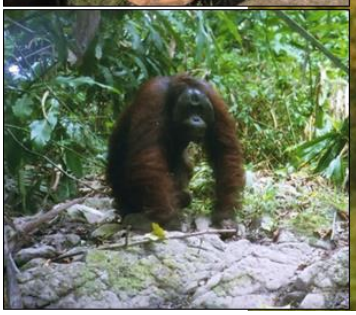
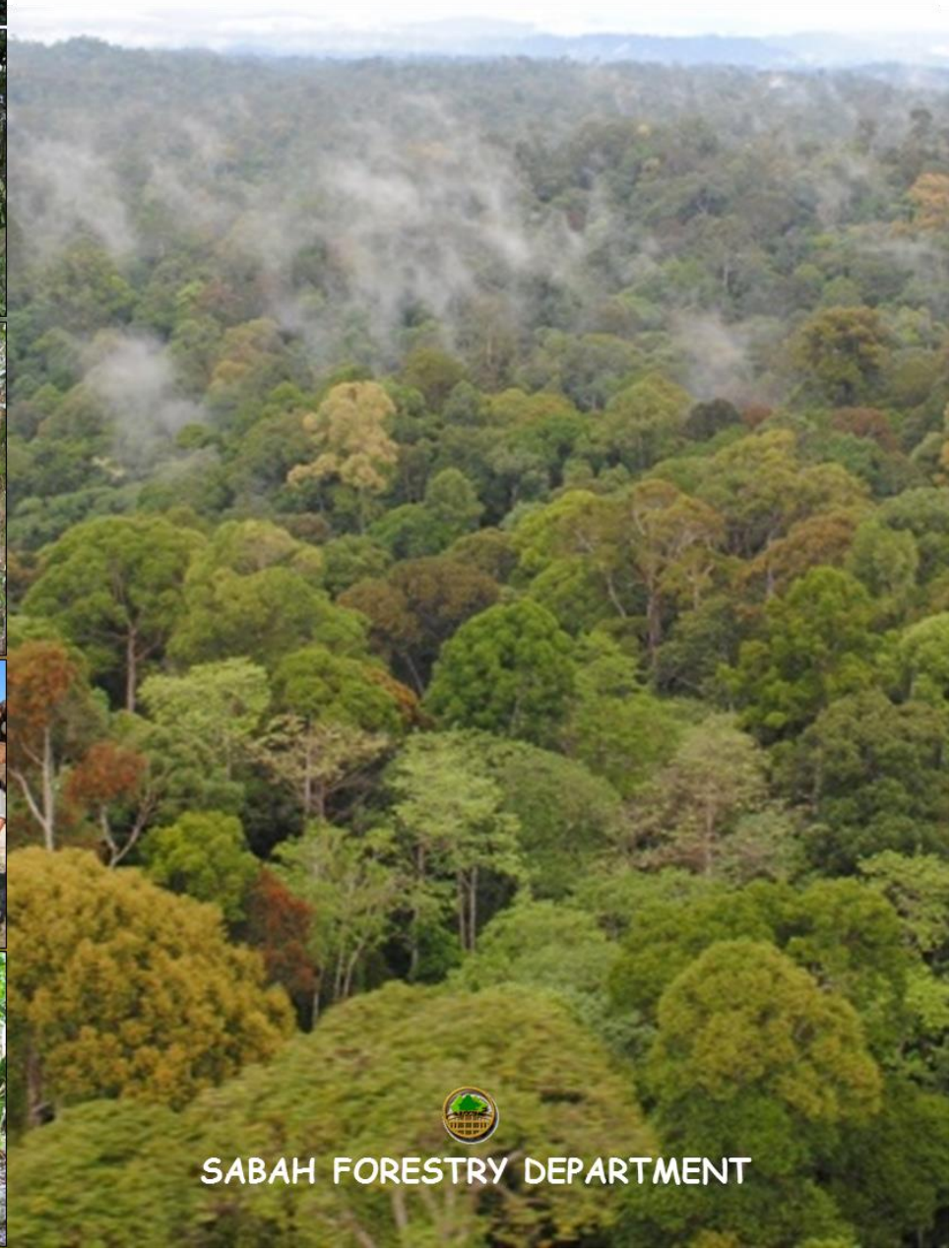


3rd Forest Management Plan

(1st January, 2015 – 31st December, 2024)

Deramakot Forest Reserve
Forest Management Unit No. 19A



SABAH FORESTRY DEPARTMENT

SABAH FORESTRY DEPARTMENT

3rd Forest Management Plan

(1st January, 2015 – 31st December, 2024)

Deramakot Forest Reserve
Forest Management Unit No. 19A

Approved By:

DATUK SAM MANNAN
(Director of Forestry)

