Government of Central Kalimantan

Government of Indonesia

Government of the Netherlands

Master Plan for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project Area in Central Kalimantan






FORESTRY IN THE EX-MEGA RICE PROJECT AREA IN CENTRAL KALIMANTAN

Technical Report No. 6

OCTOBER 2008

Euroconsult Mott MacDonald and Deltares | Delft Hydraulics
in association with
DHV, Wageningen UR, Witteveen+Bos, PT MLD and PT INDEC

Master Plan for the Rehabilitation and Rehabilitation of the Ex-Mega Rice Project Area in Central Kalimantan

Technical Report Number 6

Forestry in the Ex-Mega Rice Project Area in Central Kalimantan

Peter J. Van der Meer[1] & Bismart Ferry Ibie[2]

1 Wageningen UR

2 University of Palangka Raya

Government of Indonesia

Royal Netherlands Embassy, Jakarta

Euroconsult Mott MacDonald & Deltares | Delft Hydraulics

in association with

DHV
Wageningen UR
Witteveen+Bos Indonesia
PT. MLD
PT. Indec

October 2008

Table of contents

List of annexes

List of tables

List of figures

List of boxes

List of abbreviations

CA	Cagar Alam (Strict Nature Reserve)
CIMTROP	Centre for International Co-operation in Management of Tropical Peatland
EMRP	Ex Mega Rice Project
HL	Hutan Lindung (Protection Forest)
MRP	Mega Rice Project
MP	Master Plan for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project
NP	National Park
PA	Protected Area
PLG	Proyek Lahan Gambut (Indonesian acronym for MRP)
SM	Suaka Margasatwa (Wildlife Reserve)
TN	Taman Nasional (National Park)
UNPAR	University of Palangka Raya
KPH	Kesatuan Pengelolaan Hutan (Indonesian Acronym for FMU)
FMU	Forest Management Unit
PSF	Peat Swamp Forest
UPT	Unit Pelaksana Teknis (Technical Implementation Unit)
GDP	Gross Domestic Product
BAPPEDA	Badan Perencanaan Pembangunan Daerah (Provincial Development Planning Agency)
HPH	Hak Pengusahaan Hutan (Forestry Concession)
BKSDA	Balai Konservasi Sumber Daya Alam (Natural Resources Conservation Bureau)
HPT	Hutan Produksi Terbatas (Limited Production Forest)
HCVF	High Conservation Value Forest
CDM	Clean Development Mechanism
NTFPs	Non Timber Forest Products
CKPP	Central Kalimantan Peatland Project
REDD	Reduced Emissions from Deforestation and Forest Degradation
LULC	Land Used Land Use Change
BPDAS	Balai Pengelolaan Daerah Aliran Sungai (Watershed Management Bureau)
HTI	Hutan Tanaman Industri (Timber Estate)
R & D	Research and Development
ITTO	International Tropical Timber Organization
HKm	Hutan Kemasyarakatan (Social Forestry)
UNDP	United Nation Development Programme
WCMC	Word Conservation Monitoring Center
MoF	Ministry of Forestry
CIFOR	Center for International Forestry Research
ANR	Assisted Natural Regeneration
MRP	Mega Rice Project
DAK-DR	Dana Alokasi Khusus-Dana Reboisasi (Specific Allocated Funds-Reforestation Fund)
GNRHL-Gerhan	Gerakan Nasional Rehabilitasi Hutan dan Lahan (National Movement Rehabilitation of Forest and Land)
HTHR	Hasil Tanaman Hutan Rakyat (Yield of the Community Forest).

Summary

Forestry provides many opportunities for the sustainable development of the EMRP area. Although a large part of the original forest area in the EMRP has been degraded or destroyed, the remaining forest and degraded areas provide opportunities for the provisioning of a wide range of goods and services. However, this will only be possible when several issues have been addressed. There is a lack of clarity and consistency in many aspects of forest policy and management and illegal logging is still a major problem. A new forestry approach in the EMRP areas is needed to tackle these problems in an integrated way which should lead to the sustainable use of a renewable natural resource. This report gives a background and outline for reforestation and forest rehabilitation strategies in the EMRP area.

Many technical, social, legal, and institutional challenges in the field of forestry remain. Illegal logging remains a main threat to sustainable management of the forests in the EMRP area. Planting the right species at the right place is not always easy (or feasible) due to lack of availability of seeds and seedlings, but also because of lack of knowledge which species grow where best. Survival of planted seedlings is often low due to absence of care after planting. Monitoring of reforestation programs is poor, which is hampering the improvement of technical knowledge. Lack of local involvement has been causing difficulties with the implementation of rehabilitation programs initiated by the central government. New, innovative approaches are needed which combine the development and application of novel reforestation techniques with socio-economic benefits to private companies and local people.

Forest rehabilitation and restoration will be the most important forestry activity in the EMRP area. Forest rehabilitation can only be successful by addressing technical, socio-cultural, economic and institutional aspects. Forest rehabilitation plans should be based on balanced decisions on ecological goals, ecosystem services, competing land uses, and economic costs and benefits. Proper monitoring and after-care of reforested areas is essential.

Small scale rehabilitation programs should be done through community-led reforestation program, but in more remote parts of the area either large-scale forest rehabilitation or natural succession will be required. Pilot species trials show that various species can be successfully grown, and that this can be done in several ways, including agro-forestry techniques. Adequate law-enforcement is needed to ensure that management regulations will be properly implemented.

Recommendations are given for further development of forest rehabilitation and restoration approaches in the EMRP-area.

1 Introduction

Much of Central Kalimantan was originally covered by tropical rain forest which was rich in flora and fauna and was providing many goods and services to local communities. Use of the forest was mainly limited to coastal areas and river sides, which has been used and exploited during centuries. More remote, inland forest areas were used more extensively and most forests in these scarcely populated areas remained relatively undisturbed in the era before the 1950's. From 1980's onwards concession logging was practiced particularly in the inland peat swamp forests which may have increased forest disturbance locally.

In 1995, the Government of Indonesia initiated the Central Kalimantan Peatland Development Project – commonly known as the Mega Rice Project (MRP) - to convert up to one million hectares of peat and lowland swamp forest for rice cultivation. The project has led to serious degradation and deforestation of the area as a result of drainage, logging, and wildfires. After the formal closure of the MRP in 1999 illegal logging increased and by 2007 a large part of the forest in the Ex-MRP (EMRP) area has either disappeared or is badly damaged by over-exploitation, drainage, and burning.

With the launch of the Presidential Instructions (Inpress) No 2/2007 an official start was made with revitalisation of the EMRP area. The Inpress No 2/2007 aimed at rehabilitating and conserving peat and land in the EMRP area and restore its original condition. In addition the Master Plan (MP) for the Rehabilitation and Revitalisation of the Ex-Mega Rice Project was drafted to help assist and improve the implementation of the Inpress No 2/2007. Within the MP reforestation and forest rehabilitation play an important role. For instance, an estimated 400,000 ha of peat more than 1m deep is now without forest cover and much of this needs to be reforested. An additional 130,000ha of shallow peat (0.5m-1m) without forest could also be targeted for reforestation, although part of this area is likely to be used for agriculture by local communities.

Forest restoration in the EMRP area is urgently needed as this will provide direct income for local communities and at the same time will increase biodiversity levels and enhances long-term productivity of the forest. However, many legal, institutional, social and technical challenges remain like illegal logging, legislative discrepancies, lack of local involvement, and problems with species choice, survival, and monitoring. A new forestry approach in the EMRP areas is needed to tackle these problems in an integrated way which should lead to the sustainable use of a renewable natural resource.

This report gives a background and outline for reforestation and forest rehabilitation strategies in the EMRP area. We start with a chapter on forest cover, forest use, and forest management including the setting of boundaries of state forest areas. In the subsequent chapter the potential for forest restoration in the EMRP is discussed, focussing on both strategies as well as potential species. Also an overview is given of some recent experiences with forest restoration activities in the EMRP area. In chapter 4 the planning, implementation and financing of forest rehabilitation is given, followed by the conclusions and recommendations in the final chapter 5.

2 Land Cover, Forest Use and Forest Management in the EMRP area

2.1 Forest cover in the EMRP area

Originally most of the EMRP area was covered by peat swamp forests (PSF) on the peat areas, and lowland swamp forest on the mineral soils. Mangroves and riverine forest occurred along the coast and main rivers. Based on the soil and peat classification maps (ref Hydrology / peat report) some 927,063 ha of the EMRP area is covered by peat and the remaining 532,405 ha is covered by mineral soils.

At present, most forest of the EMRP-area has either disappeared or has been badly damaged as a result of land-clearing, over-exploitation, drainage, and/or burning. Many of the naturally abundant tree species have disappeared, and large areas are dominated by shrubs and a dense ground cover of ferns and sedges.

SARvision (2008) identified 22 vegetation and land-use classes in the EMRP area. Sixteen of these classes are referring to vegetation types which are either (degraded) forest, or are vegetation types which are the result of severe forest disturbance or forest clearance. We have grouped these 16 vegetation classes in the following 4 (forest-) vegetation groups:

- Forest (including logged-over forest) with tree cover > 10%;
- Severely degraded forest with tree cover <10%;
- Shrubland with vegetation cover > 10%;
- Open shrub with vegetation cover < 10%.

The remainder of the EMRP area is covered by a mixture of agriculture and settlements.

Table 2.1. *Main vegetation groups and their area covered (in ha) in the EMRP area (2008).*

Vegetation group	Area covered (ha)
Forest (including logged-over forest) (cover > 10%)	540,640
Severely Degraded Forest (cover <10%)	268,709
Shrubland (cover > 10%)	252,256
Grasslands, Ferns, Open shrub (cover < 10%)	221,224
Other (including agriculture & settlements)	179,467
TOTAL	1,462,295

Forest (including logged over forest) covers some 540,000 ha in the EMRP area (Table 2.1.). Peat swamp forest (including low pole forest with cover > 10%) is the most abundant forest type, covering almost 434,000 ha. This is around 47% of the peat swamp forest (PSF) area which was still present at the onset of the MRP in 1996. Large areas of these PSF have been selectively logged, but have retained much if not most of its biodiversity value. Some of the commercially interesting tree species have been removed, but in potential these forests may recover by themselves into productive and diverse ecosystems providing illegal logging is controlled and hydrology of the peat is undisturbed. Block E and B harbour the largest part of forest area, having been only partly logged (Figure 2.1). Also block A and C have some relatively

intact forest left, in both blocks some substantial areas of PSF are located in the northern parts (close to Block E). However, especially in block A, drainage, fires, and illegal logging are causing major threats to these forests. Patches of lowland swamp forest are found on the mineral soils in Block A and D. Mangrove and riverine forest occur along the coast and main rivers which have been used and exploited during centuries.

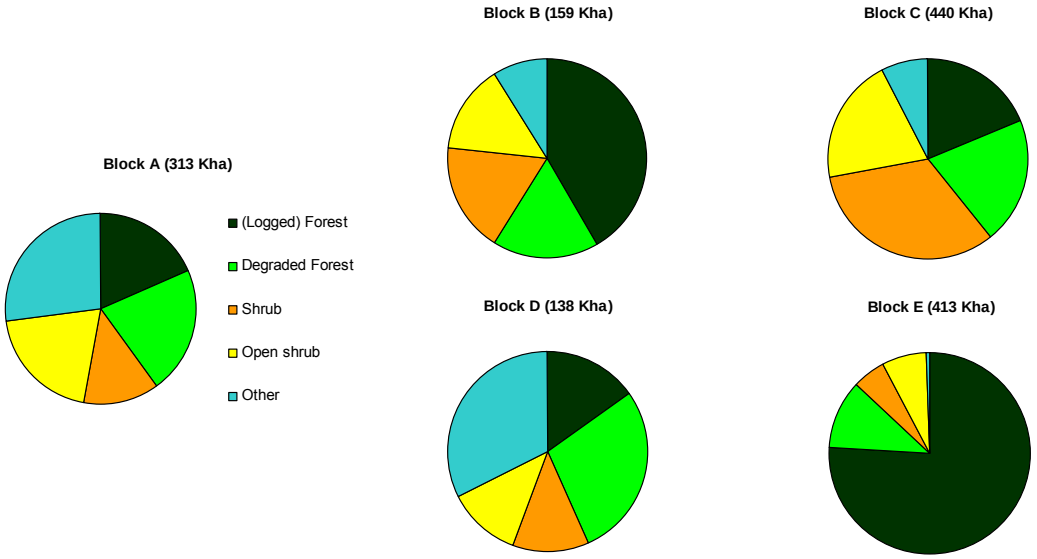

Figure 2.1. *Proportion of main vegetation groups in each of the five Blocks of the EMRP area.*

Severely degraded forest covers some 269,000 ha of the EMRP area. These areas include for a large part degraded PSF which have lost most of their canopy tree cover and its associated biodiversity, leaving a fraction of the original flora and fauna. To the west of block C and north of block E the (degraded) peat swamp forests border on still large contiguous forest areas which provide good opportunities for using natural regeneration processes for the rehabilitation of these areas. In the south of block C some areas are dominated by stands of Gelam. Severely degraded forest covers a relatively large area in Block C (Figure 2.1). Here a more active approach will be needed to rehabilitate these forests due to the isolated location and absence of forest in its immediate neighbourhood.

Shrubland covers 252,000 ha of the EMRP-area (Table 2.1.). This includes both flooded and non-flooded areas dominated by shrubs and re-growing trees ranging in height between 0.5-5 m. Often these areas were originally covered by (peat swamp) forest which was either logged, cleared, and/or bunt. Most shrubland is found in Block C (Figure 2.1) where it covers some 144,000 ha in especially the southern part. Most of this is located on a (deforested) peat dome which is partly being drained by several canals.

Open shrub (including grass, fern, and sedges) covers some 221,000 ha of the EMRP-area (Table 2.1). Like shrubland these areas where in many cases originally covered by forest but have now been cleared or burnt. The main vegetation layer consists of closed to open herbaceous vegetation, with the height ranging between 0-3m. This class includes large areas dominated by ferns and sedges in previously burnt areas and sedge/grasslands (usually dominated by *Scleria* spp.) and will probably be the most difficult areas to rehabilitate. Most open shrub is found in Block C (Figure 2.1) where it covers some 90,000 ha in especially the southern part. Also in block A, a substantial part (63,000 ha) is covered by open shrub.

BOX 1. *Vegetation groups based on sub-classes as given by Sarvision (2008) (in brackets the class number in the final map); see Sarvision 2008 for a detailed description of the individual vegetation and land-use classes.*

1. **Forest (including logged-over forest) with tree cover > 10%:**
   Peat swamp forest (cover >11%) (2): Riverine-Riparian Forest (cover >11%) (3) ; Low pole forest (cover >10%) (12): Mangrove (cover >11%) (15): Swamp forest (cover >11%) (20)
2. **Severely Degraded forest with tree cover <10%:**
   Woodland or degraded vegetation (cover 1-10%) (3); Burnt area- burnt tress (11); Low pole forest (cover 1-10%) (13); Mangrove (cover (1-10%) (14).
3. **Shrubland with vegetation cover > 10%:**
   Shrubland (cover >50%) -non flooded (4); Shrubland) (cover >50%) –flooded) (5); Shrubland (cover 11-50%) flooded or non-flooded (6);
4. **Open shrub with vegetation cover < 10%:**
   Shrubland (cover<10%) (7); Grassland + ferns (herbaceous) (8); Shrub cover, burnt (10); Sedges (16)
5. **Other (agriculture & settlements)**
   Open water (9); Fish ponds (17); Sawah (18); Dry-land agriculture (19); Tree crops (21); Urban areas (-).

2.2 Forest Use in the EMRP area

From 1980's onwards till the start of the MRP in 1995 concession logging was practiced, mainly in the inland peat swamp forests. Logging in these forests involved the felling of commercial trees like Ramin (*Gonystylus bancanus*) and Meranti, (*Shorea teysmanniana, S. platycarpa, S. uliginosa*). There are no figures on the economic yield and on how much forest area was affected during these logging operations but we suspect that logging did have a significant impact on flora and fauna. Giessen (1989) indicates that logging in a peat swamp forest area in South Kalimantan was not selective but rather a form of "successive" or re-entry logging where the best stems are harvested first, and the lower diameter trees are being cut during a second or third round of harvest. Rieley and Page (2008) indicate that between 1991 and 1997 logging, as well as land clearing for small scale farming and plantations, affected annually about 2% of the peat swamp forest area in Central Kalimantan. Between 1995-1999 an unknown but substantial amount of forest was lost during the conversion and canal construction phase of the MRP.

In 2001 forestry accounted for about 12% of GDP in Central Kalimantan, which decreased to 4% in 2006. Obviously logging was providing large revenues at the start of the MRP. Between 1994 and 1997 some 352,758 ha was logged in Central Kalimantan of which probably a large part originated from the MRP. This yielded an estimated 14,119,397 m^3 of timber (Soehardijono, 1997 in Limin living tree document), but how much of this came from the actual MRP area remains unclear. It is not known how much illegal harvesting of timber has been contributing to the economy of Central Kalimantan, but it is likely this was quite significant (estimate 10-30%) in early years of 2000.

Based on development data from BAPPEDA Tk.I Kalteng (1993/1994) the EMRP site was allocated as a (limited) cultivated area with soil physical limitation such as sand and peat depth > 2 m. According to the spatial planning map the EMRP-area was divided into four parts, i.e.: production forest, limited production forest, area for production development, and also area for settlement and others usage. For the plantation or estate activities, EMRP area was allocated for coconut, rubber, coffee, black/white pepper, clove, and

mixed commodities. From 1970 to 1994 there were 16 Forestry Concession (HPH) in the EMRP area operated for timber productions such as Ramin, Shorea, and other species. A list of its HPH is showed in Table 2.2.1, and its map is showed in Figure 2.2.

Table 2.2.1. *List of Forestry Concession (HPH) operated in EMRP.*

NO	Forestry Concession HPH	Area (ha)	Partly outside EMRP
1.	Daya Sakti	35.000	
2.	Sumber Alam Ramin	50.000	
3.	Kahayan Lumber	150.000	
4.	Arjuna Wiwaha	90.000	
5.	Djayanti Djaya I	217.000	
6.	Andalan Raya	450.000	X
7.	Mengkatip	50.000	
8.	Kayu Karya Utama	45.000	
9.	Salawati Makmur	60.000	
10.	Setia Alam Jaya	60.000	
11.	Pusaka Jaya Agung	86.000	
12.	Palangka Nusantara	100.000	X
13.	Kalang Murni	94.000	X
14.	Talawang	87.500	X
15.	Sipo Jaya Timber	103.000	X
16.	Sehati Rungan	77.000	X

For many years not only legal but also illegal logging practices have caused considerable environmental damage and social issues. Casson & Obidzinski (2007) indicate that illegal extraction and processing of timber in Kalimantan is a widespread, deeply entrenched problem with economic, social and ecological dimensions. Also in the EMRP area illegal logging provides employment opportunities that are both flexible and well paid in comparison to conventional labour. Logging by commercial logging companies (HPH) has currently stopped, but illegal logging activities are still widespread. For instance in the eastern part of Block E (Mawas area) several thousand logs are taken out monthly (mainly consisting of Jelutung (Dyera *polyphylla*) and terentang (*Campnosperma coriaceum*)). In some villages in the area (e.g. Mentangai, Manusup) many sawmills are operational. Also in the Western part of Block E and Northern part of Block B illegal logging activities are ongoing with at least several operational sawmills (Giesen, 2008).

