WATER ENVIRONMENT IMPROVEMENT BY INVESTIGATING RIVER WATER QUALITY

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ABSTRACT

Investigating river water quality is an important research topic in the integrated basin management and will providea new approach to water environment improvement. In this study, the observed environment done with the analyzing river water quality. From the observation, the results show that the water quality of Kase River basin is generally as good. The conditions in the periods after dam construction indicate that river water quality impairment do exist, but not much and still meet the environmental qualification. The replenishment of Kase River Dam reservoir with the Hokuzan dam reservoir in the basin has less affected to change the water quality along the river due to the good implementation of pollution control in this area.

Key words : observed environment, river water quality

INTRODUCTION

Kyushu Island is the southernmost of the four major islands in the Japanese Archipelago. Saga Prefecture is located in the northern part of this Kyushu Island. It has enjoyed many exchanges with other Asian countries since ancient times, evidence of which can be witnessed at the numerous historical sites in the region. Saga is blessed with natural beauty. In the north is the Genkai Sea and in the south, the Ariake Sea. In addition, the Sefuri Mountain Range is located in the north of the Prefecture and the vast Saga Plains in the south. Saga has so many things to offer visitors, with its natural beauty, rich history, plentiful hot springs and exciting festivals. The Ariake Sea, with a maximum tidal range of 6 m, is a shallow sea whose bottom is made of sandy mud and its water is a mixture of seawater flowing from the outer sea and fresh river water. Sandy mud and rich nutrients flow into the sea from the rivers and the bay is shallow for a long distance from the shore. Therefore, on full or new moon nights, a vast flat land can be seen. Kase river basin is located in the center part of Saga prefecture The basin has wide variety of land use while MLIT (Ministry of Land Infrastructure and Transport) Japan due to National Comprehensive Water Resources Plans was added Kase river dam sequentially with Hokuzan dam in this area in order to supply water needed especially for agriculture and water supply in Saga Prefecture. However the benefit derived from constructed dam reservoirs is frequently changed in the quality of water. The natural vegetation changed into water area when the reservoir is created. Actually, Kase river dam is expected as an important water resources facility for Saga prefecture. This prefecture has a big of arable land and has a regional granary for supply rice in Kyushu Island, Japan. Also dams in this basin are expected to answer the water demand in the downstream area both in the quantity and quality of water. This study is to observe environmental and water quality change before and after dam construction work along the Kase River and the reservoir.

METHODOLOGY

Outline of Kase River dam

The Kyushu region maintenance bureau is constructing Kase River dam to the upstream of Kase River part (right downstream of the Hokuzan dam), The Ministry of Land, Infrastructure and Transport direct control in a gravity concrete dam under construction. The parameter is shown in Table 1. The functions of Kase River dam are generate hydroelectric power, flood control, supply water to urban area, environmental conservation, industry uses, agricultural purpose, and provide recreational area.

Point of observation

In the this study, the investigation point was set from upstream of Kase River dam to the downstream, and it was named St.1-4 from the upstream Ozeki, Furuyu, Kanjinbashi and Kasebashi sequentially.

Parameters and methods

In this study, the water quality measurement and the obtaining water with a small CTD meter and the multi item water quality meter were done by the various place point, the water taken home was filtered, and the nutritive salt was analyzed with the spectrum absorbance meter for SS.

The water quality measurement with a multi item water quality meter and a small CTD meter was done in the location. Parameters of the water quality are shown in Table 2. Moreover, the adaptability of the purpose of use according to environmental standards in the river, lakes and marshes is shown in Table 3.