Dated:

TABLE OF CONTENTS

LIST OF FIGURES I
LIST OF TABLES III
LIST OF ABBREVIATIONS V
EXECUTIVE SUMMARY VI
ACKNOWLEDGEMENTS XI
CHAPTER 1: INTRODUCTION, VISION, MISSION, POLICY STATEMENTS AND MANAGEMENT OBJECTIVES 1
1.0 INTRODUCTION 1
1.1 What's New in this Third FMP? 3
1.2 What has been excluded in this 3rd FMP? 3
1.3 Legal Authority and Period of Operation 3
1.4 Vision Statement 4
1.5 Mission Statement 4
1.6 Policy Statements 4
1.7 Management Objectives 5
1.7.1 Overall Objective 5
1.7.2 Specific Management Objectives 5
1.7.2.1 Timber Resources 5
1.7.2.2 Fauna Resources 5
1.7.2.3 Flora Resources 6
1.7.2.4 Water Resources and Soil 6
1.7.2.5 Ecological/HCVs 6
1.7.2.6 Research & Development 6
1.8 Legal Framework and Management Guidelines 6
1.9 Management Constraints 7
CHAPTER 2 GENERAL INFORMATION 8
2.0 NAME, LOCATION, AND LEGAL STATUS 8
2.1 Climate 8
2.1.1 Rainfall 9
2.1.2 Temperature 13
2.1.3 Relative Humidity 14
2.1.4 Sunshine and Solar Radiation 15
2.1.5 Evaporation 15
2.2 Topography 15
2.3 Hydrology 15
2.3.1 Drainage System 15
2.3.2 Water Quality 16
2.3.3 Managerial Implications of Topography and Hydrology 20
2.4 Geology, Rock and Soil 20
2.5 Managerial Implications of Geology and Soils 21
2.6 Forest Ecosystems in DFR 21
2.6.1 Natural Vegetation 21
2.6.1.1 Lowland Mixed Dipterocarp Forest 22
2.6.1.2 Lowland Mixed Dipterocarp and Kerangas Forest 25
2.6.1.3 Seasonal Freshwater Swamp Forest (SFSF) 26

2.6.2 Secondary Vegetation 27
2.6.3 Forest Recovery and Regenerative Status 27
2.7 Forest Ecosystem Conservation Status 28
2.8 Flora of DFR 28
2.9 Wildlife Resources in DFR 31
2.9.1 Wildlife as Part of SFM 31
2.9.2 Scope of Wildlife Surveys 32
2.9.3 Wildlife Surveys and Diversity 32
2.9.3.1 Mammals 32
2.9.3.2 Birds 35
2.9.3.3 Reptiles & Amphibians 35
2.9.3.4 Fish 36
2.9.3.5 Insects 36
2.9.4 Threats to wildlife 36
2.9.5 Managerial Implications of Wildlife Relationships With Natural Forests 36
2.10 Social Impact Assessments 37
2.10.1 Introduction 37
2.10.2 Objectives 37
2.10.3 Methodology 37
2.10.4 Village Locations 38
2.10.5 Populations, Ethnicity & Religion 39
2.10.6 Infrastructure, Facilities & Social Services 41
2.10.7 Economic Activities 42
2.10.7.1 Employment Patterns 42
2.10.7.2 Sources of Income 42
2.10.8 Current Programs and Income Opportunities in DFR 43
2.10.9 Land Resources 44
2.10.10 Land Claims and Other Issues in DFR 45
2.10.11 DFR and Its Importance for the Local Communities 45
2.10.12 Impacts and Opportunity Assessments 45
2.10.12.1 Economic Impacts 45
2.10.12.2 Social and Cultural Impacts 46
2.10.12.3 Social Structures Impacts 46
2.10.13 Local Communities Perspectives on Potential Opportunities Associated with DFR Management 46
2.10.14 Community and the Action Process 47
2.11 Infrastructure in DFR 47
2.11.1 Buildings 47
2.11.2 Forest Roads 48
2.11 Manpower 49
CHAPTER 3: REVIEW OF PAST MANAGEMENT (2ND FMP: 2005-2014) 51
3.0 INTRODUCTION 51
3.1 The Gist of the 2nd FMP 51
3.2 Achievement 52
3.2.1 Infrastructure 52
3.2.2 Timber Production 52
3.2.3 Continuous Forest Inventory 59
3.2.4 Rehabilitation Planting 62
3.2.5 Timber Stand Improvement 62

