Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

AHW026-P01 Room:Convention Hall Time:May 27 09:00-10:45

Development of three dimensional hydrogeological model in Japanese islands and its applications

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The groundwater resource is a sustainable water resource. Recently, social demands against the groundwater resource become more multifaceted. And almost people need an optimum groundwater management achieved a good balance between conservation and utilization. Recent core technique of groundwater management is quantification of groundwater balance by numerical simulation. It is well known that the behavior of groundwater is restricted by distribution and hydraulic characteristics of a stratum. This argument points to a need for grasping the whole picture on groundwater basins and groundwater storage. And the current situation of groundwater resource development exceeds 1,000m in depth. It is necessary to improvement of advanced information on groundwater including the revaluation of co-existing information. However, basic information on the groundwater has not maintained still enough. Therefore, previous study has not been clarified the whole picture of groundwater basin and groundwater storage throughout Japan. The present work is intended to evaluate the whole picture of groundwater basin throughout Japan, and develop the three dimensional hydrogeological model in Japanese islands using the related database. We developed the three dimensional hydrogeological model based on the geological age as a key to divide from a same viewpoint, and became possible to specify the wide-range continuousness and distribution shape of a stratum which would become an aquifer. This report presents the developed three dimensional hydrogeological model and the estimation results of groundwater storage, unused groundwater resources, hot spring development potential in Japanese islands as its applications.

Keywords: Three dimensional model, Hydrogeology, Database, Japanese islands, Social demands

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Hydrologic cycle of upland-lowland system in Shimosa Upland, Chiba Prefecture and spatio-temporal distribution NO3-N in

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1. INTRODUCTION

NO3-N in the environmental water has been increasing in many places in the world because of human activity, especially by agriculture. Upland regions in Chiba prefecture is extensive crop area and much amount of NO3-N is expected to add in hydrologic cycle.

This paper deals with the NO3-N contamination in the upland-lowland hydrologic cycle. Surface waters and groundwaters are sampled and analyzed for NO3-N. With the concept of groundwater flow system, holistic understandings of NO3-N distribution are attempted.

2. Study area and the methodology

Takasaki-gawa is the tributary of Kashima-gawa which flows into Inbanuma Lake, one of the source of domestic water in urban area of Chiba Prefecture. Takasaki-gawa dissects the flat upland called Shimosa Upland, prominent crop land in Japan. Valley bottom is mostly used for paddy field. Along the dissected valleys, there are two types of land use chains, crop land to paddy field and urban area to paddy field.

Waters are sampled routinely after 2008 to measure inorganic nitrogen, and seasonal variation and spatial distribution of inorganic nitrogen are made clear. Groundwater are also sampled and analyzed for NO3-N. The flow of rivers are measured seasonally and nitrogen load is calculated.

3. Results

There are many points that shows high NO3-N concentration in upper reach of Takasaki-gawa watershed. There is seasonal change in NO3-N. Low concentration is observed in May or June. Most observation points except urban area on the upland show the same seasonal change. There may be some signal concerning hydrologic cycle and material cycle in the upland-lowland system.

The paddy fields on May and June are in flooding condition. The source of irrigation water is deep groundwater and its NO3-N concentration is revealed to be low. Low NO3-N water is added to paddy field during irrigation period. At the same time, denitrification under the paddy is possible in deoxidization condition.

There are characteristic changes in NO3-N concentration along the tributaries of the Takasakigawa-river.

Channels A (Takasaki-gawa main course) and C starts from shallow dissected valley on the upland, gradually deepening the valley and transit to boat-shaped dissected valley. There is a knick point between shallow valley and boat-shaped valley. Uppermost area is urban area, or cropland in shallow valley, and paddy fields in the bottom of boat-shaped dissected valley. NO3-N concentration increased downstream and reach its maximum. After the maximum, NO3-N concentration gradually decreased downward.

Channel B starts from valley head with clear valley walls, so-called horse's hoof shape. NO3-N concentration is high from the beginning, and gradually decrease downward or keeps high level. There is extensive flat cropland behind the valley head. NO3-N concentration at the spring in valley head is high, and exceed environmental standard. Manuring on the upland should be the source of NO3-N.

