Methodology unification; Cooperative research; Workshop on research exchange; Training. Research funding need to be co-financed by two governments.

4. Conclusion and suggestion

In the context of climate change, based on the friendship and good neighborliness of two countries, recognition of riparian interest as well as understanding of risks related to transboundary water, cooperative research on hydrology and water resources is necessary to

propose solutions of integrated water resources management in order to develop and sign agreements to deal with problems related to transboundary water between Vietnam and China.

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