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HISTORY OF TROPICAL PEATLAND IN SOUTHEAST ASIA

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SUMMARY

Geohistory of tropical peatlands in Southeast Asia and a historical retrospect of the exploitation are presented.

***Keywords**: Age, stratigraphy, early and modern ways of exploitation.*

INTRODUCTION

Coastal plains of the Malay Peninsula, Sumatra and Borneo bordering the Sunda Sea were, and still are partly, the realm of swamp forests which included mangrove at seaward outskirts, freshwater swamp forests in the tidal zone, and peat swamp forests inland. Under natural conditions, the ground surface is covered by tropical woody peat layers of varying thickness. These peatlands emerged through the Holocene submersion of the vast and flat terrains at the periphery of the former Sunda Land, and the productive tropical rain forests which expanded over the region. The tropical peatlands inhabited only by mammals, apes, birds and reptiles, remained miasmic for long periods against human interferences because of dense forests, high humidity, numberless mosquitoes, often submerged and bumpy ground surface. Now amidst the worldwide industrialism, they are swiftly changing into one of the important agro-industrial bases, and no one cannot deny that industrialism is a powerful engine to make a people richer and more free. On the other hand, we have seen negative effects of industrialism so often. London was famous for its smog by the mid 20th century. Japan in the 1960s to 1970s was an emporium with so many kinds of environmental pollution and induced diseases. These issues were met, and even now are met through dialogs, scientific studies and legislative measures supported by our own accord. Now, as everyone knows, there is a serious discord on the size of CO_2 emission from the drained tropical peatlands. Apparently, too many things are unknown to make a decisive judgment. The critical issue how to balance the economic growth and environment conservation is not only limited to the people and society living there, but also addressed to all of us who live in industrialized countries. This brief historical retrospect aims to understand how the people have been struggling to transform the miasmic lands, the natural and regional assets, into sustainable agro-industrial resources through trials and errors in the past and with ongoing improvements. I would be happy if my speech could make a voice to call for calm, sensible and fair discussions based on ecological and creative perception.

METHODS

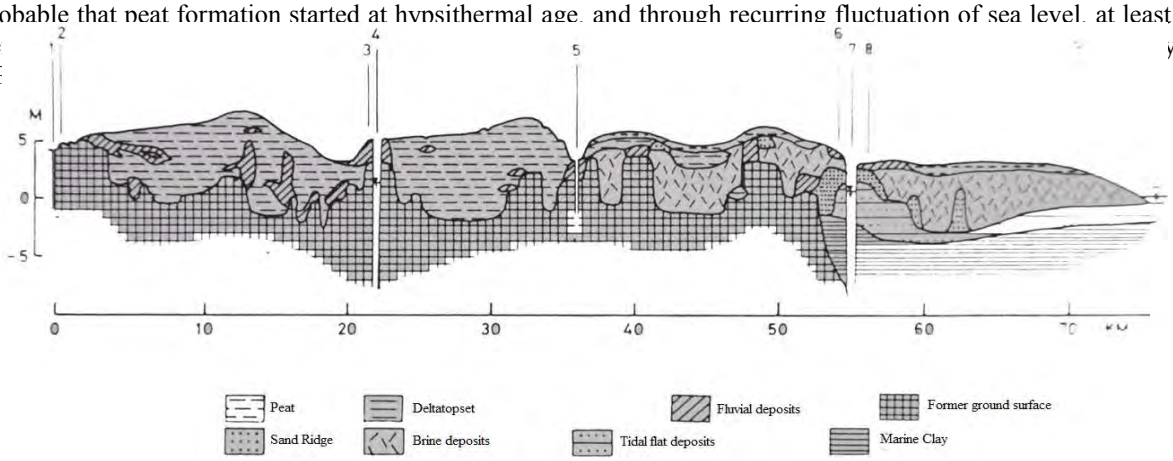
Main materials have been collected through field surveys, some in detailed level in Indonesia and reconnaissance level observations in Malaysia, interviews with dwellers, and supplemented with references.

