(4) Plant Diseases and Weeds

East Kalimantan located in the tropical rain forest zone is placed under hot and humid conditions, and plant diseases and weeds are given most favorable conditions for their growth. Since many kinds of plants are growing through the year, they are considered to be playing important roles as infection sources of such diseases.

In order to develop agricultural production in East Kalimantan under such conditions, it is important to control diseases from occurring. The description of crop diseases and weeds will be given in this section.

1) Crop Diseases

Since a list of crop diseases in East Kalimantan is not available within the range of the present survey, the main purpose was for the preparation of such a list. The names of diseases were determined based on visual diagnosis and photographs of infected portions by referring to various literatures.

A. Diseases of Edible Crops

(A) Diseases of Rice Plant

a. Sheath Blight (Rhizoctonia solani) (Fig. 38)

This disease was observed over the whole surveyed area and very severe. At first, elliptic or irregular large spot having dark brown color periphery and grayish-white color inside appears on a lower leaf sheath and a leaf. The spot gradually extends to include others and expands upward. A myceliun extends from the infected spot, creeping about the surface of leaf sheath. The adjacent stem is then infected and the intensity of the disease increases further. The lower leaf sheath and leaves die down, and the stem readily falls sideways. If the infected spots rise up to uppermost leaves, the yield will be reduced by 30 - 40 %. In case the sclerotium survives to next year in the soil and then floats on the surface of water during preparation for transplanting rice seedlings, it attaches to the plant and extends its mycelium to enter the leaf sheath and eventually forms an infected spot. Since this fungus is capable of invading many plants, even weeds, it is necessary to remove as many

weeds as possible on the footpath between rice fields. As the all rice cultivars are not resistant, it should be prevented by avoiding both dense planting of rice plants and excessive using of nitrogenous fertilizer from the cultivation standpoint. Agricultural chemicals such as Neo-asozin, Validacin are effective agents, but it would be economically difficult to use them in East Kalimantan.

b. Brown Spot (Cochliobolus miyabeanus; syn. Helminthosporium oryzae) (Fig. 39)

This disease was also often found to be widely distributed in many regions. A number of elliptic or circular small spots in dark brown color, each having a yellow halo on the periphery, appear on leaves, leaf sheaths and panicles. A number of conidia are formed on the infected spots and scattered by winds. The fungus survives in the infected spots until next year in the form of conidia and mycelia. Since this disease will be severely found on the soil short of silicic acid, iron, manganese or potassium, the supply of clayey soil affluent in such ingredients brought from another place and application of compost, calcium silicate and potassium fertilizer should be made to prevent the disease.

c. Bacterial Leaf Blight (Xanthomonas campestris pv. oryzae)

It used to be understood that the occurrence of this disease was rare because, it seems, surveys had been made during the season with less rain. This disease usually appears when rice plants are soaked into irrigation water flooded by typhoons, in which case the paddy fields are wholly covered with white color of diseased leaves. Kresek symptom of acute wilting type was not found in this survey. Bacteria as a cause of the disease survive in infected leaves and in underground stems of perennial weed belongs to rice family, and they are conveyed to growing rice plants by irrigation water. This disease can be prevented by the cultivation of the resistive rice varieties, avoidance of their submersion under water, and of excessive use of nitrogenous fertilizer.

d. Others

Blast (disease cause: Pyricularia oryzae), Penyakit habang (virus), and Grassy stunt (disease cause unknown), latter two diseases were reported from South Kalimantan, were not observed.

(B) Diseases of Maize

a. Leaf Spot (Cochliobolus heterostrophus; syn. Helminthosporium maydis) (Fig. 40)

The occurrence of this disease was widely obserbed, but damage caused by it was not so heavy. A number of small yellow or yellowish brown color spots appear on leaves and each spot grows to have a spindle or elliptic shape of 5 - 10 mm long in purple color on the periphery while ashy white color inside. The conidia formed on the infected spots are scattered by the wind so that the disease is spread. The conidia or ascospores of the fungus conceal itself and survive in the infected spots until next season. Since this disease tends to increase when manure is short, in that case must be supply sufficient manure, whereas the infected leaves should be collected and burned.

b. Rust (Puccinia polysora or P. sorghi)

The occurrence of this disease was rare. Small reddish brown spots (Uredinium) appear on the leaves. When the plants are densely planted, the symptoms increase in number and the yield is extremely reduced when the disease appears in bulk. There is no special method for preventing the disease, so that the plant should be allowed to grow healthfully and firmly.

No downy mildew (Sclerospora maydis) as the fatal disease in Java was observed.

(C) Diseases of Peanut

a. Brown Leaf Spot (Mycosphaerella berkeleyi; syn. Cercospora personata) (Fig. 41)

This disease was rarely observed. The infected leaves produce reddish brown ~ dark brown spots with a yellow halo on

their periphery. When the disease appears severely, the infected spots are united and the leaves die and fall off. The fungus survives in died leaves and forms conidia next year and then spread. This disease can be prevented by rotation of crops, burning the infected leaves and spraying Bordeaux mixture.

b. Mosaic (Groundnut mosaic virus) (Fig. 42)

This was rarely observed. The mosaic symptoms or light yellow spots are produced on the leaves. The virus as the cause of disease is spread by seeds and insects, so it is important to use healthy seeds and exterminate insect vector.

(D) Disease of Cassava

a. Leaf Spot (Cercospora cassavae) (Fig. 43)

The disease was observed frequently in every places. Small dark green color spots with a brown periphery are first produced on the leaves, and then the spots change their color into brown and form a concentric pattern. The spots finally fall off, making holes. If the disease occurs severely, it interferes with the growth of plant, reducing the yield of starch contained in tuberous roots. This disease can be prevented by the rotation of crops, removal and burning of infected leaves, cultivation of the resistive plant and Bordeaux mixture spraying.

(E) Diseases of Melon

a. Downy Mildew (Pseudoperonospora cubensis)

This was rarely observed. Light yellow angular spots enclosed by veins appear on the leaves, then the spots gradually change their color into yellow to light brown as time elapses and tend to become readily broken. The conidia are formed on the under surface of spots, and then scatter and spread. The conidia require water drops on the leaf under humid conditions for germinating and invading into the leaf. The method of preventing the disease comprises laving a little on the soil surface near the stem base, allowing the air to ventilate by standing a support, and supplying sufficient manure kept the balance among the three elements.

b. Mosaic (Cucumber mosaic virus)

A few number of diseased plants were observed. Light yellow spots are produced on the leaves, of which surface becomes crepy. Generally speaking, the height of the infected stock is shortened, and the leaves and flowers become smaller, thus incapable of bearing fruit. Many kinds of plants are liable to be invaded by this virus which is carried by an aphid. This disease can be prevented by extermination of aphids.

(F) Disease of Eggplant

a. Bacterial wilt (Pseudomonas olanacearum) (Fig. 44)

This was rarely observed. The plant above the ground suddenly withers keeping its green color for a few days, and finally dies. The trachea of the root and stem of the infected plant changes their color into brown; a white liquid of bacteria oozes out when they are cut. The bacteria as a cause of disease stay alive in the soil and enter to the damaged roots of various plants and then multiply themselves mainly in the trachea of root and the basis of stem. It is desirable to avoid repeated cultivation, to carry out inversion of top and bottom soil and to cultivate resistive plants.

