NATURAL SYMBIOSIS TYPE FISHING PORT MAINTENANCE USING THE MANGROVE (EXAMPLE OF THE JAKARTA FISHING PORT)

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ABSTRACT

The Jakarta fishing port that is the greatest fishery position in Indonesia was located in important area on the natural ecosystem where the Mangrove wood grows thick from the first. In maintenance of the fishing port, the harmony with these environments was the important subject. For this reason, in improvement of the western side of the bank, and the seawater purification system in a harbor, introduction of the natural symbiosis type facilities that utilized some functions that the Mangrove has was tried, and the effect has been grasped. Consequently, in improvement of the bank, and maintenance of the seawater purification facilities in a harbor, it was proved that the following effects were in the Mangrove. (1) Reinforcement of Foundations by Roots Which Grows Innumerably, and Topsoil Outflow Prevention (2) Protection Against Wind and Damage-from-Salt-Water Prevention by Wall of Grown-up Mangroove (3) Recovered New Ecosystems, such as shrimp and small fish by The Nursery Effect of The Roots (4) Improvement in the Amenity Nature by Formation of Beautiful Scene etc. The actual proof example how much it suits the function for which fishing port facilities is asked since the characteristic of the Mangrove differs for every kind needs to be increased.

Keywords: Natural symbiosis type fishing port; Indonesia; Mangrove; Eco-system

INTRODUCTION

Indonesia consists of 17,000 islands. It is great group of islands, which has an EEZ area of 5,410,000km² to place it as third largest country in the world next to U.S and Australia. The potential of fishing is high and along with the development of the country’s economy, fisheries had an important role in areas of fields, such as foreign-currency acquisition by stable food supply to people, offer employment opportunities, and export. For this reason, Indonesia’s development of the fishing port, which is the basic ground of fishery production, is advanced compare to other third world countries with the assistance from Japan ODA.

After the Jakarta Fishing Port (Fig.1, Photograph 1) performed a feasibility study and investigated under JICA in 1973, it was JBIC granted the GOI for Yen loan Package for the Construction of JFP. The Jakarta Fishing Port opened in 1984. However, the construction site of the Jakarta Fishing Port was under severe condition due to weak and soft soil foundation. For this matter, the influence by land subsidence etc. will appear at the second half of the 1990s, which passed through 20 years after reclamation and the necessity for immediate functional recovery was imminent.

On the other hand, all of the country’s area belongs to a tropical rain forest zone. Together with Brazil, Indonesia has the greatest Mangrove habitat region in the world. The area occupies about 30% of all Asia (about 14% of global) by about 2,500,000 ha. It was an important area on the natural ecosystem to which the Mangrove grows thick on the Java seacoast including Jakarta. Therefore, in functional recovery of the
fishing port, consideration of the harmony with these environments became the most important subject. Moreover, under the technical level by the side of Indonesia from the viewpoint of the technical support to Indonesia or the financial situation, use of use and the institution where acquisition is expensive and difficult of advanced technology, material, etc. was unsuitable. From this, the introduction of the solution adapted to the situation of these spots was asked.

For this reason, in carrying out measure against subsidence of west revetment of the Jakarta Fishing Port where about 20 years after improvement passed, and measure against a water area environmental improvement, we tried introduction of natural symbiosis type revetment facility and the sea water exchange system in a harbor, and decided that the effect is grasped by the simple and economical technique of having utilized the Mangrove which exists abundantly there.
CHARACTERISTIC GRASPS INVESTIGATION OF MANGROVE

After having grasped the characteristic of the Mangrove which carries out varieties existence there, in case of application of Mangrove to the improvement of west revetment and the seawater exchange system in a harbor, the effective Mangrove needed to be selected from the applicability to the function for which each facility is asked. Based on the result of the reference investigation of Mangrove project in Bali Island by JICA, the Mangrove wood exploration in the Jakarta circumference, etc. were performed, and the characteristic of each Mangrove and the applicability to a structure thing etc. were investigated. That which arranged the characteristic of hitting application to the Mangrove and the fishing port facility of the main kinds, which inhabit Indonesia is shown in Table I.