3.2.6 Community Forestry 65
3.2.7 Forest Resource Protection 66
3.2.8 Surveillance Audits 67
3.2.9 Research and Development 68
3.3 Lessons Learned and Management Implications for 3rd FMP 68
CHAPTER 4: HIGH CONSERVATION VALUES 72
4.0 INTRODUCTION 72
4.1 High Conservation Values in DFR Landscape 73
4.1.1 HCV 1.1 - Protected Areas 73
4.1.2 HCV 1.2 - Threatened and Endangered Species 73
4.1.2.1 Flora 74
4.1.2.2 Fauna 77
4.1.3 HCV 1.3 - Endemic Species 79
4.1.3.1 Flora 79
4.1.3.2 Fauna 81
4.1.4 HCV 1.4 - Critical Temporal Use 82
4.1.5 HCV 2 - Globally, Regionally or Nationally Significant Large Landscape-Level Forests 83
4.1.6 HCV 3 - Forest Areas That Are In or Contain Rare, Threatened or Endangered Ecosystems 84
4.1.7 HCV 4.1 - Forests Critical to Water Catchments 86
4.1.8 HCV 4.2 Forests Critical to Erosion Control 87
4.1.9 HCV 4.3 - Forests Providing Barriers to Destructive Fire 88
4.1.10 HCV 5 - Forest Areas Fundamental to Meeting Basic Needs of Local Communities 89
4.1.11 HCV 6 Forest Areas Critical to Local Communities' Traditional CUltural Identity 92
4.2 Summary of HCV Areas in DFR 93
4.3 Management, Monitoring and Research 94
4.3.1 Management 94
4.3.1.1 Protection of Critical Values 94
4.3.1.2 Modifications or Constraints on Operations 95
4.3.1.3 Enhancement Efficiency and Effectiveness 95
4.3.1.4 Restoration 95
4.3.2 Monitoring 96
4.3.3 Research and Development 96
CHAPTER 5: TIMBER RESOURCE BASE 97
5.0 FOREST INVENTORY 97
5.1 Annual Allowable Cut 100
5.2 AAC Verification 100
5.3 Yield Regulation 101
CHAPTER 6: MANAGEMENT STRATEGIES, ACTIONS AND IMPLEMENTATION 102
6.0 FOREST ZONING 102
6.1 Conservation Areas 104
6.1.1 Management Objectives 104
6.1.2 Focus of Management 104
6.2 Timber Production 104
6.2.1 Net Timber Production Area 104
6.2.2 Management Objective 105
6.2.3 Forest Harvesting and Schedule 105
6.2.4 Continuous Forest Inventory 107
6.2.5 Timber Stand Improvement 109

6.2.6 Rehabilitation Planting 112
6.3 Infrastructure Management 112
6.3.1 Roads 112
6.3.2 Buildings and Basic Facilities 114
6.4 Forest Protection 114
6.4.1 Control of Boundaries 114
6.4.2 Forest Encroachment by Outsiders 114
6.4.3 Forest Fire 115
6.5 Soil Protection and Watershed Management 115
6.6 Community Development Programmes 115
6.6.1 Employment 116
6.6.2 Communal Forest Fire Prevention 116
6.6.3 Controlling Forest Encroachments & Illegal Felling 117
6.6.4 Human Resource Development 117
6.6.5 Community Welfare Program 118
6.6.6 Agro-Forestry Programs 118
6.7 Wildlife Protection and Monitoring 118
6.8 Research & Development (R&D) 120
6.9 Manpower Requirement at DFR 120
CHAPTER 7: BUDGET AND FINANCIAL ANALYSIS 123
7.0 BUDGET ALLOCATION 123
7.1 Financial Analysis and SFM Viability in DFR 125
7.1.1 Assumptions 125
7.1.2 Results of Financial Analysis 127
7.2 Sensitivity Analysis - Changes in Timber Price and Costs 127
7.3 Break-Even Analysis 127
7.3.1 Break-Even Point 129
CHAPTER 8: EIA AND FOREST MANAGEMENT STANDARDS 131
8.0 ENVIRONMENTAL IMPACT ASSESSMENT 131
8.1 Management Standards 131
8.2 Environmental Mitigation 131
CHAPTER 9: MONITORING, REPORTING AND REVIEW 136
9.0 RESPONSIBILITY FOR IMPLEMENTATION 136
9.1 Monitoring and Auditing 136
9.1.1 Internal 136
9.1.2 External 136
9.2 Reporting 136
9.2.1 Responsibility 136
9.2.2 Reporting Frequency 136
9.2.3 Reporting Formats 137
9.3 Compartment Register Book 137
9.4 FMP Review 137
REFERENCES 138
APPENDIX 1: LIST OF DFR STAKEHOLDERS 141
APPENDIX 2: SUMMARY RESULTS OF CHEMICAL ANALYSES AND WATER QUALITY CLASSES OF 5 RIVERS IN DFR 144