The key natural resources currently (2007) extracted from forests for the whole province of Central Kalimantan are:

- Rubber (*Hevea brasiliensis*) plantations cover a total land area 396,708 ha and is the primary cash crop with a revenue in the first quarter of 2007 of US$ 20.208.658. Mix of large and small holders.
- Rattan: total production 529.553 tons during the first quarter of 2007 (undefined area and revenues). Mainly small holders and cooperatives.
- Timber: In the first quarter of 2007 there was a total log production of 1,737,202 m^3 (undefined area and revenues).
- Other non-timber forest products (NTFPs) like latex (e.g. Jelutung), resins, medicinal plants, game, fish, and seedlings are collected from the non-cultivated forest areas. Their quantities are not measured.

NB Oil palm plantations cover 571,873 ha (2007) in Central Kalimantan but are discussed under the agricultural production.

Table 2.2.2 shows the main goods and services which are being collected from the forest. An estimation is given on their importance for lively-hood, and an indication is given as to at what location these goods and/or services are being harvested/delivered.

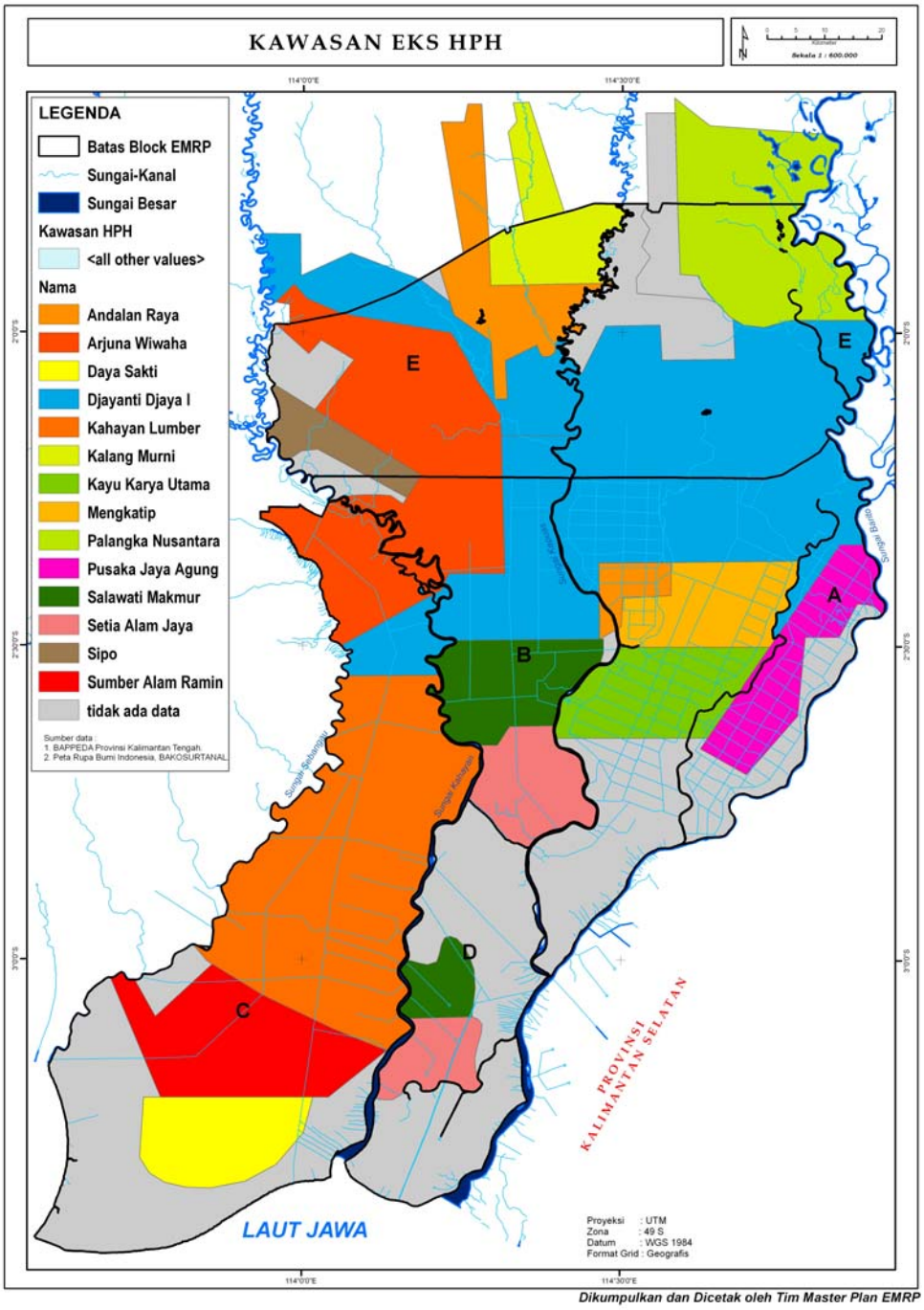

Figure 2.2. *Map of Ex Forestry Company (HPH) in EMRP (Bappeda Tk.I Kalteng, 1993/1994)..*

Table 2.2.2. *Use of Forest Goods and Services in the EMRP area.*

Category of Goods and Services	Goods and/or Services Delivered	Locations	Importance for livelihoods*
Provisioning	Rubber/Latex	Around villages and on riverbanks; non- or shallow peat ; community forests	+++
	Rattan	In disturbed peat forests; community forests	+++
	Timber	Both community and remote forests	++ (illegal)
	Fish	In creeks	+
	Seeds and seedlings	Both community and remote forests	+
	Resins and other NTFPs	Both community and remote forests	-
	Charcoal	Around villages	+
	Quartz	Specific locations	++
Regulating	Flood control	Whole area	+ (indirect)
	Climate regulation	Whole area	+ (indirect)
Supporting	Carbon	Whole area	+ (indirect)
Cultural	Adat forest	Specific locations	Neutral (indirect ?)
	Ecotourism	Rivers, wetlands	+

+++ = very important ; ++ important ; + little importance; - marginal

2.3 Forest Management in the EMRP area

2.3.1 Boundaries of the state forest areas

Based on the Forestry Law No. 41 from 1999, all of state forest in Indonesia should be managed by Kesatuan Pengelolaan Hutan (KPH). KPH is a Forest Management Unit (FMU) at site level which is formed to implement effective forest management. There are three types of KPH based on three functions i.e.: (1) KPH Production, (2) KPH Protection, and (3) KPH Conservation. FMUs are to be the smallest management units for forestry, and are to consist of single ecosystems or cover one watershed. More than one function may occur in a single FMU, but it is to be classified according to the dominant type of function.

KPH Production and KPH Protection are arranged by Local Government (Provincial) whereas KPH Conservation is arranged by the Department of Forestry through Balai Konservasi Sumber Daya Alam (BKSDA/Natural Resources Conservation Unit) (Figure 2.3.1). Up to now, the Forestry Official of Central Kalimantan Province arranged the KPH Action Plan.

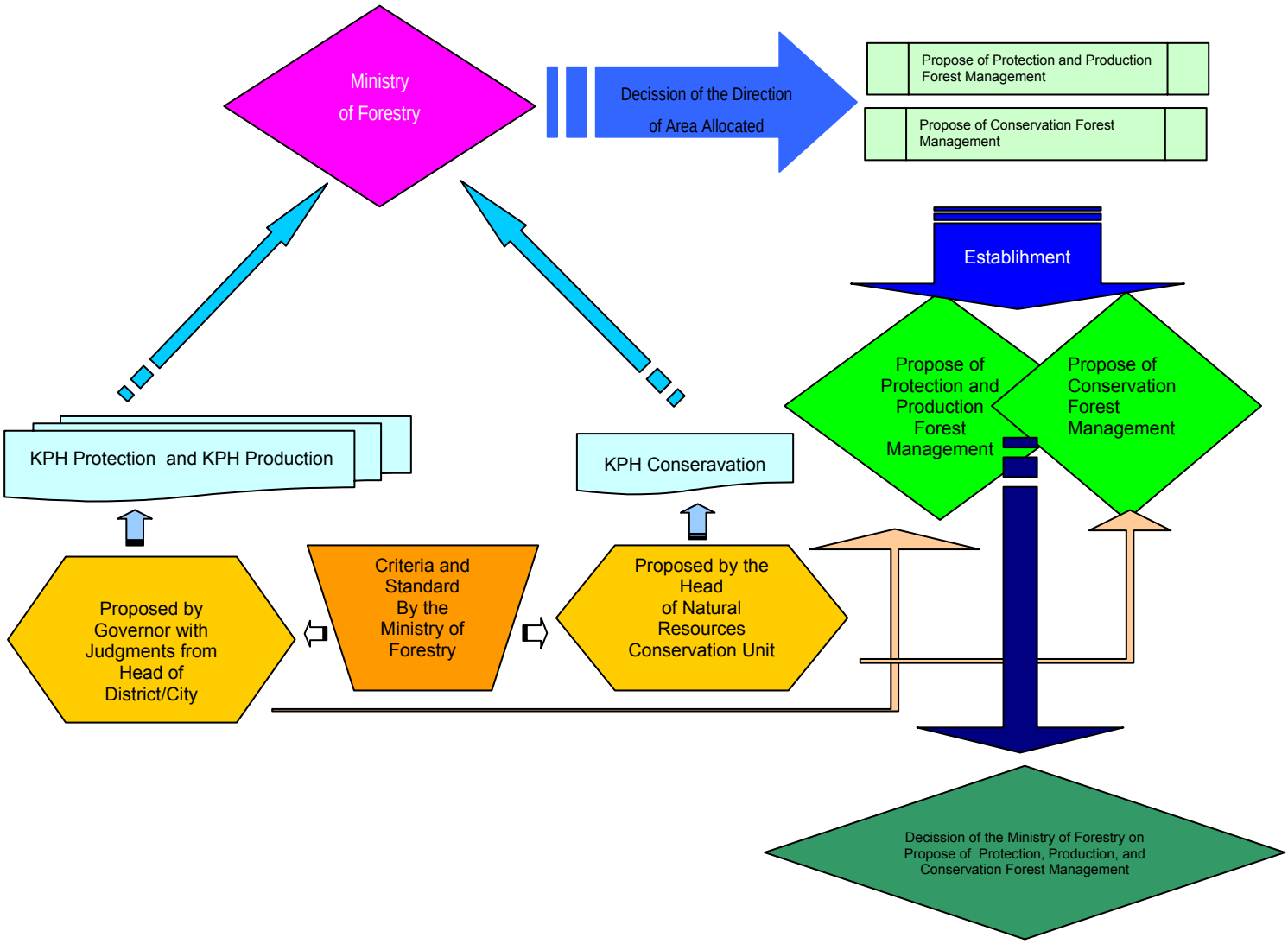

Figure 2.3.1 *Procedure establishment of KPH Production, KPH Protection, and KPH Conservation (Badan Planologi Kehutanan, 2007).*

In establishing the boundaries for state forest land and its respective function (KPH) it is important to consult with local stakeholders. We propose that stakeholder meetings and community land mapping is taken into consideration in developing new boundaries for the KPHs in the EMRP area.

2.3.2 Forest conservation areas (KPH Conservation)

KPH Conservation are formed following article 29 Government Law No.44 Year 2007. First, the Government Unit Management in Provincial level, such as BKSDA, proposes its technical design, which is guided by criteria and standards designed by the Ministry of Forestry. Secondly, based on the proposed design the Ministry of Forestry will give directions for the allocation of an area. Finally, as a follow up on these directions the Ministry of Forestry will take a final decision on the KPH Conservation. (see also figure 2.3.1)

A total of 60 % of the total of 1,454,541 ha of land in the EMRP area will be designed as forest conservation area. Once demarcated, the conservation areas will formally become public property. The establishment of conservation areas may come at the expense of community access and management rights, contributing to increasing conflicts between the social, cultural and economic interests of local people in forests and public environmental goals. It is therefore essential to link local interests in forest and local knowledge of the forest environment with the aims of forest conservation and rehabilitation of degraded peat forests. A process of local negotiation and participatory conservation planning is necessary to resolve competing land management systems and claims and arrive at sustainable forest management solutions.

The INPRES 02/2007 (see Box 2) includes a draft spatial plan developed in conjunction with Department Kehutanan's (2007) Master Plan listing seven broad "conservation targets":

1. Conservation of Flora & Fauna
2. Mangrove Conservation
3. Conservation of Black Water Systems
4. Hydrology Conservation
5. Conservation of Quartz Sand
6. Conservation of Deep Peat
7. Conservation of Melaleuca forest & Lepironia sedges

The Forestry Department Master Plan proposes that each of these seven targets will be designated as

- Protection Forest (Hutan Lindung/HL),
- Strict Nature Reserves (Cagar Alam/CA),
- Wildlife Reserve (Suaka Margasatwa/SM)
- Limited Production Forest (Hutan Produksi Terbatas/HPT),

The grouping will depend on the degree of disturbance of the original habitat and the type of utilisation by local communities. The report provides figures on the land cover (esp. tree cover) of each of the seven conservation targets, it does not provide this for the conservation designation type (HL, CA, SM or HPT).

BOX 2 *Headline of Conservation Program Inpress 2/2007*

• Definition of the forest boundary through a Decree of the Minster of Forestry;
• Deep peat conservation (281,200ha) with damming of canals to bring water levels up to 40cm;
• Gelam forest conservation (76,300ha) and planting of 7,000ha of gelam;
• Hydrology conservation (273,400ha) with damming of canals to bring water levels up to 40cm and encouragement of natural vegetation succession;
• Flora and fauna conservation (133,000ha) with reduction in illegal logging, damming canals to bring water levels up to 40cm, enrichment planting and conservation management;
• Heath (kerangas) forest conservation (87,700ha);
• Black water ecosystem conservation (18,700ha) with damming of canals and replanting of native species;
• Mangrove forest conservation and restoration (27,100ha) with replanting
• Forest and land fire management to reduce fires to 5% (not specified of what)
• Reforestation of 10,000 ha per year through planting of 12.1 million trees.

As observed by Giesen (2008) the conservation program under Inpress 2/2007 holds some inconsistencies. For instance the seven conservation targets and four conservation designation types do not match the FMU/KPH approach which has only three functions (Conservation, Protection and Production). Also conservation of Gelam forest does not make much sense as these are heavily degraded forest with little conservation value and lots of local commercial value. Finally the proposed mangrove conservation area is not forested at present and has been for a large part converted to brackish water fishpond (tambak); in contrast an adjacent area mapped on the Forestry Department Master Plan as 'Tambak' (between the Kahayan and Kapuas rivers) actually consists of primary mixed mangrove habitat with a very high biodiversity value.

2.3.3 Protection and Production forest areas (KPH Protection and KPH Production)

KPH Protection and/or **KPH Production** are formed following article 30 Government Law No.44 Year 2007. First, the Governor with judgments from the Head of District/City will make a Technical Design for a KPH Protection and/or KPH Production. This technical design should meet the criteria and standards as decided by the Ministry of Forestry. The design is lodged to Ministry of Forestry by the Governor, and the Ministry of Forestry will give directions for an allocation area for KPH Protection and/or KPH Production. Subsequently the Governor will establish a KPH Protection and/or KPH Production, which finally needs to be approved by the Ministry of Forestry, and based on its authority, it will decide as KPH Protection and KPH Production (see also figure 2.3.1)

The highest opportunities for KPH could be implemented in EMRP areas are KPH Protection and KPH Production. Both of those KPH terms are indicated through Management Unit I, II, III, and IV (See first draft for consultation, July 2008; Chapter V, Key issues and its key interventions). Those opportunities also supported by direction map of Inpress No.2 Year 2007 (Figure 2.3.2.) and result of discussion between Department of Forestry, Indonesian Science Institute, Ministry of Environmental, BAPPEDA (2007) as shows in Figure 2.3.3.

Following an action plan for the establishment of KPH in Central Kalimantan Province arranged by Forestry Official of Central Kalimantan Province and Faculty of Agriculture UNPAR (2007), there are three steps in the development of KPH Protection and KPH Production, i.e.:

1. Arranging design plan for protection and conservation forest unit management, with priority programs as below:
    a. Establishment of task forces to arrange design plan for protection and production forest unit management
    b. Establishment of Inventory Team of forest inventory and forest usage of protection and production forest unit management
2. Arranging the management institution of KPH Protection and KPH production, with priority programs as below:
    a. Establishment of task forces to arrange the management institution of KPH Protection and KPH Production
    b. Establishment of coordination team to arrange KPH Protection and KPH Production for Central Kalimantan Province and or/district/city
    c. Establishment of team to arrange standard operating procedure (SOP) to monitoring and evaluation of implementation of KPH Protection and KPH Production

d. Establishment team to find out a chance to invest in KPH Protection and KPH Production
e. Establishment team to improve human capacity building for management of KPH Protection and KPH Production

3. Arranging management plan of KPH Protection and KPH Production, with priority programs as below:
   a. Establishment team to arrange management plan for KPH Production and KPH Production
   b. Establishment team to arrange budgeting and implementation of field activities
   c. Establishment team monitoring and evaluation of implementation of the work plan.

Below we propose a framework which can be used to check what can and what cannot be done under the three KPH functions Conservation, Protection, and Production.

