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The role of rainfalls for erosion and sedimentation in the degraded mangroves, Can Gio district, Vietnam

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1. Introduction

The report likes to realize the importance of the rainfall impact at a degraded mangrove habitat for consider the role of micro landform reconstruction due to autonomous mangrove rehabilitation. The study of the field experiment is carried out at a part of Can Gio Mangrove Biosphere Reserve.

It is said that the mangrove forest only develops at between the mean water level and the highest high water level (Mochida et al., 2001). The spatial arrangement of the mangrove species so called “Zonation” established according to the differences of the ground level in such vertical range. Although, if we think realistically, the almost all ground level of Mangrove habitat in the world is located in mean high water of tidal level by continuous sedimentation under the stable sea level in last 1,000 years (Miyagi et al, 2003). It means that the area increases a time to expose from the salt water and increases a chance of erosion by rainfall. On the other side the forest and the land has been received the various human interference such as timber cutting and shrimp farming and the Agent Orange of defoliation etc. Such human impacts also same roles for the increases the possibility of the time of expose the rainfall impacts. The series of the facts say the potential of erosion is increasing now. The authors like to pay attention the rainfall impact to the degraded mangrove habitat.

The sediment of mangrove is basically soft and loose, fine grains, and just extremely unstable material. It is undisputed fact the floor of the mangrove forest is protected by crown leaf layers from the sunshine and raindrops impacts. It means that the destruction of the forest might be an important triggering factor of the land deformation.

Consequently, in this investigation, we try to present factual evidences how and what amounts the rainfall distribute and how and what impacts will carry to the forest floor based on the field data collections. The data collections as a comparative study carried in highly covered healthy forest and the destructed forest by lightning about 2002.

2. Study area and the observation items

The observation was carried in Can Gio district, in Vietnam (Fig.1). Can Gio district is large-sized delta build from many rivers such as Dongnai river and Saigon river, and almost constructed by clay.

Additionally, this area is famous, because there received catastrophic damage by Agent Orange shower

during the Vietnam War and reforested by plantation and natural expansion. The amount of the forest increased compare with the before the forest of Vietnam War.

The climatic features are as follows. The average annual rainfall is 1,336mm and it consists of clear dry season (Nov.-Apr.) and rainy season (May-Oct.).

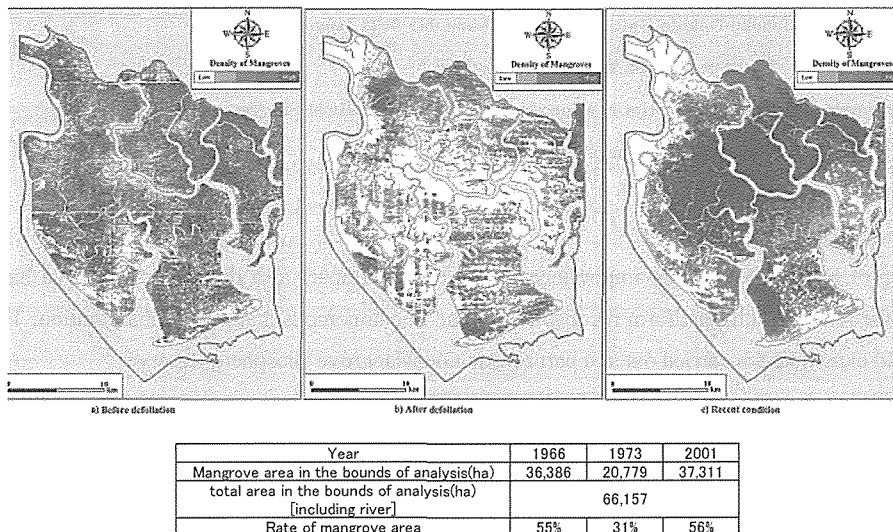


Fig. 1 The changes of the mangrove area in Can Gio District Vietnam (after Hayashi et al. 2005)

The equipment for rainfalls and sediment traps were set at the plantation forest that is about 25 years old and there is a lightning hole generated in that forest as a bare ground. The canopy coverage, the density of the forest, soil salinity and water salinity are also estimated. The forest around the observation sites except the lightning hole that is almost pure forest of *Rizophora apiculata*, and density of tree is 2500/ha, coverage of canopy is 80-90%.

