River Education on Sustainability and Disaster Prevention at Elementary Schools in Island Regions

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Abstract The participation of elementary school students studying in the area is important for the sustainability of the area. This paper is a practice of an elementary school in Tsushima City, an island region of Japan. Two years ago, elementary schools have been conducting river education through collaborative learning. Through river education, elementary school students were able to understand that the river was clean, the extent of the brackish water area was discovered, the river business was understood, and salt damage was understood. We believe that river education will lead to disaster education as a result. Also, elementary school children want the water they use as drinking water to be clean forever, and they can imagine their future life from the perspective of disaster prevention. It was revealed that such elementary school students' understanding contributes to regional sustainability.

Keywords River · Sustainability · Nita river · Farmland development

1 Introduction

Creating a sustainable society requires scientific understanding of rivers and wise decision making. River education requires a comprehensive approach to science and society. The introduction of river education in Japan's primary education was amendment of River Law in 1997. In addition to the conventional flood control and utilization, improvement and conservation of river environment were stipulated in the legal purpose. Understanding of local rivers can be concretely imagining disasters in an emergency by environmental education during normal times.

In this paper, we discuss sustainability and disaster prevention education based on case of river education at Tsushima Municipal Nita Elementary School in Tsushima City, which has been struggling with water use and agriculture historically (see Fig. 1).

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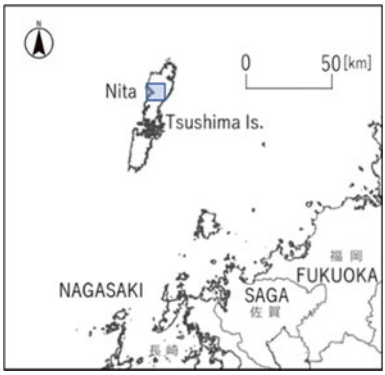

Fig. 1 Study site Nita District, Tsushima Island (From the National Geographic Institute)

2 Background of This Study

2.1 Previous Research

Since 2000, integrated studies have been newly established to promote cross-sectional and comprehensive learning and exploratory learning in the elementary school curriculum. Environmental education was also illustrated as a learning activity. In this learning, the place to learn expanded not only to the school but also to the area outside the school, and the utilization of local human resources increased. Children have more opportunities to learn knowledge from the community.

The importance of disaster prevention education has been pointed out since the 2011 Great East Japan Earthquake. The Ministry of Education, Culture, Sports, Science and Technology pointed out that in promoting disaster prevention education in schools, "By relating activities for learning the history and natural environment of the region, children and students will benefit the region from various perspectives" [1]. In addition, Teramoto stated in his geography report that disaster education requires the development of geographical imagination [2]. Teramoto pointed out the opportunity to walk experientially in the precincts to develop this ability.

From these previous studies, by setting opportunities for learning the history and environment of the region during integrated studies, exploring by walking and setting collaborative learning with the region, all knowledge of the region can be acquired. It is clear that it fosters geographical imagination and leads to disaster awareness. Furthermore, if river education that leads to regional sustainability can be developed at the time of integrated studies, it may be possible to develop disaster prevention education.

In this practice, the sustainability of the area is promoted by the river education, and the relation to the disaster prevention education is examined.

2.2 Realities of the Area

In the Seta area, which is located on the north side of the school district, the Ministry of Agriculture, Forestry and Fisheries has been engaged in a multi-functional agricultural function countermeasure project since 2014. Through this project, people in the Seta area have been able to cultivate abandoned land. They have also planted trees on both banks of the Nita River to improve the landscape of cultivated land and rivers. Furthermore, they have turned their attention to developing human resources for the next generation of agricultural engineers, as agriculture has supported regional and Japanese food production. Therefore, starting in 2018, the aim was to develop human resources for agricultural engineers, and cooperation with elementary schools began (see Figs. 2 and 3). At the beginning of April, two representatives from the Seta area came to our school. Then, in May, we and local representatives confirmed the program and the activities began. Hart discussed the participation of children and these learnings and also participated in agricultural administration [3].

Now we will explain the river education and relationship with the area before this learning began. River education teaches the function of water flowing in science classes. There is a possibility that it may develop from science learning to conduct research on aquatic life and water quality, but elementary school students did not learned that.

