

Conclusion

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Recently, general interest in the development of tropical rain forests has been aroused and its effects on the environment has especially been discussed. A worldwide reduction in forests has been discussed, though there is a slight difference in opinions.¹⁾ In Southeast Asia, some discuss the problems of forest destruction has been caused by timber export to Japan, resulting in occurrence of deserts in an extreme diminisions.

The tropical rain forests are different from dry savannahs and semideserts which are hard to afforest, and steep slopes which also are hard to maintain their soil and nutritions. The degradation of forest site quality does not follow the logging so as to change deserts, but sometimes appear that grass land occurred by agricultural development with clearing, burning, etc.

Between the tropic of Capricorn and the tropic of Cancer, the tropical rain forest is distributed in a zone with plenty of precipitation (including areas which are not affected very much by the dry season of the monsoon climate) and this corresponds to the so-called Koppen's Af. However, it is not clear what part of Am should be added into a tropical rain forest, when Af, Am and Aw are lined. Even in East Kalimantan, with a typical zone of which tropical rain forest, distribution of precipitation is different by location, which presented forests with big or small dominant trees, heath, grassland and marshland, depending upon the condition of moisture, of difference of deposit of soils and bamboo forests, mangrove forests and palm Vegetation which are seen in some areas.

The tropical rain forests have upper, middle and lower layers, and trees height of upper layers are tall and trees have full bodied trunks with buttress roots.³⁾ Dipterocarp forests are distributed widely in Southeast Asia with many valuable tree species. There are many suppressed trees, epiphytes in multi-storied forests and tree type ferns are seen in some places. The leaves of many trees species have several sizes and shapes including dripping tips. The tropical rain forest is characterized by the fact that its soil has poor

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- 1) "The global 2000 Report to the President-Entering the twenty first Century" USA, 1980.
 - 2) Watanabe, K.: How decrease the tropical forests in the world — Summary of the Tropical Forest Resources Evaluation Project (UNEP/FAO), Ringyo Gijutsu 484: 7 - 11 (1982).
 - 3) Ogawa Fusato "Ecology in the Tropics, I, Forest", PP.98. Kyoritsu Shuppan (1974)

nutrients and organic matter. When litters are supplied to the forest bed, they are decomposed very rapidly, which means that the nutrients are accumulated in the canopy or above the ground, and they cycle rapidly. Although there is concern that future resources are limited to the actual exploiting species, it is impossible that introduction of harvesting operations including selective cutting into such forests can destroy them. When light cuttings are introduced into selection system, it could be distinguished from a virgin forest only by the existence of stumps as presented in this report. By the only typical slash-and-burn method of agriculture or shifting cultivation in traditional agriculture under autoeconomy, the forest will maintain the balance of the ecosystem including farmers in the area. It can be said, however, that modern selective cutting covers large area and introduce the facilitating peoples, the farmers, or new settlers, to undertake exchange resulting destruction. If not followed by capital and techniques after cultivation of permanent farmland, forest destruction by the new settlers can cause occurrence of grassland, by shortening the cycle or an excessive commitment of machines and/or labor force. Except under special conditions, this cannot cause a large-scale occurrence of desert or denuded land in this zone, either. This study was conducted under the consideration that, to study forest development and relation between forests and the people, it was a premise to correctly understand forests in the humid tropics, the site quality, vegetation, agriculture, forestry, animal husbandry and other industries, and the communities around the forests.

East Kalimantan had been conventionally known to have much precipitation based upon data collected at some points near the coast line. This research, however, could point out the area experiencing yearly changes in precipitation and differences in the form of precipitation due to its topography such as mountains, basins, swamps, hills, and seashores, and then improper selection of crops may cause damage from drought.

There was almost no precipitation in the rainy season of November, 1982 to March, 1983 immediately after the field survey of this research, which was said to be the first time since 1967 or in 50 years. Thus, forests and farmlands dried up and forest fire occurred and spread severely. It could be pointed out in connection with this research, that yield of various crops, such as paddy rice, upland rice, cassava and also many kinds of fruits, decreased remarkably.

