# Interdisciplinary Research for Pre-prevention Measures for Turbid Water with Watershed Units

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Abstract

Recently, serious problems of water turbidity have been occurring at Soyang River Dam and Imha Dam. Even though the government, research institutes, and universities have studied the problem to take measures, they have not explored the reasons why turbid water is occurring and which measures are available in that area. Hence it is time to analyze the reason why turbid water occurs and then to plan more sophisticated measures than before.

The temperature of the Korean peninsula has gradually increased by 1.5°C over the past 100 years. Rainfall intensity has increased about 18%; On the other hand, the rainfall rate has decreased about 14%. In addition, due to the greenhouse effect, vegetation and fish species have adapted to a subtropical climate in Korea. There are several reasons why turbid water occurs, including an increase in rainfall intensity, the frequency of extreme rainfall, changes in vegetation and negligence of watershed management.

Turbid water occurs in the dam reservoir and throughout the watershed as well. It is a problem that highly turbid water in the reservoir from the upstream watershed remains for a long time and is then followed by water quality deterioration, water treatment cost increases, and other problems.

It is predicted that the possibility of turbid water will increase in the future. Therefore, it is time to research and study such topics as turbid water mechanisms, hydrodynamic moving characteristics in reservoirs and ecological impact, which represent an unexplored field relevant to the issue of turbid water.

Existing measures which are planned separately between upstream and reservoir were not elementary measures for the turbid water problem. Therefore, this research should approach watershed units and include many interdisciplinary fields: survey turbid water sources and reasons why turbid water occurs, turbid water's hydrodynamic moving analysis, potential evaluation of turbid water, and primary order decision of watershed measures for turbid water prediction.

Keyword: turbid water, watershed, Interdisciplinary research

## 1. The reasons of turbid water occurring

Recently, turbid water problems have occurred at Imha Dam and Soyanggang Dam. Therefore, government, public research institutes and universities have been conducting research to try to find the cause of the problem. However, it hasn't been enough to find the reasons for the occurrence and reasonable measures.

At present, we should find reasons for turbid water and plan measures based on the present and future turbid water problems. To begin with, turbid water occurs for so many reasons, which are as follows:

### 1.1 Climate change of Korea

Global warming is a hot issue all over the world and a major topic at international conferences. In Korea, the temperature has increased by approximately 1.5℃ over the past 100 years, as described in Figure 1.1.

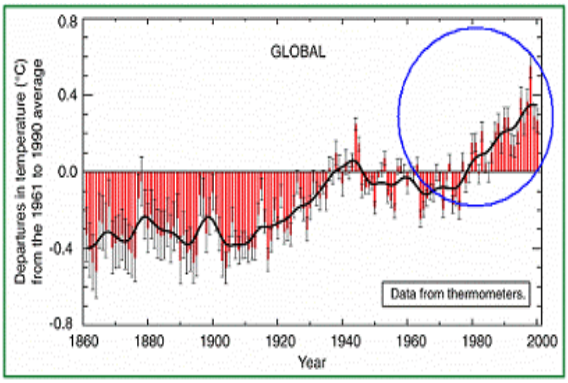



Figure 1.1 The changing trend of Korea's average temperature(1860 ~ 2000)

Based on reporting of KMA (Korea Meteorological Administration), it is stated that the Korean peninsula is shifting from the temperate to the subtropical zone. For example, long term tropical nights and locally intensive rainfall. The trend of tropical nights increasing in local areas is shown in Figure 2.1.

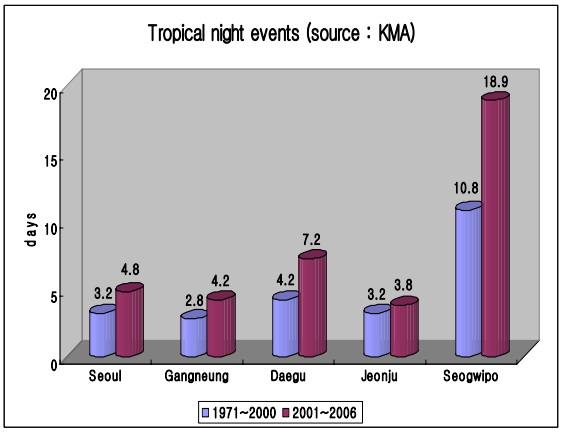



Figure 1.2 Korea's local tropical night events

### 1.2 Rainfall pattern changes of the Korean peninsula

It is hard to control Korea's water resources because it rains intensively during flood periods in the Korean peninsula. However, Korea's rainfall pattern has changed due to recent climate changes. The number of days of rainfall has decreased. On the other hand, the frequency of intensive rainfall has increased. For instance, annual rainfall increased 7%, but rainfall days decreased 14%, and rainfall intensity increased 18% compared to 1920. The changing of rainfall

patterns has made water resource management more difficult than before.

