WATER CONFLICT CAUSED BY DAM CONSTRUCTION IN THE TRANSBOUNDARY RIVER IN KOREA

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1. INTRODUCTION

As the uncertainty in water resources increases due to the climate change, the importance of water management has risen significantly as the key to prepare for the future. It is found difficult to maintain the water management especially in flood control and water supply due to geographic and climatic characteristics of South Korea; the peninsula is largely mountainous where river flows down the steep slopes and precipitation is irregular and highly variable.

There are two transboundary rivers in Korea which flow from North to South called Imjin and Hangang. Due to political climate, it has been difficult to ask for further cooperation or coordination on the water resources allocation and flood warning system with North Korea. After the construction of 5 large dams in the North, vulnerability in South Korea has increased in terms of water scarcity and the flood disaster caused by upstream dam release in North Korea. In order to reduce water conflict in the transboundary river, it is necessary to figure out the problem in relation to the dam construction in North Korea.

The purpose of this study is to analyze the water management limitations of the transboundary river and the dam management system between North and South Korea to secure the water resources.

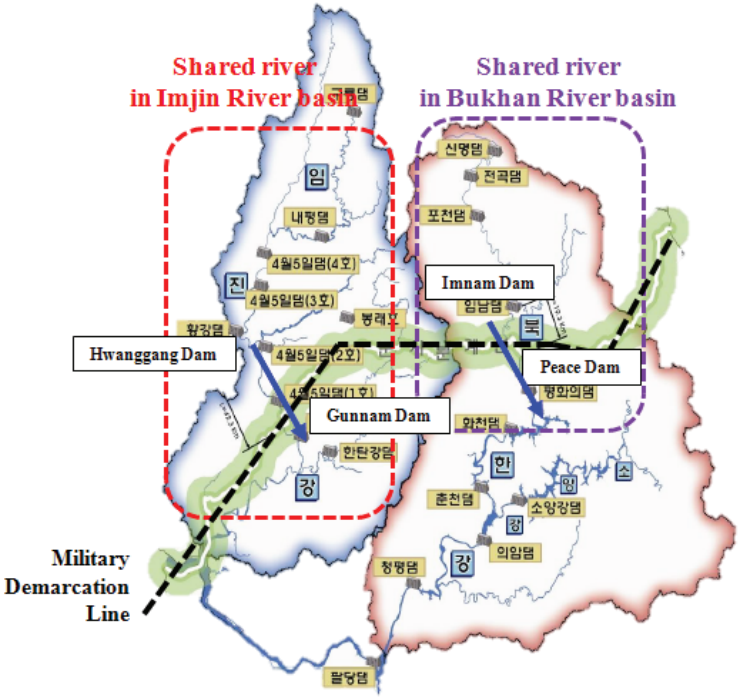


Figure 1 : Transboundary river basins between the South Korea and the North Korea

2. IMPACT ANALYSIS OF DAM OPERATION IN THE SOUTH KOREA DUE TO DAM OPERATION IN THE NORTH KOREA

In order to examine the impact of before and after the operation of the Imnam dam in Bukhan River basin and Hwanggang dam in Imjin river which constructed both in North Korea, hydrologic data from January 1991 to December 2018 (from WAMIS) were analyzed in terms of inflows, discharges, reservoir storages, water levels, rainfall events and water quality observations.

Although there have been no significant changes of averaged-rainfalls during the entire period -flood and dry seasons- the influence in downstream dams located in South Korea due to Imnam Dam operation in Han River basin was that the average inflows of Hwacheon Dam was decreased by 29.7%, and the total discharge was decreased by 34.6% shown in Table 1 and Figure 2. During the dry season, the inflow and discharge of Hwacheon Dam and Gunnam were decreased by 45.7% and 34.8% respectively.