It is said that in the tropics, high water temperature in the surface of some part of the sea appears abnormally at intervals of several months to scores of decade, thus affecting the east-west circulation of the atmosphere, and brings about occasional dry weather in the tropics and monsoon zones. Consequently, it is needed to investigate the land utilization on the premise of the abnormal weather conditions in regard not only to dry lands but also to tropical rain forests.

It could also be understood that difficulty of logging in the rainy season in East Kalimantan is not because of its practices or disease of laborers, but because of the fact that general passes are clayey roads, making it difficult to carry out felling operations due to much precipitation with great frequency.

It could be considered that the distribution of sandy soil and peat come from not only gentle topography (relief) but also from, the formation of a big inland swamp zone due to upheaval of hills situated parallel with the sea coast. Geological resistance against rainfall, i.e., permeability is reflected in the formation of topography and soil. Topography of slightly high ground of Pasir Putih (white sand) where trees grow poorly is an example. Natural characteristics such as topography, geology and climate of each region is required to recognize its relation to land and people in East Kalimantan.

It is a great pleasure to report here the result of the joint research work between the JICA team and the Mulawarman University team concerning the relationship between Tropical Rain forests and the people in East Kalimantan. In spite of limited time and researcher's capacity, it reached the clue of the initial purpose of this research method. These results are conclusions reached by researchers from a wide range of specialized fields who became involved academically by interdisciplinary approach, have dug up new and old data from a viewpoint of Japan and Indonesian side to have various discussions. The purpose of this research is not to criticize the state or get involved in politics, but to consider the trial and error, what development should be and how nature should be protected when people have tried a large-scale approach to tropical rain forests causing anxiety about development which may lead to environment destruction.

In East Kalimantan, 7,570,000 ha of forest whose trees have more than 50 cm in diameter at breast height, and 5,200,000 ha of land are supposed to be reclaimed. This fact means that a considerable portion of arable land in the forest will be subjected to reclamation. The province has 11,783,000 ha of productive

forest while the right for concession to harvest is granted for 11,514,000 ha. It should be noted how much of them is overlapping. They are planned or statistical figures, not all of them being subject to development, but show truly that cutting and reclamation are serious problems for the province.

With the above taken into account, this research proposes a draft to make clear the way of thinking and method of research concerning the relationship between the tropical rain forest and the people as a preliminary basic problem.

The following outlines are the research results achieved by each of the five groups.

The first group has proposed a draft of a simple method which permits everybody who has had the educational course of agricultural science or forestry at a university to conduct land use classification easily, rapidly and exactly, without relying upon specialists in a wide range of fields such as geology, topography and so on.

The contents are obtained by compiling the results of the field works of the land classification which uses a minimum number of land characteristic items allowing the determination of productivity of land and difficulty of the agricultural development which are the premises of performing land use classification, and of the land grading method which evaluates land classified by the simplest score method. Following this methodology may allow land use classification which can almost achieve the purpose in the district subject to this survey.

In order to make precise land use classification applicable and adaptable to the whole of East Kalimantan, more detailed survey on climate, geology, topography, soil, vegetation, etc. will be required in order to extensively consider items, categories and score for each area.

The second group began the discussions from how to study proper handling of land left after cutting of TPI based upon the research on the actual condition of virgin forests and selectively cut areas in East Kalimantan, and, it extended to the whole silvicultural researches of the tropical rain forest region.

To use Indonesian Selection Cutting System (TPI) in considering the ecological point of view is important that the composition of forest canopy should be balanced. So the researches have to be carried out with the detailed regulations of balanced crown canopy in forest management system of TPI. The research is needed to speed up work concerning composition of tree species, tree height, diameter at breast height, and estimation method of diameter growth of trunks of the trees in upper and middle crown layer after selection cutting.

Usually seed germination of dipterocarp species in the forest is good, however, the seedlings used to disappear under the suppression of forest trees. In this case, it would be better to introduce in the management methods for the growth of succeeding trees, including thinning method of layer trees in the TPI system.