APPENDIX 3: LIST OF STANDARDS OF PROCEDURES (SOP) IN DFR 149
APPENDIX 4 – SIA CHECKLIST 150
APPENDIX 5 – SIA CHECKLIST (HOUSEHOLD) 155
APPENDIX 6: RECORDS OF CORRECTIVE ACTION REQUESTS (CARS) ISSUED BY SGS FOR FMU 19A (2004 – 2013) 160
APPENDIX 7: LIST OF RESEARCH/STUDY UNDERTAKEN IN DERAMAKOT FOREST RESERVE (2005 – 2014) 173
APPENDIX 8: LIST OF COMPARTMENTS AND ASSOCIATED LAND-USE IN DFR 177
APPENDIX 9: REVENUES AND COSTS PROJECTION FOR 2015 - 2024 182
APPENDIX 10: DISCOUNTED CASH FLOW ANALYSIS 183
APPENDIX 11: MONITORING REPORT OF PERMANENT SAMPLE PLOTS IN DERAMAKOT 184
APPENDIX 12: LETTER OF EIA EXEMPTION FROM EPD 187

LIST OF FIGURES

Figure 2.1: Location of Deramakot Forest Reserve 8

Figure 2.2: State wide distribution of rainfall pattern 10

Figure 2.3: Annual total rainfall pattern for the year 1991 - 2000 11

Figure 2.4: Annual Total Rainfall Pattern for the Year 2002 - 2013 12

Figure 2.5: DFR in relation to distribution pattern of annual rainfall of Sabah 13

Figure 2.6: DFR monthly average rainfall pattern for a period 1991 - 2000 14

Figure 2.7: DFR monthly average rainfall pattern for a period 2002 - 2013 14

Figure 2.8: Topography of DFR 17

Figure 2.9: Slope map of DFR 18

Figure 2.10: The distribution of 17 minor catchments found in Deramakot Forest Reserve 19

Figure 2.11: Soil Association Map of DFR 23

Figure 2.12: Current vegetation map of DFR 24

Figure 2.13: The ten most speciose plant families in Deramakot Forest Reserve 30

Figure 2.14: Location of villages surveyed 40

Figure 2.15: Local communities involved in forest restoration project in DFR 44

Figure 2.16: Organization Chart of Deramakot District Forestry Office in 2014 50

Figure 3.1: Chalets constructed in 2014 53

Figure 3.2: Road maintenance in Jln. Mirim (MR 1) 53

Figure 3.3: Compartments harvested during the 2nd FMP (2005-2014) 57

Figure 3.4: Binuang planted in Cpt. 109 in 2007 62

Figure 3.5: Compartments treated under TSI during the 2nd FMP 64

Figure 3.6: Post-harvesting TSI in Cpt. 77 65

Figure 4.1: The location of HCV 1.1, a buffer strip of 50 m inside DFR boundary providing barriers from environmental impact that may exert to Tangkulap FR (Class I). 74

Figure 4.2: The LMDF and LMD & KF are categorised as HCV 1.2 areas that are important habitats for threatened and endangered for flora and fauna in DFR 78

Figure 4.3: Summary of the IUCN Red List Status of the wildlife species (mammals) recorded in HCV assessment and past research 79

Figure 4.4: The LMDF and LMD & KF categorised as HCV 1.3 areas that are important habitats for endemic flora and fauna in DFR 81

Figure 4.5: The locations of HCV 1.4 that indicate salt-lick areas (red star) in DFR 83

Figure 4.6: Map showing DFR categorised as HCV 2 84

Figure 4.7**:** The location of extreme lowland forests that are categorised as HCV 3a in DFR 85

Figure 4.8: The location of SFWSF and LMD & KF that are categorised as HCV 3b in DFR 86

Figure 4.9: The location of HCV 4.1 as a catchment area for community in DFR 87

Figure 4.10: The location of HCV 4.2 as critical to erosion control in DFR 88

Figure 4.11: The locations of HCV 4.3 inside DFR boundary 89

Figure 4.12: The location of HCV 5 attributes within Deramakot FR 91

Figure 4.13: The location of HCV 6 attributes within DFR 93

Figure 6.1: Forest Land-use in DFR 103

Figure 6.2: Harvested areas (1st FMP and 2nd FMP) and harvesting schedule for the planning period 2015-2024 (3rd FMP) 108

Figure 6.3: Log-fisher - ideal for RIL under all terrain conditions in DFR 109

Figure 6.4: Compartments treated and rehabilitated (1997-2014) and to be treated and rehabilitated during the planning period (2015-2024) 111

Figure 6.5: Organization Chart of Deramakot District Forestry Office (2015-2024) 122