The items of observation to understand the rainfall distribution i.e., the open air rainfall gage set where located near the forest, the gage for raindrops after interception by leaf layer (the rainfall drop from leaves,), the stem flow alongside the trunk to make data of canopy cover condition, The sediment traps of 1 m² are set at in the forest and lightning hole as a case of bare land for estimate the erosion and the sedimentation.

3. Rainfall distribution

The According to the measurement of seven events of rainfall at rainy season in 2006 and 07, the rainfall were separated into the following elements. I.e., the drop from leaves was 50%, the amount of direct reach to the ground through leaf layer was 10%, the stem flow along the tree trunk was 30% and the intercepted rain by leaf layer was 10 %. The data suggests that the 90 % of the amount of rainfall intercepted by leaf layer. We are able to recognize the role of crown coverage as the reduction role of the rainfall energy for erosion. By contrast, the almost of all amount of rain fall directly beat the exposed forest floor where the area of dead tree by lightning.

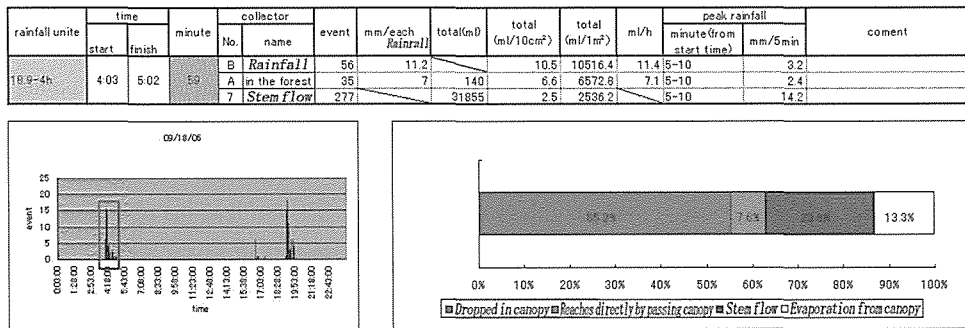


Fig. 2 Data of rainfall and the separation to each element in Can Gio mangrove forest

4. Erosion and sedimentation by rainfall event

Two sediment traps set in the forest. One is located under the highly coverage of leaf layer and the other is located in bared land by the lightning 2002. Six events were trapped. Based on the field evidence, the erosion appears like as follows. The soil movement didn't appears the event less than 5mm/h, the movement appears in both traps but no significant difference in case of 10mm/h, and the strength of rainfall reach to 40mm/h marked the significant erosion occurred at the bared trap. The sediment yield amounts 43 times larger than the trap located under the canopy.

5. Measurement the salinity and velocity of clay sediment sink

The process of erosion and sedimentation in and around the mangrove forest assume the next transition process. The Rainfall itself is pure water and has some impact energy as the soil erosion force. The soft clayey particles easy to move by raindrop, it will difficult to re-setting by ionize in the pure water. The ionization is a role of transportation of clayey sediment. The process only occurs during the forest floor exposed from the tidal water. The suspended particles move to downward and it will sink immediately where it will face to tidal water because of the salinity. Tidal water in the field includes about 1.7% of salt, the ionization might be quit and the sink will start.