Furthermore, the amount of rainfall is similar to the past but the number of rainfall days over 100mm/day is increasing by 1.5 times. In Figure 3.1, the changing trend of rainfall intensity, rain days, and annual rainfall amount are shown.

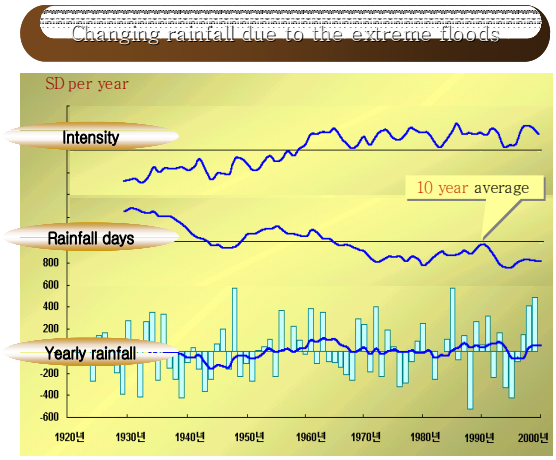



Figure 1.3 the trend of rainfall due to climate change

In addition, KMA has considered renaming the summer season the rainy season because intensive rainfall continued during 6 to 8 months after the end of "Jangma", which means intensive rainfall seasons.

### 1.3 Changing of ecosystems

Global warming is relevant to the climate and weather as well as ecosystem. Ecosystems such as vegetation and fish are shifting to subtropical conditions. According to the KEI (Korea Environment Institute's) report (2003), it is stated that the Korean peninsula is going to shift primarily from the temperate zone to the subtropical. Hence, new climate changes should be considered when national development and management is estimated.

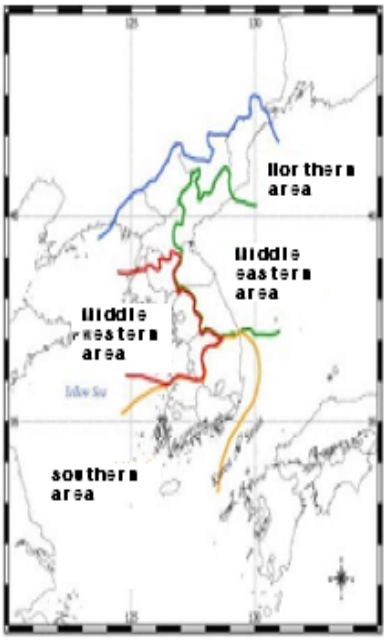
## 2. The status of turbid water

Lately, the turbid water problem is a new phenomenon due to the increase of rainfall intensity, changing vegetation, and negligible watershed management caused by climate changes.

This phenomenon should be considered not as a temporary event but as a long term event, as turbid water does not occur at an isolated dam, but at all watersheds.

The annual maximum turbidity of each dam is different based on the local rainfall intensity of each area which is shown in Table 2.1. Based on the above, we know that turbid water could occur depending on internal and external impacts.

Also, as mentioned above, turbid water occurs upstream of dam as well as all over the watershed. In 2007, rivers connecting South and North Korea were determined to be in need of co-management and co-ownership due to turbid water inflow from North Korea. The reasons of turbid water and measures should be implemented in detail by the government. In table 2.2, the status of turbid water at Bukhangang watershed is shown. In Figure 2.1, the trend of turbid water of each dam (Soyanggang Dam, Yeam Dam, Chungpyung Dam, and Paldang Dam) is shown.




| Region | | Changing forest (temperate zones □ subtropical zones) |
|---|---|---|
| Vegeta-tion | South(temperate) | 34.99% |
| | Middle west(temperate) | 16.18% |
| | Middle east(temperate) | 3.16% |
| | North(frigid zone) | 3.11% |
| Fish | East and west Sea('05) | Subtropical fish |

□ Source : KEI(2003)

Table 2.1 The status of turbid water of multipurpose dam (last 5 years)

| | Soyang | Imha | Andong | Hapcheon | Daecheong | Hwengsung | Milyang | Juam |
|---|---|---|---|---|---|---|---|---|
| Turbid water days(over 30NTU) | 226 | 315 | 41 | 20 | 50 | 28 | 15 | 13 |
| Maximum turbidity(NTU) | 328 | 1,221 | 159 | 283 | 126 | 67 | 92 | 98 |
| Maximum rainfall intensity (㎜/hr) | 88 | 76 | 60 | 75 | 61 | 60 | 77 | 41 |
| Occurring year | '06 | '03 | '06 | '04 | '02 | '06 | '06 | '06 |

