

The Relation between Distribution of Creeks and Water Utilization System on the Tsukushi Plain

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Abstract

The aim of this study is to make clear the relationship of distribution of creeks and water utilization system on the *Tsukushi* Plain. On the *Tsukushi* Plain in Japan, the high density channel networks called as "Creek" were built over a large area to overcome a disadvantage regarding water-use from old times.

At the present time, the distinctive rural landscape in this area is recognized as the cultural landscape formed by the customs of that region that reflect the local people's lives and livelihoods. In fact, however, the traditional habitat system have been lost, because of the water pollution with life modernization and the change of agricultural system.

Therefore, in this study we attempt to clarify the characteristics of distribution of creeks on the entire *Tsukushi* plain by the close analysis on density distribution of creeks and regional variation of water use habits using the statistical analysis and spatial structural analysis. In addition, we indicate the correlation between the distribution of creeks and the controlled area of many water utilization associations.

Keywords: Creeks; *Tsukushi* Plain; *Chikugo-gawa* River; Water utilization system

1. Introduction

Water is an essential for human daily human life. Water-use has various characteristics due to countries and regions. Particularly, the *Tsukushi* Plain in *Kyushu* has characteristic water-use in Japan.

On the *Tsukushi* Plain, the high density creeks were built over a large area to overcome a disadvantage regarding water-use from old times. Creeks has many various functions that waterway, storage surplus water from headstream and drain so as to maximize the use of restricted water source. Namely creeks on the *Thukushi* Plain are traditional and historical water-use system.

At the present time, the distinctive rural landscape in this area is recognized as the cultural landscape formed by the customs of that region that reflect the local people's lives and livelihoods. However, the traditional habitat system have been lost, because of the water pollution with life modernization and the change of agricultural system.

Therefore, in this study we attempt to clarify the characteristics of distribution of creeks on the entire *Tsukushi* plain by the close analysis on density distribution of creeks and regional variation of water use habits using the statistical analysis and spatial structural analysis. In addition, we indicate the correlation between the distribution of creeks and the controlled area of many water utilization associations.

As for the previous study about creeks, Masaki (1997) pointed the necessary of conservation and utilization of historical creeks in Saga Plain. In addition, about the peculiarly water-use system of creeks, Watanabe, Kuroda and Kagara (1968) attempted to obtain in-depth data on water quantity, quality and level. Also, Mashino (1990) estimated creek density in the *Hanamune* River irrigation system with capacity as an indicator.

However, little is known about the characteristics of distribution of creeks on the entire *Tsukushi* Plain. Accordingly, if creeks are regard as the landscape and environment resources, we should take the property of water into account for landscape and environment preservation.

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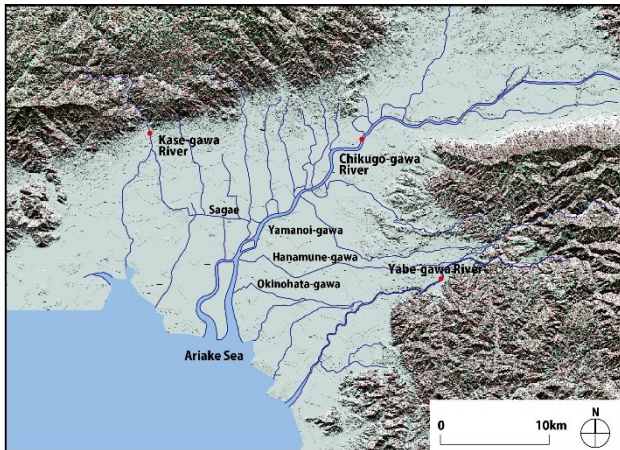


Fig.1 Subject area

2. Study Area

Figure 1 indicates subject area of this study. In this study, we analyze creeks on *Tsukushi Plain* positioned on the lower reaches of *Chikugo-gawa River*. The coastal along the *Ariake Sea* is the plain which developed as a back marsh or alluvial lowed of *Chikugo-gawa River* and several rivers flowing *Ariake Sea*. In addition the tidal range of *Ariake Sea* is largest in japan (more than 5 meters). Therefore the extensive plain was produced over the years. The flat plains had high ratio in the area of *Chikugo-gawa River* basin, and these areas suitable for farm land were large. Lands have to be sloping to some extent in order to be irrigable, so alluvial plains in the lower reach of rivers, where the slope is gentle. Also, the water level of *Chikugo-gawa River* is not stable depending on fluctuation in tide level. In addition it is difficult to irrigate rice fields by the natural inflow of river water because the riverbed of *Chikugo-gawa River* is very low. Therefore in this area the practical use of restricted water source is an important issue.