(G) Disease of Taro

a. Leaf Mould (Cladosporium colocasiae) (Fig. 45)

This disease was widely observed. First, light yellow and then light brown ~ grey brown circular spots with an obscure periphery are produced on the leaves. Later, sooty mold (conidia) is formed on the infected spot and the spot becomes to rot when the degree of disease is intense. Old leaves are often liable to be infected. Fungus as a cause of the disease survives in infected plants in the form of a mycelium and spore. This disease can be prevented by removal and burning of infected plants and Bordeaux mixture spray.

B. Diseases of Fruit and Industrial Crops

(A) Disease of Coconut Palm

a. Leaf Spot (Pestalozzia palmarum) (Fig. 46)

This disease is of mainly seedling and often observed severely in seedbeds. A number of brown or purple spots are produced on the leaves and later united so that the leaves die. This disease can be prevented by spray of Bordeaux mixture, perenox and so on.

(B) Disease of Banana

a. Sigatoka (leaf blight) (Cercospora musae) (Fig. 47)

The disease was observed everywher, and the degree of symp toms was intense. Obscure parallel lines in light yellowish ~ greenish-brown color are first produced in veining, and they later become into dark brown ~ black elliptic spots. The center of the spot is light grey in color, and the clear reddish-brown periphery is often enclosed by a clear yellow halo. As the infected spots expand and agglutinate, the leaf blade may causes partial collapse; sometimes, the whole leaf may changes its color and die. The growth of premature fruit is affected and becomes smaller in size, while its storage life as well as quality is reduced and extremely damaged. A number of conidia and ascospores formed on the infected spot are scattered by the wind and rain, so that the other plants may be infected with disease. This can be prevented by the utilization of resistive plants, removal of infected plants and copper fungicide spray.

(C) Diseases of Citrus Tree

a. Sooty Mould (Capnodium sp.) (Fig. 48)

This disease was observed in many places and the symptoms were intense. The fungus is parasitic on solid wastes (syrup) of scale insects to obtain nourishment. A number of colonies of dark grey or black mold attach to the surface of leaves. The spores produced on the colonies are diffused by the wind and rain, and also carried by ants. To prevent the disease, it is needed to exterminate the scale insects.

b. Phoma Rot (Phoma citricarpa)

This was rarely observed. Reddish brown circular spots of 1 - 10 mm in diameter are produced mainly on fruits. Infected fruits should be removed.

c. Crinkle (Virus)

The disease was observed to a certain extent. Mainly young leaves begin to shrink and become smaller.

(D) Diseases of Coffee

a. Rust (Hemileia vastatrix) (Fig. 49)

Occurrence was observed to some extent. This is one of the most important diseases of coffee plants and particularly arabica coffee plants are seriously affected. Small circular brown spots are produced on the leaves with yellow halos on their periphery. Orange color powdery summar spores are formed on the under surface of the infected spot. Young leaves as compared with old ones are readily infected with the disease and high temperatures tend to facilitate such infection. Premature leaves are fallen off and, when large scale infection occurs, most of the leaves are gradually killed. The summer spores are scattered by the wind and rain, so that the disease may be spread. To prevent the disease, the resistive plant Coffea robusta is recommended for plantation. In addition, proper pruning the a ziram or copper agent should be carried out and sprayed.

b. Die Back (Rhizoctonia sp.)

This was rarely observed. The tips of branch die back and the leaves dry up. The infected branches should be removed.

(E) Diseases of Cacao

a. Black Pod (Phytophthora palmivora) (Fig. 50)

This disease is a very important one and was severely observed. The young pod changes its color from brown to black, showing its rotting and mummification. White molds are produced on the infected surface of the pod when it is humid, while the inside of the pod and beans are grayed. The fungus survives in the infected portion as mycelium and thick-walled

spores, and spreads by rain drops. The disease can be prevented by removal of the infected pods, cultivation of resistive plants and spraying of Bordeaux mixture, perenox or other copper compounds.

b. Leaf Spot (Fungus)

It was seldom observed. A brown spot produced at the tip of a leaf is enlarged over the whole leaf. The cause of the disease is assumed as one of the fungi but actually unknown, so the preventive means are also unknown.

(F) Diseases of Pepper

a. Foot Rot (Phytophthora palmivora var. piperis) (Fig. 51)

This is the most important disease for pepper plantation and the occurrence was very severe. Since the root and stem close to the root are rotted, the plant above the ground gradually withers, and lower leaves change to yellow color and then falling off. Ultimately, the stock as a whole is rotted off. In addition, brown spots with a yellow halo are produced on the leaves. The disease can be prevented by removal and burning of infected stocks and fallen leaves, copper agent spray and cover crop cultivation.

Since some Piper genus plant is known to be resistive to the foot rot disease, any wild plant species belonging to the Piper genus should be collected and be examined for grafting.

b. Zonate Leaf Blotch (Colletotrichum piperis) (Fig. 52)

It was rarely observed. Brown ~ blackish brown circular or elliptical spots are produced on the leaves and gradually enlarged and then agglutinated to become large spots in a concentric form.

c. Crinkle (Virus or Mycoplasma?)

Relatively, it was frequently observed. The growth of the plant is deteriorated, and small crinkled leaves are produced. The cause of the disease is considered something similar to virus or mycoplasma-like microorganism; however, it is still unknown, and preventive measures have not yet been established.

d. Yellow Disease (Unknown)

The disease was observed sporadically. The color of both young and old leaves is changed into yellow. Nematode was obtained fromthe root or the soils, but the cause of disease and preventive measures are still unknown.

(G) Diseases of Clove

a. Premature Disease (Physiological Agents) (Figs. 53, 54)

The disease was severely observed in some areas. The color of the leaves in the upper portion of trees begins to change into brown, with the leaves falling off. Within 2 - 3 years, this phenomenon is gradually extended to the lower portion of the trees. Ultimately, all leaves fall off, and, in the meantime, the tree is died off. This disease was often observed in places where the soil conditions are unfavorable, particularly where the soil is damp with a high underground water level.

b. Leaf Spot (Gloeosporium piperatum) (Fig. 55)

It was frequently observed on seedlings. A number of small brown spots are produced on the leaves. Bordeaux mixture spray or dithane spray are effective.

c. Web (pink) Disease (Corticium salmonicolor) (Fig. 56)

Seldom observed. White mycelia as the cause of the disease spread on the surfaces of branches, leaves and flowers, then the plants are weakened. The infected portion should be removed, and Bordeaux mixture spray should be applied.

(H) Diseases of Rubber Plant

a. Powdery Mildew (Oidium heveae) (Fig. 57)

Very often observed. Grey white powdery spots are produced on the leaves, which are later deformed, rolled and dried, before being fallen off from leafstalks. In case most part of the leaf area is lost, latex production will be considerably reduced. Fungus as the cause of the disease spread in the form of a greyish white mycelia and, if a number of conidia are formed, they are scattered by the wind. The disease will be prevented by the cultivation of resistive plants

and the dusting of sulfur powder.

b. Spot Canker (Phytophthora palmivora and Pythium complectens) (Fig. 58)

Relatively frequently observed. Black brown vertical lines are produced in the tapping bark and wood portion, which are rotten. It is suggested that fungicides should be preventively applied during the rainy season.

