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A Geographical Study on Water Environmental Changes in the Urban Rivers in Tokyo, Japan

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It is important to assess the change of water environment in the present and past. In this study, present-day water quality standards are applied to the expressions in literary works to reconstruct the historical water environment including the quality. As the result, the historical reconstruction of water quality has been made distribution of water quality from 1905 to 1935 for the Sumida River in Tokyo.

Key words : historical water environment, urban river, Tokyo, geography, LTER (Long-Term Ecological Research)

INTRODUCTION

In Japan, various researches have been carried out to investigate of water quality in the city. However, many of these studies were begun after 1960's when the method of chemical analysis was set up. It is important to assess the historical changes in the water environment, water quality, water use and resources, because the water quality has been influenced by the human activity. However, the method to estimate water quality in the past had not been proposed. To reconstruct the historical water environment including the quality, it is necessary to get the different kinds of information from the present.

Although the quantitative data can not be obtained, descriptions of water space, maps, and statistics books in the year, pictures etc. are valuable resources on the information of water environment. The sentences are specially assessed and analyze the water environment in the past. Many valuable descriptions on aquatic environment can be found in literary works, newspaper and documents on local history. I have focused on the descriptions or expressions on water in literary works, such as novels, essays and poems in the last 100 years in Tokyo.

STUDY AREA

Tokyo was abundant in rivers, irrigation canals and these water spaces have been used for aqueducts, municipal water, irrigation, ship transportation and recreational park (Arai, 1990). Not only these water spaces have contributed to the development of Tokyo, but also had an important significance for the daily life of the citizen. According to the enlargement of city area of Tokyo since 1950's, water spaces have been much reduced by the construction of under-ground aqueducts and reclamation (Arai, 1991). 1960's was the time of sewer water pollution, after then, these pollution level decreased by the construction of sewerage (Arai, 1996). At present, water spaces such as rivers and ponds in Tokyo are recognized as park.

Emphasis was placed on the Sumida River that flows in the midst of the downtown Tokyo, because this river was described as background of many novels and essays. The length of the Sumida River is about 23 km flowing into the Bay of Tokyo, starting from Iwabuchi Water Gate in

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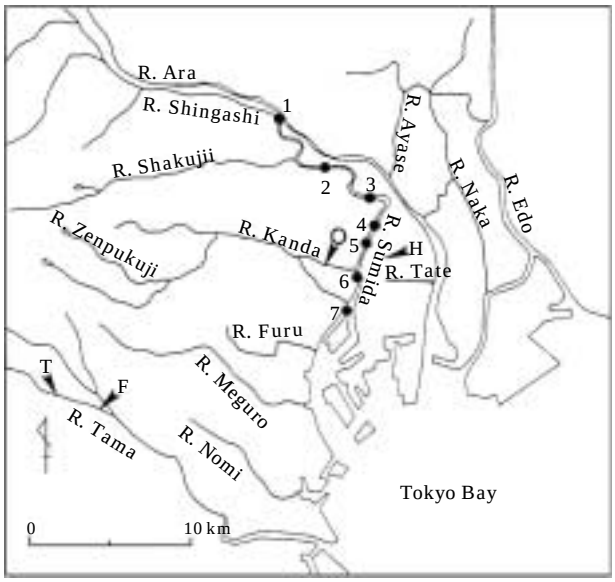

Fig. 1. Map showing Bridges points on the Sumida River. 1. Iwabuchi Water Gate 2. Odai Bridge 3. Senju Bridge 4. Shirahige Bridge 5. Azuma Bridge 6. Ryogoku Bridge 7. Eitai Bridge 8. Tsukuda Bridge F. Futagotamagawa O. Ochanomizu T. Tamagawagawara.

Arakawa. Its drainage basin area is about 390 km^2 including the Shingashi River and branches such as the Shakujii River, the Kanda River coming from the Musashino plateau (Fig. 1).

MATERIALS AND METHODS

Sentences and word on the water quality appeared in the literary works are classified into five water quality levels after the Environmental Water Quality Standard in Japanese National Environment Standards. Although some sentences in novels are not objective, it has been assumed that many of the literary works reflects the social and physical background of the time when they was written. Therefore, it was inferred that the written landscape and waterscape in literary works would be use as effective data for the reconstruction of historical aquatic environment (Taniguchi, 1995).

The author had searched the sentences of the biological and visual expression with aquatic environment in literary works that is written by writer who lived in Tokyo or as the stage in Tokyo. The literary works that described the waterscape of the Sumida River had searched numerous. In this study, 382 sentences and words were selected from 59 titles by 35 writers (Taniguchi, 1997).

Standardization of words and sentences to estimate water quality

An example of the standardization to adapt the literary work to the present water quality assessment is as follows; K. Tayama, who wrote travel essays besides many novels, in 1923, wrote in essay "*Tokyo Kinko Ichinichi no Koraku*" (One day excursion in the suburbs of Tokyo); "It is possible to catch many sweetfish in the Tama River between Futagotamagawa and Tamagawagawara." From this sentence, it can be inferred that, in 1923, the water quality of the lower leaches of the Tama River was good enough to allow sweetfish to live in the river.

This sentence can be converted into the category of the present environmental standards of the Environment Agency of Japan. There are six classifications to refer the water quality in this standard. One of the six types is "a type of the water quality level suitable for salmon and sweet fish to lives in the water." This type of water area is classified into "B type" with "*β−mesosaprob*". From this, the water area between Futagotamagawa and Tamagawagawara of Tama River in 1923 can be classified as "B type" or "*β−mesosaprob*".