The chain of land use and topography have primary influence of NO3-N concentration in river water. In channels A and C, there is a chain like upland (residential)– upland (cropland)– lowland (paddy). In channel B, the chain is upland (cropland) – valley head – lowland (paddy)

Along Takasaki-gawa main channel, the flow steadily increases downward. NO3-N concentration has its maximum and decrease downward, however, nitrogen load gradually increase downward. Total nitrogen load in the middle reach of Takasaki-gawa watershed is estimated to be 100 to 200 t/year.

Preliminary survey on groundwater reveals that the "NO3-N pool" in the upland reaches to the depth of about 50m. Below this depth the concentration of NO3-N is still low. The evaluation of local groundwater system correspond to uppermost dissected valley is important as drainage system of high NO3-N groundwater.

Keywords: nitrate-nitrogen, Shimosa upland, Chiba Prefecture, The chain of land use and topography, groundwater flow system, public water area

Japan Geoscience Union Meeting 2011
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AHW026-P03 Room:Convention Hall Time:May 27 09:00-10:45

Concentration of nitrate nitrogen in a urban and mountainous area - Case study of Kyoto Basin and Mt. Tsukuba -

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The concentration of nitrate nitrogen (NO_3-N) in groundwater rose in recent years after the 1970's, and it began to pay attention as a serious social problem. As the main source of the nitrate nitrogen in groundwater, the following are the conceivable causes; i.e. excessive fertilizer for the farmland, the excrement of domestic animals and domestic waste water. It is difficult to specify the source of nitrate nitrogen when the multi sources exist. In the mountainous area where the anthropogenic impact is comparatively little, the concentration of nitrate nitrogen is high in some cases. The reason of this is exhaust fumes from cars which are contained the nitrogen oxides. The exhaust fumes diffuse to the atmosphere and nitrogen oxides fall to the mountainous area. The problem of nitrate nitrogen is widely caused from the urban area to the mountainous area, and thus, the groundwater quality investigation is executed.

In Japan, the environmental standard values of nitrate nitrogen have established for 10mg/L since 1999. However, the concentration of nitrate nitrogen in groundwater exceeds 10mgN/L in various places, and it is necessary to elucidate the source of the pollutant and checked the improvement plan.

In this presentation, it introduces the previous study of various places, and it reports on the problem about the nitrate nitrogen using the example of observing in the tea plantation, mountainous area and urban area.

Keywords: nitrate nitrogen, groundwater, Mt. Tsukuba, Kyoto Basin

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An estimation of nitrate concentration of soil water in a valley bottom of pasture-dominated drainage basin

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In order to estimate a spacial distribution of nitrate concentration, we applied an equation derived from the reaction kinetics to a pasture-dominated drainage basin. Parameter values relating to the spatial concentration change of ammonia and nitrate nitrogen along the valley bottom was used in the equation.

Keywords: Nitrate, Transport model, Soil water, Pasture, Forest, Drainage basin

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Urbanization and water quality properties in South Asian Megacities

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Increased population not only converts our environment it also change the landscape. Increasing population results urbanization that includes conversion of cities to megacities. These increased pressures of expansion affects the condition of the environment in many ways, it increase the amount of impervious surfaces and the quantity and types of products that human produce, use, and discard, thereby affecting water quality. Water quality deterioration is one of the major consequences of urbanization. These occur very often in megacities of developing countries, where untreated industrial sewerage and unplanned water use affects both surface and ground water quality. Among the Asian megacities, Dhaka and Delhi expanded remarkably and degraded their water quality over the years. These two cities are partially depending on the river with ground water extraction. Over the decades water quality deterioration trend is an inconvenient truth. Within these scenarios, trend analysis is necessary for efficient water resource management. Parameter specific trend analysis can give a right way to the policy makers to formulate need based water policy. This study tries to grasp the trend of the important water quality parameters of both surface and ground water with population growth. The general approach for the current study is to highlight the results available in literature on water quality with some firsthand data. Study includes observation for uneven years since 1980 and analysis is developed within a longitudinal data. Yamuna of Delhi and Buriganga of Dhaka are checked with historical data for surface water quality. Result shows that most of the water qualities deteriorate with increase population in varying degrees. pH, DO, BOD and Fecal Coliform (FC) are strongly correlated with population for surface water and Conductivity, Cl, Mn and Fe with ground water. Most of the ground water qualities parameters have deteriorating trend. Among surface water parameters some shows opposite trend between Dhaka and Delhi scenarios. This study concludes by discussing policy implications and avenue for further research.

