STATE GOVERNMENT SARAWAK

FOREST DEPARTMENT SARAWAK

HEART OF BORNEO INITIATIVE

PROJECT IMPLEMENTATION FRAMEWORK

SARAWAK, MALAYSIA

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CHAPTER I – INTRODUCTION

1.1 GLOBAL FOREST PERSPECTIVES

The state of the world's forests which have shrunk from some six billion hectares from the pre-industrial era, to the current 3.9 billion hectares, more or less equally distributed between tropical and non-tropical countries, confronts humankind with growing evidence of dire consequences to human survival and well-being (Table 1.1). Global warming, loss of biodiversity and environmental values have vital linkages with intangible forest values which impact on agricultural productivity, human health, clean water, indeed the world's support system for human survival.

With tropical deforestation estimated at more than 11 million hectares annually and the extent of sustainable management and certification of tropical forest insignificant, the tropical forest crisis, compounded of late with rampant illegal logging and illegal trade, is the subject of numerous debates and conferences. It has even entered the agenda of the G-7 countries. This is because tropical forests are a treasure trove of the earth's wealth of biodiversity and the dire negative consequences will affect millions of forest-dependent people in many tropical countries.

Table 1.1 – World's Forest Area by Region, 2005

Region	Land Area* (million hectares)	Total Forest		
		Area (million hectares)	Percentage of Land Area	Percentage of world's forest
Africa	2,968	635	20	16
Asia	3,088	572	19	15
Europe	2,260	1,001	44	25
North & Central America	2,144	706	33	18
Oceania	849	206	24	5
South America	1,743	832	48	21
World Total	**13,052**	**3,952**	**30**	**100**

Note: * Excluding inland water areas

In view of the foregoing, several initiatives are being developed or being implemented, in order to address the tropical forest problematic. One of these initiatives is the Heart of Borneo (HoB) Initiative, launched in Brazil in March 2006, to promote transboundary cooperation between three neighbouring ASEAN countries, Brunei Darussalam, Indonesia and Malaysia on the Island of Borneo. Both the Malaysian states of Sarawak and Sabah will make separate contributions to this important initiative. This report is confined to the former.

1.2 THE MALAYSIAN FOREST SITUATION

Malaysia is well-endowed with forest resources which make vital socio-economic contributions to the nation's growth and development. Equally important are intangible benefits such as biodiversity and environmental values, including soil and water conservation. Indeed, Malaysia, together with Indonesia, constitutes the twelve mega-biodiversity countries in the world. Local communities, especially in Sabah and Sarawak

continue to depend on forests and forest-related goods and services for their needs and subsistence.

Apart from a wealth of biodiversity and forests, Sarawak receives heavy rainfall and is thus endowed with an abundance of water resources, vitally important, not only for domestic and industrial consumption and agricultural productivity, but also of great potential for the generation of hydroelectricity. Bakun is one such project now being completed. Others are being investigated. Water conservation and catchment management are therefore of crucial importance especially with the anticipated adverse impact of global warming on weather patterns resulting in severe flooding and droughts. The forested water catchments and their protection and management are of crucial importance. Forests are known as the lungs of the ecosystem. Recent studies indicate that forests also have the vital function of pumping like a heart. Evaporation is stronger over forested area than over the sea, due to this pumping action by forests. This creates winds laden with moisture to blow to the interior, bringing rain in catchment areas to feed rivers.

The total forested area in Malaysia amounts to 18.35 million hectares which represents 55.7% of its land mass. Out of this forested area, 14.29 million hectares have been legally constituted as Permanent Reserved Forests as indicated in Table 1.2. In addition, about two million hectares have been established, under separate legislation as Wildlife and Bird Sanctuaries out of which one million hectares are located in Sarawak. It is to be noted that one of these conservation areas, Lanjak Entimau Wildlife Sanctuary was established with ITTO support as a transboundary conservation area with Betung Kerihun National Park in Indonesian Kalimantan. These statistics indicate that the forest cover in Malaysia, at 55.7%, is higher than the global forest cover (30%) or forest cover in Europe (44%) or North and Central America (33%) as indicated in Table 1.1. Sarawak is especially green with a forest cover of more than 65%.

In a recent report (2009), the FAO published information on the state of the world's forests. Using 2005 data, it was reported that 63.6% of Malaysia was forested compared to 46.8% for Southeast Asia, 44.3% for Europe and 30.3% for the whole world. For the period 2000 to 2005, Malaysia lost 140,000 ha annually (0.4%) compared to -1.3% for Southeast Asia, +0.07% for Europe and -0.18% for the world. Malaysia's forest area for 1,000 people, reported at 800 ha, compared with 361 ha for Southeast Asia, 1,369 ha for Europe and 599 ha for the whole world.

Table 1.2 – Permanent Reserved Forests in Malaysia, 2005

Region (million hectares)	Protection Forest	Production Forest	Total Permanent Reserved Forest	Percentage of Total Land Area
Sabah	0.59	3.00	3.59	48.71
Sarawak	1.00	5.00	6.00	48.80
P. Malaysia	1.52	3.18	4.70	35.70
Malaysia	3.11	11.18	14.29	43.53

The strength of Malaysia's activities on conservation and sustainable management of its mega-diversity natural resources revolve around the establishment, protection and sustainable management of a network of Permanent Reserved Forests (Permanent Forest Estate) and Totally Protected Areas (TPAs) which are legally constituted. TPAs are totally protected and even access is strictly controlled or restricted whilst Permanent Reserved Forests are zoned into Protection and Production Forests; the former totally protected for environment and other values whilst the latter are sustainably managed for commercial timber production, as indicated in Table 1.2.

The Permanent Reserved Forests in Malaysia are in various stages of being sustainably managed. Currently, about one third of these forests have been certified for sustainable management under the Malaysian Timber Certification Scheme and the Forest Stewardship Council. Two Forest Management Units in Sarawak, Sela'an Linau (55,949 hectares) and Anap-Muput (106,820 hectares) have been certified. Indeed most of the certified tropical forests are in Malaysia.

1.3 THE HEART OF BORNEO INITIATIVE

The Heart of Borneo (HoB) Initiative was officially launched in Brazil on 27 March 2006. On 12 February 2007 the Minister of Natural Resources and Environment, Malaysia; the Minister of Forestry, Republic of Indonesia and the Minister of Industry and Primary Resources, Brunei Darussalam, signed and jointly issued a Declaration in Bali, Indonesia. The HoB Initiative was originally estimated to cover a largely forested area, totaling some 22 million hectares in one contiguous block straddling the Malaysian/Indonesian/Brunei Darussalam borders on the island of Borneo in the Malaysian States of Sarawak (5.373 million hectares) and Sabah (3.968 million hectares). The areas will be accordingly adjusted in extent, pending studies on the ground. The HoB Initiative is a voluntary transboundary cooperation of the three ASEAN nations, fully respecting each other's sovereignty, policies and development needs for the benefit of present and future generations. From this perspective, the HoB Initiative constitutes a framework for technical cooperation. In view of the global concerns and controversy outlined above about tropical forest development, the long-term objectives of the HoB Initiative, as enshrined in the Bali Declaration is ambitious, bold and imaginative:-

> *"With one conservation vision and with a view to promote peoples' welfare, we will cooperate in ensuring the effective management of forest resources and conservation of a network of protected areas, productive forests and other sustainable uses."*

The Bali Declaration also thoughtfully stated that cooperation under the HoB Initiative will be "*based on sustainable development principles through research and development, fundraising, as well as other activities that are relevant to transboundary management, conservation and development within the area of the HoB*." It is therefore clear that the underlying spirit and philosophy of the HoB Initiative is the improvement of the lives and livelihoods of the communities living in the designated area. In addition, the conservation and environmental values in the area must be protected and enhanced through cooperation and coordinated programmes of action between the three countries.

As required in the Bali Declaration, the three countries will prepare their respective project documents incorporating the strategic and operational plans, which will form the basis for the development of the road map towards realizing the vision of the HoB Initiative. The PIF will provide a broad framework or guideline in pursuit of such objectives. Pursuant to this commitment the State of Sarawak, as a partner in the HoB Initiative, appointed a Lead Consultant to coordinate the work of other consultants in various specified fields of expertise, as follows:-

Table 1.3 – Consultants and Roles

Dato' Dr Freezailah bin Che Yeom	Lead Consultant
Dr Tie Yiu Liong	Physical environment and agriculture
Dr Paul P.K. Chai	Forest resources/Asst. Lead Consultant
Prof. Dato' Dr Abdul Latiff Mohammad	Biodiversity
Jiram Sidu	Local communities
Tuan Hj Abang Kassim bin Abang Morshidi	Eco-tourism

These consultancy reports are necessary to provide the basis for the formulation of an interim Project Implementation Framework (PIF) which will outline the strategic and operational plans in the context of the stated HoB long-term objectives. The data compiled, and the analysis of issues made will also form the basis for further consultation, both within Malaysia and other HoB partners for purposes of coordination and harmonization to the extent possible to realize the vision of the HoB Initiative, apart from generating synergies and seeking funding for the various project ideas identified.

4. SCOPE OF WORK

People's welfare, biodiversity conservation and protection of environmental values are key elements in the Bali Declaration of 12 February 2007 and form the main pillars of the HoB Initiative. Put in another way, the strategic and operational plans developed in the interim PIF must address the socio-economic needs of the communities living in and around the target areas through sustainable management and development of the natural resources there to an extent and intensity such that their conservation and environmental values are not adversely affected. Thus the PIF must revolve around the following basic elements in scope:

- Assessment of the physical environment to determine the factors that permit and those that constrain development;
- Agricultural development and activites;
- The extent, nature and distribution of natural and other resources in the area;
- Socio-economic situation of the local communities;
- Based on the opportunities identified, assess the potential for sustainable development to benefit local communities taking into account environmental values and biodiversity conservation;
- Formulate project ideas to promote sustainable development which may be elaborated later into project proposals for further discussion and seeking donor support. It is also understood that the HoB Initiative is on technical cooperation, fully respecting the policies, development needs and priorities of participating countries;

- Whilst stakeholder inputs and involvement in the planning and implementation of projects are important, these initiatives are also understood to be government driven.

From the foregoing it is clear that people are at the centre of the HoB Initiative and how their lives and livelihoods may be improved through the sustainable use of the natural resources in the target area. It is therefore important that the Initiative is based upon better understanding and appreciation of the natural resources in the area and the opportunities that they present for sustainable development. To this end, various sectors as indicated in Table 1.3 are identified for further examination. The following paragraphs briefly detail the terms of reference of the scope of the studies conducted.

1. Physical Environment

- Characterization of the area to indicate terrain, geology and drainage pattern including delineation of steep land;
- Climatic conditions in the area;
- Assessment of mineral potential;
- Potential to generate hydro-electric power.

2. Agriculture

- Agriculture development and activities;
- Assessment and mapping of areas with agricultural potentials and discuss cultivation of suitable crops and practices;
- Discuss potential for fish-farming, poultry and animal husbandry;
- Training needs;

3. Forest Resources

- Characterization and mapping of forest types with information on species composition and distribution, growth potential, productivity and management issues;
- Mapping of the area to indicate forested areas, permanent/protected forests, totally protected conservation areas, forest plantations, etc.
- Current status of land under logging licenses, logged-over areas, logging roads, etc.;
- Logging operations, forest industries, log production;
- Information on forest workers;
- Forest management issues to promote sustainable management and certification.

4. Biodiversity

- Characterization and description of the flora and fauna with particular attention to endemic species found in the area;
- Assess the status of any endemic, rare, threatened and endangered species together with information on their habitats;
- Map the extent of existing and proposed biodiversity conservation areas and assess their representativeness and adequacy with reference to linkages with adjacent transboundary conservation areas and potential;
- Examine current management practices and assess effectiveness;

- Problems of hunting, fishing and poaching related to conservation and sustainable utilization;
- Assess potential for transboundary cooperation for biodiversity conservation.

5. Local Communities

- Mapping of settlements in the area including access and communications;
- Compile and analyse demographic data of the communities;
- Details of facilities and services available to the communities and needs;
- Socio-economic factors and information;
- Traditions and customs;
- Utilization of resources and state of such resources in terms of availability and demand;
- Agricultural practices and possible improvement and support needed;
- Problems encountered by communities;
- Opportunities to generate sustainable development.

6. Ecotourism

- Review of tourism in Sarawak;
- Demand for eco-tourism;
- Target areas of eco-tourism potential highlighting unique flora, fauna, natural features, cultural diversity, handicraft, etc.;
- Constraints to eco-tourism;
- Infrastructure needs, promotion, campaigns, training, etc.;
- Centres for eco-tourism development and linkages with other eco-touristic sites and in Sarawak.

All the studies undertaken as included in this report has compiled a wealth of information and data, which can also form the basis for planning, priority setting and also contribute to decision making.

The Economic Planning Unit of the Prime Minister's Department has commissioned a study entitled: Policy Strategies for the Conservation and Sustainable Use of the Highlands of Sabah and Sarawak. The various aspects of the study included conservation, agriculture, forestry, cultures and socio-economy. This report may be consulted in the preparation of project proposals for implementation under the HoB Initiative.

1.5 PROJECT IDEAS

An important output of each of the consultancy studies undertaken, as indicated above, is the identification of project ideas from which project proposals may be elaborated for seeking funding either from internal sources or from donor funding. These projects are all aimed at achieving results that will contribute to the attainment of the objectives of the HoB Initiative. In view of the importance of these project ideas, the consultants were required to identify and give special attention in their identification in a focused manner after an analysis of the issues and needs in each of the fields of the consultancy studies.

These project ideas are compiled in Chapter VIII of this report clustered under each of the thematic chapters indicated in Table 1.3. Some of the project ideas are cross-cutting but may

be recognized as addressing the Strategic Plan of Action which has been generally accepted by the partners of the HoB Initiative including:

- Transboundary management to address issues of management of natural resources and socio-economic welfare of local people in the border areas;
- Protected area management to enhance and promote effective management within the HoB area, with the emphasis of those situated on the common border, in order to conserve and maintain forest diversity and the ecological linkages;
- Sustainable management of natural resources outside the protected areas network through the development and implementation of sustainable land uses.
- Ecotourism development to recognize and protect the value of special natural and cultural places or sites within the HoB area;
- Capacity building to ensure the effective implementation of the HoB Initiative at all levels, both public and private sectors and at the local community.

The project ideas formulated are designed to contribute to the above five programmes. Malaysia's commitment to the implementation of the HoB Initiative is clearly demonstrated in that funding will also be made available under the 9th and 10th Malaysia Plans apart from contribution from state resources. The interest shown by international donor community in the HoB initiative is also encouraging. The project proposals to be developed will focus on technical issues and related technical cooperation.

It is to be noted that the project ideas recommended are well targeted to contribute to the achievement of the HoB Initiative objectives taking into account the situation in Sarawak. The approach adopted is one of pragmatism, and over-ambitious goals in terms of resources needed are avoided.

6. GEOGRAPHICAL COVERAGE

The Sarawak sector of the HoB Initiative is sited along its border with Indonesian Kalimantan, Brunei Darussalam and Sabah stretching from Batang Ai in the south-west to Merapok in the north-east (Figure 1.1). It covers an area of 2,030,200 hectares or some 16.4% of Sarawak's land area. The largely forested area transcends administrative boundaries and encompasses the interior parts of six Divisions, namely, Sri Aman, Sarikei, Sibu, Kapit, Miri and Limbang.
For ease of description and reference, the Sarawak sector of the HoB Initiative is divided into three regions, namely,

- Northern Region covering the Miri and Limbang Divisions;
- Central Region covering the Kapit and Belaga Districts of the Kapit Division;
- Southern Region covering Sri Aman, Sarikei and Sibu Divisions as well as the Song District of the Kapit Division.

As indicated in Table 1.4, the Northern Region accounts for 43.6%, the Central Region, 40.45% and the Southern Region, 15.95% of the total area of about 2.03 million hectares.

The area to be allocated by Sarawak for the HoB Initiative was initially estimated at about 5.4 million ha. This matter was further considered by the Sarawak Government and it was decided that an area of 2.1 million hectares should be initially included for the Sarawak sector.

Table 1.4 – Distribution of the HoB Area by Divisions and Districts

Region	Division	District	Area (ha)	Percent (%)[1]	Percent (%)[2]
Northern	Limbang	Lawas District	202,500	9.97	56.5
	Limbang	Limbang District	231,250	11.39	
	Miri	Marudi District	451,500	22.24	16.6
		Sub-total	885,250	43.60	
Central	Kapit	Belaga District	493,500	24.31	26.4
	Kapit	Kapit District	327,700	16.14	
		Sub-total	821,200	40.45	
Southern	Kapit	Song District	193,250	9.52	
	Sibu	Kanowit District	31,500	1.55	5.8
	Sarikei	Julau District	28,000	1.38	4.4
	Sri Aman	Lubok Antu District	71,000	3.50	10.9
		Sub-total	323,750	15.95	
		Grand total	**2,030,200**	**100.00**	

1 = As a percentage of the HoB area. 2 = HoB area in the Division as a percentage of total Divisional area.

7. METHODOLOGY

The primary task of the consultants is to compile and analyse available information and data in the various fields indicated, so that strategies can be charted to achieve the HoB objectives in a holistic manner for sustainable development, taking into account synergies for co-ordinated transboundary actions among the HoB partner countries. To this end, the consultants reviewed relevant literature to assess the situation on the ground in order to determine constraints and opportunities for sustainable development. Consultations were also held with experts, in addition to limited field work, in order to obtain certain up to date information and development on the ground. This is especially important on issues related to socio-economic situation where inputs from local communities are considered important. Some consultations were also undertaken on issues related to forest industries development.

To ensure coordination and adequate understanding of the essentials of the HoB Initiative amongst the team of consultants, three consultations were held as follows:

- On commencement of consultancy studies;;
- Discussion of the First Draft Report;
- Finalisation of the Report.

A draft report was submitted to the Director of Forests for onward transmission to various relevant Government Departments and agencies, for further comment and inputs, before a Final Report was prepared.

1.8 ORGANIZATION OF THE REPORT

The Report is structured into chapters dealing with various aspects of the area which form the Sarawak sector. The Introductory Chapter puts the study into perspective, briefly describes the objectives of the HoB Initiative, and the consultants appointed together with their respective terms of reference. Chapter II of the Report is devoted to the physical environment of the area while Chapter III is on agriculture. Chapters IV and V describe the forest resources and its biodiversity respectively. Chapter VI describes and discusses the socio-economic situation of the inhabitants of the area. Chapter VII gives an account of the unique features in the area and assesses its ecotourism potential. The list of Project Ideas identified in this study is compiled in Chapter VIII.

1.9 ACKNOWLEDGEMENT

All the consultants given the opportunity to contribute to the preparation of this important report wish to record their appreciation to the State Government of Sarawak. The HoB Initiative is a unique and inspiring milestone which could herald a new era of cooperation amongst neighbouring countries in pursuit of sustainable development, an initiative that Sarawak pioneered with Indonesia in the Island of Borneo with ITTO support. The consultants also wish to express their utmost gratitude for the guidance of YB Datuk Amar Wilson Baya Dandot, State Secretary of Sarawak; YBhg. Datu Len Talif Salleh, Director of Forests; Tuan Hj. Ali Yusop, Deputy Director of Forests; Tuan Hj. Sapuan Ahmad, Senior Asst. Director of Forests. We would like to acknowlwde the contributions of Dr. Penguang Manggil, currently the Controller of Natural Resources and Environment Board, who played a pivotal role in the development of the HoB Initiative right from the start; and all others for their valuable inputs which enable this report to be written.

CHAPTER II – PHYSICAL ENVIRONMENT

1. INTRODUCTION

This section of the report documents the existing physical environment and utilisation of the land resources in the Sarawak sector of the Heart of Borneo (HoB). This information forms the basis upon which some of the problems and opportunities in the HoB area will be assessed and strategies developed.

2. TOPOGRAPHY

Interior Sarawak along its border with Kalimantan, Sabah and Brunei is part of a broad mountain system that traverses the island of Borneo from the Crocker Range in Sabah to the central Nieuwenhuis Range, which forms a prominent water divide along the Kalimantan-

Sarawak border. From this mountainous backbone, other mountain ranges branch off to the west and the east.

Topographically, Sarawak can be classified into three physiographic units: the alluvial coastal plains, the mountainous interior and the central belt of generally rolling country between the coastal plains and the interior. The alluvial coastal plains, which cover nearly a fifth of the State, extend along the coastline from Tanjung Dato to Kuala Lawas, and are characterised by peat, mangrove, nipah and other swamp forests. Beyond the fringes of the coastal plains, the terrain is characterised by a rolling country where the low hills generally have slopes of less than 25 degrees. Further inland, the elevation rises and the hills and mountains are sharply dissected, often with very steep slopes in excess of 35 degrees. This is the physiographic unit that constitutes most of the HoB, with about half of the area having elevations of between 300 and 900 m, and another 30% rising to 900-1,500 m (Table 2.1 and Figures 2.2 A-C).

Table 2.1 - Distribution of Land Elevations in HoB (area in ha)

Elevation (m)	Southern Region	Central Region	Northern Region	Total	Percent (%)
<30	-		2,250	2,250	0.1
30-150	19,250	3,750	29,000	52,000	2.6
150-300	110,600	70,800	50,750	232,150	11.4
300-900	190,900	489,900	348,250	1,029,050	50.7
900-1,500	3,000	246,750	369,000	618,750	30.5
>1,500		10,000	86,000	96,000	4.7
Total	**323,750**	**821,200**	**885,250**	**2,030,200**	**100.0**

Mountain ranges rising to over 1,500 m divide Sarawak from Kalimantan and Sabah. The Northern Region has the highest percentage of land above 300 m. Sarawak's two highest mountains are located here - Gunung Murud at 2,424 m, from which flow the Baram, Limbang and Trusan rivers; and Gunung Mulu at 2,376 m. By contrast, the Southern Region has much lower elevations, with nothing above 1,500 m and only 3,000 ha are in the 900 to 1,500 m range.

3. CLIMATE

1. Northern Region

(a) Rainfall

Based on the rainfall records at Bario (1962-1999) and Ba Kelalan (1980-1999) (Table 2.2), the average annual rainfall for the Bario-Ba Kelalan region is about 2,300 mm. This rainfall is relatively low compared to many other areas in Sarawak, which have annual average rainfall of more than 4,000 mm.

Although there are drier months with less rainfall, the difference is not as drastic and obvious. At Bario, for example, January, February, July and August are the drier months, yet the mean monthly rainfalls are more than 150 mm. In this part of the highland the period between April and June is relatively wet (apart from the wetter months from October to December), with May being one of the wettest months.

Table 2.2 - Mean Monthly Rainfall and Evaporation in the Northern Region

Month	Mean Monthly Rainfall (mm)	Mean Monthly Evaporation (mm)
	Ba Kelalan	Bareo (Bario)
January	173	119
February	176	110
March	146	128
April	195	125
May	227	128
June	197	128
July	169	135
August	199	136
September	169	125
October	229	127
November	216	124
December	212	115
Total	**2,308**	**1,502**

Source: DID Hydrological Year Books, 1983-2003

Evaporation is recorded using evaporation pans. For the Bario-Ba Kelalan region, the evaporation records at Bario (Station 3754307) show an annual average pan evaporation of about 4.2 mm/day with the pan evaporation rate being highest in the months of July and August at 4.3 to 4.4 mm/day. The monthly evaporation is presented in Table 2.2.

(b) Temperature

Some temperature data are available for Long Semadoh and Bario (DOA, 1985) and for Gunung Mulu (Anderson et al., 1982). Long Semadoh at 770 m has a minimum daily temperature range of 16-21°C, and a maximum daily temperature range of 24-34°C. In Bario, the lowest recorded temperature was 12°C, and the mean day temperature was 20- 23°C. At Gunung Mulu, the mean maximum and mean minimum temperatures (under forest canopy) at 1,790 m (5,800 ft) were recorded at 19°C and 14°C respectively.

Temperatures are expected to decrease with increasing altitude. However, the rate of decrease in Mulu (for example) is relatively low, as is common with other humid tropical mountainous environments (Anderson *et al.*, 1982). This is because of the low saturated adiabatic lapse rate once the condensation level has been reached, especially under forest canopy.

(c) Relative Humidity

Relative humidity (RH) values are available for Long Semadoh and Ba Kelalan (DOA, 1985). The data show that the Maligan Highlands have lower mean and maximum RH than the lowland areas of Sarawak. The mean maximum RH values for Long Semadoh and Ba Kelalan are 83% and 85% respectively, while the lowland areas generally show mean maximum RH exceeding 94%. The mean minimum RH values for these places are both 61%. Variation in RH is diurnal in nature, being highest at dawn and lowest in the early afternoon. Under the forest canopy, however, the RH rarely falls below 90% even in the afternoon. On

higher altitudes, however, the RH is expected to be higher, usually at 95% or higher (Anderson *et al*., 1982). This has important consequences in reducing evaporation rates and accounting for the distribution of the mossy upper montane forest. The general dampness of the air is probably related to the normal level of cloud development on the mountain.

(d) Sunshine Hours

Data on the sunshine hours on the highlands are lacking. Local experience suggests that low cloud cover and mist are usually lifted by about 9 am at both Long Semadoh and Ba'kelalan, while at Bario (surrounded by higher mountain ranges), the sky only clears by about 10:30 am. As a result, the sunshine hours here would be expected to be lower than the lowland areas of Sarawak.

(e) Wind

There are hardly any recorded data on the wind conditions in the highlands. However, wind damage on houses had been reported from both Ba Kelalan and Bario but not from Long Semadoh. The Gunung Mulu study by Anderson *et al.* (1982) reported that the local mountain wind systems with katabatic winds at night and anabatic winds by day occur widely and the former might be partially responsible for triggering off convectional cells in the valleys. On mountain ridges in particular, wind speeds may be high for long periods, particularly during storms. As these highlands are somewhat sheltered on the eastern and northern sides, winds from the south and the west will be of more concern.

2.3.2 Central Region

Available data from the Long Unai Station (DID Station No. 1947001), Long Busang Station (DID Station No. 1843001) and Long Singut Station (DID Station No. 1544001) show that the mean annual rainfall in this region is about 4,350 mm, which is higher than the coastal areas. The drier months seem to spread from May to September, while the wetter months often start in October and last till March (Table 2.3).

The potential evaporation as indicated by the Penman open-water evaporation data recorded at the Kapit Station (DID Station No. 2029302) is 1,531 mm per annum (mean monthly evaporation of 127.5 mm). Slightly higher evaporation rate is experienced in the drier months between March and August compared to the wetter months towards the end and early parts of the year.

Table 2.3 - Mean Monthly Rainfall and Evaporation in the Central Region

Month	Rainfall (mm)			Evaporation (mm)
	Long Unai	Long Busang	Long Singut	Kapit
January	355	389	384	127
February	404	362	385	113
March	396	391	428	129
April	385	420	388	128
May	240	376	372	136
June	297	293	292	123
July	250	292	312	128
August	310	342	365	127
September	241	330	315	128
October	420	450	425	135

November	423	377	468	130
December	354	381	439	127
Total	**4,075**	**4,403**	**4,573**	**1,531**

Source: DID Hydrological Yearbook 1987 to 2003

2.3.3 Southern Region

From the rainfall data collected by DID since 1964, Ng Bangkit consistently receives some 4,000 mm of rain per year. The annual mean rainfall is 4,550 mm for this station, which corresponds to 379 mm per month or 12.6 mm of rainfall per day.

Annually, the drier months are confined to June and July. During these months rainfall is unpredictable with the station typically receiving 100 mm less rain per month than average. Periods of very little rain (10 mm or less) can occur during these months with the longest duration of 21 days recorded between 13th July and 2nd August 1981. During the Northeast Monsoon period of October to January, about 100 mm more rain per month may be received.

Further south at Lubok Antu, an analysis of the rainfall for the period of 1983 to 1995 gives an annual mean of about 3,244 mm with a monthly mean of 270 mm and a standard deviation of 304 mm. This is slightly lower than the rainfall recorded at many places in Sarawak. This is because the Batang Ai area is sheltered from the monsoons by the ranges along the northern boundary of the Sri Aman Division. A 5-year running mean shows that the period from 1983 to 1990 received 15.7% more rainfall than the latter period of 1991-1995. A comparison of the total mean rainfall for the periods 1954-1982 and 1983-1995 indicates a decrease of about 4% of rainfall for the latter period. The monthly rainfall pattern, however, remains the same with the wet period falling within the months of October to January and the dry period within the months of May to September.

4. GEOLOGY AND MINERAL RESOURCES

1. Geology

The HoB area in Sarawak is largely built up of igneous and metamorphic rocks of the Mesozoic to Tertiary age, and uplifted and intensely folded sedimentary rocks of the Paleogene age. The central mountain ranges curve along the length of interior Sarawak and the adjacent part of Kalimantan into Sabah. These mountains are built up of pre-Tertiary and Lower Tertiary marine rocks which are intensely folded and thrusted to the northwest; they appear to have been formed by the subduction of the South China Sea floor during the Eocene time. Neogene andesite, dacite and basalt overlie these strata unconformably along a broad arcuate belt and form spectacular plateaux in both Sarawak (Hose Mountains rising to 2,006 m, Usun Apau 1,372 m, Linau-Balui Plateau 1,127 m), and Kalimantan (Nieuwenhuis Range 1,530 m).

In Central Sarawak, the highlands are formed by a great thickness of predominantly slightly metamorphosed, turbiditic sediments of the Rajang Group, to which the Belaga Formation belongs. These sediments of the Late Cretaceous to Early Miocene age had been accreted, folded, faulted and uplifted against the West Borneo Block of West Sarawak during the Late Miocene times. They form part of the Sibu Zone which represents an accretionary prism and other turbidite fan sediments, deposited upon oceanic crust, and subsequently compressed between the West Borneo Block and the continental block of the Luconia Province (Hutchison, 1996).

The Layar Member of the Belaga Formation is widely distributed in the southern segment. It is of the Late Cretaceous age and is characterised by a sequence of regionally metamorphosed, turbiditic sediments comprising rhythmically interbedded shale, mudstone, slate, phyllite and metagreywacke.

Large portions of the highlands in the Central and Northern segments of the HoB area are underlain by the Kapit Member of the Belaga Formation, Kelalan Formation and Mulu Formation. These Paleocene Formations are composed of deepwater, thinly-bedded turbidites of shale, slate, phyllite, sandstone, calcareous sandstone and rare limestone, and had undergone weak regional metamorphism. Many highland areas in Central Sarawak south of the Dulit Range are underlain by rocks of the Pelagus Member of the Belaga Formation. This predominantly Eocene Formation is characterised by thick sandstone that forms massive beds several metres thick, interbedded with thin grey shale, thin sandstone and siltstone (Liechti *et al*., 1960). The steeply bedded sandstone commonly built rapids and subparallel ridges.

In the Northern segment, the highlands are composed of folded and faulted, predominantly deltaic to shallow marine sediments in contrast to the deepwater sediments of the Rajang Group. The Miri Zone in Northern Sarawak was formed by the collision of the Luconia Platform sediments with the Rajang Group of the Sibu Zone in the Late Miocene times. Besides the Kapit Member of the Belaga Formation, the Kelabit, Setap Shale, Nyalau, Meligan and Belait Formations are also found. The Kelabit Formation, Setap Shale and Nyalau Formations are made up of fluvial-estuarine-lagoonal-shallow marine sediments comprising shale, mudstone, siltstone and minor calcareous sandstone and coal. They are Oligocene in age. The Melinau Limestone of the Eocene-Oligocene age forms the northern edge of the highlands south of Limbang. It has given rise to the spectacular cave system of Mulu.
The Meligan and Belait Formations are composed of Miocene sediments of alternations of sandstone, shale, mudstone, siltstone with some conglomerate and lignite deposited in a changing fluviatile-deltaic shallow environment. The Meligan Formation underlies much of the Kelabit Highlands and the Bario area. It formed Gunung Murud, the highest mountain in Sarawak and the Batu Lawi twin peaks in the Ulu Limbang area, about 15 km to the NNW of Bario.

Extensive eruptions of basalt, andesite, dacite lava and dacitic tuff that occurred during the Late Miocene and Pliocene times have formed the high tablelands at the Usun Apau Plateau and the Linau-Balui Plateau and the rugged mountain ranges of the Hose and Nieuwenhuis Mountains.

The regional trend of the rocks forming the highlands of central and northern Sarawak is mainly ESE in the southern region between Lubok Antu and the Nieuwenhuis Mountains,

from where it swings gently to the NNE and NE. At the Tinjar Fault, the trend veers quickly to the NNE, to the east of the Usun Apau Plateau.

Some outstanding geological-geomorphological features in the HoB area in Sarawak include:

- The Mulu Caves developed in the Melinau Limestone,
- The volcanic tablelands of the Usun Apau and Linau-Balui,
- Waterfalls developed over the volcanic plateaux of Usun Apau and Linau-Balui, and the Hose and Nieuwenhuis Mountains,
- The spectacular peaks of Mount Murud and Batu Lawi that are formed by the massive sandstone of the Meligan Formation.

2.4.2 Mineral Resources

Mineral resources include deposits of limestone, dolomite and phosphate, and some occurrences of salt springs, coal and gold. Construction stone, clay, sand and gravel occurrences have not been investigated so far but they would certainly be important for future infrastructure development.

Limestone, Dolomite and Phosphate: Limestone is found at Gunung Api (Melinau Limestone, Mulu Caves) and in upper Batang Baram. Associated with the Melinau Limestone is almost pure dolomite at Sungai Berar, a tributary of Sungai Melinau. Being located in the Mulu National Park, exploitation of the limestone, dolomite and phosphate found in the caves is prohibited. In other parts of Ulu Baram, any large-scale exploitation of the limestone resources would seem unlikely due to their remoteness, except perhaps for local constructional purposes.

Salt Springs: More than 30 salt springs occur in the mountainous country between Lio Matoh and Ba Kelalan, which is drained by the headwaters of Batang Baram and Batang Trusan. In the past, most of these salt springs were worked and there was a flourishing salt-making industry. The salt produced contains iodine, and this helps to explain why incidence of goitre is almost non-existent among the highlanders in Bario and Ba Kelalan. With the advent of imported salt, the springs are now seldom exploited. Some of the springs near Bario and Ba Kelalan can be developed at a cottage industry scale into a tourist attraction, and the salt packaged and sold as a souvenir. The salt water of the springs probably originates from salt-bearing beds of the underlying Meligan and Kelalan Formations, rising up to the surface from some depths along steep fractures.

Coal: Coal is found in the Kakus Formation in the Plieran and Kaluan just east of the Linau-Balui Plateau. The coal seams in the latter area are generally thin, impure and of a low calorific rank. The coal of the Plieran is better in quality and the seams have thickness varying from about 1 to 3 m, with several million tonnes of coal deposit. However the seams are steeply dipping and faulting is widespread, which together with the remoteness of the locality, greatly reduce the economic value of the coal.

Gold: Gold occurrences are known at four localities but none of them appears commercially attractive. There are alluvial gold found in rivers draining the volcanic and intrusive rocks in the Usun Apau and the Nieuwenhuis areas. The other is a sample of quartz vein from the Sungai Julan area north of the Usun Apau Plateau, which was reported to contain 2.2 dwt (pennyweight)/ton of gold.

Construction Stone, Clay, Sand and Gravel: No systematic search for these construction materials has ever been conducted in the highlands because of lack of demand. The nearest operating quarries are located at Batu Gading, Bukit Besungai and Bukit Betok near Long Lama in the Miri Division, all working on limestone. It is foreseeable that with the coming of infrastructure development particularly in the Long Semadoh - Ba Kelalan region, there will be a demand for these construction materials.

Potential sources of constructional stone for use as road and concrete aggregates are the massive sandstone beds of the Meligan Formation. The proposed link road from Lawas to Ba Kelalan would require a large amount of road aggregates. Limestone resources of the upper Batang Baram area may also be exploited for local use. Sand and gravel may be obtained from the upper reaches of the rivers. Clay weathered from shale and mudstone is probably suitable for use as brick clay. It is envisaged that the start of these activities would be on a small scale to meet local demand and hence, their locations would be dictated by the proximity of developing centres.

5. RIVER SYSTEMS

1. Water Resources

The highlands of Sarawak form the headwaters of most of the major rivers that flow in the State. The Kelabit Highland, for example, is the headwaters for the Limbang and Baram rivers. Such major river systems (Figures 2.1 A-C) include:

Headwaters	Major River System
Maligan (Murut) Highlands & Maligan Range	Batang Trusan & Batang Lawas
Gunung Murud, Kelabit Highlands	Sungai Limbang
Kelabit Highlands, Apo Duat Range, Usun Apau	Batang Baram
Usun Apau, and Iran & Nieuwenhuis Ranges	Batang Rajang
Klingkang Range	Batang Lupar

Being located far from the sea and tides, saline water is not an issue in the HoB area. The water levels in the small tributaries near the headwaters in the HoB are very sensitive to rainfall. The sub-catchments are relatively small and have very short retention times, due to the steep terrain and the shallow soil layer, resulting in very high river flow after a rainfall event. The water levels would rise very quickly after a heavy downpour, but would soon subside if rain does not persist. Thus, flash flooding may be common, especially during the rainy season at the end and beginning of the year. Nevertheless, since low hills often come right up to the riverbanks, flash flooding is only confined to the low-lying narrow alluvial belts. Siltation is therefore not a problem along these streams, but most riverbanks are affected by erosion to varying degrees.

Rivers are of great importance to Sarawak due to the major roles that they play in the economic and social systems of the State. Up to now, rivers still form the major transportation arteries, especially in the interior. The rivers generally have steady flows due

to the high and evenly distributed rainfall throughout the year. The mountainous interior (e.g. Mulu, Murud) receives the highest rainfall in Malaysia, often exceeding 4,000 mm per year.