(I) Disease of Pineapple

a. Heart Rot (Phytophthora spp.) (Fig. 59)

This disease was severely observed in some districts. Large peripherally dark brown spots with white inside are produced on the leaves and black spore masses are formed on the under surface of spot. The infected spots expand and coalesce, and finally the overall leaf changes to brown color and dies. Preventive methods are unknown.

(J) Disease of Nutmeg Tree

a. Fruit Crack (Physiological agents) (Fig. 60)

Frequently observed. Before the fruit matures, it cracks and this makes it impossible to obtain good fruits. The cause is assumed as physiological abnormality or some unknown microorganism. Preventive methods are unknown.

(K) Diseases of Jack Fruit

a. Gummosis (Diplodia sp.?) (Fig. 61)

Rarely observed. Brown secreting fluid or rubber-like resin flows down on the trunks of plants. When the trunk base is infected with the disease, the plant begins to wilt and gradually dies. It is still unknown whether the cause of the disease is a physiological one or a microorganism.

b. Fruit Rot (Phytophthora palmivora) (Fig. 62)

Centrally light brown water-soaked spots are produced on young fruit and quickly enlarged to rot the fruit, which is ultimately mummified on the plant.

(L) Disease of Mango

a. Anthracnose (Gloeosporium mangiferae) (Fig. 63)

Frequently observed. Brown or red brown tiny spots having a yellow halo on the periphery are produced on the leaves. The spot falls off and tends to make a hole. The color of the flower changes into black under highly humid condition and sunken spots or lines are also generated on the fruit, which is then deformed and deteriorated. The young fruit is rotted off. Infected branches and leaves should be removed and Bordeaux mixture should be sprayed (in rainy season).

(M) Disease of Cotton

a. Angular Leaf Spot (Xanthomonas campestris pv. malvacearum)

Occurrence was rare. Water-soaking and then brown square spots are produced on the leaves. Since the plant is infected with the disease through the infected seed and the remainder of diseased plant, healthy seeds and resistive plants should be used, while the infected plants should be removed and Bordeaux mixture should be sprayed.

Fig. 38. Sheath blight of rice plant.

Fig. 39. Brown spot of rice plant.

Fig. 40. Leaf spot of maize.

Fig. 41. Brown leaf spot of peanut.

Fig. 42. Mosaic of peanut.

Fig. 44. Bacterial wilt of eggplant.

Fig. 43. Leaf spot of cassava.

Fig. 45. Leaf mould of taro.

Fig. 46. Leaf spot of coconut palm.

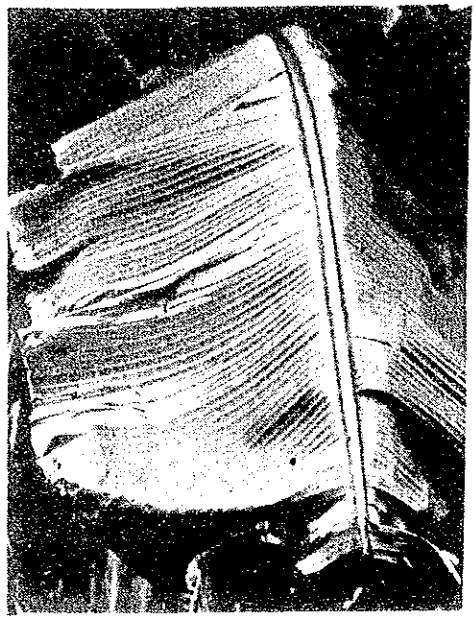

Fig. 47. Sigatoka (leaf blight) of banana.

Fig. 48. Sooty mould of citrus tree.

Fig. 49. Rust of coffee.

Fig. 50. Black pod of cacao (Arrow shows a black pod).

Fig. 51. Foot rot of black pepper (Arrow shows a rotted part).

Fig. 52. Zonate leaf blotch of black pepper.

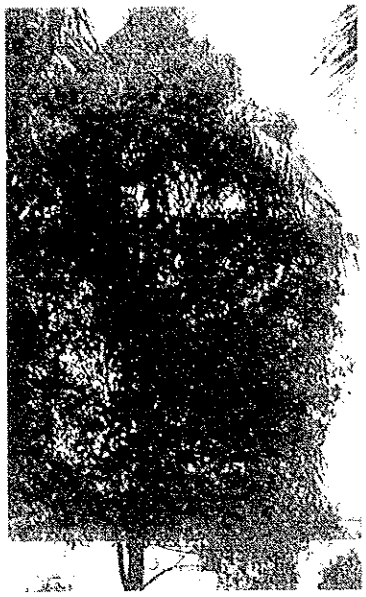

Fig. 53. Healthy clove.

Fig. 54. Premature disease of clove.

Fig. 55. Leaf spot of clove

Fig. 56. Web (pink) disease of clove.

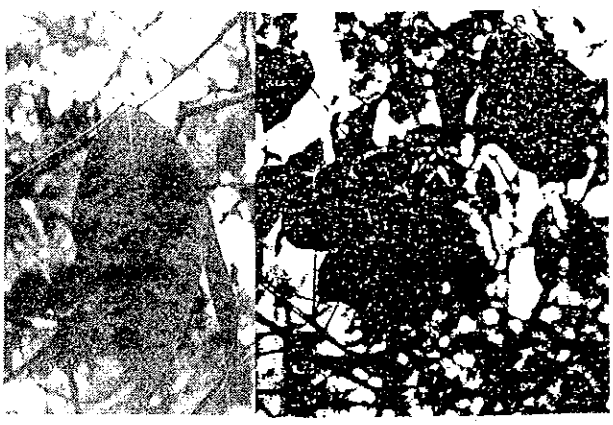

Fig. 57. Powdery mildew of rubber.

Fig. 58. Spot canker of rubber.

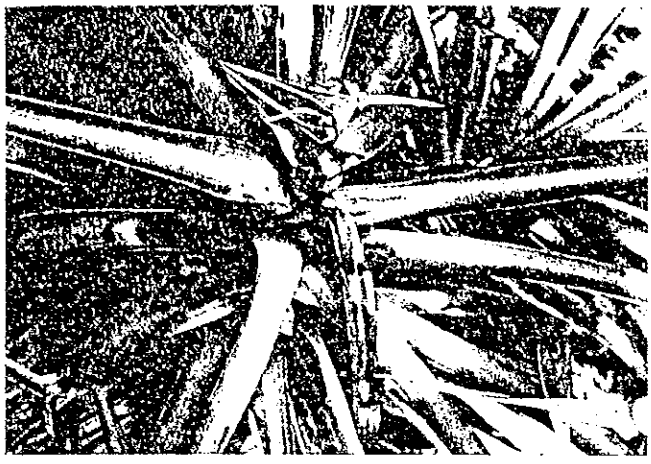

Fig. 60.
Fruit crack of nutmeg (physiological disease?). Arrow shows a cracking portion.

Fig. 59. Heart rot of pineapple.

Fig. 61.
Gummosis of jack fruit (Arrow shows a gummosis).

Fig. 62.
Fruit rot of jack fruit (Arrow shows a rotted fruit).

Fig. 63.
Anthracnose of mango.

2) Weeds

The control of weeds for crop cultivation is very important to secure the production and, if it is not properly done, that crops will not be satisfactorily growing. In East Kalimantan under humid tropic conditions, weeding before planting rice in rainfed is so heavy work. The establishmen of the reasonable weeding method is very important for not only crop production but also reducing the weeding work.