RESULTS AND DISCUSSIONS

Geohistory

A clear model of tropical peat formation has been presented by J. A. R. Anderson, who studied the swamp forests of Sarawak and Brunei. He divides coastal wetlands into freshwater swamp and peat swamp, based on differences in surface structure and degree of flooding. He explains the process of peatland formation as starting from the coastal mangrove clay, which was dated 5,400 years BP, and also how the distinctive saucer-shaped foundation of peat swamp is formed (Anderson, J. A. R., 1964). Our studies in Jambi Province of Sumatra revealed peatland stratigraphy in a bit different mode, which is illustrated in Fig. 1 (Furukawa, H. & Sabiham, S.,1985; Furukawa, H. 1994). We consider as follows: As the sea level rose in the post-glacial age, choked river water flooded over the former ground surfaces in lower reaches, accreting more fluviatile sediments nearby and rather less faraway. This process made the saucer-shaped topography of the foundation and induced the wood debris to be piled up as woody peat in water-saturated conditions. The littoral zone was accreted with mangrove clay, marine clay and tidal flat deposits, which were exposed on the ground as the sea receded, and changed into fresh water swamps of the present tidal zone. The peat on the former ground surface is thicker and older than tidal zone peat.

The lowest part of peat on the former ground surface was dated 6,830 years BP (400-430 cm), 5,710 years BP (700-750cm), and the peat covered by mangrove clay as 5,980 years BP (335-390cm), while tidal zone peat with 100 to120 cm thickness were dated around 1,120 to 1,440 years BP. From the forgoing survey of carbon dating, it seems probable that peat formation started at hypsithermal age, and through recurring fluctuation of sea level, at least two pe years BI



1. Kumpeh River 2. Bangso Village 3. Rantaupangjang Village 4. Batang Hari River 5. Dendang River 6. Teluk Buan 7. Batang Hari River 8. Lambur Village 9. Simburnaik Village

Figure 1: Stratigraphy of peatland in Jambi, Sumatra

The underground structure of peat cannot be observed without digging a deep pit, and we were not able to meet this task in long-distance transect surveys. But, from the experiences of borings with peat sampler we supposed it to be a scaffolding structure: stumps, fallen tree trunks and branches which peat samplers could not penetrate are embedded underground; these would function as posts and beams and the framed space would be filled with water, partly decomposed wood and plant debris, and porridge-like peat mud. A similar depiction has been made by Polak as well:" a brown mash held together by a framework of tree branches and trunks" (Polak, 1975). This structure is quite different from the sphagnum moss peat in the cold temperate region. This assumption has been confirmed at many pit profiles in Sarawak thanks to the painstaking toils by Tropical Peat Research Laboratory Unit. Understanding the peculiar feature of structured tropical woody peat would have a great meaning in predicting the subsidence and decomposition, and be related to the choice of proper measures for water regime control, field maintenance, and cropping performances.

Early exploitation

Tropical peat swamp forest is by no means primeval forest that has never known the ax. It has been frequently touched by man. Close inspection of old aerial photographs reveals countless lines, running through a monotonous texture. While not all can be said to be man-made, man has been into the forest more than might be expected. On walking the ground one finds many narrow paths cut for many aims. There are many paths trodden by collectors of various forest products, such as *jelutung* (*Dyera* spp.) latex, *Agathis* dammar, *nibung* (*Oncosperma* spp.) palm pole, rattan cane of *Calamus* spp. and *Daemonorops* spp., sago starch of *Metroxylon* spp. and many kinds of tropical timbers. Sago logs and timber logs were extracted through man-made ditches and on sledge. This is an old tradition.

