Investigation and Analysis on the Function of Space Formation of Spur Dike for Around Shingen Bank Japan

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Abstract: The Shingen Bank is famous for its flood control in Japan. Spur dike is skilfully used in river management, which creates good conditions for the human activities. In this paper, using the representative of the river regulation buildings in the Shingen Bank as the object to analyze the space formation function of Spur dike and examine human activities at the water edge. Firstly, by analyzing the ecological function and utilization of Spur dike in river space, the relationship between the Spur dike and human activities is clarified. And then, the configuration method of spur dikes in the course of river management was put forward, which could provide reference for the management and landscape planning of the near natural rivers.

1. Introduction
River landscape system of all kinds of natural elements is the basis of the formation of hydro logical ecological function. As the river management in the process of reinforced embankment, cutoff, the implementation of the dam and so on, continuity decay and loss of natural elements cause a great change of the surrounding ecological environment[1]. From the perspective of hydro technologies, ecology, landscape engineering, environmental protection and other multi-disciplinary, systematically research and the realignment of rivers have become a important issue at present.

In the construction technology of natural rivers, water production is an indispensable element for the stability of river banks. The formation of the natural environment of ecological system and human activities, and its various functions are widely recognized [2-3].

However, some problems such as the setting method of the spur dike, the change of riverbed around spur dike, the relationship between hydrophilic activities and spur dike have not been thoroughly studied.

In this paper, the Kamaokawa Shingen Bank in Fujikawa River system, Yamanashi Prefecture, Japan, is taken as the research object, taking into account both the landscape potential of the spur dike and the human activities at the water’s edge. The function of spur dike is investigated, and the allocation method of the spur dike in the river management process is proposed [4].

2. The Concept and Research Brief of Spur Dike
Spur dike are the controller class building in hydraulic facilities [5] covers the spur dike, suitable dam, diversion dam and bottom protection, hydraulic facility [6].

From the perspective of material, structure, type, function and application field, spur dike has a
broader scope and more detailed content. It is not only widely used in hydraulic engineering, civil engineering and environmental engineering, but also widely used in landscape engineering, human factors engineering and other fields [7-8]. Therefore, the concept of the spur dike is still used as the central term in this paper.

In water conservancy and water of river, the Japanese scholar Shinohara Osamu repairing the famous landscape, the rivers of one-sided concept of functional dominant criticized [9] Shinohara Osamu said "starting from the functional mode of thinking, in setting numerous rivers of water conservancy works, make the massive loss" of natural rivers, he advocated in the water conservancy should retain river has a rich variety of functions. Mukoi Akie studies the agricultural drainage spur dike is used to create the formation of the shoal and control technology, advocate in agricultural drainage systems at the same time [10]. Yang Jianiing made use of the landscape potential of the spur dike and proposed the design method of waterside space from the comprehensive perspective of hydraulics, ecology and landscape science [11]. Many domestic scholars have studied spur dike.

The above research points out that both water benefit and water treatments should take into account disaster prevention, transportation, leisure, landscape, ecology, cultural value and other "multi-functions". One of the charm of the river itself is the activities close to the water edge space as far as possible.

3. Implementation of River Survey

The object of the field survey is Kamaokawa of Fujikawa River system, a first-class river in Japan, and the object area is within 15 kilometers of the left bank of Shingen bank (figure 1) The author studied for my master's degree at Yamanashi University, and her research is part of the author's Master's thesis.

![Figure 1. The survey area of a river](image)

River survey mainly includes four parts: river course, spur dike, flood and human activities.

The investigation of the basic characteristics of the channel includes, the average size of the river, the width of the river, the depth of the river, the gradient, the material of the channel, the shape and the granularity of the sand, the distribution of the channel bar, etc.

The flood investigation includes the occurrence times, scale, changes of water level and the setting of flood control works in the past five years.

The investigation of spur dike includes: location, type, quantity, material, flood level, sediment accumulation, Sedimentation before and after a flood, human activities around spur dike, etc.