The survay was made to prepare the weeds list in East Kalimantan as a basic materials for establishing effective weeding method.

There are 173 kinds of weeds already known in Indonesia (Table 9). Among those weeds, about 45 kinds of them have been confirmed in paddy and upland fields in East Kalimantan and 20 kinds of them were recognized to be dominant weeds (Table 10). The weeds observed in paddy fields were as follows:

Table 9. Weeds list in Indonesia (Japan Association for Advancement of Phyto-Regulators, 1975)

	Scientific name	Japanese name	Indonesian name
1	Aeschynomene indica L.	Kusanemu	peupeuteyan 9 (katisan)
2	Ageratum conyzoides L.	kakko - azami	Bandotan'
3	Alocacia indica Schott.		tales (bira)
4	Alternanthera sessilis DC.	tsuru - nogeitoo	kremah
5	Alysicarpus vaginalis DC.	sasahagi	sesenep (brobos)
6			
7	Amaranthus hybridus L.	honaga - aogeitoo	bayam (bayam keyorg)
8	A. lividus L.	inubiyu	bayem itik (bayem merir)
9	A. spinosus L.	haribiyu	bayam duri
10	Amorphophalus variabilis BI.		kembang bangke (iles - iles)
11	Aneilema nudiforun R. Br.	shima - ibokusa	tapak burung (bawangan)
12	Argemone mexicana L.	azamigeshi	druju
13	Artemisia indica Willd	nishi - yomogi	baru cina (suda molo)
14	Arthraron hispidus Makino	kobunagusa	jukut garingsing (blabahan alit)
15	Aronopus compressus P.B.		rumput pait (suket paitan)
16	Bidens pilosa L. var minor Snerll.	shirobana - sendangusa	hareuga (ketul)
17	Biophytum renwardtii Klotzs		inja payung (krambilan)
18	Blyxa aubertii L.C. Rich	oo - subuta	seserowan
19	Boehmeria nivea Caud.	nanban - karamushi	rami (haramay)
20	Borreria latifolia Schum.		jugul
21	B. ocimoides DC.		sayur babi (balungan)
22	Brassica nigra L.	kuro - garashi	sawiitem (sawa ireng)
23	Briza minor L.	hime - kobansoo	suket menuran
24	Calopogonium muconoides Desv.		kacang
25	Canna hybride Hort.		ganyong
26	Cannabis sativa L.	asa	ganja
27	Carex nomame Honda.	kawara - ketsumei	tuturian (kedimdng)
28	C. tora L.	ebisugusa	ketepeng kecil (ketepeng leutik)
29	Celosia argentea L.	nogeitoo	bayan ekor (baroco)
30	Centipeda minima O. Krmtze.	tokinsoo	bacoan

Scientific name	Japanese name	Indonesian name
31 Ceratophyllum demeersum L.	kingyomo (matsumo)	kancil (ganggeng)
32 Ceratperis tartarea Link.		pakis tembogo
33 Chenopodium album L.	shiroza	dieng putih
34 Chloris barbata Sw.	murasaki - higeshiba	rumput jejarongan
35 Chrysanthemum leucanthemum L.	furansugiku	margrit
36 Cleome aspera Koen.		kebo - keboan
37 Clidemia hirta D. Don.		harendong bulu
38 Coix lacryma - jobi L.	juzudama	jali (hanjere)
39 Colocasia gigantea Hook		kemumu (rombang)
40 Commelina benghalensis L.	maruba - tsuyukusa	gewor
41 C. nudiflora L.	shima - tsuyukusa	brambangan
42 Corchorus olitorius L.		rami cina (gadangan)
43 Crepis japonica Benth.	oni - tabirako	midilan (cemondelan)
44 Crotalaria retusa DC.	kogane - tanukimame	geger sore (orok 2 cina)
45 C. striata DC.		kroncongan
46 Cryptotaenia canadensis DC.	mitsuba	honeywort, umbel weed
47 Cuscuta australis R. Br.	mamedaoshi	cacingan
48 Cynodon dactylon L.	gyogishiba	rumput kawatan
49 Cyperus iria L.	kogome - gayatsuri	jekeng
50 C. rotundus L.	hamasuge	teki
51 Datura atramonium L.	shirobana-chosen-asagao	kecubung leutik (kecubung wulung)
52 Digitaria rhopalotricha Buse.		sunduk gangsir
53 Dopatrium junceum Hemilt.		gendot
54 Derymoglossum heterophyllum C. Chr.		picisan (duduwintan)
55 Dryopteris arida O. Kutze.		pakis
56 Echinochloa colona L.		
57 E. crus - galli L.	inubie	
58 E. crus - galli var. oryzicola.	ta - inubie	
59 E. crus - galli var. praticola.	hime - inubie	
60 Eclipta alba Hassk.	takasaburoo	

Scientific name	Japanese name	Indonesian name
61 Eichhorinia crassipes Solms.	hotei - aoi	orang - aring eceng gondok (bengok)
62 Eleocharis dulcit Trin.		peperetan
63 Eleusine indica Gaertn.	ohishiba	rumput belulang (lulangan)
64 Eragrostis cilianensis Lutatai.	suzumegaya	suket paren
65 E. nigra Ness.		jukut kepluk
66 E. unioloides Ness.		emprit - empritan
67 Erechtites hierarcifolia Raf.	dando - borogiku	tespong (mandrung 2)
68 Erigeron bonariensis L.	arechi - nogiku	jelantir (sembung lancur)
69 E. truncatum Buch - Ham.		babawangan
70 Eupatorium pallescens DC.		kirinyu
71 Epherbia geniculata Ortega.		katemas
72 E. hirta L.	shima - nishikiso	gelangasu (patikan kebo)
73 E. prostrata Ait.	hai - nishikisoo	gelang pasir
74 E. reniformis Bl.		patikan cina
75 Fimbristylis Vahl.	tentsuki	
76 F. globulosa Kunth.	hanashi - tentsuki	kodokan
77 F. miliacea Vahl.	hideriko	bulu mata munding (adas-adasan)
78 Flemingia lineata Roxb.		gobok utan (hahapaan)
79 Galinsoga parviflora Cav.	kogomegiku	jukut minggu (bribil)
80 Gleichenia laevigata Hook		paku rincang
81 G. linearis Clarke.		paku resam (pakis andam)
82 Glinus lotoides L.	monba - zakurosoo	kumpait (awon 2)
83 Glycine soja Sieb. & ZZucc.	tsurumame	kedele
84 Gynura crapidioides Bth.		beluntas cina (tempuyung)
85 Heliotropium indicum L.	nanban - rurisoo	tusuk konde (tlale gajah)
86 Hemitelia latebrosa Mett.		paku riung
87 Hydrilla verticillata C Casp.	kuromo	ganggerg
88 Hydrocotyle sibthorpioides Lam.	chidomegusa	antanan tikus (katepan)
89 Hymenachne amplericaulis Mess.		rumput sumbu (blemben rawa)
90 H. indica Buese.		darendeng (tropongan)
91 Hyptis capitata Jacq.	iga - nigakusa	sontoloyo