At Nita Elementary School, upper elementary school students are working on rice production. For more than 10 years, the Kaidokoro area has been cooperating with the school. In addition, they were learning about regional food culture through

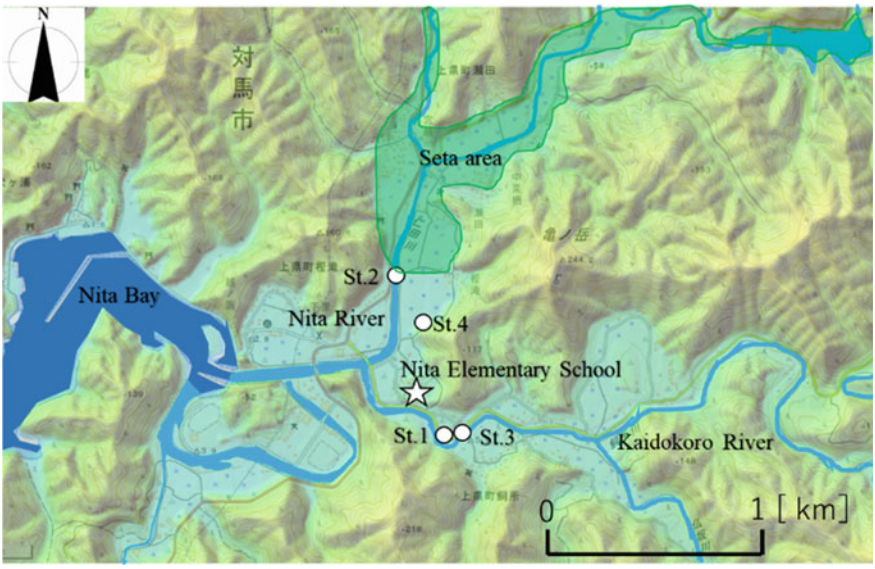

Fig. 2 Land in the Nita area (From the National Geographic Institute)

Fig. 3 Elementary school students receiving guidance on farm work on abandoned arable land [2019.5.25]

interaction with elderly care facilities in the Kashitaki area. In the lower grades of elementary school, the elderly men in the area taught students old games.

In other words, it can be said that elementary school students at Nita Elementary School learned about rivers in science lessons and had a lot of interaction with the community.

3 Study Site and Methods

Nita Elementary School, Tsushima City, Nagasaki Prefecture, which conducted this research, has 53 students and 9 teachers in 2018. It is located on a hill in the Nita area of Kamiagata Town, Tsushima City. In front of the school is the Kaidokoro River (stream extension 12.9 km, basin area 26.20 km), a tributary of the Nita River (stream extension 14.2 km, basin area 106.09 km), and the road along the river is a school route(see Fig. 2).

The Nita elementary school has been practicing river education since 2018. Promoting practice outside the school in collaboration with the community. In 2019, Tsushima City suffered flood disaster every 50 years, three times. In this area as well, there was no human injury, but there was damage caused by the calves being raised.

The analysis target of the educational contents is the review notes of the students and the lesson records of teachers during the practice in 2018 and 2019. In addition, knowledge of river life such as land use of the target river, agricultural land development, migratory fish, etc. was obtained by interview survey with residents.

4 Surveys

We will describe the practice in the Nita River basin at Nita Elementary School, the natural conditions there, and the development process. Tables 1, 2, 3, 4 and 5 show the elementary school students' awareness of the techniques of vegetable making and water circulation. The authors categorized the awareness of elementary school students.

4.1 Practice of Utilization of Abandoned Land

St.4 in Fig. 2 is a farmland developed jointly by the Seta area and elementary school students. From Table 1, elementary school students learned how to grow vegetables, such as erecting struts according to soil preparation and vegetable growth. From Table 2, it was also understood that the Kashitaki area where the developed farmland is located uses the water of Meboro Dam. It was also found that the river construction expanded the brackish water area and constructed a movable weir. The expansion of the brackish water area is also apparent from the fact that the goby classified in Table 3 lived in the brackish water area.

Elementary school students have learned not only the agricultural technique but also the fact that the cultivated land is taken from the dam, the nearby well water

Table 1 Understanding elementary school students in vegetable cultivation

Categorization			Students' expression
Vegetable cultivation skills	Preparation for cultivation	Revitalization of abandoned fields	Remove roots and stones from abandoned fields
		Agricultural action	Loosen the hardened soil in the field, sprinkle fertilizer, and mix it with a machine
			Ridges of the fields covered with vinyl protection
	Procedure		Soften the soils, put the seed, spray the water
			Water and fertilizer for harvest
			Along the growth of vegetables, band them to pillars by eight shape knot
	Tools		Utilization of bamboo as the pillar