Rivers are also the primary sources of potable water supplies for the cities, major towns and settlements. Apart from the coastal towns and settlements where freshwater may be sourced from peat swamps or artificial rain harvesting ponds, almost all the rest of the waterworks are abstracting raw water from the rivers for treatment and distribution to consumers. The catchment area upstream of a raw water intake point is called a water supply catchment (WSC). Since water is one of the most essential substances for the survival of human kind and the development of a nation, the need to protect the WSC and the water resource therein is of paramount importance. In Sarawak, this is provided for under the Water Ordinance 1994, which prohibits many activities such as logging, intensive agriculture, mining, etc. in the WSC within an 8-km radius of the intake point. As discussed below under each major river system, much of the HoB area is within these catchments. Although such areas may be outside the 8-km radius of the water intake points, their protection will contribute tremendously to the preservation of the water qualities in the downstream stretches of the waterways.

In the rural area, the majority of the people depend on gravity-feed systems for their water supplies, most of which have been installed with assistance from the Health Department and/or logging companies. The gravity-feed water supply system will normally source relatively clean water from a small stream at a higher elevation on a hill close to the settlement, often within a few hundred metres. A small dam is usually constructed across the stream to create a small reservoir, and the water is fed to the kampung or longhouse through a system of plastic pipes. Treatment is normally not required because the water quality is usually good enough. However, some systems with smaller reservoirs are known to dry out during periods of prolonged drought. Unless alternative water supplies can be provided, these small gravity-feed water supply catchments are always protected when timber harvesting and plantation development activities are carried out in the areas concerned. Since these are *Prescribed Activities* under the Natural Resources and Environment (Prescribed Activities) Order, such a requirement can be identified and enforced through the environmental impact assessment (EIA) process.

In the upper reaches, the topography is more rugged, with steep to very steep V-shaped slopes. The rivers and streams usually have high current speeds and sandy to rocky bottoms. Such areas are ideal for implementing hydroelectricity projects (HEP). The large HEPs will be discussed below under the major river systems concerned. In the HoB area, the relevance of mini-/micro-hydro schemes cannot be ignored, as the rural people usually have to rely on small generators for electric power. Due to the remoteness and difficult access, fuel to run the generators is often not available, and even if it is, the cost is prohibitive. It would be a tremendous help if a mini-/micro-hydro could provide the much-needed alternative. To-date, only a few mini-/micro-hydro schemes have been implemented in the HoB area. A micro-hydro has been in use for some time at Buduk Nor in Ba Kelalan. Another project was completed in November 2008 in the village of Buduk Bui, also in Ba Kelalan. About 40 homes there now enjoy a 24-hour supply of electricity free of charge. There are also two mini-hydro projects in Bario. The one at Bario Asal was implemented by the Federal Government about ten years ago, but this project failed because the catchment for the dam was too small and there was not enough water in the reservoir to run the turbine on a sustainable basis. It was revived by the residents of Bario Asal in 2008 and is running well,

with the nearby Pulong Tau National Park serving as catchment. Such schemes should be more widely implemented to benefit more rural communities. A detailed study should be undertaken to identify suitable mini-/micro-hydro sites near settlements. For Long Semadoh, for example, Pa Rabatuh, a tributary of upper Trusan River, is a potential site worthy of further investigation. When it comes to implementation, financial and technical assistance should also be provided.

Batang Trusan flows from the Maligan Highland and the Maligan Range. Presently, there are no major reservoir dams in the Trusan River. However, the Trusan water treatment plant just upstream of Trusan is being upgraded for the Lawas regional water supply. This plant is abstracting raw water from the Trusan River upstream of Trusan.

To the north of Batang Trusan, Batang Lawas also originates from the Maligan Range. Along the Lawas river system, Syarikat Sesco Berhad (formerly SESCO) has constructed two mini-hydro projects in Sg Kalamuku and Sg Kota with a maximum combined capacity of 3 MW. The State Government is also planning a Lawas HEP (Figure 2.1A) with a capacity of about 100 MW; this project is presently under study.

The Limbang River originates from the Kelabit Highlands and the Gunung Murud-Batu Lawi area. It flows north-westwards through the Limbang Division, eventually discharging into the Brunei Bay. Navigable for about 210 km, it serves as the main linkage for cargo and passenger vessels communicating mainly between Limbang, Brunei and Labuan. There is no water supply intake point in the Limbang River itself; the Limbang Waterworks is abstracting raw water from its tributaries of Sg. Berawan and Sg. Pandaruan. A Limbang HEP is being planned and studied (Figure 2.1A). If this HEP gets implemented, it is very likely that it will double as a source of irrigation water for developing the commercial wet paddy estates in the Limbang valley downstream of Nanga Medamit.

Batang Baram originates from the Kelabit Highland, the Apo Duat Range along the Sarawak-Kalimantan border, and the Usun Apau Plateau. It has a catchment of approximately 23,000 km^2. Its major tributaries include the Tutoh, Tinjar and Bakong rivers. The lower reaches of the Baram River have a slow flow rate, and the meandering river has formed a series of ox-bow lakes. Water levels fluctuate by up to 4.5 m and 2.5 m at Marudi and Kuala Baram respectively. While shifting cultivation is practised around the settlements nearer to the waterways, timber harvesting activities are widespread throughout the catchment. To date, there are no major dams in Batang Baram but at least one potential hydro-electricity project (HEP) is currently being studied in the Baram basin just below Long Akah (Figure 2.1A). There is a mini-hydro at Long San, which was set up by a Christian missionary.

Batang Baram and its major tributaries provide important transportation linkages to the hinterland. It is navigable by small steamers for about 370 km from the river mouth. Small ships, launches and barges carrying goods, logs and other produce as well as express passenger boats are common along Batang Baram up to Long Lama. The main Baram River is also a source of raw water for the Marudi and the Long Lama Waterworks that supply potable water to these towns and the surrounding kampungs.

Batang Rajang is the largest river in Malaysia with a total catchment area of approximately 5.1 million ha and a mean discharge of 4,033 m^3/s. It originates in the Usun Apau Plateau and the Iran and Nieuwenhuis Ranges, from where it flows for approximately 760 km into the South China Sea. The annual rainfall in the Rajang basin is 3,000-3,500 mm with peak

monthly rainfalls occurring in December and January. Batang Rajang and its upper tributaries are busy and important highways into the hinterland. It is navigable by small steamers for about 570 km. Vessels such as sea-going ships and barges carrying goods, logs and other produce as well as express boats are also common along Batang Rajang.

The Bakun Dam in Batang Balui, a major tributary of the Rajang River is near completion, and will have a power generating capacity of 2,400 MW. The Murum HEP (Figure 2.1B) is now being constructed, and will have a power generating capacity of 900 MW. Another potential HEP in the Rajang river system is in Batang Baleh, upstream of Nanga Putai. The Baleh HEP is still under study.

Batang Rajang itself also provides raw water for the Kapit Waterworks. Many of its tributaries are also sources of public water supply for many towns in the Rajang basin. However, those having their catchments inside the HoB include only Sg Katibas (for Song's water supply) and Sg Kanowit (for Machan and Kanowit). Batang Lupar is another major river that originates from the HoB area, flowing from the Klingkang Range into the South China Sea. Its tributaries are Batang Lemanak, Batang Skrang and Batang Ai. Traditional longhouses may still be found along the Lemanak River while the Skrang River is a popular tourist spot due to its scenic and water-rafting attractions.

Presently, there is one major hydroelectric dam in Batang Ai, about 12.5 km to the north of Lubok Antu Town in the Sri Aman Division.

2.5.2 Fisheries Resources

Very little up-to-date data on the fish stocks in the river systems in the HoB area are available because the Inland Fisheries Division of the Agriculture Department or other institutions do not regularly undertake systematic stock assessment studies in the rivers and streams of Sarawak, especially in the upper reaches. In Sungai Dappur, a study in 1995 recorded 24 species belonging to seven families and 19 genera (Nyanti *et al.*, 1998). The dominant families were Cyprinidae and Balitoridae.

More recently in 2005, Nyanti and Jongkar (2007) conducted another study on the fish fauna of the Pulong Tau National Park, particularly the Dappur and the Tutoh Rivers and their tributaries. A total of eight families of fish represented by 84 species were recorded. Out of these, 17 of the species are endemic to Borneo, and five species (*Barbodes sunieri, Tor douronensis, T soro, T tambra* and *T. tambroides*) are listed in the 1990 IUCN Red List of Threatened Species.

In the rural areas, fish is always an important source of protein for the people. Although commercial catch fisheries is practically non-existent, excess catch sometimes does get sold for cash at the logging camps and some village shops nearby. At the upper reaches of the rivers, Empurau (*Tor tambroides*) and Semah (*Tor douronensis*) are the two most popular fish species that are of high economic importance. Other species of lesser economic importance (but a source of protein to the local people nonetheless) include *Mystus* spp., *Rasbora* spp., *Gastromyzon borneensis, Nematabramis borneensis, Hampala* spp. and other species of small fish.

Local fishermen have reported a declining trend in fish catch - a reflection of declining fish stock in the rivers. This trend is believed to be attributable to environmental degradation, in

particular sediment pollution and siltation. Nyanti and Jongkar (2007) noted that cyprinids like the *Tor* spp. live in clear water with very little total suspended solids (TSS) and prefer lower water temperature of around 18-24°C. Similarly, fishes from the family Balitoridae that live on gravel or stone river beds prefer clear and fast flowing water that contains very little TSS. High TSS would have direct negative impacts on the fish communities, including reductions in feeding rates and clogging or mechanical damage to fish gills. Siltation would affect the general fish habitats, spawning grounds and the macrobenthos. Other threats to the fish fauna include loss of forest and allochthonous materials, loss of productivity and food organisms, unpredictable flow regimes, and over fishing. This same scenario is prevalent in most of the river systems in the State affected by logging and other forms of large-scale land development in the interior.

6. SOIL RESOURCES

Existing data on the soil/land resources are available in the form of soil maps, soil survey reports and annual reports. These have been exhaustibly researched, reviewed and interpreted within the context of the present study. To avoid complications, the soils are described under the main agricultural capability (AC) classes, which have a strong correlation with the topography described in Section 2.2 above. Soil distribution is shown on the soil maps in Figures 2.3 A-C and summarised in Table 2.4 below. The soils are identified and classified according to the local soil classification system (Tie, 1982).

Soils are evaluated and grouped into five general AC classes using the Sarawak Agricultural Capability Classification (Maas, Tie & Lim, 1986) ranging from the best Class 1 to the very poor Class 5, according to the severity and number of limitations present. The five AC classes are listed below:

- Class 1 - land imposes no significant limitation to plant growth and is highly suitable for the widest range of crops;
- Class 2 - suitable for most agricultural crops;
- Class 3 - moderately suitable for most agricultural crops;
- Class 4 - land has marginal agricultural capability; and,
- Class 5 - land has such severe limitations that it should not be used for agriculture unless the limitations can be ameliorated and the soil conditions made more favourable, thus changing the capability rating to a better class.

The typical limitations encountered are indicated by alphabets suffixed to the class number. For example, Class 3wi denotes land or soil that is moderately suitable for most agricultural crops, being limited mainly by wetness or poor drainage (w) and inundation hazard (i). Other common limitations encountered in the study area include:

- shallow soil depth (d);
- steep slope (t);
- erosion hazard (e);
- low fertility (f); and,
- low moisture availability (m).

Organic Soils have unique problems, and are evaluated on a separate set of properties, such as:

Main AC Class	Main Soil Series	Associated Landform	Area in ha (by Region)				Percent
			Southern	Central	Northern	Total	(%)
2i, 3iw	Seduau, Bemang	Levees and valley floors	0	1,840	16,500	18,340	0.9
2t	Merit, Bekenu	Undulating hills, slopes mainly 6-12°	0	0	2,750	2,750	0.1
3wi	Bijat	Valleys and margins of peat swamps	0	0	12,850	12,850	0.6
3te	Merit, Bekenu	Rolling hills, slopes mainly 12-25°	25,250	830	19,000	45,080	2.2
4fm, 5md	Buso, Miri, Bako	Old terraces/inclined planes; mainly <6°	0	2,020	11,750	13,770	0.7
4te	Kapit, with some Merit, Nyalau, Bekenu	Steep hilly land, slopes 25-33°	22,630	13,420	121,500	157,550	7.8
5te, td, 5dt	Mainly Kapit	Very steep hilly land, most slopes over 33°	275,870	803,090	699,150	1,778,110	87.6
O5go	Bario, Anderson	Peat swamps	0	0	1,750	1,750	0.1
			323,750	821,200	885,250	2,030,200	100.0

- very deep peat (o); and,
- high groundwater table (g).

Table 2.4 - Soils and Associated Landforms in the HoB

The capability classes of Organic Soils are prefixed by a capital 'O' to highlight such differences from the mineral soils. For example, undrained deep peat of Anderson series is often rated as Class O5go, being a Class 5 Organic Soil (O) limited by very deep peat (o) and high groundwater table (g). Bario soil has other limitations, such as low fertility (f) and the unhumified nature of the peat (h), but by convention, only the two main limitations, 'g' and 'o', are indicated.

The capability class and associated limitations determine suitability for specific crops. At the same time, they indicate ameliorative measures that may be taken to improve conditions for crop growth. For example, for the Class 3wi soil, the class rating and main limitations show that it is suitable for wet rice cultivation, and that the poor drainage may be improved for the cultivation of dry-land crops that can tolerate some flooding.

2.6.1 Soils of the Peat Swamps – Organic/Peat soils

About 1,750 ha of Organic or Peat Soils are mapped in the Northern Region. They are mostly found in the flat, low-lying valleys of the Kelabit Highland, comprising deep Peat Soils of Bario series. Some Anderson soils are also mapped at the Gunung Mulu National Park, where the deep peat has accumulated above podzol with a hard impervious humus pan.

In these soils, the top 10-40 cm of organic soil materials are generally well decomposed, below which the peat usually becomes fibric and woody in nature. Such materials provide a poor physical environment for plant growth. After drainage, decomposition and consolidation of surface peat can lead to the formation of a mellow, friable soil. There is very little anchorage for tree crops and, in addition, the woody nature of the peat makes field tillage impractical. Land preparation is difficult, and mechanical excavation of drains, in particular, is a formidable task because of the presence of large pieces of wood.

Although some shallower Peat Soils of Umur series have been reclaimed for wet paddy cultivation, the Peat Soils on the highlands have largely been left undisturbed. In their natural state, they are invariably waterlogged, with groundwater table at or close to the surface most of the year round. Drainage is therefore a prerequisite for the cultivation of most agricultural crops on this soil type. Organic soils, especially those of Anderson series, are therefore extremely low in the levels of most macro- and micro-nutrients. All of these nutritional problems have to be solved before crops can be grown satisfactorily.

2.6.2 Soils of the Riverine Alluvial Floodplains

Within the study area, riverine alluvial soils are found in the valleys and along some of the upper reaches of the rivers. The main soil types encountered are Gley Soils (Bijat series) and Alluvial Soils (Seduau & Bemang series).

The Bijat soils are, by definition, poorly drained. As a result, the soils are grey to light grey in colour. The Bijat series comprises Gley Soils that are clayey in texture and derived from recent riverine alluvium. The soils are non-calcareous, non-saline and non-sulphidic. They have a relatively high cation exchange capacity and are generally fertile, but are often subject to short frequent flooding. They are further limited by poor drainage, and are thus rated as

Class 3wi, and are naturally suitable only for wet rice. With sufficient drainage improvement, the soils may be upgraded to Class 2i and may become suitable for other crops, such as fruit trees. About 0.6% of the area is endowed with these soils, being found only in the Northern Region.

The Seduau and Bemang series are locally classified under the Alluvial Soils group. The Seduau soils are clayey in texture, with brown to greyish brown clay loams at the surface, grading quickly into brownish yellow or yellowish brown clays. They are moderately well drained to imperfectly drained. Imperfect drainage, where present, is manifested by mottling in the subsoil. The Bemang soils are loamy in texture and are usually better drained than the Seduau soils. Both of these soils are quite fertile. Their main limitation is flooding. Within the HoB area, flooding of these soils (including Bijat) is relatively infrequent and of short duration, and such soils are rated as Class 2i or 3iw. They can be used for the cultivation of wet rice and some fruit trees. Short-term annuals, such as vegetables and maize, and short-term fruits, such as watermelon and rock melon, may be cultivated during the flood-free season. This category of soils covers about 0.9% of the area, mostly in the Northern Region but some are also mapped in the Central Region.

Most of these soils in the Northern Region have been used by the local people for smallholder agriculture. Crops cultivated are mainly wet paddy. Large-scale development of these soils is hampered by the narrow configuration of this land unit, which amplifies the development cost

per unit area. Large contiguous blocks of such land are relatively rare, and this explains why large-scale wet paddy cultivation projects have rarely been implemented.

2.6.3 Mineral Soils on the Mountain Ranges

The HoB area in Sarawak is endowed with steeply dissected mountain ranges (95.4%) and some rolling to undulating low hills (2.3%). The hill soils mapped consist mainly of Red-Yellow Podzolic Soils of the Merit and Bekenu series, and Skeletal Soils of the Kapit series. Among these hill soils, the Kapit and Merit series are the most dominant.

Soils of the Merit series are locally classified under the MERIT family of the Red-Yellow Podzolic Soil group. Basically they are deep, brownish or reddish-yellow hill soils with a clayey particle-size class. The soils are well to moderately-well drained, and are derived from shale or other non-calcareous argillaceous sedimentary rocks.

The Merit soils are generally characterised by 15-25 cm of brown clay loams at the surface. The sub-soils have a clay texture and the colour ranges from brownish yellow to reddish yellow. The soils are generally deep, but at the steeper convex-shaped foot-slopes, where soil erosion is more active, shallower members of Merit soils can be encountered. They have a high cation exchange capacity, more than 16 meq/100 g clay. Levels of major nutrient elements are moderately high. These soils have a moderate level of fertility and normal rates of fertiliser applications as recommended by DOA, Sarawak (e.g. DOA, 1985) are adequate to sustain satisfactory crop yields.

The Bekenu series are also classified under the Red-Yellow Podzolic Soil group. The Bekenu soils have a fine loamy particle-size class, and are characterised by greyish-brown to brown sandy clay loams grading into yellowish-brown clay loams. Lower subsoils may be clayey in texture. The soils are usually deep (>100 cm) and well drained. In comparison to the Merit soils, these soils are more friable and can support better root growth.

Most of the deep hill soils such as those of the Merit and Bekenu series are associated with moderately steep slopes of 12-25°. They are rated as Class 3te, with two moderate limitations due to slope (t) and erosion hazard (e). Most tree crops can be recommended.

On the mountain ranges with steep slopes, the Merit soils are mapped in association with the Kapit series. Here, the steep slopes of 25-33° and the high risk of erosion result in very marginal suitability for agriculture. Such lands, rated as Class 4te, can only be used for smallholder tree crops that require very little maintenance, with an occasional crop of hill rice. They should also be suitable for forest plantation and agro-forestry.

On the very steep slopes (>33°), soils of the Kapit series predominate. These soils are classified under the Skeletal Soil group, and are very shallow with an effective soil depth of less than 50 cm. Kapit soils are derived from sedimentary rocks. This mapping unit has been rated as Class 5te, 5td or 5dt, with very steep slopes, shallow soil depth and severe erosion hazard as the main limitations. Such land is not recommended for agriculture.

The slope classes discussed above are based on the agriculture capability classification undertaken by the DOA. The Forest Department, Sarawak (FDS) has its own terrain classification interpreted and classified in accordance with the Forest Type Map B. The system divides the terrain into four classes as follows:

- Terrain Class I- flat to undulating with slopes of less than 5°
- Terrain Class II - undulating to moderately steep with slopes of 5-20°
- Terrain Class III - moderately steep to steep with slopes of 20-35°
- Terrain Class IV - very steep with slopes greater than 35°

This FDS system tends to under estimate the slopes.

2.6.4 Mineral Soils on Old Alluvial Terraces, Inclined Planes and Ridge Tops

On gently sloping old alluvial terraces, inclined planes and ridge tops with sandy materials, Podzols are usually encountered. Podzols are sandy soils with sub-surface humus and/or iron pans. Where the pans are still incipient and soft (Buso or Silantek series), rooting depths are still not very restricted and the soils are usually classified in Class 4fm of 4fd. Where the pans are indurated (Miri or Bako series) rooting depths are restricted by the hard pans, and the soils would be graded as Class 5fd.

Due to their sandy nature, these soils have extremely low levels of plant nutrients and nutrient retaining capacity. Where their effective rooting depths are not restricted, they have serious limitations due to very low fertility and very low moisture-holding capacity. These soils are marginally suitable for coconut, cashew nut and perhaps pineapple and star fruit (where elevation is not limiting). Very high dosages of fertilisers need to be applied regularly in order to reap satisfactory yields from these crops. Where their depths are also limited, then they should best be left undisturbed.

7. LAND USE

1. General Settlement Patterns and Regional Land Use

The land-use pattern in the HoB area is characterised by large expanses of forested areas and scattered settlements along the river valleys. Small agriculture holdings or farmlands are located close to the settlements, on more gentle slopes and in the valleys. Existing National Parks and other Totally Protected Areas (TPAs) are mostly concentrated in the Northern and the Southern Regions; they include Gunung Mulu National Park and Pulong Tau National Park in the north, and Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park in the south.

The bulk of the HoB area is kept under Permanent Forest Estate (PFE), comprising Protected Forests and Forest Reserves that are currently managed for commercial timber production. Some of these PFE have further been licensed under Licence for Planted Forests (LPF) for the development of forest plantations for a validity period of 60 years.

As the river systems have traditionally provided the sole means of transportation in the interior, the settlements are therefore mostly located close to the main rivers and their tributaries. There are more settlements in the Kelabit and the Maligan Highlands in the Northern Region than the Central and Southern Regions.

Kapit town is the only divisional administrative headquarters located in the interior but outside the HoB. In terms of the hierarchy of service centres in Sarawak, the existing service centres in the HoB and its immediate vicinities can be classified as follows:

- Divisional Administrative Centre - Kapit
- District Administrative Centres - Lawas, Song, Lubok Antu
- Service Centres - Long Semadoh, Long Sukang, Ba Kelalan, Long Napir, Bario, Long Banga, Lio Matoh, Long Seridan, Long Lellang, Nanga Bangkit

This structure, however, does not imply that the higher order of services and goods are catered for by Kapit Town and the district centres for the entire HoB area. Because of the transportation system and the distances, many of the communities are drawn to the nearest centres for their different needs, and these are normally within the bounds of the Divisional hierarchical structure. For example, the Miri City's sphere of influence covers the highlands within the Miri Division, whereas the residents in the neighbouring Ba Kelalan area would look towards Lawas town as their sub-regional centre.

Most of the smaller service centres have basic facilities such as primary school, rural health centres and village shops catering for the villages in the vicinities. Some government agencies such as the District Office and Department of Agriculture also have small set-ups in these rural settlements. The District Office, for example, is often represented by the so-called Upriver Agent (URA).

Presently, the only gazetted border post with Kalimantan, Indonesia (as defined under the Immigration Act 159/1963) is at Lubok Antu, which is situated to the south of the Southern Region. Bario is a gazetted border post under the Immigration Act but not under the Customs Act. The government is planning to establish another border post at Pa Dalih south of Bario. Ba'kelalan and Long Banga in the Northern Region and Long Sinyut (Central Region) are known border crossings, but are not border posts in the legal sense as there are no immigration posts there. Cross-border trade and other activities are normally carried out through these centres, albeit there are other unofficial entry points along the long stretch of the international border.

CHAPTER III - AGRICULTURE

3.1 INTRODUCTION

At both the national and state levels, the importance of agriculture in terms of its contribution to the Gross Domestic Product and its level of employment is indisputable. Since the First Malaysian Plan (1965-1970), agriculture has always featured prominantly in the development plans. Under the Ninth Malaysian Plan, agriculture has been termed the third engine of growth after the manufacturing and service sectors.

In the rural areas where the bulk of the people are farmers, agriculture provides the main livelihood for the people. Agriculture in such areas consists predominantly of smallholder

farms. Smallholder agriculture is mostly a variation of mixed farming systems incorporating largely a variety of crops (mainly food crops) with livestock rearing and freshwater fish culture in fishponds as minor activities. The production of food crops (consisting mainly of hill paddy and wet paddy; and to a smaller extent, fruits and vegetables) in smallholder agriculture is traditionally subsistence activities. With the exceptions of Bario and Ba'kelalan, agriculture development in the HoB area is even more limited due to the mountainous terrain and inaccessibility. Outside Bario and Ba'kelalan, agricultural activities comprise mainly shifting cultivation in pockets of more gentle hillsides with elevations of 300-900 m. This practice is essentially a traditional slash-and-burn agricultural system that centres round the planting of hill paddy for 1-2 years, followed by a long bush fallow period.

2. AGRICULTURE IN THE NORTHERN REGION

The Northem Region is probably the most well settled area, although the settlements in this region are widely spread out, reaching up to the international border with Kalimantan, Indonesia. The main population centres are located along the upper reaches of Batang Baram and Batang Trusan, particularly in the Maligan and Kelabit Highlands.

The Miri and Limbang Divisions are linked by a road that passes through Brunei Darussalam. There are also regular flights operated by MASWings between Miri, Limbang and Lawas, and between these main urban centres and rural service centres or settlements such as Ba Kelalan, Bario, Long Lellang, Long Banga and Gunung Mulu National Park. Development in the highlands has been hampered by the lack of a proper road. In the last two decades, ramification of the extensive logging tracks has provided an alternative means to transport people and goods between the settlements and the main towns. The logging tracks from Long Lama, for example, have reached as far as Long Banga and Long Bedian, and Long Lama is connected to Miri by a feeder road. From Lawas, logging tracks have reached as far as Ba'kelalan, but there is no road link between Bario and Ba'kelalan. A new logging road has been constructed to the upper Tutoh area; this road has almost reached Bario.

The lack of economic and employment activities, and inadequate community facilities also constitute major socio-economic problems. As a result, growth has stagnated and out-migration is rampant, leading to a general decline in the population in the region. Miri and the coastal area in general continue to provide better opportunities and quality of life, exerting a major pull factor on the rural populace.

1. Agriculture in the Bario Highland

The main crops currently being cultivated are wet paddy, pineapple and vegetables. In addition, buffalo rearing is an important economic activity.

Bario rice is well-known quality rice that fetches a premium price in the local markets. Apart from their own consumption, farmers in the Kelabit and Maligan Highlands grow rice as a cash crop. It is mainly grown in the valleys and riparian areas with poorly drained alluvial soils; although at Bario itself, some muck soils and some hill soils on the terraced lower slopes are also cultivated. Manual labour is used to level the wet paddy plots. In general, only a single crop of wet paddy is cultivated annually, between the months of October and March. The paddy fields are used for grazing buffaloes during the off-season. Tramping by the buffaloes puddles the soils and the droppings of the animals in the fields also enrich the soils.

Pineapple has recently gained prominence in the local trade at Bario even though it has been cultivated for some time. In contrast to the lowland where it is mainly grown on peat soils, pineapple here is cultivated on slopes around the settlements. The fruit is very juicy and sweet, and is in good demand. In view of low input requirement, it is a potential commercial crop. However, high transportation cost by air prohibits its export to Miri and elsewhere. Being a perishable crop, timely delivery to the market is critical. Hence, further development of this crop will depend very much on a vast improvement in transportation out of the Kelabit Highland.

Buffalo is the main livestock kept by the highlanders, apart from backyard pig and poultry. It is used as the draught animal for ploughing the field and pulling carts. It is allowed to graze in the paddy field during the fallow period. The animal is sometimes slaughtered during festive seasons, or sold in Lawas or Brunei. Buffalo rearing is highly compatible with wet paddy cultivation, especially in Bario where fossil fuel is costly, and animal feed and fertilisers are expensive.

2. Agriculture in Ba Kelalan and Long Semadoh Areas

The mixed agriculture system practised here, consisting of wet paddy cultivation and buffalo rearing, is similar to that in the Bario Highland.

Buffalo rearing is particularly important to the Lun Bawang. Brunei imported, mostly from the Lawas District, a total of 8,982 heads of cattle and buffaloes in 1991, with value estimated at B$8.982 million. This figure increased to 9,251 heads in 1992, with a value of B$9.251 million (Source: Sundar-Awat Awat RGC's report). Based on export permits issued, however, the official export figures (DOA, *per. comm.*) were 50 heads of buffaloes in 1996, 6 heads in 1997 and 23 heads in 1998 (up to July). This huge difference between the 1991-92 and 1996-98 figures is difficult to reconcile, and may be partly due to the facts that:

- Buffaloes are mostly sent to Brunei without following proper official procedure (and hence there is no proper record); and,
- Brunei owns a large cattle ranch in the Northern Territory of Australia, which supplies much of her imported beef, thus reducing the demand for buffaloes from Sarawak after the mid-1990s.

In the old days, it took 2-3 weeks to herd the buffaloes from Ba'kelalan to Lawas for sale. With the logging roads, some farmers now use 4WD to transport their buffaloes. Improved road access is likely to accelerate commercialised agricultural activities in the area. Ba'kelalan (and Bario) is one of the few locations in the State with potential for sub-temperate crops including fruits (apples, longan, lychee, sweet orange, etc), vegetables (cabbages, cauliflower, broccoli, lettuce, etc.) and flowers. Currently a small farm next to the Ba'kelalan airstrip is producing apples for sale in Lawas. Strawberry has also been grown.

3.2.3 Agriculture in the Central Region

The Central Region includes the Kapit and the Belaga Districts of the Kapit Division. Even though it is a divisional centre, Kapit is not linked by road to the State trunk road system. The

sole means of transportation is by river via Batang Rajang. The journey from Kapit to Sibu by powerful express boat takes about three hours.

The only road link between Kapit and many of the settlements in the Central Region of the HoB is by logging roads. For example, Long Busang and Long Unai at the headwaters of Batang Balui may be reached via a logging road that starts at Nanga Baleh, about 10 km upstream of Kapit.

In the north, the road to the Bakun hydro-electric project (HEP) from Bintulu via Tubau was completed in the early 2000s. It also provides access to the Bakun Resettlement Scheme (BRS), located at the Sg Asap area. There are two small local centres which cater for the needs of the resettled population.

The Central Region houses the Bakun HEP. The 180-m Bakun Dam, which is presently near completion, is located on the Balui River, approximately 37 km from Belaga. The dam will create a lake of approximately 70,000 ha (the size of Singapore). The HEP will generate 2,400 MW of electricity. The resettlement project at the Sg Asap area, comprising 15 longhouses for a total population of 9,500, was completed in 2000.

The Batang Rajang river basin is home to a number of settlements. While smallholder agriculture is prominent, there are also other economic activities in the region, including timber harvesting, forest plantation development, and coal mining at Ng Merit. There are also some potential for ecotourism, with attractions including white-water rafting. A tourist resort has been built at Pelagus where the series of Pelagus Rapids is one of the local tourist attractions.

Basic community facilities such as clinics and primary schools are fairly well distributed at strategic locations in the region, while others like police station, post office, community hall and recreational facilities are generally inadequate. Remote settlements also lack amenities such as treated water, electricity and telecommunications.

Subsistence farming represents the most widely practised economic activity for the longhouse dwellers in the region. Shifting cultivation is mainly found on slopes along existing logging roads or rivers/streams. Hill paddy is cultivated in rotation or simultaneously with maize. Miscellaneous tropical fruit trees are grown around the longhouses. These include durian (*Durio zibethinus* and *D. kutejensis*), isau (*Dimocarpus longan*), dabai (*Canarium odontophyllum*), petai (*Parkia speciosa*), mangosteen (*Garcinia mangostana*), keranji (*Dialium indum*), langsat (*Lansium domesticum*), coconut, sukun or bread-fruit (*Artocarpus communis*), pinang (*Areca*) palm, rambutan (*Nephelium*) and banana (*Musa*). Other crops grown in scattered plots are yam, tapioca and vegetables. Rearing of chicken and pig are usually done on a very small scale for own consumption.

3.2.4 Agriculture in the Southern Region

This is the small area that forms the southern tip of the HoB area, covering the southern half of the Song District of the Kapit Division, and the interior parts of the Sibu, Sarikei and Sri Aman Divisions. Although quite a number of settlements are located along Sg Katibas, Sg Kanowit, Sg Entabai, Sg Engkari and Batang Ai, only two settlements are actually found inside the HoB. They are Rumah Linggang in the ulu Engkari area and Rumah Nyayang in the ulu Kanowit area. Many settlements are located just outside the Lanjak Entimau Wildlife

Sanctuary and the Batang Ai National Park, widely scattered and with sparse populations. The Batang Ai HEP is located near Lubok Antu. This small town serves as the main service centre for the Batang Ai National Park and is accessible from Kuching by road.

Like the Central Region, subsistence farming is the most widely practised economic activity. According to the DOA's Annual Report for 2001, there were 2,714 ha of hill paddy in the Song District with an average yield of 529 kg/ha. Minor crops such as maize, cassava, cucumber, pumpkin and ensabi (a local vegetable) are usually inter-cropped with hill paddy. The DOA provides hill paddy fertiliser at a subsidised price. Some wet paddy may be cultivated in the low-lying swampy alluvial lands. Cash crops include rubber, pepper, cocoa, fruit trees and annual crops. Song District has 3,366 ha of ordinary rubber and 840 ha of high-yielding clonal rubber (DOA 2001 Annual Report). With the recent increase in rubber prices, tapping frequency has increased lately. Local fruits are popular; these include pineapple, rambutan, durian, dabai, langsat, isau, keranji and banana.

3. PROMOTING SUSTAINABLE AGRICULTURE

1. Major Issues and Constraints

Inadequate access and infrastructure: As mentioned earlier, one of the most critical issues concerning agriculture in the HoB area is the lack of accessibility, infrastructure and facilities. In the Northern Region, Twin Otter planes with a maximum load of 18 passengers and limited cargo space fly from Miri to several areas where rural airstrips are available, such as Bario, Ba'kelalan, Long Lellang and Long Banga. Additional flights will have to be chartered to fly extra passengers and cargo. Another alternative is using logging roads but this is only possible during fine weather or if the roads are regularly maintained. Cost of living is very high especially in Bario, where one has to pay RM 35 for a gallon of diesel and RM 160 for a tank of cooking gas. The famous *Bario rice* would cost about RM 10.00 per kg by the time it gets to Miri. This is several times higher than the lowland local rice or imported rice.

The government has ambitious plans to turn the northern highlands into a centre for commercialised agriculture, via the Agropolis project. This is possible only if proper road access is made available in the near future.

Lack of suitable land: The steep terrain and associated shallow soils and serious erosion hazards limit the availability of suitable land or soil for agricultural development. Based on the Soil Memoir for the Northern Interior Sarawak (Eilers & Loi, 1982), the Long Semadoh Rural Growth Centre (RGC) Study (SDI, 2001) estimated that only 15-20% of the Maligan Highland is suitable for agriculture. The study also found that the Lun Bawang people only owned about 1,005 ha of arable land - 788 ha in the Long Semadoh area and 217 ha in the Ba Kelalan area - with an average of 2.9 ha and 1.7 ha per household respectively.

On the Maligan Highland, suitable lands are mainly confined to the narrow alluvial plains of upper Trusan and Kelalan Rivers. Similarly, suitable soils are confined to the flat valleys and along Sg Dappur and its tributaries around Bario. Since these areas do not occur in large contiguous blocks, such a soil distribution pattern would greatly restrict any development of large-scale wet paddy scheme. The Highland Development Study (DOA, 1985) also cautioned that some of the alluvial lands on the Kelabit Highlands had been left uncultivated because of serious flooding problem.

As wet paddy is a major crop on the highlands, the other challenge to the farmers is the availability of a reliable system of irrigation. Sometimes, there is a lack of an adequate and reliable source of water at a reasonable distance from the paddy fields. For some others, the conveyance system may not be good enough to ensure that all the fields concerned get sufficiently irrigated.

Shortage of manpower: The Kelabit and Lun Bawang people were among the first to receive secondary and tertiary education beginning as early as the 1960s. It is natural that out-migration has been the highest among these people. Lack of manpower has resulted in many paddy farms being gradually abandoned. In the past, Indonesian labour from across the international border was readily available and cheap. To-day, many farmers have to engage Penan as casual labourers, in spite of their lack in farming skills.

Marketing problems: In the early 1980s, the DOA conducted a comprehensive study to gauge the agricultural development potentials of the Kelabit and the Maligan Highlands based on detailed appraisals of the soil resources, other biophysical characteristics and the socio-economic environment including existing land use. The study came up with several development proposals involving wet paddy, highland vegetables, fruit trees (citrus), Arabica coffee, highland tea, cardamom, fish culture, and buffalo rearing. Several projects such as coffee and cardamom planting were implemented but they had to be abandoned due to pest problems (e.g. borers) as well as poor marketing.

Inadequate processing facilities for paddy: In the Kelabit and Maligan Highlands, the wet paddy harvested is milled locally in the village's single-pass milling machines. As these machines are quite old, they usually produce a high percentage of broken grains. Quality control is important if the rice is to be exported.

Packaging is also important. Modern rice mills should be complete with packaging or bagging facilities. The vacuum-packed 2x1kg packages done by the Sarawak Farmers' Organisation for tourists is a good example of how the *Bario rice* can be nicely packaged for the local and overseas markets.

Lack of skills/knowledge among the local farmers: Evidence suggests that the number of younger farmers engaged in wet paddy cultivation has been declining, especially in Bario. Corollary to this, the farming knowledge and skills of the ageing farmers will gradually be lost. There is a growing interest among the highland farmers in organic farming and to grow new and high-value crops such as *Vanilla* (in particular *Vanilla planifolia*) and Arabica coffee, for which new knowledge and skills must be acquired.

Potential for high-value crops and buffalo rearing: The prevailing climate in the Kelabit and the Maligan Highlands, characterised generally by low air (and water) temperatures, is suitable for sub-temperate fruits, vegetables and other high-value crops, though it should be noted that the temperature changes here are diurnal in nature rather than seasonal as in the temperate latitudes. Based on previous studies (e.g. Highland Development Study, DOA, 1985), suitable sub-temperate vegetables include white cabbage, Chinese cabbage, cauliflower, tomato, sweet pepper (capsicum), lettuce and sweet pea. Fruits with very good potential include oranges (e.g. Mandarin orange) and persimmon; while lychee, apple, longan and strawberries have also been proposed. Other high-value crops include Arabica coffee, vanilla and several spices such as cardamom and cinnamon. It must be cautioned, however,

that based on the current accessibility, it would be premature to consider production and marketing of many of these crops on a commercial scale.