Also, K. Nagai, a famous novelist and essayist who loved downtown Tokyo, in 1915 wrote in "*Hiyori Geta*"; "In the Sumida River, Ocyanomizi in the Kanda River, Honjo in the Tate River and in the other rivers in Tokyo... fishing and casting net became impossible. Fish already disappeared due to the water pollution in the recent years." This sentence suggests that types of the water quality of the Sumida, the Kanda, and the Tate River in 1915 can be classified as "D type or E type" and "*α−mesosaprob*".

Finally all the sentences and words are classified into five levels (Table 1). For instance, "cleanly" and "a kind of trout" etc. were classified into "class A level"; "Rusty" and "gray" etc. were classified into "class E level"; "Blue" and "verdure" etc. were classified into type of "Slightly polluted water".

Table 1. Standard for water quality assessment based on descriptions in literary works.

Type of water environment[1)]	A	B	C	D	E
Classification used in this study	Clear unpolluted water	Slightly polluted water		polluted water	
Indicator and key expression in Japanese[2)]	cleanly (*kiyoraka*) beautiful (*utsukushii*) drinking (*nomu*) azure (*sora–iro*) a kind of trout (*yamame*) char (*iwana*) firefly (*hotaru*)	blue (*ao–iro*) verdure (*heki–iro*) light blue (*mizu–iro*) emerald (*emerarudo*) crystal (*suisyou–no–youni*) salmon (*sake*) sweet fish (*ayu*) dace (*ugui/haya*) whitbait (*shirauo*) short–necked clam (*asari*) waterweed (*mizumo*)	carp (*koi*) crcian (*funa*) eel (*unagi*) crayfish (*zarigani*) corbicula (*yamatoshizimi*) laver (*asakusanori*) lotus (*hasu*) sweet flag (*syobu*) swimming (*suiei*) fisherman (*tsuri–bito*)	green (*midori–iro*) indigo blue (*ai–iro*) conger (*anago*) sea bass (*suzuki*) young sea bass (*seigo*) reed (*yoshi/ashi*)	rusty (*sabita*) black (*kuro–iro*) gray (*hai–iro*)

[1)]Water quality standard by the Environmental Agency of Japan.
[2)]Indicators are taken from fish and aquatic plant appearing in the literary works.
Key expressions in the table are several examples. The letter that was written italic is Japanese.

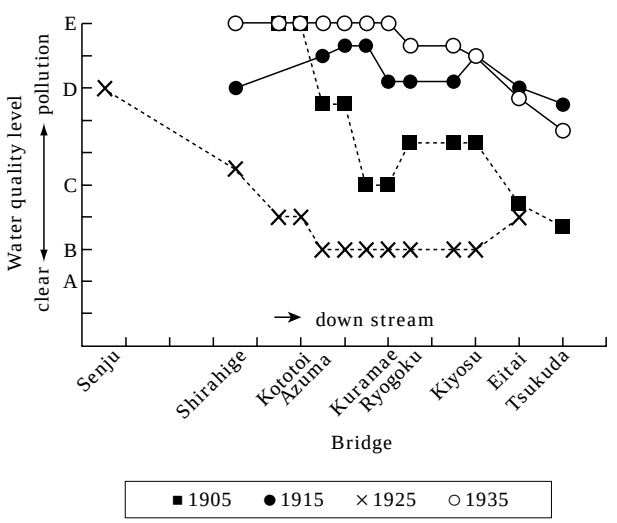

Fig. 2. Changes of water quality of the Sumida River assessed from literary works from 1905 to 1935.

RESULTS

In Figure 2, estimated change in the water quality of the section from Senju Bridge to Tsukuda Bridge from 1905 until 1935 was presented. Figure 2 shows clearly that the water quality level changed from B or C to E with time, indicating increased water pollution, although the pollution level had recovered after the Great Kanto Earthquake in 1923.

It can be inferred that the water quality of the Sumida River at Azuma Bridge in 1905 had already been polluted at Class E level of heavily polluted water, because this region was densely populated since the beginning of twentieth century (Masai, 1986). Azuma Bridge showed the worst water quality than any other locations throughout the ages. In 1915, the water quality of the section between Azuma Bridge and Kiyosu Bridge was Class E level, and that at Shirahige, Eitai and Tsukuda Bridge were Class D level of polluted water. In 1935, the whole section from Shirahige Bridge through Eitai Bridge turned into Class E level of heavily polluted water. Also, there is a trend that the water quality at Ryogoku Bridge is lower than at Eitai Bridge.

DISCUSSION

This study is intending to reconstruct post water quality by focusing on the descriptions or expressions in literary works, such as novels, essays and poems. As the result, it had been clear that the change of water quality is largely

influenced by human activity.

It is difficult to clear the water quality of the river and channel has once polluted, although the situation has been recovering in Tokyo by the spreading of the municipal sewerage service. It is not easy to restore the river and channel that have been much reduced by the construction of under-ground aqueducts. The regional aquatic environment is reflecting the nature of the area. Because of this, it is necessary to understand the change of water environment in the present and past. This method for the reconstruction water in the past can afford good result. Also, sustainable observation lacking the surveying instruments may be used. Although this method has not been completely established, it can be said that the results in this paper can give a guideline for this viewpoint.

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