Table 1. Description of Kase River dam

Position	33 ^{0} 23' 22" N 130 ^{0} 13'01" E
River	Kase River
Dam model	Gravity concrete dam
Height	97.0m
Crest length	480.0m
Volume of dam	1,220,000m^3
Drainage area	368.0m^3
Surface area	270.0ha
Total reservoir capacity	71,000,000m^3
Active storage capacity	68,000,000m^3
Flood control capacity	17,500,000m^3
Use capacity	50,500.000m^3

Figure 1. Measurement using CTD meter

Figure 2. Measurement using multi item water quality meter

Figure 3. Observation point

Table 2. Assorted parameters of water quality

Item	Unit	Explanation	Measuring instrument machine
pH		Power of the concentration of the hydrogen ion	Multi item water quality meter
DO	mg/L	Oxygen that has melted in water	Multi item water quality meter
COD	mg/L	Typical index that shows water pollution	Spectrum absorbance meter
SS	mg/L	The insoluble matter in water	Filtration
NH4-N	mg/L	Nitrogen ammonium salt or in ammonia contained in water	Spectrum absorbance meter
NO2-N	mg/L	Product on the way of degradative process by aerobic microorganism soil and in water . It generates it by reducing the nitrate.	Spectrum absorbance meter
NO3-N	mg/L	Ultimately product resolved by aerobic microorganism soil and in water	Spectrum absorbance meter
T-N	mg/L	Gross weight of nitrogenous substance	Spectrum absorbance meter
T-P	mg/L	Gross weight of phosphorus compound	Spectrum absorbance meter

Table 3. Environmental standards qualification of River and Lake/Marshes
(Environmental Agency, Japan 1992)

Pattern ＼ item	River	Lakes and marshes
AA	Water supply class 1, conservation of natural environment, and uses listed in A-E	Water supply class 1, conservation of natural environment, and uses listed in A-C
A	Water supply class 2, fishery class 1, bathing and uses listed in B-E	Water supply class 2and 3, fishery class 2, bathing and uses listed in B-C
B	Water supply class 3, fishery class 2, and uses listed in C-E	Fishery class 3, industrial water class1, agricultural water, and uses listed in C
C	Fishery class 3, industrial water class1, and uses listed in D-E	Industry water class 2 and conservation of environment
D	Industrial water class 2, agricultural water and uses listed in E	
E	Industry water class 3 and conservation of environment	

pH
pH is a measure of the acidity or alkalinity of water.It is measured by using a multi item water quality meter to see the change of increased acidity or alkalinity. pH varies naturally within streams as a result of photosynthesis. The pH scale ranges from 0 to 14:
Acidic : 0 to 6.9
Neutral : 7
Alkaline : 7.1 to 14
Moreover, because the pH influences the chemical reaction in water, the value of the pH becomes an important factor in which the water quality change in the stream water.