The composition of Tropical Rain Forest is complicated, so usually in such natural forest, the pest damage is not severe. However, it might damage harvested logs, and the control method should be extended to all logging sites. And the researches will be useful for obtaining good harvesting to escapes from the forest exploitation and pest damages. And also it is recommended that the researches should take up immediately the afforestation work such as seed collections of commercial tree species, nursery work, planting and tending, and prepare the site index table or land capability classification for land use classification for the plantation of each tree species.

The third section had investigated on the tropical rain forest ecosystem in East Kalimantan, especially the vegetation and fauna, where the most typical forest in Southeast Asia survive. And this investigation tried to establish protection criteria for them.

Tropical rain forests such as lowland evergreen tropical rain forests (dipterocarp forests), heath forests, mangrove forests, brackish-water forest (Nippa forest), peat swamp forest, freshwater swamp forests, etc. are distributed widely in East Kalimantan except for the highland. However, there are few untouched virgin forests and most forests are old forests left after selective cutting of Ulin (Eusideroxylon zwageri) or old residual dipterocarp forests. On the other hand, some typical dipterocarp forests still exist in the northern area of Balikpapan and in part of Sebulu, which are the best in Southeast Asia.

Much of clear cutting lands are used for shifting cultivation or for permanent agriculture, and not a little of cultivated land is abandoned. Secondary forests such as Macaranga and Trema or secondary shrubs such as Melastoma grow there. In addition, Alang alang (Imperata cylindrica) grassland exists in some areas.

Many old selective cutting forests have already recovered high naturalness, and also many of the secondary forests and secondary grassland are beginning to recover to the natural forests. However, part of the secondary grassland is stable edaphically and forest recovery is difficult there.

As for the fauna, especially Mammals in East Kalimantan, 9 individuals (6 species) were caught and 18 species were observed in the 5 areas. The change in the fauna and the population of wild animals including those species in East Kalimantan is affected greatly by wild animal hunting and tree cutting in tropical rain forests which serve as their main habitat.

We made it clear that protection of such vegetation and fauna in tropical rain forest region would require establishment of protection criteria in a broad sense such as standards for selection and evaluation of objects to be protected; decision of grade of protection level and of protection range; etc., and establishing those criteria by the score method and applied them to the ecosystems in several areas of East Kalimantan as a case study.

The fourth group conducted their researches in hilly areas of East Kalimantan mainly where transmigrants from Java, Sulawesi, etc. engage in agriculture. The surveys showed that many kinds of crops are cultivated there in conjunction with its complicated topography, with about 30 families and more than 50 species which are classified into four main crop groups, namely, edible, fruit, vegetable and estate crops. Rice cultivation in lowland might be adequate in this landscape from the viewpoint of the soil productivity and maintenance of soil fertility. It was indicated, however, that cultivations are carried out in rainfed paddy areas and it occupies the major part of rice fields in East Kalimantan so they require the maintenance of irrigation and drainage facilities and establishment of the technique of their rational use to improve rice production. Reclamation study including cultivation of floating rice plants may be desired depending upon conditions.

It should be pointed out that for fields cultivation on the upland slope, measures should be taken for soil conservation and maintenance of soil fertility against rainfall. It was also indicated that, to maintain and improve the soil fertility, it would be better to practice mixed cultivation of leguminous trees or perennial woody crops rather than a single crop cultivation. There are necessity of breeding considerable region, and thus providing stable supply of excellent seeds.

Considering frequent occurrence of pathogenic and insect damages or harmful weeds in lowland and upland field, it was desired to establish an integrated pest control by cultivation, including chemical and biological methods, against weeds, pathogens and insects in the severe environment.

The above are indications from the viewpoint of cultivation. Actually, field reclamation is conducted by clearing and burning forests. It was indicated that a rapid decrease of soil fertility has occurred in farmland, especially in upland, since no proper land use classification or its corresponding techniques of reclamation of lowland and upland field have been established. What appeared to be the most important things for the promotion of agriculture in East Kalimantan are to develop fields for cultivation based upon topography and geology and to consider environmental conservation such as arrangement of forests for disaster prevention and for farming.

