Present State and Functions of Coastal Forests
- Effective Damage Reduction Enabled by Coastal Forests during Indian Ocean Tsunami -

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1. Introduction

"Hakusha Seisho (white sand and green pines)" is an expression that describes the beauty of the Japanese coastline. As this expression simply shows, our country's 34,000-km coastline often consists of a combination of "sandy beach" and "pine forest".

The scenery of "Hakusha Seisho" exists as a result of artificially developing pine forests over an extended period of time and maintaining/managing them in order to protect our lives from damage caused by "blown sand", "gales", "sea breezes", "tsunamis" and "tidal waves".

However, such coastal pine forests, which have been closely connected with our lives, are battered today, except for some parts, as though the expression "Hakusha Seisho" were obsolete. As a consequence, we are about to face a situation where the multiple natural functions of our pine forests cannot continue.

Meanwhile, catastrophic disaster struck Indian Ocean coastal countries because of the Indian Ocean Tsunami caused by the Sumatra earthquake at the end of 2004. This was followed by a series of big earthquakes such as the Java earthquake and the Solomons earthquake that also caused a tsunami disaster. What magnified the destructive effects of the tsunamis was that many of the tsunami-stricken countries were not prepared for a tsunami because a tsunami had occurred very rarely in the past in these countries. In particular, unlike our country where there are many coastal forests, they did not have coastal forests planted for the purpose of preventing a tsunami disaster. In my opinion, this caused the damage to spread. On the other hand, there were some areas where damage was reduced because of the naturally distributed coastal forests. This attracted attention to a coastal forests' ability to effectively reduce tsunami disaster damage.

It is thought that tsunami-stricken countries in Southeast Asia will actively develop coastal forests.

Japan, which has suffered damage from tsunamis countless times in its past, knows well that the development of coastal forests is effective in reducing tsunami disaster damage. In addition, there is a certain degree of knowledge on the effective method of arranging coastal pine forests. However, this knowledge is limited to our country's coastal pine forests, and we have not gained knowledge on other tree species. The actual situation is that there is no data on "what types of coastal forests are effective in reducing tsunami disaster damage" in countries other than Japan. The author et al. have been conducting research on this issue in tsunami-stricken countries in Southeast Asia, mainly Sri Lanka.

I will first mention the background of how coastal forests were developed in Japan and the present situation for these forests. Then, I will explain the situation of our research on coastal forests in Sri Lanka. Lastly, based on the research status and the present situation of our country's coastal forests, I will mention the plan for developing coastal forests designed to prevent tsunami disaster in Sri Lanka and outline future research tasks.

2. Formation of "Coastal Forests" in Our Country and Present Situation
1) Formation of "pine forests"
In Japanese coastal areas that are hacked by plains and also are under severe conditions, the use of land has been a problem for a long time. One way was to use the sandy soil along the coast directly for production, and the other way was to control the sandy soil in order to prevent the inland areas from gales, blown sand, sea breezes and tsunamis. Coastal pine forests were developed in consideration of these problems.

The active development of coastal pine forests started in the early Edo period. This is because many sandy areas became bare land after original vegetation overgrown on the shore was burned off by the fires of war or cut down as fuel (firewood) for salt making. This caused blown sand to bury houses, fields, roads, rivers and harbors and led to other types of damage, including crops damaged by sea breezes.

In order to prevent these problems, the development of forests was actively implemented (1). In Figure-1 showing the case of Shonai Dune in Yamagata Prefecture (Picture of Nishihamayama forestation by Rokujo Sonehara), damage caused by blown sand covering fields, roads and rivers in the feudal era is meticulously drawn.

As described above, on a national level, the major motive for planting pine trees at the initial stage of pine forest development was to prevent existing agricultural land from being damaged by the disastrous phenomena unique to coastal areas (blown sand, see breezes, tsunamis and tidal waves), to develop new fields and to protect harbors and rivers. The development of coastal pine forests was closely linked to the lives of local residents.