Table 2 Understanding elementary school students in water awareness

Categorization		Students' expression
Awareness of water	Old water use	There was an old well in the area of Nita
		Wells become tide water and are rarely used
		The field is made near the pond
		In the old days, farmers pumped water from the river
		The water supply was formed, and the well water was not used
	Effects of river civil engineering	The water in the fields of the Kashitaki area comes from the Meboro Dam
		The tide rose by the river construction, and a movable weir was formed
		The water taken from the weir is sent to the fields in the Shimoharu area

Table 3 Understanding elementary school students in identification of goby

Categorization			Students' expression
Classification of goby	Body morphology	Overall morphology	Striped pattern with 5 fins
		Detail pattern of parts	Some cheeks are red
		Overall color	The body is pale
			The body is yellowish
		Detail color of parts	The belly is pale
			The eyes are blue or green
			There is no orange in the tail as seen in other goby
		Detail color with morphology	The mouth is red, and there is a bump
	Habitat	Overall	Inhabits shallow places
			Inhabits brackish waters
		Detail	Not on rocks, but on pebbles

Table 4 Understanding elementary school students in biotope making

Categorization		Students' expression
Biotope making	Land height	The land is low and not suitable for farmland
	Relationship with dam	The water of the biotope has disappeared
	Natural environment	I would like to add aquatic plants to the biotope, but I am not growing up in the Nita River now
		Frogs and the Japanese giant beetle lived in the biotope
	Relationship with dam	The water of the biotope has disappeared

Table 5 Understanding elementary school students in water quality survey

Categorization		Students' expression
Water quality survey	Understanding the meaning of values	The COD values of the Nita and Kaidokoro Rivers are different
		The Kaidokoro River has a COD value of 0, so it is clean because it does not require oxygen to decompose dirt
	River cleanliness	Kaidokoro River is cleaner than Nita River
		The COD values of the Nita and Kaidokoro Rivers are low, so it's beautiful
	Survey methodology	We examined the results in three groups and found no significant differences in COD values

cannot be used due to salt damage, that is, the influence of civil engineering works on the river rehabilitation water cycle.

A biotope was made next to the farmland shown at St4 in Fig. 2. As a practice to learn the management of aquatic ecosystem, we have been working on biotope making since June 2018. We investigated the aquatic plants that inhabited the Nita River, and transplanted hornwort that grew naturally in the wetlands of the Tanohama area of the school district to the biotope (see Fig. 4). As you can see from Table 4, in the fall, we were able to observe the representative creature of the paddy field. However, the biotope failed to retain water and was completely drained in December.

In 2019, we moved the cultivated land, which is a place for field activities of agricultural practice, near the school. Biotope making was supported by an environmental protection organization in 2019. The water retention capacity was improved, and the goby that inhabit the Nita River was released. Water does not drip even now.

Fig. 4 Elementary school students making biotopes on abandoned arable land [2019.6.21]

4.2 Survey of Aquatic Organism and Water Quality

We also worked on river environmental surveys. Surveys of river organisms were done by our elementary school students in 2018 (see Fig. 5). Students surveyed aquatic organisms at St. 1 in Fig. 2. Students were able to find goby, crab, and

Fig. 5 Elementary school students surveying aquatic organisms [2019.8.1]

Fig. 6 Elementary school students collecting water for river water quality surveys [2019.8.3]

mollusks that live in brackish waters. In 2019, we began a water quality survey by working on a pack test to measure COD values (see Fig. 6). They surveyed aquatic organisms at St. 3 in Fig. 2. These activities were partnered with university research institutes and water quality research experts.

In the August study, we captured and observed dobsonflies, which are indicator organisms of the clear stream. In addition, COD values ranged from 0 to 2, and elementary school students were able to recognize that the quality of the river in the school district was good, together with the evaluation of experts. COD values up to 2 indicate clean water because it indicates rainwater and upstream water from rivers. COD values up to 2 indicate rainwater and upstream water of the river, 2 to 10 indicate downstream water of the river, and 20 indicates sewage and sewage. The Nita River has a COD value of 2, so it is clean water. These learnings solve a trend away from river mentioned by Nakamura [4].

4.3 Land Use and Farmland Development

The history of the Nita River basin was examined. The area is dotted with ruins from more than 7000 years ago. Being able to see the entire area and to confirm the residence by being a human being continuously through the times of hunting, gathering, and farming means that sustainable living had been established in this basin.

The Kashitaki area in the middle reaches was developed in Nitta in the 1700s. In the 1970s, 1980s, and 2000s, the area was developed as agricultural land (see Fig. 7).

