The Estimate on Environmental Change of Kase River Basin due to Dam Construction

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1. Background and Purpose of This Study

Japan has relatively high precipitation and plenty of water resources per square meter of its territory, compared to the global standard. However, river flows largely fluctuate throughout the year; high in the spring thaw, and low in other periods. On the other hand, the amount of water for domestic and industrial uses does not fluctuate as largely as the river flow. In order to secure stable water supply, water resources development facilities such as dams have been constructed, so that the required amount of water is made available in all seasons of the year.

Kase River Dam construction started in December 1992 to store water needed especially for the purpose of water supply and agriculture in Saga prefecture. It is located at Kase River that drains slightly to the east central part of Saga. Kase River Dam is the newest dam in Kyushu island, and it will be managed by MLIT.

However the benefit derived from constructed dam are frequently marred by pollution or contamination. The land use practices and their spatial distribution around dam are critical factors that influence changes in the quality of



water. The natural vegetation of Kase river basin area in the distant past was artificial coniferous forest and rice field. However, over the years it has degraded into gravel ground, moorland and cut over land, largely due to dam construction work. There are some negative effects considered in this study caused by dam construction work, turbidity and SS will increase due to erosion according to the road and dam construction, while the dissolved oxygen levels will become lower, and water quality in downstream might be changed due to dam construction work. The objective of this study is to assess environmental and water quality change before and after dam construction work.

Figure 1. Land use change before and after dam construction in Kase river basin

2. Research Methodology

Data on the water quality parameters before dam construction obtained mainly from Ministry of Land Infrastructure and Transport (MLIT) Japan while data after dam construction were collected by MLIT and our laboratory during November 2009-October 2010 just before the impoundment of the dam. The period of water quality data before construction in 1992 represent the time when all the work had not yet exist, and Furuyu point represent the downstream face to all the work place. Information on land use change were obtained from MLIT. Kase River basin was delineated using ArcSWAT 2009 and intersect land use data from MLIT data using analysis tool in ArcGIS 9.3.

3. Analysis

Figure 1 visualizes a land use change before and after dam construction in Kase River basin. The inside of subset shows significant change of land use. In 1975 most of this area was rice field and artificial coniferous forest. By 2007 the orange color shows area of gravel ground or collapse ground caused by construction work.

Figure 2 shows the concentration of measured parameters in Furuyu, just downstream after the dam location. The value of turbidity is higher after construction work. This value shows the clarity of water may be affected by the amount of solids suspended caused by material erosion of construction work. Turbidity values before construction are between 1 and 3 NTU, and after construction its value increases between 4.65 and 7.27 NTU. Turbidity that have a value more than 30 NTU will inhibit the growth of environment organism, but from overall observation turbidity value not exceed 30 NTU. Viewed from the data, average concentration of SS after the work (5.11 mg/L) is greater than before work (2.93 mg/L), an increase in the amount of suspended solids particles in the water maybe visually describe as cloudiness or muddiness. DO is amount of oxygen dissolved in water, the ability of water to hold oxygen in solution is inversely proportional to the temperature of the water. This component in water is critical to survival of various

aquatic life in streams. In the period before construction, values of DO are higher than after construction, whose range is between 8.7 and 12.2 mg/L. After construction period DO value ranges between 8.1 and 10.69 mg/L. The DO level



Figure 2. Water quality indices measured in Furuyu point (Blue:Before dam, Red: After dam)

becomes lower due to amount of oxygen usage in degradation process by organic substances. PH is a measure of the concentration of water, indicates the acidity or alkalinity of the water. Japan environmental quality standards posted for naturally fresh waters the PH range between 6.5 and 8.5. During the observation the PH after construction tend to be acid, but mostly still in Japan Environmental Quality Standard, only in July 2010, the PH value has a bit over the standard level. Water temperature that exceeds 18° C has a deleterious effect on environment especially for fish. Figure shows temperature over 18° C occurred in summer. Temperature before construction is in the range of 7° C- 27° C and after construction 8.86° C- 20.22° C.

4. Conclusions

- The following conclusions are obtained.
- (1) The construction of a dam will have consequences on the nature of environment.
- (2) Land use images show significant change of the studied area. The change before and after dam construction work becomes visible.
- (3) Turbidity and SS are higher after construction due to the land and material erosion.
- (4) DO levels become lower after construction and may result in environmental degradation

References

- (1) Ministry of Land Infrastructure and Transport: Kase dam construction office report, Japan, 2004.
- (2) Japan Ministry of The Environment : Environmental Quality Standard
- (3) Blackland Research Center : ArcSWAT 2009 User Guide, Texas
- (4) WaterResources in Japan, <u>http://www.mlit.go.jp</u>