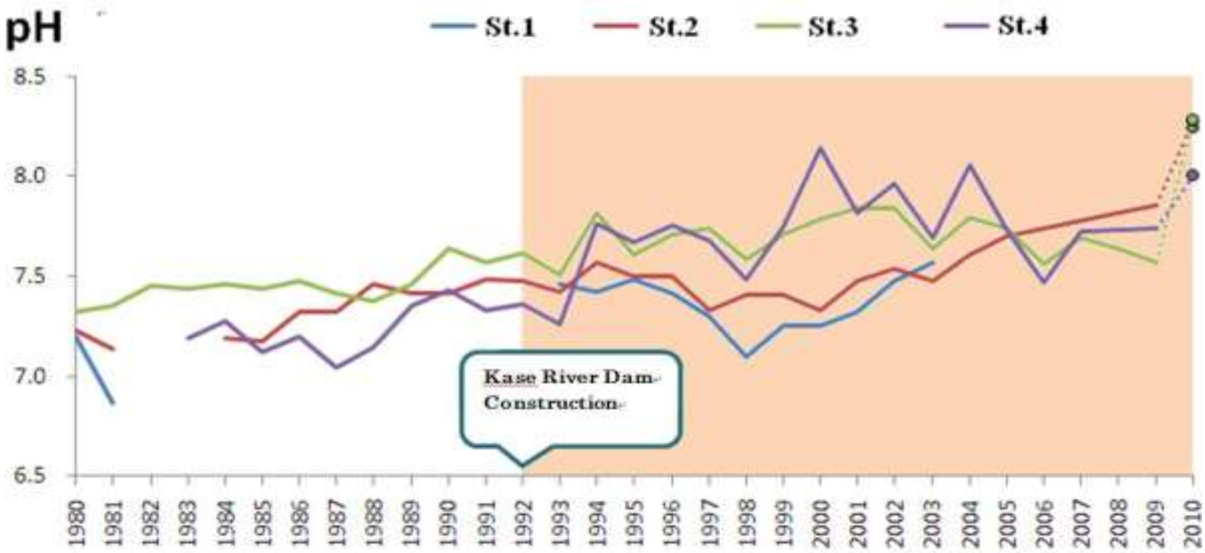

Figure 4. pH in Kase river

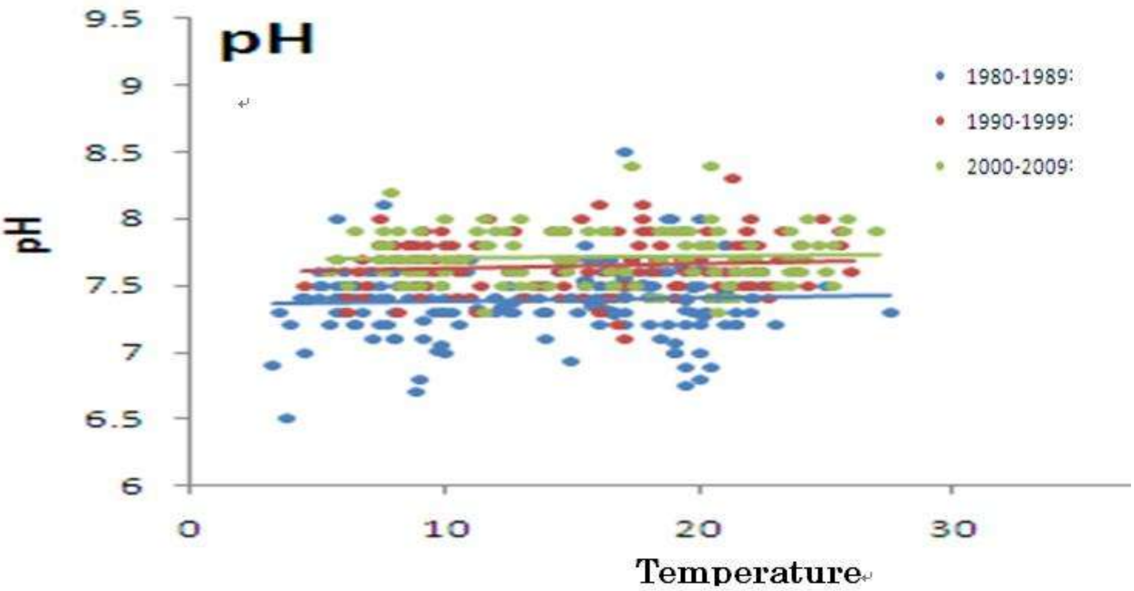

Figure 5. Corelation of pH and temperature

DO (dissolved oxygen)
DO (Dissolved Oxygen) is the amount of oxygen in water, to a degree, shows its overall health. When oxygen levels are high, we can presume that pollution levels in the water are low. Conversely, if oxygen levels are low, we can presume there is a high oxygen demand and that the body of water is not of optimal health. Apart from indicating pollution levels, oxygen in water is required by aquatic fauna for survival. In conditions of no or low oxygen availability, fish and other organisms will die. DO is used as a pollution indicator of water in the river, lakes and marshes, and the sea area. The change of the DO in Ozeki (St.1), Furuyu (St.2),Kanjinbashi (St.3), and Kasebashi (St.4) point is shown in Figure 6 for 30 years. It is show that the graph tend to increaseat every point though it is