Figure 7.1: DFR budget breakdown for the planning period (2015-2024) 123

Figure 7.2: Break-even point of SFM in DFR 130

LIST OF TABLES

Table 2.1: Annual Total and Yearly Monthly Rainfall for the Period 1991 to 2000 11

Table 2.2: Annual Total and Yearly Monthly Rainfall for the Period 2002 to 2013 12

Table 2.3: The 17 sub-catchment areas in relation to the forest management zones in DFR 16

Table 2.4: The geographical location and site description of water quality sampling in DFR 20

Table 2.5: Current vegetation cover and relative extent of forest-cover type in DFR 22

Table 2.6: Number of plant taxa according to plant groups from DFR 29

Table 2.7: Bornean endemic bird species that can be found in Deramakot Forest Reserve, based on Phillipps & Phillipps (2014) 35

Table 2.8: Location of the villages adjacent to DFR 39

Table 2.9: Boundary re-brushing and marking records from 2010 – 2014 44

Table 2.10: Road Classification in DFR 48

Table 2.11: Conditions of access roads in DFR 48

Table 3.1: Physical infrastructure maintained, repaired, constructed and/or provided during the plan period (2005-2014) 54

Table 3.2: Area and volume harvested (2005 – 2014) 55

Table 3.3: Proportion of total production by timber groups (%) 59

Table 3.4 Compartments in DFR where continuous forest inventory has been established during the 2nd FMP 60

Table 3.5: Standing timber stocks for 4 compartments 60

Table 3.6: Compartments treated under TSI (2005 – 2014) 63

Table 3.7: Community liaison programmes & community participation during the 2nd FMP 65

Table 3.8: Records of unwanted activities in DFR during the plan period (2005-2014) 67

Table 3.9: Records of CARS issued by SGS during the 2nd FMP period 68

Table 3.10: Number of published research papers based on the three research types in DFR during the 2nd FMP period 68

Table 4.1: HCVs as described in the HCVF Toolkit for Malaysia (2009) 72

Table 4.2: Identified tree species assessed according to the Global IUCN Categories 76

Table 4.3: List of Bornean endemic mammal species found in DFR 81

Table 4.4: List of Bornean endemic bird species found in DFR 82

Table 4.5: Location of villages and population adjacent to southern boundary of DFR 90

Table 4.6: Forest function areas with designated HCVs in DFR 93

Table 5.1: Inventory results showing number of sound commercial trees/ha and their estimated volume in m^3/ha (given in parenthesis) for individual compartments in DFR 97

Table 5.2: Calculation of annual allowable cut for the planning period 2015 –2024 100

Table 6.1: Land use classification based on forest functions in DFR 102

Table 6.2: Net timber production area in DFR 105

Table 6.3: Harvest schedule for the planning period 2015 – 2024 105

Table 6.4: Schedule for the establishment and measurement of permanent inventory lines (2015-2024) 109

Table 6.5: List of compartments scheduled for TSI (2015-2024) 110

Table 6.6: The program to improve, repair and maintain existing roads during the plan period (2015 – 2024) 113

Table 6.7: Ground and river patrols for boundary control and surveillance 114

Table 6.8: Manpower requirement in DFR 2015-2024 121

Table 7.1: DFR budget allocation for the planning period (2015-2024) 124

Table 7.2: Timber prices 125

Table 7.3: Projected Timber Production and Revenues 125

Table 7.4: Proportion of timber production by species groups (%) 126

Table 7.5: The management, establishment and operational costs 126

Table 7.6: Returns on investment 127

Table 7.7: Sensitivity analysis at 7% interest rate: NPV at various timber prices and costs (Thousand RM) 128

Table 7.8: Sensitivity analysis at 10% interest rate: NPV at various timber prices and costs (Thousand RM) 128

Table 7.9: Fixed costs 129

Table 8.1: List of Management Standards 131

Table 8.2: Mitigation of environmental impact of forest management activities 133