Three waves of peatland exploitation in pre- modern and current times

The first known peak of swamp land reclamation emerged in the tidal zone of Kedah-Perlis plain and Johor coast of Malaya in the mid- to late-19th century through the influx of Chinese and Siamese farmers, who drained the waterlogged plain by digging tidal canals. With the increasing demand for gambier, pepper, sago and cassava starch under British colonial rule, their cultivation spread in swamp lands of Malaya in much the same way that sugarcane cultivation had been pushed forward in Province Wellesley in 1840s.The villages opened by the Chinese migrants were located, in the case of Johor, for example, upstream from the coast along the tidal rivers and creeks, just inside the fresh water tidal zone. Agricultural lands were cleared in the swamp forest nearby, and canals were dug between the farms and migrants' villages, and waterways were interlinked to form a network. Tree stumps were uprooted and piled up, covered with soil, incinerated, and the ash spread as fertilizer. The European planters who followed the Chinese discovered that the large tidal range facilitated drainage, and that sugarcane could be transported cheaply through the canal network (Jackson, J. C., 1968). This trend in Malaya, together with the reclamation design based on tidal irrigation and drainage, came to be known by Banjarese pilgrims on their way and by Javanese and Buginese who had permeated to the Malayan states. Banjarese transmitted the reclamation design to the tidal zone peatland around Banjarmasin through 1910s. Banjarese, Javanese and subsequently Buginese farmers further

migrated through 1930s to every feasible corner of tidal zone peatlands of Sumatra and Kalimantan. The design was almost same with that mentioned above, and planted wet rice, coconut and rubber. These pre-modern reclamations rarely had water gates other than simple wooden weirs to adjust water level, but mostly still function because their ditches are small and short, at the longest 3 to 4 km from tidal creeks, and fields can be drained and irrigated.

Large scale modern reclamations of peatlands, the second wave, emerged first in the west coast of Selangor State of Malaya. The representative memorial example was Tanjong Karang-Sekinchan Project that started in 1945 and completed the first phase irrigation and drainage works in 1952, succeeded by complimentary phases afterwards, and was integrated into Barat Laut Selangor Irrigation Project that completed in 1995. The project area was located on the tidal zone shallow peat, aiming at two crops a year of wet rice culture, and presently it is surrounded completely by coastal and river bunds equipped with tidal control gates. In this project, the inland peat swamp forest with thick peat was reserved as a catchment for the irrigation, and still sustains. On the other hand, selective logging in deep peat forests had appeared extensively in Malaya and Indonesia. Timber extraction was, after the 1950s, facilitated through installing railway on which small locomotives pulled timbers. Meanwhile in Indonesia, the government started the Transmigration Policy in the late 1960s, when several millions ha of tidal zone peat forests of Sumatra and Kalimantan were transformed into agricultural fields through total logging and drainage. Big and deep drainage canals were cut through between the tidal rivers and creeks, hardly heeding the water level control. The thin peat layers swiftly disappeared, and underlying pyritic sediments were exposed on the ground, releasing a huge amount of sulfuric acid. Soils of reclaimed areas changed from peat to acid sulfate soils. Migrants suffered critical hazards, which, 30, 40 years afterwards now, seem to be mitigated significantly thanks to natural flushing processes. Barren fields are recovering green again.

Figure 1: Miserable rice culture, Jambi, 1983

Figure 2: Vast wasteland in Jambi, 1983

The current third wave, a total transformation of deep peat swamps into plantations for perennial crops such as oil palm and coconut palm, seems to have occurred in the early1980s in Johor State, and soon extended to Sumatra and Kalimantan. In Riau, Jambi, South and Central Kalimantan, selective logging in concession forests changed to the total cutting of forests. Sawmill, plywood, pulp and paper, and palm oil companies sprang up. Soon resources extinguished and enterprises started to make plantations of acacia and oil palm to meet big capacity of the factories. Fire, smoke and haze occurred rampantly. After the early 1990s, deep peat swamps of Sumatra east coast changed into plantations, collaborating with the government‘s Industrial Tree Plantation Programs. In this last phase, major enterprises started to implement sophisticated water management systems. Drains are not cut through to tidal rivers but segmented with many dams, water gates, sedimentation ponds, and designed so as to drain only the surplus water. From a technical point of view, this system seems to be highly elaborated with regard to the sustainability of the plantations inside concession areas. However, the neighboring shrubs, forests and dwellers‘ lands are left uncontrolled, and vast areas get dried, easily catch fire in *el nino* years, degraded and abandoned.