Table I: Characteristic Comparison of the Main Mangroves in Indonesia

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Spot Name</th>
<th>Suitable environment for habitat</th>
<th>The characteristics of roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avicennia marina</td>
<td>Api-api</td>
<td>Currently comparatively dried with the viscous ground, the bank of river.</td>
<td>Many roots grow in the earth shallowly at the ground and parallel.</td>
</tr>
<tr>
<td>Rhizophora apiculata</td>
<td>Bakau</td>
<td>Submersion, brackish water region, the viscous ground.</td>
<td>Many roots like foot of octopus being extended from the air is stretched underground deeply.</td>
</tr>
<tr>
<td>Sonneratia alba</td>
<td>Pupat</td>
<td>Comparatively high seawater density, the sand mixture viscosity ground.</td>
<td>Same as those of Api-api.</td>
</tr>
<tr>
<td>Nypa fruitcans</td>
<td>Nipah</td>
<td>Submersion, brackish water region, a mouth-of-a-river part.</td>
<td>A root is not taken out in the air like common trees.</td>
</tr>
</tbody>
</table>

Moreover, Bakau (a Photograph 2, scientific name Rhizophora apiculata, spot name Bakau) is suitable for the environment where it always sinks, as a result of the Mangrove exploration of the Jakarta Fishing Port circumference, and the place on the first which sinks several hours a day found that the Api-api (a Photograph 3, scientific name Avicennia marina, spot name Api-api) was suitable. And in here, it turns out that two (2) kinds of this Mangrove is the most general kind. Thus, as a kind applied to this revetment facility and seawater exchange system, since Bakau stretches a root deeply, it is suitable for reinforcement of foundations. On the other hand, the characteristic that it is suitable for topsoil outflow prevention since the Api-api stretches a root shallowly and widely became clear.
APPLICATION EXPERIMENT INVESTIGATION TO WEST REVETMENT IN THE JAKARTA FISHING PORT

Selection of the Mangrove

At Jakarta Fishing Port, about twenty (20) years or more had passed after the reclamation of poor ground. It became evident that about 1 km of the west revetment had sunk in a non-grade. And as a result, the body of the revetment was partially cracked and the back of the revetment was flowed out and flooded. As the concerned measure, the top raising by revetment made from concrete was examined at the beginning. However, there were problems in the case where the bearing capacity of foundation runs short and great cost needs to construct new revetment. For this reason, it was planned to rehabilitate the revetment using the Mangrove said that an effect is in the measure against an outflow of topsoil as the method of replacing with this, utilizing the existing revetment. Being based on the investigation result in previous chapter. In application of the Mangrove behind the revetment to which the greater part of a day has sunk, in order to aim at the stability of ground, it was thought that Bakau which root stretches deeply was good. Moreover, in order to aim the outflow prevention of topsoil back the revetment that sinks several hours, judging that Api-api which stretches root widely and shallowly was good and adopted.
Examination and planting (Fig. 2)

In examination of a section, existing body of the revetment was utilized as it was. It restored in original reclaimed ground board quantity by raising the back, the level with fill in a landslide from a mean sea level on a loose slope (1:5). Thereby, it considered as estuary zone to which the Mangrove tends to grow a slope portion. The seed of Api-api and the seed of the Bakau were extracted from the nearby Mangrove wood at December 2000. And the seed of Bakau was planted at intervals of about 2 m along with the revetment, and the seed of the Api-api was sown on the slope whole surface (Photograph 4). After several days, Bakau began its growth, bud came out, became stalk, the leaf was extended, and the Api-api grew rapidly.

Figure 2. Section of west revetment using Mangrove

Photograph 4. Revetment immediately after planting Mangrove (Dec. 2000)
Result

The Mangrove is also a plant with early growth power and with strong and spontaneous generation power from the first. Two years after, the seed dropped personally, especially the Api-api repeated natural breeding, and grew up to be the height of 5 m in 2003 after about three years. Consequently, natural revetment of 1-km to which the Mangrove grows thick over the whole mostly was done (Photograph 5). Consequently, the following things became clear.

a) When the countless roots (Photograph 6) by 2 kinds of Mangroves rooted into the ground, foundations reinforcement of the revetment back and the topsoil outflow prevention function were produced. Consequently, the revetment function in which it is not influenced of necessary land subsidence was secured.
b) The grown-up Mangrove wood serves as the natural wall, which also becomes 5 m grade, and the function of protection against wind and damage-from-salt-water prevention increases.
c) The scene and the environment where the green wall of the Mangrove has soft grace in a fishing port are created.
d) Construction expense is almost unnecessary.
e) People can touch the Mangrove close and it offers a place of study to understand the role of Mangrove (Photograph 7).
Photograph 6. The root of the Api-api which grows thick

Photograph 7. Lesson scenery of Jakarta Japanese school
APPLICATION EXPERIMENT INVESTIGATION TO SEAWATER EXCHANGE SYSTEM

View of a Seawater Exchange System (Fig. 3, 4, Photograph 8)

The inside of the harbor of the Jakarta fishing port has strong closing nature, its ebb and flow of tide is usually as small as about 60 cm. If remained as it is, the environment that seldom carries out natural exchange as for about 2,000,000 tons of seawater in a harbor was suited. Moreover, by old fishery activity etc., the inside of a harbor became dirty from garbage or oil and water quality also suited its tendency of aggravation.