6. Summary

- 1) The process of erosion and sedimentation: At the actual mangrove forest, the coverage of the leaf layer has an important role of the protection of the ground from the erosion. If the ground expose under the rainfall by forest destruction the severe soil erosion start at the moment of heavy rainfall. The ground level will down by the soil erosion. At the same time, the material of the erosion that transport by pure water and resetting at the area of the tidal water distribute at the moment. The resetting will give a role of the new mangrove habitat development. Because the mangrove will replace where the ground level reach to the mean water level. The present days geo-ecosystem stabilized by the factors such as heavy rainfall, leaf layer, soft clayey sediment, salt and tide. The idealized structure of the factors is illustrated in Fig. 3.

2) The rehabilitation of the mangrove ecosystem not only by the human activities but also by the natural processes is deeply influenced by this mechanism. The process is summarized in Fig. 4. There were higher mangrove forest floor widely developed and *Ceriops* and *Phenix* shrub distributed on the area. Actually, *Rhizophora apiculata* forest distributed as a small belt at along the river (Miyagi et al., 2000). During the Vietnam War, the forest had destroyed by defoliation. The operation destroyed about 60% of mangrove area. The operation not only destructed the forest but also lead the severe soil erosion. The bared mangrove floor easy to start the soil erosion at the moment of heavy tropical rainfall. By this movement, the ground floor widely lowered. The lowering means the increase the potential for *Rhizophora* plantation. At the same time, large amount of the erosion materials sunk around the forest and established the new habitat for natural expansion of mangroves. *Avicennia* replaced at the new habitat.

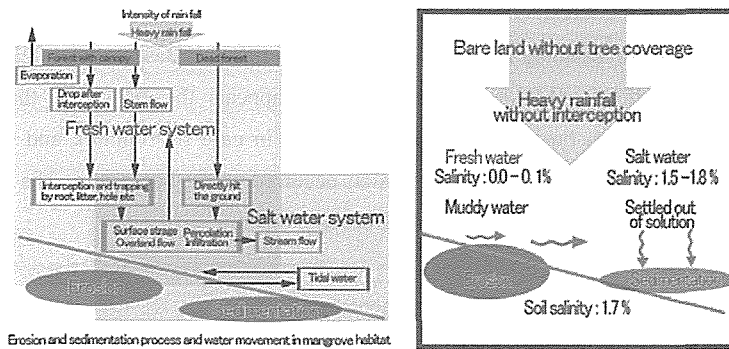
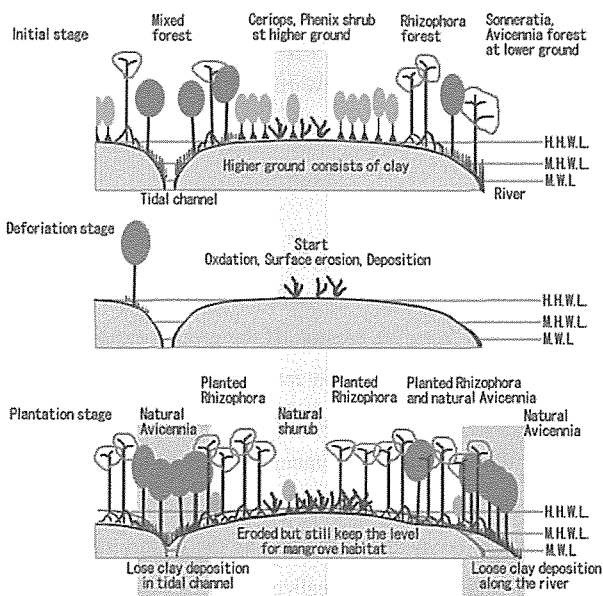


Fig. 3 The water cycle at the mangrove forest and the movement of clayey sediment in the area



Roles of the main factor
Tide: small change and continus (increase the inundation frequency)
Material: clay sedimentation at saline area
Topography: establish the new mangrove habitat and keep the ground level for mangrove plantatin
Vegetation zone: Zonation establish at the lower part of the area

Fig. 4 The changes of the micro topography and the mangrove distribution in three stages in Can Gio deltaic area