3. Methods

In this study, we collected the previous studies and many materials related to creeks to clear the density distribution of creeks. First, we restored the creek network of 1968 maintained creek function. Then, we attempted to quantitative study on creek density, and indicated the trend of creek density on distribution map. In addition, we revealed the irrigation system and the creek management division of each region. Moreover, we analyzed a correspondence between the management area of each water utilization association and the creek density distribution and water use habits in high-density areas.

4. The Density Distribution of Creeks

Figure 2 indicates the density distribution of creeks of 1968 in *Tsukushi Plain*. In this paper, *Tsukushi Plain* is divided into 250m mesh first, and the total sum of

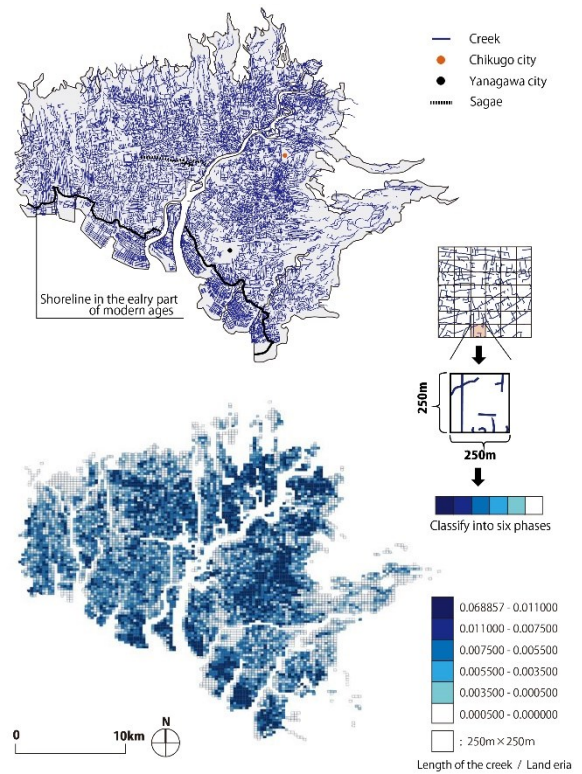


Fig.2 Density distribution of creeks.

length of creeks located within the mesh concerned is calculated with respect to each mesh. In addition, we remove the wide river as *Chikugo-gawa River* and *Yabe-gawa River*, *Kase-gawa River* and the sea in the calculation. Thereby, creek density was classified into 6 categories. Generally speaking, within the creek density it is relatively higher on the coastal area of *Ariake Sea*. The coastal area had been intentionally developed to improve agricultural production.

On the other hand, in the inland, creek density from north of *Sagae* is high in the right bank, and from *Hanamune-gawa River* is high in the left bank. *Sagae* is the artificial river with a role to join the *Kase-gawa River* and *Chikugo-gawa River* together. Therefore *Sagae* had a close relation with backflow water and drainage function from the upper reaches, it took an important role in draining of water.

Creeks doesn't exist alone. It is strongly connected with rivers and main line waterway. These systems were constructed in the early modern age.

5. Water Utilization System

5.1. Forms of Water Intake

In large part of the lower reach of *Chikugo-gawa*

River, many cultivators had drawn water from *Yabe-gawa* River and *Kase-gawa* River for irrigation, because of the water level of *Chikugo-gawa* River was not stable as described above. In this area creeks were sourced from several rivers, *Chikugo-gawa* River, many stream tributaries to *Chikugo-gawa* River, *Yabe-gawa* River and *Kase-gawa* River. Especially, the fresh water by *Chikugo-gawa* River backflow at high tide was stored in creeks because the tidal part was 26km from river mouth. This fresh water intake method was called “AO” in this area.

Also, another peculiar custom of water use was developed in the lower reaches of *Yabe-gawa* River called as ‘*Harumizu Kanko*’. In the lower reaches of river, cultivators stored the surplus water in creeks before the rice-planting season of the upper reaches of river. Because the rights of the upper reaches of river concerning the water-use were given preference over the rights of lower area. Therefore in the lower reaches of *Yabe-gawa* River, there were the high density creeks on the ground surface, and creeks are very large and deep to store water for a prolonged term. In this chapter, we cover water utilization systems of two major river (*Yabe-gawa* River irrigation system and *Kase-gawa* River irrigation system) in more detail.