slow. Especially, the increase speed of 1992-2002 years in Kasebashi (st.4) is earlier than that of other points. It is thought that the influence of Kase River dam at the beginning of mission is stronger because the change is not seen in Furuyu (St.2) and Kanjinbashi (St.3) though it starts road works for the construction of Kase River dam in 1992. The reason for the measurement day is that only winter in this though a very high value has gone out in Furuyu (St.2) point of 1986. The mean value in the various place point is 10.60 mg/L and 10.19mg/L for Furuyu (St.2) and Oozeki (St.1) 10.37 mg/L for Kanjinbashi (St.3) and 10.66 mg/L at Kasebashi (St.4), and the entire mean value is 10.46mg/L. The maximum value is 13.13mg/L measured with Furuyu (St.2) in 1986, and minimum value is 9.03mg/L of Kanjinbashi (St.3) in 1984.

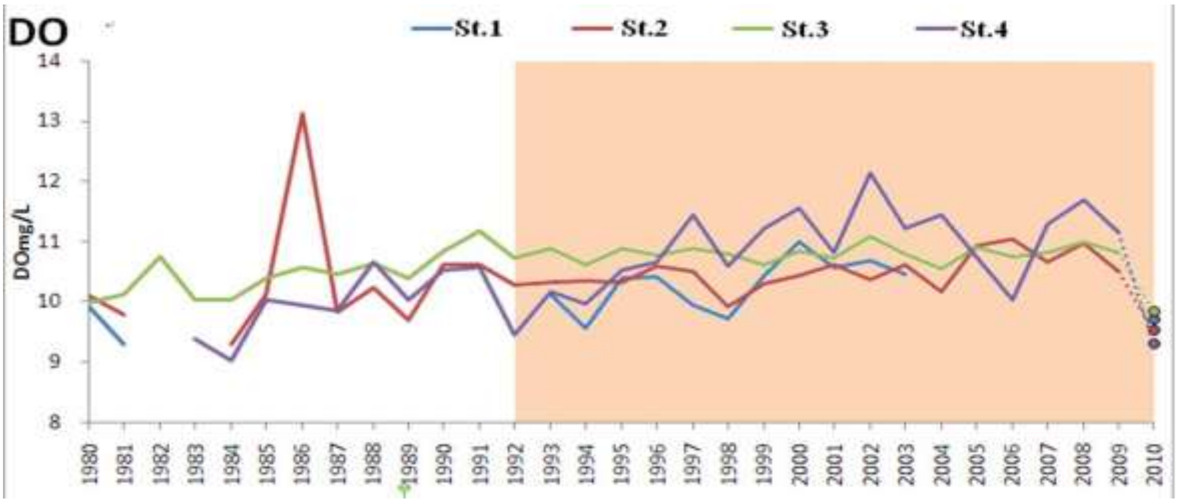

Figure 6. DO concentration in Kase River

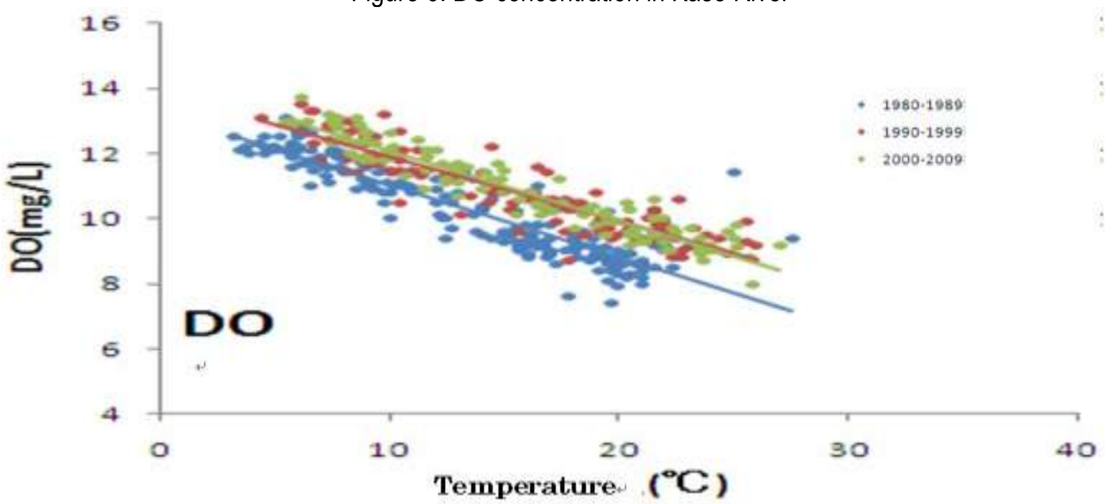

Figure 7. Correlation of DO concentration and Temperature

COD (chemical oxygen demand)

COD(chemical oxygen demand) is an indicator of organics in the water, ussualy used in conjungtion with BOD. Organic levels decrease with distance away from the source. In a standing water body such as dam reservoir or a lake, currents