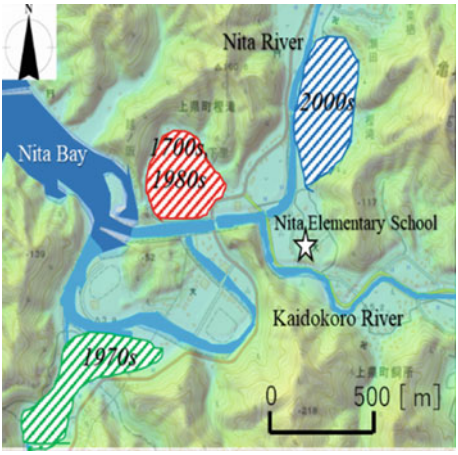

Fig. 7 State of farmland development in Nita area

However, agricultural land that has been permanently developed over 300 years is at a turning point. There was a shortage of successors due to the national reduction policy and group employment during the high economic growth period. Since these farmlands were originally floodplains of the alluvial plains that were deposited by the flood of the Nita River, they have been hit by floods every time of heavy rain.

The reality is that some land is not suitable for cultivation. Despite many years of farmland development, many are now abandoned.

4.4 Biota of Nita River Before River Civil Engineering Business Development

Currently, to prevent floods, the Meboro and Nita dams have been constructed in the Nita River, and the meandering estuary has been expanded with straightening the flow and straightening the flow. According to interviews with the residents, before the construction of these rivers, both sides of migratory fish, ayu, were seen in the entire Nita River, and Japanese eels and Mokuzu crabs, which are organisms in the brackish waters, were inhabited. It was clear that the Nita River was rich in nature, although there was damage from the flood, such as water plants growing in the upper stream. Even now, natural sweetfish inhabitants can be seen in the Nita and Kaidokoro rivers.

5 Result

Figure 8 is a flowchart showing this practice. First, we will discuss what kind of river education practices were connected from the actual conditions of the community and schools.

In this area, we are promoting a multifaceted agricultural low-functionality countermeasure project. River projects have been promoted in this area to prevent drought and floods. The school had multiple classes because it was connected to researchers and it is a small school. Therefore, I was able to study aquatic organism researches and water quality surveys by having researchers. In addition, I was able to make biotope and experience farming in abandoned cultivated land during the time of