The fifth group examined the development of tropical rain forests first. A statement made at the Session of a Special Chapter conducted by the United Nations Environment Programme held in Nairobi in 1982 regretted that a remarkable decrease of the area of tropical forests and worsening of environments had not been possible to prevent in the last decade. Partly due to inadequate knowledge of the tropical forests, especially tropical rain forest, resources were overestimated and worldwide rapid development and reclamation conducted. As a result, the Philippines reflected her excess log production and fields it in 1972. The promotion of forest clearing, development of agriculture fields due to an increase in population may have more serious effects than does forest development of logging.

A view that "there is enough land available for agricultural development"⁴⁾ issued by A U.W. President in Science Advisory Committee in 1967 was misunder-

4) "World Food Problem" President Science Advisory Committee (1967).

stood. A report "The global 2000 Report to the President"¹⁾ was published in July, 1980 in a form to ignore it. It concluded that "A worldwide decrease in natural resources may regrettably cause a miserable life in the world at the end of this century". It is considered that the delay in recognizing such a crisis is due to insufficient scientific research, and thus the research aimed to make clear the actual condition of tropical rain forests and understand their relation with the people.

It was difficult to quantitatively understand phenomena under changing rapidly at a region of a developing nation through the collection of data, opinion, and observation. Major problems are as follows:

- (1) Statistics of forests only are not enough to understand the state of devastation of land, and necessity to follow the research directory in many developing countries.
- (2) In spite of the regulation of selective cutting system, some companies harvested all principal parts of their concessions in 7 to 10 years because they could not understand the ratio of the area of productive forests, volume of the stands, etc. researches over a wide area are required.
- (3) The progress of reclamation according to the transmigration program is remarkable. However, a great reduction of forests follow such progress, and irreversible devastation occurred in some places.
- (4) A remarkable shortening of rotation or interval in shifting cultivation was seen due to agriculture directed towards a merchandise economy and participation by many new settlers. A follow-up research is required to be conducted over a wide range of areas to see a difference from aboriginal old methods.
- (5) In the Alang-alang fields and poor secondary forests, the researches of suited tree species and their tending in the plantation are necessary, and also the technique of land evaluation should be developed.
- (6) The group could notice some social demands by local farmers in the site investigated. Development of agricultural techniques, its extension and guidance to those farmers should be needed to investigate and study in this province where no policy for forestry can be taken without stable agriculture.

Thus, the cooperative research group could learn the forest development and people's life in the province, and recognize the need for research and studies conducted by the groups 1 to 4 to be continued further.

Since these groups did not touch on any part connected with the policies of the Indonesian Government, in the property of such international study, they could not develop any study corresponding to the expansion of exploited tree species and regeneration techniques other than natural reproduction which were necessarily expected within several decades. The group could not take up as its themes those matters which were concluded politically because they were regarded as having been studied. Therefore, independent study of those matters should be conducted further by the Indonesian side, taking the methodology based on this research.

As reported here, it may be recognised that such study is important to be conducted by harmonizing agriculture, forestry and animal husbandry as mutually supplementing industries. To locally apply the methods of study mentioned above, it may also be necessary to obtain cooperation from the field of agricultural engineering. It may also be understandable that surveys by satellites or airplanes must be conducted in conjunction with the elucidation of basic conditions. It does not mean that people involved in these fields in the past had no interest in this point, but does that, when a theory accompanying poor fact-finding was accumulated and got involved in any corrective measures, a one-sided survey and research might be conducted causing unbalanced development and its study, and bringing partial consideration in relation to the people.

The climate, topography and soil of East Kalimantan make people's relation with plant production difficult exposing them to diseases. It can be seen from many examples that assurances of plenty of circulation and production of materials bring the sanitary environments for the people. In other works, it is desirable that, with this study as a starting point, study methods be adopted for producing policies which may bring about development, allowing people to live, using land permanently. For the population in the 21st. century, it is necessary to utilize this rich green drive for mankind to stop global environmental devastation. Indonesia should make the most of her advantages that techniques can easily be introduced as compared with cold or dry areas. Using his wisdom, mankind should adjust its population, cycle its resources, and put his environment in order on the limited area of the earth. It is desired that these

methods of study provide a help for the above, and that interdisciplinary study and cooperation in accordance with the actual condition be conducted in several countries.

JICA