are generally not powerful enough to transport large amount of organics. In a moving water body, the saprotophic organism break down the organics during transportation away from the source. Hence, there is a decline in the oxygen demand and an increase of dissolved oxygen in the water.

The change of the COD in Ozeki (St.1), Furuyu (St.2), Kanjinbashi (St.3), and Kasebashi (St.4) is shown in Figure 8 for 30 years. Four points and rises are seen in 1992. It rises rapidly in Kasebashi (St.4) though Ozeki (St.1), Furuyu (St.2), and Kanjinbashi (St.3) are gradual changes. It is not easy to think that it is a cause because a high value has gone out for the long term, and it is high after the restoration is completed though the investigation and the excavation of Ishibi start. The numerical value is not steady to this dissatisfied though great fluctuations are seen in Ozeki (St.1) in the 80's volume of data. The maximum value is 4.6mg/L of Kasebashi (St.4) in 2000, and minimum value is 1.3mg/L Ozeki (St.1) in

1991 and 1986. A high value is often occurred in Kasebashi (St.4) after 1994, and the substantial change is not seen in other points.

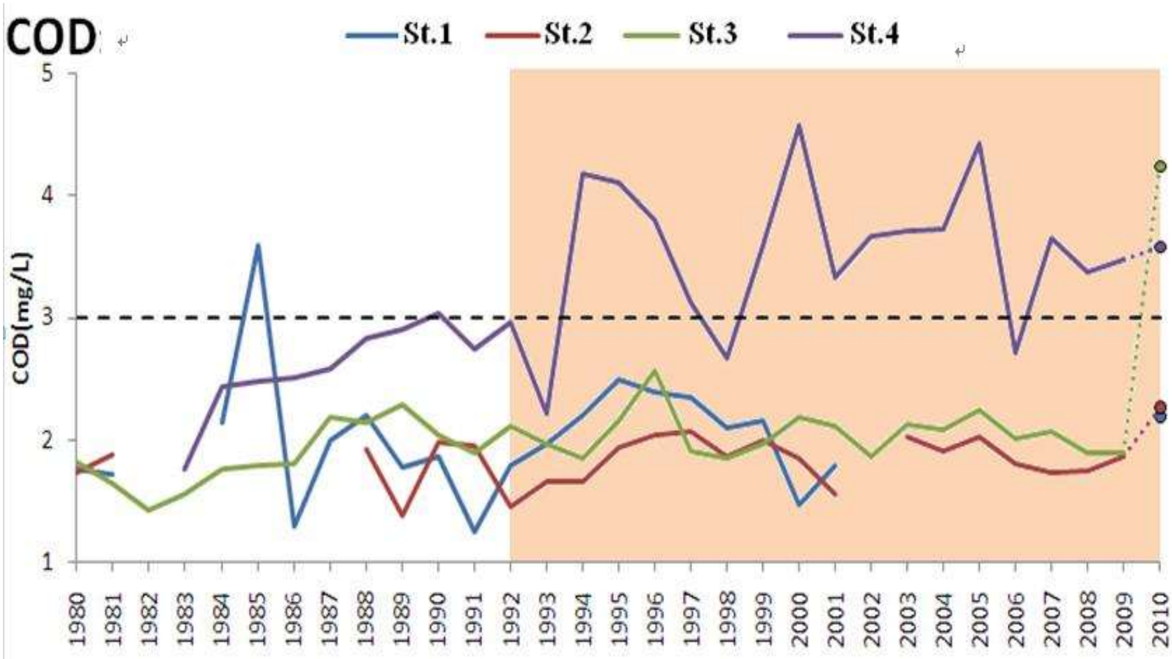

Figure 8. COD concentration in Kase River

SS (amount of suspended solid)