For this reason, the purification system of inner harbor water, which utilized the tidal range was devised, using the water park (Area of a pond: about 10,000m², Capacity: a maximum of 10,000m³ in H.W.L) currently planned as an environmental lot in a fishing port. While seawater in the Jakarta Fishing Port is once stored via this pond by using a tide level difference, after this system receives the purification action by the living thing generated along with the Mangrove or this, it is discharged out of a harbor. Moreover, the in-let that collects oil and garbage is formed between the inside of a harbor and the pond. Bakau, which was breeding on the outskirts of the Jakarta Fishing Port from the first, was mainly adopted from most being all over seawater and mainly expecting seawater purification in selection of the Mangrove to the concerned facility.
The details of the structure of a seawater exchange system are as follows. (Fig. 5)

a) The pond that stores water temporarily in seawater in a harbor is prepared. Culvert for drainage is prepared in a floodgate. Moreover, an adverse current prevention gate is installed in each.

b) Close the gate by the side of the exit of a pond at the time of ebb tide. At this time, a pond is in an empty state. A tide level goes up, a floodgate is exceeded and seawater in a harbor flows into a pond. In this case, after removing seawater in the garbage, which is floating on the screen formed in front of the floodgate, oil is removed by oil removal equipment and it can once be stored in the reservoir.

c) Seawater that once stored water attains seawater purification according to the natural capability by the ecosystem, which grows in connection with the Mangrove or this.

d) When a tide level becomes the highest and a tide level begins to fall, in order to prevent water of a pond flowing backwards into a harbor, shut the gate of the place of a floodgate. And the gate by the side of an exit is opened, and water of a pond is discharged out of a harbor.

e) A tide level falls, and after the pond has become empty, repeats the same work. By which about 6,000 tons of seawater is discharged out of a harbor by this a series of work every day.
Result

The following became clear as a result of the pursuit investigation of the concerned institution.

a) Oil and the garbage recovery effect were checked and the degree of transparency of water quality improved.

b) Ecosystems, such as a new shrimp and crab, were recovered according to the nursery place creation effect by the animals-and-plants plankton and the root, which occur on the outskirts of a root, which grew thick.

c) Breeding of the Mangrove and the oldest lighthouse in Indonesia produce a good scene. This offers a place for citizens where they could stroll or take a walk and the pond itself became a good fishing space. Thus, the comfortable nature of fishing port space improved (Photograph 9).

In addition, it is expected that the water-quality purification function by the Mangrove, is useful to the decomposition and the absorption of an organic matter, which are contained by the new living generated on the root at which the Mangrove grew thick, or the outskirts of it’s in seawater. However, since a part of factory wastewater in the fishing port was now mixed in the pond, after making the maintenance management of institution such as this prevention, surely the fixed-quantity effect needs to be measured from now on.
MAIN CONCLUSION

It is important to adopt the kind that suited the function for which fishing port facility is asked in having grasped the vegetation and the characteristic of a spot Mangrove in application to the fishing port institution.

(1) It is important to adopt the kind that suited the function for which fishing port institution is asked in having grasped the vegetation and the characteristic of a spot Mangrove in application to the fishing port institution of the Mangrove. Since revetment is hard to be eaten away, an effect is obtained by planting Bakau, which the greater part of first day will sink, and stretches a root deeply when the necessity for foundations reinforcement is high. Moreover, an effect is obtained by arranging the Api-api, which sinks several hours of a day, and will stretch a root widely shallowly when the necessity for outflow prevention of topsoil is high.

(2) In the improvement case of west revetment of the Jakarta fishing port, the countless roots by two kinds of Mangroves rooted into the ground. While foundations reinforcement of the west revetment and the topsoil outflow prevention effect are produced, this secured the necessary function also to old subsidence and construction expense was almost unnecessary. Moreover, effects that is, that the grown-up green wall demonstrates protection against wind and a damage-from-salt-water prevention function that new ecosystems such as shrimp, are recovered on the outskirts of root to which the small root grew thick, and a still green belt zone produces a soft scene, were produced.

(3) Moreover, effects that is, those new ecosystems such as shrimp, are recovered on the outskirts of the root of the Mangrove, producing a good scene, and the pond itself offers good fishing space, were obtained. In addition, the fixed-quantity effect needs to be measured about the water-quality purification function of the Mangrove from now on.

(4) In improvement of fishing port revetment, and maintenance of a inner harbor water exchange system had great effects, such as the improvement in amenity nature like the function as for which revetment
becomes that is hard to be eaten away, protection against wind and a damage-from-salt-water prevention function, recovery of an ecosystem, and the improvement in amenity nature and a scene, in the Mangrove.

(5) It is important to adopt the kind the Mangrove that suited the function for which fishing port facility is asked in having grasped the vegetation and the characteristic of a spot Mangrove in application to the fishing port facility.

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