Keywords: urbanization, water quality, megacity, pollution, south Asia

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Water pollution characteristics of mega-cities: seasonal variation, BOD sources and recovery process

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Water samples were collected in the Ciliwung River, sewage and ponds on 25 - 26 April in 2010 under a low flow condition and 12 - 13 June in 2010 under a high flow condition after a storm flood. The spatial distribution of EC, DO, BOD and DOC in the Ciliwung River from mid-stream to downstream on 12 - 13 June, 2010 was shown in the figures (see the report). The EC and DO were measured by portable meters, BOD analyzed by PD PAL JAYA, and DOC analyzed in Hiroshima University. In the case of water with less suspended materials, such as the sewage or river water in downstream, the EC and BOD relationship was similar to the best-fit curve shown. On the other hand, BOD values were high and EC were low in water with suspended solid.

The relationship between BOD and DOC in river in Jakarta in June 2010 indicated that BOD values were mostly higher than DOC in June. This suggests that these water samples included the suspended solids of organic substances. The EC and DOC relationship in April was better than that in June. The water samples with suspended solids tended to have high DOC concentration. EC is normally related to total ion, and DOC is one of the main ions in case of organic polluted area. The good correlation between EC and DOC supports these properties. But in case of high suspended concentration, part of DOC includes unionized compounds.

Based on the preliminary results of this survey, the Survey team finally proposed a real time monitoring system which included a suspended solid sensor to the system. Good correlation between EC and DOC, and EC and BOD were confirmed in many cases including that from Japan. Based on these relationships, The Survey team could estimate BOD in sewage without suspended material. However, it is required to use the relationship between SS and BOD in case of high suspended concentration.

In the proposed system, the cost is one fifth of that of BOD and the sensor has high durability. The Survey team is confident that the proposed monitoring system for Indonesia would be effective.

Keywords: water pollution, river, mega-cities, BOD, dissolved nitrogen

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Stream water quality in snow melting period and snow water quality in the Uono river basin.

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1.Introduction

The stream water quantity increase with the snow melting water is seen putting it in the snow region in early summer at the early spring, and the snow melting water also influences the river quality strongly. Moreover, the snow melting is frequently generated for the snowfall period in a clement snow region compared with the cold snow region. Also snow melting mechanism are greatly different from that of the cold snowfall ground. In the Niigata Prefecture Shinano river basin Uono river, the amount is a lot of absolutely heavy snowfall areas of the snow in the point where a lot of snowfalls in winter exist that are exceeding 3m. It considered it by using the snow condition of the influence that the snow melting water generated in the same valley along with the snow and the snowfall gave to the watershed environment, the aquatic environment, and the river quality by the field observation in the present study.

2.Method

It went in hydrological measurement (AT,WT,pH-RpH,EC,TDS,DO) once a month.Not only winter but also summer in April, 2009. Winter and the snow melting period did a similar observation once a week. One observation a month was done on the first weekend. Moreover, the depth of snow cover observation and the snow scale gathered the snowfall sample at the same time. In the laboratory,the sample that did the obtaining water and measured EC measurement,needed main dissolved constituent analysis,total carbon,it was total inorganic carbon,and it was total organic carbon. About the snow sample,the amount was measured,it was assumed 1ml=1g,measured the density,and snow conditions were requested at the same time.