SS(suspended solids) is an indication of the amount of erosion that took place nearby or upstream. This parameter would be the most significant measurement as it would depict the effective and compliance of control measure e.g. riparian reserve along the waterways. The series of sediment-induced changes that can occur in the water body may change the composition of an aquatic community. A large volume of suspended sediment will reduce light penetration, thereby suppressing photosynthetic activity or phytoplankton and algae. This leads to fewer photosynthetic organisms available to serve as food source for many invertebrates. As a result, overall invertebrate numbers may also decline, which may then lead to decreased fish population.

The change of SS in Ozeki (St.1), Furuyu (St.2), Kanjimbashi (St.3), and Kasebashi (St.4) is shown in Figure 9 for 30 years. The width of the change narrows after 1998 when the gravel mining in the minister management district was prohibited, and the numerical value has lowered though it changed greatly until 1980-1997 in Ozeki (St.1), Kanjimbashi (St.3), and Kasebashi (St.4) located from Kase River dam to the downstream, too. In addition, after 2005 when the commutation had been begun, most changes were not seen. An immediate originating is uncertain. In the mean value in the various place point, the entire average is 7.3mg/L. In the maximum value, 27.0mg/L of Furuyu (St.2) and minimum value are 2.5mg/L Ozeki (St.1) in 2000.

T-N (total nitrogen)

Total nitrogen refers only to those amounts of nitrogen that gives rise to nitrate/nitrite ions. Total nitrogen is the sum of nitrate (NO3), nitrite (NO2), organic nitrogen, and ammonia (all expressed as N). The supply source of the nitrogen to the river includes the inflow, agricultural activity, the household sewage, etc. The change of the T-N density in Ozeki (St.1), Furuyu (St.2), Kanjinbashi (St.3), and Kasebashi (St.4) is shown in Figure 10 for 30 years. It has descended gradually, and it seems to have been changing into the rise with four points in 1996-1998. Only the difference before and behind 0.2mg/L is repeated, and a difficult point under the influence of rain whether catch when greatly moving in this because it is a range with the possibility of changing enough though changes seem to be larger than other points in Ozeki (St.1) that is the point of the uppermost stream and Kasebashi (St.4) of the downstream point. The maximum value is 1.55mg/L of Kasebashi (St.4) in 1980, and minimum value is 0.45mg/L of Kasebashi (St.4) in 1996.