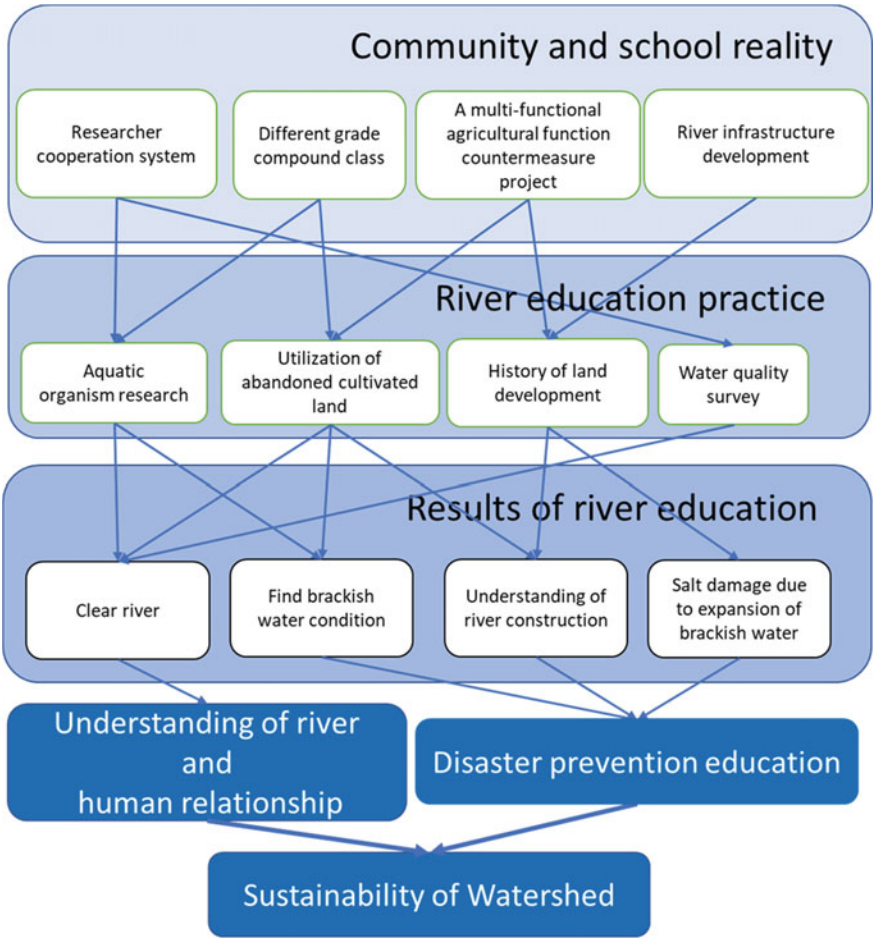

Fig. 8 River education and disaster prevention education, flow diagram of local sustainability

general studies and integrated studies shown in the curriculum guidelines. By participating in the multi-functional agricultural function countermeasure project, I was able to experience farming and know that farmland developed. Land development was to supplement the opening of cultivated land, and it was necessary to develop river infrastructure.

Next, we will discuss what kind of results were obtained by practicing river education. In the river survey, it became clear from the water quality survey that the river was a clear stream, and from the aquatic organism survey, the place that was thought to be fresh water was brackish water. Elementary school students will discover again that the river is clean because it takes advantage of the abandoned farmland to pass along the riverbank, which is also a school road. And they also understood that the water in the cultivated land came from distant dams, and that the nearby wells and rivers were brackish and could not be used for agriculture. They also understood that a dam was needed for agricultural use and a weir was needed to secure fresh water. Examination of the history of land development revealed that river works were necessary to prevent flood damage. However, due to the river infrastructure construction, the brackish water area has expanded, causing well water and salt damage to farmland.

We will summarize the results of river education. The extent of brackish water is closely related to sea level rise due to global warming and storm surges. If we can recognize how much brackish water is, we can think about where to live. It can be understood that the flood countermeasures are taken by the river infrastructure construction. However, we must understand that we cannot say that we are protecting everything by these works. The land where salt damage occurs is low in the first place. In other words, it is necessary to understand that it is not suitable for farmland or residential land. Through river education, the extent of brackish waters and the limits of river civil engineering projects are known, and the ability to decide whether or not to live can be developed, leading to disaster prevention education. It is this learning that fosters the geographical imagination through the town walk described above.

In other words, by grasping the size of the brackish waters and the status of river infrastructure development, it can be judged that land with salt damage is dangerous for disaster prevention. This is the reason why river education and disaster prevention education are related. By promoting river education, we want to leave a beautiful river that can be used as drinking water forever. Elementary school students can understand the relationship between the river and people.

Through the practice of collaborating with local residents, elementary school students found that river rehabilitation, land development and coordination with the environment, and farmland that had been cultivated by ancestors' hardships are being abandoned due to disaster prevention and changes in social conditions. Elementary school students learned the natural characteristics of local rivers and gained the experience of thinking from a historical perspective. Such educational programs are expected to develop human resources who can predict what will happen in the future due to climate change and sea level rise, and to develop it into regional disaster

prevention education. River education has expanded the framework for collaborative learning through the cooperation of local human resources and the involvement of various research institutions, experts, and organizations. Elementary school students continue to the present by finding a viewpoint to explore the Nita River in a multifaceted and multifaceted manner. By utilizing abandoned cultivated land, river biological surveys, and water quality surveys, we were able to get a glimpse of the benefits and negative aspects of river civil engineering projects.

6 Conclusion

In the practice of river education, I will mention the educational effects. The first is that students have the ability to interact. Elementary school students had the opportunity to talk to people from various regions by utilizing abandoned farmland. I was able to interact with the researchers I met for the first time. It can be said that the ability to interact has improved by expanding the learning target. In other words, it can be said that elementary school students have the power to classify living things. Students were also able to add power to classify organisms by traits. It is a classification of goby. At first, they were classified according to the overall shape, but they were judged comprehensively based on the shape, color, habitat, etc. We believe that such educational effects are close to the OECD's key competency [5].

Tsushima, which is an island, has a mountainous area and an inlet, and has little flat land, so the industry was live trade and fishing. Only by studying the area of the elementary school ward, the development of farmland and the securing of water have continued to be promoted since the early modern period, but however there was a fight against flooding in lowlands, storm surge disaster, and salt runup. Even under such conditions, it was found that the residences were able to sustainably live on this island by devising their residences on hills and lowlands, industry for semi-agriculture and semi-fishing, and agriculture for the right areas. This kind of learning is UNESCO's quality education [6].

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