Table 2.2 Turbid water status of Bukhan river watershed ('07.8.27)

| Rainfall (㎜) | The amount of turbid water ($10^6$ ㎥) | | | |
|---|---|---|---|---|
| | Total | Pyunghwa | Hwachun | Chunchen |
| 610 | 784 | 24 | 626 | 134 |

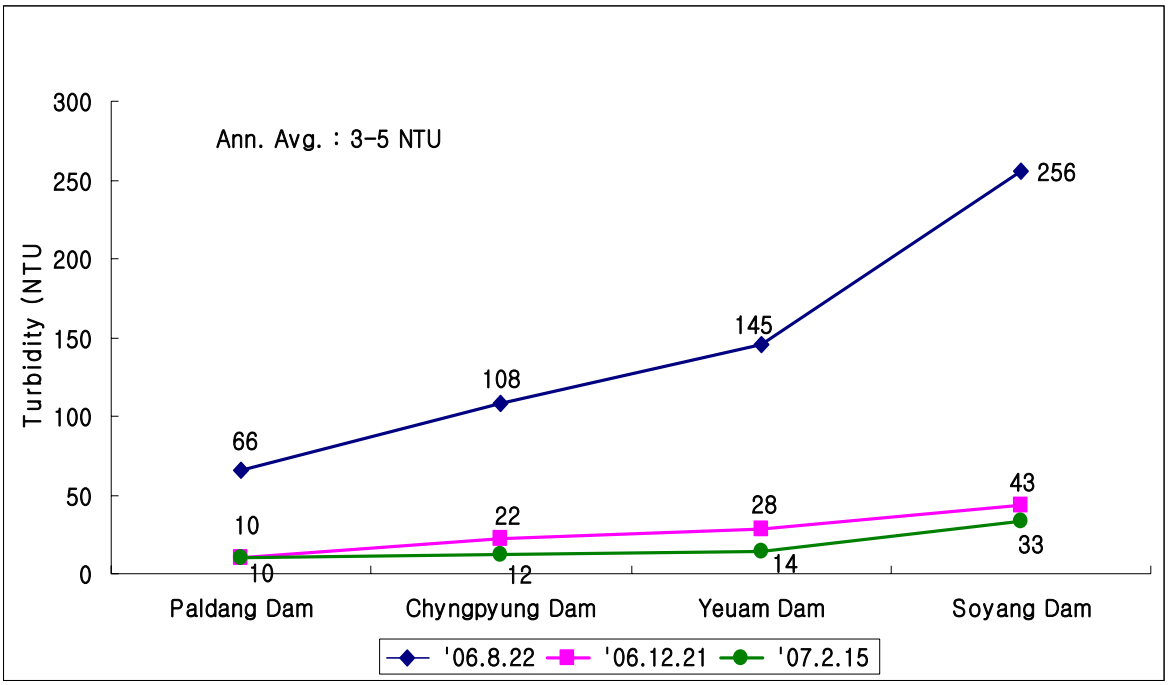



Figure 2.1 Turbidity trend of Bukhan river watershed

### 3. New concept for setting of turbid water measures

Turbid water is caused by a variety of reasons such as climate, rainfall, hydraulics, hydrology, geography, geology, vegetation, soil and the characteristics of watershed and river. It is impossible to solve the problem with only some specialized experts. Therefore, in order to find out the reasons of turbid water occurrence, turbid water mechanism and reservoir/river impactions of turbid water, interdisciplinary research should be implemented in order to consider the various factors.

Especially, research and measures should be conducted not at individual dams but at the watersheds for the following: the reasons for turbid water, path of discharge, and connection between two dams. And then, a complex measure for turbid water should be set.

In order to solve the above problem, interdisciplinary research and measures should be fixed at each watershed by considering sustainable nation management and development.

### 4. Establishing the complex measures for preventing turbid water at each watershed

In order to establish the complex measures for preventing turbid water, after establishing the detailed action plans during the basic planning stage, the complex measures for preventing turbid water will be established for all watersheds.