	Scientific name	Japanese name	Indonesian name
92	Ilysanthes antipoda Merr.		sawi tanah (mata yuyu)
93	Imperata cylindrica L.	chigaya	alang-alang
94	Impatiens platypetala Indl.		pacar leuweung (pacar banyu)
95	Indigofera errecta Hochst		tom
96	Ipomea aquatica Forbk.	yoosai	kangkung
97	Isachne globosa O. Kuntze.	chigozasa	waderan
98	I. pngerangenis Z. & M.		tengon
99	Ischaemum aristatatum L.	noge - kamonohashi	blembem watu
100	I. timorensis Kunth.		jampang tatanbagan
101	Jussiaea angustifolia Lamk.		cacabean
102	J. linifolia Vahl.		cacabean (lo bokan)
103	J. repens L. var. glabrescens Ktzu.	mizukinbai	pangeor (krangkong)
104	Kyllinga brevifolia Rottb.		teki bandot (undel 2)
105	Lantana camara L.	shichibenge	tai ayam (telekan)
106	Leersia hexandra Swartz.	taiwan - ashikaki	benta (kalamenta)
107	lemna minor L.	ko - ukikusa	
108	L. polyrhiza Schleid.	ukikusa	kakarewoman (mata lele)
109	Leonurus sibiricus L.	mehajiki	dendranan (ginjean)
110	Leucas lavandulifolia Smith.		pati 2 (leng 2 an)
111	Limnophila aromatica Merr.	shisokusa	kehkehan
112	Limnenthemum indicum Gris	gagabuta	tunjung (cicikuran)
113	Lobelia chinensis Lour.	azemushiro	kitombe
114	Marsilea quadrifolia L.		
115	Marsilea crenata Presl.	nangoku - dendisoo	semanggi
116	Melastoma malabathricum L.		harendong (senggani)
117	Melotheia corchorifolia L.	noji - aoi	jaring (gendiran)
118	Mentha arvensis L. var, piperascens hakka	hakka	daun pok - o (gendiran)
119	Minosa invisa Kart.	oo-togemimoza	borang (ri rendet)
120	M. pudica L.	ojigisoo	rebah bangun (pis kucing)
121	Mirabilis jalapa L.		kembang pukul ampat (pati geret)

Scientific name	Japanese name	Indonesian name
122 Monochoria vaginalis L.	konagi	eceng padi (wewean)
123 Mollugo stricta L.	zakurosoo	daun mutiara (galinso)
124 Monochoria hastata Solms.	mizu - aoi	bia 2 (eceng kebo)
125 Nephrolepis hirsutula Pres.		paku jeler (pakis kinca)
126 Nothosoordum fragrans Kunth	hatakenira	babawangan
127 Otellia alismoides Pers.	mizuoobako	cowehan
128 Oxalis europoea Jord.		calincing gede
129 O. corymbosa DC.		calincing (semanggi gunung)
130 Pancum ambiguun Trin.		blabahan
131 P. barbatum Kunth.		jamrak (suket jambean)
132 P. futescens Weigel.	kin - enokoro	jukut hileud (uler - uleran)
133 P. palmifolium O. Stapf.	sasa - kibi	wuluh - an
134 P. purpurascens Raddi.		rumput malela (jukut malela)
135 P. repens L.	hai - kibi	lempuyangan
136 P. sarmentosum Roxb.		suket petungan
137 P. tripheron Schultes.		suket gulonan
138 Paspalum conjugatum Bergius.		suket canggah
139 P. vaginatum SW.	sawa - suzumenohie	asinan
140 Passiflora foetida L.	kusa - tokeisoo	permost
141 Physalis angulata L.	sennari - houzuki	ceplukan
142 Phyllanthus vrinaria L.	komikansoo	meniran
143 Pistia stratioites L.	botan - ukikusa	apu 2 (kiapu kayu apu)
144 Plantago major L. var. asiatica Dec.	oobako	daun urat (sam bung otct)
145 P. paniculata L.		jukut tikukur
146 Polxgala barbatum L.	ketade	jukut carang (mengkrengan)
147 Portulaca oleracea L.	suberihiyu	gelang (krokot)
148 Pteridium aquilinum L.		kuhn warahi paku gila
149 Pichardsonia brassiliensis Gomez.		j emprak.
150 Salvinia natans All.	sanshomo	rayambang
151 Scirpus articulatus L.		mendongan
152 S. grossus L.	oosankakui	walingi
153 S. supinus var. lateriflorus.		sriwit

	Scientific name	Japanese name	Indonesian name
154	Scoporia dulcis L.		joko tuwo
155	Selaginella opaca Warb.		paku lukut
156	Senecio sonchifolia L.	usubeni - nigana	jom bany (deligiyu)
157	Siegesbeckia orientalis L.	tukushi - menamomi	nampong (limpungan)
158	Sida rhombifolia L.	kingojika	idem
159	Solanum nigrum L.	inu - houzuki	leunca (ranti pait)
160	Sonchus arvensis L.	taiwan - hachijona	jombang (tempuyung)
161	S. asper L.	oni - nogeshi	jombang (delgiyu)
162	Spermacoce tenuior L.		kikirang
163	Sphenoclea zeylania Geerth.	nagabo - nourushi	gundo
164	Spilanthes acmella Murr.		jotang leutik
165	Sporobolus berteroanus Hitche & Chase.		jukut nyenyeroan (suket sadan)
166	Stephania hernandifolis Walp.		seloro (seluru)
167	Striga asiatica kuntze.	nayo - himenomaegami	jukut cengceng
168	Synedrella nodiflora Gaerth.	fushizakisoo	jotang (rojo tuwo)
169	Taraxacum officinale Weber.	seiyo - tanpopo	jombang
170	Tridax procumbens L.	kotobuki - giku	gletang (sidowolc)
171	Urena lobata L.		pulutan
172	Wedeliea biflora L.		lalangkapan (sruni)
173	Xyris irdica L.		jukut pentolan

* Data from Japan Association for Advancement of Phyto-Regulators, 1975. Weeds list in Asian-Pacific Area.

Table 10. Weeds observed in surveyed area

Low land	
Alternanthera philoxeroides	Hyptis brevipes
A. sessilis	Aguatica
Caladium bicolor	*Jussiaea leptocarpa
Cenchrus brownii	Leersia hexandra
*Ceratopteris thalictroides	Limnocharis flava
Commelina diffusa	*Marsilea crenata
*Cyperus difformis	Melastoma polianthum
*C. iria	Monochoria vaginalis
	Pistia stratioites
*C. platystylis	Poligonum tomentosum
*C. tenuispica	Rolippa prostrata
*Eleocharis dulcit	*Salvinia molesta
*Eleusine indica	*Scirpus mucronatus
Elipta prostrata	*S. supinus var. lateriflorus
Fimbristylis littoralis	Scleria poaeformis
Upland	
Ageratum conyzoides	*Paspalum conjugatum
Cyathula prostrata	*P. vaginatum
*Imperata spp.	
*Momordica spp.	Sida rhombifolia
Hymenachne pseudointerrupta	
Rainfed	
*Amaranthus hybridus	*Mollugo oppositifolia
*Cassia tora	Phyllanthus niruri
*Echinochloa colonum	Vernonina cinerea
Hyptis brevipes	

* Dominant weed.

A. Weeds of Paddy Field

Kinds of weeds observed in paddy fields were Pistia stratiotes, Salvinia natans, Marsilea crenata, Cyperus spp., Scirpus spp., Polygonum tomentosum and others, all of them being very harmful weeds through the rice growing season. (Fig. 64 - 67.)