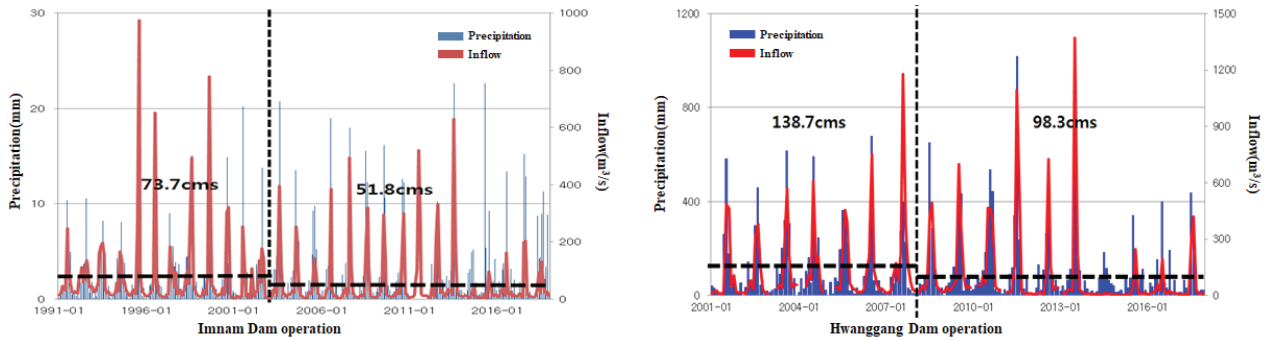
As a result of examining the inflow change of the Gunnam Dam according to before and after the Hwanggang Dam operation in the Imjin River in Table 2, although the rainfall totals had no significant difference, the monthly averaged-inflow of the Gunnam Dam was decreased by 29%. During the dry season, the averaged-inflow was decreased by 53%. The drastic decrease of inflow into Imjin River basin, with no significant change in rainfall totals, can be the key sign for the main cause of the Hwanggang Dam operation.

Table 1 : The impact of Peace Dam and Hwacheon Dam due to Imnam Dam operation

Condition	Entire period			Dry season		
	Inflow (m^3/s)	Release (m^3/s)	Rainfall (mm)	Inflow (m^3/s)	Release (m^3/s)	Rainfall (mm)
Before the operation of Imnam Dam(~2003)	73.7	74.9	93.0	28.9	38.8	36.0
After the operation of Imnam Dam (2004~)	**51.8**	**49.0**	99.0	**15.7**	**25.3**	48.0
Entire period (1991~2018)	62.0	61.1	96.0	21.8	31.6	42.0

Table 2 : The impact of Gunam Dam due to Hwanggang Dam operation

Condition	Entire period		Dry season	
	Inflow (m^3/s)	Rainfall (mm)	Inflow (m^3/s)	Rainfall (mm)
Before the operation of Hwanggang Dam (~2007)	138.7	115.5	45.7	45.3
After the operation of Hwanggang Dam (2008~)	98.3	113.9	21.5	46.3
Entire period (2001~2017)	113.7	115.5	30.7	45.9



(a) Imnam Dam operation (b) Hwanggam Dam operation

Figure 2 : The inflow changes in downstream dam before and after dam construction in North Korea

3. RESULTS AND DISCUSSION

3.1 Analysis of the instream flow and dam operation for the sustainable water management

As an example of the current dam operation in Han River basin, the release discharges of dams were analyzed based on the instream flow in the Han River, and the comparative analysis was conducted to examine whether the inflow and release discharge of each dam (from Peace Dam to Paldang Dam, total 7 dams) satisfy the instream flow.

Based on the results of dam operation data from May 1998 to December 2018, the dams with the lowest instream flow were estimated in the order of Uiam Dam, Soyang River Dam, and Cheongpyeong Dam. The total shortage period against legal instream flow to be satisfied with shows a tendency to decrease from the Peace dam (upstream) to the Paldang Dam (downstream), but the total shortage of instream flow of the Paldang Dam was much larger than dams in the upstream because the amounts of instream flow of dams in the downstream is larger than the upstream.