Yabe-gawa River provides the water for three tributaries, *Okinohata-gawa* River, *Hnamune-gawa* River and *Yamanoi-gawa* River through the diversion weirs built for irrigation. The water supply ranges of every rivers are spread gradually toward a downstream side. Therefore there was a chronic shortage of water in the lower reaches of each rivers. On the other hand, in *Kase-gawa* River system, the some water supply channel were built artificially for transportation and irrigation like *Sagae* in the early modern age.

Figure 3 indicates the sources of water intake. In the lower reaches of *Chikugo-gawa* River can be largely divided into two areas, ‘only fresh water intake’ and ‘major rivers and coexisting with small-scaled rivers’ in the backflow water intake area. Another area can be divided 4 areas “major river” “small-scaled rivers” and “small-scaled” rivers and coexisting with the agricultural irrigation pond or wells”.

Figure 4 indicates the ratio of creek density according to water source. A correlation exists between the creek high-density areas and the areas of “Backflow Water”. Furthermore, a ratio of “Backflow water and *Yabe-gawa* River system” is high in the *Yabe-gawa* River system and a ratio of “Backflow water and small

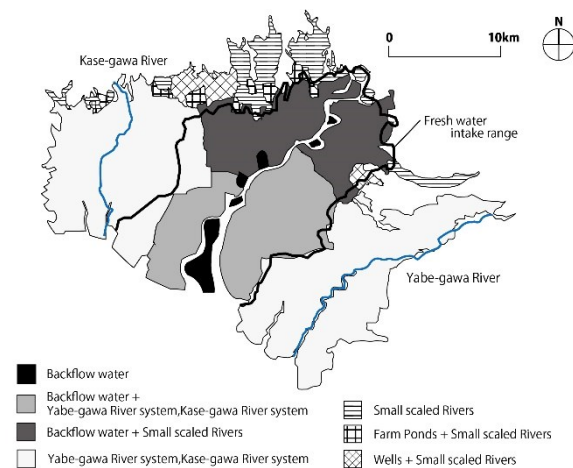


Fig.3 Sources of water intake.

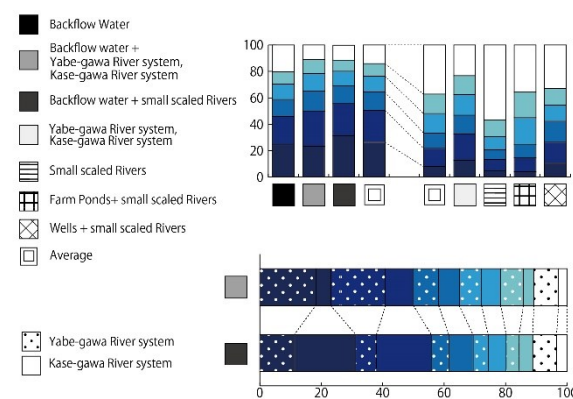


Fig.4 Ratio of creek density according to the water source.

scaled Rivers” is high in the *Kase-gawa* River system. Namely, the forms of water intake of high-density areas in the left bank (*Yabe-gawa* River system) and right bank (*Kase-gawa* River system) are slightly different

5.2. Water Utilization Organization

In this study, we regard the water utilization organization as functional organization that manages agricultural land and water separately municipality existed in 1968. Figure 5 indicates the management area divisions by water utilization organization and the distribution of major water intake facilities in 1968. 175 organizations existed in the right bank of *Chikugo-gawa* River, whereas 21 organizations existed in the left bank of *Chikugo-gawa* River. There were many small-scale organizations and a lot of water intake facilities in Zone-A. On the other hand, there were several large-scale organizations in Zone-B, and the water intake facilities were distributed in each organization.