The *Bario rice* is an obvious candidate for highland agriculture. A number of characteristics or sub-issues regarding its cultivation should be recognised. These include:

a) *Bario rice* is actually what the local people called *Padi Adan*, of which three main sub-varieties are recognised: *Adan Medium, Adan Slender* and *Adan Coarse*. All of them are well adapted to the local micro-environment, but the yields are relatively low, averaging about 2.0 t/ha;

b) They are long-term rice varieties that require 150-180 days to mature, and are thus not really suitable for double cropping;

c) The highland paddy farmers observe strictly a predetermined planting schedule of the crop. The main purpose of synchronising the farming activities is to minimise damage by rodents and birds, and pest and disease infections. The disadvantage is that water and human resources have to be made available at about the same time in all the paddy-planting areas. This creates a very keen competition on the limited resources of manpower, water, etc. As a result, farmers face the problems of labour shortage, especially during harvesting;

d) Through generations of cultivation, most of the fields have been properly levelled and bunded. Very little land preparation work is carried out either by tillage or puddling in the fields before transplanting. However, weed eradication before planting is necessary. Due to labour shortage, more herbicides have been used in recent years. Some farmers use synthetic chemicals such as cypermethrin, etc. to control stem borers, leaf feeding caterpillars and sucking insects. This is contrary to the concept of organic farming;

e) The practice of single cropping enables the integration of buffalo rearing in the off-season. After harvesting, buffaloes are allowed to graze the remnants of the paddy crop and weeds in the fields until the next cropping season. In the process, buffaloes provide the fields with organic fertiliser in the form of excreta. Smallholder farmers planting traditional long-term rice varieties seldom apply inorganic fertiliser because the crops are not very responsive towards the chemical fertiliser applied. Other limiting factors are high fertiliser and transportation costs, as well as additional labour cost of applying the fertiliser. All these imply that a low-input system of cultivation integrated with animal husbandry (e.g. buffaloes and ducks) and other practices (e.g. culture of fish and nitrogen-fixing azolla) would be more appropriate;

f) Mechanisation of field operations is virtually non-existent. Land preparation by farm tractors is very expensive due to the high fuel cost, inexperienced operators and soft submerged fields throughout the year. Another reason is the non-availability of farm machinery support services and proper paddy field infrastructure;

g) Most of the farm plots are fragmented, being found largely along both sides of rivers such as Sg Dappur and its main tributaries Sg Marario, Sg Ukat and Pa Lungan in the Bario area; and Sg Kelalan and Ulu Trusan in the Ba Kelalan-Long Semadoh area. The farm plot sizes range from 0.1 to 1.0 ha. On average, each household owns about 1.3 ha (3.3 acre) but during each planting season, only about 0.4-0.8 ha (1-2 acre) may be cultivated. Production is thus limited. Fragmentation also means that centralised management would be difficult to implement, and the cost of infrastructure provision per unit area of cultivation would be high;

h) For centralised or commercial production, the problem of water shortage for irrigation purposes must be addressed, including size of water catchments. Presently, the fields are supplied with water either by open earth canals or plastic piping with diameters up to 150 mm. The total farm area irrigated by a single water source is usually less than 15 ha.

Wet paddy cultivation is very closely integrated with buffalo rearing. In 2001, about 60% of the households obtained substantial income (mean of RM 646 per month) from the sale of buffaloes (SDI, 2001). Buffalo rearing is mainly done by farmers who have the money to purchase the stock, and extra land to provide enough grazing ground. Problems that need to be overcome are lack of good breeders, in-breeding among the existing stock, and diseases and parasites. Foot-and-mouth disease is common, while haemorrhagic septicaemia is endemic in the highlands. Buffalo louse (*Haematopinus tuberculatus*) and eye-worm (*Thelazia* sp.) are also quite common.

4. DEVELOPMENT OUTLOOK

1. Northern Region

There is a continued expansion of development from the coastal areas towards the rural hinterland in the region, particularly with the establishment of large commercial oil palm and forest plantations. Roads are continually being upgraded by the Government to provide the necessary access. For example, Lapok along the bank of Batang Tinjar is now accessible by road from Miri, and the section from Lapok to Long Lama is under construction.

There are proposals made under the Miri Regional Study (MRS) and the Border Towns' Study (BTS) to link the highland areas with the main towns by road, in order to facilitate economic development and to improve the quality of life of the highlanders. The proposed road from Miri to Limbang through Long Lama and Long Bedian may be implemented under the Ninth Malaysian Plan (9MP). The MRS also recommended the upgrading of the existing logging road from Long Lama to Long Banga via Long San/Long Akah into a regional road. The Lawas-Long Semadoh-Ba Kelalan Road has also been approved under the 9MP.

The MRS also recommended that Bario be upgraded to a district-level centre, and the Long Semadoh Rural Growth Centre (RGC) report suggested that Long Semadoh and Ba Kelalan should be also turned into sub-district-level centres to facilitate growth. Ba Kelalan has also been identified in both the RGC Study and BTS as a potential area for a border town in view of the very active cross-border trading activities. Another border post has been considered at Pa Dalih together with a new airport. Pa Dalih is situated to the south of Bario.

The recent announcement by the State government to develop a deep sea port and a new airport at Lawas, and the construction of the Lawas-Long Semadoh-Ba Kelalan Road will strengthen the position of Lawas as a major growth centre in the extreme north of Sarawak. These developments (if realised) will position Lawas as a hub to the northern highlands.

2. Central Region

The most significant projects to be undertaken in this region are the Bakun and the Murum HEP projects. The Baleh HEP project is presently being planned. The resettlement project for the people affected by the Bakun dam was completed in the early 2000s at the Sg Koyan-Sg Asap area, while the construction of the dam itself is currently near completion. Construction

works on the Murum dam have also been initiated recently. These projects are likely to have a significant economic and environmental impact on the highlands around the dam, with potential economic spin-offs in the areas of tourism and fisheries. Oil palm plantations in the surrounding areas will provide employment and economic opportunities to the new settlers and other indigenous people. The Bakun area is envisaged to accommodate a population of some 48,000 by 2015, under the medium growth scenario. If this materialises, it will become a significant growth area.

Other studies such as the Mid-Rajang Integrated Development Study and the RGC Study have made several recommendations for the development of service centres, agriculture, forestry and tourism development in the Rajang River basin. The proposed Baleh HEP located in the upper reaches of Batang Baleh is also a potential project which can spur development in the southern half of the Central Region.

Road linkage of Kapit to the state trunk road is currently under consideration. The Mid-Rajang Study has proposed a road from Kapit to be connected to Tatau/Bintulu via Nanga Merit. This will help to open up another development corridor in the Central Region.

3.4.3 Southern Region

In the Southern Region, the Batang Ai National Park and the Batang Ai hydro dam, together with the rich Iban cultures can be further developed and promoted as a popular tourist destination. The adjacent Lanjak Entimau Wildlife Sanctuary may be developed for limited ecotourism; the sanctuary has tremendous potential to be developed as a tropical field centre for research. When the Lubok Antu border crossing is complete with customs, immigration and quarantine facilities, a higher flow of cross-border trade and ecotourism can be expected.

The Batang Ai Reservoir created by the Batang Ai HE has a huge potential for aquaculture. In actual fact, since the start of the fish cage culture industry in the Batang Ai Reservoir in 1993, the local people and agencies directly involved in the rearing of the fish have benefited from the venture. To date, the sales of fish by the local people involved in the cage culture business under the supervision of the DOA (i.e. with subsidies) have generated a value of more than RM3 million.

The DOA, wanting to capitalise on the success thus far and make better use of the Batang Ai Reservoir, has plans to expand and commercialise the cage culture venture for the local and the overseas markets under the Aquaculture Industrial Zone (AIZ) concept. However, to be able to capture and cater for wider market, a significant increase in the volume of production from what is currently available must be achieved. Consistency in supply is also important. The DOA has lately estimated that a production rate of approximately 8,000 mt per year can be sustained. At such a level of consistent production, the goal of supplying both to the local as well as the export markets can be realised.

The new AIZ concept is expected to spur the aquaculture industry to new heights by taking stock of our existing resources, while at the same time addressing global concerns regarding environmental sustainability and food safety. It is a concept that integrates technology, expert information and marketing. At the same time, the idea of constructing suitable infrastructure such as used water treatment and solid waste removal facilities, for both aquaculture farms as

well as associated downstream activities, would ensure the disposal of debris and refuse in an organised manner and prevent the receiving natural waterways from being polluted by the used waters from the aquaculture farms.

It is understood that the expansion and commercialisation of the cage culture project by the DOA will not compromise the interest of the local people. Those local people who want to have their own cages will be allowed to do so and be given some assistance as it is practised currently. The proposed Batang AIZ Project will have tremendous beneficial spin-offs, including the potential for agro-tourism. It project will also provide ample employment and business opportunities. These beneficial socio-economic impacts would help to diversify and stimulate the economy of the region.

Such an approach is also very much in line with current thinking as a result of problems now being encountered after the green revolution, where high input of fertilizers, use of pesticides and irrigation have adverse impact on agricultural productivity (Bourne Jr.,2009.)

3.5 DEVELOPMENT STRATEGIES

Agriculture is the main economic activity and source of livelihood for the communities living in the HoB area. Wet paddy cultivation and buffalo rearing are practised by farmers in the Northern Region; elsewhere, shifting cultivation of hill paddy is widespread, while other food crops such as tapioca and maize (corn) are also planted. In the Maligan and Bario Highlands, the farmers enjoy good income by selling their surplus of good-quality rice. In Long Semadoh, for example, SDI (2001) reported that farmers accounted for about 72% of those in the working-age group, and surplus rice was the common source of income for about 92% of the households.

The strategy for the Maligan and Bario Highlands in the Northern Region is to develop niche and/or high-value products that are economically viable, socially agreeable, and environmentally acceptable. The development should adhere to the following basic principles:

a) Focus on improving the livelihoods of the local communities;

b) Tailor development to the highlands giving due consideration to their unique environmental settings and agricultural capabilities, where small communities are involved and suitable lands are relatively scarce;

c) Build on the existing facilities and the farmers' knowledge and experience, giving priority to established products such as *Bario rice* and buffalo rearing;

d) Low input organic farming should be encouraged in view of high transportation and fertilizer costs. Organic farming, if practised properly, would also add value to the produce and remain competitive;

e) Agricultural development projects should be carried out in stages so that small communities with limited labour force are not overwhelmed;

f) The local communities should be involved in project planning, and their views and aspirations should be sought, and where relevant, incorporated into the final outcomes.

In summary, agricultural development, particularly in the northern highlands, should be enhanced by improving existing agricultural production, adding value to existing products, introduction of new high-value crops, enhancing livestock production, improving marketing and providing credit facilities, and improving skills of local farmers. Taking into account the constraints and opportunities of the physical environment for sustainable agricultural and other development, a few project ideas have been proposed (see Chapter VIII) in order to achieve the objectives of the HoB Initiative.

3.5.1 Sarawak's Agropolis Concept of Agriculture Development

On the Maligan and the Bario Highlands where there are some potential for commercial agriculture, the Agropolis concept of agricultural development may be applied. This concept is outlined below.

The Agropolis concept introduced by the State government is to accelerate the industrialisation and modernisation of the agriculture sector in the State with strong emphasis on value-adding activities, both upstream and downstream. An ordinance based on this concept had been enacted in 2004 for the promotion of commercial agriculture and agro-based industries as the Laws of Sarawak, Chapter 58: Promotion of Commercial Agriculture And Agro-based Industries Ordinance, 2004. This enactment is to provide the legal mandate for the relevant government agencies to establish institutions for the formation of an Agropolis Advisory Council and the establishment of Agropol Company (under the Company Act 1965), a corporate body which can establish subsidiary companies for certain agri-business enterprises, which may be in collaboration or joint-venture with private companies and landowners.

The strategy to bring about some structural transformation in line with the National Agricultural Policy and the State Agricultural Policy is promoting and facilitating the parallel development of corporate private sector and smallholders in the production of certain priority crops that have the potential for export, and exploit the opportunities of synergy between these two players. The corporate private sector would lead in establishing large-scale production while the smallholders could tag on the networks and services of the former as out-growers or contract suppliers. The industrial leaders would be able to utilise qualified management personnel, establish market networks, and penetrate markets with assured supply and quality including niche branding. Large-scale production by the corporate sector will enable adoption of mechanisation and automation, and improved technologies and practices with precision farming; assure quality of products and consistent supply with the necessary bulk to spur and support export, downstream processing and manufacturing industries. All these features will make the production more competitive. The improved production technologies can be transferred to the smallholders.

Therefore, the aim of the Agropolis concept is basically to develop effective smart partnership and investment, and the application of modern technology, so as to bring together the key players in the public and private sectors involved in all levels of agricultural production, from primary production to the final products. The focus will be on selected strategic agricultural and agro-based industries, especially the food industries with the products having the quality that is competitive in the larger markets overseas as well as local large markets such as in Kuching, and other big cities in Peninsular Malaysia. To ensure

competitiveness in the larger markets, productions will be strongly supported by research and development (R&D) and human resource development (HRD) programmes, with strong emphasis on biotechnology development.

The main function of the Agropolis Advisory Council is to advise the State government on the policies, strategy, direction, plan and programme to: (a) promote commercial agriculture on a sustainable basis; (b) co-ordinate activities and schemes for collaboration between the parties participating or investing in commercial agriculture and agro-based industries; (c) promote investment in the agriculture sector of the economy; and (d) direct the Agropol Company to execute, implement and comply with all the policies, and directions formulated by the Government on the advice of the Council.

The Agropol Company, which is to execute and implement the policies and directives of the government, will be solely owned by the State government, which will provide financial assistance for the company's business activities. The company may be vested with state land, or state land may be alienated to the company for commercial agricultural projects. Private landowners are encouraged to participate in commercial farming projects in joint venture or in collaboration with the company. The company may also acquire pieces of land which adjoin or are within the project area when the landowners have no interest in participating in the project concerned.

CHAPTER IV – FOREST RESOURCES

4.1 INTRODUCTION

Sarawak has a land area of 12.4 million ha making it the largest state in Malaysia. Presently, an estimated 65% of the land is occupied by forest. Over the past fifty years shifting cultivation, commercial logging, excisions and gradual conversion to agriculture, plantations and other forms of land uses have resulted in the natural forest cover being reduced.

Forestry still remains the backbone of the State's economy after petroleum and petroleum products. The timber rich coastal peat swamp forest was the first to be logged. Logging in the hill forest began after a state wide survey of the timber resources by the Food and Agricultural Organization (FAO) was completed in 1973. The operation started in the

lowland forest and from there gradually progressed into the higher mountainous area in the interior, including much of the 2.03 million ha that is within the HoB.

The HoB Initiative emphasizes balance in conservation and development, through sustainable resource management and utilization, to generate socio-economic benefits for local communities living in and around the area. Forestry is the main socio-economic activity that has brought about a dramatic change in the rural physical, biological and socio-economic environments and lives of the local people for at least two decades. Besides logging in the natural forest the government also encourages development of tree plantation, to ensure an adequate supply of wood fibre to meet future needs.

4.2 FOREST TYPES

In Sarawak forest types are related to the important factors of soil and climate. Forests that are specifically associated with soil types are also known as edaphic forests. In the high mountains temperature is affected by increasing altitudes and the forests so formed are called climatic forests. The HoB comprises lowland forests to montane forests that may be found on the summits of Bukit Lanjak (1,300 m) in the Lanjak Entimau Wildlife Sanctuary in the south, and Gunung Mulu (2,376 m) and Gunung Murud (2,424 m), both in the northern highlands. Gunung Mulu N.P. is most remarkable in that it encompasses a diversity of vegetation that includes all of Sarawak's major inland forest formations, with the exception of forest on igneous-derived soils (Anderson and Chai, 1982). Lanjak Entimau and Pulong Tau are equally rich and diverse.

The vegetation formations in these three totally protected areas, as well as those of the Batang Ai National Park located immediately south of Lanjak Entimau W.S., have been studied in some detail. Together, they encompass a complete range of the forests that exist in the HoB area in Sarawak. Mixed dipterocarp forest is the dominant forest type that covers most of Sarawak's interior hilly terrain.

Vegetation zoning, structure and physiognomic characteristics are influenced by a combination of factors including altitudes, exposure, topography and soils. This has resulted in the development of montane vegetation on Bt. Lanjak that is similar in character, structure and species composition to that on Mulu and Murud, although in altitude, Bukit Lanjak is lower than Mulu and Murud by over 1,000 m (Chai, 1995).

Tables 4.1, 4.2 and 4.3 summarise the major forest types in Lanjak Entimau Wildlife Sanctuary (LEWS), G. Mulu N.P. (GMNP) and Pulong Tau N.P. (PTNP) respectively. A general description of the forest types follows.

Table 4.1 - Forest Types on Bukit Lanjak, Bukit Entimau and Bukit Sengayoh in Lanjak Entimau Wildlife Sanctuary (Chai, 1995)

Altitude	Forest Type	Locality
1250 m	Upper montane forest	Bt. Lanjak
1150 m	Lower montane forest	Bt. Lanjak
600 – 900 m	Mixed dipterocarp forest	Bt. Lanjak
200 – 700 m	Mixed dipterocarp forest	Bt. Entimau
800 – 900 m	Tall pole forest on summit ridge	Bt. Entimau & Bt. Sengayoh
150 m	Alluvial forest	Bt. Entimau & Bt. Sengayoh

400 – 550 m	Old secondary forest	Bt. Lanjak
160 m	Old secondary forest	Bt. Entimau & Bt. Sengayoh

Table 4.2 - Land Types and Associated Vegetation Formations in G. Mulu N.P. (Anderson & Chai, 1982)

(Land types are based primarily on geology and geomorphology embracing the main soil types)

Land Types & Sub-Types	Vegetation Formations
G. Mulu Massif	
1. Up to 800 m	Lowland mixed dipterocarp forest
2. 800 – 1200 m	Upper montane forest
3. 1200 – 1900 m	Upper montane forest (tall facies)
4. 1600 – 2100 m	Upper montane forest (short facies)
5. 2177 m – summit	Upper montane forest (summit facies)
Melinau Limestone	
1. Scree slopes	Lowland limestone scree forest
2. Cliffs	Lowland limestone cliff forest
3. Slopes, up to 800 m	Lowland limestone forest
4. 800 – 1200 m	Lower montane limestone forest
5. 1200 m – summit	Upper montane limestone forest
Alluvial Plains	
1. Alluvium	Lowland alluvial forest
2. Quarternary terraces	Kerangas forest
3. Peat swamps	Peat swamp forest
Setap Shale in Mentawai Drainage	
1. Setap shale formation	Lowland mixed dipterocarp forest
2. Mentawai drainage	Kerangas forest

Table 4.3 - Vegetation Types based on Altitudinal Zones (Lim, 2006)

Altitude (approx.)	**Formation Types**	**Forest Type; major floristic groups**
Below 900 m	Lowland rain forest	Mixed dipterocarp forest; Dipterocarpaceae
900 - 1800 m	Lower montane forest	Fagaceae, Clusiaceae, Myrtaceae, Lauraceae, Sapotaceae
Over 1800 m	Upper montane forest	Myrtaceae, Ericaceae, Clusiaceae dominated
900 – 1800 m	Edaphic forest	**Kerangas**: *Gymnostoma, Cratoxylum, Agathis*
900 – 1800 m	Edaphic forest	**Riparian**: Dipterocarpceae, Fagaceae, Clusiaceae
100 – 1800 m	Edaphic forest	**Alluvial**: Dipterocarpaceae, Clusiaceae

All altitudes	Disturbed vegetation	**Secondary forest:** Euphorbiaceae, Moraceae, Theaceae
All altitudes	Disturbed vegetation	**Open areas:** Ferns, gingers, grasses

1. Riparian Forest

Riparian forest (RF) or *emperan* is associated with the rivers and is made up of a narrow belt of vegetation that is rarely more than 10 m wide on immediate banks of rivers (Chai, 1995). River basins are flat and experience occasional floods that deposit alluvium. In the HoB area, lowland riparian forests in LEWS, and highland riparian occurring along small rivers or streams at over 900 m in Pulong Tau N.P., have been studied (Chai, 1995; Lim, 2006).

The forest is relatively simple in structure and species composition. *Dipterocarpus oblongifolius* (keruing ensurai) and *Shorea macrophylla* (engkabang jantong) are among the most dominant species. They are both large trees and are protected under the Wildlife protection Ordinance 1998 to check bank erosion. Other typical tree species are *Pometia pinnata* (kasai), *Dracontomelon dao* (sengkuang), *Pentaspadon motleyi* (pelanjau), *Syzygium* spp. (ubah), *Dysoxylum* (kelampu), *Ficus obpyramidata* (kayu ara) and *Aglaia odoratissima* (segera). *Swintonia acuta* (upih ai) is particularly common in Batang Ai N.P. (BANP), while *Crateva religiosa* (family Capparidaceae) is a rare shrub found along Sg Melinau in Mulu N.P. *Tristaniopsis* is another group of trees that is present both in the lowland and highland. In Pulong Tau N.P., this tree forms gallery along Sg. Belaban that is named after the local name of the tree.

Palms are represented by *Arenga undulatifolia* (aping) and *Eugeissona utilis* (pantu), as well as several bamboo species. Common herbs include gingers, palms, ferns and aroids. Small rheophytes grow on rocks in fast flowing streams, the most common being *Myrmeconauclea strigosa* (Rubiaceae), *Pinanga riparia* (Arecaceae), *Homenophylla* spp. (Araceae) and many others. Another small shrub *Osmoxylon borneense* (Araliaceae) is locally common.

Riparian forest is often destroyed or damaged by human settlement, construction of wharves, jetties and logging camps or log ponds. Busy river traffic, especially passenger express boats that move at fast speed along the Batang Rajang or Batang Baram often cause severe bank erosion.

2. Alluvial Forest

This forest has a wide distribution in the alluvial plains from the lowland to 1,800 m a.s.l. It is affected by occasional flash floods that deposit alluvium. The most extensive and complex lowland alluvial forest is located in G. Mulu N.P., occurring on gley soils within the flood plains of Melinau and Melinau Paku Rivers (Anderson and Chai, 1982). The forest has an uneven canopy with emergents attaining 30-40 m and diameters over 70 cm. The largest trees belong to *Eusideroxylon malagangai* (belian malagangai), growing to 80 cm in diameter.

Alluvial forest shares many common species with the riparian forest, such as the *Pometia, Dracontomelon,* and *Pentaspadon* mentioned above; along with *Octomeles sumatrana, Parashorea macrophylla, Pterospermum subpeltatum* and *Shorea seminis*. Species characteristic of the lower storeys are *Polyalthia hookeriana, Bhesa paniculata*, and *Paranephelium* sp.

Small palms are frequent, in particular species of *Iguanura, Licuala* and *Pinanga*. Also frequent to abundant are gingers *Achasma, Globba, Kaempfera* and *Plagiostachys*. Climbers include many species of rattan in the genera *Ceratolobus, Daemonorops, Korthalsia* and *Calamus*. Epiphytes are equally common, such as *Freycinetia, Medinilla*, and *Poikilospermum*.

Near the Mulu park headquarters, shallow peat overlies alluvium, with many species more characteristic of either peat swamp or kerangas forest. The pole-like forest is subject to periodic flooding. *Alstonia pneumatophora* (pelai paya) is a principal species that may attain massive size. Others are *Blumeodendron tokbrai, Jackia ornata, Shorea platycarpa* and *Shorea teysmanniana.*

Lowland alluvial forest also occurs in LEWS and BANP on less extensive flood plains (Chai, 1995). In PTNP, highland alluvial forest is found within the lowland rain forest complex, on flood plains, levees, and terraces bordering rivers; here the trees do not grow to large size (Lim, 2006).

In spite of frequent periodic flooding and water-logged condition, the forest with relatively fertile alluvium has been cleared for rice cultivation and planting of rubber and fruit trees by many rural communities.

4.2.3 Peat Swamp Forest

In GMNP, a small area of peat swamp of about 180 ha is situated between the Terikan and Medalam Rivers. Although small in size, the forest shows some of the typical features found in large coastal peat swamp forests in Sarawak. A concentric zonation of four forest types from the periphery to the centre is recognized, relating to decreasing fertility of the peat soils. The peripheral zone is a mixed type of high forest that is floristically the most complex, exhibiting an uneven emergent canopy of about 32 m. The middle and lower storeys are moderately dense. Principal species include *Calophyllum retusum, Copaifera palustris, Combretocarpus rotundatus, Dactylocladus stenostachys, Dryobalanops rappa* and *Shorea albida*. Shrubs and herbs are scarce.

Next to this zone is a denser forest of generally even canopy of 28 m. This Type 2 forest is tall and pole-like and resembles a kerangas forest. The main species of the upper canopy are *Calophyllum retusum, Copaifera palustris, Litsea crassifolium, Palaquium cochlearifolium* and *Shorea albida.* The middle sparse storey contrasts with a dense lower storey. On the ground *Pandanus andersonii* forms thickets. Climbers and herbs are absent or few.

Type 3 forest that follows is less tall and much denser, comprising numerous small trees up to 20 m tall, and has the same species composition as Type 2. A thick litter covers the surface roots, and ground flora is sparse. Type 4 in the centre zone is an open forest with short or stunted small trees usually not exceeding 10 m. The larger trees belong to *Combretocarpus rotundatus*; while *Pandanus andersonii, Pandanus motleyanus* and *Thorachostachyum bancanum* are scattered and form the main ground flora. Epiphytes are more frequent and include orchids, *Dendrotrophe* and *Dischidia*.

This small peat swamp ecosystem is protected, but the coastal peat swamp forest has been exploited for its rich timber resource.

4. Kerangas Forest

Kerangas in the Iban language refers to forest or land that is too poor for paddy to grow due to the impoverished soil. The forest is widespread on high or flat terraces of sandy podzols that are highly leached and deficient in plant nutrients. Depending on soil depth and water condition, kerangas forest may occur as low scrub rarely up to 10 m tall, or forest of tall facies exceeding 30 m. In GMNP, this forest covers the extensive terraces in the Mentawai drainage area. In PTNP it occurs in parts of the Tama Abu Range in the southern region, and in G. Murud up to 1,800 m. Shorter pole-like forest also occurs in the villages of Bario and Pa Lungan. The podzol here is water-logged due to an impervious humus pan below.

In GMNP, the forest on the margin of the terraces is taller and floristically richer than the more extensive forest on the terraces, with medium-sized trees over a canopy that is uneven and usually below 30 m. Typical of the upper canopy species are *Gymnostoma nobile, Dipterocarpus lowii, Gluta macrocarpa*, and three species of *Shorea* (*S. albida, S. ovata* and *S. venulosa*). Common middle and lower storey trees include *Alstonia excelsa, Hopea vaccinifolia, Myristica lowii, Santiria laevigata* and *Whiteodendron moultonianum*. The shrubby layer is rich in palms and pandans, with abundant *Euthemis minor* and *Agrostistachys longifolia*.

In PTNP and its vicinities, members of the Podocarpaceae (*Agathis, Dacrycarpus, Dacrydium* spp.); Casuarinaceae (*Gymnostoma* spp.) and Myrtaceae (*Tristaniopsis* and *Syzygium* spp.) have been recorded in the tall facies forest. *Agathis* produces good timber that is popularly used in the highlands for construction, furniture and panelling. In the scrubby forest around Bario and Pa Lungan members of the Myrtaceae are common, in particular the genus *Syzygium* and *Tristaniopsis*, along with Casuarinaceae (*Gymnostoma nobile*), Clusiaceae (*Calophyllum*), Theaceae (*Schima*) and Podocarpaceae (*Dacrydium*). Shrubby trees belong to the families of Ericaceae with many species of *Rhododendron*, as well as members of the Myrsinaceae, Rubiaceae, and Ochnaceae. Ant plants (*Hydnophytum* and *Myrmecodia*), carnivorous plants *Nepenthes*, and orchids are frequently encountered.

Being of little commercial value and not suitable for agriculture, kerangas forest is often left unexploited. In the northern highlands like Bario, the forest has been cleared for settlement and many trees like *Tristaniopsis* are cut for firewood.

5. Limestone Forest

A spectacular landscape of GMNP is the extensive limestone formations of the Melinau with an immense network of underground cave systems that house the largest cave passage, largest cave chamber, and the fifth longest cave in the world. Limestone forest also occurs in Gunung Buda N.P. north of Mulu. Anderson and Chai (1982) have identified five vegetation formations (Table 2). The soils mainly of silty or clayey loam are very thin and mixed with limestone gravels.

1. Lower Limestone Scree Forest

Screes at the foot of limestone massif are found on steep slopes strewn with limestone boulders. The forest is generally open with scattered emergents up 50 m in height. They include *Azadirachta excelsa* (sentang), *Pometia pinnata, Scorodocarps borneensis* (bawang hutan), and *Paranephelium nitidum* (rambutan hutan). Typical middle and lower storey trees are *Diospyros cauliflora, Popowia pisocarpa* and *Dendrocnide stimulans*. In the shrubby layer *Lunasia amara, Acranthera involucrata* and *Mycetia javanica* are present. The damp soil supports a rich herbaceous flora comprising *Chloranthus officianalis, Arthrophyllum parvulum,* and many species of Gesneriaceae, particularly *Monophyllaea*.

2. Lower Limestone Cliff Communities

Limestones form immense cliffs that are lacking in soil or moisture when fully exposed to the sun. This extreme habitat supports a community of small shrubs and herbs. Typical among them are *Boea* with at least five species, *Fagraea auriculata* and *Ficus tinctoria*. Several species of ferns occur as lithophytes, e.g. *Adiantum* and *Taenitis*. At the lower levels the cliffs are less exposed, and is a typical habitat for Gesneriaceae, particularly of the genus *Monophyllaea* (one-leaf plant) with several species, and the genus *Cyrtandra*. The small calcicolous palm *Salacca rupicola* is common and known nowhere else.

3. Lower Limestone Forest

This occurs on steep limestone slopes up to 800 m with gradients exceeding 45 degrees. The forest comprises of a dense community of small trees and shrubs, but occasional emergents may attain 40 m in height. Several dipterocarps make up the principal species: *Hopea andersonii, Hopea dasyrachis* and *Shorea multiflora*; together with non-dipterocarps *Brownlowia glabrata* and *Palaquium sericeum*. Species of *Rinorea, Chisocheton, Cleistanthus* and *Chaetocarpus* are common among the small trees and shrubs.

4. Montane Limestone Forest

On Gunung Api, lower montane forest is considered to start at 800 m, over a terrain that is very steep and rugged with large rocks. As on Mulu, the trees have decreased in size and in the occurrence of dipterocarp trees. The dense forest is less than 25 m. *Hopea argentea* is the only dipterocarp found, in association with *Parishia maingayi, Canthium didymum, Palaquium rostratum* and *Tristaniopsis obovata*. Species of Gesneriaceae and Urticaceae are common among the herbs, along with *Begonia* and *Argostemma*.

The upper limestone forest formation also begins at around 1,200 m on Gunung Api. A typical feature is abundance of bryophyte flora covering a deep humus layer on the ground and tree trunks. This is a scrub forest with trees that are also found on Mulu at this altitude namely, *Dacrydium beccarii, Phyllocladus hypophyllus, Syzygium bankense* and *Palaquium gutta*. *Leptospermum flavescens* occurs at 1,500 m, with myrmecophytes growing on its trunks. Orchids, pandans, and *Rhododendron* (3 species) are common on the summit at just under 1,600 m.

Limestone forests are safe from logging but the stones are sought after in road construction. Many caves in the Ulu Baram produce excellent quality birds' nests.

4.2.6 Mixed Dipterocarp Forest

This is the most dominant forest type that extends from the lowland to about 800-900 m on Mulu and Murud, where it gradually merges into the lower montane forest. Mixed dipterocarp forest (MDF) is sometimes differentiated into lowland dipterocarp forest (LDF) and hill dipterocarp forest (HDF) (Chai, 1995), but both are really part of a continuum. Dipterocarps are richest in the lowland but the number of species decreases up the higher elevation spectrum where the steep slopes and shallower soil are unstable. The forest grows best on well-drained sandy clay loam and is currently the main producer of commercial timber in Sarawak. In the HoB area, as in much of the lowland, large tracts of this forest have been licensed for timber harvesting.

Structurally, the mature phase of this forest has four canopy strata with a maximum height of 55 m. The large trees have cylindrical boles and are often highly buttressed. Principal emergents are *Koompassia excelsa* (tapang), *K. malaccensis* (menggris), and members of the Dipterocarpaceae (*Shorea* and *Dipterocarpus*). Dipterocarpaceae is the dominant family with over 200 species, with species of *Shorea* (meranti and selangan batu) and *Dipterocarpus* (keruing) being the most numerous and producing the bulk of the commercial timber.

Growing in association with the dipterocarps in all the canopy strata are up to 100 tree families that are collectively known as the non-dipterocarps. Among the non-dipterocarps, species of the genera *Syzygium, Diospyros, Durio, Garcinia* and *Xanthophyllum* are very common. In the middle stratum, dipterocarp trees are up to 35 m in height, and many have attained commercial size. Common dipterocarps in the lower stratum (up to 25 m) are *Shorea*, *Hopea* (luis) and *Vatica* (resak). Non-dipterocarp families that produce commercial timber include Anacardiaceae (rengas), Sapotaceae (nyatoh), Lauraceae (medang), Burseraceae (seladah) and Myrtaceae (ubah). Euphorbiaceae is the family with the most number of species, and are particularly common in the middle and lower storeys. Large climbers are abundant. Small trees or treelets belong to the families Rubiaceae, Euphorbiaceae, Annonaceae and Meliaceae, and palms (*Pinanga, Areca, Licuala*), make up the ground flora, along with a dense community of dipterocarp and non-dipterocarp juveniles.

The trees are randomly scattered over a wide range of habitat types from low gentle ground to gullies, slopes, ridges and mountain tops, but forests growing on drier ridges and hill tops are usually of a slightly different species composition to those growing in low-lying and wetter areas, while subtle changes in soil fertility may also reflect differences in composition (Lim 2006).

The non-tree species form another important plant group, comprising climbers of all sizes (many reaching the emergents), palms, epiphytes and herbs. Species of rattan, ginger, pandan and herbs are important sources of non-timber forest products to the local communities for weaving, tool and handicraft making, food and medicine.

In all, an estimated 100 families, 500 genera and no less than 2,500 species are probably found in this forest alone (Rantai and Chai 2007).

7. Montane Forest

1. Lower Montane Forest

Sometimes also called sub-montane forest or mossy forest (*hutan lumut*), lower montane forest (LMF) occurs as part of a continuum of MDF from about 1,000 m to 1,800 m on Mulu

(Anderson & Chai, 1982) and Murud (Lim, 2006). On Bt. Lanjak it occupies a narrow zone at between 1,150 m and 1,250 m (Chai, 1995). A characteristic feature of this and the upper montane forest (UMF) above it is the dense carpets of mosses (bryophytes) covering the ground, tree trunks and branches due to high moisture regime. LMF is sometimes regarded as an intermediate zone or zone of change between MDF and UMF (Lim, 2006), but is often quite distinct in terms of structure and stature – being taller and with trees that are generally in upright position.

The montane forest of Mulu was studied by Martin in 1977. Martin established ecological plots in the lower and upper montane forests on the west ridge to study structures and species compositions. LMF usually attains 20 m in height but may grow to 30 m on Murud. Like the kerangas forest, this forest also has a pole-like appearance, but usually lacks an emergent stratum with only the main canopy, lower storey and ground flora strata. The forest on Murud has an estimated density of 600 to over 900 trees/ha (Lim, 2006).

Trees making up the main canopy include *Agathis endertii* (Podocarpaceae), *Shorea monticola* and *Shorea platyclados* (Dipterocarpaceae), *Quercus* and *Lithocarpus* (Fagaceae), *Engelhartia serrata* (Juglandaceae), *Platea latifolia* (Icacinaceae), *Syzygium* spp. (Myrtaceae), *Palaquium* (Sapotaceae), and *Adinandra excelsa* and *Gordonia* (Theaceae).

In the middle and lower storeys members of the Euphorbiaceae (*Aporosa, Blumeodendron*), Burseraceae (*Canarium, Santiria*), Lauraceae (*Beilschmiedia, Cinnamomum, Litsea, Cryptocarya*), Myristicaceae (*Myristica, Knema*), and Fagaceae (*Quercus, Lithocarpus*) are common. Ground flora comprises members of Rubiaceae (*Argostemma*), *Rhododendron*, *Diplycosia* and *Vaccinium* (Ericaceae), palms, ferns, and orchids. Epiphytes include many orchids, *Scindapsis* (Araceae), ferns, *Nepenthes* and *Rhododendron*.

4.2.7.2 Upper Montane Forest

Upper montane forest caps the summits of Mulu and Murud above the 1,800 m altitude zone, and above 1,250 m on Lanjak. As the summit zones are exposed to elements of strong wind and cold (temperature as low as 14 degrees Centigrade on Murud), the forest has a low stature and is small in diameter, with many trees in a slanting position due to weak anchorage and the effects of strong wind.

(a) Tall Facies Montane Forest

This forest is in continuum with the lower montane forest and rises to a height of 15 m, but emergents may attain over 20 m. It is often described as montane ericaceous forest or scrub (Anderson and Chai, 1982; Lim, 2006). Thick mosses cover the ground and tree trunks and are often dripping with water. Due to low bacteria activity, the dark brown humus soil is highly acidic. Many small plants grow on moss-covered rocks.