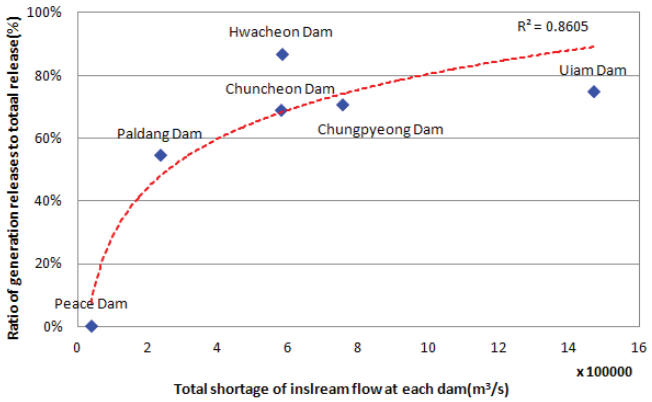


Figure 3: Relationship between the generation releases to total releases and the shortage of instream flow at each dam

It was confirmed that the total release discharges of each dam have not been satisfied with legal instream flow. The major reason of not satisfying the instream flow was because the dam operation mainly has been conducted for the hydroelectricity generation.

Figure 3 shows the relationship between the generation releases to total releases and the shortage of instream flow at each dam.

It was also examined whether the Imnam Dam operation in the North Korea affected the operation of dams located in Han River system and the satisfied instream flows. When comparing the inflows of each dam before and after the Imnam Dam operation of the North Korea, inflows of Hwacheon Dam, Chuncheon Dam, Chuncheon Dam, Uiam Dam, Cheongpyeong Dam, and and Paldang Dam were changed by -40%, - 20%, -30%, -40%, and -20% respectively.

3.2 Proposal to solve the water shortage in Han River basin by co-operation of the transboundary rivers

This study can suggest two suggestions to solve the water shortages in the Han River basin. First is to make use of Peace dam which is dry dam for the flood prevention. In order to satisfy the total shortage of instream flow at the downstream point on Paldang Dam, the reservoir storage of Peace Dam can be increased by raising the reservoir storage level. However, this plan should consider the problem of changing the purpose of dam from single to multipurpose use of the Peace Dam. However, in that case, the expansion of backwater flooded areas due to raising the water level at the dam site may cause the conflict between North and South Korea without any agreement.

Second, the possibility of increasing release from the North Korea Dams through the cooperative management of transboundary river can be considered. If Imnam Dam in the North Korea release the amount of instream flow shortage, then South Korea can prepare corresponding compensation plans. Currently, the compensation plan can be calculated and prepared by ecosystem service-based policy (PES, Payments for Ecosystem Services).

4. CONCLUSION

This study was to improve water management system and to solve the water scarcity of the Han River basin as the transboundary river basins. In the influence analysis of the dam operation in North Korea, the averaged-monthly inflows of Hwacheon Dam was decreased by 29.7%, and the monthly averaged-inflow of the Gunnam Dam was decreased by 29% due to the Hwanggang Dam operation.

As a result of examining the amount of dam release discharges in the Han River basin, on the basis of legal instream flows, most of the dams did not satisfy the instream flows. The major reason was because the dam operation mainly focuses on the hydroelectricity generation. Moreover, when comparing the inflows of each dam before and after the Imnam Dam operation of the North Korea, shortage of instream flow in Han river increased after the Imnam Dam constructed.

Therefore, two considerations were suggested to solve the water shortages in the Han River basin. The first plan was to utilize the Peace Dam, and the second one was to organize the committee for the cooperative management of transboundary rivers between North and South Korea.

REFERENCES

WAMIS www.wamis.go.kr

Korea Meteorological Administration (KMA) www.kma.go.kr

K-water, 2014, A Study on the Management of Flood Control Site in Hantan River Dam

Kim et al., 2005, A Study on the Peaceful Uses of the South-North River Basin