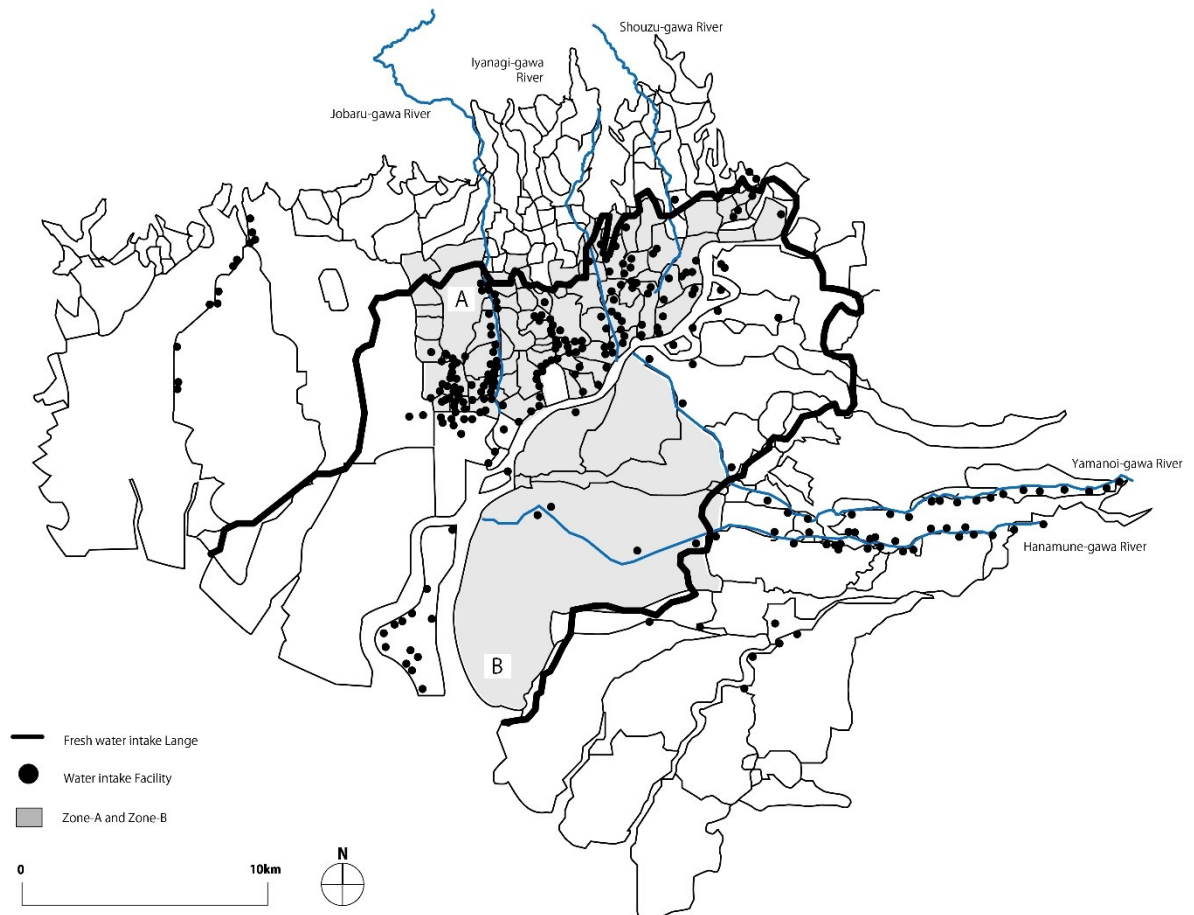


Fig.5 Water utilization organization and water intake facility.

6. The Relation between Distribution of Creeks and Water Utilization System

6.1. Zone-A

A lot of water intake facilities such as weir and device used to draw up water were distributed all over the water intake area in Zone-A which there is in the right bank of *Chikugo-gawa* River. Zone-A was located far away from *Kase-gawa* River which was a main river of the *Chikugo-gawa* River right bank. Therefore, taking water from *Kase-gawa* River directly was difficult. Also, the flux of small scaled rivers such as *Shouzu-gawa* or *Iyanagi-gawa* River which flowed through Zone-A was not sufficient for irrigation, and many devices used to draw up water were needed at every small scaled rivers. In addition, each water utilization organization on Zone-A was extremely small in scale and scope. Therefore, small-scale water utilization organizations established individual water intake facilities, and it is thought that limited water resources used it by utilizing a high-density creek. In other words, it is assumed that water intake river and