Table 2.3.5. *Overview of forestry activities which can be done under three different KPH functions.*
+ = can be done - cannot be done

Use	Conservation status	Protection status	Production status
.			
Harvesting of NTFPs	+	+	+
Selective logging	-	-	+
Community forestry	-	+	+
Commercial logging	-	-	+
Plantation establishment	-	-	+

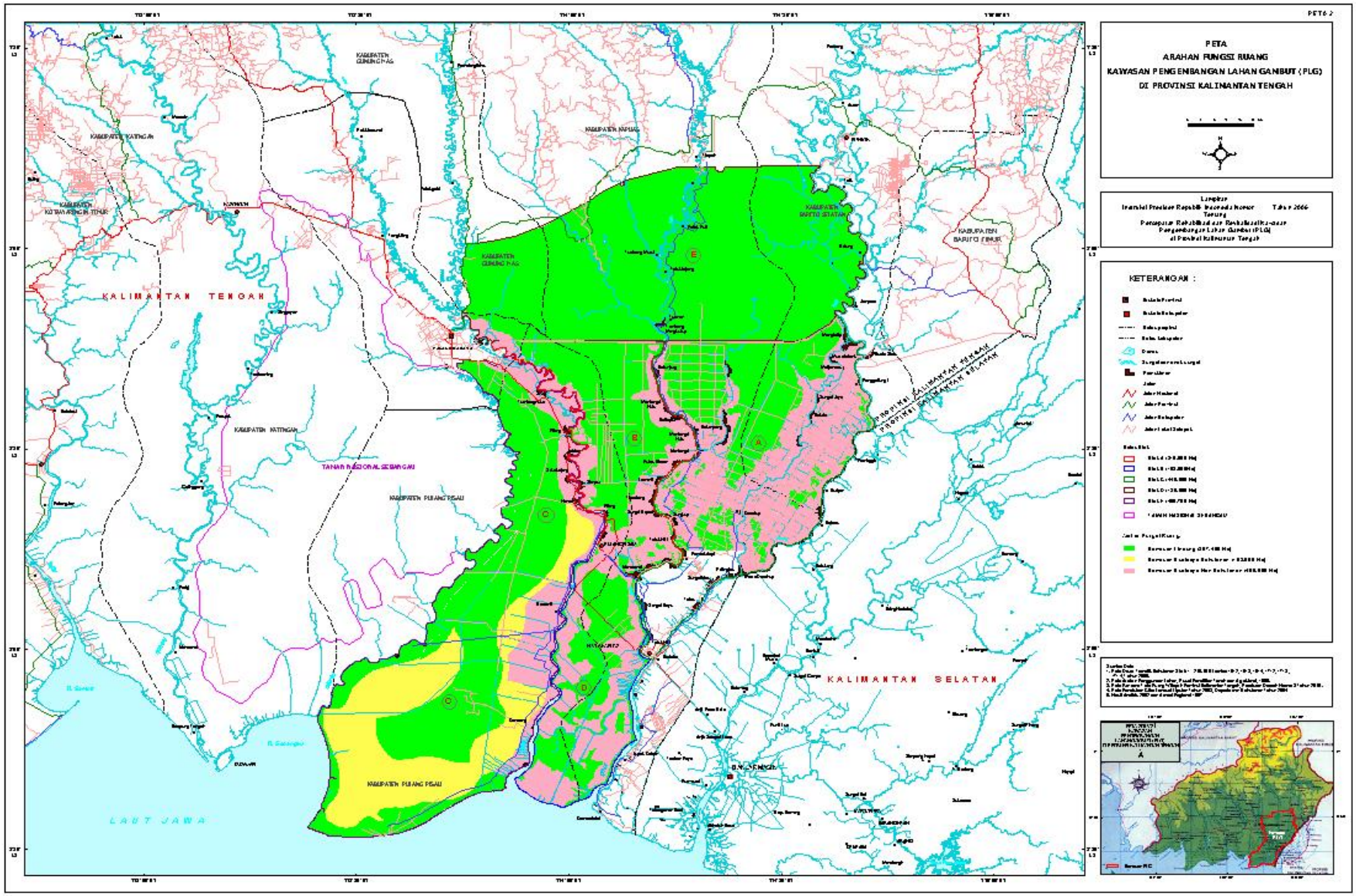

Figure 2.3.2. *Map of Direction on Inpress No.2 Year 2007.*

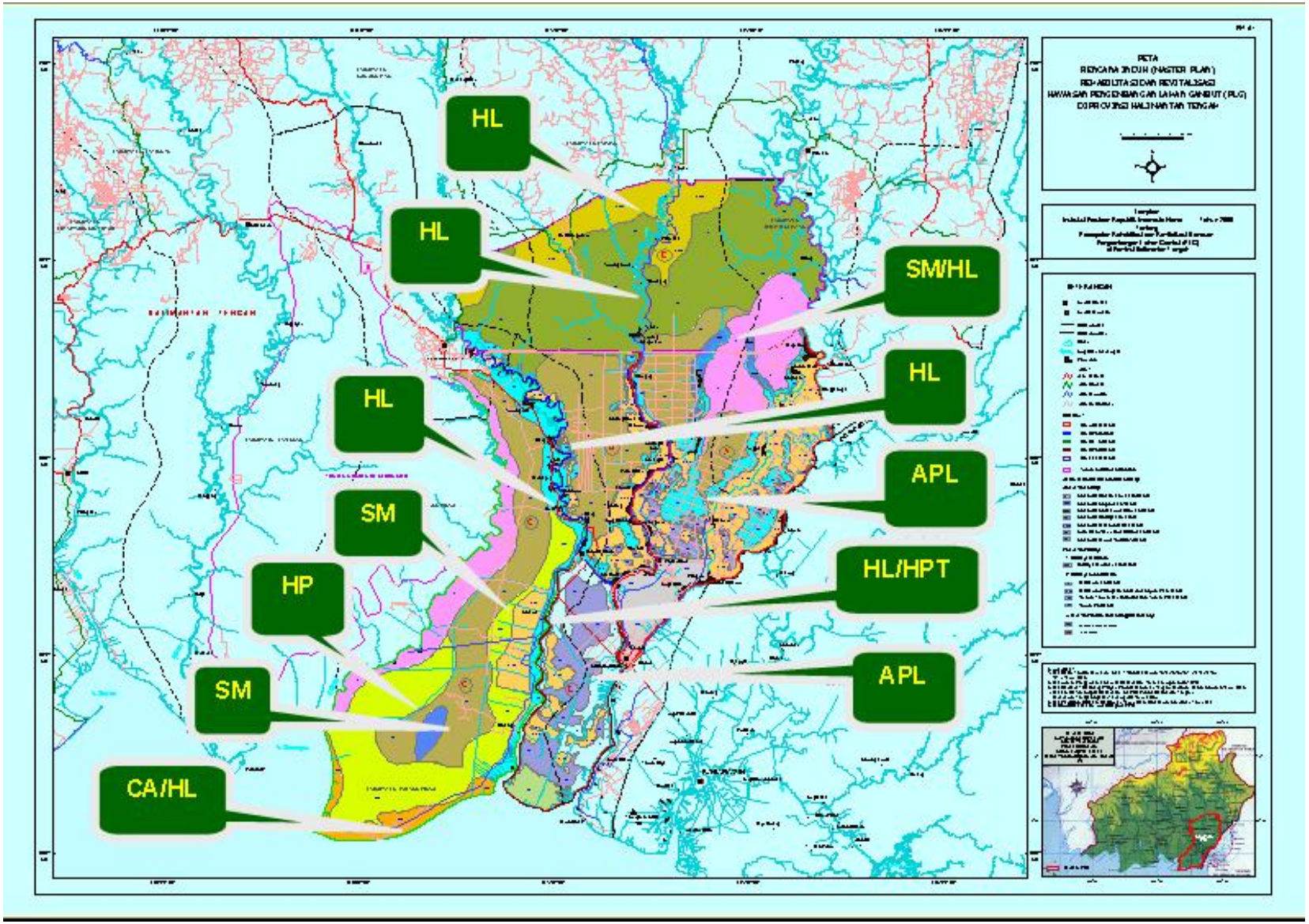

Figure 2.3.3. *Map of discussion result between Department of Forestry, Indonesian Science Institute, Ministry of Environmental, BAPPEDA (Pusat Pengukuhan dan Penatagunaan Kawasan Hutan, 2007).*

2.4 Main forestry strategies

Based on the LULC map we suggest the following rough classes for conservation and reforestation:

- Areas with a forest cover greater than 50% would be selected for conservation;
- Areas with a forest cover between 10-50 % would be selected for reforestation;
- Areas with the lowest forest cover class (<10% tree cover) would generally require heavy investment for reforestation. These would require major investment to achieve reforestation and could be possible sites for non-forestry purposes.

Other factors including distance from urban centres/settlements and peat thickness are also important criteria influencing selection of forest activities. For instance, we suggest to prioritise forest conservation rehabilitation activities in the thicker (> 3 m) peat areas. Shallow peat areas (< 3 m deep) will be more likely to be developed for agricultural use, with which it will be hard to compete economically although ideally these should also be forested.

2.4.1 Forest conservation

Areas with high forest cover are more likely to regenerate naturally, provided illegal logging and fires are prevented. The most obvious dominant FMU type would be conservation. Based on other factors such as peat thickness and location of villages a further refinement should be made to the conservation FMU to allocate sub-functions to specific sub-regions in the FMU. Working with stakeholders in a participatory approach is needed to identify high conservation value forest (HCVF) which needs protection (e.g. local biodiversity hotspots), in combination with information on local livelihoods and agricultural systems.

Appropriate key strategies:

- Identification of local biodiversity hotspots and priority areas of degraded forest to be linked to them
- Formulation of objectives and preparation of management plans for joint conservation and livelihood use
- Identification and mitigation of key threats to biodiversity loss
- Explore alternative incomes for forest protection through REDD and other initiatives

2.4.2 Rehabilitation/reforestation

Balai Pengelolaan DAS Kahayan is coordinating the rehabilitation of forest and land in the ex-PLG area. This agency is responsible for Gerhan (Land Rehabilitation Movement). In 2007 the Gerhan program in Central Kalimantan covered 78,000 ha. Field observations show that implementation and success rate can be locally problematic possibly because of poor species-site matching and the lack of after care.

Appropriate key strategies:

- Protect, diversify, and sustainably manage the areas with more than 50% tree cover using natural regeneration and succession
- Restore degraded forest areas (10-50% cover) through enrichment planting and reforestation
- Reforestation of heavily degraded and burnt areas (< 10% cover) with appropriate pioneer species

Specific guidelines will have to be developed for:

- Species – site matching (including species trials),
- growth of seedlings for reforestation activities (including setting up of nurseries),

- preparation of planting sites,
- planting of seedlings,
- after care including weeding, wildfire prevention, replacement planting and security
- evaluation and monitoring

Chapter 3 & 4 will discuss forest rehabilitation in more detail.

2.4.3 Community forestry

Currently many (traditional) villages in the EMRP area have a forest garden system of which up to 90% consists usually of rubber (*Hevea brasiliensis*). Durian, coffee, sago and banana are also cultivated. Production of older Rubber trees is decreasing and production should be stimulated. Research is needed to identify solutions.

Appropriate key strategies:

- Promote and conserve local forestry practices (including agroforestry systems) in and around village areas
- Stimulate growth and production of specific high value tree crops (e.g. rubber)
- Develop suitable agroforestry systems for new transmigrant villages

2.4.4 Timber Plantations

Timber is currently scarce in the EMRP area. Forest plantations can help to relieve the pressure on natural forests by producing high quality timber in a highly efficient way. Apart from technical issues like species choice and optimisation of silvicultural techniques, land availability, financial and social issues will need to be addressed to identify the needs and develop appropriate plantation strategy for the region, including

Appropriate key strategies:

- Stimulate the development of fast growing, high quality timber plantations.
- Financial and other incentives to promote private sector participation
- Technical support, plantation silviculture, seed supplies, R&D requirements
- Effective institutional arrangements
- Implications for industry
- Link with REDD

3 Restoration of Degraded Forest Areas

3.1 Forest degradation

Forest degradation refers to the reduction of the capacity of a forest to produce goods and services (ITTO 2002). Degraded forest has (partly) lost the structure, function, species composition and/or productivity natural forest types.

Three broad conditions of degraded forests can be identified (cf ITTO 2002):

1. **Degraded primary forests** retain many of the physical (soil, humidity) and structural characteristics of the former primary forest, as well as a generally heterogeneous species composition. Without silvicultural interventions, natural succession in degraded primary forests will eventually restore most of the characteristics of primary forests;
2. **Secondary forests** comprise various stages in the process of succession. The dominant trees of the initial colonizing phase are short-lived, fast-growing pioneers; structure and species composition are changing in the course of one to two centuries. Depending on site quality restoration of the full range of species may require several centuries.
3. **Degraded forest lands** are characterized by eroded or nutrient-deficient soils, hydrologic instability, reduced productivity and low biological diversity. Persistent physical, chemical and biological barriers prevents natural succession. Many factors like low propagule availability, seed & seedling predation, lack of suitable microhabitats for plant establishment, low soil nutrient availability, and fire prevent natural forest regeneration.

These three categories usually exist in complex mosaics that are constantly changing which makes it sometimes difficult to distinguish between them. There are generally clear difference between the three different categories, relating for instance to the intensity and cause of the disturbance, and the vegetation development process (see Table 3.1).

Most forests in the EMRP area would classify as degraded forest lands and secondary forest. Only a small proportion of the forests in the EMRP classified as forest (cover >10%; table 2.1) would classify as degraded primary forest.

Table 3.1. *Differences between the three major categories of degraded and secondary forests (ITTO 2002).*

	Degraded primary forest	Secondary forest	Degraded forest land
Intensity of disturbance	▪ Slight to moderate intensity within the range of common natural disturbances	▪ Severe intensity, caused by the clearing of at least 90% of the original forest cover	▪ Drastic and repeated intensity with complete removal of the forest stand, loss of topsoil, and change in microclimate
Common causes of disturbance (human-induced or natural)	▪ Excessive wood exploitation ▪ Over-harvesting of non-wood forest products ▪ Destructive natural disturbances such as forest fires, storms ▪ Over-grazing	▪ Clear-cutting, burning and subsequent abandonment of an area ▪ Catastrophic large-scale natural disturbances: eg fire, flooding, storms, landslides	▪ Repeated over-use, repeated fire, grazing, or ecological mismanagement on fragile soils ▪ Soil erosion
Vegetation development process	▪ Relatively small changes in growth and regeneration dynamics, except where over-grazing prevents natural regeneration ▪ Relic trees are often damaged (crown, stem), or are potential 'losers' unable to achieve dynamic regrowth or are phenotypically inferior ▪ Recovery mainly through autogenous and spontaneous cycle replacement regeneration, usually complemented by coppice and seed bank ▪ Species composition change with over-exploitation of timber ▪ Successional changes are limited to more intensively affected areas	▪ A sequence of successional changes takes place after the perturbation. In this process, several phases or stages with specific floristic, structural and dynamic characteristics can be distinguished. Plant species composition changes in dominance gradually from early to late successional species ▪ Start of a highly dynamic growth process, with high rates of carbon assimilation and biomass aggregation	▪ There is only very sluggish successional development after the cessation of the main disturbance ▪ The process generally leads directly from forest cover to grassland or bushland, or, in extreme cases, to barren soil surface
Characteristics	▪ Forest structure not significantly damaged ▪ In forests subject to over-grazing, poor understorey development and absence of young age classes of the canopy species ▪ Light-demanding species regenerating after the disturbance are usually similar to those in the original forest stand	▪ Regrowing forest differs in species composition and in physiognomy from primary forest. Species are highly light-demanding	▪ Forest vegetation is lacking; single or small groups of pioneer trees and shrubs may or may not occur

3.2 Restoration of degraded forests

3.2.1 Approaches of forest restoration and rehabilitation

The choice for a forest restoration approach depends strongly on (1) the type or category of degraded forest and (2) the desired restoration outcome (e.g. Chazdon 2008). Furthermore forest restoration goals should be brought into line with sustainable rural livelihoods and community participation. Restoration strategies like reforestation with native species, agroforestry, and assisted natural regeneration (ANR) can increase biodiversity and ecosystem services, as well as the income for local livelihoods. However, they also require input in terms of money and time. Depending on the available inputs and required output a choice can be made for a specific restoration approach.

Chazdon (2008) proposes a restoration staircase where, depending on the state of degradation of an initially forested ecosystem, a range of management approaches are given which can be applied to restore the biodiversity and ecosystem services (Figure 3.2.1.). These approaches range from reclamation and rehabilitation on severely degraded sites to (assisted) natural regeneration on more intact forest areas. Depending on time and financial investment (capital, infrastructure, and labour) these approaches can be used to at least partially restore levels of biodiversity and ecosystem services. Restoration approaches should take into account the spatial distribution, abundance, and quality of residual vegetation which is a strong indicator of the potential for natural regeneration (Chazdon 2008).

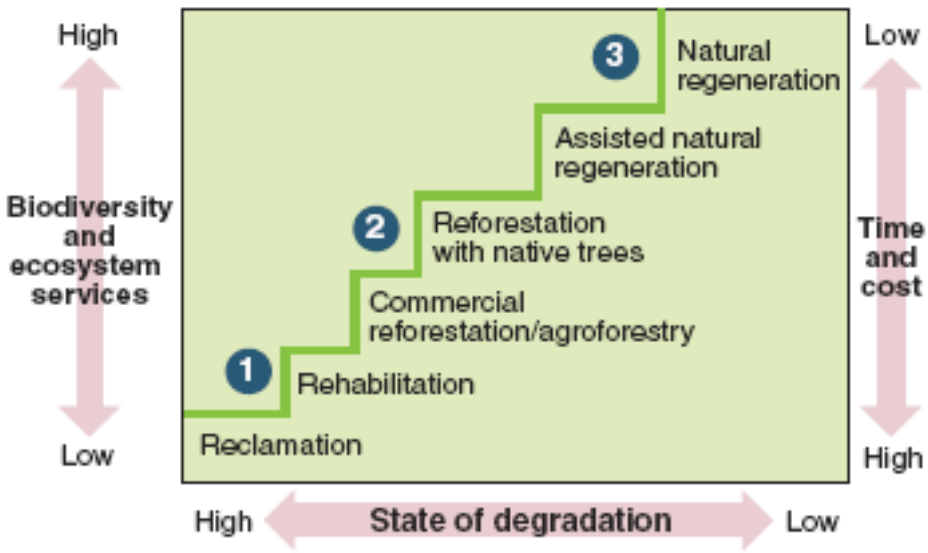

Figure 3.2.1. *The "restoration staircase" (After Chazdon 2008). Outcomes of particular restoration approaches are (1) restoration of soil fertility for agricultural or forestry use; (2) production of timber and non-timber forest products; or (3) recovery of biodiversity and ecosystem services.*

UNDP/WCMC (2008) indicate that it also important to focus on restoring resilient natural vegetation, as it may be very hard to restore the "original" forest. This may be done through paying attention to connectivity and dispersal, rather than assuming that all original forest species may come back at the restored forest.

Sayer et al (2004) indicate that it is important to take an ecosystem approach in setting up restoration programs. This means not only focus on a single commodity but also recognize that land must be managed for multiple goods and services to meet the needs of diverse stakeholders. They suggest six principles for restoration programs to enhance environmental and social benefits:

1. Involve stakeholders in the definition of objectives.
2. Define objectives in measurable ways.
3. Ensure that causes of degradation are understood and addressed and not just symptoms.
4. Invest in people and local institutions and not just in physical infrastructure.
5. Encourage learning and adaptation in the management of programs.
6. Apply ecosystem and common property management principles.

Management strategies for degraded and secondary forests aim to regain ecosystem integrity in order to enhance human well-being. Choices about the forest management strategy to be employed should be made on a landscape scale based on specific local conditions. The ITTO forest restoration guideline (ITTO 2002) makes a distinction between three principal management strategies to restore and rehabilitate degraded forests (see 3.1):

- **forest restoration**, which is the principle management strategy for degraded primary forests (part of forests > 10% cover; table 2.1);
- **management of secondary forests**, applied where forest conditions are such that active management can lead to increased output or goods and services (logged over forests > 10% cover; table 2.1);
- **rehabilitation of degraded forest land**, applied where the site is so heavily degraded that the spontaneous regeneration of tree and shrub species is severely limited (severely degraded forest < 10%; table 2.1).

In chapter 4 we will describe how these strategies can be applied to the EMRP area.

3.2.2 Reforestation and forest rehabilitation in Indonesia

Some 96 million ha of forest (out of a total of 120 million ha forest land) in Indonesia is degraded as a result of illegal logging, forest fires, forest conversion, unplanned agricultural expansion, and others (Nawir et al. 2007). Forest rehabilitation in Indonesia started to be managed intensively once the Ministry of Forestry (MoF) became an independent ministry in 1983 (separated from the Ministry of Agriculture). The government divided forest rehabilitation into the two categories:

- **reforestation** (reboisasi) in state forests
- **afforestation** or regreening (penghijauan) in community areas outside state forests.