The Murud forest has a density of 500 to 760 trees per ha, and basal area up to 55 m2 per ha (Lim, 2006). Among the tallest trees are *Agathis kinabaluensis* (Podocarpaceae), *Castanopsis hypophoenicea* (Fagaceae) - both over 60 cm dbh; and *Syzygium* and *Tristaniopsis* spp. (Myrtaceae), *Calophyllum* and *Garcinia* spp. (Clusiaceae), *Madhuca* (Sapotaceae), *Adinandra* (Theaceae), and *Dacrydium* (Podocarpaceae). On Mulu summit, *Decaspermum flavescens and Dacrydium beccarii* are particularly common (Martin, 1977; Anderson and Chai, 1982).

Understorey families include Annonaceae (*Goniothalamus*), Araliaceae (*Schefflera remotiserrata*), Fagaceae (*Quercus, Lithocarpus*), and Myrtaceae (*Syzygium*). Ground flora is equally diverse, comprising palms and rattan, and species of Illiciaceae (*Illiceum*), Gesneriaceae (*Cyrtandra*), Liliaceae (*Dianella*), and *Drimys* (Winteraceae). Another group of common plants are small climbers belonging to *Aeschynanthus* (Gesneriaceae), *Smilax* (Liliaceae), *Embelia* (Myrsinaceae), *Tetrastigma* (Vitidaceae) and *Nepenthes* (Nepenthaceae).

On exposed ridges, the low ericaceous scrub enables visitors a panoramic view of the summit and surrounding landscapes on a clear day. Here members of the family Ericaceae abound, in particular species of *Rhododendron* and *Vaccinium*, although these are generally shorter than many of their associated species. Taller trees are made up of *Prunus* (Rosaceae), *Fagraea* (Loganiaceae), *Symplocos* (Symplocaceae), *Adinandra* (Theaceae), *Syzygium* (Myrtaceae) and *Dacrydium* (Podocarpaceae). Many orchids, *Nepenthes*, ferns and lichens are equally abundant at this altitude.

(b) Short Facies Montane Forest

This forest overlaps with the tall facies forest below it and is largely confined to exposed ridges. The small stunted trees are often slanted or bent, and are up to 5 m or sometimes higher. Tree height is further reduced to 3 m or less on exposed ridges towards the summit. Members of the Fagaceae, Myrtaceae and Podocarpaceae are dominant among the taller trees. Species of Euphorbiaceae (*Aporosa, Baccaurea*), Symplocaceae (*Symplocos*) and Theaceae are also common on Murud. Ericaceae dominates the shrubby layer with many species of *Rhododendron* and *Vaccinium*. Ground flora on Murud includes palms, rattan, orchids, *Dianella* and *Drimys piperita*. The summit soil and vegetation of Mulu and Murud has been disturbed or damaged by visitors.

8. Secondary Forest

This forest is largely the by-product of shifting cultivation that is widespread throughout Sarawak, but also develops in gaps in logged forests. About 60% of Batang Ai N.P. is covered by secondary forests of 10 to 60 years old. In LEWS, the secondary forest in Ulu Sg. Katibas, estimated at over 130 years old, is probably the oldest ever known (Chai, 1995). The forest appears to resemble the mature phase of MDF in structure, but is distinctly different in species composition, the most obvious being the smaller number of dipterocarps of 3 to 9 species. Members of the Euphorbiaceae are the most abundant with 14 genera and 27 species, followed by Myrtaceae with 12 species in the genus *Syzygium* (ubah). Lauraceae, Annonaceae and Moraceae are also common, each with nine species. Secondary vegetation in logged-over forest is relatively young with species of *Macaranga* and *Ficus* being among the more common.

9. Logged-over Forest

Large areas of mixed dipterocarp forest in the HoB area are under timber license. An extensive network of logging roads has been constructed to reach the forests in the interior, providng access to the timber workers and local residents alike. Within each license area, skid trails are constructed to extract logs from the logging blocks using crawler tractors. With the bulk of commercial timber trees in the top canopy layers removed, logged-over forest is frequently characterized by a broken and open top, creating many gaps that allow abundant

sunlight to reach the lower strata of denser trees and the forest floor. The middle and lower strata are dominated by medium to small-size trees that comprise largely non-dipterocarp species. Short-lived secondary species such as *Macaranga*, *Ficus*, and *Tristaniopsis* take advantage of the abundant sunlight to quickly colonize the gaps. Colonization is less successful on the skid trails, where the soil has been compacted. Early pioneers that are able to take root here are small shrubs and herbs like *Melastoma malabathricum, Ficus, Scleria, Axonopus* and gingers.

The scrambler *Merremia* is often the first species to appear on abandoned timber roads, and plays an important role in checking soil loss from surface runoff.

Productive forests in the PFE will be managed for sustainable timber production, while those in the State land may be used for other forms of development like agriculture and tree or oil palm plantation.

3. POLICY ON SUSTAINABLE FOREST MANAGEMENT

Under the policy on sustainable forest management (SFM), the Sarawak Government has set aside six million ha of production forest as Permanent Forest Estate (PFE) for sustainable timber production, and another one million ha as Totally Protected Areas (TPAs) comprising national parks, wildlife sanctuaries and nature reserves. The total six million ha of PFE is made up largely of existing and proposed Protected Forests (PF) and Forest Reserves (FR). Out of this six million ha, one million ha will be developed for tree plantation that includes 20% for oil palm for one planting cycle of 20 years. Licenses for Planted Forest (LPF) are issued for companies involved in plantation development. (Figure 4.1)

It was later realized that in order to meet the target of one million ha of plantation, the gross area for LPF within the PFE had to be substantially increased, because about 50 percent of the original one million ha fall within a gradient of 35 degrees or more, and are considered to be not suitable for planting. Such areas will be conserved.

4. CURRENT STATUS OF FORESTED LAND IN THE HoB AREA

Out of the total area of 2.03 m ha in the HoB, about 1.6 million ha are occupied by 15 PFE including about 513,555 ha of Licensed Planted Forest (LPF) (Table 4.4). Thirty four timber licenses occupy an area of about 1.7 million ha, with 1.6 million ha in the PFE and 100,000 ha in the State land. Seven of the LPF are sitting on existing timber licenses, either wholly or partially, with some of them traversing several adjacent timber licenses (Figure 4.1). TPAs occupy about 526,652 ha, while the remaining areas are agricultural plantations, Native Customary Rights (NCR) land and alienated land.

Table 4.4 - Forested Land and Land Use in HoB Sarawak (*Sarawak Forest Department, 2008*)

Status	Number	Approx. Area (ha)
Existing PFE	15 including existing/proposed extensions	1,608, 555
Existing LPF	8	513,555
Existing Timber Licenses	34	1,696,873

Existing TPA	10 including extensions to existing & proposed TPA	526,652
Agriculture Plantations	5	8,176
NCR Land	*Not known*	
Alienated Land	*Not known*	
State Land	About 100,000 ha	

4.5 PERMANENT FOREST ESTATE AND TIMBER LICENSES

Permanent Forest Estate (PFE) is established to ensure sustainable supply of timber from natural productive forests. The two categories of PFE are Protected Forests (PF) and Forest Reserves (FR). The basic difference between the two is that local communities are allowed access into the PF to collect timber and forest produce for domestic consumption, whereas no such privilege is granted in the FR. To cater for local needs, new reserves comprise largely of Protected Forest.

Out of the total 15 PFE, 12 are located in the PF and 3 in the FR, including existing or proposed extensions (Table 4.5). Parts of the PFE that lie outside the HoB boundary have been excluded.

Table 4.5 - Number of PFE in HoB Sarawak (*HoB Map, 27-03-2008, FDS*)

No.	Name	Approx. Area (ha)
1	Limbang PF	203,385
2	Katibas-Bangkit PF + prop. 1st ext	51,865
3	Kenaya FR + 1st ext	24,812
4	Kota FR + 1st ext	29,693
5	Tutoh-Apoh FR + prop. 1st ext	18,422
6	Ang Moh PF (prop.)	19,723
7	Trusan-Kelalan PF (prop.)	29,137
8	Ulu Trusan PF (prop.)	64,946
9	Tama Abu PF + prop. 1st ext	112,608
10	Danum PF	80,503
11	Baleh PF + 2nd ext + prop. 3rd ext	471,006
12	Tapang-Baiong PF	97,366
13	Linau PF	260,340
14	Bahau PF 1st ext	139,842
15	Medalam PF	4,907
	Total	**1,608,555**

The 34 timber licenses that are currently operating in the HoB area range in size from 20 ha to over 139,282 ha - some of the small licenses are actually sawmill licenses. Twenty five of the timber licenses exceed 10,000 ha in size (Table 4.6).

Table 4.6 - A list of Timber Licenses exceeding 10,000 ha each (FDS)

License No.	License Name	Area (ha)
T/3342	Shin Yang Industries (Bintulu) S.B.	129,850
T/0222	Board of Trustees Sarawak Foundation	14,929
T/0412	Samling Plywood (Baramas) S.B.	29,823

T/9082	S.I.F. Management S.B.	76,974
T/3132	Sanitama S.B.	27,044
T/3370	Jaya Tiasa Holdings Bhd.	56,636
T/3372	Jaya Tiasa Holdings Bhd.	100,392
T/0280M	KTN Timor S.B.	62,426
T/3148	First Count S.B.	18,206
T/0129	Limbang Trading (Limbang) S.B.	117,676
T/0390	Merawa S.B.	85,647
T/3236	Ankura Trading (M) S.B.	45,140
T/3491	Tanjong Manis Holdings S.B.	48,758
T/3218	Usama Industries S.B.	19,856
T/0212	Board of Trustees Sarawak Foundation	52,333
T/3228	Shin Yang Trading S.B.	74,486
T/3343	P.P.K.K.S.	125,814
T/0294	Ravenscourt S.B.	139,282
T/3346	Woodley S.B.	37,969
T/3135	Pasin S.B.	80,795
T/0413	Samling Plywood (Miri) S.B.	78,930
T/3476	Interglobal S.B.	63,100
T/3283	Samling Plywood (Bintulu) S.B.	24,707
T/3355	P.P.K.K.S.	15,829
T/3371	Jaya Tiasa Holdings S.B.	136,725
Others	9 small licenses below 10,000 ha each	33,546
Total		**1,696,873**

Depending on the size and license conditions, the cutting periods of the licenses differ. The oldest license (i.e. Messrs Balleh Sawmill) was issued in 1967 for a cutting period of 40 years. The period was reduced to 30 years for licenses issued in the mid-1980s, and to 16 and 20 years in the late 1990s. Several licenses will expire in 2009, while others will expire by 2022. Upon expiry, licenses may be renewed for another round of cut. Each license is divided into to a number of annual felling coupes, with each coupe varying in size from about 1,500 ha to 2,500 ha. Each coupe is further divided into logging blocks averaging 100 ha each. The minimum diameter cutting limits are 60 cm dbh and 45 cm dbh respectively for dipterocarp and non-dipterocarp trees. Before felling is allowed, each timber licensee is required to carry out an inventory to identify and mark timber trees that have exceeded the minimum cutting limits. One tree per hectare is to be retained as mother trees. In the LPF, all merchantable trees will be salvaged before the forest is cleared.

Conventional ground logging is practised in forests below 35 degrees gradients, using heavy machineries and logging trucks with capacities of up to 35 tons each. A network of main roads and secondary roads are constructed over long distances into the forests. Skid trails are additionally provided to haul out logs from logging blocks using crawler tractors. Some licensees have proposed to use helicopter logging in areas exceeding 35 degrees but as this method is more expensive, it may not be carried out unless the timber price is attractive enough. Without adequate control, conventional logging may cause substantial damage to the vegetation and soils especially in forests over steep terrain.

Interior Sarawak is typically deeply dissected, rugged and mountainous, and this presents a great challenge to the timber operators or contractors to get timber out of the forest and transport it to the log ponds, often incurring very high costs. Many of the licenses in the Ulu Balleh and Ulu Baram are located at least 400 km away from the nearest log ponds or

temporary log storage areas, from where they are further transported to the coastal ports in Bintulu or Miri.

1. Downstream Industry

Companies like Samling Strategic Corporation and Rimbunan Hijau and their subsidiaries have established veneer and plywood mills within or near the HoB area. Samling's mills are located in S.I.F. Management Sdn. Bhd. and Selaan-Linau. The monthly capacity for each mill is about 6,000 m3 of raw material and the recovery is estimated at 40%. The monthly production of veneer is 2,400 m3.

The Jaya Tiasa Plywood Mill is located in Bahau-Linau PF outside the HoB area, but receives raw materials from five timber licenses located in the HoB. The monthly milling or reservation quotas from the various licenses are: Timber License T/3114 with 5,760 m3; T/3370 with 10,350 m3; T/3371 with 11,000 m3; T/3372 with 6,750 m3; and T/3236 with 3,000 m3. The total monthly quota is estimated at 36,860 m3. A monthly milling quota is the amount of raw material required by a particular mill each month.

2. Licensed Planted Forest

Tree plantations are expected to gradually replace the natural forest as the main producers of wood fibre beginning in the next five years, with a predicted annual production of up to 15 million m3 about 15 years from now. This volume will be much greater than the 9 million m3 that is currently being extracted from the natural productive forests in the PFE. This will not only ensure a sustainable log supply but also relieve pressure on the natural forests.

Many licensed planted forests (LPF) are located within existing timber licenses. In the MDF, in forests that are located on very steep land with gradients exceeding 35 degrees, logging is not permitted. In interior Sarawak, such areas may take up 50% or more of the total license area. In the LPF such areas are classed as 'un-plantable'. The Government's target is to reach one million hectares in about 15 years. The annual planting target of the companies involved is usually between 2,000 to 3,000 hectares.

Of the total 41 LPF in the State, including the government-owned Sarawak Forest Plantation Sdn Bhd in Bintulu, seven are located in the HoB, belonging to five companies and occupying a total area of approximately 514,000 ha (Table 4.7). Many of these plantation licenses have been excised from existing timber licenses. *Acacia mangium*, a fast-growing exotic, is the principal and preferred species due to its ability to adapt well to a wide range of local site conditions. Other exotics like *Eucalyptus* and several indigenous species such as *Neolamarckia cadamba* (kelampayan) and *Duabanga moluccana* (sawih) have also been tried but with less success due partly to patchy or uneven growth.

Table 4.7 - Licensed Planted Forests in HoB Sarawak (FDS)

License No.	Name	Approx. Area (ha)
LPF 005	Samling Reforestation (Bintulu) Sdn Bhd	139,729
LPF 0010	Ta Ann Plywood Sdn Bhd (2 areas)	48,661
LPF 0040	Ta Ann Plywood Sdn Bhd	48,760
LPF 0024	RH Forest Corporation Sdn Bhd	92,296
LPF 0028	RH Forest Corporation Sdn Bhd	71,830

LPF 0027	Billion Ventures Sdn Bhd	31,984
LPF 0038	Limbang Jaya Sdn Bhd	80,295
		513,555 Total

Acacia mangium fibre is suitable for pulp and paper production but varieties for solid timber have also been introduced by some companies like Ta Ann. Planting distance is usually 3 m by 4 m. The mean annual increment is estimated at 2.7 cm, and the harvesting schedule is seven years after planting. This should produce an estimated volume of 127 m3 per hectare (Jawa, *pers. comm.*) per harvest. This volume would be more than double the production of the natural forest. The government's pulp and paper mill near Bintulu is expected to be operational by 2011.

4.5.3 Totally Protected Areas (TPAs)

The National Parks and Nature Reserves Ordinance (1998) and Wild Life Protection Ordinance (1998) provide for the constitution of Totally Protected Areas (TPAs) comprising national parks, nature reserves and wildlife sanctuaries. Tourism is allowed in national parks and nature reserves. In wildlife sanctuaries tourism will be allowed only with the permission of the Chief Wild Life Warden. Existing TPAs include 20 national parks, 4 wildlife sanctuaries and 5 nature reserves, covering a total of about 600,000 ha (excluding water bodies of approximately 100,000 ha). Another 18 national parks, two new wildlife sanctuaries and several extensions to existing parks have been proposed. This will increase the total area of TPAs to one million hectares.

Six national parks and two wildlife sanctuaries are located within the HoB, totalling about 526,700 ha including proposed extensions (Fig. 4.1, Table 4.8). The Lanjak Entimau Wildlife Sanctuary in the south, and Gunung Mulu National Park and Pulong Tau N.P. in the north-east are the three largest TPAs in the State. Gunung Mulu N.P., renowned for its rich plant and animal diversities, spectacular limestone formations and underground caves, is a World Heritage Site – the first in Sarawak.

Table 4.8 - National Parks and Wildlife Sanctuaries in HoB Area

No.	Name	Area (ha)	Division (s)
1	Batang Ai N.P. incl. prop. extensions	35,200	Sri Aman
2	Lanjak Entimau W.S. incl. prop. extensions	192,600	Sri Aman, Sibu, Serikei
3	Gunung Mulu N.P. incl. prop. extensions	87,190	Miri
4	Gunung Buda N.P. incl. extension	11,297	Limbang
5	Pulong Tau N.P. incl. prop. extensions	140,000	Miri, Limbang
6	Balleh N.P. (proposed)	22,300*	Kapit
7	Danum Linau N.P. (proposed)	30,000*	Kapit
8	Sg. Moh W.S. (proposed)	8,065	
	Total	**526,652**	

* Revised figures by Forest Dept. Sarawak

4.6 SUSTAINABILITY OF PRODUCTIVE FORESTS IN THE PFE

The family Dipterocarpaceae comprises numerous tree species belonging to the genera of *Shorea, Dipterocarpus, Dryobalanops*, *Anisoptera*, *Hopea, Vatica* and several other smaller

ones. *Shorea* and *Dipterocarpus* are the principal sources of commercial timber in the mixed dipterocarp forest. Many non-dipterocarp families also produce valuable timber, such as Sapotaceae (nyatoh), Lauraceae (medang), Fabaceae (menggris, sepetir) and Anacardiaceae (rengas).

The polycyclic logging system being practised in Sarawak differs from the monocyclic system in Peninsular Malaysia. Sarawak has adopted the polycyclic system because the timber trees in the State belong in different age groups or sizes, thus allowing the oldest or biggest trees to be harvested first, leaving the medium size or smaller ones to be harvested in subsequent logging cycles. The monocyclic system is more applicable to Peninsular Malaysia where the trees are generally uniform in age or size.

Based on the principle of polycyclic felling, sometimes also known as selective felling, only trees attaining breast height diameters of 60 cm for dipterocarps and 45 cm for non-dipterocarps are permitted to be harvested. Trees below these diameters will be retained as future crops.

Polycyclic cutting assumes that (a) there are sufficient stocks of medium and small-sized trees left in the residual forest after each cut, and (b) commercial trees in the residual forest will grow fast enough to attain the minimum diameters for felling in the next cutting cycle. Tree assessments are carried out for each long term license before logging is allowed to commence. The assessments or inventories are normally confined to 10 percent of merchantable trees that have attained the cutting limits of 60 cm for dipterocarps and 45 cm for non-dipterocarps. Below these diameter limits, very little data is available with respect to the types and populations of timber trees and their diameter classes.

With each successive cut, trees of greater diameter sizes will be progressively extracted leaving behind the under-sized stocks. Species composition of commodity timber will also change with the non-dipterocarps becoming dominant. Non-dipterocarp timber not only fetches a lower price in the commodity market but is also less known.

With the changing situation, the present prescriptions and the practice of SFM, including the terms and conditions of the licenses - such as requirements for minimum cutting diameters, length of cutting period and annual production quota - may need to be reviewed or amended. To do this, we need to know what is left in the forests after logging through an inventory.

According to Leslie (1999), a well-known forester who had worked in Sarawak, the market for decorative timber is less vulnerable than the commodity timber market. This market would not be able to substitute for the present industry, but future development should concentrate on decorative species that are mostly non-dipterocarps. Leslie's suggestion on SFM in the natural forests is to develop decorative species by gap filling in the natural forests. However, sustainable yield of decorative timber would be too small and could not be expanded by plantation rapidly. Due to its growing scarcity, there will be future demand for such timber in the elite market.

Leslie also reiterated the need for Sarawak to develop supplementary plantations to provide a low cost roundwood output of no less than 75 percent of the present log intake capacity of the existing industry. Another strategy is to develop pulp wood plantations.

The conditions of many logged-over productive forests in the PFE are indicative of intensive logging. Such forests are best left to recover. Supplementary plantations are expected to produce the bulk of the roundwood and pulp wood beginning about five years from now; and production is expected to reach a peak of 15 million m3 in 15 years.

Within the HoB, tree and oil palm plantation development is likely to be limited by the remote locations, lack of suitable land and high investment cost. Under favourable conditions, the natural choice would be *Acacia mangium* and oil palm. In the natural forests, in spite of the low yield due to slow growth rates, sustainability must still be ensured. Enrichment planting with selected highland timber species like *Agathis* should be considered.

Another possible option is to promote *Agathis* as a medium term plantation crop, for which research on its ecology and silviculture will need to be carried out.

4.7 EMPLOYMENT IN THE TIMBER INDUSTRY

As the second most important revenue earner, the timber industry has created steady employment for more than 100,000 people. In the earlier days, many employees were Iban and Melanau from the coastal areas, working mainly as tree fellers and debarkers. More recently, many educated local workers have been trained as forest surveyors, drivers and mechanics. In the HoB area, employees from the local Kayan, Kenyah and Penan communities have been engaged as drivers, forest surveyors, mechanics, security guards, cooks and casual labourers. The number of employees in each camp averages about 100 people. Penan employees are relatively very few. They usually work on a temporary or short-term basis, often leaving their jobs during rice planting or fruiting seasons and starting to seek re-employment again at the end of the seasons. The industry also depends heavily on Indonesian workers, especially in saw mills and plywood mills.

Security guards and cooks receive a fixed monthly salary of RM 600 to RM800. Surveyors and mechanics are paid an average of RM 1,500 to RM 2,000. Tree fellers and timber truck drivers are not paid fixed salaries but incomes are calculated based on the quantities or tonnes of logs felled or transported to the log ponds. Their monthly incomes may range from RM 2,500 to more than RM10,000.

Timber companies are aware of their social responsibilities to their employees as well as local communities that are affected by logging operations. Other than employment, many companies regularly provide assistance and welfare services including building materials and generators; and construction of access roads to settlements, gravity feed water supply, fish ponds and wet paddy fields or *sawah*, etc. – all free of charge.

Some companies also provide free transport for patients to visit nearby clinics for medical treatment, or send children to schools and fetch them back during the holidays. Some community heads are also paid monthly allowances. Not withstanding the negative impacts of logging, the industry has helped to improve the rural economy and the living standards of the people. Logging roads have made it possible for many villagers to travel to the nearest towns or cities to shop, apply for birth certificates and identity cards, seek medical treatment, and meet with government officials.

8. NEED FOR CERTIFICATION

Increasing global concern on the environment and loss or degradation of tropical forests is58 putting pressures on the tropical countries to manage their production forests based on the principle of sustainability. ITTO's Objective 2000 was developed with the aim of encouraging and assisting its tropical members to achieve SFM. More and more consumer countries will only want to buy timber or timber products with certified origins and many producers will have to go for certification if they want to remain competitive in the global market and assure market access. Malaysia has developed its own Malaysian Timber Certification Scheme; and is currently negotiating with the European Union to conclude a Voluntary Partnership Agreement under the EU's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, to ensure that only legal timber may be exported into the EU market. The EU is also in the process of enacting legislation compelling their importers of timber to undertake due diligence to ensure that only legal timber will be imported.

The United States of America has its own Lacey Act that ensures legality of timber that is imported to the country. The Act requires the origins and names of timber species used in the manufacture of timber products to be provided, among others.

Currently two FMUs in Sarawak have been certified under the Malaysian Timber Certification Scheme at Selaan Linau and Anap Muput, both of which are outside the HoB area. SFM practices and certification are important in order to achieve sustainability and be competive in the global market. This also applies to forest plantations under the LPF.

4.9 BIODIVERSITY CONSERVATION IN THE HoB AREA

Eight of the State's 29 exisitng TPAs are located in the HoB area and together occupy up to 75% of the total area of about 600,000 ha. The number includes the four largest TPAs, namely, Lanjak Entimau Wildlife Sanctuary, Batang Ai N.P., Gunung Mulu N.P. and Pulong Tau N.P. Nearly all of Sarawak's inland forest types may be found in the Gunung Mulu; while Pulong Tau N.P. and Lanjak Entimau Wildlife Sanctuary are equally rich and diverse. Lanjak Entimau together with the Batang Ai N.P. next to it is also home to Sarawak's 1,400 orangutan populations as well as a host of other rare and threatened animal species like Borneon gibbon, two species of langur, and seven species of hornbill. Old secondary forest estimated to be up to 130 years old has been reported in Lanjak Entimau (Chai, 1995). HoB's biodiversity will be further safeguarded once all the proposed TPAs are finally established (Table 4.8).

The four largest TPAs play a vital role in the conservation of biodiversity in its pristine state. Lanjak Entimau and Pulong Tau have also formed partnerships with national parks in Kalimantan, Indonesia to promote transboundary biodiversity conservation. The first transboundary biodiversity conservation area (TBCA), between Lanjak Entimau W.S., Batang Ai N.P. and Betung Kerihun N.P. was officially launched on 7 October 1994. Collaboration between Pulong Tau N.P. and Kayan Mentarang N.P. was initiated in 2005. Although much basic research has been conducted in recent years, large areas of the TPAs and TBCAs still remain un-explored, and numerous species of plants and animals still await documentation and scientific discovery. Their other functions as water catchments are equally crucial but are less known.

Safeguarding the TPAs and their rich resources requires conscious and real effort by all concerned stakeholders. Rapid advances of socio-economic development into the interior will result in increasing demand for land and natural resources. Commercial logging, plantation

development, and local communities' dependence on forests, and need for agricultural land will continue. These activities will all involve, and may adversely affected existing and potential catchment forests. Future development and planning must also address any potential conflicts between land use and water catchment protection, particularly as the government is proposing to develop 12 mega hydroelectric projects in the State. An integrated land use management plan, developed through thorough studies and research will be necessary to ensure a healthy balance between land use and conservation. For the TPAs, real enforcement efforts must be made to ensure adequate protection, through manpower development, strengthening management presence on the ground, awareness education and active local participation in management. Cooperation of other land users like the timber and agricultural industries will also be crucial.

4.10 SARAWAK'S CONTRIBUTIONS TO THE HoB INITIATIVE

Participation in the HoB initiative is voluntary. For the Sarawak zone, the government has decided to set aside about 2.1 million ha instead of the 5.4 million ha that was originally proposed. In spite of this reduction in size, it is envisaged that Sarawak will be able to contribute to the HoB's long term objectives as given under the Bali Declaration. These objectives are one conservation vision and with a view to promote the people's welfare, and cooperation to ensure effective management of forest resources and conservation of a network of protected areas, productive forests and other sustainable land use.

Sarawak's contributions to the HoB initiative will be its policy on SFM, nature conservation through the TPAs and TBCAs, and planning and development of new socio-economic projects to benefit the rural populations, all of which will contrinute to conservation and sustainable development.

Rural development is an important agenda of the government, with projects emphasizing education and agriculture. The government has approved an agricultural-based project called Agropolis (See 3.5.1) to develop the Maligan Highland and Kelabit Highland into a hub for the production of *halal* meat and agricultural products and as ecotourism destinations.

The border highland communities of Kelabit and Lun Bawang in Sarawak have a long history of social and economic interactions with the communities living across the common borders in East Kalimantan and Sabah, sharing similar ethnic origins, languages, cultures, customs and traditions. These communities will have the opportunities to benefit from projects developed under the HoB.

The Iban communities of Batang Ai have long been recognized for their contributions to ecotourism due to their rich colourful cultures and traditions. The region's other tourist attractions are nature and adventure offered by the Batang Ai N.P. and Lanjak Entimau W.S. These two TPAs offer a unique experience to watch orang-utan in the wild. Some longhouse communities have capitalized on this to attract overseas tourists. Another socio-economic potential is to develop the Batang Ai hydro lake into a major centre for inland fisheries and water-based sports.

The timber industry has made significant contributions to the rural economy and improved the living standards of the rural populations by creating access and opportunities for employment, apart from various forms of assistance. The existence of timber roads has made it easier for the government to bring development to the rural areas, for the people from

different settlements to travel and visit each other, to go to towns for pleasures, medical treatments or meet government officials, and for more children to attend school.

4.11 LOCAL PARTICIPATION IN HoB INITIATIVE

Involving local communities as co-partners in conservation management, already initiated under the ITTO-supported projects in Lanjak Entimau W.S. and Pulong Tau N.P., should be further promoted and strengthened because (a) many local communities live just outside the parks and still depend on the forests for subsistence, and (b) the parks' remote and widely scattered locations, coupled with lack of road access have rendered boundary patrols and enforcement ineffective. Occasional and brief visits by wildlife rangers or park rangers are unlikely to render enforcement effective. On the other hand, the people living in the peripheries are free to enter the forests whenever they wish, to hunt, fish and collect jungle produce. Under these circumstances, involving the local people in conservation management and enforcement will be crucial and necessary. Collaborative management is also being implemented in the Betung Kerihun N.P. and Danau Santarum N.P. in West Kalimantan where many local members are engaged as field rangers and field assistants.

CHAPTER V – BIODIVERSITY

5.1 INTRODUCTION

Borneo is the third largest island in the world and thus is one of the most important centres of tropical biodiversity. The island covers more than 200 million hectares of equatorial rain forest and is home to 10 primate species, over 350 bird species, including eight hornbill species, more than 150 species of reptiles and amphibians (WWF International, 2005) and more than 15,000 known species of plants. The forests of the Heart of Borneo are some of the most biologically diverse in the world, possessing a high number of endemic species across all groups of plants and animals.

Borneo is one of the only two places on earth (the other being Sumatra) where the orangutan, Asian elephant and Sumatran rhinoceros still co-exist and where forests are currently large enough to maintain viable populations of these iconic mammals. Some of the most abundant animal and plant species provide an important source of protein and carbohydrate to many

indigenous peoples (Caldecott, 1988), who depend on the forest for a variety of resources, including edible fruits, medicinal plants, fishes, meat, construction materials and water.

The central highlands of Borneo are the location of the headwaters of Borneo's major rivers, some of which flow for thousands of kilometers before they reach their estuaries either in South China Sea, Sulu Sea or Sulawesi Sea. The protection of this area is therefore critical in ensuring clean water supply to a large number of human settlements, both rural and urban. To-day, an estimated 17 million people share the island, with the main concentrations in the coastal lowlands, especially in the capitals or provinces of Kalimantan, Brunei and the Malaysian states of Sabah and Sarawak.

Many of the important existing conservation areas within the Heart of Borneo are found in Sarawak, including Lanjak-Entimau Wildlife Sanctuary, Gunung Mulu National Park, Pulong Tau National Park, Batang Ai National Park; and several proposed TPAs like Danum Linau National Park and Ulu Balleh N.P. (see Chapter IV). These lush tropical forests together with the Bornean peat lands hold significant amounts of carbon and therefore, play an important role in future climate regulation.

2. BIODIVERSITY IN SARAWAK

1. General

Sarawak possesses a remarkable diversity of natural landscapes and biological wealth at all levels of biodiversity, namely the ecosystem or community, species and genetic levels. It has some of the iconic mammal species such as the orangutan, proboscis monkey and hornbills; and also the rafflesias and slipper orchids. While much of its primary forests have been set aside for socio-economic transformation and development such as logging and conversion to agriculture, there have been many important conservation initiatives carried out by the State Government over the last few decades, through state agencies such as Sarawak Forestry Department, Sarawak Forestry Corporation, Department of Agriculture and Land and Survey Department. Central to this is the designation of a comprehensive network of 29 Totally Protected Areas (TPAs) that include national parks, wildlife sanctuaries and nature reserves. Eighteen new ones (including extensions) are in the proposal stage. The State's target is to reach the one million mark in a few years time. Sarawak may be seen as a model for conservation strategy.

In addition to securing the protection of many of the key habitats and species biodiversity in the State, the national parks, wildlife sanctuaries and nature reserves also promote research, nature education, ecotourism and socio-economic development; and in doing so generate employment and provide an important source of income to the government and the people.

The Sarawak Biodiversity Centre Ordinance which came into force in 1997 paved the way for the establishment of the Sarawak Biodiversity Council and the Sarawak Biodiversity Centre. These have helped to strengthen the existing legal framework for the management, conservation, protection and research of the State's rich biological resources.

Research to document and upgrade the State's flora began in the late 1950s, when botanical specimens collected largely during the colonial time were transferred from the Sarawak Museum to Forest Department. In 1962, Sarawak engaged its first Forest Botanist (Dr. Peter Shaw Ashton) to take charge of the new Herbarium and to initiate a series of botanical and

ecological projects that have lasted until the present day. To-date, there are 103,300 voucher specimens in the Herbarium belonging to a total of 8,580 species (Angelia Muri, *pers. comm.*).

Recent studies on non-timber forest plants include Ethnobotany of the Iban and Kelabit (Christensen 2002), Medicinal Plants of Sarawak (Chai 2006), and several studies on NTFP in Lanjak Entimau, Batang Ai and Pulong Tau under the projects supported by the International Tropical Timber Organization (ITTO).

2. Biodiversity in the HoB Area

Sarawak's four largest TPAs are located in the HoB. These are Batang Ai N.P. and Lanjak Entimau W.S in the south; and Gunung Mulu N.P. and Pulong Tau N.P. in the north-east. When constitutions of several new national parks and extensions are completed, HoB will have up to 75% of the total area of TPAs in the State.

A description of the ecology and flora of the four TPAs is given in Chapter IV and will not be repeated here. The following is a brief account of the four parks with their scientific research and findings.

1. Gunung Mulu National Park

Gunung Mulu National Park was the site for the 15 month-long scientific expedition that was jointly organized by the Royal Geographical Society of London and the Sarawak government in 1977/1978. Table 5.1 gives a summary of the plant and animal species that were recorded during the expedition.

Table 5.1 - Ecology and Species of Gunung Mulu National Park

Description	Total	Endemic	Protected
I. Forest Type	9 types		
II. Flora	1,541 species		137 species
III. Fauna			
Mammals	67 species (6 primates)	12 species	39 species
Birds	262 species	22 species	57 species
Fish	47 species		
Amphibians & Reptiles	113 species		5 species
Butterflies	281 species		1 species

Source: Gunung Mulu National Park – A Management and Development Plan (Royal Geographical Society London 1982)

The ecological diversity of the Gunung Mulu National Park is manifested by the numerous underground limestone caves present, each with its own niche supporting a diversity of flora and fauna. Mixed dipterocarp forest is the most dominant forest type. Riverine habitats

include rivers and streams that meander across the floodplains. An account of the geology and soils in the HoB area is given in Chapter II.

Anderson and Chai (1982) gave a detailed account of the forest types and flora of the park in Chapter IV of this report. The mixed dipterocarp forest which rises to about 800 m above sea level, is dominated by members of the Dipterocarpaceae. They are large and lofty trees often exceeding 80 cm diameter. Common among them are kapur bukit (*Dryobalanops beccarii*). Wild species of durian *(Durio),* kandis and mangosteen *(Garcinia),* ubah *(Syzygium),* mango *(Mangifera),* kayu malam *(Diospyros*) dominate the main canopy layers. While on the ground, palms like biris *(Licuala),* pinang *(Pinanga)* and large climbers predominate. In a survey, a total of 284 tree species with girths exceeding 30 cm and more were enumerated in an area of 1.2 ha.

Among the spectacular plants are periuk kera *(Nepenthes lowii, N. muluensis)*, festooning the mossy forests. On the ridges are the rhododendrons (Ericaceae), and members of the oaks (Fagaceae) and myrtle families (Myrtaceae) such as *Tristaniopsis obovata.* Orchids are represented by many epiphytes, including the prized slipper orchid, *Paphiopedilum sanderianum, Habenaria elatius* and *Plocoglottis javanica* amongst others.

The fauna is represented by more than 20,000 species, the majority being insects, the single most diverse group. There are about 67 species of mammals, 262 birds, 23 lizards and 75 species of amphibians. The most common mammals are the bearded pigs (*Sus barbatus*) and the deer or rusa (*Cervus unicolor*), kijang *(Tragulus napu*) and pelanduk *(Tragulus javanicus).* Four species of monkeys are present, and they occupy their own niches: the Bornean gibbon (*Hylobates muelleri*), the long-tailed macaque (*Macaca fascicularis*), pig-tailed macaque (*M. nemestrina*), and the red leaf monkey (*Presbytis rubicunda*). Other mammals include sun bear (*Helarctos malayanus*), civet cat and mongoose. Among the bird fauna, all eight species of Sarawak's hornbills, the Argus pheasant and many other protected species are present.

The high numbers of protected plant and animal species reflect the government's seriousness in conservation and preventing exploitation of rare and threatened species and species of potential economic importance. For example, all species of orchids (Orchidaceae), pitcher plants (Nepenthaceae), all species of fig trees (Moraceae) that are an important source of food for the animals, all species of *Begonia* (Begoniaceae) and many species of palms and herbs that possess ornamental values are protected under the Wild Life Protection Ordinance 1998.

Sarawak is the only Malaysian state with a Master Plan for Wildlife that was developed in 1996. Under the Plan, commercial hunting and sale of wild meat including wild boar are banned. Sale of cartridges is also controlled.

The IUCN Technical Report on G. Mulu N.P. World Heritage Site nomination recommended that cross-border collaboration with the adjacent Labi F.R. in Brunei be initiated. The 2nd Periodic Report of the G. Mulu WHS that was submitted recently further recommended that this collaboration be implemented under the HoB Initiative.