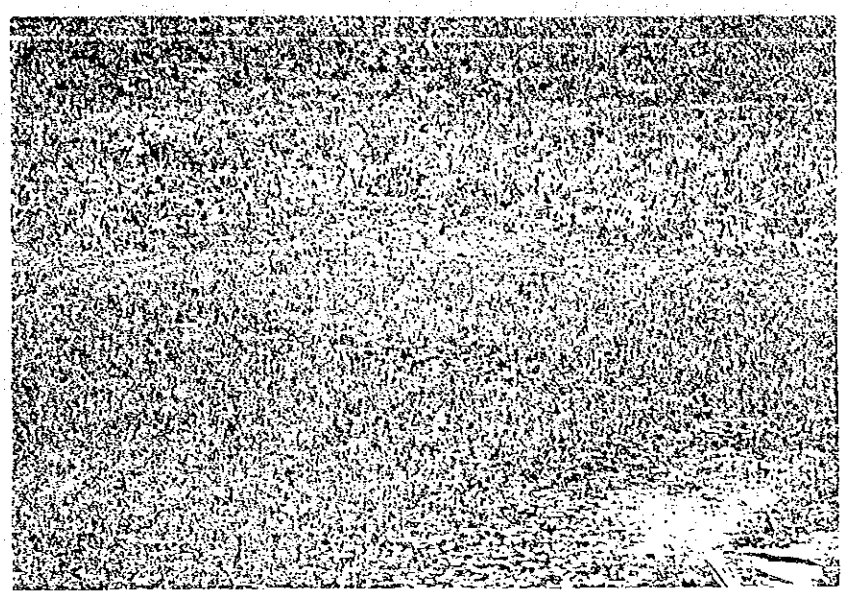

Fig. 64. Rice nursery beds thickly covered with Marsiles crenata.

Fig. 65. Pistia Stratioites (Salvinia natans).

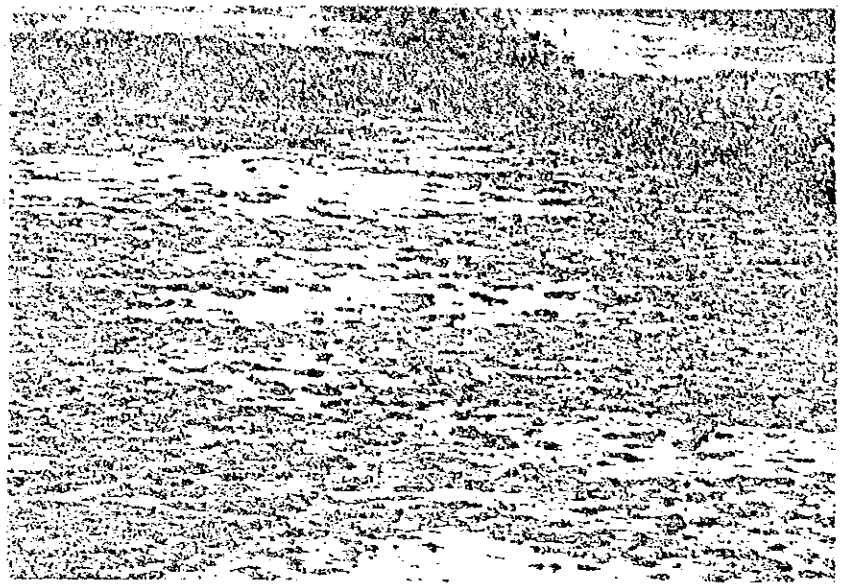

Fig. 66. Field thickly covered with Salvinia (Salvinia natans) before rice planting.

Fig. 67. Field thickly covered with Kibana-Omodaka (Limnocharis flava) after rice planting.

B. Weeds in Upland Field

Very harmful weeds were rarely observed in first year old fields according to the shifting cultivation. However, in two or three years old fields, grasses such as alang-alang, Cyperus spp., ferns and shrubs were observed (Figs. 68, 69).

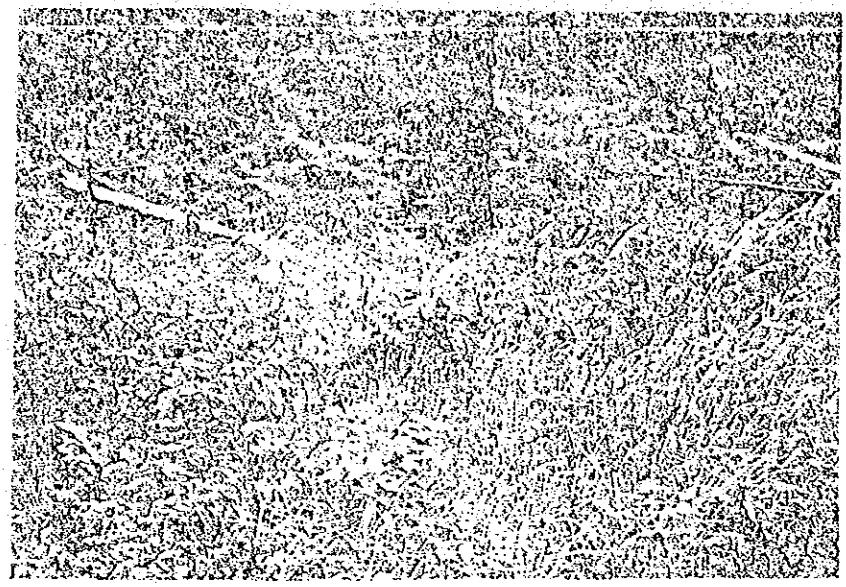

Fig. 68. Abandoned field due to heavy weeds.

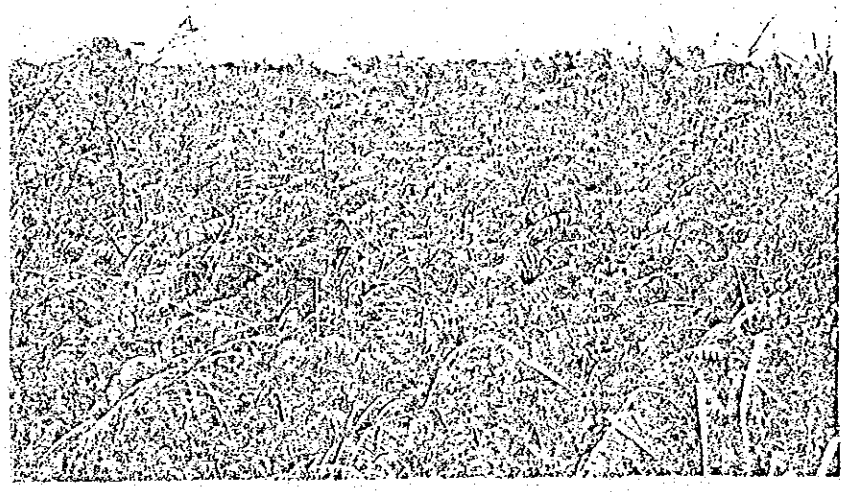

Fig. 69. Aquatic weeds in abandoned paddy field.

C. Weeds in Estate Crops Field and Orchard

The growth of weeds in the orchard and perennial crops field was different according to the size of the tree crown. In the case of young tree with the small crown, the alang-alang was dominant (Fig. 70), and, when the surface of field was covered with tree canopy, weed was found very rare. In the pepper field, weeds were not observed, because of the soil management was being done by clean cultivation.