Many of the rehabilitation programmes were government driven and often these projects focused mainly on the technical aspects of rehabilitation. From 1998 onwards there has been a gradual shift from privately based and large scale forest management to smaller-scale community-based forest management. A major problem which remains however is that many of the developed rehabilitation techniques are hardly used by the local people living in and around the target areas. According to Nawir et al. (2007) this is because little attention is paid to institutional arrangements for executing the rehabilitation programmes to establish effective implementation on the ground.

There are several important institutional factors which have contributed to the ineffectiveness of many rehabilitation programmes in Indonesia. According to Nawir et al. (2007) these include:

- the targeting of forest resources as the main source of national income, still a priority for local governments;
- the development of more complex issues of both direct and indirect causes of deforestation and degradation;
- the transition and implementation of policies affecting rehabilitation initiatives;

In addition, Nawir et al. (2007) give several more practical reasons for failures which according to them can be attributed to the fact that rehabilitation projects have been too much approached as a one-off project, instead of a long-term development program. These factors include:

- inadequate maintenance of planted trees;
- lack of funding sustainability beyond the project period
- unclear economic incentives leading to a lack of voluntary community participation;
- limited community participation due to unresolved tenure problems and ineffective community organisation;
- ineffective capacity building for the community;
- inadequate considerations of socio-cultural aspects;
- unclear distribution of rights and responsibilities among the stakeholders involved, particularly local government, community and technical forestry agencies.

It is clear that forest rehabilitation can only be successful by addressing both technical, socio-cultural, economic and institutional aspects. In their review of fifty-four rehabilitation programmes (comprising 101 projects) performed in Indonesia Nawir et al (2007) conclude that not one project was a complete success or a complete failure, depending on the stakeholders' perceptions. For example a rehabilitation project that is successful in environmental terms may have components that has negative impacts on local communities.

Also the scale of rehabilitation programs is important to consider. On community land this should be done through a community-led reforestation program, but in more remote parts of the area either large-scale forest rehabilitation or natural succession will be required. The potential for large-scale forest rehabilitation needs to be examined with a focus on management arrangements.

In table 3.2.2 an overview is given of the various methods and species used in different rehabilitation approaches as applied in Indonesia given by CIFOR (Nawir 2007). These species are grouped according to the purpose of the rehabilitation, in this case industrial plantations (HTI), community forestry, farm forestry, and watershed protection. It should b noted here that the tree species listed are generally no peat swamp species, and only several of them would be suited for planting in the EMRP area on the shallow peat areas and mineral soils.

Table 3.2.2. *Technologies and species used in different rehabilitation approaches in Indonesia (Nawir et al 2007)*

Rehabilitation approach	Technical method	Species used
Industrial Plantation Forest (*HTI*)	Planting; assisted natural regeneration	*Acacia mangium*, *Acacia auriculiformis*, teak *(tectona grandis)*, mahogany *(Swietenia macrophylla*, *Swietenia mahagony)*, *peronema (Peronema canescens)*, eucalyptus (*Eucalyptus spp*), *Gmelina arborea*, *damar* (*Agathis borneensis*), pine (*Pinus merkusii*), *meranti* (*Shorea spp.*), *perupok* (*Lapopetalum spp.*), and *merbau* (*Intsia bijuga*)
Community forestry, reforestation programme via agroforestry	Planting; enrichment planting; creating terracing on sloping areas	Mahogany, teak, rubber (*Hevea braciliensis*), candle nut (*Aleuritus moluccana*), cashew nut (*Anacardium occidentale*), falcata (*Paraserianthes falcataria*), *petai* (*Parkia speciosa*), breadfruit (*Arthocarpus brasiliensis*), jackfruit (*Arthocarpus heterophylla*), *tengkawang* (*Shorea spp.*), *jengkol* (*Pithecellobium jiringa*), *pinang* (*Areca catecu*), and *gamal* (*Glirisidia sepium*)
Farm forestry (small-scale plantation)	Planting; enrichment planting; creating a simple terrace (*guludan*)	Falcata, teak, mahogany, tamarind *(Tamarindus indica)*, *damar* (*Shorea javanica*), *durian* (*Durio zibethinus*), *gambir* (*Uncaria gambir*), cashew nut, *jengkol*, *petai*, *melinjo* (*Gnetum gnemon*), jackfruit, *morinda* (*Morinda citifolia*), breadfruit, candle nut, mango (*Mangifera indica*), and *cassiavera* (*Cinnamomum burmani*)
Watershed protection	Planting; creating terraces; planting along contour lines; grassing slopes; building waterfall channels, checking dams, gully head structures and gully plugs; stream-bank protection	Teak, mahogany, *durian*, falcata, cashew nut, mango, *rambutan* (*Nephelium lappaceum*), annual crops: maize (*Zea mays*), rice (*Oryza sativa*), beans (*Glyxin max*), and grasses for livestock fodder

3.2.3 Natural succession and assisted natural regeneration (ANR)

Natural succession and regeneration can be a great asset in restoration and reforestation with both ecological (locally adapted species) and economic (relatively low cost) advantages compared to tree planting. When the remaining forest cover is sufficient to provide propagules of desired species, natural regeneration can be stimulated by fire prevention and other silvicultural treatments (e.g. Ashton et al 2001; Harvey et al. 2008).

Ashton (1998) gives a schematic representation of the different successional stages of stand development for a mixed dipterocarp forest, showing the species which may occur during the different successional stages (Figure 3.2.2)

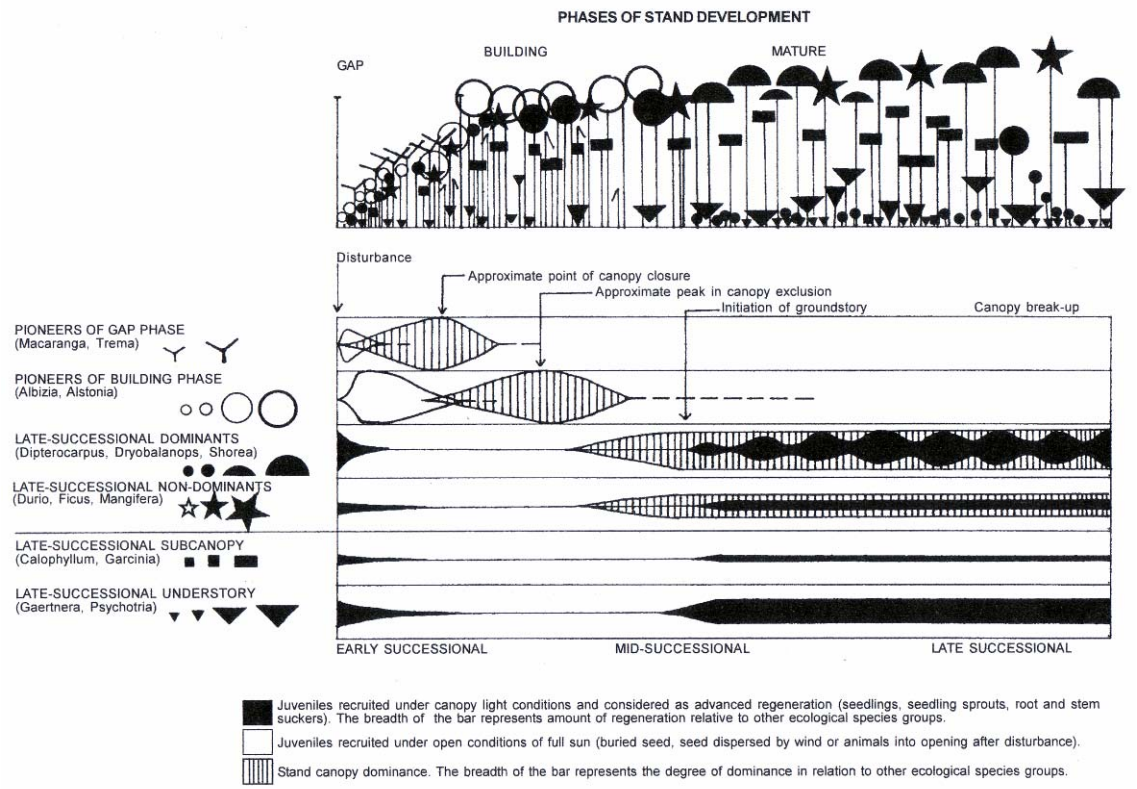

Figure 3.2.2. *Regeneration recruitment frequency and stand canopy dominance of ecological species groups over different successional stages of stand development for a mixed dipterocarp forest. Examples of species are given for each ecological group along with codes denoting their structural position within the stand over time. Note the periodic recruitment of seedlings for tree species belonging to the late-successional canopy dominants (Ashton 1998).*

A range of factors determines the pace at which succession proceeds, including the intensity and duration of the perturbation, the distance to primary forest and the availability of seed-dispersers. Site conditions (e.g. local topography and climate, soil characteristics and light availability), the nature of the seed bank in the soil and the potential for root and stump resprouting will all influence successional processes (ITTO 2002)

Peat swamp forest areas which have been disturbed heavily may struggle to regenerate naturally (e.g. Van der Meer et al 2005). For instance when seed sources and primary seed dispersers are absent it will be hard to use these principles, and other strategies should be chosen. In PSF areas where flooding is more common water may be an important primary vector involved in seed dispersal. Preliminary results of a study by Laura Graham show that seed dispersal by birds along PSF fringes is actually quite limited.

Assisted natural regeneration (ANR) is a technique which can be used to assist restoration of degraded forest in order to increase the production, protection, or biodiversity value of a forest. It involves helping forest tree seedlings to survive and grow well so that the opportunity to reach maturity of these seedlings is enhanced (cf. Upton & de Groot 2008). ANR makes use of the principles of natural succession.

When applying ANR following steps should be followed (cf Upton & de Groot 2008):

- Selection and demarcation of suitable site
- Assessment of the naturally occurring tree species that are a priority for regeneration
- Inventory of abundance and quality of appropriate seedlings

- Assessment of requirements of the target seedlings (water, nutrients, temperature, light)
- Site modification to stimulate growth and survival of target species, e.g. by
  - Canopy opening
  - Selective thinning, weeding
  - Soils disturbance (to stimulate germination)
- Sowing seeds
- Collecting and replanting of wildlings
- Fire protection

3.2.4 Tree species choice

The choice for a certain (mix of) tree species in peat swamp reforestation depends on several factors. The purpose of plantings (e.g. production, protection, conservation), the planting environment (vegetation, hydrology, peat depth), the availability of seeds and seedlings, and the scale of area all determine which species can be used in reforestation activities. Another important factor is whether of not a species is able to perform well in (degraded) peat swamp areas. The performance is relating to survival and growth of the species. Page and Waldes (2005) show the principal tree species occurring in three peat swamp forest communities on peat of increasing depth across a peatland dome in the Sebangau catchment, Central Kalimantan (Table 3.2.4.). This shows that it is important to consider the peat depth in planning reforestation activities in peat areas.

Table 3.2.4. *Principal tree species occurring in three peat swamp forest communities on peat of increasing depth across a peatland dome in the Sebangau catchment, Central Kalimantan (Page & Waldes 2005).*

Principal tree species	Mixed swamp forest at the edge of the peat dome	Low pole forest nearer to the centre of the peat dome	Tall interior forest on the central peatland dome
Palaquium ridleyi	x		
Calophyllum hosei	x		
Mesua sp.	x		
Mezzettia parviflora	x		
Combretocarpus rotundatus	x	x	
Sizygium		x	
Tristaniopsis obovata		x	
Shorea teysmanniana		x	x
Palaquium leiocarpum			x
Stemonurus secundiflorus			x
Mezzettia parviflora			x
Neoscortechinia kingii	x		x
Palaquium cochlearifolium	x		x

x : Species occurring in peat swamp forest community.

Table 3.2.5. *Tree species used in restoration trials in Southeast Asia (after Giesen 2008)*

No	Species	Family	Locations/ countries	Occurs at EMRP	Perform -ance	Refer- ence
1	*Alstonia spathulata*	Apocynaceae	Jambi	?+	■	5
2	*Anisoptera marginata*	Dipterocarpaceae	Malaysia		■	2
3	*Baccaurea bracteata*	Euphorbiaceae	Thailand	+	■	1
4	*Calophyllum ferrugineum*	Guttiferae	Malaysia		o	2
5	*Combretocarpus rotundatus*	Rhizophoraceae	Jambi	+	■	5
6	*Dialium patens*	Leguminosae	Thailand	+	o	1
7	*Diospyros evena*	Ebenaceae	Kalimantan	+	■	6
8	*Durio carinatus*	Bombaceae	Jambi, Malaysia	+	o, o	2, 5
9	*Dyera (lowii) polyphylla*	Apocynaceae	Jambi Kalimantan	+	■, o, ■	5, 6, 7
10	*Eugenia kunsterli*	Myrtaceae	Thailand		■	1
11	*Ganua motleyana* (syn. *Madhuca motleyana*)	Sapotaceae	Thailand, Malaysia	+	■, ■	1,2
12	*Gluta wallichii*	Anacardiaceae	Jambi		■	5
13	*Gonystylus bancanus*	Thymelidaceae	Jambi, Malaysia Kalimantan	+	■, ■, ■	2, 5, 6
14	*Hibiscus* sp.	Malvaceae	Riau		■	5
15	*Litsea johorensis*	Lauraceae	Thailand		o	1
16	*Macaranga hypoleuca*	Euphorbiaceae	Riau		■	5
17	*Macaranga* sp.	Euphorbiaceae	Thailand		■	1
18	*Melaleuca cajuputi*	Myrtaceae	Thailand, Vietnam	+	■, ■	2,3
19	*Palaquium* sp.	Sapotaceae	Jambi, Kalimantan	+	■, ■	5, 6
20	*Peronema canescens*	Verbenaceae	Kalimantan	+	o	4
21	*Polyalthia glauca*	Annonaceae	Thailand		■	1
22	*Shorea balangeran*	Dipterocarpaceae	Kalimantan	+	■, ■, ■	4, 6, 7
23	*Shorea pauciflora*	Dipterocarpaceae	Jambi		■	5
24	*Shorea pinanga*	Dipterocarpaceae	Kalimantan	+	o	4
25	*Shorea platycarpa*	Dipterocarpaceae	Malaysia		■	2
26	*Shorea seminis*	Dipterocarpaceae	Kalimantan		o	4
27	*Shorea* sp.	Dipterocarpaceae	Kalimantan	+	o	6
28	*Stemonurus secundiflorus*	Icacinaceae	Thailand, Kalimantan	+	o, o	1, 7
29	*Syzygium oblatum* (syn. *Eugenia oblata)*	Myrtaceae	Thailand		■	1
30	*Tetramerista glabra*	Theaceae	Jambi	+	o	5

■ = good to very good (or >50% survival) o = poor to fair (or <50% survival)

1 = Urapeepatanapong & Pitayakajornwute (1996) 2 = Ismail *et al.* (2001)

3 = Maltby *et al.* (1996) 4 = Takahashi *et al.* (2001)

5 = Giesen (2004) 6 = Limin (2007)

7 = Wibisono & Gandrung (2008)

Giessen (2008) lists 30 species which have been tested in peat swamp areas in the Southeast Asia (Table 3.2.5). Of the 30 tested species 17 are known to occur in Central Kalimantan. Giessen also indicates the success rate of species in terms of survival and indicates that 10 of the 17 species in Central Kalimantan have been successful. He indicates that more in-depth analysis is needed to determine what the reasons for success and failure are.

From own observations following tree species are currently being used and planted for timber and NTFP purposes in the EMRP area:

- **Rubber (*Hevea brasiliensis*).** Rubber is no peat swamp species, and is generally planted on higher locations. Not in large scale plantations. Often seedlings are grown by small-holders in villages, and sold to companies involved in replanting. Rubber is being planted widely by farmers in the EMRP on mineral soils (e.g. Pangkoh) and in shallow peat areas (e.g. Jabiren, Pilang). Rubber will grow on peat but requires drainage and in Pulang Pisau, the district Public Works Agency is constructing canals between the deeper peat in the north of Block C near the main Palangkaraya-Banjarmasin road to the Kahayan River in order to lower water levels. Water control will be required here to ensure that water levels do not drop too low in the dry season
- **Jelutung (*Dyera polyphylla*).** Jelutung is a fast growing PSF species. It is planted along canals so that latex can be tapped easily. Dyera fruits or seedlings are collected in the wild by villagers, who either then use these in their own nurseries, or sell the fruits for Rp 6,000 each. Seedlings are sold to companies involved in replanting, and the price of Dyera is Rp1,500 per seedling. The current price for latex is around Rp 6,500/kg.[1]
- **Belangeran (*Shorea balangeran* Korth.).** Belangeran is common and often gregarious in PSF; replaced in Brunei, Sarawak and West Kalimantan North of Kapuas river by *Shorea albida*. Formerly an important timber producer in the swamps of Kalimantan, but now largely cut out. Range of its grow from Sumatra and throughout Kalimantan, except north of Kapuas River (Newman, Burgess, and Whitmore, 1996).

Others species, such as: Sungkai (*Peronema canescen* Jack.), Waru (*Hibiscus spp*), Mahoni (*Swietenia mahagoni*), Gaharu (*Aquilari*a spp.), Mahang (*Macaranga sp*), Rangas (*Gluta renghas*), Gemor (*Alseodaphne*), Api api (*Avicenia sp*), Bakau (*Rhizophora sp*), Rambai (*Soneratia sp*), Akasia Daun Lebar (*Acacia mangium*), Rotan/Rattan (Callamus sp) were reported by Department of Forestry and BPDAS Kahayan planted spread over EMRP areas. But, no data or information about its growth rata or its survival percentage.

It is suggested to carry out an analysis of ongoing species and variety tests in the EMRP area, and on the basis of findings propose best practice modifications, and increase species and variety options based on experience from similar peat land environments. Giesen (2008) follows a similar approach and lists species that have a promising potential for peat swamp restoration attempts recognising four different flooding regimes. For each of the 4 flooding types he recommends the following species for green engineering:

- Deep water: *Hanguana malayana, Pandanus helicopus*
- Deeply flooded: *Combretocarpus rotundatus, Lepironia articulata*
- Moderately flooded: *Cratoxylon glaucescens, Ploiarium alternifolium, Shorea belangeran*

[1] One local in Pilang village said Jelutung was inferior to rubber due to lower growth rates and the time required to produce a tree with a good harvest of latex. Jelutung was probably a good option for tapping when mature trees existing in natural state but we need to know more about its growth rates and time until it becomes productive. The data presented earlier on mortaility and in Giesen (2008) need to be further investigated.

- Rarely flooded; *Alstonia spathulata; Dyera polyphylla*

3.3 Forest restoration trials in the EMRP area

A number of PSF restoration trials that have been carried out lately in the EMRP-area by CIMTROP, various NGOs (Wetlands International, WWF, BOS Foundation), and the Forestry and Agriculture departments of Central Kalimantan (Gerhan). These trails provide some initial indications regarding the potentials and challenges for reforestation in the EMRP area. These include both reforestation (reboisasi; inside state forest) and penghijauan (community land / outside state forest) activities. Below they are described in more detail.