5.2.2.2 Lanjak Entimau Wildlife Sanctuary and Batang Ai National Park

In 1992, the International Tropical Timber Organization (ITTO) supported a biodiversity conservation project entitled: Development of Lanjak Entimau Wildlife Sanctuary as a

Totally Protected Area. The project has been extended to four phases with Phase IV scheduled to end in March 2009. An important achievement of the project was the establishment of the Transboundary Biodiversity Conservation Area (TBCA) between the Lanjak Entimau W.S and Betung Kerihun N.P. in West Kalimantan in 1994. This is the first TBCA in the humid tropics. In 2003, the Batang Ai N.P. was included in the TBCA giving a combined area of about one million ha. In 1997, ITTO sponsored a scientific expedition in the TBCA, called the ITTO Borneo Biodiversity Expedition 1997 or IBBE 1997. Like Mulu, LEWS was confirmed to be another biodiversity hotspot in the State (Table 5.2). Results of scientific findings are given in several technical reports (Chai, *pers. comm.*) as follows:

- A Checklist of Flora, Fauna, Food and Medicinal Plants [Chai, (*ed.*), 2000],
- Development of Lanjak Entimau Wildlife Sanctuary as a Totally Protected Area, Phases I and II – Scientific Report [Soepadmo and Chai (*ed.*), 2000];
- ITTO Borneo Biodiversity Expedition 1977 Scientific Report [Kuswanda *et al.* (*ed.*), 1999].

The sanctuary contains a wide range of varied habitats that include low-lying valleys and flood plains, mixed dipterocarp forest, montane forest on Bukit Lanjak, and old secondary forests that are believed to have developed more than 100 years ago after the Iban settlers left the area. Chai (1995) recorded a total of 1,075 trees exceeding 30 cm in diameter, with an additional 179 species of herbs, climbers and shrubs. The montane forest alone contains more than 123 species of trees exceeding 10 cm in diameter, including selangan batu padi *(Shorea obscura*). The ground flora is extremely rich with orchids, palms, pandans, members of the Rubiaceae and Melastomataceae families, and four species of *Nepenthes* that includes *Nepenthes tentaculata.*

Table 5.2 - Ecology and Species of Lanjak Entimau Wildlife Sanctuary

Description	Total	Endemic	Protected
I. Forest Type	8 types	-	-
II. Flora			
Total Vascular Plants	2,807 species	61 species	113 species
Ethnobotanical Plants	484 species		
Fungi & Lichens	542 species		
III. Fauna			
Primates (including @ 1,100 orangutan)	6 species	3	6 species
Small Mammals	48 species	13 species	30 species
Birds	235 species	13 species	63 species
Fish	82 species	8 species	
Amphibians & Reptiles	77 species	26 species	4 species
Insects	1,050 species		1 species

Source: *ITTO Project technical reports*

The animal life is also diverse. The iconic species is orangutan (sub-species *Pongo pygmaeus pygmaeus*) that has an estimated population of over 1,000 individuals, in addition to other primates such as Bornean gibbons (*Hylobates muelleri*), white-fronted langur (*Presbytis frontata*) and red langur (*P. rubicunda*). Other primates that occur here are pig-tailed and long-tailed macaques, western tarsier (*Tarsius bancanus*) and slow loris (*Nycticebus coucang*). Small mammals are well represented by the common tree shrew (*Tupaia glis*) and many species of squirrels. Carnivores such as sun bear, martens, otters, civet cats and clouded leopards are also present.

Of the 235 species of birds, 10 are migrants and 13 are Bornean endemics. Seven species of hornbills occur here, including the most well-known rhinoceros hornbills (*Buceros rhinoceros*), bushy-crested hornbills (*Anorrhinus galeritus*) and wrinkled hornbills (*Aceros corrugatus*). The great Argus pheasant (*Argusianus argus*) and the Bulwers's pheasant (*Lophura bulweri*) also occur, along with other smaller birds such as the cuckoos, nightjars, swifts, trogons, kingfishers and bulbuls.

Lanjak-Entimau also has a remarkably high diversity of reptiles and amphibians with 77 species, of which 26 are endemic to Borneo (Table 5.2). There are 13 species of snakes, 12 species of lizards and 52 species of frogs. The rivers and streams have a variety of fishes which form the main components of the diet of the local communities. High value species include semah, empurau and tengadak (*Tor* spp.), fetching between RM 80 and RM 150 per kilogram on the market.

Batang Ai National Park is located south of LEWS and the two share a common boundary. This national park is also home to about 300 individuals of orangutan, along with many other species that have been reported to also occur in LEWS (Table 5.3).

Table 5.3 - Ecology and Species of Batang Ai National Park

Description	Total	Endemic	Protected
I. Forest Type	5 types		
II. Flora	611 species		
Economic Plants	178 species		
III. Fauna			
Primates (including @ 300 orangutan)	6 species	3	6 species
Other Mammals	29 species	8	16 species
Birds	121 species	13	23 species
Fish	63 species	4	

Sources: Draft Management Plan for BANP (Meredith, 1993); ITTO Project technical reports

The ecological diversity of the Batang Ai National Park is composed of a variety of vegetation and forest types on the sedimentary rocks of the Belaga Formation. They originated mainly from the shale and coarse-grained sandstone. Major forest types are primary mixed dipterocarp forest, kerangas forest, riparian and alluvial forests and old

secondary and young secondary forests; the latter two being the result of past settlement and shifting agriculture. Secondary forests are estimated to occupy about 60% of the park.

Because of their similar geology and landforms and their importance as orangutan habitats, the two will be managed as an integrated ecosystem. The management plan for Lanjak Entimau W.S. is being revised to include Batang Ai N.P., while an orangutan strategic plan is also being developed. The strategic plan will include transboundary orangutan conservation and research as one of its main objectives.

To sustain more than 16 years of effort by ITTO in Lanjak Entimau, the State government has approved two projects to continue the work of the Organization. These projects are called Centre for Plant Research based in Ulu Ketibas in LEWS, and Centre for Orangutan Research based in Nanga Delok in BANP.

5.2.2.3 Pulong Tau National Park

Located nearly 70 km east of Mulu, this national park occupies an area of about 60,000 ha and is an important habitat for highland biodiversity. The park's land mark is Gunung Murud which at 2,424 m a.s.l., is Sarawak's highest mountain.

Pulong Tau was selected as the site for another ITTO-supported project in 2005, entitled: Transboundary Biodiversity Conservation-The Pulong Tau National Park, Phase I. Its tranboundary partner is the Kayan Mentarang National Park in East Kalimantan that has an area of nearly 1.3 million ha. This project has been extended to Phase II, and is currently being implemented by Forest Department.

Under Phase I of the project, the park's geology and soil, ecology and flora and fauna were studied. The results are contained in 13 technical reports jointly published by ITTO and Forest Department Sarawak. Species diversity is summarized in Table 5.4 below.

Table 5.4 - Ecology and Species of Pulong Tau National Park

Description	Total	Endemic	Protected	IUCN Red List
I. Forest Type	7 types	-	-	-
II. Flora	1,150 species	89	178	33
Economic Plants	250 species			
III. Fauna				
Mammals	57 species	17	24	4
Birds	315 species	27	67	47
Fish	84 species	17	-	5
Amphibians & Reptiles	44 species	20	40	29
Crustaceans	6 species	4	-	-
Aquatic Insects	75 species	8	-	-

Source: ITTO Project technical reports

An important timber tree in the highland is *Agathis* (locally called tumu). Trees up to 100 cm in diameter are common. The timber is widely used for house construction in Bario and Ba Kelalan, but the resource is gradually being depleted (Chai, *pers. comm.*).

A study on uses of forest plants among the Penan communities living in the peripheries of PTNP show that the Penan people are still very much dependent on the forest for their many needs (Tipot *et al.* 2008). The palm *Eugeissona utilis* produces a sago starch that is the staple diet of the community.

In the scientific expedition organized by Universiti Malaysia Sarawak to Bario (Kelabit Highland) in 1995, more than 197 species belonging to 143 genera and 68 families of flowering plants were documented. An additional 165 taxa of flowering plants were recorded from Gunung Murud, many of which are rare. Orchids, ferns and fern-allies, and lichens were represented by many taxa (Ghazally Ismail & Laily bin Din 1998).

Among the lower plants, a total of 93 species of ferns and fern-allies were recorded. A new discovery of a rare fern, *Marratia sambucina* was made (Haja Maideen *et al.* 2002). Mosses and lichens are more diverse as this area is on the highland. There were many new records of lichens for Borneo (Laily bin Din *et al.*, 1998).

Among the fauna, species of ants, cicadas, freshwater fishes, frogs and toads, and small and large mammals were also studied.

The on-going Phase II of the Pulong Tau N.P. project will conduct further baseline ecological and biodiversity studies in areas that are proposed as extensions to the national park. One such study is flora and fauna survey in a mixed dipterocarp forest that was destroyed by the forest fires of 1997.

5.2.2.4 Other Protected Forest Areas

Other protected forests in the HoB area include two proposed national parks and one wildlife sanctuary with an estimated total area of 60,000 ha, several extensions to existing parks, and the Permanent Forest Estate (PFE) (Chapter IV). The proposed parks and extensions to existing parks will cover logged-over forests where many habitats remain intact and biodiversity is still rich. Such forested areas can serve the useful functions of conservation and catchment protection.

Besides biodiversity, the protected forests together play vital services as water catchments, gene banks and wildlife corridors; and in catering to the subsistence needs of the rural populations. Research and development will have to cover these areas in due course. For example, forests that possess high conservation value can be identified and added to the existing network of Totally Protected Areas.

5.3 PROTECTION OF BIODIVERSITY

Conservation management and protection of biodiversity is the overall responsibility of the Sarawak Forestry Department and assisted by the Sarawak Forestry Corporation (SFC). The relevant Ordinances are:

- The National Parks and Nature Reserves Ordinance (1998),

- Wild Life Protection Ordinance (1998) and,
- A Master Plan for Wildlife in Sarawak (1996).

The Master Plan aims to be a long term strategy for wildlife conservation and management. In 1997, the Sarawak Biodiversity Centre Ordinance was enacted to regulate access, collection and research of biological resources.

The Department also implements the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and contributes to the implementation of the Convention of Biological Diversity (CBD), World Heritage Site, and the RAMSAR Convention and other relevant international, regional and bilateral agreements.

To assist in conservation management in the TPAs, the government appoints Honorary Wildlife Rangers, Special Park Committees for national parks and Special Wildlife Committees for the wildlife sanctuaries. The honorary wildlife rangers and members of the committees are selected from the local communities, government representatives and the timber industry. Training for the honorary wildlife rangers and committee members is provided by Forest Department through the SFC.

5.3.1 Problems of Law Enforcement

While rules and regulations are in place, effective enforcement is extremely difficult due to a number of problems as discussed below.

(a) Remote Locations and Difficult Access

Most of Sarawak's 29 existing TPAs are widely scattered and remotely located. Access usually begins with river and/or road travel if rivers and logging roads are available, and followed by trekking. Depending on the entry points, it may take several days just to reach the peripheries of the parks. Boundary checking and patrolling are time consuming and costly. In particular, the long and physically challenging common boundaries shared by Lanjak Entimau W.S., Batang Ai N.P. and Betung Kerihun N.P. in West Kalimantan in the south is making it almost impposible to conduct effective boundary patrol to check illegal cross-border activities. In the north, there is much on-going cross-border traffic between the communities living on both sides of the internation borders, mainly to trade and on social visits.

(b) Shortage of Manpower

Forest Department and its operating arm of Sarawak Forestry Corporation are constrained by a shortage of wardens and rangers, and management on the ground is weak. Some TPAs like the Pulong Tau N.P. are still lacking in field facilities like offices and rangers' stations.

(c) Local Dependence on Forests

Many communities have their settlements just outside the boundaries of the parks, and depend on the forest's resources for subsistence livelihoods. While the people are largely aware of the park rules and regulations, they still enter the parks to fish and hunt and to collect materials and minor forest produce, largely for their own

consumption. These are traditional activities that will be continued for as long as the people are living in the forest.

(d) Lack of Awareness on Conservation

Sign boards containing rules and regulations and penalties for committing offences are provided at entrances and along boundaries of some TPAs. Posters on protected plant and animal species are displayed in some government offices, rangers' stations, rural schools, longhouses or villages and logging camps. Management presence is shown by occasional patrolling duties and visits by wardens and rangers.

Awareness education is increasingly being regarded as a necessary and appropriate tool for effective enforcement because the local people are staying close to the TPAs and have easy access to them. For enforcement to be effective, cooperation of the local people must be sought. In recent years, a series of environmental awareness programmes has been initiated in BANP, LEWS and PTNP jointly by the ITTO and SFC under the ITTO-supported projects in the three national parks. The target groups are the rural school children and local populations. The World Conservation Society (WCS) office in Kuching had similarly conducted awareness programme on orangutan in LEWS.

5.3.2 Strengthening Conservation Management

In order to strengthen conservation management, both in the HoB and in other parts of the State, urgent issues that need to be addressed are to increase the human and financial resources of Forest Department and SFC, encourage more officers to carry out field work, and engage the local communities as co-partners in collaborative management. Qualified school leavers from among the communities can be recruited and trained as wildlife and park rangers. More field offices and rangers' stations must be constructed and adequately manned.

Another strategy is to recognize the people's traditional user rights and their knowledge on sustainable use, as well as sharing the forest resources with them for as long as they and their descendents decide to live in the forest. Whenever necessary, their views and knowledge should be sought during all stages of planning and development. Support to community-based activities like fish culture and crop cultivation, can help to reduce the people's dependence on the forests.

Besides the local communities, the timber industry must also be made more aware of their social responsibilities and the crucial roles they play in conservation, especially in the protection of soil and water resources. As management of the PFE is often more popularly associated with sustainable timber production, the function of forested catchments often tends to be down-played.

One way to motivate the local populations living around the TPAs is to encourage them to grow useful products such as medicine plants. Forest Department/SFC or Sarawak Biodiversity Centre can take the lead and provide the necessary expertise and technology in training, maintenance, processing and marketing.

CHAPTER VI – LOCAL COMMUNITIES

6.1 INTRODUCTION

One of the objectives of the HoB is to promote the welfare of the people through the effective management of a network of protected areas, production forests and agriculture. Socio-economic studies are necessary and crucial as the local communities have been depending on the surrounding forests and other resources for their livelihoods for many generations. Numerous settlements are located within the timber production forests, but outside of the totally protected areas like national parks and wildlife sanctuaries. There is increasing recognition that active participation of the local communities in conservation and development efforts is undoubtedly a central feature for the success and sustainability of any conservation programme. The local communities should thus be considered as an important and major stakeholder in the HoB Initiative.

In order to better understand and be clear about how the HoB may promote the people's welfare as well as their roles in the project, information and data on demographics, their lives and livelihoods, problems, aspirations and needs, and attitudes towards conservation must be gathered to facilitate planning and project identification. It is also to ensure that the development proposals will be environmentally friendly, economically viable, and socially and culturally acceptable.

6.2 DEMOGRAPHIC DATA ON THE LOCAL COMMUNITIES

With its vast area and varied agro-ecological features, Sarawak may be broadly divided into three different regions, namely, the coastal region, inland flat & hilly region, and riverine, upriver and mountainous region. Each of these regions has its own socio-economic characteristics with different levels of development.

Based on these classifications, the HoB area is centrally located within parts of the the second and third regions, which comprise mainly of undulating hills and mountainous slopes. The main socio-economic activities are commercial logging and cultivation of wet and hill paddy, the latter through shifting agriculture, which consequently replaces the original forest with secondary growth. Cash crops like rubber, cocoa, pepper, fruit trees and more recently oil palm have been introduced and are gaining acceptance by the farming community.

A total of 101 settlements spread across eight Districts have been identified in the HoB area, comprising 7 ethnic groups, namely, Iban, Kenyah, Punan Vuhang, Kelabit, Lun Bawang, Penan, and Sa'ban. These 101 settlements make up a total of 2,089 households with a population of 12,841 people.

Table 6.1 shows the basic profile of the seven communities, indicating ethnic affiliations, locations by district, number of settlements, households and populations.

Table 6.1- Settlements by Ethnic Groups within the HoB Area

Ethnicity	Districts	Settlements	Households	Population
Iban	Song	4	94	770
	Julau	1	18	129
	Lubok Antu	1 (6)	22 (134)	151 (1,050)
Kenyah	Baram	1	40	364
	Belaga	1	54	514
	Kapit	1 (3)	49 (143)	616 (1,494)
Penan	Limbang	10	105	466
	Baram	26	624	2,843
	Belaga	1 (37)	37 (758)	153 (3,362)
Punan Vuhang	Belaga	2 (2)	36 (36)	161 (161)
Kelabit	Baram	21	389	2,398
	Limbang	1 (22)	39 (428)	156 (2,554)
Lun Bawang	Lawas	29 (29)	522 (522)	3,649 (3,649)
Sa'ban	Baram	1 (1)	68 (68)	571 (571)

7 Ethnic groups	**8 Districts**	**101**	**2,089**	**12,841**

3. REGIONAL BACKGROUND

1. Lowland Communities

1. The Iban Community

From a socio-economic study of the Lanjak-Entimau Wildlife Sanctuary (LEWS) carried out in 1994, 102 Iban longhouses were found to be located within the peripheries of the Sanctuary and Batang Ai National Park (Jiram, 1994). However, only the longhouses located in the upper reaches of the rivers had direct access to LEWS. They all live outside the TPAs but are closely associated with them. These longhouse communities are clustered around the Batang Ai N. P. in Lubok Antu District, in the Upper Sg. Katibas in Song District, and in Upper Sg Kanowit in Julau District.

Based on their present locations, there are six Iban settlements with a total household of 134 and a population of 1,050 people - 4 in Song District, and one each in Julau District and Lubok Antu District. Many communities or households have been granted special privileges by the government under the Wild Life Protection Ordinance and National Parks and Nature Reserves Ordinance, to hunt and collect jungle produce in the sanctuary or national parks for domestic consumption only.

(a) Social and Cultural Features of the Iban Community

(i) Longhouses

The Iban longhouses vary in size from less than 10 households to more than 50 households, but mostly in the range of 10 to 20. Since the main mode of transport in the region is by rivers, the longhouses are located mainly along the major tributaries of the rivers in the areas (Table 6.2).

A longhouse must have at least 10 households or *bilek-families* in order to have a recognised headman or *Tuai Rumah*. However, longhouses with less than 10 households are quite common, especially when some members decide to move to new places, or when there is a conflict among the members of the community.

Traditionally, the longhouses are built on stilt with belian or ironwood supports. Except for the roofs which are often made of zinc sheets, most of the materials used are made of timber from the forest, including split and unsawn timber. Nowadays, it is not uncommon to see modern or better built longhouses alongside older traditional ones.

Table 6.2 - Longhouses and Populations in the Periphery of LEWS (Jiram, 1994)

AREA (River system) (District)	No. of Longhouses (Villages)	Total households	Total population
Upper Kanowit River	26	559	3,268

(Julau District)			
Upper Ngemah River (Kanowit District)	51	747	5,530
Upper Katibas River (Song District)	22	415	3,350
Upper Engkari River (Lubok Antu District)	3	40	250
Total	102	1,761	12,398

(ii) Cultural Background

A few hundred years ago, the ancestors of the Iban arrived from Sg. Kapuas in Indonesia and first settled in Lubok Antu, before migrating to other parts of Sarawak during the early decades of the 19th century (Freeman, 1995). Based on their migration history, two major movements can be detected, with one group migrating through the rivers of Lemanak, Skrang and Layar into the Entabai and other headwaters of Kanowit River; and the other group migrating through the headwaters of the Btg. Lupar into Katibas River to as far as Upper Rajang River or Balleh area. The main rivers leading to LEWS have, therefore, served as the main migratory routes of the Iban pioneers, whose descendents now live in the peripheries of the Sanctuary. Their migration into the present areas was partly dictated by their pioneering spirit in search of better areas with virgin jungles, where they could do shifting cultivation of hill paddy and where food, including fish and animals were plentiful. Traditionally, the Iban communities associated with the Sanctuary are shifting cultivators, hunters and gatherers; and growing hill paddy is their main activity for sustenance. Their settlements are all located outside the Sanctuary.

Coming from the same ancestral root with a relatively similar environment, the Iban in the four main areas neighbouring the Sanctuary are relatively homogenous in terms of the socio-cultural features. Being a closely-knit community, they live in longhouses even up to the present day.

As far as the people could recall, most of them have been staying in their respective areas for an average period of not less than 50 years; and some longhouses have been in existence for more than 150 years. This is not surprising as the first migration commenced in the early decades of the 19th Century.

(iii) Households

Like all the other ethnic groups, the Iban have their basic bilateral kinship organization with nuclear families as the basic socio-economic units for household groupings. The Iban household unit refers specifically to the *bilek-family*. One particular household may comprise of two or more sub-families as in the case of extended families. Each family is economically self-sufficient, possessing and managing its own resources, including farm land and other household properties. Communal or common property ownership is rare but does happen among close kindred and in respect of certain properties, such as fruit trees and old *temuda* (secondary forest), which are normally inherited from their common ancestors. Apart from having a common burial ground, the community may also have an area of communal forest or *pulau kampong*, mutually left uncleared by the shifting cultivators but are surrounded by their secondary forests. Such communal forest is normally maintained as it serves as an area from where they can get their supply of timber and other forestry products.

Despite being individualistic in terms of property ownerships, a high degree of cooperation prevails among the community as in the longhouse environment, as well as communal ties based on kinship and consolidated community cohesion. With their norms and values, the longhouse members have high regard for cohesion and cooperation. Depending on the longhouse leadership, there is not much difficulty in organizing them into cooperative work force. In fact, much of their daily and seasonal activities are undertaken on a communal basis. The spirit of mutual help such as *gotong-royong* (cooperative work) and *bedurok* or labour exchange has long persisted, especially in times of disasters, as well as during hill paddy production and longhouse construction.

(iv) Social Organization and Institution

In terms of social structure, the Iban are basically an egalitarian society without any traditional stratification like the Kayan-Kenyah groups. Iban community leaders acquire influence not by traditional status, but through personal achievement. They have less influence in the running of individual family affairs in their longhouses, but respected and capable leaders are important in maintaining the stability, close relationship and cooperation among the community, as well as close rapport with the government agencies. Under the State government administrative machinery, there is a formalised structure of leadership at various levels for each community. The highest in authority is the *Temenggong* who is head at the Divisional level, and the next in hierarchy is the *Pemanca* who takes charge of several *Penghulu* in the District. The number of *Penghulu* appointed for each District will depend on the accessibility of the area and its population size, since the *Penghulu* has the responsibility over a number of the longhouses led by the *Tuai Rumah* or Village Headmen.

Being part of the civil service, all of these community leaders are officially appointed and paid monthly wages/allowances by the government. However, the *Tuai Rumah* are normally appointed by consensus of the members of the respective longhouses. The government merely gives them official recognition, as without such recognition, the *Tuai Rumah* would have no right to act on behalf of the villagers and would not be entitled to receiving honorarium from the government.

Being the grass-root leadership, the *Tuai Rumah* represents the focal point through which cooperation and participation of the longhouse community can be established. At the village level, most longhouses have formed a Village Development & Security Committee or *Komiti Pemansang enggau Penglikun Rumah Panjai* under the chairmanship of their *Tuai Rumah.* Normally, the Committee may comprise of several sub-Committees, like the Sub-committees for Agriculture Development, Water/Electricity Supply and Maintenance, Home Economics & Management (for the women), Longhouse Safety (for fire hazard), Village Health and Welfare. Along with these so-called formal institutions, several other informal groupings, in particular among the women, the youth and the labour exchange groups may exist, depending on how active and cordial the relationships are in the longhouse. These formal and informal institutions can be utilised to mobilise the community in the implementation of conservation management of the Sanctuary and National Park in the southern region.

(v) Educational Level

As a whole, the level of education among the communities in the study area is still relatively low compared to the urban populations. A survey in 1994 (Jiram, 1994) indicated that overall, about 52% were known to be educated including those that were still schooling at the

time. Out of the remaining 32% that had no formal education at all, 16% were pre-school going children. Most of the educated group had attended only primary schools. One reason for this was the lack of schools in the rural areas, and sending children to the district town schools could be rather costly for most parents. Secondary education would be beyond the reach of most parents.

(vi) Migration Trend, Temporary Migration or *Bejalai*

Geographical mobility is common to all the communities at the individual level throughout the State. There is rural-urban migration within and between the Divisions, as well as to other States in Peninsular Malaysia and countries like Singapore, Middle East and others. The main reasons are either for the sake of their children's education or to seek employment. Within the State, many take up employment in the towns or cities, and in sawmills and logging camps in the rural areas. The problem of rural youth migrating to urban centers is a serious concern to all. Although the real extent of the problem has not really been determined, there are indications that the farming communities are becoming deprived of able-bodied young men.

It has been the tradition for young Iban men to go on *bejalai* or temporary migration to other places. This tradition originated from their ancestral need and quest for social prestige. Under the present economic situations, the incidence of *bejalai* among the economically active men seems to be quite common as the opportunities to earn cash incomes are rather limited in the remote areas. The money they send home helps to lessen the financial burden of their household members; and the trend is expected to continue. Out-migration has not only resulted in a shortage of manpower at the farm, but also in the husbands leaving their wives and young children at home with their aged parents. Many rural longhouses are thus near empty especially when the children are at school, to be tended usually by a few aged couples.

(vii) Health and Sanitation

Generally, the standard of health and sanitation of the people is related to their economic status. With improved economic situation they will be able to build better longhouses with modern facilities like toilets, piped water supply, electricity, and radios and televisions. This provides for a more decent and clean environment. On the whole, the standards of health and hygiene of the longhouses in the four Districts have improved tremendously over the last 10 years (Table 6.3).

Table 6.3 - Medical & Health Facilities in the four Districts as on 31st December 1991

Types of Facility	Lubok Antu	Julau	Kanowit	Song
Divisional Hospital	-	-	-	-
District Hospital	-	-	Kanowit	-
Specialist Hospital	-	-	-	-
Polyclinic	-	-	-	-
Health Centre	-	Julau Pakan	-	Song
Health Center 1 (Pusat Kesihatan 1)	Ng kesit Engkilili Lubok Antu	Ng Wak Ng Entaih Lassi Ng Entabai Ng Mujok	Ng Machan	Ng Bangkit Tekalit
Rural Clinic (Klinik Desa)	Merindun Bag Ai (Lemanak)	Ng Ensirieng	Ng Jagau Ng Poi	Chemanong

Static Dispensary	-	-	-	-
Sub-Dispensary	Ng Delok Ng Stamang Ng Pratoh	Ng Kara Tekalong	Ng Jagau	-
Village Health Team	Ng Kesit Lubok Antu (R) Lubok Antu (M) Engkilili	Julau (R) Ng Wak Ng Entaih Lassi Ng Entabai Pakan	Machan Kanowit 1 Kanowit 2 Kanowit 3	Song (R) Ng Bangkit Tekalit
Isolated MCH Clinic	- -	- -	- -	- -

Source: Annual Report, 1991, Medical & Health Services Department, Sarawak

No doubt some longhouses, especially the more backward and older ones, are still suffering from a low standard of health and hygiene, without proper toilets and with domestic pigs roaming around their longhouses foraging for food. The Medical and Health Department has assisted by providing materials for gravity-feed piped water supply and toilets, and cement for construction.

(viii) Water and Electricity Supply

Lack of basic facilities such as clean water and electricity supply is one of the main problems of the rural communities, particularly those in the remote interior. As the longhouses are also widely scattered, it is extremely difficult and costly for the government to provide these basic facilities to all the longhouses. There is also the problem of regular supply of fuel and maintainence, both of which can be very costly.

The communities living immediately adjacent to LEWS and BANP are able to enjoy clean water from the rivers, but outside of this the rivers are being increasingly polluted by human activities such as logging and agriculture. With the exception of the resettlement areas in Ulu Ngemah that have been provided with a proper water treatment plant built by the Public Works Department, most of the other longhouses have to rely on gravity-feed water supply system provided by the Medical Department. Table 6.4 below shows that 28% and 14% of the longhouses in Ulu Kanowit and Ulu Katibas respectively still have to depend on river and rain water for their domestic needs. Despite the fact that the majority of them have gravity-feed water, the supply system for some longhouses is often not functioning or insufficient to meet the needs of their increasing population as they were built about 20 years ago.

Table 6.4 - Water Supply of the Longhouses in Four Districts (Jiram, 1994)

Water Supply System	Upper Kanowit		Upper Ngemah		Upper Katibas		Upper Engkari	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
None	7	28	0	0	3	14	0	0
Gravity System	18	72	6	25	19	88	3	100
PWD (JKR)	0	0	18	75	0	0	0	0
Total	25	100	24	100	22	100	3	100

Note: None - dependent on river and rain water for their water supply; Gravity System - gravity-fed piped water supply; PWD (JKR) - water supply provided under the Department of Public Works (PWD)

Only few longhouses have electricity supply mostly from the portable generators provided under the Minor Rural Projects (MRP); while some individual households may have their own portable generators. Running these generators can be very expensive due to the much higher fuel cost in the interior.

(b) Land Tenure and Land Use

Based on the land classification in the State, most of the lands owned by the communities in the interior regions, including those adjacent to the Sanctuary, are categorized as Native Customary Rights or NCR lands. As has been clearly explained by Freeman (1955), the basic principles of land tenure among the Iban is based on the fact that "Actual family ownership is established by the felling of the primary jungle (*kampong*), and this is always undertaken by individual *bilek*-families. By clearing the virgin forest from a tract of land, a *bilek*-family secures full discretionary rights over the secondary jungle (*damun*), and thereafter, for as long as it remains in the local community this *bilek*-family retains ownership of all land, for the initial cultivation of which it has been responsible. Once land has been acquired in this way it becomes part of the general property of the *bilek*, and is inherited in the same way as the other valuables of the family"

The most common method of creating customary rights was, therefore, through felling of virgin jungles for the purpose of hill rice cultivation. However, with the enactment of the State Land Code in 1957, any areas of virgin jungle cleared after the year 1958 would not be considered as NCR land unless permission had been granted by the relevant authority. The enactment clearly states that NCR land only refers to "land in which native customary rights, whether communal or otherwise, have lawfully been created prior to the 1st day of January, 1958".

With respect to the boundaries between adjacent longhouses which are strung along the rivers, these have been clearly defined and normally natural landmarks such as rivers, mountain ranges and ridges are used as their main boundaries. However, the inland areas, which are not within reasonable communicating distance from their respective longhouses, are often not clearly delineated. Within the longhouse territory, most of the secondary forest lands are owned by individual households. Likewise, natural features like streams, ridges, tall trees and dead belian tree stumps are used as boundaries. Sometimes, tree crops like rubber and fruit trees are planted to maintain their rights, as well as to avoid any dispute over the land and its boundary. Communal ownership of land area is rare, though this may happen in respect of their *tembawai rumah* (old longhouse sites) and sometimes over *Pulau kampong* (uncleared forest areas surrounded by their shifting cultivation areas).

Like any other communities, in so far as land is concerned, the notion of land ownership is still strong. Although there is some flexibility in their usufructuary rights, ownership rights - either communal or individual - remain the basis of attachment to the land. This could be the factor why most of the people are still sceptical over any development plan which involves resettlement.

In terms of acreage, there are significant differences in the land ownership among the households and between the four district areas. The size of land owned by individual households varies from less than one hectare to as high as 200 ha, but on the whole, the average land size is 20 hectare per household (Table 6.5).

Table 6.5 - Distribution of Households by Total Land owned

Acreage (Hectares)	Upper Kanowit		Upper Ngemah		Upper Katibas		Upper Engkari		Total	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Nil	1	1	6	8	6	10	0	0	13	6
5 & Below	10	12	16	22	0	0	0	0	26	11
5 - 10	13	15	11	15	18	29	11	92	53	23
10 - 15	15	18	3	4	9	15	0	0	27	12
15 - 20	14	17	10	14	6	10	0	0	30	13
20 - 25	7	8	7	10	6	10	0	0	20	0
25 - 30	7	8	2	3	3	5	0	0	12	0
30 - 35	4	5	3	4	5	8	1	8	17	0
35 - 40	3	4	3	4	2	3	0	0	8	3
40 - 45	2	2	0	0	0	0	0	0	2	1
45 - 50	1	1	0	0	3	5	0	0	4	2
Over 50	7	8	11	15	4	6	0	0	22	10
Total	84	100	72	100	62	100	12	100	230	100
Average	24		25		20.8		8.2		20	
Range	1-163		0.5-200		1-68		2-34		0.5-200	

The majority of households own land of 5 and 20 hectares. The communities in Ulu Engkari appear to have some land problem as over 90% of the households surveyed own between 5 and 10 ha - or an average of only 8 ha - per household, compared to an average of around 21 to 25 ha for the other three districts (JIram, 1994). Populations in Ulu Ngemah are the richest owners despite the fact that some of them were without any land after being resettled downriver in the two main Resettlement Areas. For most owners, the land areas are highly fragmented, and are located far from each other. Major factors that affect proper land use are difficult terrain and poor accessibility to their longhouses.

(c) Major Economic Activities

(i) Hill Paddy Farming

With a generally hilly and rugged terrain, the main economic activity is shifting cultivation of hill paddy. The over-riding objective of the subsistence farmers is to produce enough food for sustenance. Shifting agriculture is the people's traditional way of cultivating hill rice and is still widely practised in Sarawak. Teng (1990) estimated that about 50,000 farm households in the rural areas are engaged in this mode of agriculture. The numbers of farmers engaged in hill paddy cultivation in the four districts are given in Table 6.6.

Table 6.6 - Percentage of Households Planting Hill Paddy

No. of Households	Upper Kanowit		Upper Ngemah		Upper Katibas		Upper Engkari		Total	
	Freq	%	Freq	%	Freq	%	Freq.	%	Freq.	%
Planting	78	93	67	93	59	95	12	100	218	94
Not Planting	6	7	5	7	3	5	0	0	14	6
Total	**84**		**72**		**62**		**12**		**230**	

Initially, the practice was essentially a pioneering system of land use, involving the felling of the primary forest, but later it developed into an established system, with periodic use of the secondary forest as part of the production cycle. Due to the difficult terrain, poor soils and shortage of labour, hill rice production for many families has been below the average yield of 464 to 590 kg/ha. The result is more than half of the households have inadequate supply of rice to meet their own needs until the next harvest.

In the present century, perennial cash crops like rubber, pepper and cocoa have been incorporated into the farming system. There is thus, an indication that shifting cultivation is on a gradual decline. Some amount of rice is purchased with cash income derived from cash crops, temporary wage employment and other income-generating activities, such as hunting, fishing and collection of jungle produce like rattan, belian wood and vegetables.

Generally, socio-economic development in the region has been rather slow resulting in a relatively high incidence of poverty and other related problems among the rural communities.

(ii) Other Agricultural Activities

Some families in the Batang Ai area have engaged in rubber planting and cage culture of red tilapia fish. In Ulu Mujok and Ulu Ngemah, many have benefitted from the community development activities initited by the International Tropical Timber Organization (ITTO), such as fish culture in valley ponds and planting of local fruit trees. Cash incomes derived by some participating longhouses and individual farmers have been in the range of over RM 1,000 to 2,500 per harvest. To-date, a total of 23 fish ponds have been constructed (Chai, *pers. comm.*).

(iii) Utilization of Forest Resources

Popular activities are hunting, fishing and collection of jungle produce, from both outside and inside the TPAs. The percentages of households involved in hunting and fishing are given in Table 6.7 and Table 6.8 respectively. A recent study by Engkamat and Cluny (in draft) indicated that the forests in community-used zones were rich in animal life, including several game species.

Table 6.7 - Percentage of Households involved in Hunting (Jiram 1994)

Area	Percentage Hunting and Species			
	Wild Boar	Rusa	Kijang	Other Animals
Ulu Kanowit	65	48	54	57
Ulu Ngemah	46	29	36	-
Ulu Katibas	63	18	19	23
Ulu Engkari	67	-	-	-
Overall	59	31	36	27

Note: Other animals include mousedeer, porcupine, ant-eater etc.)

Fishing activity in LEWS and BANP has been affected by river pollution in many rivers, over fishing, and by illegal fishermen coming from nearby towns and longhouses. High-value fish like semah and tenggadak are worth up to RM 50.00 per kg in the villages, and as much as RM 300 per kg in the towns. Methods include *ginti* (fishing line), *jala* (cast nets) and *pukat* (drift nets). Fishing by poison (*tuba*) or explosives are illegal.

Although there have been some reports of the people entering the TPAs to fish and hunt, the impacts have not been significant. Recent efforts by ITTO to promote awareness education and collaborative management have brought about positive results (Chai, *pers. comm.*).

Non-timber forest products (NTFP) help to supplement food supply and provide cash incomes. There are many kinds of wild fruits and vegetables, including palm and rattan shoots and edible fungi. The most commonly collected wild vegetables are miding (*Stenochlaena palustris*), paku (*Athyrium esculentum*), daun sabung (*Gnetum gnemon)*, and kepayang (*Pangium edule*).

Table 6.8 - Percentage of Households involved in Fishing (Jiram 1994)

Area	Percentage Fishing and Species				
	Semah	Tenggadak	Baong	Bantak	Kulong
Ulu Kanowit	33	19	86	86	-
Ulu Ngemah	28	-	72	58	-
Ulu Katibas	45	16	77	23	47
Ulu Engkari	33	-	50	92	58
Overall	35	11	77	59	16

The people also obtain construction timbers and materials for houses and boats, handicrafts, tools, and fuel wood from the forest, although there is no detailed study to determine the quantities consumed. These materials are normally taken only when the need arises.
Many families have been granted special privileges under the Wild Life Protection Ordinance (1998) and National Parks and Nature Reserves Ordinance (1998) to collect timber and jungle produce in the TPAs for domestic consumption only. Unfortunately, these privileges are sometimes abused by those who bring their friends or relatives from outside to hunt and fish in the TPAs.

(d) Household Economy and Incomes

As subsistence farmers, their overriding objective is to produce enough rice for sustenance. When this is not possible, many have to work to earn some cash, and in doing so neglect their farms and gardens. The possible alternative is to create local opportunities for them to increase their cash incomes.

Except for rubber, cash crops like pepper and cocoa were recently incorporated into their farming systems. However, problems like diseases, high cost of transportation and market access, and fluctuating prices have made it difficult for them to make good enough profits. Other sources of income are non-farm activities like hunting, fishing and sale of jungle produce. The study by Jiram (1994) indicated an average household income of RM1,100 per annum or an equivalent of RM 92 per month. The majority of the households were earning a cash income of less than RM5,000 per annum, and only 3% of them earned more than RM5,000. Wage employment constituted about 20 to 40% of household incomes.