LIST OF ABBREVIATIONS

AAC	Annual Allowable Cut
ADFO	Assistant Deramakot Forestry Officer
a.s.l	above sea level
AWP	Annual Work Plan
CERKU	Centre for Ecological Research Kyoto University
CFI	Continuous Forest Inventory
CHP	Comprehensive Harvesting Plan
Cpt.	Compartment
dbh	diameter at breast height
DFO	Deramakot Forestry Officer
DFR	Deramakot Forest Reserve
EIA	Environmental Impact Assessment
EPD	Environmental Protection Department
FMP	Forest Management Plan
FMU	Forest Management Unit
FR	Forest Reserve
FSC	Forest Stewardship Council
GIS	Geographic Information System
Ha	Hectare
HCVF	High Conservation Value Forest
HQ	Head Quarters
ITTO	International Tropical Timber Organization
Jln.	Jalan
Kg.	Kampung
LMDF	Lowland Mixed Dipterocarp Forest
LMD&KF	Lowland Mixed Dipterocarp and Kerangas Forest
MC&I	Malaysian Criteria & Indicators
mm	millimeter
NFM	Natural Forest Management
NGO	Non-Governmental Organization
NTFP	Non-Timber Forest Products
NQWSM	National Water Quality Standards for Malaysia
PACOS	Partners of Community Organizations
PCT	Potential Crop Tree
R&D	Research & Development
RIL	Reduced Impact Logging
SFD	Sabah Forestry Department
SFSF	Seasonal Freshwater Swamp Forest
Sg.	Sungai
SFM	Sustainable Forest Management
SIA	Social Impact Assessment
TSI	Timber Stand Improvement
UF	Ultramafic Forest
VJR	Virgin Jungle Reserve
WU	Wildlife

EXECUTIVE SUMMARY

The purpose of this Executive Summary is to provide a synopsis of the 3rd Deramakot Forest Reserve 10-Year Medium Forest Management Plan (2015-2024), hereafter known as the 3rd FMP, which is the Sabah Forestry Department's comprehensive document for guiding the management of Deramakot Forest Reserve (DFR). DFR is a logged-over Class II Commercial Forest Reserve. It is located in the central part of Sabah, which is within the Forest Management Unit (FMU) 19A. It covers an area of approximately 55,507 ha, which represents 2.5% of the Commercial Forest Reserves in Sabah. DFR is one of the Commercial Forest Reserves directly being managed by the Sabah Forestry Department (SFD).

Ecosystem Management

The management of DFR has been an evolving process, beginning with a high research component in collaboration with the German Agency for Technical Cooperation (GTZ), which ended in 2000. The initial or 1st FMP (1995 – 2004), focused primarily on timber management and protection of wildlife and watershed. In the pursuit of SFM and further guide on forest management in DFR that can balance the ecological, economic and social functions, the 2nd 10-Year Forest Management Plan (2005 – 2014) was formulated by incorporating new knowledge and reflected changing management philosophies and biodiversity and cultural values. Throughout the period of the 2nd FMP, the SFD continued to implement (not without constraints) all activities in accordance with the plan, based on sustained yields and with full integration of social and ecological conditions by strictly following the FSC principles.

The current planning effort - a 3rd FMP (2015 – 2024), has evolved into an ecosystem management-based approach. In ecosystem management, the overarching goal of forest sustainability in turn assures the array of resources, uses, and values for current and future generations. According to Grace (2003), ecosystem management can be defined as an ecological approach to resource management, where all aspects of an ecosystem are considered important, and decisions are made based on the best understanding of ecological interactions and processes necessary to sustain the ecosystem's composition, structure, and function over the long term.

Strategic Plan and Forest Certification

As part of the strategic planning effort, the SFD adopted a vision and a mission statement for DFR in this 3rd FMP, which articulates the SFD's commitment to manage DFR using the principles of ecosystem management. In 1997, DFR became the world's first tropical forest to be certified as a well-managed forest under the gold standard of the FSC of which, the SFD was closely audited by the third-party auditor – the SGS-Forestry Malaysia. And because of this significant progress, the SFD has every reason to be proud in terms of its management in DFR. This was amplified by the success of DFR in receiving another five-year certification by the FSC's certification scheme as a well-managed forest. The re-

certification covered the period between October 31st, 2014 and October 30th, 2019 (4th FSC Certification), making DFR the longest continuously certified tropical rainforest in the world to be certified under the FSC scheme.

Planning Process

The planning process for this 3rd FMP, which was carried out by the FMP Team that comprises of various disciplines and expertise began in early 2014. Collectively, past management, lessons learned, the findings, recommendations from the re-certification process and comments and inputs from stakeholders provided the philosophical foundation for this 3rd FMP and the future management of DFR. As in the case of the previous management plans where they were revised at 5-year intervals, this 3rd FMP will also be revised and updated during the mid-term review, which is in 2019. This process will allow for increased opportunities for comments and inputs preferably from stakeholders, and allow the SFD to more effectively anticipate and respond to changing issues, understandings, technologies, and forest conditions. The execution of this 3rd FMP planning process consisted of the following basic steps:

- Resource inventories and computerized information systems were conducted and/or updated as part of the SFD's continuous forest inventory process in DFR.
- A comprehensive review of the SFD's past performance effectiveness and efficiency (quality, cost, budget, schedule performance, etc.) and lessons learned were conducted. The review and the lessons learned form a platform or foundation for the preparation of the 3rd FMP.
- A draft plan was developed and distributed for comment to help determine the stakeholders' acceptance of the draft.
- The draft plan was revised, considering comments received.