3.3.1 CIMTROP

At the CIMTROP site in the northern-tip of block C about 12,000 seedlings have been planted in various experimental plantations. For instance a large number of belangiran (*Shorea belangeran*) and jelutung (*Dyera polyphylla*) have been planted in degraded swamp, along with several other species (including gaharu, *Aquilaria* sp.; cashew) on the elevated areas along the canals. Local communities have in addition been provided with jarak (*Jatropha*) and rubber (*Hevea*). A full list of species tested is given in Table 3.2.1. Natural regeneration in the fern-dominated heavily degraded parts of the CIMTROP study area consisted mainly of tumih (*Combretocarpus rotundatus*) and geronggang (*Cratoxylon glaucum*), with some asam-asam (*Ploiarium alternifolium*).

The results of the CIMTROP restoration trials show that typical peat swamp species like Ramin and Belangaran have high survival rates (Table 3.3.2). Growth rates have not been reported. The reported survival rate of Jelutung is low (21%) without any causal factors given.

Limin (2004) indicated already that when seeds and seedlings were planted without maintenance and monitoring on the survival of the seedlings this would not give an opportunity for community. Therefore, he introduced a concept named the “Buying Living Tree System”. Planters of trees will be paid a compensation as monthly salary for plant maintenance till one years period after planted. This concept will give the farmer or community direct benefits.

Research results (in collaboration with Hokkaido University-Japan) show that at least four local tree species can be successfully planted at burnt, deep peat areas. The growth and survival over 2.5 years was as follows (NB planted in block C, south of Kalampangan village) (after Limin 2004):

a. Kahui (*Shorea balangeran*), survival 92 %; height growth 88 cm;
b. Uring Pahe (*Diospyros sp*), survival 83 %; height growth 5,7 cm
c. Ramin (*Gonystylus bancana* Kurz), survival 75 %; height growth 3,2 cm
d. Jelutung (*Dyera polyphylla*), survival 64 %; height growth 5,7 cm.

Table 3.3.1. *Tree species used in reforestation trials by CIMTROP.*

No.	Family	Species	Canal Banks	Peat-land	Local name & uses
1.	Apocynaceae	*Alstonia pneumatophora*		+	Pulai; light construction
2.		*Dyera polyphylla*	+	+	Jelutung (rawa); latex
3.	Chrysobalanaceae	*Parastemon spicatum*	+	+	Bintangur; timber
4.	Clusiaceae	*Garcinia sp.*	+	+	Manggis hutan
5.	Dipterocarpaceae	*Dryobalanops spp.*	+	+	Kapur naga; timber
6.		*Shorea belangeran*	+	+	Kahui; timber
7.		*Shorea spp.*	+	-	Meranti; timber
8.	Ebenaceae	*Diospyros evena*	+	+	Uring pahe; timber
9.	Euphorbiaceae	*Hevea brasiliensis*	+	-	Rubber unggul; latex, timber
10.	Lauraceae	*Alseodaphne coriacea*	?	+	Gemor; plant bark
11.	Myrtaceae	*Melaleuca cajuputi* *note: does not do well on peat*	+	-	Galam; construction
12.		*Syzygium sp.*	+	+	Jambu-jambuan
13.	Sapotaceae	*Palaquium sp.* *many species*	+	+	Hangkang/nyatoh ; timber
14.	Tetramisticaceae	*Tetramerista glabra*	-	+	Punak; beams & light construction
15.	Thymelaeaceae	*Aquilaria malaccensis (?)*	+	-	Gaharu; resin
16.		*Gonystylus bancanus*	-	+	Ramin; timber

+ = suited for planting / - = not suited for planting

Table 3.3.2 Results of CIMTROP restoration trials (after Giesen)

No	Species	Family	Local name	Number planted	Survival rate (%)
1	*Dyera polyphylla*	Apocynaceae	Jelutung, Pantung	100	21
2	*Diospyros evena*	Ebenaceae	Uring pahe	100	92
3	*Gonystylus bancanus*	Thymelidaceae	Ramin	100	78
4	*Palaquium* sp.	Sapotaceae	Hangkang	100	56
5	*Shorea belangeran*	Dipterocarpaceae	Kahui	1073	89
6	*Shorea* sp.	Dipterocarpaceae	Meranti	1290	37

Adapted from Limin (2007).

3.3.2 The Borneo Orang-utan Survival (BOS) Foundation

The Mawas project area covers roughly 240,000 ha in Block E. In 12 villages reforestation groups have been formed which are active in setting up nurseries and planting of trees. In total 34 units of village nurseries have been set up, with a total seedling production of around 500,000. Up until June 2008 some 1,200 ha of degraded forest has been re-planted. According Giesen (field report 6) main species have

been jelutung (local name = pantung) and belangiran (local name = kahui), although also other species have been used at small scale. Some of the planted trees are doing well, with reported growth rates (jelutung) of up 2.5-3.0 (even > 4m) tall after 2 years. In other places however growth rates are lower (< 2 m after 2 years) with heavy competition from ferns (both belangiran and jelutung). The different growth rates may be caused by variation in drainage levels (e.g. by nearby canals), and lack of weeding (Giesen 2008).

3.3.3 Wetlands International Indonesia Programme Central Kalimantan

Reforestation of barren areas in Block A-B of the EMRP (Buffer Zone of Mawas) is carried out by Wetlands International Indonesia Programme for Central Kalimantan. In this area some 50 ha is planted with 20.000 seedlings i.e.: Jelutung Rawa (*Dyera lowii*), Belangiran (*Shorea belangeran*) dan Kepot Bajuku (*Stenomorus* spp). Based on a first assessment (4 months after planting) the overall survival percentage was 62% (Wibisono and Wardoyo, 2008). The height growth rate of Jelutung and Pasir-pasir was ± 1 cm per month, and Belangeran ± 4,9 cm per month (Wibisono and Gandrung, 2008). Survival percentage of Pasir-pasir is < 10%, Jelutung < 60%, and Belangeran < 85%.

3.3.4 BPDAS Kahayan

The Forestry and Plantation Departments have also implemented rehabilitation programmes for degraded peat swamp forest areas. The Gerhan (Land Rehabilitation Movement) programme focuses on planting, maintenance, protection, and harvesting. Rehabilitation activities funded through DAK-DR and GN-RHL/Gerhan in Indonesia are divided into several stages including site selection and consolidation, technical design, spatial layout, seedling production, design of infrastructure, selection of tools and methodologies, planting design, plant maintenance during establishment and in years 1 & 2 after planting.

However, Jaya BPDAS Kahayan and Wana Khatulistiwa (2007) report that the impact and benefits of GN-RHL/Gerhan have been limited so far. From the technical aspect the implementation in the 3 (three) last years of the GN-RHL/Gerhan has improved capacity building of involved stakeholders and shareholders, mainly for planning and organization. However, implementation, monitoring and evaluation have not yet benefitted from the Gerhan program. From the economic aspect the impact of Gerhan has been low: the average household income has hardly increased, and also the diversification and improvement on economic infestation to support GN-RHL/Gerhan has remained low. The environmental impact of Gerhan has also been limited so far, partly because the planted trees are still young (but also because many have died). Finally, from the social aspect that GN-RHL/Gerhan gave benefit of community participations, such as the selection of locations and species, setting up nurseries, and training especially at community forest.

In 2007 the Gerhan program in Central Kalimantan covered 78,000 ha with funding of Rp 188 billion (about USD 20 million). However also in Central Kalimantan the impact of the Gerhan rehabilitation program has been limited so far is. Field observations in the EMRP area show that implementation and success rate of Gerhan activities can be locally problematic (e.g. Giesen 2008). During early 2008 several Gerhan sites were visited (e.g. Habaring Hurung, Henda) which had been planted in 2006 and 2007 with *Jatropha* (250 ha), rubber (125 ha) and *jelutung* (125 ha). Also, in block E Pulang Pisau District, Kapuas District and Barito Selatan District sites were inspected. It was observed that seedlings were absent for much of the area were they had been planted and it is concluded that survival rates are generally very low in these programs. Lack of weeding was generally thought to be the main cause of the low survival rates. Also observed growth of the surviving *jelutung* seedlings was minimal.

The Forestry Department's BPDAS Kahayan and Multima Krida Cipta are currently making a five-year plan for the rehabilitation of forest and land in the EMRP area (2008-2012). Out of a total of 1,454,541 ha in the EMRP area the Forestry Department recommends that 874,453 ha (60%) will be designated as conservation area, while the balance (40%) will be utilised for both forestry and non-forestry purposes (Dep. Kehutanan, 2007). One of the new possibilities for reforestation is HTHR (Hutan Tanaman Hasil Rehabilitasi) - RLPS is now completing the guideline for its implementation.

Three different priority classes for restoration are identified on the basis of land cover, management regime, erosion class, slope class, peat thickness, depth of pyrite layers, flooding and productivity (priority class 1: 588 ha, class 2: 61,939 ha and class 3: 119,607 ha). In all, 39 tree species have been identified for replanting, including mangroves (e.g. *Avicennia, Rhizophora, Bruguiera, Excoecaria, Xylocarpus* and *Sonneratia*) and species for mineral soil areas (*e.g. Melaleuca cajuputi*). Giesen has identified some problems with a number (8) of species in relation to their site requirements and/or naming. It is also observed here that Gelan (Melaleuca sp.) does not require reforestation as this species seems capable of massive natural regeneration in many suitable areas.

The new program has targeted the EMRP area in the two of the districts and one city, i.e.: Kapuas, Pulang Pisau, and Palangka Raya. The major anticipated outcomes of the program are:

1. Supporting the Central Kalimantan Province and Indonesian Governance on Rehabilitation and conservation of peat land;
2. Giving the guideline and direction of the implementation of land and forest rehabilitation for the future
3. Follow up the Presidential Instruction No.2 Year 2007 on Acceleration of rehabilitation and revitalization EMRP area in Central Kalimantan, interrelated with the main functions of BPDAS Kahayan;
4. Improvement of the BPDAS Kahayan performance and its contribution to reduction of land and forest fire, environmental damage, and implementation of land rehabilitation movement;
5. Increase contribution of BPDAS Kahayan in coordination of rehabilitation;
6. Monitoring and preparing information and data on bio-geo-physical and socioeconomic of the communities in EMRP;
7. To form an agency which is responsible for the technical and administrative implementation of BPDAS Kahayan.

A detailed description of the master plan for the each district and city is shown in Annex 2.

3.4 Conclusion: restoration strategies & approaches for the EMRP area

We conclude that basically there are 4 strategies to rehabilitate forests (e.g. following Chazdon 2008, Upton & de Groot 2008);

- reforestation (new forest on previously forested land);
- afforestation (establishment of forest where there has been no forest for last 50 years);
- artificial regeneration (plantations, including HTI and agroforestry);
- natural regeneration, including assisted natural regeneration (ANR).

For the EMRP area six approaches of forest rehabilitation and restoration have been identified which can be grouped under the three principal management strategies of the ITTO forest restoration guideline (ITTO 2002):

- FOREST RESTORATION:

- Natural Regeneration: allowing the system to regenerate naturally.
- Assisted Natural Regeneration (ANR): interventions to overcome barriers to natural succession including enrichment planting, site modification to stimulate growth and survival, and (large-scale) sowing of seeds.

- MANAGEMENT OF SECONDARY FORESTS:
  - Community-based Forest Management: such as community forestry rights (HKm).
  - Community-based Agro-forestry: planting of economically valuable tree crops.
- REHABILITATION OF DEGRADED FOREST LAND:
  - Reforestation with Native Trees: replanting with native species.
  - Commercial Reforestation: private sector-led tree plantations.

In the following chapter we will elaborate on the planning and implementation of reforestation strategies in the EMRP area.

4 Forest rehabilitation in the EMRP

4.1 Planning forest rehabilitation in EMRP

Forest rehabilitation plans should be based on balanced decisions on ecological goals, ecosystem services, competing land uses, and economic costs and benefits. To better prepare local authorities to make such a decision a procedure for using scientific knowledge and structuring the different viewpoints and attitudes could be useful. Here we describe a number of steps which can be used to support the forest rehabilitation decisions in the EMRP area.

There are four management zones in the EMRP area: (1) adapted management zone, (2) development zone, (3) coastal zone, and (4) conservation zone. The choice for a certain forest rehabilitation approach in a particular zone (or part of a zone) should depend primarily on the existing hydrology, soil condition / peat depth, forest condition, and local forest use. The forest cover classes identified in chapter 2.1 should be brought in line with the It is essential that choices for a particular rehabilitation strategy are made in close consultation with the immediate user of the forest, and not in isolation in the offices of a government agency, forest service, research institution or NGO.

The scale of rehabilitation programs is important to consider. On community land this should be done through a community-led reforestation program, but in more remote parts of the area either large-scale forest rehabilitation or natural succession will be required. The potential for large-scale forest rehabilitation needs to be examined with a focus on management arrangements.

We propose the following steps in planning forest rehabilitation activities in the EMRP area:

1. Determine the present conditions:
    - Stand: forest cover, species composition, regeneration capacity, etc
    - Site conditions: peat depth, hydrologic, etc
    - Socioeconomic context: who uses the forest, how nearby are villages, what kind of impact does forest use have on forest conditions
2. Determine the cause(s) of degradation:
    - Was the area under shifting cultivation?
    - Is the stand a logged-over forest?
    - Did forest fire occur?
3. Determine what current regeneration potential of the site is:
    - What will happen to the stand if there is no management?
    - For example, ecologically (succession, etc) and socially (conversion into other land-use, etc)
4. Determine what management strategies are needed to achieve a particular outcome (restoration, secondary forest management, rehabilitation)?
    - Depending on who manages the forest, the question of who plans, who harvests and who monitors will influence the outcome of this
    - Determine which type of FMU (protection, production, conservation) the areas is part of;

- Make use of participatory and adaptive management planning for the particular forest stand or the degraded site and determine the silvicultural options, collaborative use management, multiple-use management

5. Designing reforestation plans including following steps:
   - Formulation of the objective. In the objective a general statement is given on the what should be reached with the reforestation plan. The objective should be brought into line with the FMU (protection, production, conservation).
   - A feasibility study. The goal of the feasibility study is to determine whether the objective of the reforestation plan is feasible or not.
   - Formulation of the requirements (output oriented). Here a list is given of all the requirements which are needed to achieve the objective of the reforestation plan.
   - Formulation of a management plan. Here all activities are given which are needed, including a time-schedule and the expenses.

Below a schematic overview is given of the possible management objectives and desired future conditions for each of the three categories of degraded and secondary forests and their respective management strategies. This scheme should be elaborated for the specific conditions of each of the 4 management zones of the EMRP area.

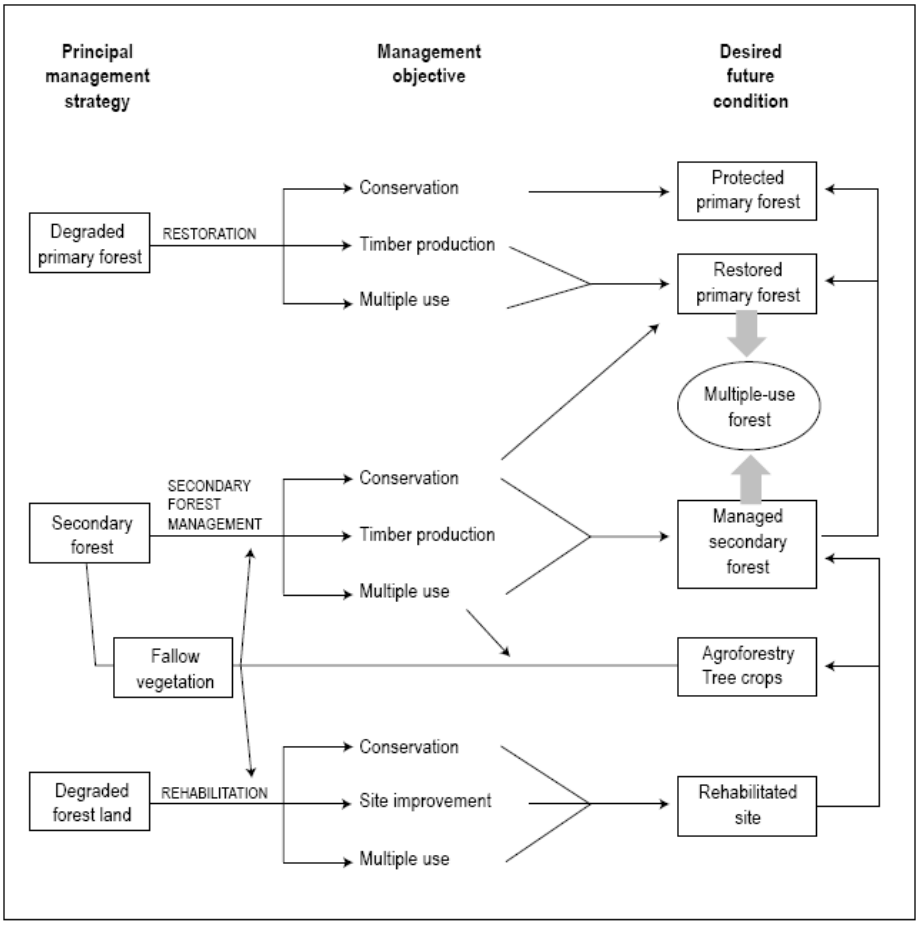

Figure 4.1. *Principal forest rehabilitation strategies and possible pathways to plan forest-based land-use options in degraded and secondary forests (from ITTO 2002).*

4.1.1 Ecological and social aspects

The particular ecological and socioeconomic criteria and indicators should be linked to site-specific objectives and goals. The following criteria should be considered:

Environmental Criteria:

- Vegetation cover: needs to be either forest or severely degraded forest (cf table 2.1). Vegetation coverage will high relation with light intensity, relative humidity and also temperature on the forest floor.
- Damage intensity, include: agency, duration, and actual situation.
- Soils / Peat Depth: for mechanised planting peat depth is limited (e.g. < 3m); but this needs to be determined further. Also, maturity level of peat, such as: fibryst, hemyst, or safryst
- Climate type and its relation with flooding condition (water level)

Social aspects;

Several local community activities in EMRP areas is still active, for example: fishing, cutting trees, and harvesting NTFP. Important information are needed to understand, such as: number people, the origin of village, from when their activities, and motivation. The presence of people around site, could be a source of weakness or strength in rehabilitation activities.

Criteria and indicators can be used to evaluate the success of rehabilitation activities. Multima Krida Cipta and BPDAS Kahayan (2007) developed criteria, indicators, and verifiers to analyze and evaluation the impacts and benefits of rehabilitation activities in its working area. These are shown in Annex 3.

4.1.2 Legal Aspects (include Forest status & institutions)

Forest Management and Conservation is the responsibility of the Department of Forestry. The Department has responsibility for the delineation of the forest estate, the allocation of forest to specific functions production, protection and conservation), forest and the issuance of licenses for forest utilization and other key responsibilities. The provincial and district government are mainly responsible for the operational administration of forest management. The department is supported in its duties by several technical implementation units (UPT) in the region for forest planning, mapping and inventory (Balai Pemantapan Kawasan Hutan based in Banjarbaru), land rehabilitation and reforestation (BP DAS Kahayan in Palangkaraya) and conservation (BKSDA in Palangkaraya).