Fig. 70. Alang-alang grass (Imperata cylindrica), dominant weed in cacao field.

D. Weed Control

Weed control in the tropical rain forest zone is not an easy work. There are many kinds of weeds growing vigorously in paddy fields, and weeding requires heavy work. Some paddy fields which have been abandoned for heavy growing weeds, was found in this area.

Generally speaking, paddy fields in East Kalimantan are rainfed and the basic system such as irrigation and drainage was not arranged. The arrangement of such systems are important for the cultivation of rice and also weed control. It seems that weeding for rice cultivation on rainfed is available to be done by the following method. i) Weed control by utilizing non-selective herbicides (Paraquat, Glyphosate, etc.) with less

after-effects in the stage of soil preparation for planting and then weeding was done by burning, ii) Hand-weeding with simple weeders done after planting, and in 20 to 30 days after of planting, weeds such as Cyperus spp. and Scirpus spp. were killed by using the herbicides like 2,4-D and Bentazon, and iii) plowing is available method for controlling weeds in the field after harvesting. However, although weeding control by herbicides is an effective method, it seems that the weeding method by herbicides is difficult to be using it extensively from the economic situation of farmers in this area. Regarding the reasonable weeding in the field, it is suggested that the combined method with covering crops by mix cropping and use for hand weeding are effective.

Since there are not unknown thoroughly on the kinds of weeds and the ecology in humid tropical zone, influences on the environmental condition by herbicides should be studied throughly before the application of it, and moreover, it is necessary that the extension of weed killer should be combined with the results of the studies.

(5) Reasonable Agricultural Development of Forest Land

When the agricultural production is viewed from "Human Being and Tropical Rain Forests" as the main subject of this survey, the most important thing is the reclamation and utilization of arable land through deforestation. Agriculture in East Kalimantan has been based on the slash-and-burn shifting cultivation, in other words, self-sufficiency economy. Although reclamation is being carried out by political plans in recent years, agricultural productivity in this area is lower than that in Java.

In order to secure food for the people of Indonesia where the population is growing rapidly, plans have been made for the dispersion of the population and agricultural development supported by transmigrants from the area which has high population to other island which has low population such as Kalimantan. Those transmigrants are provided with fields for crop production and the fields are reclamated by cutting of forest and burning method. However, suitable land classification and the techniques of reclamation by that application have not yet been established by taking consideration of topography, the quality of the

soil and environmental preservation, some parts of the land unsuitable for cultivation were appropriated for cultivation and this fact resulted in rapid decreasing of soil fertility, that is, the large-scale appearance of an alang-alang land (Fig. 71). As the results of the survey in Samboja region (see the inter-report prepared by the Section 5), the repetition of deforestation-and-burning for agriculture field during short time under severe conditions have changed the region into an alang-alang land for these 50 years.

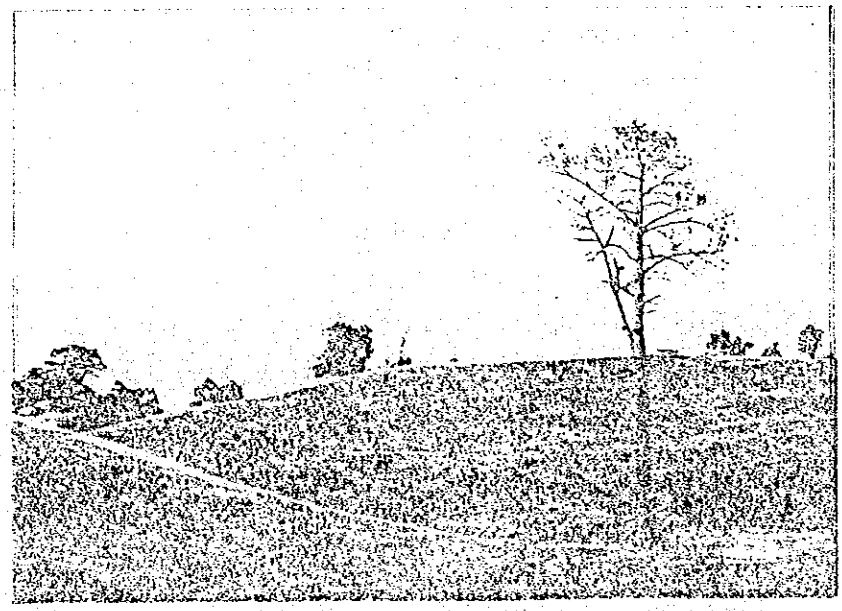

Fig. 71. Abandoned field covered with alang-alang (Imperata cylindrica) at hilly area.

If the present cultivation method is continued in the field to be opened in the transmigration area, the land will lose its value as agricultural field and will have to be abandoned in a near future. Consequently, reclamation of the forest should be done to discuss thoroughly on the conditions of location from the viewpoint of the results obtained by Section 1.

6. Suggestion

The results of the survey are as above described and, on the basis of such results, the following will be pointed out in conclusion.

(1) On the Upland Field

1) In creating field of crop cultivation on hilly land by reclamation with deforestation and burning method, it is necessary to select the land according to the classification of land utilization, through the topographical, soil quality and locating condition of the field. Therefore, the forest which plays a role as a water source conservation should be kept in preservation depending on the locating conditions in the hilly land. This is important in view of the erosion control by the running water in case of heavy rain, and of the utilizing potential soil fertility effectively.

2) Regarding the upland field already opened, available trees should be planted on the upper portion of slope land so as to circulate the soil nutrient and to utilize the potential soil fertility. It is suggested that the crop cultivation in the field on slope land should be done by mix cropping or inter-cropping, whereas annual crops should be cultivated on gentle slope land in order to control the soil erosion and to increase the soil productivity.

3) To prevent soil fertility decline, the erosion control is important. Terraces should be provided along the contour line or cover crops are used to control the soil erosion. However, easy method instead of terracing would have to be considered if the actual situation of the farmers and the transmigration policy within Indonesia are understanding. For example, arranging the logs in a row along the contour line at the time of reclamation and planting of leguminous plants for soil erosion control, as seen in Java, are so easy treatments.

4) It seems that the inter-cropping or mix cropping along the contour line is good cropping system for the control of soil erosion in view of the crop cultivation in East Kalimantan. Since the decreasing soil fertility and decline of the soil properties are caused by clean cultivation under humid tropic conditions, the introduction of cover crops is important to control the soil temperature; thus, erosion control becomes possible. Moreover, some

positive methods to improve soil fertility should be taken to be enlargement of the available soil layer and to supply the organic matter such as coconut shell.

5) The arable land has been created by deforestation, with the slash-and burn method, and then the farmer cultivate the land without plowing, fertilizer and pest control. The field is left abandoned without crop growing within several years as the soil fertility decline. Secondary forest grow in the abandoned field. Farmer transfers to the new location and make the new field by the above method. Field of crop cultivation in this area have been made by the repetition of above process. This type of agriculture is called shifting cultivation. The field rotation system like this may be one of the methods for recovering the reduced soil fertility. However, a long term is necessary for recovering the fertility in the tropical rain forest zone. Shifting cultivation, one of the rotation systems, had been made by native farmers and they came back to the same place which recovered the soil fertility with reforestation. However, increasing population by transmigrant from other area had broken long-cycle rotation maintained by native farmer and in recent years, the rotation cycle is becoming cycle with short term.