Plan Structure

This 3rd FMP is organized into nine (9) core Chapters, plus an Executive Summary to address the resources, uses and values and to sustain the ecosystem's composition, structure and function of DFR:

- Introduction, Vision, Mission and Management Objectives
- General Information of DFR
- Review of Past Management
- Forest Resource Base
- High Conservation Value
- Management Strategies, Actions and Implementation
- Environmental Impact Assessment and Forest Certification
- Budget and Financial Analysis
- Monitoring, Reporting and Review

All information found in each Chapter provides a basic understanding on the direction that the SFD intends to follow concerning the management of DFR. In addition, operating manuals, standards of procedures (SoP), and other documents are referenced; and attached in Appendices. Together, with its reference materials, the plan provides a comprehensive source of information and guidance on the management issues of the state's forest in DFR for the SFD and the public.

3rd FMP Highlights

This 3rd FMP provides a comprehensive source of information and guidance for the SFD in general and the Deramakot management team in particular, on the management issues of DFR for the next 10 years. CHAPTER 1 of the plan provides information or basic background of DFR and an understanding of the directions the SFD is to follow concerning the management of DFR. It also highlights a number of key changes from the 2nd FMP. This part of the plan also includes the SFD's vision, mission and policy statements and management objectives to ensure the perpetuity of DFR as a natural resource, which is managed to balance a variety of uses and values in an ecologically sustainable manner.

CHAPTER 2 describes the basic information pertaining to DFR. This basic information amongst others includes location, legal description of DFR, physical features and resources (climate, hydrology, topography, geology and soils, vegetations/forest types, wildlife), infrastructure, socio-economic, etc. CHAPTER 3 on the other hand, is a comprehensive review of the SFD's operations during the 2nd FMP (2005 to 2014), which had been undertaken based on the effectiveness and efficiency of the SFD's management performance and achievements against its objectives, prescriptions, implementation schedules, community needs and budgets. In this Chapter, it highlights the SFD's operational achievements and lessons learned over the last 10 years in DFR and management implications for the 3rd FMP.

CHAPTER 4 of the plan provides details on the high conservation values (HCV) in DFR. The HCV assessment in DFR was executed from 9th to 20th of July 2013 by a team of various biological and social experts by following the national standards as prescribed in the High Conservation Value Forest Toolkit for Malaysia in 2009. The findings emphasized the importance of maintaining selected sites as HCVF or Areas within DFR that include unique or threatened ecological areas, habitats of high conservation significant species and/or areas of cultural significance that must be managed so as to maintain the value of the attributes. The SFD also emphasized that HCV forests and areas will not be converted to other land-use types that may degrade the attributes' conservation values.

CHAPTER 5 prescribes the timber resources in DFR based on the forest inventory assessment results reported in the 2nd FMP. The AAC of 17,600 m^3 as set in the 2nd FMP is maintained for the current planning period (3rd FMP), while CHAPTER 6 is the most important part of the plan. It prescribes the management strategies, actions, and implementation of various activities that are to be carried out within the three (3) main zones or land-uses, namely, Conservation, Production and Community Forestry.

There are 19 compartments with a gross area of 5,548.6 ha that have been designated for protection/conservation in DFR. These areas are mostly steep areas with slopes >25° that form

part of the catchment areas. In addition, there could be another approximately 7,449 ha within the production area that have been identified for conservation areas. These areas comprise of patches of steep areas with slopes >25°, riparian reserves and HCVs. Therefore, the total protection/conservation area in DFR for the planning period is 12,998 ha or 23.4% of the total area of DFR.

A gross area of about 49,941.6 ha comprising 117 compartments in DFR is designated for natural forest management (NFM), particularly for timber production by selective harvesting, while there are two (2) sub-compartments (16.7 ha) in NFM that have been set aside for the local communities in Kg. Balat for their community forestry programs. The long-term objective of NFM in DFR in general is to sustain production of high value timber for revenue generation based on the AAC limit while maintaining a high degree of species and structural diversity. Forest harvesting, which is be based on an area-control yield regulation and the AAC of 17,600 $m^3$is confined to the net production area of approximately 41,571.9 ha. There are twenty five (25) compartments covering an area of about 10,581 ha scheduled for harvesting in the planning period 2015–2024. The gross area that has been identified to be harvested annually range in size, that is, from 970.6 ha to 1,221.6 ha, giving an estimated annual yield of between 15,000 and 20,000 m^3. Logging operation is based on reduced impact logging (RIL).