There is a lack of clarity and consistency in many aspects of forest policy and management.
It seems that there is need for identification of clear rules and regulations, including the division of tasks and responsibilities over the different levels, in order to develop proper management guidelines.

Illegal logging is still a major issue in the EMRP area. Adequate law-enforcement is needed to ensure that management regulations will be properly implemented. Proper management, backed by clear legislation is needed to ensure that if managed properly, can provide a sustainable exploitation of its goods and services.

4.2 Implementation of reforestation plans

4.2.1 Monitoring rehabilitation success

As mentioned under step 4 an adaptive management approach is needed as the outcome of rehabilitation activities will rarely be totally predictable. Therefore a monitoring program linked to periodic assessments of project results should form the basis of management decisions regarding the species or species mixtures to include in restoration and rehabilitation programs.

For example, monitoring may include evaluations of tree growth rates, forest stand structure and composition, changes in physical and chemical properties of soils and the frequency of fire or other major disturbances. Monitoring of plantations is important so that possible failures can be detected in an early phase and suitable measures can be taken. There are several options to check on the status of planted trees like field surveys, remote sensing techniques, and permanent sample plots.

Field surveys to check on the success rate of plantations have some limitations. First, field surveys are time consuming and labour intensive, tedious jobs, with a high potential for errors. Secondly, spatial distribution of seedlings may not always be accurately measured with the current regeneration surveys with the risk of missing large un-stocked areas.

Aerial survey methods can be useful tool in regeneration assessments. In addition it may be an easy way to survey the effects of pests and other threats (e.g. Brand et al. 1991). However, maintenance of equipment and proper data analysis needs commitment and continued (financial) input which may be problematic. Also ground-truthing of remotely sensed images proved difficult in making the LULC map and may pose problems for proper implementation of remote sensing techniques. Therefore, such techniques are not recommended, as it is cheaper and more reliable to directly conduct monitoring on the ground, in the field.

Permanent sample plots can be used to monitor growth and survival of planted areas, and can raise early warnings in case of outbreaks of pests and diseases. They need to be carefully planned and it needs to be considered whether both technical and financial infrastructure will be available in the long-term to maintain a PSP system in the future.

4.2.2 Field testing

Despite the various peat swamp forest restoration and replanting field trials (e.g. Giesen 2004) there does not exist a clear and consistent guideline on tree planting in the EMRP area. Additional field trials are needed to get a systematic overview of which species can best be grown at various locations, and which systems are likely to perform best.

Below recommendations are provided for the selection of various species for further testing. However it should be stressed that this is an ongoing process and that it may become logic to test additional species in the future. We will also give general frame works for the design of field trials for various test, including elimination trials for selection of species, and trials to improve assisted natural regeneration (ANR). We will also discuss the need for permanent sample plots in setting up reforestation programs.

4.2.3 Selected species for trial(s)

The choice to plant a certain species at a specific location should be guided by following considerations;
1. Purpose of plantings: biodiversity, economic, protection.
2. Planting environment: vegetation, soils, (micro-)climate where will trees be planted: in degraded forest, open (burn area), or on sedges. Also peat depth, flooding and rainfall determine species choice.
3. Who will do plantings: either commercial large scale plantings, or smallholder planting on small areas.
4. Availability of seeds and seedlings/planting material; possibility of making cutlings etc.

We propose the following species for further testing (Table 4.2.3).

Table 4.2.3. *Species will be selected for further testing, where found in EMRP area (Planted and/or Naturally grow).*

No.	Local Name	Latin Name	Family
1	Alau	*Dacrydium spp*	*Toxaceae*
2.	Api-Api	*Avicennia spp*	*Avicenniaceae*
3.	Belangeran	*Shorea belangeran*	*Dipterocarpaceae*
4.	Bungur	*Lagerstroemia speciosa*	*Lythraceae*
5.	Durian	*Durio carinatus*	*Bambocaceae*
6.	Galam	*Melaleuca cajuputi*	*Myrtaceae*
7.	Garunggang	*Cratoxylon arborescens*	*Guttiferaceae*
8.	Jambu-jambu	*Garcinia sp*	*Guttiferaceae*
9.	Jelutung	*Dyera costulata*	*Apocynaceae*
10.	Karet	*Hevea brasilie*	*Euphorbiaceae*
11	Kayu bulan	*Fagracea crenulata*	*Anonaceae*
12	Mahang	*Macaranga mingayi*	*Euphorbiaceae*
13	Maharanjang	*Shorea virescens*	*Dipterocarpaceae*
14	Malam-malam	*Diospyros malam*	*Ebenaceae*
15	Manggis Hutan	*Garcinia mangostana*	*Cluciaceae*
16.	Meranti	*Shorea leprosula*	*Dipterocarpaceae*
17	Meranti	*Shorea spp*	*Dipterocarpaceae*
18	Meranti Rawa	*Shorea spp*	*Dipterocarpaceae*
19.	Merawan	*Hopea mangarawan*	*Dipterocarpaceae*
20.	Palas	*Licuala acutufida*	*Palmae/alcaceae*
21.	Pelawan	*Tristania spp*	*Myrtaceae*
22.	Pilau	*Agathis borneensis*	*Pinaceae*
23.	Pulai	*Alstonia scholaris*	*Apocynaceae*
24.	Ramin	*Gonystylus spp*	*Gonystylaceae*
25.	Resak	*Vatica spp*	*Dipterocarpaceae*
26	Sagu	*Metroxylon sago*	*Palmae*
27.	Semarum	*Palaquium microphylum*	*Sapotaceae*

28.	Sengon	*Parasherientes falcataria*	*Leguminoceae*
29.	Sungkai	*Peronema canescen*	*Verbenaceae*
30.	Suntai	*Palaquium burck i*	*Sapotaceae*
31.	Tabaras	*Ilex cymosa*	*Aquifoliaceae*
32.	Tarentang	*Camnosperma auriculata*	*Anacardiaceae*
33	Tumpung	*Elmerrilia mollis*	*Euphorbiaceae*

Source : BPDAS Kahayan and Multima Krida Cipta (2007).

Testing species should be done for following factors:

- o Seed production areas / seed orchards (nursery stock)
- o Production of fruits (for wildlife consumption)
- o Growth performance (timber) of provenances
- o Spacing & planting trails
- o Maintenance (weeding, fertilisation and chemicals for weeding and pests)

4.2.4 Potential lay-out of field trials

Below several options are given for forest field-trials in the EMRP area. This is a first proposition and needs to be discussed and further elaborated with local stakeholders (including tree growers, local communities, and research groups).

Elimination trial of selected high timber value PSF species

An elimination trial of selected PSF species with high commercial value is proposed to determine which species have highest potential to produce high-quality timber in short rotations. This experiment will provide information on growth performance, mortality and quality of planted PSF species in converted and degraded peat swamp forest areas. Survival and growth will be monitored for 3 years under three light-conditions (open, half-shade, shade). It is envisaged to have replications of the experiment at three locations in the EMRP-area, e.g. Block E (Bos-Mawas), Block C (Cimtrop), and Block B/D (southern part).

Further details on species, experimental layout, data collection, data analysis and reporting need to be discussed and developed with local counterparts.

Assisted Natural Regeneration (ANR) and enrichment plantings

In order to apply ANR (and enrichment plantings) successfully in the EMRP-area following field trials seem to be highly relevant:

- ➢ Development of criteria for selection of suitable ANR sites;
- ➢ Field trials to determine water, nutrients, temperature, light requirements of selected target species;
- ➢ Field experiments to determine best site modification method to stimulate growth and survival of target species,
- ➢ Sowing experiment with selected species to determine options for use of (large scale) sowing of seeds

Further details on species, experimental layout, data collection, data analysis and reporting need to be discussed and developed with local counterparts. We recommend that this work will be brought in line with research projects currently being done at Sebangau research site (e.g. Laura Graham PhD work).

Natural regeneration

As stated before, natural regeneration can be used in rehabilitating degraded forest, given the right conditions of the forest. What exactly those conditions are is not well known, and may vary between forest types and locations. Here we suggest to investigate what factors determine whether a (un-assisted) natural regeneration is a viable option to rehabilitate the forest.

We suggest to focus on selected key-stone peat swamp forest species (e.g. Ramin, Shorea sp.) and to investigate the following aspects:

- Population dynamics (phenology, fruiting, seed-dispersal, germination, growth and survival)
- Inventory of mother trees (e.g. using remote sensing techniques)
- Determine thresholds for easy to determine parameters (e.g. canopy cover, number of mother trees/ha, links with fauna) which indicate whether natural regeneration is an option;
- What is the need for protection of sites (e.g. fire, human intervention); link with involvement local communities.

Further details on experimental layout, data collection, data analysis and reporting need to be discussed and developed with local counterparts.

4.2.5 Recommendations for implementation of field testing trials

Field trials should be kept as simple as possible, testing 1-3 treatments and one control. A 2x2 trial is preferred when interaction between two kinds of treatment is expected (for instance water and nutrients). A uniform test site is important, and there should be at least 20-30 trees in each plot or treatment, with at least 4 or 5 replicates. Figure 4.2.5 shows a schematic outline of imaginary experimental lay-out for testing two factors with 5 replications (blocks) (after Longman (1995). Uniformity of seedlings/trees is important as well (height, diameter, form). Test sites should also be protected against wind, fire, pest, weds, browsing, and human disturbance. Finally, specifics of field trials should be discussed and elaborated with local stakeholders.

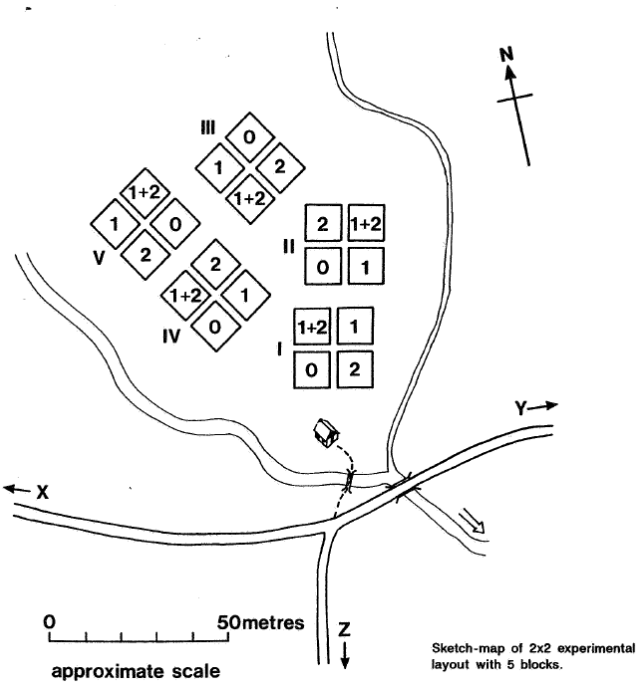

Figure 4.2.5. *Schematic outline of imaginary experimental lay-out for testing two factors with 5 replications (blocks); after Longman (1995).*

Data recording should be done by well-trained people at regular intervals. Data should be entered in spreadsheets ASAP after recording. Preliminary analysis should be done to check for obvious errors. Research results should be analysed and reported at regular times (e.g. yearly). Communication of results through workshops and (local) journals and newspapers. Test sites should be well maintained and sign-posted to show visitors the set-up and results of the experiment.

4.3 Financial aspects

The current government regulation on Reforestation Funds (Dana Reboisasi – DR) PP No. 35, was introduced in 2002 to replace PP No. 6/1999. The regulation states that forty per cent of the funds are to be reallocated to the provinces that have contributed to the central government's Reforestation Funds - called the 'contributing provinces'. The programme developed under this funding is called the Specific Allocated Funds – Reforestation Funds (Dana Alokasi Khusus – Dana Reboisasi - DAKDR). This has been in operation since 2001 under the coordination of the district governments. The objectives of the programme are: to facilitate community participation in rehabilitation activities by providing assistance with designing the activities, developing community institutions and providing technical assistance in implementing the planned activities. Farmer groups are given compensation for land preparation, maintenance cost and form of plant seeds.

4.3.1 Funding mechanisms for Carbon Stocks.

Revenues from reduced carbon emissions may be an important source of finance for sustainable peat land management in the EMRP area. There are several options for alternative finance sources market based instruments related to the Climate Change Framework Convention and the Kyoto Protocol, including:

- Reduced Emissions from Deforestation and forest Degradation (REDD)
- Clean Development Mechanism (CDM)
- Selling Emission Reductions at the Voluntary Carbon Market

REDD is a new international scheme of carbon market through reducing emission from deforestation and degradation. Pilot projects are planned to implemented in the period 2008-2012. Peat restoration is not yet included in REDD, but peat land is eligible for REDD if the land is still forested and remains forested. Potential efforts for Carbon credits will focus on halting forest conversion and protecting forest from illegal timber harvesting and fire. Pilot projects will have to prove if and how degradation of peat soils and protection of peat soils from wild fires can be included under the REDD scheme.

The Clean Development Mechanism (CDM) is a carbon trading mechanism. Industrialized countries with a greenhouse gas reduction commitment (Annex 1 countries) invest in projects that reduce emissions in developing countries. Afforestation and reforestation activities are eligible for carbon credits under the CDM for areas that were non forested areas in 1989. As most land in the EMRP area was covered with forest in 1990, the potential of generating carbon credits under the current CDM regulation is limited.

Voluntary market seems to have the best possibilities for generating alternative sources of finance for conservation and restoration activities in the EMRP. In this systems carbon credits are purchased by companies that generate carbon emission reductions against generally recognized but voluntary standards which are not officially approved under the United Nations Framework Convention. Possible emission reductions for the voluntary market include peat land conservation through canal blocking, fire prevention, forest conservation and reforestation.

5 Conclusions & Recommendations

5.1 Conclusions

1. Most of the original forests of the EMRP areas have been disturbed. Blocks A, C and D have less than 25% of forest area left, most of which is being disturbed. Blocks B and E have relatively more forest cover left, although here too large forest areas have been disturbed by (illegal) logging as well;

2. Forests provide < 10% of the GDP in the EMRP area. Most important forest products are rubber, rattan, timber, latex (jelutung). Illegal logging is providing important but unknown income to and goods and services;

3. Forest rehabilitation and restoration will be the most important forestry activity in the EMRP area. Forest rehabilitation can only be successful by addressing technical, socio-cultural, economic and institutional aspects. Forest rehabilitation plans should be based on balanced decisions on ecological goals, ecosystem services, competing land uses, and economic costs and benefits. Proper monitoring and after-care of reforested areas is essential.

4. Depending on the degradation state of the remaining forest the following rehabilitation strategies are recommended:

- On (slightly) degraded primary forest areas (1) natural regeneration and/or (2) assisted natural regeneration (ANR);
- On more degraded forest areas with secondary forest cover (3) community-based forest management or (4) community-based agro-forestry;
- On the most degraded forest lands (5) reforestation with native trees or (6) commercial reforestation like private sector-led tree plantations (HTI).

5. Planning of forest rehabilitation activities should be brought into line with the KPH/FMU approach.

6. Small scale rehabilitation programs should be done through community-led reforestation program, but in more remote parts of the area either large-scale forest rehabilitation or natural succession will be required. Pilot species trials show that various species can be successfully grown, and that this can be done in several ways, including agro-forestry techniques.

7. The tree species choice depends on the purpose of plantings and the planting environment (vegetation, hydrology, peat depth). The availability of seeds and seedlings and the scale of area will also determine which species can be used in reforestation activities.

8. Illegal logging is still a major issue in the EMRP area. Adequate law-enforcement is needed to ensure that management regulations will be properly implemented.

5.2 Recommendations

1. Inpress 2/2007 allocates 153,000ha in the southern area of Block C for silviculture (budidaya kehutanan). Although detailed information on the suitability of this area is lacking and needs to be collected, this area could be suitable for tree crops that are tolerant to water inundation and limited drainage requirements. It is recommended that an evaluation of the suitability of this area for timber plantations and of potential tree species is made.

2. Natural succession should be stimulated where possible, e.g. by opening up layers of pioneers trees to release late successional species which may have other timber values. In general, pioneer species are likely to be tolerant of open, un-shaded conditions, while species characteristic for primary peat swamp forest are likely to be more shade tolerant or shade requiring. Naturally regenerating species observed in the EMRP area like tumih (*Combretocarpus rotundatus*), geronggang (*Cratoxylon glaucum*), asam-asam (*Ploiarium alternifolium*), and ubah (*Eugenia* spp.) can be used to establish a first forest cover on badly degraded sites.

3. Natural succession can take a long time, ranging from tens to hundreds of years. To speed up the process of natural regeneration, or to help it getting started in badly disturbed forest area, assisted natural regeneration (ANR) should be applied when and where possible.

4. An important question which needs to be addressed urgently concerns the responsibility for reforestation: e.g. who does the reforestation (whom, where, when, funding etc.). It is important to directly link funding/implementation of reforestation plans to successes elsewhere (esp. stopping illegal logging and fires). There is a need for identification of clear rules and regulations relating to forest policy and management, including the division of tasks and responsibilities over the different levels.

5. It is suggested to carry out an analysis of ongoing species and variety tests in the EMRP area. Based on these findings best practice guidelines will be produced.

6. The voluntary market should be further explored to investigate the possibilities for generating alternative sources of finance for conservation and restoration activities in the EMRP.

6 References

Ashton, M.S. 1998. Seedling Ecology of Mixed-Dipterocarp Forest. In A Review of Dipterocarps Taxonomy, Ecology and Silviculture. Editors; S. Appanah and J.M. Turnbull. CIFOR. Bogor.

Ashton, M.S., Gunatilleke, C.V.S., Singhakumara, B.M.P. and Gunatilleke, I., 2001. Restoration pathways for rain forest in southwest Sri Lanka: a review of concepts and models. Forest Ecology and Management, 154: 409-430.

BAPPEDA TK.I Kalimantan Tengah. 1993/1994. Peta HPH. Skala 1:750.000. Data Pokok untuk Pembangunan. Palangka Raya.

BPDAS Kahayan and Wana Khatulistiwa Jaya. 2007. Evaluasi Dampak dan Manfaat GN-RHL/Gerhan Balai Pengelolaan DAS Kahayan Provinsi Kalimantan Tengah. Jakarta.

BPDAS Kahayan and Multima Krida Cipta. 2007. Rencana Rehabilitasi Hutan dan Lahan (RHL) 5 (Lima) Tahun Areal Eks PLG di Wilayah Kerja BPDAS Kahayan Tahun 2008-2012. Jakarta.

Brand, D.G., Leckie, D.G. & Cloney, E.E. 1991. Forest regeneration surveys: design, data collection, and analysis. Forestry Chronicle 67(6): 649-657.

Casson, A & Obidzinski, K. 2007. From new order to regional autonomy: shifting dynamics of illegal logging in Kalimantan, Indonesia – pp in L. Tacconi (ed.) Law enforcement, livelihoods and the timber trade. 301 pp., Earthscan London.