The prevalence of poverty could be the main factor for a relatively high incidence of malnutrition among pre-school going children. Even in times of sickness, many have difficulties seeking medical treatments in nearby clinics. Poverty is a critical problem that must be addressed.

2. Highland Communities

There are two highland areas in northern Sarawak - the Maligan Highland located along the border with Sabah in the north, and the Kelabit Highland located along the border with East Kalimantan in the east. The Gunung Mulu N.P. and Pulong Tau N.P. are located in the region, cutting the divisional boundaries of Miri and Limbang Divisions. Pulong Tau is situated close to the Sarawak-East Kalimantan border. These highlands are a part of the HoB and home to many human settlements belonging to the ethnic communities of Kelabit, Lun Bawang, Penan, Punan, Kenyah and Sa'ban.

1. The Kenyah Community

There are three Kenyah settlements with a total household of 143 and a population of 1,494 people. Two of these are Kenyah Badeng, located respectively at Lio Matu in Baram District and Long Busang in Belaga District. The other is a Kenyah Bakong settlement, located at Long Singut in the headwater of the Baleh in Kapit District. They are spread far from each other in the most interior of the three districts. The two Kenyah Badeng settlements are each provided with a full Primary School and a Rural Health Clinic. There is no school or health centre at Long Singut; these facilities are available at the Iban settlement of Ng Entawau, a few hours by outboard motor downriver.

6.3.2.2 The Punan Vuhang Community

There are only two Punan Vuhang settlements located in the most interior of Belaga District, and far apart from each other. The one at Long Lidem is situated in the headwater of the Kajang, a tributary of the Linau, which in turn is a tributary of the Balui; and consists of 20 households with 78 people. The Long Unai settlement is situated in the headwater of the Balui, and has 16 households and 83 people.

Traditionally a nomadic people, they began to live a settled way of life in the 1960s. They now cultivate hill rice, but occasionally go back to the forest to process wild sago when rice is insufficient. Hunting is an important activity to provide protein. They are fine weavers of rattan mats and baskets that are their main source of cash income.

There is no school or rural clinic in either settlement. These facilities are available at the Kenyah Badeng settlement at Long Busang, located not far downriver from Long Unai; and at Lusong Laku, a Penan settlement in the Linau River, which can be reached by a day's journey by outboard motor downriver from Long Lidem.

3. The Sa'ban Community

The Sa'ban comprises a single community at Long Banga in the upper Baram. Linguistically and culturally related to the Kelabit, they are considered under the Kelabit in this report.

4. The Kelabit Community

Kelabit settlements in the HoB area can be divided into two clusters: the Kelabit Highland Proper around Bario area; and outside the Kelabit Highland proper. The two clusters comprise 23 settlements, 496 households and a population of 3,125 people.

(a) Kelabit Highland Proper

This has 14 settlements with 286 households and a population of 1,677 people (Table 6.9). Bario serves as the centre and is accessible by air (19-seater light aircraft) from Miri and Marudi daily. Logging roads have reached the southern villages of Ramudu, Pa Mada (Arur Dalan) and Pa' Dalih and will soon reach Bario.

Table 6.9 - Kelabit Settlements and Populations (1990) in the Kelabit Highland Proper
(District Office, Baram)

	Settlement	Household	Population
1	Bario Asal	32	192
2	Ulong Palang A	33	197
3	Ulong Palang B	12	72
4	Pa' Ramapuh Atas	18	109
5	Pa Ramapuh Bawah	11	69
6	Arur Dalan A	17	104
7	Arur Dalan B	18	105
8	Arur Layun	11	66
9	Pa'Umor	16	98
10	Pa Lungan	35	213
11	Pa Ukat	35	208
12	Padang Pasir	23	136
13	Kampung Baru	13	36
14	Pa Derong	12	72
	14	**286**	**1,677**

(b) Outer Kelabit Highland

There are 9 settlements comprising 210 households and a population of 1,448 people, including the Sa'ban village at Long Banga, a minority group that is linguistically and culturally related to the Kelabit and Lun Dayeh of East Kalimantan (Table 6.10). The settlements can be reached by logging roads and by once a week flight each to Long Seridan and Long Banga from Miri and Marudi. The only Kelabit village of Long Napir in Limbang District is accessible from Limbang Town by logging road and outboard motor.

	Settlement	Household	Population
1	Ramudu A	11	69
2	Ramudu B	6	45
3	Pa Dalih	36	142
4	Long Peluan	14	127
5	Long Banga	68	571
6	Batu Patong	8	53
7	Long Seridan	16	192
8	Buyo Seridan	12	93
9	Long Napir	39	156
9	**9**	**210**	**1448**

Table 6.10 - Kelabit Settlements and Populations (1990) in the Outer Kelabit Highland
(District Office, Baram)

(i) Socio-Economic Activities

The Kelabit are rice or paddy cultivators, planting both hill and wet paddy, mainly for home consumption, with surplus sold in Miri. Hill rice is inter-cropped with other crops such as maize and various types of vegetables. They also raise buffaloes which are used to work the fields and fertilize the soil, as a beast of burden, or sold for cash. Another source of income is selling of mineral salt obtained from underground salt mines.

The cool highland climate makes it suitable for growing sub-temperate crops, such as longan, lychee, sweet orange, but only pineapple has gained prominence and is widely planted in the area.

For generations, the Kelabit have cultivated or nurtured fruit trees, standing individually or in groves along with other trees of significance around their present settlements or sites of old settlements occupied by their ancestors. The present generation knows the locations of these fruit trees or groves of fruit trees. They are valued for their fruits as well as documentary evidence of ancestral occupation.

Silting caused by recent logging activities has adverse effects on the fish populations in the Kelabit Highland Proper, as well as in Long Peluan and Long Seridan, although some areas continue to enjoy adequate supply of the resource. Ecotourism is similarly affected.

Hunting is still an important activity in the highland and surrounding areas. The preferred game includes wild boar and deer. Various jungle products are collected for domestic needs, like firewood, bamboo, rattan cane, palm shoots, wild fruits, edible leaves, fungi, tubers, and other uncultivated foodstuffs.

(ii) Facilities and Services

Basic facilities and services include schools, rural health centres, agriculture stations, police stations, etc. as indicated in Table 6.11.

Table 6.11 - Basic Facilities and Services in the Kelabit Settlements

	Facility	Kelabit Highlands Proper	Outer Kelabit Highlands
1	Primary School	1 (Bario)	3 (Lg Banga, Lg Napir, Lg Seridan)
2	Secondary School	1 (Bario)	0
3	Kindergarten	1 (Bario)	3 (Lg Banga, Lg Napir, Lg Seridan)
4	Rural Health Centre	1 (Bario)	2 (Lg Banga, Lg Seridan)
5	Agriculture Station	1 (Bario)	0
6	Police Post	1 (Bario)	0
7	Upriver Agent	1 (Bario)	0
8	Immigration Post	1 (Bario)	0
9	Library	1	0
10	Community Hall	1	3
11	Football Fields	6	4
12	Badminton	3	3
13	Church	14	9
14	Village Shop	20	2
15	Lodging House	10	0
16	Internet	1 e-Bario	0

(iii) Water and Electricity Supply

All settlements are provided with gravity-feed piped water supply, but lack public facility to supply electricity. Well-off families provide their own electricity through privately owned generators. In January 2009, however, the village of Bario Asal in Bario constructed a mini-hydro and now enjoys continuous free electricity supply.

(iv) Transportation

Being remotely isolated, it is very difficult and expensive to transport goods from the urban centres to the highland. Before the recent fuel price increase, the people relied on chartered flights from Miri. Nowadays, fuel and other essentials are mainly transported via logging road from Miri to the southern edge of the highland at Pa'Dalih or Ramudu, and from here brought to Bario by longboat. In Bario, government subsidized diesel is RM2.50 per litre, super benzene at RM3.00 per litre, and cooking gas at RM32.00 per tank. Unsubsidized diesel is RM5.00 per litre, super at RM7.00 per litre, and gas in the range of RM55.00 and RM60.00

per tank. In times of extreme shortage, diesel would cost RM10.00 per litre and gas RM160.00 per tank.

(v) Stone Momuments

The Kelabit landscape is endowed with numerous stone monuments, such as carved stones *(batuh narit),* erect stones or menhirs *(batuh senuped),* dolmens or stone tables *(batuh nangan),* and stone piles *(perupun)*, etc. These monuments are clear evidence of antiquity of Kelabit occupation of the area. A collection on such a scale (perhaps up to 100) is not found anywhere else in the world. A survey of the cultural relics was conducted by Cluny and Chai in 2007. Also of cultural significance is the numerous salt springs scattered across the Kelabit Highland.

6.3.2.5 The Lun Bawang Community

The Lun Bawang settlements can be grouped into 3 clusters, located respectively at Ba Kelalan, Long Semado, and Long Sukang-Pa Berayong. These clusters have a total of 30 settlements, with 562 households and a combined population of 3,642.

(a) Ba Kelalan Settlement

This settlement is located along the Sarawak-East Kalimantan border. There are 10 villages with 162 households and a population of 1,022 people (Table 6.12). Buduk Nur (made up of the villages of Punang Kelalan, Long Muda and Long Kumap) is a couple of hours on foot from Long Midang - a Lun Dayeh village in the Krayan District of East Kalimantan. Ba Kelalan is accessible by air from Lawas and Miri three days week, and also by logging road from Lawas (5 hours if the road is in good condition).

Table 6.12 - Settlements and Population (1990) in the Ba Kelalan Cluster
(District Office, Lawas)

No.	Settlement	Household	Population
1	Punang Kelalan	15	88
2	Long Muda	20	112
3	Long Kumap	24	141
4	Long Langai	42	229
5	Long Lemutut	13	96
6	Long Ritan	5	21
7	Long Rusu	18	108
8	Long Nawi	16	107
9	Long Talal Buda	16	108
10	Pa' Tawing	3	12
		162	**1,022**

(b) Long Semado Settlement

This is located along the Sarawak-Sabah border, and has a cluster of 12 villages comprising 243 households and a population of 1,840 people (Table 6.13). It is accessible by logging road from Lawas, taking 3 to 4 hours by 4WD. Long Semado is about one day's walk from the Lun Dayeh village of Long Pasia in Sabah.

Table 6.13 - Settlements and Populations (1990) in the Long Semado Cluster
(District Office, Lawas)

No.	Settlement	Household	Population
1	Long Kerabangan	24	160
2	Long Beluyu	32	173
3	Long Tanid	31	212
4	Long Semado Naseb	24	152
5	Long Semado	32	219
6	Long Telingan	17	126
7	Punang Trusan	21	121
8	Long Luping	31	250
9	Long Reraku	17	74
10	Pa' Berunut	11	101
11	Long Meringau	3	10
		243	**1598**

(c) Long Sukang-Pa Berayong Settlement

There are 8 villages in the Long Sukang-Pa Berayong Cluster, comprising 117 households and a total population of 1,029 people (Table 6.14). The 8 villages are located in three general areas, namely, Pa Puti, Long Sukang and Pa Berayong. Pa Puti is located at the foot of the Meligan, about one hour by logging road from Lawas Town. Long Sukang is located south of Pa Puti, two hours by logging road from Lawas. There are four villages in the Long Sukang area. Pa Berayoung is located east of Long Sukang, two and half hours by logging road from Lawas. There are three villages in the Pa Berayong area. There is a footpath linking Long Sukang to Long Pasia, with a two-day walk distance.

Table 6.14 - Settlements and Population (1990) in the Long Sukang-Pa Berayong Cluster
(District Office, Lawas)

No.	Settlement	Household	Population
1	Punang Berayong	30	200
2	Pa'Berayong	11	72
3	Long Tuyo	31	213
4	Long Sukang	38	220
5	Long Lutok	15	116
6	Long Remirang	9	65
7	Long Resina	4	22
8	Pa Puti	19	111
		117	**1029**

(i) Economic Activities

The Lun Bawang practise a mixed agriculture system with paddy as the principal crop. It is grown on dry hilly land or on irrigated flat land along narrow valleys.

Surplus harvest of the *adan* variety ('Bario' rice) is sold in the market in Lawas, Kota Kinabalu, Brunei and Miri. Fish thrives in the wet rice fields and is an important source of protein. Like the Kelabit the Lun Bawang raise buffaloes that are used mainly to maintain fertility of the rice fields and as beasts of burden, and sometimes sold for cash.

Farmers in Long Sukang-Pa Berayong cluster are largely hill paddy cultivators. The advantage of this system is that the paddy can be intercropped with other crops such as maize, millet and various kinds of vegetables, which can be sold in the market in Lawas. Its disadvantage is that it is a rotational system, requiring a new field for the next farming session. When there is a population increase land for such a rotation becomes insufficient.

Fresh water fish in the rivers and streams used to be plentiful, but this resource has largely been depleted since the 1980s by logging operations, either through over fishing by the influx of timber workers, or siltation of rivers and streams. Long Tuyo has a *tagang* system in operation and is reported to be quite successful. The village of Long Kerabangan in the Long Semado cluster is planning to adopt the system.

Hunting is still an important activity for rural communities. The preferred game includes wild boar and deer. The forest is the source of firewood, bamboo, cane, palm shoots, wild fruits, edible leaves, fungi, tubers, etc. Production of handicrafts such as weaving of rattan mats and baskets is a sun-set activity as raw materials from the forest are fast depleting, largely caused by logging operations. Rattan mats and baskets are normally purchased from their Lun Dayeh cousins across the international border.

(ii) Facilities and Services

Basic facilities are available and include primary schools, rural health centres, agriculture stations, and an agriculture experiment station at Long Semado (Table 6.15). Ba Kelalan is in need of an immigration post to regulate visitors crossing the international border.

Table 6.15 - Basic Facilities and Services in Lun Bawang Settlements in the HoB

	Facility	Ba Kelalan	Long Semado	Long Sukang-Pa Berayong
1	Primary School	1 (Lg Langai)	2 (Lg Semado, Lg Luping)	1 (Lg Sukang)
2	Kindergarten	1 (Lg Langai)	2 (Lg Semado, Lg Luping)	1 (Lg Sukang)
3	Rural Health Centre	1 (Buduk Nur)	1 (Lg Semado)	1 (Lg Sukang)
4	Agriculture Station	1 (Buduk Nur)	1 (Lg Semado)	0
5	Agric. Experiment Station	0	1 (Lg Semado)	0
6	Police Post	1 (Buduk Nur)	1 (Lg Semado)	0
7	Upriver Agent	1 (Buduk Nur)	1 (Lg Semado)	0
8	Library	1	0	0
9	Village Shop	10	4	2
10	Community Hall	2	2	2
11	Football field	4	9	2
12	Badminton Court	2	2	1

13	Internet	1 (Private)	0	0
14	Lodging House	5	0	0
15	Church	10	11	8
16	Seminary	1	0	0

(iii) Water and Electricity Supply

All villages are provided with gravity-feed piped water supply. There are two mini-hydro electricity power stations in Ba'kelalan - one at Buduk Nur supplying power to a few households in the village of Long Muda, the other at Buduk Bui supplying power to the villages of Long Talal Buda and Long Nawi.

(iv) Transportation

Settlements in the Long Sukang-Pa Berayong cluster can be reached within two and a half hours from Lawas, by a logging road that is maintained by Samling Company up to their timber camp at Long Merarap. There is, however, no maintenance of the road after Merarap leading to the settlements in Long Semado and Ba'kelalan, since the timber company is not operating in this area. It is almost impossible for 4WD to pass through this stretch of the road during the rainy season. It is difficult and expensive to transport goods to the interior, especially to Ba Kelalan. Diesel fuel costs RM2.05 per litre if subsidized, and RM 3.00 if not subsidized; subsidized unleaded fuel is RM2.15 per litre, or RM3.80 if not subsidized.

Subsidized cost for cooking gas is RM30.00 per tank, and increases to RM55 to RM60.00 per tank without subsidy.

6.3.2.6 The Penan Community

Penan settlements in the HoB area can be grouped into seven clusters: Kuba'an, Tutoh, Magoh, Silat, Upper Limbang, and Adang. The first five settlement clusters are in the Baram District, and the last two in the Limbang District.

The seven clusters consist of 37 Penan settlements with 759 households and a population of 3,362 people. Twenty seven settlements are settled with 670 households and a population of 2,987 individuals. Three groups are semi-settled, comprising 35 households and a population of 134. Six groups with a population of 241 people are nomadic; they live in 53 households. The Penan settlement of Long Malim in Belaga District is not included, as it is located far from any of the clusters.

(a) The Kuba'an Cluster

This is a relatively small cluster with 5 settlements – three settled and two semi-settled – comprising 52 households and 205 people (Table 6.16). These settlements can be reached by two days of walking from Bario, or one day by driving on logging road from the town of Long Lama, but one needs to walk for two hours from the end of the logging road to the village of Long Lobang. It is possible that the timber road to Kuba'an may be closed soon. Footpaths link the Kuba'an area to the Penan village of Long Sabai in the south, and other Penan groups on the Tutoh and Magoh in the east.

Table 6.16 - Settlements and Population (1990) in the Kuba'an Cluster

(District Office, Baram)

No.	Settlement	Household	Population	Remark
1	Long Lobang	13	52	Settled
2	Ba Tik 'A'	8	35	Settled
3	Ba Tik 'B'	9	31	Settled
4	Ba Medamut	12	51	Semi-settled
5	Long Tah	10	33	Semi-settled
		52	**205**	

(b) The Tutoh Cluster

Eight settlements are located along the Tutoh River comprising 146 households and a population of 605 people. These settlements are Long Sabai, Long Taha, Ba Tepen, Long Siang, Ba Puak, Long Kawah, Long Iman, and Batu Bungan (Table 6.17). Long Sabai in the

Table 6.17 - Settlements and Population (1990) in the Tutoh Cluster
(District Office, Baram)

No.	Settlement	Household	Population	Remark
1	Long Sabai	22	100	Settled
2	Long Taha	13	47	Semi-settled
3	Ba Tepen	11	56	Nomadic
4	Long Siang	10	39	Settled
5	Ba Puak	16	50	Nomadic
6	Long Kawah	14	54	Settled
7	Long Iman	32	183	Settled
8	Batu Bungan	28	106	Settled
		146	**605**	

upper Tutoh can be reached in one day from the Kelabit settlement of Long Lellang. The journey involves a 4-hour trek from Long Lellang to Aro Kangan, and from there a couple of hours by outboard motor to Long Sabai.

Long Taha, Long Siang, Ba Puak and Long Kawah are accessible from Long Lama in one day by 4WD vehicle on logging road. There are traditional footpaths linking these settlements to Long Sabai, the Kuba'an, and Magoh area.

To reach Ba Tepen one needs to walk on foot from Long Taha through the forest along the Tepen River going in the north direction. The walk will take one day. Batu Bungan and Long Iman are located outside the Mulu N.P., and can be reached by air from Miri to the national park, followed by a short boat trip.

(c) The Magoh Cluster

Table 6.18 shows the numbers of settlements and populations in this cluster. To reach these villages one needs to take a small plane from Marudi to the Kelabit settlement of Long Seridan and from there walk on foot. The walking time takes from half a day to about a day depending on the distances. These settlements are linked to other Penan settlements on the Tutoh and Kuba'an by a number of footpaths.

Table 6.18 - Settlements and Population (1990) in the Magoh Cluster
(District Office, Baram)

No.	Settlement	Household	Population	Remark
1	Long Ludin	9	59	Settled
2	Long Mera'an	16	108	Settled
3	Ba'Bala	29	110	Settled
4	Ba Ubong	9	48	Nomadic
5	Ba Bareh	8	38	Nomadic
6	Ba Magoh	6	39	Nomadic
		77	**401**	

(d) The Upper Baram Cluster

This cluster comprises three settlements in the upper Baram with a population of 880 (Table 6.19). The settlements can be reached by logging road from Long Lapok on the Tinjar in one day. One can also take a small plane from Marudi to the Sa'ban settlement of Long Banga, and from there walk to the settlements. There is also a footpath linking these settlements to Bario in the north and Lio Matu down the Baram River.

Table 6.19 - Settlements and Population (1990) in the Upper Baram Cluster
(District Office, Baram)

	Settlement	Household	Population	Remark
1	Long Lamai	133	544	Settled
2	Long Beruang	55	255	Settled
3	Ba Lai	12	81	Settled
		200	**880**	

(e) The Silat Cluster

These are the Western Penan settlements located in the Silat River, comprising 179 households and a population of 752 people (Table 6.20). They can be reached by logging road from Long Lapok in one day. They are linked to several Kenyah settlements in the Baram by river. There is also a traditional footpath linking them to other Western Penan villages in the Belaga District, especially those in the Plieran and Danum rivers.

Table 6.20 - Settlements and Population (1990) in the Silat Cluster
(District Office, Baram)

	Settlement	Household	Population	Remark
1	Long Jekitan	79	339	Settled
2	Long Tikan	20	107	Settled
3	Ba Purau	56	228	Settled
4	Long Bee	24	78	Settled
		179	**752**	

(f) The Long Napir Cluster

This is one of the smallest clusters with 291 people (Table 6.21). The settlements are accessible by longboat and also by logging road from the small town of Ng Medamit on the Limbang within half a day.

Table 6.21- Settlements and Population (1990) in the Long Napir Cluster
(District Office, Limbang)

	Settlement	Household	Population	Remark
1	Long Napir	24	114	Settled
2	Tegaan	11	57	Settled
3	Ketadam	10	47	Settled
4	Long Sulong	7	32	Settled
5	Long Rayeh	19	41	Settled
		62	**291**	

(g) The Adang Cluster

There are 5 settlements comprising 43 households and a population of 175 people (Table 6.22). They can be reached in one day by logging road from the town of Lawas. There are also various footpaths linking these Penan settlements groups on the Adang and Magoh rivers.

Table 6.22 - Settlements and Population (1990) in the Adang Cluster
(District Office, Limbang)

	Settlement	Household	Population	Remark
1	Long Adang	12	55	Settled
2	Long Kenang	7	29	Settled
3	Long Peresik	14	55	Settled
4	Long Pusit	7	26	Settled
5	Ba' Ureu	3	10	Nomadic
		43	**175**	

(i) Livelihood of the Penan

(a) Nomadic Penan

The six groups of nomadic Penan comprise 53 families and 241 individuals, with five groups in the Tutoh and Magoh watersheds between the Gunung Mulu National Park and Pulong Tau National Park, and one in the Adang River. They are hunters and gatherers and depend solely on the forest for their livelihoods. Their staple food is wild sago (*Eugeissona utilis*) supplemented by meat, especially wild boar and fish; and wild vegetables including shoots of bamboo and various types of wild palms. They also eat a lot of wild fruits. The fruit season is a period of abundance in food resource as this is the time when game animals, especially wild boars are plentiful.

Logging has affected the volume of food resources in the forest, making it difficult for them to obtain food. The exact impact of logging on the livelihoods of the people is difficult to determine as there are no studies done to address the issue.

The nomadic Penan of Ba Puak in the ulu Tutoh planted 1,200 wild sago trees a year or so ago in the vicinity of two streams - the Kemawah and Selulong, tributaries of the Puak River. This project was assisted by a local NGO - a branch of the Non Timber Forest Products Exchange Programme for South and South East Asia, with funding from IUCN. The ones they planted around their camp are thriving well, but a few of the plants located far from the camp had been eaten or destroyed by animals.

Rattan is an important resource for weaving into mats and baskets for domestic use and for sale. These are their main source of cash income. One trader from Long Lama on the Baram, and another from Long Bedian on the Apoh occasionally organize barter trade meetings with nomadic and semi-settled Penan in the Tutoh-Magoh area. Gaharu or scented wood (*Aquilaria* spp.) is an important jungle produce that is sold to middlemen for cash. During the gaharu boom in the 1980s, the Penan made a lot of money, but this resource is now largely depleted.

The forest is virtually their home; it is where they build their camp huts, look for food and all other resources that they need. As more forest areas are open for major economic activities like logging and plantation development, survival of the Penan people in the area will be further affected. Perhaps there should be options to assist or enable them to sustain their livelihoods in the future.

(b) Semi-Settled Penan

This group has a population of 134 people living in 35 households. Two villages are found in the Kuba'an adjacent to the Pulong Tau National Park, and one in the Tutoh just below the mouth of the Kuba'an. Apart from having established a more permanent place to live and starting to cultivate paddy and cassava, their way of life is much like that of the nomadic group. Being newly settled, many are handicapped by the lack of knowledge and skill in crop cultivation.

(c) Settled Penan

The history of settlement is as follows:

- Long Lamai and Long Beruang groups began to settle around the mid 1950s;
- Ba Lai, Long Sabai, Long Lobang, Ba Tik 'A', Long Iman, Ba Balau, Long Napir; and the four Western Penan groups of Long Jekitan, Long Tikan, Ba Purau, and Long Bee began to settle in the late 1960s;
- Batu Bungan, Long Kawah, Tega'an, and Ketadam in the early 1980s;
- Ba Tik 'B', Long Ludin, Long Mera'an, Long Sulong, Long Rayeh, Long Adang, Long Kenang, Long Perisik, Long Pusit, and Long Siang in the mid-1990s.

All the settled Penan have adopted cultivation of mainly hill paddy. Their success in adapting to their new life depends on a number of factors like length of settlement, relationship with neighbouring settled communities, such as Kayan, Kenyah, Kelabit, etc; and cohesiveness of the communities.

Most of the earlier settlers in the 1950s and 1960s are self-sufficient in rice; many households have started wet paddy cultivation due to influence by their Kelabit and Sa'ban neighbours. Those that do not produce enough rice supplement their diet with cassava and wild sago.

Groups that settled in the 1980s and 1990s are still in the process of learning the technique of hill paddy cultivation. Presently they rotate their diet on rice, cassava and sago.

The settled Penan in the HoB area have not started cultivation of cash crops. Their source of cash income comes from the sale of rattan mats and baskets, and gaharu whenever this is available, and now the resource is fast depleting. They earn their cash income by making and selling *parang* (bush knives) besides rattan mats and baskets. They are perhaps the best weavers in the whole island of Borneo. Through the ITTO-supported project in the Pulong Tau N.P. some villages have been provided with gravity-feed water supply, and toilet and bathing facilities (Chai, *pers.comm.*)

Four settlements with primary schools are shown in Table 6.23. Neighbouring settlements without schools send their children here. Many Penan parents also send their children to other schools located in various parts of the highlands (Table 6.24). One other school is located outside the HoB area in the Penan settlement of Long Kevok.

Table 6.23 - Primary Schools in Penan Settlements in HoB

	Location of School	Settlements using the School
1	SK Long Lamai	Lg Lamai
2	SK Long Napir	Lg Napir, Tega'an, Ketadam, Lg Sulong, Lg Rayeh, Lg Adang, Lg Kenang, Lg Pusit, Lg Perisik
3	SK Batu Bungan	Batu Bungan, Lg Iman
4	SK Long Jekitan	Lg Jekitan, Lg Tikan, Ba Purau, Lg Bee

Table 6.24 - Primary Schools in Neighbouring Villages that Penan utilize

	Location of School	Settlements using the School
1	SK Bario	Lg Lobang, Ba Tik 'A', Ba Tik 'B', Ba Medamut, Lg Tah
2	SK Long Lellang	Lg Sabai
3	SK Long Seridan	Ba Balau, Lg Ludin, Lg Mera'an
4	SK Long Banga	Lg Beruang, Ba Lai
5	SK Long Kevok	Lg Kawah, Lg Siang, Lg Taha

Health services are still inadequate. Of the two Rural Health Centres in the HoB area one is located at Batu Bungan near Gunung Mulu N.P., catering mainly for the Penan of Batu Bungan and Long Iman. The other at Long Jekitan is used by the people from Lg Jekitan, Lg Tikan, Ba Purau and Lg Bee. Table 6.25 shows other clinics that are visited by the Penan populations. Flying doctor service visits Ba Tik 'A' to treat the sick and distribute medicines to the people in nearby settlements. Some Penan volunteers have received basic health training to enable them to dispense medicines upon request.

More and more Penan families are seeking medical and maternity treatments like child birth in hospitals in Marudi, Miri and Limbang. The problem is that they often just have enough money to get them to the towns, but are left with little or no cash for food and accommodation and to pay hospital fees. The men will try to look for odd jobs while in the towns but often with little success.

Table 6.25 - Rural Health Centres in Neighbouring Villages visited by the Penan

	Location of Rural Health Centre	Settlements utilizing the Rural Health Centre
1	RHC Bario	Lg Lobang, Ba Tik 'A', Ba Tik 'B', Ba Medamut, Lg Tah, Ba Tepen
2	RHC Long Lellang	Long Sabai
3	RHC Long Banga	Lg Lamai, Lg Beruang, Ba Lai
4	RHC Long Seridan	Ba Balau, Lg Ludin, Lg Mera'an, Ba Magoh, Ba Bareh, Ba Ubong
5	RHC Long Bedian	Lg Kawah, Lg Siang, Lg Taha, Ba Puak, Ba Bareh
6	RHC Long Kevok	Lg Kawah, Lg Siang, Lg Taha, Ba Puak, Ba Bareh

4. SOCIAL ORGANIZATION OF THE HIGHLAND COMMUNITIES

The Kelabit, Lun Bawang and Penan share more or less the same pattern of social organization and village/settlement institutions which are described below.

1. The Household

The household is the basic unit of production, consumption and education. It is a corporate group that owns for instance the apartment/house, various kinds of work implements, farmlands, etc. It is also responsible, together with members of fellow villagers, for bringing up the children to become useful members of the community. A nuclear family is the norm, and extended family is rare. The average family size is 6 people.

2. The Village/Settlement

Each village or settlement is the primary unit of social and political identity with its own headman and village development committee. The office of *Ketua Kampung* (Headman) is the most important institution at the village level. The holder of the office is the intermediary between the villagers and the government as well as outsiders, presides over the general affairs of the village and acts as an arbitrator to settle disputes between members. He is expected to be knowledgeable in the customs and traditions of the community, and commands the respect of the people. Above the *Ketua Kampung* is the *Penghulu* (Regional Chief). An important role of the *Penghulu* is to maintain cordial relations between villages under his or her jurisdiction.

3. JawatanKuasa Kemajuan dan Keselamatan Kampung (JKKK)

This is the Village Development and Security Committee that is headed by the *Ketua Kampung*. Among the Penan, only the settled communities have JKKK. The JKKK in each village is responsible for the general development of the village, social welfare, and health and security. It oversees the implementation of minor rural development projects such as gravity-feed water supply, cement walkways, footpaths, small bridges, and sport facilities like badminton courts or football fields. Sub-committees may be formed depending on the needs of villages. How active a JKKK is varies from village to village.

4. The Church

The Kelabit, Lun Bawang and Penan are Christians belonging to the *Sidang Injil Borneo* (SIB) or Evangelical Congregation of Borneo. The church *(gereja)* is one of the most

important institutions in the village and is headed by a Pastor. Apart from spiritual activities, a lot of social activities revolve around the church. Economic and social activities are announced in the church during services. It also acts as a centre for the dissemination and exchange of information, where members renew their commitments to the well-being of the village, and is a source of solace and support in time of crisis.

5. Facilities and Services

Basic facilities are often provided for in centrally located villages, and include the office of the Upriver Agent (an extension of the District Office), schools, rural health centres, and agriculture and police stations. These have been discussed earlier.

6. Agricultural Practices

Farming or rice cultivation is the most important activity in the highlands among the Lun Bawang and Kelabit. Farm work is done on a co-operative basis, through a work group known as *ruyud* (Lun Bawang) or *baya* (Kelabit), with each group comprising 4 or 6 households. Members of each group work on each other's farm on a rotational basis. The advantages of this system are that it keeps the community working together, the weak will benefit from the labour of the strong, and boredom of working alone is avoided.

When a member's farm work is not completed within the rotation period, there are a number of options open to gather a work force to complete the work. One is to throw an agricultural feast where the owner of the farm slaughters a pig or buffalo to feed the volunteer workers who have come to provide free labour to complete the work. Another is for the farmer to invite the church congregation to work on the farm, and the farm owner contributes to the church a sum of money equivalent to the amount that he or she would have to spend to organize an agricultural feast to feed the volunteers.

7. Grassroot Initiative

In 2003, the borderland peoples, comprising the Lun Dayeh of Krayan in East Kalimantan and Long Pasia in Sabah; and the Kelabit and Lun Bawang of Bario, Ba'kelalan and Long Semado in Sarawak, formed an informal trans-boundary network of communication and information to help steer development in the highlands in ways that are sustainable and suitable to their needs and aspirations. This initiative is indicative of the people's interest in matters pertaining to sustainable development and conservation of the environment. The communities along the Sarawak-Sabah-East Kalimantan border have long standing ethnic and kinship ties with each other and a long established trans-border trading network.

5. DEPENDENCY ON FOREST RESOURCES

1. Use of Forest Resources

Under the existing situation, dependency of the local population upon the forests and their resources can, in fact, be seen from many angles, be that in cash terms (cash income), in dietary terms (amount of food or nutritional importance), in seasonal terms (can be safety measures in times of bad weather or drought), or in gendered or age specific terms.

Although no detail study has been done, there are clear indications that the communities in the neighbouring areas are definitely, and on varying scale, dependent on the forest for their sustenance and livelihoods. Practically, most of the materials that they need for their daily use, especially timber for building their houses, have been obtained from the nearby forests.

2. Hunting and Fishing

These are important activities that provide food and help to generate cash incomes. Among the most frequently hunted game animals are the wild boar *(Sus barbatus)*, rusa (*Cervus unicolor*), kijang (*Muntiacus munjak*), and other smaller animals. Wild boar is the most common and popular species. The Kelabits and Lun Bawang mostly hunt with shot guns while the Penan normally use blowpipes with the help of hunting dogs, or by traps or snares.

Various types of fish are caught, and the main ones include ikan semah (*Tor duronensis)*, tenggadak (*Puntius schwanenfeldi*), baong (*Mystus* spp.). These fishes are considered indigenous to the respective areas as some of them are not found in other rivers. Semah and tenggadak are very high value fish that may be sold at between RM 100 and RM 300 per kg in the towns.

Fishing activities are confined mainly to rivers nearby their respective villages, and very few of the households occasionally go fishing in other rivers or in areas within the national parks. It is not uncommon for many of them to go fishing almost daily but just for a few hours to get supply for immediate consumption. Being aware of the need to ensure a continuous supply of the resource in their rivers, most of the villagers use the traditional methods of fishing, such as using fishing lines and cast nets or drift nets.

The main problems facing the rural populations are over hunting and over fishing, depletion of game and fish resources due to logging and plantation development, and river pollution.

3. Non-timber Forest Products

Another important activity that helps to supplement household cash income and food supply is the collection of other non-timber forest products like rattan for making mats, baskets and handicrafts; wild vegetables, indigenous fruits, medicinal plants and others. They have an intimate knowledge of the forests, and know exactly the types of ferns, gingers, bamboo shoots, palm shoots, fungi and numerous other plants that can be eaten or used as medicine. A study of the ethnobotany of the Kelabit community in Bario and Iban community in Nanga Sumpa in Batang Ai was carried out by Christensen (2002); and more than 1,000 species were recorded. A forest resource utilization survey under the Pulong Tau N.P. project in 2006 has documented more than 250 species of plants, 13 species of fish and 19 mammals used by the Penan communities in the vicinities of the National Park.

4. Timber for Building Materials and Fuel

The local communities require timber for building houses, and collect firewood for cooking. Like other communities, construction of a house is a social obligation, especially for new families. Their socio-economic status can also be judged based on the types and sizes of the houses that individual families can afford to build. In view of the distance from the nearest towns and transportation problem, it is almost impossible to bring the necessary building

materials to their areas. Most will have no choice but to obtain their building materialsfrom nearby forests.

Fuelwood is important for all the rural communities, and particularly for villagers involved in the processing of natural salt in Bario and Ba'kelalan. Liquefied natural gas (LNG) is available but many households can ill afford it. One tank of LNG costs RM150 in Bario and RM50 in Ba'kelalan. Many Kelabit and Lun Bawang familes are already faced with the problem of shortage of fuelwood around their villages.

6. LOCAL COMMUNITIES AND FORESTS

1. Perceptions on the Forests and Nature Conservation

Being a part of their immediate environment, the forests and their resources occupy an important place in the minds of the rural communities. To the Iban, the forests are their *pakai menua* or *kampong galau* (community forest or forest for future use). The forests are *pulong tau* (our forest) to the Kelabit and Lun Bawang. To the Penan, the forests are their home and 'supermarket', as described by one community leader. Thus strong attachements to the forest still prevail among the rural populations. Due to their strong association with nature, the various ethnic communities have largely come to understand the need to use the resources in a sustainable way, taking only what they need and leaving the rest for the future – long before the modern concept of sustainable management was introduced.

Gunung Mulu N.P. and Pulong Tau N.P. are important traditional and cultural landmarks of the highland people. Socio-economic study in the northern highlands (Jiram, 2007), indicated that 87% of the surveyed households in Bario, Ba'kelalan, Long Lellang and Long Sabai areas agreed with the establishment of the Pulong Tau N.P. (Table 6.26). The creation of the Pulong Tau N.P. was in fact at the initial request of the Kelabit community in Bario in the 1980s. The same feeling was expressed by the Penan community (Tipot *et al.* 2006). The people also want the adjacent area of Batu Lawi to be included in the national park. One main reason for the strong support was the fear that more forests might be licensed for commercial logging thus causing further damage to their environment and depleting the available resources.