3.Result

The stream water at the snow was plotted at the position where which Cl^-,$SO_4{}^{2-}$,$NO_3{}^-$,Na^+ and K^+ density were high and the Ca^{2+},Mg^{2+} density was low. It is suggested that it is shape that the stream water quality element is pulled to the density of Cl^-,$SO_4{}^{2-}$,$NO_3{}^-$ in A layer on Asamadaira bridge, the Onohara bridge, Yokkamachi bridge, and the snow form the water quality of the stream water. It is thought that it is a water quality that underground water mixes with the snow and the snowfall water because the element of the geological features origin named Ca^{2+},Mg^{2+} has increased, too. Therefore, the tendency has lowered in there is a lot of underground water and the valley. As for the dilution of the river quality, a plain relation to the snowfall element was not seen by neither April nor May it though it was thought that February 27 was the snow melting initial and the snowmelt runoff started. However, the Cl^-,$SO_4{}^{2-}$,$NO_3{}^-$ density has decreased obviously though January and the water quality composition on February 27 greatly see the difference key diagram in the Ono field bridge in the style part in the main stream. It is thought that the Ca^{2+},Mg^{2+} element flows out directly from no increase to the river the snow melting water and caused the concentration reduction. JIt seems that the antifreezing agent element is not so included in the snow melting water because the melting amount is thought to be an outflow of the element in the throwing away snow to the river already because of the progress of a lot of snow meltings than the amount thrown away as for the snow throwing away place in the expressway of not only that but also this time.

4.Conclusion

I want to clarify the water budget and the mass balance of the aquatic environment in the entire clarifying Uono river basin of the valley of each small watershed based on the Hydrological data that has been observed since April 2009 and the snow data in winter.

Reference

Yoichi Morimoto Koji Kodera(2011): Relation of water quality composition of snow and stream water in the Uono River basin,Year 2011 Committee Association of Japanese geographers

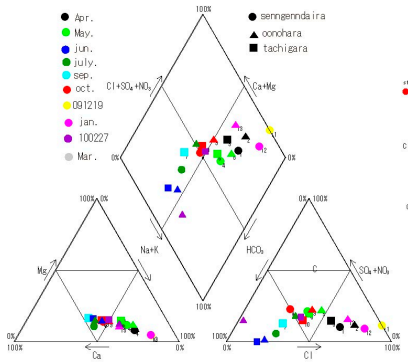

Figure1 Trilinear diagram in the main stream upstream (0904～1003)

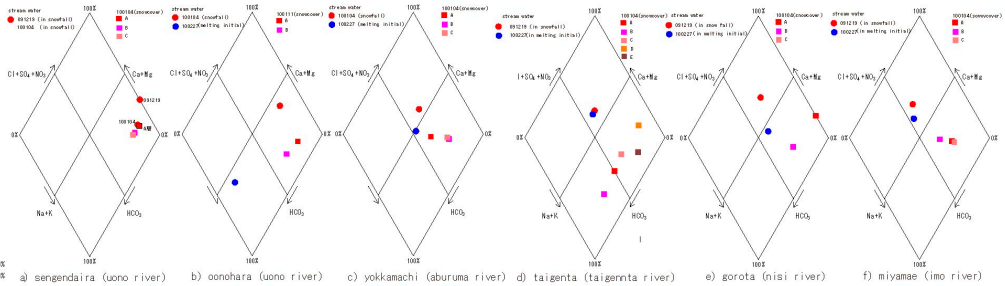

Figure2 Keydiagram(snowcover・streamwater)

Keywords: Uono river basin, snow melting period, stream water quality, snow, dissolved constituent

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Characteristics of outoflow variations of rivers in Ishigaki Island

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1 Preface

In Islands around the sea, surface water immediately flows out to the ocean, and various materials flow out to the ocean at the same time. Land waters that flows in the island and flows out to the ocean influence the littoral region because the coral reef etc. especially develop to surroundings on the island, and a valuable environment is formed in Yaeyama islands that belong to the subtropics climate. The red soil runoff has been put in question since before in Ishigaki Island and R.Nagura, R.Todoroki the present study aims not only the unit of the valley but also to catch inland waters in the large area, and to clarify the change by the seasonal variation and the rainfall event.