## 【 Basic Plan Establishment Process (SOP) 】

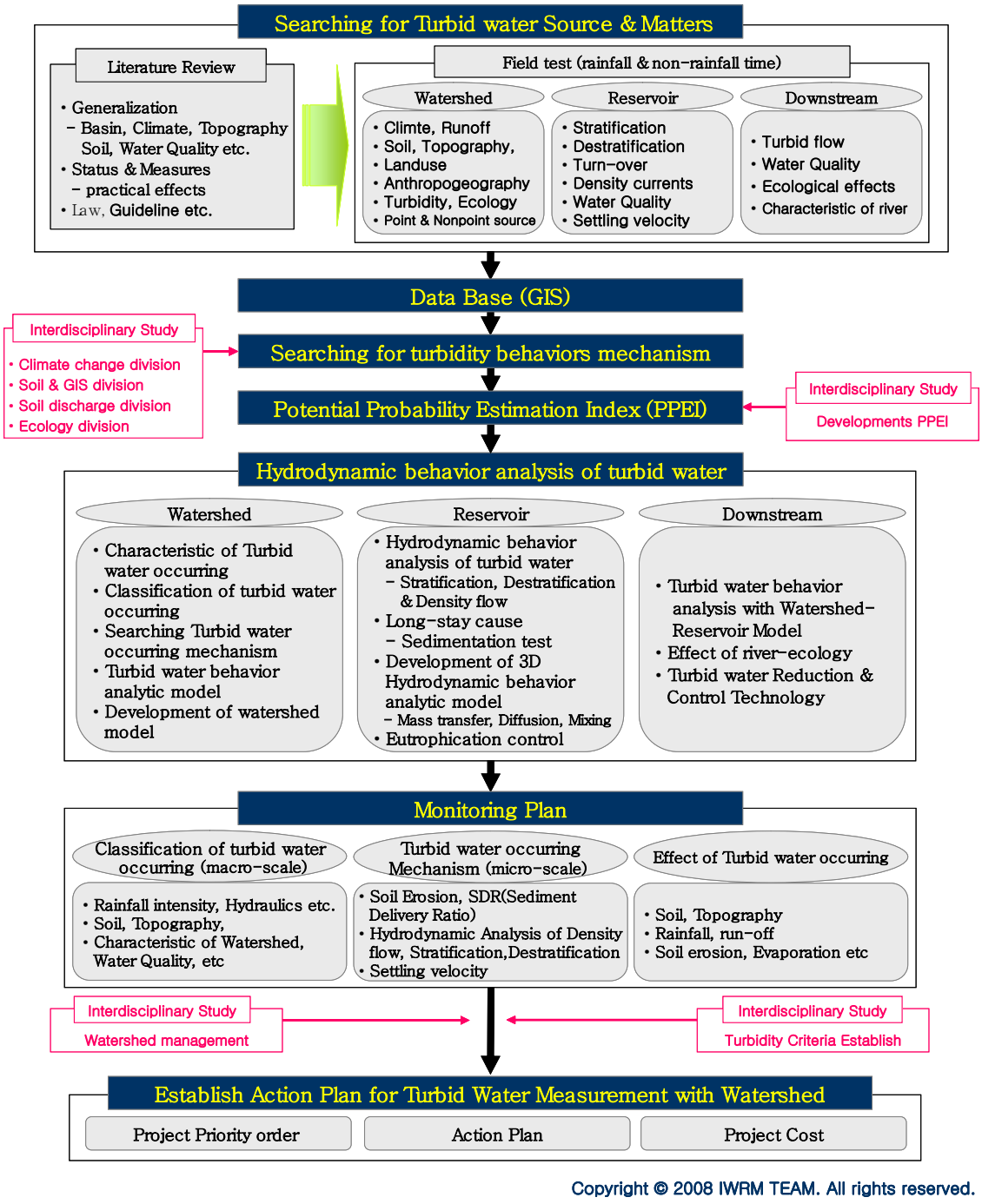



Figure 4.1 Schematic of establishing basic plan

Various researches will be carried out as follows during the basic planning stage for preventing turbid water at each watershed: surveying turbid water sources and reasons for occurrence, analysis of turbid water moving as hydrodynamic in reservoir, modeling and monitoring plan of turbid water moving,

evaluating turbid water potential, and determinant of priority for starting project.

After completing the above procedures, we will establish complex measures for preventing turbid water at each watershed.

In addition, research will cover many fields such as climate, geology, GIS, ecological impact, evaluation of soil discharge, development of potential evaluating of turbid water, evaluating and choosing turbid water modeling, analyzing of hydrodynamic turbid water moving, criteria turbid water, and watershed management method for minimizing of turbid water.

## 5. Conclusions

In order to establish the element measures for preventing turbid water, the reasons for turbid water occurrence and discharge characteristics should be investigated. To do this work, as mentioned above, many fields' experts will be involved this project to connect each research part as interdisciplinary research. The direction of research is enlarged from individual dam to the watershed to consider an integrated watershed management concept focusing on dam reservoirs. This basic plan for preventing turbid water is going to represent the cornerstone of sound and sustainable national development.

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