2) Present situation of “coastal pine forests”

Our country’s coastal pine forests developed for disaster prevention, as mentioned above, are currently decreased or battered because of “succession”, “pine mortality” and “change in land usage”. Additionally, while each of these contemporary problems is individually responsible for the decreased or battered state of the pine forests, these problems actually influence one another and accelerate the decrease and exhaustion of coastal pine forests, making it difficult to find a solution. Furthermore, there is an underlying major root cause, a “lack of maintenance management of pine forests”, which is common to all these problems (see Figure-2).

Therefore, it is no exaggeration to say that the major task for our country’s coastal pine forests in the future, depends on “how the system for their maintenance management is going to be restructured”. In association with this, we must promptly decide the future direction of pine forest maintenance; whether entire coastal forests
will be maintained as pine forests or whether potential vegetation will be actively introduced. In regard to this point, as indicated in Figure-3, there is a strong need for establishing an organization where local residents, the administrator, non-profit organizations, volunteer groups, people involved in education and academic experts can gather together and discuss the future of local coastal forests.

3. Tsunami Disaster in Sri Lanka and Development of Coastal Forests

1) Damage of tsunami disaster

The reason why Sri Lanka was selected as a place for research is because this country received no damage from the earthquake, but only the damage caused by the tsunami. Despite the fact that this country was 1,400 km away from the center of the earthquake, the areas stretching 1,000 km along the coast were hit by the tsunami and over 40,000 people were found dead or missing. Moreover, more than 50,000 houses were destroyed, forcing over 400,000 people to take shelter.

2) Research methods and results obtained currently

Research is underway with a focus on field surveys and satellite photo analysis. The field surveys conducted on the coast of southern Sri Lanka include research on coastal forests themselves, topographic surveys and interviews.

In the empirical method used for our field surveys, since landform greatly influences tsunami inundation, as many combinations of various types of landform and coastal forests as possible are studied so that a coastal forest that is relatively effective in reducing tsunami damage can be selected.

The analysis of satellite photos is being conducted mainly to understand the land usage of this coastal area.

Because the field surveys are still underway, I cannot draw a conclusion on the effects of coastal forests on tsunami disaster at this point. However, the following three points are the results obtained so far:

1. Coastal forests effectively block wreckage
2. People can hold on to coastal forests
3. Coastal forests effectively prevent foredune destruction

These points, the results already obtained in our country, were also confirmed in Sri Lanka.

Additionally, the following are the characteristics in terms of the ratio of tree species in the surveyed areas discovered through the analysis of satellite photos.

1. Mangrove forests are not found along the beach facing the open sea but are found along the slightly inland part of the estuary as well as around lagoons.
2. Casuarina forests, which are artificial forests, are found only in some parts of the surveyed areas.
3. Palm forests are found throughout the areas in question.
Furthermore, it was confirmed that coastal landform has a significant influence on tsunami inundation and the higher the foredune is the more effectively the inundation is prevented. For this reason, I find it necessary to pay attention to coastal forests’ "effect of preventing foredune destruction", which has so far received little attention in our country.

Considering the results described above and interviews on tsunami damage conducted locally, I believe the answer to the question, "What kind of coastal forests are effective in reducing tsunami disaster damage?", is the "combination of high foredune and casuarina forests" shown in Figure-4.

3) Coastal forests as tsunami damage prevention

I have presented the results of the research in Sri Lanka available at this point. As I mentioned in the section describing the present situation of coastal forests in Japan, it is essential to establish an organization for maintaining artificially developed coastal forests on a long-term basis. In the case of developing coastal forests in Sri Lanka in the future, I consider it important to thoroughly refer to the current situation of coastal forests in Japan. As for the casuarina forests mentioned earlier, it is also necessary to win the good understanding of local residents on whether long-term maintenance is possible. The maintenance of coastal forests depends on how useful they are for local residents. Therefore, there will be a need to lay out a coastal forest development plan which allows local residents to use coastal forests.

In the future, I would like to continue this research while also considering the aspects of coastal forest maintenance mentioned here.

References

(1) Tomoo Tateishi (1988): Kaigan Sakyu no Henbou (Transformation of Coastal Dunes), Daimeido, p.214, Tokyo