2 An area for summary

it exists as a center island in Yaeyama islands. The normal temperature is 23.7 degree, the average precipitation is 2127.2mm, and the rainfall at the rainy season and the typhoon accounts for 60 percent of the annual rainfall. there are Mt Omoto that is the most high mountain in Okinawa. Main river are R. Miyara, R. Todoroki, R.Nagura.

3 A study method

I performed water sentence observation in about 90 spots in Ishigski Island. The observation item was AT, WT, pH-RpH, EC, TURB, DO, TDS, and the sample performed measurement of the alkalinity and major dissolved componnts measurment with the ion chromatograph, all dissolved carbon quantity analysis with the TOC analyzer.

4 A result and consideration

The standard deviation of EC under 20 concentrates around Mt.Omoto. It is characteristic that value and average of EC are large. The water in Ishigaki island quality are grouped Ca-HCO3 type. Especially the trend are conspicuous at R.Todoroki by limestone area. Na-Cl type is shown in some erea but volume of Ca2+, HCO3- are small while Na+, Cl- are same degree.at Ca-HCO3 type erea. After rainfall EC decrease suddenly and the minimum value of EC250uS/cm or less was observed around noon increase Sep.4. Recovery speed is early at headwaters and slow at downstream. Ca2+, Mg2+, Cl- vary together with variation of EC. It has been understood to exist without making it to the place where the soil component flows out because the difference is in the size because of the point though the outflow of the dissolved matter according to the rainfall causes EC to change by the rainfall event.

5 Conclusion

If the relation of the soil erosion to rainfall strength can be found, it becomes possible to calculate the rainfall according to the value of EC at the rainfall. It is necessary to lead outflow strength of the soil component from various factors like the inclination and geological features, etc. , and to clarify the relation between EC and the rainfall of the river.

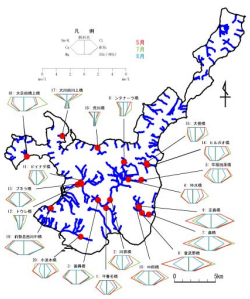
fig.1 stiff diagram

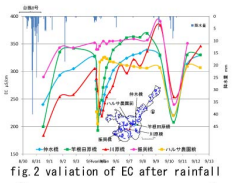
fig.2 valiation of EC after rainfall

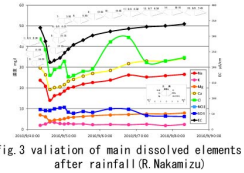
fig.3 valiation of main dissolved elements after rainfall(R.Nakamizu)

Keywords: electrical conductivity, main dissolved elements, rainfall, typhoon, Ishigaki Island

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Estimation of Groundwater Recharge from Low-Discharge and Gravelly River by Synoptic Survey using Handheld ADV

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Synoptic survey, performing stream gauging at a number of stream cross sections over a short period, is often applied to estimate how and where the groundwater recharge in an alluvial fan occurs. But the complex and variable distribution of depth and velocity due to gravelly riverbeds cause the unacceptable uncertainty of river discharge.

In the Toyohira River, which flows through the center of Sapporo city, Japan, the rate of water loss is estimated to be about 1 to 2 m3/s. If so, it is afraid to influence the well pumping and the river environment by the losing. Although many synoptic surveys were performed in past times, they were inconsistent and incoherent because of the uncertainty of the measurement.

In this study, the improved synoptic survey are applied, which uses Handheld ADV(Acoustic Doppler Velocimeters) , "FlowTracker" designed by Sontek/YSI. And vertical measurement points of velocity were arranged densely so that the river discharge in each subsection is less than 5 to 10% of the total. In result, the distribution of discharge and the rate of water loss are able to be estimated more correctly. In addition, the measurements by the propeller velocimeter and by ADCP are compared to assess the adequacy of each method.