Table 6.26 - Percentage of Households that supported Establishment of PTNP

Agreed with Establishment of PTNP	Bario		Ba Kelala		Long Lellang-Long Sabai		Overall	
	Freq	%	Freq	%	Freq	%	Freq	%
1	33	77	26	93	23	100	82	87
2	6	14	0	0	0	0	6	6
3	4	9	2	7	0	0	6	6
Total	**43**	**100**	**28**	**100**	**23**	**100**	**94**	**100**

n=43 n=28 n=23 n=94

Code: 1.Agreed; 2. Disagreed; 3. Not Sure

Within the HoB area, the lowland Iban communities in the southern region are closely associated with the Lanjak Entimau Wildlife Sanctuary and Batang Ai N.P. Based on the socio-economic survey of LEWS (Jiram, 1994), an overwhelming 92% of the surveyed Iban

households supported conservation, as they believed that LEWS and BANP would benefit the whole community.

In spite of living close to the TPAs, the people's main targets of exploitation are the forests that are located in the immediate vicinity of their settlements, including old secondary forests and forests affected by logging. Many of the communities around LEWS, BANP and Mulu have been granted special privileges to collect timber and jungle produce in the TPAs for domestic consumption only, but this has rarely led to any serious abuse of the privileges as the people have largely come to realize the importance of these forests to their lives. Their main concerns are dwindling forest resources over the years, and pollution of the rivers and water resource.

6.6.2 Impacts of Logging

There is without a doubt that commercial logging has impacted on the environment and affected the livelihoods of the local communities. The most direct impacts are damage to the forests and natural landscapes, causing depletion of resources, soil erosion and sedimentation of waterways. Forests that have been their regular sources of materials, protein and plant produce, as well as water catchments, have been reduced or badly affected. Better access has also allowed illegal hunters and fishermen from outside to come into the area.

On the other hand, the people have also benefitted from logging. Logging roads have provided easier access and made travel to other settlements and the towns much faster. Due to the recent oil price increase that resulted in cancellation of rural chartered flights and high cost of transportation, the people of Bario and Ba Kelelan almost had to rely entirely on the timber roads to bring in fuel, gas, materials and food from Miri or Lawas. The timber industry has also created opportunities for employment; and farmers have been able to sell their farm or jungle products to the timber workers for cash.

Many timber companies provide free transport for the people to go to the towns or nearby clinics or schools. Other assistance include free materials for house construction, gravity feed water supply, generators, construction of *sawa* or wet paddy farms, fish ponds, and access roads to the settlements, etc. The companies also ensure that the people's water catchments are protected.

7. PROBLEMS FACED BY THE LOCAL COMMUNITIES

Based on socio-economics surveys under the ITTO projects in LEWS, BANP and PTNP, the common problems faced by the various communities may be summarized as follows:

1. Lack of Infrastructure

Most people in the lowlands have to depend on river travels; and those in the highlands on infrequent rural flights and timber roads during good weather. The results are the very high cost of foods, materials and fuel and gas in the rural areas; and no easy access to market their products.

2. Increasing Scarcity of Wild Protein and Water Resources

The people's experience in the past 5 to 10 years has indicated that game animals and fish have been on the steady decrease due mainly to logging and plantation activities. Malnutrition among the rural communities is quite widespread, especially those who depend largely on the forests for their sustenance. Water is obtained directly from rivers and streams. Clean water supply may often be affected by logging activities nearby.

3. Limited Suitable Land for Farming

This problem is faced by many of the Iban and highland communities, particularly those that are practising shifting agriculture. The main causes are difficult terrain and poor skeletal soils. Access provided by logging roads has enabled many farmers to move to the license areas and farm along the roadsides.

4. Lack of Basic Amenities and Social Services

These include schools and clinics, electricity and water supply, and telecommunication. As the settlements are widely scattered and access is extremely difficult, it is not possible for the government to provide these facitities to all of them. The Penan communities, in particular, live in small scattered communities in remote areas, making it impractical for the government to build schools or clinics for them. Parents have to send their children to school in places like Bario and Long Lellang, and often stay with them for the entire term. Some Penan villages are visited by the Flying Doctor Service.

5. Limited Opportunities to Earn a Living

This is caused by remoteness and isolation from the mainstream of development. Limited opportunites for employment are provided mainly by the timber and plantation industries. Thus the people have little choice but to depend on agriculture and forests to meet their everyday needs.

6. Lack of Manpower

The increasing trend of rural-to-urban migration has resulted in a shortage of manpower to work in the farms. In Bario, for example, wet paddy farming has slacked due to a lack of labour. In fact, 87% of the surveyed households in Bario have expressed labour shortage as a very serious problem (Jiram, 2007).

8. POTENTIAL BENEFITS OF THE HoB PROJECT

Promoting community welfare is an important agenda of the HoB Initiative. Government agencies like the Forest Department Sarawak and Sarawak Forestry Corporation have become more aware of the crucial roles of the local communities in conservation and sustainable forest management. In recognizing the people's problems and needs, the government has been actively promoting community development projects to benefit the local populations, either on their own, or in collaboration with international agencies like the ITTO and UNDP or GEF. Under the HoB Initiative, more such activities will be proposed, and capacity building will be emphasized, so the people will be better prepared to participate in socio-economic development projects planned by the govenment.

Another potential is agro-forestry development. Although it has never been part of their culture to plant trees, agro-forestry practices have been widely undertaken by the

communities. For example, among the Iban community, after hill paddy planting, fruit trees and rubber trees are planted to maintain their usufructuary rights over their *temuda*. With strong attachment to their land, the villagers should be interested in various agro-forestry projects as they help to maintain their ownership rights, and at the same time, rehabilitate their *temuda* for economic purposes. Besides, the longhouse communities are experiencing a rapid socio-economic change, and even those in the remote areas are slowly being absorbed into the market-oriented cash economy. Consequently, any effort to diversify their economic base into agro-forestry should be attractive given the necessary assistance and incentives.

CHAPTER VII – ECOTOURISM

1. INTRODUCTION

The Heart of Borneo project is a long-term conservation initiative that will contribute to the protection of the physical environment and rich biodiversities of central Borneo. The initiative will serve to enhance the conservation of one of the oldest tropical rainforests on earth. Sarawak has large areas of land under various types of forest and the most number of Totally Protected Areas (TPAs) in Malaysia – 20 national parks, 4 wildlife sanctuaries and 5 nature reserves. The national parks and nature reserves are sites for passive and active nature-based recreation or ecotourism, conservation and research. Wildlife sanctuaries are primarily for conservation and research, but limited ecotourism may be permitted. Since the late 1960s, tourism has been part of the Sarawak landscape. It started with rural tourism based mainly on native cultures and longhouses. This concept was later expanded to encompass culture, adventure and nature or CAN. The CAN tourism is also known as ecotourism as it fulfills and meets all the requirements of the ecotourism concept.

2. TOURISM INDUSTRY IN SARAWAK

The tourism industry is the second most important industry for Malaysia after manufacturing. In Sarawak, it is still considered as a young and small industry of great potentials. Good and suitable facilities and greater accessibility, especially air-linkages from various destinations (local and international), are necessary to further develop or boost the industry. Lack of good infrastructure poses a hindrance to promoting ecotourism in the remote rural areas.

Foreign visitor arrival has exceeded the two million mark in the last four years, and it was projected that arrival in 2008 would increase by at least 15%. This did not include visitors from Semenanjung Malaysia and the State of Sabah, which averages around 800,000 per annum (Table 7.1).

Table 7.1 - Yearly Visitor Arrival to Sarawak (million)

YEAR	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Foreign Visitors	0.75	1.04	1.03	1.15	1.38	1.43	1.49	1.66	1.73	1.68	2.24	2.26	2.03	2.41
Malaysian Visitors (Peninsula Malaysia, Sabah, Sarawak*)	1.390	1.094	2.032	2.078	1.885	1.876	1.790	1.823	1.939	1.622	2.030	2.218	2.418	2.915

*50% of Malaysian are Sarawakian (*Source: Ministry of Urban Development & Tourism*)

The three-fold increase in tourist numbers between 1994 and 2007 is a good indicator of the potential of the tourism industry in the State. The increase in the number, especially among foreign tourists (who normally have a higher purchasing power), has generated higher revenue (about RM3 billion in 2007) and larger multiplier effects, while helping to create more business and a myriad of job opportunities. It has also uplifted the income level of those who are directly or indirectly involved in the industry, in the urban and rural areas. In order to

maintain the socio-economic function of the industry in the State's economy, it is1important to ensure that 'sustainable tourism' is practised across the board by all stakeholders.

Sarawak has been marketed as a premier destination for culture, adventure and nature (CAN) based on the products identified by the Second Sarawak Tourism Master Plan 1993. The State has the largest forested area, with a spectacular spectrum of national parks and nature reserves, and large rivers and scenic highlands that are suited for CAN to flourish and grow. In particular, the totally protected national parks and nature reserves, with their unspoiled and pristine environment, are great ecotourism assets that can be aggressively promoted. Local community participation has also been increasingly recognized as an essential element in ecotourism, especially in the rural areas.

Although foreign visitor arrival has been on the increase, only a small percentage has ventured into the rural areas, to visit the many national parks and longhouses.

7.3 ECOTOURISM POTENTIALS IN THE HoB AREA

Ceballos Lascurain (1993) defined ecotourism as "environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features, both past and present), that promotes conservation, has low visitors impact and provides for beneficially active socio-economic involvement of local populations."

There is immense potential for ecotourism in HoB area because it contains some of the largest and most important national parks in the State. These are the Batang Ai N.P. and Lanjak Entimau Wildlife Sanctuary (LEWS) in the south; and Gunung Mulu N.P., Gunung Buda N.P. and Pulong Tau N.P. in the northern highlands in Ulu Baram (see Table 4.8).

Together with the permanent forest estate (PFE) and other forested lands, the area is also extremely high in biodiversity. The flora and fauna of Gunung Mulu N.P., Pulong Tau N.P., Batang Ai N.P and Lanjak Entimau W.S. have been documented, and are summarized in Chapters IV and V. For example, Pulong Tau National Park has 315 bird species out of 535 in Sarawak (total for Borneo is 620 species), 58 mammal species and 84 fish species; and 151 species of orchids, 18 species of rhododendrons and 9 species of pitcher plants.

LEWS and BANP in the south are home to the rare and endangered orangutan, and the Hose's langur, maroon langur and white-fronted langur that are among the rarest in the world. The conservation value of the TPAs is therefore enormous and ecotourism, which is a tool for conservation, is the most appropriate type of tourism in the HoB.

The north-eastern portion of the HoB is also unique in its geological formations, and comprises Sarawak's two highest mountains namely, Gunung Murud (2,424 m) and Gunung Mulu (2,317 m). The Maligan Highland and Kelabit Highland – collectively called the Northern Highlands - are located here. The national parks and their ecotourism potentials are described below.

1. Batang Ai National Park

Before this national park was gazetted in 1991, the area was occupied by the Iban communities of Batang Ai for many generations. For their subsistence, the Iban settlers were engaged in shifting agriculture of hill paddy. As a result, about 60% of the national park is covered by secondary forest of varying ages (Chapter IV). Nevertheless, BANP, together with the LEWS adjacent to it, is the most important habitat in Sarawak for the orangutan population totaling about 1,400 individuals.

Ecotourism was first introduced in the Batang Ai-Skrang region in the late 1960s by the private sector, essentially as a culture-based tourism with its focus on the Iban cultures. In 1984, a large lake was created for the development of the Batang Ai Dam for hydro electricity. An international standard hotel (based on the longhouse concept) was built to promote the lake as a new tourist attraction. However, water-based activities, including boating or kayaking and line fishing or angling, are yet to be properly organized and aggressively promoted.

In spite of the magnificent man-made lake and the national park, ecotourism to-day is still very much culture based. Tourists visit the area mainly for the home stay and cultural experience in longhouses in the Batang Ai and Skrang areas. The Iban are well known for their skills in traditional weaving and handicraft making, *ngajat* dancing with gong music, and preparation of delicious foods from jungle produce. Tourists who stay at Nanga Sumpa longhouse near the dam also get to enjoy rapid shooting, outdoor camping, and watching of orangutan in the wild, but outside the national park.

The ecotourism potential of BANP lies in its natural environment and rich wildlife. Orangutan watching in the wild would be a great attraction, and Lubang Baya has been identified as a good site. Other attractions are jungle trekking, river safari, and bird watching. To promote these activities, proper facilities like rest areas, jungle trails, animal hides and river transport must first be improved. Park guides must also be properly trained, and management on the ground strengthened.

The trip to Batang Ai involves a four to five hour drive from Kuching. Upon arrival at the dam, visitors are ferried to their respective destinations – Hilton Longhouse Hotel or longhouses – by boat.

2. Gunung Mulu National Park and Gunung Buda National Park

The Gunung Mulu N.P. first became known to the outside world as a result of the Joint Royal Geography Society (UK) - Sarawak Scientific Expedition that lasted 15 months in 1977/1978, followed later by a number of international speleogical or caving expeditions to its underground limestone caves. The park was declared a UNESCO World Heritage Site on 19 November 2000. Gunung Buda is essentially an integral part of the Melinau limestone complex, and is connected to Mulu. The area was declared a national park in 1991. Gunung Mulu N.P. covers an area of 52,000 ha, with its highest peak of Gunung Mulu (2,376 m) rising above the limestone peaks of Gunung Api and Gunung Benarat.

Apart from its extremely rich and diverse ecosystems and biodiversity, Mulu also boasts of one of the most complex underground cave systems in the world, including:

- The world's largest cave passage - the Deer Cave (120 m to 150 m wide);
- The world's largest cave chamber - the Sarawak Chamber (600 m long, 415 m wide and 80 m high) - big enough to accommodate 40 Boeing 747 arranged head to tail and wing to wing;
- The world's fifth longest underground cave system and Asia's longest - The Clearwater Cave (108 km long);
- The razor-sharp limestone pinnacles that rise to over 100 m on top of Gunung Api;
- The spectacular view of nearly a million bats that roll and twist like black clouds as they leave the Deer Cave every fine evening for the coast to feed on insects.

Cultural elements are provided by the Penan and Berawan communities living in the vicinity of Mulu N.P. The Penan, in particular, have become an integral part of the Mulu tours that include visits to their settlements at Batu Bungan and Long Iman.

Mulu can be easily reached by daily flights from Miri or Marudi, and also by river from Marudi. Visitor accommodation includes an international standard hotel and a number of cheaper hostel type accommodation managed by the park management and local entrepreneurs. The hotel and hostels owned by the locals are located outside the park.

7.3.3 Pulong Tau National Park

Pulong Tau in the Kelabit and Lun Bawang language means 'Our Forest'. This was the name the local people had chosen for the national park when it was first proposed. The park was gazetted in 2005, comprising an area of about 60,000 ha, and is topped by Gunung Murud which at 2,424 m is the highest mountain in the State.

Although Pulong Tau lacks the elements of limestone and caves, recent studies by an ITTO-supported project have confirmed that the park equals Mulu in its ecology and diversity of highland and montane flora and fauna. Together, the two parks will ensure a full protection of the highlands' biodiversity.

Three inland communities live in the vicinity of the park. They are the Kelabit community in the Kelabit highland, the Lun Bawang community in the Maligan highland, and small settlements of Penan that are scattered around the periphery of the park.

These northern highlands are well known for their cooler climate that averages around 28 degrees maximum during the day. The Kelabit settlement of Bario has been a popular place for visitors since at least three decades ago, although visitor arrival has been very small even to the present day. Apart from the rich Kelabit culture and hospitality, Bario is also famous for its Bario rice, salt from inland salt springs, and sweet pineapples. In addition, the Kelabit Highland is an important site for a collection of megaliths that were surveyed and mapped for the first time in 2007 (Cluny and Chai, 2007). With proper development and management, these unique relics will provide added attraction to tourists.

The Lun Bawang farmers at Ba'kelalan also produce Bario rice in their wet paddy farms and make salt for sale to visitors. One local businessman has also established an apple orchard at the village of Budok Nor. Being situated near the foot of Murud, Ba'kelalan is also the gateway to the Pulong Tau N.P.

Tourism attractions in the highlands include:

- Diverse landforms and biodiversity of Pulong Tau N.P. One of the main reasons for visiting the park is to see and photograph nine species of pitcher plants, over 150 species of orchids, and 19 species of rhododendrons. Visitors will also be rewarded with a spectacular panoramic view of the surrounding landscapes and the unique rock gardens near the summit of Gunung Murud;

- The rich and diverse culture and traditions of the Kelabit, Lun Bawang and Penan communities. Local travel agents in Bario and Ba'Kelalan organize trekking tours to places of interest along a network of established jungle tracks that also connect Bario and Ba'Kelalan. Visits to Penan settlements are relatively less frequent;

- The large collection of megaliths of unknown age. These cultural relics made of stones are unique to Sarawak, and indeed to Malaysia. So far 40 sites have been located and mapped, but the number may reach over 100 once all the sites are discovered;

- Batu Lawi, located about 15 km west of Pulong Tau, is another landmark of significant geological and cultural importance. The mountain is characterized by its twin vertical peaks that rise majestically from the forest below. The proposal to include Batu Lawi as part of the extension to PTNP is under process.

Unlike Mulu, access and visitor facilities in the highlands and PTNP are limited. Bario is better connected by daily flights on 19-seater planes from Miri. For Ba' Kerala, only a twice-weekly flights from Miri or Lawas are available. Ba'Kelalan is further linked to Lawas by logging road; a five-hour journey long during fine weather. Local residents and visitors have been greatly inconvenienced by the recent cancellation of the 12-minute connecting flights between the two settlements. Now if the Bario and Ba'Kelalan residents wish to visit each other, they must first fly to Miri to take the flight from there.

A new logging road that was constructed several years ago is being extended to reach Bario. This has enabled the Kelabit people to transport materials and goods from Miri by road, a journey that takes at least eight hours during good weather. Prior to this, goods were brought to Bario only by air.

Local travel agents and entrepreneurs in Bario and Ba'Kelalan provide visitor accommodation, in the form of home stay or lodges. Visitors who occasionally make it to Murud will have to stay at the Church Camp located near the summit. The Camp consists of some 90 small simple huts or longhouse type accommodation built by followers of the Borneo Evangelical Mission, who trek up the mountain for several days' of religious retreat every two years.

The number of visitors to Gunung Mulu N.P. and Batang Ai N.P. is still small, although there has been a steady increase in the past few years (Table 7.2). Outside visitors to PTNP are presently limited to a few small groups each year.

7.3.4 Other Potential Areas

The proposed Danum-Linau N.P. in Ulu Kapit and Balleh N.P. in Ulu Belaga cover an area of over 30,000 ha and 22,000 ha respectively, and are located close to the international boundary with Kalimantan. Their potential for ecotourism will need to be studied once the parks are constituted.

Table 7.2 - Yearly Visitor Arrivals to National Parks in the HoB Area

		2001	2002	2003	2004	2005	2006	2007
MULU	Local	5424	7421	8164	11 250	11 727	11 395	8615
	Foreign	8435	8663	7882	15 487	12 009	12 677	11 273
BATANG AI	Local	100	171	61	54	64	64	154
	Foreign	324	388	260	230	289	126	252
All NP and NR	Local	298 179	243 223	186 634	244 062	263 325	233 926	246 311
	Foreign	51 577	50 607	41418	73442	78 896	78 486	83 205

(Source: Ministry of Urban Development and Tourism and Forest Department)

7.4 CONSTRAINTS IN ECOTOURISM DEVELOPMENT IN THE HoB AREA

Ecotourism denotes nature tourism with the element of sustainability introduced, and includes such criteria as (i) intact and relatively unimpaired or undisturbed natural areas, (ii) appreciation of nature, culture and traditions, (iii) promoting conservation, (iv) low impact and (v) involvement of local communities.

With some of the best national parks in the State, the HoB area has immense potential for development. The Batang Ai N.P., Gunung Mulu N.P. or Pulong Tau N.P. offer a complete package of experience that centres on nature, culture and adventure that is unique, but with more specific differences in the cultural element - with Batang Ai focusing on Iban community; Mulu on Penan and Berawan communities; and Pulong Tau on the Kelabit, Lun Bawang and Penan communities.

Ecotourism in the national parks is still rather slow, judging by the number of visitor arrival each year. G. Mulu N.P. is the most developed park that has been in existence for over 20 years, and quite aggressively promoted in the past 10 years. Yet, it was able to attract only about 20,000 visitors in 2007 (Table 7.3). Major constraints faced by the national parks in the HoB area are as follows:

(a) **Accessibility** - All the national parks are remotely located and difficult to get to in a short time. Only the very adventurous who have the time to travel will make these parks their holiday destinations;

(b) **High cost of travel** - Compared to other popular holiday destinations in the region, such as Thailand, Bali and Sabah, air travel to Kuching and Miri is not only less frequent, but also costs a lot more. After arriving at the cities, tourists will have to pay additional cost to get to places like Mulu or Bario. Inadequate flights with limited seats to the highlands, coupled with frequent cancellations due to weather and other reasons, are an added disadvantage. Road travel in the northern highlands, where available, is similarly unreliable, time consuming and expensive. In the southern

region, a tar-sealed road links Kuching to Lubok Antu, the gateway to the Batang Ai hydro lake and Batang Ai N.P. The suggestion to have an airstrip near Lubok Antu had been investigated by the Department of Civil Aviation, but no suitable site was available.

(c) **Inadequate infrastructure and tourist facilities** - Basic infrastructure and facilities are available in Mulu, but not in the other parks. For example, there is no visitor information and accommodation in Batang Ai N.P., while plank walks and jungle trails have not been well maintained. Being quite new, Pulong Tau N.P. is similarly lacking in facilities, and is without a proper rangers' station;

(d) **Limited networking and promotion** - Ecotourism in the highlands is pretty much confined to a small group of local operators in Bario and Ba'Kelalan. As far as can be ascertained, there is a lack of networking or cooperation with tour operators in the town area – either in promotion or in packaging of tours. Outside tour operators are not encouraged to bring in tourists. Cooperation among the local operators themselves also seems to be lacking;

(e) **Lack of local expertise** - This is a state wide phenomenon that is likely to pose a greater problem to ecotourism development especially in the HoB area. Out-migration among the better educated younger generations in the Iban, Kelabit and Lun Bawang communities has been on the increase. Another reason for loss of local manpower is also due to young parents who move to nearby towns or cities where their children are attending school, with many parents ending up settling down and seeking employment there. This is happening to a certain extent even among the Penan community. If ecotourism is to be realized, greater effort must be taken and certain incentives given to contain the problem of out-migration. There needs to be a long term programme or plan to train locals in various areas of ecotourism in order to avoid the influx of manpower from outside;

(f) **Financial constraints among local tour agents** – Local tour agents are normally responsible for identifying local attractions and products, and packaging and selling them to the outside market. This will require adequate funding which is very limited at the local level. Promotion is normally through the e-Bario website (in Bario) or by word of mouth. Development is limited to cutting and maintenance of a number of jungle trails. In Bario, a greater part of the investment is put into the cost of setting up the Bario trek (known as the Bario Loop), purchase of longboats and engines, four-wheel drive vehicles, and construction of lodges. The lodges can accommodate up to 20 people or more each, but are unfortunately under-occupied for most of the year. Being better connected to Lawas by road, tourist arrival to Ba' Kelalan is more regular; visitors come from West Malaysia, Brunei, and as far as Japan and Europe.

(g) **Loss of culture and traditions** – This loss is caused by a number of combined factors, like better infrastructure and facilities, such as communication and health care; improved economy, modernization, and better opportunities for education in the rural areas. The younger generations are either not interested in learning the knowledge and skills of their forefathers, or rarely have the opportunity to do so, as they are away in school most of the time. Gradual loss of traditional knowledge, skills in dancing, playing of musical instruments, weaving and handicraft making, and traditional uses of numerous forest plants can therefore be expected;

(h) **Lack of local participation in park management and ecotourism** – All of the national parks and wildlife sanctuaries are surrounded by longhouses or villages that have been in existence long before the parks or sanctuaries were constituted. Many communities are still depending on the forest for subsistence livelihoods. In order to be effective and successful, TPA management must involve local populations as co-partners. There are many ways in which the local people can participate in and benefit from ecotourism, such as planning and development of products, home stay programme and cultural activities, guiding, and in tour packaging;

(i) **Lack of management on the ground** – The TPAs in the HoB area occupy up to 31% of the total area of 2.03 million ha. There is a lack of management presence on the ground, like in the Batang Ai N.P. and Pulong Tau N.P. This is an issue that requires the urgent attention of the relevant authorities. Other than the normal park headquarters and rangers stations, rangers' posts will be needed, to be strategically located near settlements or main access points, and manned by trained local employees as assistant rangers. These posts will help to facilitate co-management between the park staff and local populations. These facilities are urgently needed for BANP and PTNP;

(j) **Logging and tree plantation development** – These activities have direct or indirect impacts on ecotourism, particularly where the timber licenses or plantations are located in the periphery of the national parks. Apart from damage to the vegetation, these activities also result in soil erosion and river pollution in nearby waterways. One recent example is the logging operation south-east of Bario that has affected the Bario tour because the forest in the Bario Loop has been affected, and Sg. Dappur where tourists go to is polluted as a result.

5. STRATEGIES FOR ECOTOURISM

Ecotourism should initially focus on Batang Ai N.P. and its vicinities, and Mulu N.P. and Pulong Tau N.P., including Bario and Ba Kelalan. It is important to bear in mind that the attractions provided by these parks will largely appeal to eco-tourists who are adventurous and have a love for travel, local culture and nature. The following strategies may be considered:

- Visitor facilities must be moderate but adequate, comfortable, safe and environmentally friendly, taking into consideration difficulties of access and very high cost of materials and transport in the rural areas;

- Strengthen management on the ground. Park Headquarters, rangers stations and rangers' posts must be constructed where necessary; and additional manpower (park wardens, park rangers) recruited, trained and posted to the field;

- Implement the concept of co-management by bringing local populations into the mainstream of development. Recruit and train suitable local graduates and school leavers in park management as well as in ecotourism;

- Assist and support local initiatives in ecotourism, such as the Iban communities in Batang Ai, the Berawan and Penan in Mulu, and the Kelabit, Lun Bawang and Penan communities around Pulong Tau. This support should be provided by the government through its ecotourism development master plans, in the form of infrastructure and facilities, development and maintenance of local products and culture, marketing and promotion;

- Help to sustain and promote local knowledge, culture and traditions by organizing seminars or workshops, regular training programmes to train young people in handicraft making, cultural dances and music and songs. It is also important that local knowledge among the various communities is documented and preserved through oral tradition;

- Encourage private sector participation. In Sarawak, many private investors and tour operators have been responsible for ecotourism development in the rural areas. Well known examples are the tour and home stay programmes in Batang Ai (Nanga Sumpa), Skrang and Lemanak in the south; and in Bario and Ba Kelalan in the north. Government support can include infrastructure development and financial incentives;

- Ensure that precious tourism products like the pristine rain forests, unique landforms and rivers, flora and fauna, and cultural sites (e.g. megaliths) are safely guarded. Close cooperation with the private sector is important, in particular the timber and plantation companies and the local communities, in environmental protection. Effective law enforcement can be made more effective through awareness programme and environmental education;

- Speed up the constitution of the proposed Danum-Linau N.P. and Balleh N.P., so that the local communities in these areas will be able to enjoy the benefits of ecotourism development in the near future;

- Last but not least, Sarawak's HoB strategies may consider and explore the possibilities of joint ecotourism development and promotion with Sabah, Brunei and Indonesia.

7.6 THE WAY FORWARD

The HoB has all the attractions of natural landscapes, pristine environment, diverse ethnic populations, unique cultures and traditions that are all important ingredients for ecotourism. The only effort is to take advantage of its potentials and prepare a comprehensive and holistic programme for planning and development. Once everything is in place, marketing and promotion will be the next logical step to take, by selling the products through various tour packages or marketing tools. This can be carried out by government agencies or tour operators themselves. The contents of the tour packages, especially the itineraries, must be flexible to cater to the needs of tourists from different regions and markets. This also applies to the duration of travel. For the preparation of tour packages, it is necessary to undertake market research, and to understand and know the profiles of each country in the different market places. For example, what is good for the European may not be good for the Chinese and *vice-versa*. The principle of 'matching the right products for the right markets' must be recognized during promotion and marketing.

To ensure success, it is of outmost importance to have a coordinating body or committee to coordinate various activities, so that participation of the local people is taken into account or guaranteed. The committee can consist of the local people, the operators, government agencies and non-governmental organizations (NGOs). The role of the government bodies is to guide and enforce certain requirements related to current laws, regulations and policies.

The willingness of the State Government to dedicate large areas under the HoB is proof that the State is sensitive to environmental conservation. There is a need to examine other areas outside the present boundary which are suitable to be included in HoB in the near future. This is important for the creation of flight corridor for avifauna and migration corridor for terrestrial animals.

Ecotourism's life span depends very much on the intrinsic and aesthetic values and health of the environment *in situ*. There are a few areas which need to be looked into in detail in the future planning and development. As has been mentioned earlier, the HoB area has all the potential ingredients to become an important site for this green and environmental friendly special niche tourism. To realize these potentials, efforts must be focused on key areas for regional ecotourism plan studies. This is to take stock of the existing infrastructure and facilities, human capital requirement, the local capacity to handle tourists, and participation in the business activities. Any recommendations from the studies in future should be implemented properly and effectively, and should not be compromised, lest the benefits of ecotourism would not be fully realized. Proper understanding of the principles of ecotourism and its effects on the rural population is of paramount importance. There must be an understanding on profit sharing of economic benefits among all partners, but not at the expense of the environment.

The key priority areas proposed for regional ecotourism studies are the Mulu-Buda-Ba' Kelalan-Bario-Pulong Tau Complex, and the Batang Ai/Skrang areas. The central region in the upper reaches of Baleh River in Kapit Division will be the next focus. The studies in the two key areas should be embarked upon as soon as possible, preferably by local experts from various government agencies, institutions of higher learning, relevant NGOs and individuals. The time frame should not be less than six months. The study will come up with recommendations on the various strategies, and the types of suitable and eco-friendly projects that can be implemented to boost the existing ecotourism industry in the two areas. The same is true for the central region.

The study should be carried out within two years from the start of the project which can be determined later. The study proposals will need to be coordinated and liaised properly with all relevant stakeholders, in order to reconcile ideas and synthesize pertinent local issues. The need to have consultative dialogue with various parties is critical to iron out all inherent problems that may exist. There are also certain requirements to be met with regards to the policy, planning and the State's laws.

In order to jump start the effort to boost the existing ecotourism industry in the area, it is necessary to initiate a few small projects *in situ*. The possibilities are many, but one must look into the immediate requirements of the industry. For example, there is a need to have more local guides, be it tour guides or specialized guides (Table 7.4). At present, most of these guides are urban based, except for those who are trained to guide in the national parks and nature reserves. Training of more guides can be implemented through short courses, to be held for a week at least twice a year. These courses are preferable to be held *in situ*, and

suitable local candidates must be included. Syllabus for the course can be tailor-made to fit the local environment.

Table 7.4 - Licensed Tourist Guides as in 2007

No.	Division / Districts	Status of License		Equity		Total
		Level 3 Tourist Guide	Level 2 Tourist Guide	Bumiputra	Non-Bumiputra	
1.	Kuching / Samarahan	115	22	54	83	137
2.	Sri Aman / Lubok Antu		2	2		2
3.	Sibu	5	2	2	5	7
4.	Kapit		7	6	1	7
5.	Miri	4	10	7	7	14
6.	Bario		12	12		12
7.	Ba' Kelalan		4	4		4
8.	Limbang	1	1	1	1	2
	Total	**125**	**60**	**88**	**97**	**184**

(Source: Sarawak Tourist Guides Association)

Other projects of no less importance are training for local communities in small businesses, in the areas of hospitality, food preparation and handicrafts. In order to support these activities, there must be sufficient local supplies of raw materials, in terms of food items and materials for weaving and so forth. Such supply of raw materials can be produced by embarking on specific agro-forestry projects. The local communities should be encouraged to assist in organic food production, and planting of bamboo and rattan. The latter is for the purpose of providing adequate raw materials for weaving and related handicrafts.

Since culture is part of ecotourism, it is also important and desirable to preserve the various ethnic cultures of the area. The new world order brought about by modernization has affected the way of life of the locals too. This inevitable change can affect their traditions and cultures. There must be effort to keep interests in local dances, and the new generations must be taught the art of cultural dancing inherited from their forefathers. The younger generations must be encouraged to be proud of their heritage.

All the above strategies and projects can be supported by the State and/or Federal funding. Fund can also be solicited from international donors or relevant NGOs. The private sectors namely, the tour operators themselves, should invest in some of the local projects, and even in marketing and promotion of products, domestically or overseas. As has been stated earlier, the packages must be flexible enough with different mixes, to be compatible with local conditions. The packages must value addition and be acceptable to local hosts. It is important not to over-emphasize the real situation *in situ*, in order to avoid dissatisfaction and negate the good experience expected or promised.

The overall intention to implement new strategies and related projects in the area is to create more job opportunities, so that migration of the young people from key areas to larger towns looking for jobs can be contained. Availability of human resource is an important factor to

consider if ecotourism is to develop further and succeed in the rural areas. There must be enough incentive to retain or encourage the young, literate and able bodies to stay put in the longhouses or villages. The industry should boost the interest of local people to make tourism a profession which is rewarding.

The overall ecotourism situation in the State is full of enthusiasm and people in the public and private sectors seem to realize that such tourism is important to the State's economy. But the government has yet to come out with a workable or doable comprehensive plan to really turn the industry as one of the engines of growth in the tourism sector. The business of ecotourism seems to be in an *ad hoc* situation, as players of the industry are not clear or focused on the right direction to follow. There are still many who do not understand or subscribe to the principles of ecotourism, as many seem to treat ecotourism as just bringing tourists to rural areas. There is a real danger that such an approach can turn ecotourism into mass tourism, and this can jeopardize efforts in maintaining the right environment for ecotourism.

CHAPTER VIII – PROJECT IDEAS

The project ideas that have been developed are considered relevant and necessary for Sarawak. Brief information is provided for each project idea so that it may be formulated into full project proposals for implementation to contribute to the objectives of the HoB Initiative. The project ideas are essential outputs of this study, as required in the Project Implementation Framework. They are presented in this Chapter in accordance with substantive chapters of this report. The general approach adopted in formulating these project ideas is explained in Section 1.5 of Chapter I of this report.

In the development of these project ideas into full project proposals for implementation, the need for capacity building, in terms of staffing of the implementing institutions, must be given due consideration. Additional staffing may be provided to ensure project sustainability, apart from ensuring the absorptive capacity of project results.

Many of these project ideas are to promote the welfare and well-being of local communities. In this respect, the Residents' Offices and District Offices should play an active role to ensure effectiveness in implementation.

SECTION 1 - AGRICULTURE

Project 1.1 Implementation of Organic Farming Pilot Project in the Kelabit and Maligan Highlands

Duration: Five years.

Justification: The main economic activity and source of livelihood of the highland communities is agriculture, which is essentially based on wet paddy cultivation (and buffalo rearing). In many areas of the highlands, it is the only source of their livelihood. It is therefore important that, while recognizing the fragility of the environment, agricultural development in the highlands shall focus on improving the economic livelihood of the local communities, and developing niche and/or high-value products that are economically viable, socially agreeable, and environmentally acceptable. One of the main strategic thrusts in enhancing agricultural production shall be directed at the improvement of the *Padi Adan* cultivation under the present smallholding system.

Objectives: The locally well-known Bario rice already fetches a premium price in the local market. The main objective is to add further value to or maintain the premium price of the produce.

Resources Needed:

- The DOA shall be the lead agency. Its research-extension services shall be strengthened to enhance the development and transfer of production technologies with respect to organic farming (e.g. integration with buffalo, duck and azolla). Azolla is an alga that has nitrogen fixing function;
- Once the whole production package is perfected, it could be transferred to other areas, with the possibility that the highlands could be declared an organic farming zone eventually;
- RM 250,000 or RM 50,000 per year for five years.

Implementation Strategy:

- Dedication of suitable areas for the production of organic rice for certain niche markets, and implementation of organic Bario rice accreditation scheme to promote the organic rice as specialty rice.

- Promotion of Bario rice as a specialty rice product through certification, quality control, and eventually branding to ensure genuineness, purity and superior quality. The DOA has already started with the Bario rice certification scheme that should endorse the authenticity of the rice. To meet the certified requirements of organic rice, follow the "Guidelines for Organic Farming".

Project 1.2 Improving Irrigation Systems in the Kelabit and Maligan Highlands

Duration: Five years.

Justification: One of the main strategic thrusts in enhancing agricultural production in the Kelabit and Maligan Highlands shall be directed at the improvement of the *Padi Adan* cultivation under the present smallholding system. Although the highlanders have been using some form of irrigation in their traditional practice of wet paddy cultivation, many of them still face problems in protecting the water supply catchment areas, ensuring a reliable source of water, and getting adequate irrigation water to their fields in a timely manner.

Objectives: The main objective is to improve the irrigation systems, making them more reliable and more efficient.

Resources Needed:

- The DOA shall be the lead agency. Its soil surveying and engineering services shall be strengthened and tasked to undertake this project. More detailed information on the topography and the existing paddy field layout are required to come out with concrete proposal for upgrading the irrigation system. This is site-specific; blanket and general approaches do not serve the relevancy of the proposal.
- The nature of the irrigation system from higher paddy fields to lower ones requires co-operation of all farmers concerned.
- Conservation of the water supply catchments also requires the assistance and co-operation of the timber licensees and the relevant authorities (e.g. Forest Department and Sarawak Forestry Corporation).
- It is estimated that the DOA shall require about RM 1.0 million or RM 200,000 per year, for five years.

Implementation Strategy:

- In upgrading the irrigation system, it is important that the source of irrigation water shall be protected. In other words, dedicated catchment areas should be preserved to ensure that there are adequate amounts of irrigation water throughout the growing season;
- Potable water and irrigation water usually do not share the same source; catchment areas for irrigation purpose may therefore be separately designated;
- The need to maintain water supply catchments for irrigation purpose often tends to be taken for granted. Forests in such areas should not be cleared by the local people (for shifting cultivation or turning them into buffalo grazing grounds), or logged by timber licensees or their contractors.