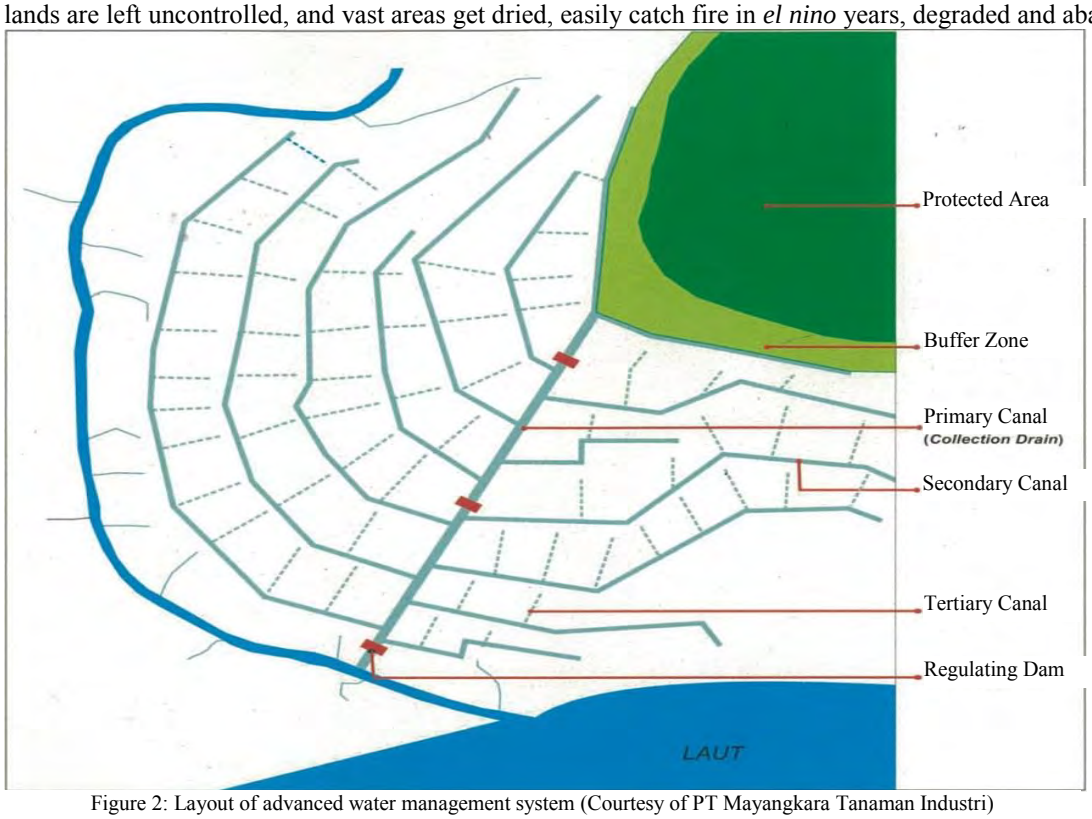


Figure 2: Layout of advanced water management system (Courtesy of PT Mayangkara Tanaman Industri)

The third wave extended to Sarawak as well, particularly in the 3rd National Agriculture Policy spanning from 1998 to 2010. Consequently Sarawak peatlands with thick peat layers have been opened for oil palm plantations, rapidly expanding the number and area. Here, a new catalog was created for enhancing the sustainability. That is the compaction of the peat ground surface by heavy machine after destumping. This treatment diminishes the coarse porosity in the surface layer, makes the bulk density a bit heavier, improves the capillary rise of ground water, and induces the better crop growth on properly moist peat surface. This new technology is widely adopted by many planters.

Figure 3: Collecting Acacia log, Riau, 2014

CONCLUSION

This brief historical retrospect reveals that miasmic tropical peatlands are changing into one of the worldwide industrial nodes through the collaborated toils of the people in this region. It is a fact, it is good. And all of us stand now equally on a new horizon to make our desire reconcilable with the nature.

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