The synoptic surveys were performed at some of 10 gauging sites and 2 tributaries several times in which the variation in water level are small, from September, 2010 to December 2010. It was revealed that the discharge losing section located between 16 to 17 km from where the Toyohira River and the Ishikari River join together. In the measurements, the rate of water loss between the two gauging stations, the Moiwa st. and the Kariki st., was constant at about 0.2 m3/d and was independent on both the river discharge, ranged between 3 to 15 m3/d, and the temperature of surfacewater, ranged between 1 to 21 degrees Celsius.

The rating curves of the Moiwa st. and the Kariki st. are estimated for considering the losing statistically. The groundwater recharge from the Toyohira River is probable to be decreasing in decades. The factor is thought to be the long term decline in water table around the river owing to the increased well pumping and the urban developments such as the subway construction, drainage and so on.

Keywords: alluvial fan, groundwater recharge, synoptic survey, ADV, ADCP, rating curve

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Contribution of the Otaki dam and water environment in the surrounding area

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Otaki dam itself was built 84 million tons of storage capacity in 2002, a landslide dam occurred at the bottom of the gate is open, they failed to present the reservoir. Once completed, the water level to rise more than 60m, an internal dam, the downstream effects of concern. Therefore, in this study was to investigate the environment for a long time before hanging up the reservoir, to gather information to determine whether the symptoms occur after water from the reservoir. The survey of the river water of dissolved constituents from upstream to downstream of the dam, the species composition of phytoplankton. The effect of dissolved chemical components, phytoplankton, are investigated to assess the impact of temperature and other physical and chemical effects along with the flow.

As a result, For first quality, in the Otaki dam dam size is small, temperature stratification was formed in the summer. The upper 26.5 degrees Celsius, in the lower 22.7 degrees Celsius, while the concentration of dissolved ions upper dam, found that differences seen in the lower. For turbidity, the turbidity point average near the headwaters of most monitoring sites was 0.3. This point was also very good in the sense transparent look. In contrast, the turbidity of the phenomenon can be seen wearing mud sites in the downstream region Otaki dam, and there was no difference between the prediction about the difference between 0.4 and turbidity of the near and Ryuu Hazime. However, it looks completely different look in the lower reaches of the river water has a creamy color. This is a very small particle size is considered that the idea of getting close to the colloidal state. It was found that likely precipitated the very state that it is difficult.

Keywords: The Otaki dam, Kino river, Tubidty, Plankton, Diatom

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Phosphorus dynamics in ponded shallow reservoir

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Phosphorus rock which is material of fertilizer faces to depletion in this century due to food demand behind human population increasing. Prevention of loss of phosphorus from farmland and reuse the material which includes phosphorus are strongly desired in agriculture because Japan obtains all of phosphate rock from import. Therefore it is important to look for the location of accumulation of phosphorus and to evaluate amount of loosed phosphorus.

The objective of this study is to clarify the mechanism of long-term variation for nutrient discharge in the Seto Inland Sea. Especially, we evaluate nutrient retention efficiency by small weirs on the stream using hydrodynamic ecological model.

The result of simulation for nutrient dynamics in the small reservoir using an eco-hydrodynamics model indicates that phosphorus overflows from water column to downstream in flood event while phosphorus circulates with sedimentation-resuspension inside the reservoir in ordinary condition. The net flux of phosphorus was estimated that 23% of total inflow is trapped in the reservoir and the residue is overflowed toward downstream. On the other hands, the net flux of nitrogen was estimated that 15% of total inflow is trapped as sedimentation, 26% is attenuated by denitrification and the residue is overflowed. These results suggest that the small reservoir has a capability of nutrient retention. The total sediment in the reservoir was estimated 62352 ton include with 42.4 ton of phosphorus. The result was equal to an accumulation of 15 years of estimated sediment. The result suggests that there is a possibility to be resource of phosphorus because the pore water was actually higher concentration than that in the water column. For fertilizer usage, it is an easy way to recycle of phosphorus from extraction of sediment than other material such as steel slag and sewage sludge.

Keywords: Phosphorus, Retention, Agricultural reservoir, Hydro-eco reservoir model, Takaya River