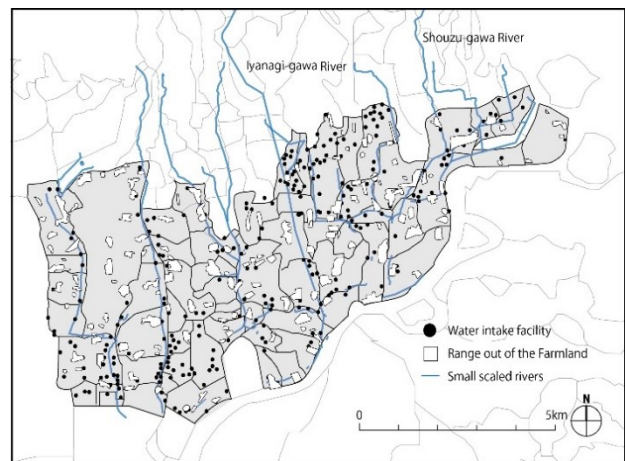


Fig.6 Water utilization of Zone-A.

water utilization organization division had an influence as a factor of the creek distribution on Zone-A.

6.2. Zone-B

There is Zone-B located in the left bank of *Chikugo-gawa* River within fresh water intake range, but the number of water intake facilities were limited. In

addition, the range of each water utilization organization in the left bank became larger than right bank. On the other hand, the major part of water intake facilities were distributed outside of fresh water intake range along *Hanamune-gawa* River, *Yamanoi-gawa* River.

Figure 7 indicates the positions of water intake facilities which assumed *Hanamune-gawa* River a water intake source and the range to supply water each water intake facility. Water intake facilities were located relatively densely in the upper reaches of *Hanamune-gawa* River, and water supply was performed individually in the group of small villages in this area. However, the number of water intake facilities decreases as it becomes the lower basin, and the range that each water intake facility took charge of extends to the wide area. This relationship of the receive benefits range of such a water intake facility and the basin of the river was confirmed in the *Yamanoi-gawa* River. Zone-B was located in the lower *Hanamune-gawa* River area, and it is assumed that it was necessary to use the water from limited water intake facilities in a wide area.

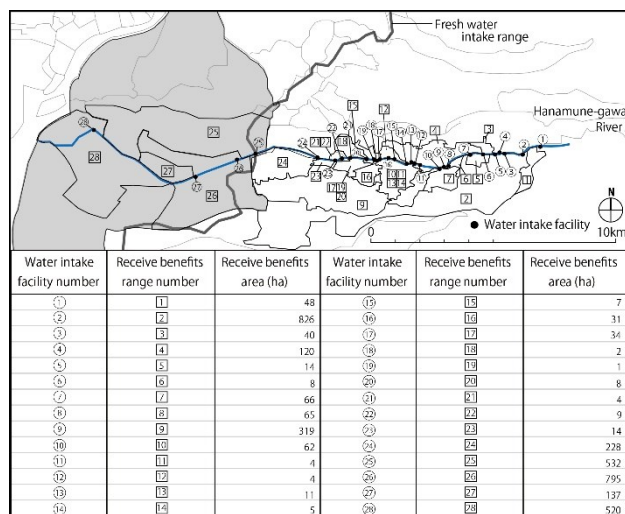


Fig.7 Water utilization of Zone-B.

7. Conclusion

Creek density is relatively high in the fresh water intake range. However, the distribution trend of especially high-density area is different from each bank of *Chikugo-gawa* River.

In particular, high-density area was located on “Backflow water + small scaled river” area in the right bank of *Chikugo-gawa* River, on the other hand, high-density area was located on “Backflow water + *Yabe-*

gawa River system” area in the left bank of *Chikugo-gawa* River based on the sources of water intake.

There are many small-scale organizations on Zone-A located in the right bank of *Chikugo-gawa* River, and there are many facilities for water intake in proportion to it along the small-scaled rivers.

On the other hand, Zone-B of the left bank of *Chikugo-gawa* River is located in the lower basin of *Hanamune-gawa* River and *Yamanoi-gawa* River and irrigates it by the water intake facilities of the limited number for the range of the water utilization organization having a large-scale area.

In this study we attempted to clarify the characteristics of distribution of creeks on the entire *Tsukushi* plain by the close analysis on density distribution of creeks and regional variation of water use habits using the statistical analysis and spatial structural analysis. In addition, we indicated the correlation between the distribution of creeks and the controlled area of many water utilization associations. As a result, the influence of the plural water utilization system according to geographical conditions on the density distribution of creeks is clarified. It is thought that a condition for water intake of the limited water resources in *Tsukushi* plains greatly influences the factor that a regional difference produces to creek distribution density.

In the end, it is supposed that the difference occurring to the creek distribution density occurred in what geographical, technical and social factors are related to complicatedly.

8. References

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