The survey of human activities includes: residents' water activities (splashing water, receiving water), water path, movement along the traffic axis (walking, etc.), (convergence point and stopping place), entertainment and leisure, etc.

4. River Survey Result

4.1. River Course Overview and Spur Dike Setting

Kamokawa is located in the upstream of Fujikawa River, with a total length of 68 km. In the mountainous region, it presents a natural rich stream landscape. The average riverbed gradient around Shingen bank, I= 1/200, and the average river width B = 400 meters.

The central axis of the river are bent about 15° from the upper part.
The slope of the river bank is revetment with grass and the embankment is revetment with stones. There are 18 spur dikes near Shingen Causeway, including 14 sacred cow spur dike (figure 2) stone masonry spur dike (figure 3).

During the flat water period (usually does not flood, does not dry up period) the river velocity is slow, the flood period the river velocity is fast. Shingen bank is integrated with the surrounding environment and forms a natural ecological park.

4.2. Survey of Sandbanks
There are two factors contributing to the formation of sandbars near the Shingen Causeway. One is a sandbar formed by the river's own conditions, and the other is a sandbar formed by the setting of sacred cow water (figure 4).

The river has a large ratio of river width to water depth. On such a river, 2-5 sets of compound sacred ox spur dike are set across the direction, which creates conditions for the formation of surrounding sandbars.

4.3. The Area Changes Around the Spur Dike Caused by Flood
After the calculation of sand and soil movement performance index [5] the flood scale is classified according to the amount of sand and soil movement. When depth $H \geq 2\text{m}$ is called medium scale flood, depth $H \geq 1.5\text{ m}$ is called a minor flood. During the 8 months of the Investigation in Kamokawa, there were two medium-scale floods and three Small-scale floods (over 1.5 meters), and the area change around the spur dike caused by the flood was shown in figure 5.
4.4. Survey Results of Human Activities

Types of Human activities around the Shingen bank are: water activity (specific form for shallow water swimming, walking in the water, the water), stop activities: (specific form for reading, talk, think, rest, fishing, group gathered, group assembly), mobile (specific form is: walking along the Banks of the river, through the shore, and running around the shore), overlooking: (specific form for overlooking the other side, looking across the river upstream, overlooking the river downstream.

Types of human activities around the spur dike: splashing around the trap water, catching water around the sacred cow water, group activities and catching water around the sacred cow water, and walking on the beach around the sacred cow water at low water level [5].

5. Proposal for the Spur Dike Setting

Through the field investigation of the river, it can be seen that proper spur dike configuration is conducive to the regulation of sandbar form and the formation of foot field. In addition, hydrophilic activities near Shingen bank Causeway account for 26.6% of human activities, and the full range of human activities is yet to be further expanded.

In order to extend the full field range of hydrophilic activity space, a new scheme of adding spur dike is proposed according to the existing spur dike spacing in the Shingen bank, referring to the river curvature, riverbed material, bank protection and current solid state.

The spur dike configuration proposed in this paper is shown in figure7. Three pieces of submerged water are configured in the upper part of the sacred cow. The height of the spur dike does not interfere with the line of sight, forming a linear arrangement, and there is a significant sedimentary morphology.
in the downstream. The 12th sacred cow spur dike has a stone cage spur dike nearby. The convex shape of spur dike ensures the foot field function of spur dike.

![Proposal for spur dike setting](image)

**Figure 7. Proposal for spur dike setting**

6. **Conclusion**

This paper focus on the setting and utilization of the river regulation with spur dike, investigates the spur dike and the shape of river course and the change of micro-topography by spur dike from the perspective of the integration of water science and river engineering, and understands the relationship between the human activities at the water edge and spur dike.

It is expected to overcome the dominant concept of one-sided functionalism in the future river management, restore the original "multi-functional" appearance of river disaster prevention, transportation, tourism, leisure, landscape, ecology and cultural value, promote the benign circulation of hydrology and ecology of river course, and create more comfortable space for human activities.

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