- DOA is aware of this and has identified villages that are facing serious water problem. Possible sites include: Long Komap, Long Karabangan, Long Beluyu, Long Semadoh Naseh, Long Telingan and Long Lopeng. In particular, the people of Long Semadoh area have requested for the upper catchment of Batang Trusan to be preserved for these purposes. The catchment area that they have in mind is shown in Figure 8.1.

Project 1.3 Buffalo Rearing in the Kelabit and Maligan Highlands

Duration: Five years.

Justification: The main economic activity and source of livelihood of the highland communities is agriculture, which is essentially based on buffalo rearing (and wet paddy cultivation). Buffalo rearing in the highlands, particularly in the Kelabit Highlands, shall therefore be intensified.

Objectives: The main objective is to intensify buffalo rearing as a means to improve the economic livelihood of the local communities.

Resources Needed:
- The DOA shall be the lead agency. In conjunction with this project, the DOA extension services should be strengthened, by upgrading the technical capability of the extension staff on buffalo rearing, pest and disease control, etc.;
- RM 1.0 million or RM 200,000 per year for five years.

Implementation Strategy:
- In order to build up the quality of the stock, good breeders from the existing stock shall be selected and, where necessary, others from outside the State shall be imported;
- Selected breeders shall be distributed to farmers through subsidy or some form of Pawah system. Training programmes should be formulated and carried out;
- While this initiative shall eventually involve all communities, it shall recognise that in some areas (especially at Ba Kelalan), availability of grazing land may be a problem, and that grazing land shall NOT be created at the expense of water supply catchments. In this respect, the Bario Highland shall probably be able to set aside a larger area for livestock development;
- Capable local buffalo grazers shall be selected and trained in general livestock husbandry;
- The present grazing system shall be improved by the development of better grazing lands and where necessary, the provision of supplementary feeds. Within the designated grazing lands, more nutritious grasses may be planted to replace coarse non-nutritious varieties such as lalang (*Imperata cylindrica*), in order to improve the pastures.

Project 1.4 Agricultural Extension Services in the HoB Area

Duration: Five years.

Justification: The main economic activity and source of livelihood of the HoB area is agriculture. In the areas outside the Kelabit and Maligan Highlands, it is essentially based on subsistence agriculture, particularly shifting cultivation of hill paddy. Amongst the settled Penan in particular, their knowledge of agriculture could be quite rudimentary and their level of skills very low. Hence, there is an urgent need to educate them and transfer the skills to

them. Assistance to the other subsistence farmers in the remote areas of Sarawak is of course equally important.

Objectives: The main objective is to intensify the agricultural extension services to the rural communities in the HoB Area, in order to improve their skills, enhance productivity and increase production.

Resources Needed:

- The DOA shall be the lead agency. To ensure the efficiency and effectiveness of crop project implementation, implementing agencies need to be strengthened in the areas of human resource development (HRD) and institutional arrangement.
- RM 500,000 or RM 100,000 per year for five years.

Implementation Strategy:

- There should be a strong linkage between research institutions and the extension organization of DOA to ensure effective delivery of technologies to the producers, and the timely feedback of problems and needs from the farms to the research institutions. The mechanism for such a linkage could be in a form of a research-extension team working together in the field to promote new and proven technologies, and to elicit problems and needs of the farmers for the purpose of analysing the situations in the farms;
- For many of the small scattered communities that do not have large tracts of suitable land and do not have the skills, the more pressing need is to upgrade their skills in the production of food crops such as paddy, sago, tapioca, maize, vegetables and fruits;
- Where suitable wet paddy lands are available, they should be developed and brought into production; such potential areas include Long Sabai, Long Lobang, Ba' Tik, Long Lamai, Long Beruang and Ba' Lai at the upper Baram area in the Northern Region.
- Under the various crop development programmes, provide material assistance and technical advice to participants;
- Provide technical support and advice to farmers in crop protection, such as prevention and control of pests and diseases;
- Explore new varieties of crops and assesses their potentials in terms of yields and other qualities through field trials. In remote and inaccessible areas, consider the introduction of low-input and low-cost technologies;
- Procure and produce good quality planting materials for the implementation of crop development.

Project 1.5 Land-use Planning Study

Duration: 18 months.

Justification: The Sarawak sector of the HoB is mainly of mountainous terrain and thus important for environmental values, especially for soil and water conservation. SFM for timber production and forest plantation development must therefore be confined to appropriate areas in the context of topography. Whilst most of the area is under PFE, TPAs and LPF, it is important that this matter is critically examined to facilitate and rationalize land-use planning and decisions.

Objectives:

- Map current land-uses in the Sarawak HoB area;
- Prepare detailed topographic and soil maps of the area;
- Assess needs for soil and water conservation based on topographic features and other constraints; and,
- Assess adequacy of land-use zoning taking into account environmental protection and conservation, including maximum connectivity for biodiversity conservation for transboundary cooperation.

Resources Needed: RM 500,000.

Implementation Strategy:

- This study should be led by the State Planning Unit;
- Steering Committee established comprising relevant agencies;
- Study through consultancy.

SECTION 2 FOREST RESOURCES

Project 2.1 Resource Inventory in Logged-over Productive Forest in the Permanent Forest Estate

Duration: Two years.

Justification: No resource assessment of commercial timber in the hill production forest has been undertaken since logging started in the mid-1970s. Timber stocks decline with each cut, and some licenses have already been subjected to a second cutting cycle. Re-inventory is necessary for long term strategic management planning for SFM.

Objectives:

- To determine the species, populations and diameter classes of residual commercial timber trees;
- In line with the principle of SFM, to assess the capacity of the forest for continuous supply of timber in the future;

Resources Needed:

- Forest Department will initiate the study and provide the necessary manpower, financial resources and field transport;
- RM 500,000.

Implementation Strategy:

- The inventory should preferably cover all long term timber licenses.
- Obtain information on history of logging, yearly production quota and species extracted, so as to understand the effects of past logging on the forest;
- Conduct 10% random sampling using either linear transects, or a series of plots of 50 m by 50 m each;
- Identify, measure and record all potential commercial trees from a minimum of 20 cm dbh;
- Where necessary, propose silvicultural prescriptions for the residual forests;
- Analyze data and produce final reports, with recommendations dor achieving SFM.

Project 2.2 Study on Natural Regeneration in Logged-over Productive Forest

Duration: Twelve months (longer for phenological studies).

Justification: Natural regeneration depends on the availability of sufficient quality mother trees for seed production. With logging, many of these trees are removed, in particular species of the Dipterocarpaceae. Studies are needed to assess the extent to which the natural regeneration of commercial species is affected by logging.

Objectives:

- To assess the regeneration potential of commercial timber trees;
- To recommend appropriate silvicultural treatments to enhance growth and productivity.

Resources Needed:

- FDS or SFC to lead the survey and make available necessary manpower and financial resources;
- RM 350.000.

Implementation Strategy:

- Determine suitable sites for the study, including undisturbed sites as a control;
- Establish systematic transects or plots to identify and mark presence of sound mother trees, and record seedling populations and distributions in areas affected by different intensities of logging;
- Assess adequacy of potential mother trees and juveniles for natural regeneration;
- If necessary, establish permanent plots to study recruitment and monitor seedling growth, pests and diseases, and mortality;
- Establish gene bank plots to identify suitable trees for seed production, phonological observations and monitoring;
- Prepare reports to promote adequate regeneration of prime species.

Project 2.3 Training in Dendrology and Tree Identification

Duration: One weekly course twice a year for up to three years.

Justification: Knowledge and experience in dendrology and tree identification is acquired through many years of field work in forest inventory, silviculture and research. As there has been little emphasis in these areas of forestry in the past two decades, many of the new FDS/SFC staff rarely have the opportunity to work in the field. Today, only a handful of FDS and SFC staff in the junior categories (including three tree climbers) possess the skills and knowledge of tree identification and most of them will be retiring in the next few years.

Even with new focus on tree plantation, sustainable management of the production forests in the PFE will remain an important task of FDS and SFC in the future. SFM will involve studies and research in forest inventory, silviculture, forest ecology, forest botany, and conservation. To undertake these tasks, FDS must have a team of officers that are knowledgeable and proficient in dendrology and species identification. They can also help to check the accuracy of species identified by timber licensees.

Objectives:
- To train young officers and para-taxonomists in dendrology and plant identification;
- To organize regular training or refresher courses to enhance their skills;
- To train instructors on courses in dendrology, forest botany and ecology;

Resources Needed:
- The training to be led by FDS and assisted by SFC;
- RM 300,000.

Implementation Strategy:
- Revive the Department's forest school programme;
- Identify and appoint qualified chief instructor and assistants;
- Prepare/revise syllabus and programme for courses, including introduction on dendrology and forest botany, and theories and practical;
- Courses will include class lectures with emphasis on field work;
- After each course, trainees should be given opportunities to work in the field and in the herbarium to enhance their knowledge;
- Select capable instructors to continue the training course.

Project 2.4 Training for Forest Workers of Local Communities

Duration: Ten-day course twice a year for as long as necessary.

Justification: This is to enhance the employment skills of local inhabitants in forest survey, tree identification, tree felling, etc.; and in various aspects of plantation development.

Objectives:
- To promote welfare of the local communities;
- Through training and employment, to bring the local people into the mainstream of economic development;
- Train workers for more skilfull and higher paid jobs.

Resources Needed:
- Sarawak Timber Association (STA) to lead the training and provide finance;
- RM 300.000.

Implementation Strategy:
- Determine the types of skills needed by the industry;
- Incorporate introductory lectures on forests and conservation to raise awareness of participants;
- Forest Department will collaborate and assist under the HoB project by:
  - Identifying suitable candidates from the various communities;
  - Giving talks on forests and conservation;

Project 2.5 Develop an Integrated Forest Management Plan based on SFM

Duration: Nine months.

Justification: The Forest Policy of Sarawak (1995) has clearly stated the need to protect forests to safeguard the soil and water resources. The policy on SFM similarly recognizes the multiple functions of forests. An integrated management plan for the productive forest is fundamental in order to achieve SFM, and to maintain the vital functions of forests particularly as water catchments. A holistic approach in forest management is becoming more and more urgent as the State is embarking on the second wave of socio-economic development programme.

Objectives:

- To ensure a balance between economic development and conservation;
- To ensure that other vital functions and services of the productive forests are safeguarded;
- To emphasize the need for certification;
- To ensure that an integrated approach in SFM is approved and implemented.

Resources Needed:

- The study is to be led by FDS and SFC;
- RM 250,000.

Implementation Strategy:

- As custodians of the forests, FDS and SFC have a crucial role to play in future development of the State. Protecting the forests and their environmental services is fundamental to ensuring sustainability and success in socio-economic development;
- Review the current management plans and conditions for timber harvesting in the light of current development spearheaded by the Sarawak Corridor for Renewable Energy (SCORE) project;
- Consider zoning of land use in productive forests if necessary,
- The timber industry, through the Sarawak Timber Association, will render their cooperation and support to DFS/SFC in developing the integrated plan;
- Prepare an appropriate forest management plan for submission to the Government for approval.

Project 2.6 Establish a Protected Area Network in the Permanent Forest Estate

Duration: Twelve months or more.

Justification: The State and its people will definitely need more intact forests to meet their increasing needs and to further safeguard the State's natural environment, soil and water, and biodiversity. The protected area network (PAN) within the PFE will complement and enhance the roles of TPAs in conservation. These areas can also serve as corridors for wildlife.

Objectives:

- To identify and map forests within the PFE that possess high conservation value, and are little affected by logging;
- To conserve such a forest for environmental protection, water catchments, biodiversity conservation, gene banks, and as wildlife corridors;
- To manage the PAN as an integral part of the Totally Protected Areas network in the HoB area.

Resources Needed:

- FDS/SFC will lead the study;
- RM 600,000.

Implementation Strategy:

- Conduct field surveys to identify and map forests within existing timber licenses in the PFE that are suitable for conservation;
- Establish the values of the forests in terms of the various services that they are able to provide;
- The timber licensees will render all necessary assistance in making available license maps, identifying the sites and conducting studies;
- Consider gazetting such forests as nature reserves under the National Parks and Nature Reserve Ordinance 1998.

Project 2.7 Community Forestry

Duration: One year to plan and initiate project, identify suitable species, set up nurseries and provide training.

Justification: The Kelabit and Lun Bawang people will continue to depend on local timber for house construction. In particular, *Agathis* (tumu in Kelabit and Lun Bawang; also known as bindang or jati) is the most popular species that grows naturally in the highland forest. The resource is steadily being depleted due to local demand and commercial logging. The people are also facing a shortage in fuel wood for cooking and salt making. Suitable fuelwood includes rhu bukit (*Gymnostoma sumatrana*) and belaban (*Tristaniopsis*).

Objectives:

- To introduce community forestry with the planting of medium term plantation species;
- To meet the need for construction timber and firewood by the local communities;
- To rehabilitate idle land and logged-over forest near settlements.

Resources Needed:

- The study to be led by FDS/SFC;
- RM 500,000.

Implementation Strategy:

- The pilot study can be developed as a community project with the collaboration of timber licensees and local people, in the form of enrichment planting in logged-over forest, or planting in idle community land;
- From available literature and reports such as PROSEA, collect information on the ecological and silvicultural characteristics of selected species;

- Conduct field surveys to obtain information on soil, species distribution and population, and materials (seeds, wildings) for propagation and planting;
- Establish nurseries to develop planting material;
- Provide necessary training to participants.

Project 2.8 Management of Pulong Tau National Park

Duration: A long term HoB project that will be initiated under the 9th and 10th Malaysia Plans.

Justification: Pulong Tau N.P. has immense potential to be developed into a prominent centre for highland biodiversity conservation and ecotourism, and to promote the rich and diverse cultures of the highland Kelabit, Lun Bawang and Penan communities. The national park is an inseparable part of the highland people, culturally, socially and economically.

Objectives:
- To develop PTNP into a centre for biodiversity conservation and ecotourism destination in the northern highlands;
- To protect the fragile ecosystems and biodiversity of the park against visitor use;
- To develop tourist infrastructures and facilities;
- To promote local participation in conservation management and ecotourism;
- To conduct baseline studies in extended areas of the national park.

Resources Needed: Forest Department has submitted proposals to request for funding of RM 25 million under the 9th and 10th Malaysia Plans, and will be responsible for its implementation together with SFC.

Implementation Strategy:
- As the area is remote and access difficult, FDS and SFC will seek the help of local communities and timber industry for advice and support in planning, transportation of materials and construction;
- Engage architects to prepare simple and practical plans for buildings and facilities that do not cost too much to implement;
- As far as possible, identify local carpenters who are skillful in house construction, as engaging outside contractors by normal open tender will be very expensive and ineffective, especially if the contractor is not familiar with local situations and conditions. As proven in Lanjak Entimau W.S. and some national parks, the contracters' ignorance had resulted in long delays and very poor quality workmanships. Using local contractors will be much cheaper and easier to manage;
- Obtain permission from the relevant authorities to call for quotations of timber materials from local sources (e.g. licenses operating in the area); and to purchase other materials directly from the lowest suppliers in town;
- Seek help from timber companies to transport materials at subsidized costs;
- Involve the local people in material transport and construction;
- Collaboration with ITTO may be possible through the PTNP Transboundary Biodiversity Conservation project.

SECTION 3 - BIODIVERSITY

Project 3.1 Collaborative Research on the Sub-species of Orangutan in Borneo

Duration: Three years.

Justification: This project will address the important issue of transboundary conservation management of the Bornean sub-species of *Pongo pygmaeus pygmaeus*, found in the TBCA of Lanjak Entimau W.S., Batang Ai N.P. and Betung Kerihun N.P., as well as in Sabah. An orangutan strategic management plan is currently being prepared under Phase IV of the ITTO Lanjak Entimau W.S. Project.

Objectives:

- To conduct collaborative research of the orangutan in the TBCA between Malaysia and Kalimantan;
- To develop long term plans and strategies for collaborative management and research;
- To ensure that the orangutan populations and their habitats are fully protected.

Resources Needed: RM 500,000.

Implementation Strategy:

- Malaysia (Sabah and Sarawak) and Indonesia will jointly conduct the study;
- Refer to existing orangutan management plans developed by Sarawak, Sabah and Indonesia as a guide for formulating proposals for collaborative research and management;
- Incorporate all necessary preventive measures to safeguard the orangutan populations and their habitats, such as prevention of illegal logging and trade of the species, and regularly conducting joint patrols;
- The participating countries must be totally committed to the conservation of the only viable population of *Pongo pygmaeus pygmaeus* on the island of Borneo;
- Present findings and recommendations at the tri-lateral workshop.

Project 3.2 Scientific Research in the TPAs and other Forested Areas

Duration: Five years.

Justification: The TPAs with their pristine rainforests contain many of the State's magnificent landscapes and diverse flora and fauna. Surveys and research must continue in Batang Ai N.P., Lanjak Entimau W.S., Mulu N.P. and Pulong Tau N.P., in order to update scientific baseline data for management. The study will cover other forests that are currently outside the TPA network within the HoB area.

Objectives:

- To continue baseline research in the TPAs and extended areas;
- To document resources of economic potentials for research and development;
- To extend the TPA network for biodiversity conservation and environmental and social services within the HoB area.

Resources Needed: RM 250,000.

Implementation Strategy:
- FDS/SFC to lead the study;
- Develop research programmes for the TPAs;
- Seek the support of research agencies and institutions such as ITTO, WCS and universities in conducting research;
- All research activities will be coordinated by FDS and assisted by SFC;
- Where necessary, propose field centres to facilitate research, such as the Centre for Plant Research based in Lanjak Entimau.

Project 3.3 Biodiversity Conservation in the PFE

Duration: Eighteen months.

Justification: One of the criteria of SFM is biodiversity conservation. Commercial logging will affect the natural habitats and survival of the plant and animal species living therein. The continuing role played by production forests in conservation must be understood and sustained.

Objectives:
- To investigate impacts on logging on species diversities;
- To assess the conservation values of forests under difficult terrain, or low in commercial productivity, such as minor forest types and forests above 35 degrees gradients;
- To identify habitats of specific importance for conservation and species survival;
- To develop strategies for biodiversity conservation in logged-over forests, such as through zoning and creating wildlife corridors or buffers.

Resources Needed:
- FDS/SFC to initiate studies and make available funds and expertise;
- RM 350,000.

Implementation Strategy:
- For flora, establish a series of random ecological plots in residual forests or habitats affected by different logging intensities;
- For faunal survey, linear transects may be used to observe animal presence. Small mammals and birds can be caught using traps or mist nets;
- For general comparison, control plots or transects may be established in undisturbed forests;
- Incorporate conservation management as a requirement or condition for long term timber licenses in production forests.

Project 3.4 Transboundary Biodiversity Conservation with Brunei

Duration: Eighteen months

Justification: This cooperation will be between the Gunung Mulu N.P. and the adjacent Labi Forest Reserve in Brunei. The 2nd Periodic Report of the G. Mulu World Heritage Site has recommended that such a project be implemented through the HoB Initiative.

Objectives:
- To initiate transboundary biodiversity conservation initiative with Brunei;
- To conduct joint scientific research;
- To make appropriate recommendations for management of biodiversity across the borders.

Resources Needed:
- Sarawak and Brunei to make available the necessary fund and human expertise;
- RM 400,000.

Implementation Strategy:
- Sarawak and Brunei will jointly prepare an MOU for transboundary cooperation;
- Organize joint scientifc expeditions to collect or update baseline data for both sides;
- Compile scientific findings and recommend appropriate strategies for transboundary biodiversity management.

Project 3.5 Transboundary Biodiversity Conservation Area (TBCA) Cooperation – Lessons from Past Experience

Duration: 6 months

Justification: Transboundary cooperation of conservation areas commenced in 1994 with ITTO support between the Lanjak Entimau Wildlife Sanctuary in Sarawak and Betung Kerihun National Park in West Kalimantan. The TBCA covers a total area of about one million hectares straddling the Sarawak/Kalimantan border. The second TBCA project is between Pulong Tau N.P. in the northern highlands and Kayan mentarang N.P. in East Kalimantan, initiated in 2005, with a total area of over 1.3 million hectares. Certain activities were jointly conducted, including the ITTO Borneo Biodiversity Expedition in 1997. Such initiatives were expected to generate synergies in projection, management, research etc. to enhance conservation values. As the HoB Initiative is to further expand and strengthen such cooperation, it is considered important that lessons learnt in the two TBCAs be carefully examined to benfit the HoB Initiative.

Objectives
- To review the objectives, inputs and outputs of the two projects;
- To critically review and assess results of joint activities conducted;
- To discuss methodology, structure of project manegement, staffing etc., and assess effectiveness of cooperation;
- From experience gained in the implementation of the two projects and joint activities undertaken, discuss lessons learnt in the context of wider challenges and opportunities in developing plans for cooperation in the HoB Initiative.

Resources Needed: A lead consultant should undertake this project with two consultants, one from Malaysia and the other from Indonesia. The project is expected to cost RM 400,000.

Implementation Strategy:
- The Forest Department/Sarawak Forestry Corporation should lead this project;

- An experienced consultant appointed to work with two consultants, one experienced with the implementation of Lanjak Entimau W.S./Pulong Tau N.P., and other with Betung Kerihun N.P./Kayan Mentarang N.P.;
- A full report be prepared in an anylytical manner focusing on lessons learnt and recommendations for the HoB Initiave;
- Convene a trilateral workshop to discuss the consultants' report and strengthen the recommendations.

SECTION 4 – LOCAL COMMUNITIES

Project 4.1 Development of Community-based Projects

Duration: Twelve months to plan and develop each project.

Justification: One way to improve the welfare of the local people is to encourage them to participate in entrepreneurial activities that will generate steady cash incomes. These activities can be in the form of fish culture or cultivation of cash crops, like wild fruit trees or other non-timber forest products (NTFP).

Objectives:
- To promote community development among the rural populations and improve their living standards;
- To tap the potential of NTFP in the State - gaharu, kayu manis, tenom, jerangau merah, tongkat ali and other medicinal plants, spices, essential oil, high value fish (sema, tenggadak) – for commercial production;
- To reduce the people's dependence on forests.

Resources Needed:
- Forest Department/SFC to lead study in collaboration with Department of Agriculture;
- RM 750,000 to initiate projects in selected communities.

Implementation Strategy:
- Initiate three NTFP pilot projects, to be located around Batang Ai, Bario and Ba' Kelalan;
- Tap on the experience and lessons learned from the ITTO projects in Lanjak Entimau W.S. and Pulong Tau N.P;
- Establish nurseries to supply planting materials for medicine plants and materials for handicraft, etc., for research, and for sale;
- For the people living in the periphery of Lanjak Entimau and Pulong Tau, extend fish culture and crop planting to other interested communities;
- Encourage culturing of high value indigenous species like sema, tenggadak and empurau in valley ponds and tanks, or by *tagang* system;
- Introduce new crops like gaharu, kayu manis, jerangau merah, tongkat ali, spices and essential oil. Make available planting material from seeds or wildings; establish nurseries for propagation and raising of planting materials for distribution to interested farmers;
- Conduct market studies to assist farmers on sale/promotion of products;
- Participants will initially be provided with training and all necessary materials to kick start the project; where appropriate, implementation will be on a *gotong-royong* basis;
- A unit to promote and sustain the development of NTFP may be formed under the FDS.

Project 4.2 Integrated Tree Planting with *Acacia mangium* and Apiculture

Duration: Three years.

Justification: The rural communities need assistance to maximize the use of their agricultural land, and to improve their livelihoods.

Objectives:
- To diversify rural economy and improve livelihoods of the people;
- To promote better use of agricultural or idle land;
- To provide training on bee keeping, harvesting and processing of honey;
- To provide assistance in marketing.

Resources Needed:
- RM 300,000 to start pilot projects among selected communities;
- FDS to make available necessary financial and human resources with the help of DOA.

Implementation Strategy:
- FDS to take the lead with assistance of DOA and the timber industry;
- Identify suitable land for project;
- Consult Sarawak Tree Plantation in Tatau on development of apiculture;
- Provide initial expertise and funding to help farmers to start project;
- Recommend programme for other communities.

Project 4.3 Irrigated Terrace Hill Paddy Production

Duration: Three years.

Justification: Irrigated terrace hill paddy cultivation is new to Sarawak, but has been successfully developed in Asian countries like Indonesia and the Philippines. The system may be suitable for some parts of Sarawak.

Objectives:
- To study the feasibility of the system to improve productivity of hill paddy;
- To introduce farmers to new techniques of paddy cultivation where appropriate.

Resources Needed:
- DOA to be the lead agency with support from FDS;
- RM 600,000 for feasibility study and implementation,s and training farmers on new planting techniques.

Implementation Strategy:
- Study feasibility of the system in the HoB area;
- If found to be feasible, identify suitable land for pilot projects;
- Develop plans and strategy for implementation;
- Train farmers to adopt the new system;
- Assess success of the system and make appropriate recommendations.

Project 4.4 Development and Conservation of Freshwater Fisheries

Duration: Three years.

Justification: Many studies have indicated a steady decline in fresh water fisheries, either due to water pollution or over fishing. Conservation of the fishery resources is urgently needed.

Objectives:
- To promote *in-situ* and *ex-situ* conservation of local fresh water fish species;
- To improve techniques in fish culture to increase productivity;
- To benefit local communities.

Resources Needed:
- RM 800,000 to develop project in selected communities;
- DFS and DOA to take the lead and provide necessary expertise and field support;

Implementation Strategy:
- Introduce techniques of *tagang* system and pond culture including use of valley ponds. *Tagang* has been successfully developed in Sabah and among some communities in Lawas. Pond cultures have been implemented by ITTO in LEWS;
- Consult authorities in Sabah and DOA in Sarawak on the *tagang* system;
- Select suitable sites for project development;
- The project should be jointly developed and managed by an entire community and not individually;
- Assist participating communities to develop a proper system for project management, financial management and entrepreneurship;
- Provide materials and transport free of charge; participants to develop project on a *gotong-royong* basis. Cash subsidies are to be discouraged.

Project 4.5 Protection and Promotion of Cultural Relics

Duration: Two years.

Justification: The cultural relics that require urgent protection are the stone monuments or megaliths of the northern highlands. These relics are rare and unique, and found nowhere else in Malaysia. More than 40 such relics have been identified, but there are many more.

Objectives:
- To document and preserve the rare cultural relics of highland Sarawak;
- To promote cultures of the highland people through ecotourism;
- To encourage and assist local communities to protect and maintain their cultural heritage.

Resources Needed:
- FDS to be the lead agency with cooperation of local stakeholders;
- RM 350,000

Implementation Strategy:
- ITTO initiated the study in the highlands in 2006 and can be consulted;
- Identify sites with the help of local informants and guides;

- As many sites are located in existing timber licenses, the licensees and their contractors must be involved;
- Describe all the relics and produce a report;
- Assist in the protection of the relics, such as providing materials for fencing;
- Prepare brochures to promote cultural ecotourism.

Project 4.6 Development of Handicraft and Cottage Industry

Duration: Three years.

Justification: Handicraft and cottage industry at the community level is still very much lacking. Handicraft production is largely at the initiative of individuals who still possess the skills. Without organized training, such skills will die out.

Objectives:
- To assist local people to develop cottage industry at the community level;
- To train young people the skills of handicraft making, including the Penan community;
- To develop community cultural museums or exhibition centres to promote traditional cultures and ecotourism;
- To provide assistance in marketing.

Resources Needed:
- FDS/SFC to take the lead and provide necessary resources;
- RM 1,000,000 to develop the industry and build local centres.

Implementation Strategy:
- Conduct study to identify communities for implementing the project;
- Seek the support of the State Handicraft Department and Ministry of Culture;
- Build exhibition centres and collect handicrafts for display;
- Encourage cultivation of plant resources for handicraft making;
- The Western Penan of Silat River are skilled in making bush knives or *malat* (called *po'e* by Eastern Penan), and small knives or *penat* (*na'at* in Eastern Penan); and can teach the Eastern Penan who lack the skill.

Project 4.7 Establishment of Community-use Zones

Duration: Three years or longer if necessary.

Justifications: Community forests for domestic use are limited, and many communities continue to obtain resources from nearby TPAs. Having forests for community use will reduce the people's dependence on national parks and wildlife sanctuaries.

Objectives:
- To meet immediate needs of local communities for forest resources;
- To consider forests for community use in existing and new TPAs.
- To assist in sustainable management of such forests.

Resources Needed:
- FDS/SFC to provide necessary expertise and support;
- RM 800,000

Implementation Strategy:
- Identify suitable forested areas for community use, especially for those living the vicinities of existing and new TPAs;
- Recommend special privileges for domestic use of resources in the new TPAs;
- Make recommendations on the need for community-use forests in the light of current rapid development in the State;
- Create awareness on sustainable use among local communities.

Project 4.8 Environmental Education Programme for Local Stakeholders

Duration: Three years.

Justification: There is a real need to encourage timber licensees, contractors and local communities to participate actively in the government's efforts on conservation; and to raise their awareness on the importance of forests, not just for timber production, materials and food, but also for their many environmental values like soil and water protection.

Objectives:
- To create awareness in sustainable utilization of forests and other resources;
- To encourage active local stakeholder participation in conservation management, and to raise their awareness on environmental protection;
- To make them co-partners of the government in environmental protection.

Resources Needed:
- DFS/SFC to be the lead agencies;
- RM 500,000

Implementation Strategy:
- FDS/SFC to develop appropriate programmes for implementation;
- Other government departments, public and private agencies like Education Department, Natural Resources and Environment Board (NREB), Sarawak Timber and Industry Corporation (STIDC), and Sarawak Timber Association (STA) can play very useful collaborative roles;
- Existing Special Parks Committees, Special Wildlife Committees, and Honorary Wildlife Rangers, appointed by the SFC for the various TPAs, can assist in implementation;
- Prepare publicity materials on different themes for dissemination.

Project 4.9 Protection of Water Catchment in the Long Semadoh Cluster

Duration: One year.

Justification: A cluster of seven villages in Long Semadoh in Sarawak and Long Pasia in Sabah are in need of a water catchment. The forest to be conserved is located along the Sarawak-Sabah border, between the Trusan and Rabungan rivers and their tributaries - the forest on the Sabah side has been converted into a nature reserve, and is a popular European

and Japanese tourist destination to Long Pasia (Figure 8.1). This network of rivers provides water for 7 villages comprising 181 households and a population of nearly 1,200 people. The Trusan and Rabungan rivers are an important source of fresh water fish, including *ikan semah*. Fish thrives in the unpolluted water in the rice fields, as farmers do not apply chemical fertilizers or pesticides.

Objectives:

- To conserve and protect water catchments for the people living along the Sarawak and Sabah borders;
- To sustain the fish resources in the rivers.

Resources Needed:

- DFS/SFC to investigate and determine the financial resources needed;
- RM 300,000

Implementation Strategy:

- The investigation will be carried out by Forest Departments of Sarawak and Sabah;
- Assess the needs of the people;
- Determine the size and status of the forest, and make recommendations for catchment establishment.

SECTION 5 - ECOTOURISM

Project 5.1 Regional Ecotourism Plan Study

Duration: Two years.

Justification: In the two key areas, namely, the Northern (Maligan and Kelabit Highlands and Mulu-Buda-Pulong Tau N.P.) and Southern (Batang Ai-Skrang) regions, basic facilities for ecotourism are already in place, although these facilities have largely being developed in an *ad hoc* manner. Proper planning is fundamental to facilitate regional ecotourism development and growth.

Objectives:

- To establish the current status of the tourism industry in the area, and its impact on the local populations;
- To carry out an inventory of tourism products that can be made available to tourists;
- To assess the existing facilities and cost of travel to various tourist destinations;
- To assess the existing supply of professionals in the ecotourism industry for the HoB area.
- To assess the capability of the local people to handle inflow of tourists to their longhouses or villages;
- To recommend appropriate action plans.

Resources Needed:

- Solicit funds from State or Federal government, NGOs, or international organizations;
- Engage local experts, as they are more familiar with local conditions, and usually can be more effective and cost saving;
- RM 500,000

Implementation Strategy:

- The studies for the two key areas can be carried out simultaneously;
- Form a small steering committee to formulate the terms of reference, monitor and coordinate the studies, and be given proper guidelines and mandate to make speedy decisions;
- The study team should comprise those who have natural resources, tourism, planning, social and economic backgrounds, and the team should come up with progress reports as required by the committee;
- At the end of the studies, present two regional ecotourism plans for the two areas separately, as the two key areas have their individual uniqueness. The plans should be comprehensive, and can be implemented or executed easily by the end-users.

Project 5.2 Tourist Guides Course

Duration: Not less than one week, and to be held twice a year *in situ* for a period of three years.

Justification: There are 185 licensed tourist guides in Sarawak, and the majority is in the Level 3 category, whilst the rest are in Level 2. Level 2 category guides are those licensed to guide locally, and they are confined to certain areas only, thus known as localized tourist guides. In Ba' Kelalan and Bario, there are already 16 localised tourist guides trained in the past few years, and more is required to service the tourists in the near future. With visitor arrival predicted to increase in the region of 10 to 15 percent in the next few years, more guides will be needed in the national parks.

Objectives:

- To train more tourist guides from local populations;
- To enable trained tourist guides to present a more creative and effective interpretation on products and environment;
- To increase the communication skill and capability of the tourist guides to service tourists and,
- To look after tourists' welfare and ensure their safety.

Resources Needed:

- Adequate resources to finance the training courses and subsistence allowances for eligible participants;
- Cost estimated at RM 200,000 annually.

Implementation Strategy:

- Guiding courses to be organized by the Federal and State Ministries and their agencies;
- The courses on Certificate in Park Guiding, and Park Products and Services, as prescribed under the Park Guide and Licensing System, Reg. 8 of the National Parks and Nature Reserves Regulations 1999, should be consulted;
- The guiding course should be held *in situ*, and duration of the course is to be not less than a week;
- The frequency of the training should be at least twice per annum if not more;
- The course should be more on fieldwork rather than too much theory;
- There is a need to acknowledge the level of education of participants, as well as the skill and local knowledge they have acquired through experience;

- The course can be taught in English or Bahasa Malaysia, and even with a little dose of the local dialect, but it is important that participants upgrade their skills in English.

Project 5.3 Workshop on Basic Hospitality and Visitor Handling

Duration: One week.

Justification: The tourism industry deals with people, and handling people is not simple, especially those who are alien to local culture and environment. The way tourists are welcomed, both at the arrival point and at the final destination, by the tour operators and the local people need to be carefully managed. The wrong beginning will end up in an unhappy ending. There is a need to guide the locals to ensure that visitors or tourists to their respective places are informed of their traditions and customs in an unoffending manner. Success of the visit depends very much on the hospitality and tourist handling capacity of the people at large.

Objectives:
- To enable the local to realize the importance of ecotourism to their socio-economy;
- To impress on the local people the need to portray a good image to visitors during their sojourn at the villages or longhouses;
- To improve their communication skill;
- To ensure that tourists are given the genuine experience through cultural activities.

Resources Needed:
- The workshop can be organized by relevant government agencies or private institutions;
- Trainers can be sourced from government agencies, non-governmental organizations and institutions of higher learning;
- RM 250.000

Implementation Strategy:
- The basic training course is planned for a week;
- The training programme should be tailor-made to meet the requirements of the various local communities whose backgrounds are different;
- In order to have the full support of the local community, a dialogue should be held prior to the training itself. The objective is to explain to them the importance of hospitality, and need to improve the ways they handle tourists on their arrival and during their short stay;
- Evaluate the success of the training workshop, and recommend programme for subsequent workshop in terms of duration, course contents, etc.

Project 5.4 Workshop on the Development of Ecotourism Business Community

Duration: One week.

Justification: The ecotourism industry which is basically nature-based tends to be seen as a prominent component of the rural setting. The business of promoting ecotourism in Malaysia, particularly in Sarawak, falls into the hands of few tour operators who are mainly based in the major towns such as Kuching, Sibu and Miri. Participation of the local communities at the destinations is very minimal. Thus, there is an urgent need to encourage the local people to

engage in the ecotourism business in their own areas. This is to ensure that the economic benefits from the industry are shared among them.

Objectives:
- To establish a business community at the village or longhouse level;
- To enable the local people to participate and benefit from ecotourism;
- To teach the local community in basic book keeping and handling cash-flow;
- To inform them on the current financial assistance that is available.

Resources Needed:
- Since it is a business workshop the trainers can be sought from the relevant institutions of higher learning or business organizations, e.g. the University of Technology MARA (UiTM) or the University Malaysia Sarawak (UNIMAS). Individuals from business sector can also be invited as resource persons to give talks or deliver some papers;
- RM 100,000

Implementation Strategy:
- The workshop can be organized by relevant government agencies or NGOs;
- Conduct workshops at the local level in the two key areas, either during school holidays or semester break. This is to enable individuals and teaching staff from the university to take part;
- The contents or syllabus of the workshop must suit the background of the local participants;
- The language used must be English or Bahasa Malaysia or both;
- The organizer of the workshop has to make sure that only those who are genuinely interested in taking up business activity, or are already engaged in one, will be selected to participate.

Project 5.5 Publicity Materials on Ecotourism in Sarawak

Duration: Six months.

Justification: Publicity on ecotourism in Sarawak is of fundamental importance. Whilst a lot of materials may be available on the attractions Sarawak can offer for CAN, much of this information is not readily available or presented in a convincing manner. A great deal of thinking is necessary on how suitable publicity materials may be produced and distributed.

Objectives:
- Develop a framework on the preparation of a series of publicity materials possibly by themes, e.g. rainforests, biodiversity, flora, fauna, culture, crafts, etc.
- For each theme, commission different writers to prepare brochures in a coordinated manner;
- Arrange for wide dissemination.

Resources Needed:
- The project is to be led by the Sarawak Tourism Board or Ministry of Urban Development and Tourism;
- A steering committee comprising relevant agencies should be established;
- RM 500,000.

Implementation Strategy:
- An initial workshop may be organized to generate ideas from all relevant parties on how this project may be implemented;
- The steering committee established should meet at regular intervals, even after project completion, to assess impact and plan for the next phase.

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