Chazdon, R.L. 2008. Beyond deforestation: Restoring forests and ecosystem services on degraded lands. Science, 320: 1458-1460.

CIFOR Rehab Team. 2003. Project proposal 'Review of forest rehabilitation initiatives - Lessons from the past'. CIFOR and the Government of Japan. Bogor.

Forestry Official of Central Kalimantan Province and Faculty of Agriculture UNPAR. 2007. Rencana Tindak Pembangunan Kesatua Pengelolaan Hutan (KPH) Propinsi Kalimantan Tengah. Palangka Raya.

ITTO 2002. ITTO guidelines for the restoration, management and rehabilitation of degraded and secondary tropical forests. ITTO Policy Development Series No 13. International Tropical Timber Organization in collaboration with the Center for International Forestry Research (CIFOR), the Food and Agriculture Organization of the United Nations (FAO), the World Conservation Union (IUCN) and the World Wide Fund for Nature (WWF) International.

Nawir, A.A., Murniati, Rumboko, L. 2007. Forest rehabilitation in Indonesia: where to after three decades? Center for International Forestry Research (CIFOR). Bogor, Indonesia.

Newman, M.F., P.F. Burges and T.C. Whitmore. 1996. Manuals of Dipterocarps for Foresters. Borneo Island Light Hardwoods. Royal Botanic Garden Edinburgh, UK., and CIFOR. Jakarta.

Giesen, W. 1989. Vegetation of the Sungai Negara Wetlands. - Paper presented at the workshop on "Integrating Wetland Conservation with Land-use Development, Sungai Negara, Barito Basin, Indonesia". Banjarbaru, South Kalimantan, March 1989.

Giesen, W. 2004. Causes of peatswamp forest degradation in Berbak National Park and recommendations for restoration. Water for Food and Ecosystems Programme Project on: "Promoting the river basin and ecosystem approach for sustainable management of SE Asian lowland peat swamp forests". ARCADIS Euroconsult, Arnhem, the Netherlands, 125 pp.

Harvey, C.A., Komar, O., Chazdon, R., Ferguson, B.G., Finegan, B., Griffith, D.M., Martinez-Ramos, M., Morales, H., Nigh, R., Soto-Pinto, L., Van Breugel, M. and Wishnie, M., 2008. Integrating agricultural landscapes with biodiversity conservation in the Mesoamerican hotspot. Conserv. Biol., 22: 8-15.

Limin. S.H. 2004. Beli Tanaman Tumbuh – Buying living tree. Centre for International Co-operation in Management of Tropical Peatland (CIMTROP), University of Palangka Raya. Internal Report, 15 pp.

Limin, S.H. 2007. RESTORPEAT Project, CIMTROP UNPAR Tasks. Centre for International Co-operation in Management of Tropical Peatland (CIMTROP), University of Palangka Raya. Internal Report, 25 pp.

Longman, K.A., 1995. Preparing to plant tropical trees. Commonwealth Science Council, London, 238 pp.

Page, S.E., and Waldes, N. 2005. Unlocking the Natural Resource Functions of Tropical Peatlands: Understanding the Nature and Diversity of Peat Swamp Forest Vegetation as a Fondation for Vegetation Restoration Studies. In Proceedings of the International Symposium and Workshop on Tropical Peatland, Held in Palangka Raya, 20-24 September 2005. "Restoration and Wise Use of Tropical Peatland: Problems of Biodiversity, Fire, Poverty and Water Management". Editor: J.O. Rieley, S.H. Limin, and A Jaya. CIMTROP and the EU INCO RESTORPEAT Partnership. Prima Karya, Bogor-Indonesia. Page 33-40.

Pusat Pengukuhan and Penatagunaan Kawasan Hutan. 2007. Bahan Presentasi Rapat Menteri Kehutanan. Tata Ruang Kawasan Pengembangan Lahan Gambut Sejuta Hektar di Propisi Kalimantan Tengah. 21 September 2007. Jakarta.

Reichert, P., Borsuk, M., Hostmann, M., Schweizer, S., Spörri, C., Tockner, K. and Truffer, B., 2007. Concepts of decision support for river rehabilitation. Environmental Modelling & Software, 22: 188-201.

SarVision. 2008. Revised Land Use / Cover Map of the Ex-Mega Rice Project Area and Sebangau,Central Kalimantan.

Sayer, J., Chokkalingam, U. and Poulsen, J., 2004. The restoration of forest biodiversity and ecological values. Forest Ecology and Management, 201: 3-11.

UNDP/WCMC. 2008. Forest Restoration Information Service (FRIS). (http://www.unep-wcmc.org/forest/restoration/fris/default.aspx)

Upton, D. and P. de Groot. 2008. Planting and establishment of tropical trees. Commonwealth Science Council, London, 142 pp.

Wibisono, I.T.C., and Gandrung, A.Y. 2008. Ujicoba Penanaman Beberapa Jenis Tanaman Asli Hutan Rawa Gambut pada Beberapa Lokasi di Lahan Gambut Terdegradasi. WIIP-Central Kalimantan.

Wibisono, I.T.C., and Wardoyo. 2008. Reforestation of Barren Areas in Block A-B of The Ex-MRP (Buffer Zone of MAWAS). WIIP-Central Kalimantan.

Van der Meer, P.J., Chai, F.Y.C., Hillegers, P.J.M. and K.G. Pearce. 2005. Sustainable Management of Peat Swamp Forests of Sarawak with special reference to Ramin. Final Technical Report. Alterra, Wageningen UR, Sarawak Forest Department, Sarawak Forestry Corporation. Kuching. 739 pp.

Annex 1 Main forest related vegetation and land-use classes.

SARvision (2008) identified 22 vegetation and land-use classes. Sixteen of these classes are referring to vegetation types which are either (degraded) forest, or are vegetation types which are the result of severe forest disturbance or forest clearance. We have grouped those 16 vegetation classes in the following 4 categories:

- Forest (including logged-over forest) with tree cover > 10%;
- Severely degraded forest with a tree cover <10%;
- Shrubland with vegetation cover > 10%;
- Open shrub with vegetation cover < 10%, including grasslands and land covered with ferns

The remaining 6 classed have been grouped in “other “ (e.g. non-forest) classes, including agriculture, tree crops, and settlements.

Below the sub-classes as given by Sarvision (2008) are given for each of the main forest and vegetation classes.

Forest (including logged-over forest with cover > 10%)

- Low pole forest (cover >10%) (12): (Lowland evergreen broadleaved forest, low pole swamp forest). Tree cover >11%, broadleaved evergreen occurring in elevations <1000m above sea level. This forest type has small diameter trees reaching height up to 25m but with a lot of under-canopy, areas are seasonally flooded and peat can be waterlogged or sometimes flooded in pools, (e.g. Page et al, 1999). More advanced coding is needed, technically coded as aquatic; (peat) swamp forest, fresh or brackish water.
- Peat swamp forest (cover >11%) (2): (Lowland evergreen broadleaved forest (mixed swamp forest)). Tree cover, closed to open (cover >15%), broadleaved evergreen elevation <1000m. Upper canopy layer is tall and stratified, with a second more open layer (Page et al, 1999). More advanced coding needed, technically coded as aquatic; (peat) swamp forest, fresh or brackish water.
- Riverine-Riparian Forest (cover >11%) (3): (Swamp forest and woodland (Riverine)) The main layer consists of broadleaved evergreen closed to open woodland on temporarily flooded land. The crown cover is >11% and tree height can reach 40m. This class is intermediate between freshwater swamp forest on mineral soil and peat swamp forest (Page et al. 1999). Due to its similar structure and more readily detectable water seasonality under the canopy, Forest regrowth in previously burnt and collapsed peat swamp forest types is (mis)classified as Riverine.
- Swamp forest (cover >11%): (not present in previous legend but mentioned in report Heath forest (kerangas)). Is known to occur to the north of block E and SNP. It is a distinctive lowland evergreen broadleaved forest type dominated by small diameter trees with a tree cover higher than 11%, occurring on sandy soils of poor fertility, often subject to water stress (either drought or water-logging). It is now included as a distinct forest type in the map since the forest fragments of the 2007-CKPP LULC map were overlaid with the peat depth map available for

the area (CKPP-project, 2007). Forest fragment outside the depth peat areas were labelled as swamp forest.

- Mangrove (cover >11%) (15): (Mangrove forest). The main layer consists of broadleaved evergreen mangrove trees over tidal flooded terrain. The crown cover is higher that >11%. The height is in the range of 5-20m.

Severely Degraded Forest (cover <10%)

- Low pole forest (cover 1-10%) (13): (no corresponding class in previous map). This type of Vegetation is located in the peat domes with tree cover not exceeding 10%. Corresponds to open vegetation with standing low pole tress and shrubs. It is regularly flooded with waterpools between the open vegetation.
- Woodland or degraded vegetation (cover 1-10%) (3): (Forest mosaics, degraded). Vegetation with tree cover not higher that 10%, tree cover includes forests that have been degraded by fire and intensive logging over several years or tree regrowth and high shrubs.
- Burnt area- burnt tress (11): (Tree cover, burnt). The main layer consists of closed to open trees. Recently burnt, dead/dry trees standing over green new growth vegetation (stems, canopy cover lost). Burn severity unknown and precise burnt date between 2006 and 2007. Burnt area- burnt shrubs and bare
- Mangrove (cover (1-10%) (14): (Mangrove forest). The main layer consists of broadleaved evergreen mangrove trees over tidal flooded terrain with tree cover lower than <10%. The height is in the range of 5-20m with open canopies and low biomass.

Shrubland (cover > 10%)

- Shrubland (cover 11-50%) flooded or non-flooded (6): (no corresponding class in previous map). This class has a shrub cover between 11-50%. The rest can be herbaceous vegetation.
- Shrubland (cover >50%) -non flooded (4): (Shrubland and forest regrowth). The main layer consists of broadleaved evergreen closed to open vegetation. Vegetation cover >50%. The height is in the range of 0.3-5m. This class includes regrowing tree cover. For example in previously burnt and collapsed low pole and mixed swamp forest.
- Shrubland) (cover >50%) –flooded) (5): (Regularly flooded shrub cover). The main layer consists of broadleaved evergreen closed to open shrubs. Vegetation cover is >50%. The height is in the range of 0.3-5m. More information is needed about this specific type. The class likely includes many dead dry trees. Flooding duration is estimated on more than 4 months a year.

Grasslands, Ferns, Open shrub (cover < 10%)

- Sedges (16): (Regularly flooded herbaceous cover).Regularly flooded areas including sedges such as (e.g. Thorachostachyum spp) and pandans (e.g. Pandanus spp) (Page et al, 1999).
- Grassland + ferns (herbaceous) (8): (Grassland and ferns). The main layer consists of closed to open herbaceous vegetation. Vegetation cover is >50%. The height is in the range of 0.3-3m. The class includes large areas dominated by ferns in previously burnt areas and grasslands (Alang alang).
- Shrubland (cover<10%) (7): (no corresponding class in previous map). This class has a shrub cover not higher that 10%. Rest of the cover can be high herbaceous or Ferns.
- (10): (Shrub cover, burnt). The main layer consists of closed to open shrub dry by burning with remaining or regenerating vegetation (stems, leaf cover lost), although biomass levels are

lower than for the tree cover, burnt class. Sometimes areas are completely bare depending on burn severity.

Other (agriculture, tree crops, settlements)

- Dry-land agriculture (19): (Cropland – dry land agriculture). Terrestrial, cultivated and managed areas. The herbaceous vegetation cover is artificial and requires maintenance. It is characterised by the periodic removal of the (semi)natural vegetation cover and cultivated crops are managed and/or (partly) harvested at the end of the growing season. This areas are been edited using field information and secondary remote sensing observations (Landsatt imagery and an specific colour composite of the radar images. The colour composite of figure 7 shows the areas of dry agriculture in both bright-blue and red. Still the difference between them is unknown and more field data is necessary.
- Tree crops (21): (Mixed cropland and plantations). Vegetation cover includes perennial cash-crops plantations such acacia, oil palm, but also tree or shrub cover. Cultivated and managed terrestrial, trees or shrubs/ herbaceous.
- Sawah (18): (Cropland – rice paddy fields). Aquatic, cultivated and managed areas. The herbaceous vegetation cover (graminoids), are grown in irrigated or temporarily flooded (rice) areas.
- Fish ponds (17): (not corresponding class in previous map). Areas of artificial or man made water bodies use for fish farming.
- Open water (9): (Water bodies). Water bodies, permanent, including sea.
- Urban areas (-): Edited manually, assisted by a settlement GIS shape file available from Bakosurtanal. In the large agricultural area in block C distinct square areas classified as shrub cover were recoded to urban. The land cover consists of artificial surface(s); built up area(s) including cities such as Palangkaraya.

Annex 2 BPDAS Kahayan plans for Palangka Raya City, Kapuas District and Pulang Pisau District

A. Rehabilitation Model for Palangka Raya City in BPDAS Kahayan Working Area 2008-2012.

SITE	SUB DISTRICT	ID	VILLAGE	AREAS (Ha)	CRITICAL LEVEL	PRIO-RITY	LAND COVER	DIRECTION OF AREA FUNCTION	REHABILITATION MODEL	NOTES	NUMBER OF CANAL	NUMBER OF MONITORING WELL
YEAR 2008												
Inside	Sebangau	16	KAMELOH BARU	500	Rather Critical	2	Bush Shrub	Hydrology	R	Canal Blocking		
Forest		17	SABARU	1.000	Rather Critical	2	Bush Shrub	Flora and fauna	RA	Canal Blocking	5	100
State		14	SABARU	1.000	Rather Critical	2	Bush Shrub	Deep Peat	RA		5	100
Outside	Sebangau	15	KALAMPANGAN	1.100	Rather Critical	2	Bush Shrub	Annual Crop	HR			
TOTAL				***3.600***							***10***	***200***
YEAR 2009												
Inside	Sebangau	47	KALAMPANGAN	1.000	Rather Critical	2	Bush Shrub	Deep Peat	RA	Canal Blocking	***4***	80
Forest		45	KALAMPANGAN	500	Rather Critical	2	Bush Shrub	Deep Peat	RA		***2***	40
State		46	KAMELOH BARU	400	Rather Critical	2	Bush Shrub	Hydrology	RA	Canal Blocking		
TOTAL				***1.900***							***6***	***520***
YEAR 2010												
Inside	Sebangau	75	KALAMPANGAN	500	Rather Critical	2	Bush Shrub	Deep Peat	R	Canal Blocking	***2***	40
		73	SABARU	500	Rather Critical	2	Bush Shrub	Deep Peat	R	Canal Blocking		
Outside	Sebangau	74	KALAMPANGAN	500	Rather Critical	2	Bush Shrub	Annual Crop	HR			
TOTAL				***1.500***							***24***	***880***
YEAR 2011												
Inside	Sebangau	90	SABARU	650	Rather Critical	2	Bush Shrub	Flora and fauna	R	Canal Blocking	***1***	20
		89	SABARU	150	Rather Critical	2	Bush Shrub	Deep Peat	R		***1***	20
TOTAL				***800***							***2***	***40***
YEAR 2012												
Inside	Sebangau	108	KALAMPANGAN	75	Rather Critical	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people	***1***	20
		110		200	Rather Critical	2	Bush Shrub	Deep Peat	R	Canal Blocking	***2***	40
Outside	Sebangau	107	KALAMPANGAN	165	Rather Critical	2	Agriculture	Annual Crop	HR	Technical design is arranged with local people		
		106	KALAMPANGAN	440	Rather Critical	2	Bush Shrub	Annual Crop	P	Canal Blocking		
		109	KAMELOH BARU	220	Rather Critical	2	Bush Shrub	Annual Crop	P			
TOTAL				***1.100***							***3***	***60***

Source: BPDAS Kahayan and Multima Krida Cipta (2007).

Notes:

HKM : Social forestry

HR : Community forest

R : Reforestation

RA : Reforestation with agroforestry design.

B. Rehabilitation Model for Kapuas District in BPDAS Kahayan Working Area 2008-2012.

SITE	DISTRICT	ID	VILLAGE	AREA (Ha.)	CRITICAL LEVEL	PRIO-RITY	LAND COVER	DIRECTION OF THE AREA FUNCTION	REHABILITATION MODEL	NOTES	NUMBER OF CANAL	NUMBER OF MONITORING WELL
TAHUN 2008												
INSIDE FOREST STATE	BASARANG	5	BATUAH	150	Crital	2	Barren Areas	Gelam/Purun	R		2	40
		13	PANGKALAN REKAN	70	Crital	2	Barren Areas	Gelam/Purun	R		1	20
	MANTANGAI	8	DANAU RAWAH	1.500	Crital	2	Barren Areas	Sand Quartz	R	Canal Blocking	15	300
		7	KATANJUNG	1.210	Very Critical	2	Barren Areas	Deep Peat	R		15	300
		9	LAHAI MANGKUTUP	4.000	Crital	2	Barren Areas	Sand Quartz	R		20	400
		6	MANTANGAI HULU	460	Crital	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people	7	140
	SELAT	4	PULAU MAMBULAU	250	Very Critical	1	Barren Areas	Gelam/Purun	R		4	80
	TIMPAH	10	ARUK	750	Crital	2	Barren Areas	Hydrology	RA		4	80
		1	LAWANG KAJANG	210	Very Critical	1	Barren Areas	Sand Quartz	RA	Canal Blocking	5	100
		3	PETAK PUTI	200	Crital	1	Barren Areas	Hydrology	R		3	60
		2	PETAK PUTI	200	Crital	1	Barren Areas	Sand Quartz	RA		3	60
		11	TIMPAH	500	Rather Critical	2	Barren Areas	Sand Quartz	RA			
OUTSIDE	KAPUAS KUALA	12	BANDAR RAYA	500	Crital	2	Barren Areas	Annual Crop	HR	Technical design is arranged with local people	2	40
TOTAL				***10.000***							***81***	***1.620***
TAHUN 2009												
INSIDE FOREST STATE	MANTANGAI	35	DANAU RAWAH	1.000	Crital	2	Barren Areas	Hydrology	R		10	200
		36	DANAU RAWAH	1.000	Crital	2	Barren Areas	Sand Quartz	R		10	200
		42	KATANJUNG	490	Very Critical	2	Barren Areas	gambut tebal	R		5	100
		37	LAHAI MANGKUTUP	4.000	Crital	2	Barren Areas	Hydrology	R		5	100
	SELAT	40	SEI JANGKIT	180	Crital	2	Barren Areas	Gelam/Purun	R	Canal Blocking	2	40
	TIMPAH	41	LAWANG KAJANG	330	Rather Critical	2	Semak Belukar	Sand Quartz	RA		2	40
		38	LAWANG KAJANG	330	Crital	2	Barren Areas	Sand Quartz	R		4	80
		39	PETAK PUTI	1.500	Crital	2	Barren Areas	Hydrology	RA		15	300
		43	TIMPAH	170	Rather Critical	2	Bush Shrub	Sand Quartz	RA		4	80
OUTSIDE	MANTANGAI	44	DANAU RAWAH	1.000	Rather Critical	2	Bush Shrub	Annual Crop	HR	Technical design is arranged with local people	10	200
TOTAL				***10.000***							***67***	***1.340***
TAHUN 2010												
INSIDE FOREST STATE	BASARANG	71	BASUNGKAI	180	Crital	2	Agriculture	Gelam/Purun	HKM		6	120
	KAPUAS KUALA	63	BANDAR RAYA	370	Rather Critical	2	Agriculture	Gelam/Purun	HKM		4	80
		64	WARNA SARI	300	Rather Critical	2	Agriculture	Gelam/Purun	HKM		4	80
	MANTANGAI	62	LAHAI MANGKUTUP	3.000	Very Critical	2	Barren Areas	Hydrology	R	Canal Blocking	20	400
		67	MANTANGAI HULU	900	Crital	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people	10	200
		66	TUMBANG MUROI	680	Crital	2	Agriculture	Deep Peat	HKM		7	140
	SELAT	65	PULAU MAMBULAU	500	Crital	2	Agriculture	Gelam/Purun	HKM		5	100
	TIMPAH	68	ARUK	1.400	Crital	2	Barren Areas	Sand Quartz	R		14	280
		69	PETAK PUTI	650	Crital	2	Barren Areas	Hydrology	RA	Canal Blocking	7	140
		70	TIMPAH	420	Rather Critical	2	Bush Shrub	Sand Quartz	RA		4	80
OUTSIDE	SELAT	72	SELAT HILIR	1.600	Rather Critical	3	Agriculture	Annual Crop	HR	Technical design is arranged with local people	10	200
TOTAL				***10.000***							***91***	***1.820***
TAHUN 2011												
INSIDE FOREST	MANTANGAI	85	DANAU RAWAH	1.100	Crital	2	Barren Areas	Sand Quartz	R	Canal Blocking		
		87	KATANJUNG	3.200	Crital	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people	12	240
STATE		86	LAHAI MANGKUTUP	3.700	Crital	2	Barren Areas	Sand Quartz	R	Canal Blocking	10	200
		88	MANTANGAI HULU	500	Crital	2	Agriculture	Gelam/Purun	HKM	Technical design is arranged with local people	10	200
OUTSIDE	MANTANGAI	119	KATANJUNG	1.500	Rather Critical	3	Bush Shrub	Annual Crop	HR	Technical design is arranged with local people	6	120
TOTAL				***10.000***							***38***	***640***
TAHUN 2012												
INSIDE FOREST STATE	MANTANGAI	105	KATANJUNG	3.200	Crital	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people	16	320
		102	MANTANGAI HULU	2.100	Crital	2	Agriculture	Deep Peat	HKM		10	200
		101	SEI AHAS	4.200	Crital	2	Agriculture	Deep Peat	HKM		20	400
	SELAT	103	PULAU KUPANG	180	Crital	2	Agriculture	Gelam/Purun	HKM		4	80
	TIMPAH	104	ARUK	320	Crital	2	Barren Areas	Hydrology	RA	Canal Blocking		
TOTAL				***10.000***							***50***	***1.000***