   In order to maintain and improve the soil fertility, it seems to use a means for utilizing the field rotation system to increase the fertility using perennial leguminous plants like the mountain area in central Java.

6) It is also important to obtain good seeds for agricultural production. Since allogamous crops such as maize tend to induce easily a cultivar degeneration, the stable supply of good quality seeds must be fulfilled. For this purpose, development of the study on the seed production is very important.

7) Pest control has an important role in crop production. However, the application of pesticides and herbicides for the control is not expected to be used popularly in the near future, if the economical situation of transmigrants in East Kalimantan is considered.

   Therefore, it is necessary for the development of crop production to be the establishment of the method of integrated pest control

combined with ecological system, resistance of plant and chemical control under the environmental conditions observed in East Kalimantan. For this purpose, a basic study for establishing the integrated control method must be developed.

(2) On the Lowland Field

1) Paddy rice is the main crop in the lowland field. In East Kalimantan, irrigation and drainage systems on the lowland field are not arranged well and most of the fields is rainfed. Multiple cropping is possible in rainfed, provided that irrigation and drainage systems are improved. Consequently, importance things should be attached to improvements in irrigation and drainage systems to develop paddy rice cultivation in East Kalimantan. In addition, construction of irrigating, and draining facilities in the inland damp zone would make it possible to change a vast area into paddy fields.

2) The soil fertility of the paddy field can easily be maintained as compared with the upland field because nutrient is quite naturally supplied by irrigation water. Consequently, decline of the soil fertility is considered relatively small. However, since multiple cropping through the improvements of irrigation and drainage systems may cause the decreasing of soil fertility, it is important to keep in mind that organic matter such as the stems and leaves of the plants harvested are returned to the soil.

3) As noted in the section of upland farming, the pest control is quite important and, in the case of paddy rice cultivation, various kinds of the pests are expected to increase by the cultivated area development, so that the establishment of pest control method and systems are desirable.

4) East Kalimantan has many marshland and swampland. It may be advantageous to utilize deep water or floating rice adaptable to the change in water level. For this purpose, not only variation in water level in the vast marshland but also the minimum required modification of the lay of the land as well as the above-described breeding should be thoroughly studied.

(3) Agriculture Development in forest land

Land use capability classification is, as mentioned in the Section 1, carried out on the basis of the land type classification and development of agricultural field must be done under the classification. Hence, the development is further promoted in search of arable land in marshland, barren land, the forest and so on. As a result, a greater portion of the development will be selected for agriculture in the forest land.

1) In creating arable land by cutting the forest, its history, the state of the soil condition, the degree of slope, the presence of water irrigation, utilization in the past and so on should be investigated firstly on the selected land for development by land type classification. In that case, the portion that is efficiently utilizable only should be used, or otherwise such undertakings may end up with failure.

2) For agriculture development of agricultural field, it is desirable to provide paddy fields in lowland in view of the maintenance of soil fertility. In the case of upland, even though it looks suitable as arable land from the soil condition, the field should be set in and lower than the midslope of a hill and the portion higher than that should be left as water conservation forest.

7. Summary

This research was intended and carried out to clarify the study methods for the extraction of basic problems related to the crop cultivation in relation to the development of forest in East Kalimantan. The survey was carried out in the following fields of transmigrated area regarding weather conditions, kinds and growth of crops cultivated, soil conditions, plant pests and weeds and so forth.

A) Kutai area: Loakulu, Maluhu, Rempanga, Bukitbiru, Hasfarm, and Loajanan.

B) Samarinda area: Samboja, Muara Jawa Kampung - Batuch.

(1) Results of the Survey

1) Climate

A. Temperature

The annual mean temperature was 26 - 27°C and the difference between the highest and lowest temperature was 12 - 13°C throughout the year.

B. Precipitation

The annual precipitation was approximately 2,000 mm and the number of rainy days was 100 or over. The precipitation and the number of rainy days were smallest in September. Variation in precipitation was relatively small throughout the year but large by months. In a certain year, monthly precipitation was shown to be extremely small (less than 30 mm), with caused drought injury in some area. Precipitation and the number of rainy days tended to increase in inland.

Discrimination between the dry season and rainy season was unclear.

2) Kind of Crops Observed in Transmigration Area

Crops of approximately 30 families and 50 genera were observed and classified into four main crops as follows:

Edible crops: rice (lowland and upland rice), maize, cassava, sweetpotatos, taro, peanut, soybean and other leguminous plants.

Fruit crops: banana, papaya, citrus fruits, jack fruit, rambutan, durian, langsat, mangosteen and others.

Vegetable crops: tomato, eggplant, cabbage, ganges amaranth, chilli pepper, cucumber and others.

Estate crops: coffee, cacao, coconuts, clove, nutmeg tree, cinnamon, para rubber, pepper and others.

3) Cropping System

The following are the cropping system.

Monoculture: rice, maize, cassava, pepper, coffee, para rubber, clove and others.

Mix cropping: fruit trees and estate crops

Inter-cropping: maize-cassave-sweet potato; peanut-maize; coconut-coffee

4) Soil and Plant Growth Relationship

Survey of the plant growth was made on maize and pepper.

A. Maize

The surveies were made in the Maluhu and Bukitbiru fields cultivated by transmigrants from central Java.

The Maluhu field was located on steep slope land (18 - 22°) and the survey was made by measuring the plant height of maize 45 days after sowing along the contour line. The results shown that individual variation was large among the plants (plant height = 111.7 ± 20.8, CV = 18.6 %). This was considered due to ununiformity of seed quality.

The Bukitbiru field was on slope land gentler (11 -12°) than that at Maluhu and the survey was made by measuring the plant height of maize along the contour and slope line. The results indicated that the growth was relatively uniform as compared with the case of Maluhu, however, the individual variation among the plants along the slope was greater than that along the contour line. As the growth of the plant was affected by the depth of top soil layer, the crop was growing well in the field with deep layer of top soil.

In soil profile in both the Maluhu and Bukitbiru fields, there was no humus in the A layer in comparison with that of selection cutting system forest at Sebulu and this proved that physical and chemical properties of the soil had been deteriorated.

Therefore, the cultivation of crops in the tropical rain forest zone should be done the maintenance and improvement of soil fertility in addition to the prevention of soil erosion due to rainfalls.

B. Pepper

The survey was held in Loajanan. Pepper plants about three years after planting were used to survey their growth by measuring plant height. The results showed that individual variation of the growth was large (plant height = 178.6 ± 38.0 cm, CV = 21.3 %) with a high percentage of missing plants. The field shown no top soil layer with heavy soil erosion. Therefore, the reasons for bad growth were considered to induce by improper soil management after planting.

C. Diseases and Weeds

Since East Kalimantan is placed under humid tropic conditions, the situation helps disease infection and weed growing.

Edible, horticultural, estate and many other crops were observed to have been infected with diseases. Rice was the most important crop in this area and infectious rice with rice blight was not observed.

There were many kinds of weeds and highly harmful weeds were often observed in upland and lowland fields, especially lowland. As weeding requires heavy labor, it is necessary to establish mechanical and chemical weeding methods for the purpose of reducing such labor.

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