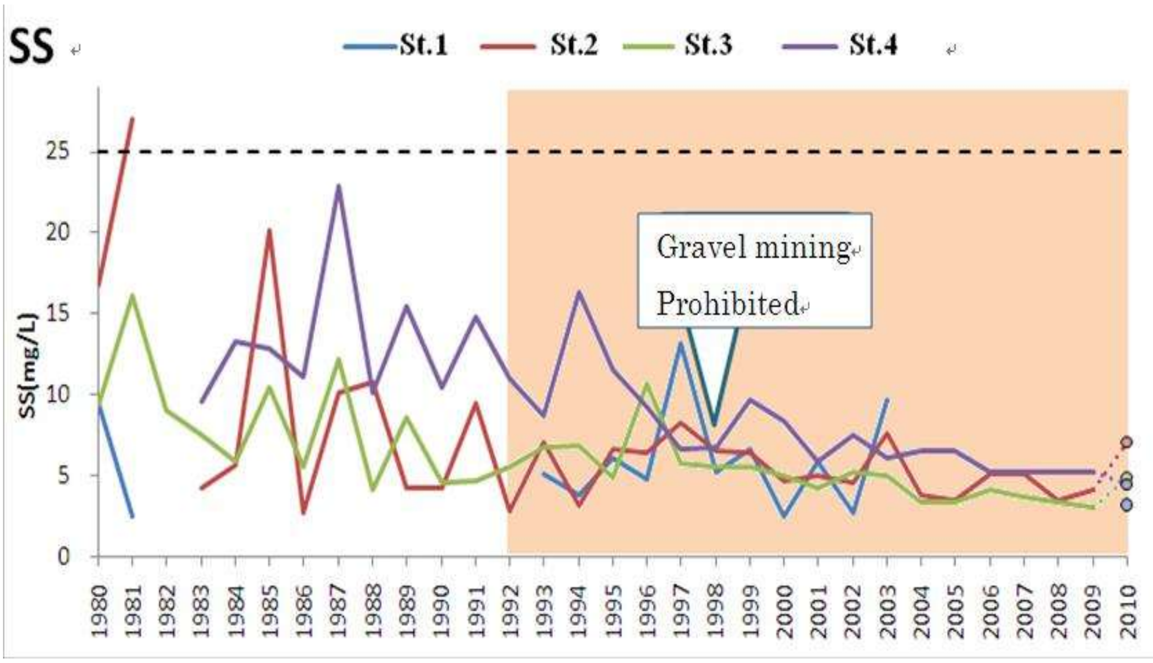

Figure 9. SS concentration in Kase river

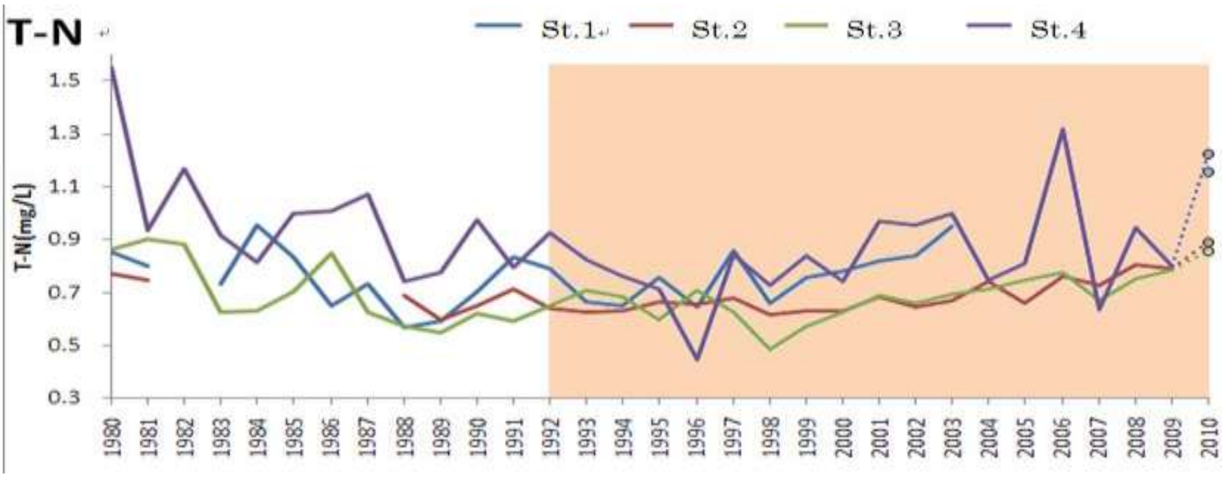

Figure 10. TN concentration in Kase River

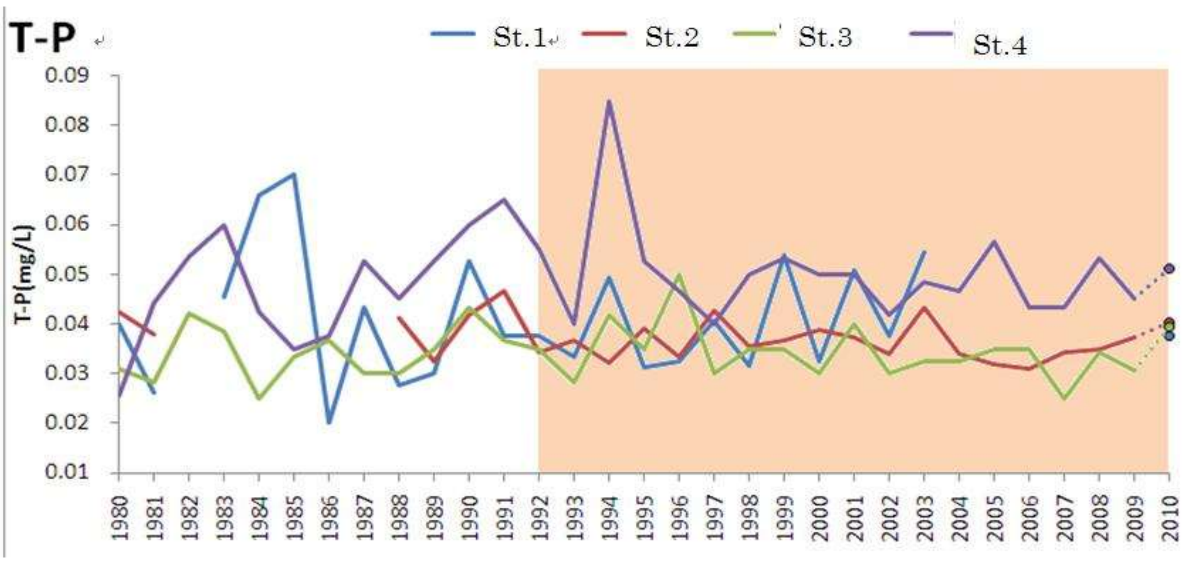

Figure 11. TP concentration in Kase River

T-P (total phosphorus)

The gross weight of phosphorus in various forms is called total phosphorus. Excessively scattered in the soil, the forest, and the farmland that flows out by the overexploitation as a load source of phosphorus. The loading dose has been decreased from occupying the load with big phosphorus in a synthetic detergent by converting to soap and making a synthetic detergent no phosphorus about the household effluent. River systems, with their associated impoundment of dams and stream components, provide much opportunity for nutrients to be transformed and removed as they are transported through the watershed. The change of the T-N density in Ozeki (St.1), Furuyu (St.2), Kanjimbashi (St.3), and Kasebashi (St.4) is shown in Figure 11 for 30 years. There is roughly no change with four points. Because the influence such as rain is received easily very much, and the numerical value is returned to the level-off at once, T-P will not be able to be called a change in the water quality though seems to pull out greatly by Kasebashi (St.4) in 1994 and to go out. In the mean value of the various place point, 0.05 mg/L and 0.04 mg/L at Furuyu (St.2) and Koseki (St.1) 0.04 mg/L at Kanjimbashi (St.3) and 0.03mg/L at Kasebashi (St.4) and the entire mean value is 0.04mg/L. In the maximum value, Kasebashi (St.4) and the minimum value in 1994 are Ozeki (St.1) in 1984. The mean value of Kasebashi (St.4) located in the downstream region where the housing lot extends has risen more than other points.

CONCLUSIONS

From the observation, the results show that the water quality of Kase River basin is generally as good. The conditions in the periods after dam construction indicate that river water quality impairment do exist, but not much and still meet the environmental qualification. The replenishment of Kase River Dam reservoir with the Hokuzan dam reservoir in the basin has less affected to change the water quality along the river due to the good implementation of pollution control in this area. Measurements of SS show that the concentration begins to settle down since the gravel mining is prohibited in 1998 and the fluctuation tend to decrease. It will be necessary to continue investigating in the future because Kase River dam's examination pounding just still started, the detention period becomes long and the potential substantial change could happen to the aquatic environment.

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