Source: BPDAS Kahayan and Multima Krida Cipta (2007).

Notes:

HKM : Social forestry

HKMA : Social forestry with agroforestry design

R : Reforestation

RA : Reforestation with agroforestry design.

C. Rehabilitation Model for Pulang Pisau District in BPDAS Kahayan Working Area 2008-2012.

SITE	DISTRICT	ID	VILLAGE	AREAS (Ha.)	CRITICAL LEVEL	PRIO-RITY	LAND COVER	DIRECTION OF AREA FUNCTION	REHABILITATION MODELS	NOTES	NUMBER OF CANAL	NUMBER OF MONITORING WELL
YEAR 2008												
Inside	JABIREN RAYA	27	PILANG	40	Very Critical	1	Barren Areas	Deep Peat	R	Canal Blocking	1	20
	KAHAYAN HILIR	18	ANJIR PULANG PISAU	1.100	Very Critical	1	Barren Areas	Flora Fauna	RA			
		19	BUNTOI	650	Very Critical	1	Barren Areas	Flora Fauna	RA	Canal Blocking		
		32	PULANG PISAU	670	Rather Critical	2	Semak belukar	Flora Fauna	R			
	KAHAYAN KUALA	25	BAHAUR GUNUNG	1.000	Very Critical	1	Barren Areas	Deep Peat	R	Canal Blocking	10	200
		20	BAHAUR HILIR	250	Very Critical	1	Barren Areas	Forestryculture	R		6	120
		34	CEMANTAN	500	Critical	2	Barren Areas	Forestryculture	R			
		30	CEMANTAN	1.000	Critical	2	Barren Areas	Mangrove	R			
		31	PAPAYU I SEI PASANAN	1.000	Very Critical	2	Barren Areas	Deep Peat	R	Canal Blocking		
		28	PAPAYU III SEI PUDAK	800	Critical	2	Barren Areas	Forestryculture	R			
		29	PAPAYU III SEI PUDAK	500	Critical	2	Barren Areas	Mangrove	R			
		33	SEI RUNGUN	100	Critical	2	Barren Areas	Forestryculture	R			
	KAHAYAN TENGAH	26	BAHU PALAWA	60	Critical	1	Barren Areas	Sand Quarzt	R		2	40
		22	PAMARUNAN	460	Very Critical	1	Barren Areas	Sand Quarzt	R	Canal Blocking	5	100
		21	SIGI	70	Very Critical	1	Barren Areas	Hydrology	RA		2	40
	SABANGAU KUALA	23	PANDURAN SEBANGAU	200	Very Critical	1	Barren Areas	Forestryculture	R		4	80
Outside	JABIREN RAYA	24	TUMBANG NUSA	1.600	Rather Critical	3	Bush, Shrub	Annual Crop	HR	Canal Blocking	16	320
JUMLAH				***10.000***							***46***	***920***
YEAR 2009												
Inside	KAHAYAN HILIR	50	ANJIR PULANG PISAU	1.500	Critical	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people and canal blocking		
		51	GOHONG	550	Rather Critical	2	Bush, Shrub	Flora Fauna	R			
		52	GOHONG	600	Rather Critical	2	Bush, Shrub	Deep Peat	R			
	KAHAYAN KUALA	59	BAHAUR HILIR	1.110	Very Critical	2	Barren Areas	Deep Peat	R	Canal Blocking	12	240
		60	BAHAUR TENGAH	1.070	Very Critical	2	Barren Areas	Deep Peat	R		12	240
		57	SEI RUNGUN	400	Critical	2	Barren Areas	Forestryculture	R	Canal Blocking		
	KAHAYAN TENGAH	49	BAHU PALAWA	460	Rather Critical	2	Bush, Shrub	Hydrology	R	Canal Blocking	2	40
		48	BUKIT RAWI	850	Rather Critical	2	Bush, Shrub	Hydrology	RA		4	80
		61	PENDA BARANIA	500	Rather Critical	2	Bush, Shrub	Hydrology	RA	Canal Blocking		
	MALIKU	53	TAHAI BARU	170	Critical	2	Barren Areas	Gelam/Purun	R		3	60
	PANDIH BATU	55	DANDANG	650	Very Critical	2	Barren Areas	Deep Peat	R	Canal Blocking	12	240
		54	DANDANG	500	Very Critical	2	Barren Areas	Deep Peat	R		10	200
		56	TALIO	670	Very Critical	2	Barren Areas	Deep Peat	R		14	280
Outside	JABIREN RAYA	58	GARONG	970	Rather Critical	3	Bush, Shrub	Annual Crop	HR		10	200
TOTAL				***10.000***							***79***	***1.580***
YEAR 2010												
Inside	KAHAYAN HILIR	79	ANJIR PULANG PISAU	750	Rather Critical	2	Bush, Shrub	Deep Peat	R	Canal Blocking	14	280
		78	MANTAREN I	1.200	Critical	2	Agriculture	Deep Peat	R		12	240
	KAHAYAN TENGAH	83	BUKIT RAWI	1.290	Rather Critical	2	Bush, Shrub	Hydrology	RA	Canal Blocking	13	260
		82	PENDA BARANIA	2.400	Rather Critical	2	Bush, Shrub	Hydrology	RA	Canal Blocking		
		76	TUWUNG	660	Rather Critical	2	Bush, Shrub	Sand Quarzt	RA		6	120
		84	TUWUNG	2.400	Rather Critical	2	Bush, Shrub	Hydrology	RA	Canal Blocking	12	240
	PANDIH BATU	80	DANDANG	700	Critical	2	Agriculture	Forestryculture	HKM		7	140
		81	PANGKO HULU	300	Critical	2	Barren Areas	Forestryculture	R		3	60
Outside	JABIREN RAYA	77	SAKA KAJANG	300	Rather Critical	3	Bush, Shrub	Annual Crop	HR			
TOTAL				***10.000***							***67***	***1.340***
YEAR 2011												
Inside	KAHAYAN HILIR	94	ANJIR PULANG PISAU	1.000	Critical	2	Agriculture	Deep Peat	HKM	Technical design is arranged with local people and canal blocking	4	80
		93	BUNTOI	4.000	Critical	2	Agriculture	Deep Peat	HKM		22	440
		99		310	Critical	2	Agriculture	Deep Peat	HKM			
		95	PULANG PISAU	1.200	Critical	2	Agriculture	Deep Peat	R		12	240
		98		350	Rather Critical	2	Bush, Shrub	Flora Fauna	R		4	80
		96		1.100	Rather Critical	2	Bush, Shrub	Deep Peat	R		10	200
	KAHAYAN TENGAH	100	BUKIT RAWI	1.000	Rather Critical	2	Bush, Shrub	Hydrology	R	Canal Blocking	5	100
	KAHAYAN KUALA	92	BAHAUR HILIR	400	Very Critical	2	Barren Areas	Forestryculture	R			
		91	BAHAUR TENGAH	270	Very Critical	2	Barren Areas	Deep Peat	R		8	160
Outside	MALIKU	97	TAHAI JAYA	370	Critical	2	Barren Areas	Annual Crop	HR		2	40
TOTAL				***10.000***							***67***	***1.340***
YEAR 2012												
Inside	JABIREN RAYA	118	TUMBANG NUSA	2.400	Rather Critical	3	Bush, Shrub	Deep Peat	R	Canal Blocking	12	240
		117	TUMBANG NUSA	2.100	Rather Critical	3	Bush, Shrub	Hydrology	R		12	240
	KAHAYAN HILIR	112	MANTAREN I	500	Rather Critical	2	Agriculture	Forestryculture	HKM	Technical design is arranged with local people and canal blocking		
		114	MINTIN	250	Rather Critical	2	Agriculture	Forestryculture	HKM			
		113	UPT ANJIR PULANG PISAU	250	Rather Critical	2	Agriculture	Forestryculture	HKM			
	KAHAYAN TENGAH	111	TANJUNG SANGALANG	500	Rather Critical	2	Bush, Shrub	Hydrology	RA	Canal Blocking	5	100
		115	TANJUNG SANGALANG	700	Rather Critical	2	Bush, Shrub	Hydrology	RA		7	140
Outside	JABIREN RAYA	116	TUMBANG NUSA	3.300	Rather Critical	3	Bush, Shrub	Annual Crop	HR	Canal Blocking		
TOTAL				***10.000***							***36***	***720***

Source: BPDAS Kahayan and Multima Krida Cipta (2007).

Notes:

HKM : Social forestry; HR : Community forest

R : Reforestation; RA : Reforestation with agroforestry design.

Annex 3 Criteria, Indicator, Verifier, Data, and Verification method for Rehabilitation Activities

NO.	CRITERIA	INDICATOR	VERIFIER	DATA AND INFORMATION		VERIFICATION METHOD	
				DATA TYPE AND INFORMATION	DATA SOURCE AND INFORMATION	COLLECTING METHOD	ANALYSIS METHOD
1	2	3	4	5	6	7	8
I.	Technical (T) Improvement of stakeholder capacity and capability, where describe its learning process in planning, organizing, actuating, and controlling	Capacity of stakeholder on planning implementation of rehabilitation (T1)	1. Stakeholder understanding of the planning criteria	Planning criteria for rehabilitation Stakeholder understanding on criteria planning Knowledge/understanding source on rehabilitation criteria planning			
			2. Stakeholder understanding on process and planning mechanism	Standard planning for process and its mechanism Stakeholder understanding on process and its mechanism Knowledge/understanding source on rehabilitation process and its mechanism			
			3. Stakeholder understanding on document legality planning process	Criteria, process, and mechanism standard of planning Stakeholder understanding on document legality planning process Knowledge /understanding source on legality planning process			
			4. Existence and planning quality	Planning criteria Existence of planning document Process and arrangement document mechanism Quality of document plan			

		Capacity of stakeholder on organizing implementation of rehabilitation (T2)	1. Stakeholder understanding on its position and role	Organization structure and relationship role of worker Job description for the each level organization Record process of stakeholder meeting Knowledge/understanding source of organization implementer			
			2. Stakeholder understanding on organization structure and its working relationship	Standard organization structure Organization structure and job relationship value Understanding of stakeholder structure and its job relationship value Knowledge/understanding source of stakeholder on structure and job relationship value			
			3. Coordination between stakeholder	Record process of coordination meeting of stakeholder Realization (type, role, schedule, and volume of rehabilitation activity) Supporting and limitation factors Stakeholder understanding on mechanism of coordination implementation Knowledge/understanding source on implementation of coordination			
		Capacity of stakeholder on implementation of rehabilitation (T3)	1. Stakeholder understanding on technical aspect and steps of activity	Standard implementation steps and technical design document Realization of activity for every step Stakeholder understanding on implementation step Understanding source on implementation step			
			2. Ratio between land suitability and its area	Site and area plan Site area of realization The reasoning of			

				area changing			
			3. Ratio realization and target area for plantation	Areas plan Areas realization Supporting and limitation factor to achievement target			
			4. Ratio between survival percentage and its planted	Number of planted Number of realization Supporting and limitations factor to achievement planting target			
			5. Ratio between number of plant was maintained and growing plant	Number of plant success to grow Number of plant are maintenance Supporting and limitation factors to achieve maintenance target			
			6. Ratio in schedule between finance allocated and its realization	Planning of time schedule and finance for implementation Realization of time schedule and finance for implementation Supporting and limitation factors to achieve time schedule and its finance			
			7. Ratio of plan suitability and realization for development of soil conservation building	Number, type and location of soil conservation building in the plan Realization of number, type, and location of soil and water conservation building Supporting and limitation factors to achieve target of number, type, and location of conservation building			
		Capacity of stakeholder on monitoring and evaluation of rehabilitation (T4)	1. Stakeholder understanding on controlling and activity control	Monitoring and evaluation standard activity Realization of monitoring and evaluation Stakeholder understanding on monitoring and evaluation Understanding of monitoring and evaluation source			

			2. Controlling and monitoring mechanism by stakeholder 3. Affectivity stakeholder on control and evaluation	Standard process and mechanism of monitoring and evaluation Stakeholder understanding on mechanism of monitoring and evaluation Understanding on mechanism of monitoring and evaluation source Activity problem of rehabilitation			
II.	Economic (E) Improvement of micro economic condition of community and regional macro economic until rehabilitation process is finished	Improvement of community income (E1)	1. Community income before rehabilitation 2. Community income after rehabilitation 3. Percentage of increasing of the community income from rehabilitation sector				
		Level of worker involving (E2)	1. Type of job for community of rehabilitation activity 2. Broadening of chance for economic income 3. Number of worker coverage				
		Contribution of Provincial or District PDRB on Rehabilitation Program (E3)	1. Allocation of APBD province and or district on rehabilitation activity 2. Ratio of APBD province and or district of total cage 3. Mechanism allocation cage assistance of total cage rehabilitation 4. Affectivity assistance cage of province and or district of total cage rehabilitation program				
		Diversification community job (E4)	1. Diversity of community activity to earn money 2. Improvement of community economic capacity				
		Improvement of economic value of natural resource (E5)	1. Economic value added of land 2. Economic				

			value added of plant/stand 3. Economic value added of production tool				
		Improvement of infestation and economic infrastructure after rehabilitation (E6)	1. Improvement of infestation at the implication moments 2. Improvement of economic facility				
		Projection of timber and non timber product from rehabilitation (E7)	1. Type and volume of timber product 2. Type and volume of non timber product 3. Intensity of timber usage 4. Intensity of non timber product usage				
III.	Environmental (L) Improvement watershed management function to support environmental carrying capacity	Land ability to decreasing surface run off (L1)	1. Increasing of land coverage 2. Decreasing of critical land 3. Decreasing of flooding potency				
		Increasing of land conservation function (L2)	1. Affectivity of soil conservation building 2. Positive effect of plantation and land cover 3. Decreasing of erosion and landslide potency				
		Increasing of Biodiversity (L3)	1. Biodiversity at species level of flora 2. Biodiversity at level species of fauna				
		Increasing of quality of the ecosystem area (L4)	1. Improvement of hydrology 2. Improvement of soil quality 3. Increasing of area productivity				
IV.	Social and Culture (S) Behavioural and value system changes with result the improvement of human capacity and strengthening of community institutional to support implementation of rehabilitation	Community participation level (S1)	1. Type of activity in rehabilitation where cooperation with community 2. Type of community participations 3. Number of people are participated as year activity 4. Community participation				

	activity		intensity 5. Mechanism on community participation 6. Learning lesson process for community				
		Participation level of community institutions (S2)	1. Play of role of community institution on rehabilitation activity 2. Existences strengthening and community play of role of rehabilitation implementation 3. Affectivity of community institution for achievement of aim/purpose in rehabilitation 4. Learning lesson process for community institution				
		Adoption level on value system and custom law (S3)	1. Play of role of value system and custom law in community in rehabilitation implementation 2. Affectivity adoption value system and custom law in community 3. Learning lesson of value system and custom law in community 4. Strengthening of value system and custom value in community				
		Level community behavioural change (S4)	1. Behaviour pattern of community in line with rehabilitation 2. Behaviour change process of community 3. Affectivity of behaviour change in community				
		Improvement of the community capacity and capability (S5)	1. Ratio between number of worker well trained in community before and between rehabilitation activity 2. Ratio of skill diversity in				

			community before and after rehabilitation activity 3. Mechanism for improvement of capacity and capability of stakeholder				
		Changing level on community autonomy (S6)	1.Type of community autonomy changes in rehabilitation program 2. Strengthening of community autonomy changes 3. Affectivity of change of community autonomy 4. Learning process of community autonomy				

Source: BPDAS Kahayan and Wana Khatulistiwa Jaya. 2007.

Bappenas
Secretariat
Inpres 2/2007

Jl. Taman Suropati
No.2,
Jakarta 10310

www.bappenas.go.id

Bappeda
Central
Kalimantan
Secretariat Inpres
2/2007

Jl. Diponegoro 60,
Palangka Raya
73111,
Kalimantan Tengah

www.kalteng.go.id

Royal
Netherlands
Embassy

Jl. H.R. Rasuna
Said Kav. S-3,
Kuningan
Jakarta 12950

indonesia.nlembassy.org

Euroconsult
Mott MacDonald

S. Widjojo Centre, lt. 3
Jl. Sudirman Kav. 71
Jakarta 12190

www.euroconsult.mottmac.com

Deltares | Delft
Hydraulics

P.O. Box 177
2600 MH Delft
The Netherlands

www.wldelft.nl