In the current planning period, about 11,037 ha covering 26 compartments are scheduled for timber stand improvement treatment. On the other hand, rehabilitation planting with Laran (*Anthocephalus cadamba*) and Binuang (*Octomeles sumatrana*) will be continued in compartments 108 (100 ha) and 109 (100 ha) respectively. The new additional area of DFR, that is, Cpt. 136 (363.4 ha) was also being identified for the rehabilitation program.

An essential part of yield regulation is the permanent monitoring of the growing stock by repeated inventories or by the use of permanent plots - a practice known as *continuous forest inventory* (CFI). A permanent monitoring and control system will be established during this management planning period, and repeated inventories will be carried out as a routine management activity. A portion of the former inventory lines of each compartment will serve as permanent inventory lines, and will be repeatedly inventoried every 5 to 10 years. There are 32 compartments where permanent plots will be set-up during the management planning period.

The SFD will continue to involve the local communities in Kg. Balat, Kg. Kuamut, Kg. Desa Permai and Kg. Tulang-Tulang, which are all located along the three major rivers, namely, Kinabatangan River, Kuamut River and Milian River, in various community development programmes through the DFR Social Forestry Committee. There are five main activities that have been outlined in this 3rd FMP for the local communities throughout the plan period. These are (i) to employ many competent villagers for the various management and labor jobs in DFR; (ii) to involve the local communities in forest fire prevention; (iii) to involve the local communities in controlling illegal forest encroachment and felling in DFR; (iv) the SFD will continue to organize necessary training and courses to the local communities for human capacity building; (v) the SFD will continue to promote the goodwill of forestry to the local communities by extending various community welfare programs, or better known as CSR (Corporate Service Responsibility); and (vi) the SFD will help the local communities to implement agro-forestry activities.

CHAPTER 7 of the plan prescribes the estimated financial requirement to implement the various activities particularly those that are described in CHAPTER 6. This Chapter also looks at the viability of SFM in DFR. The SFD would require approximately RM 86 million to implement all SFM activities as prescribed in this 3rd FMP. More than half of the total budget is being allocated for forest harvesting (33%) and on personnel salary and allowance (30%). The rest of the costs are for silviculture operations, forest rehabilitation, forest protection (forest encroachment, illegal logging, forest fire and illegal hunting) and socio-economic development programs for the local communities.

Based on the results of the financial analysis, the generated gross revenue from DFR during the plan period is projected at RM 124 million and a net revenue at RM 38 million at current prices. This shows that SFM in DFR is viable at 7% and 10% interest rate. The computed Net Present Value (NPV) for the implementation of SFM at 7 % interest rate is RM 27,434,393, while at 10 % interest rate, the NPV is RM 24,283,648. The benefit-cost ratio is 1.46; both at 7% and 10% interest rate. However, SFM in DFR is not viable if the timber prices decrease by 20% at base costs, or if the costs increase by 20% and the log timber prices decrease by 5%, both at 7% and 10% interest rates. Therefore, the SFD must reduce its operation costs, increase efficiency and strive to have higher log prices to avoid losses. In this case, the SFD must produce at least 103,621 m^3 of timber, which requires a total area of 6,229.7 ha to be harvested during the planning period in order to avoid loss. The SFD must exceed the break-even point of about 72,379 m^3 of timber production within the planning period in order to break-even. It demonstrates that the amount of timber (AAC of 176,000 m^3) to be harvested during the planning period is adequate and economically feasible.

CHAPTER 8 of the Plan highlights the requirement of an Environmental Impact Assessment (EIA). In this Chapter, various mitigation measures were recommended to manage the impact of the forestry activities, which are to be undertaken in DFR. The last Chapter, that is, CHAPTER 9 prescribes the issues on monitoring, reporting and plan review. The SFD monitoring will include all aspects of forest management such as, timber harvesting operations, road construction, soil protection, environmental impacts and wildlife.

As in the case of the 2nd FMP, this 3rd FMP is also flexible that allows for change. Therefore, although this 3rd FMP is valid until 2024, it is subject to be reviewed or updated by 2019. The intent is to maintain or create a desired or preferred future forest, as determined by society's expectations and the dynamics of natural ecosystems in the DFR.

ACKNOWLEDGEMENTS

The development of this 3rd Forest Management Plan (FMP) for Deramakot Forest Reserve (FMU No. 19A) required the dedication of many individuals. The Sabah Forestry Department (SFD), therefore, wishes to express its gratitude to the many individuals who supported, contributed and participated in the consultation and discussion meetings and who commented at various stages in the development of this plan.

Special thanks to Ms Fong Pek Yee who arranged all the FMP Team meetings and writing the minutes and to Miss Malihana Ason and Mr. Mohd Jumri Abd Hamid who both prepared the maps.

Writing of this plan was facilitated and accomplished by a collaborative effort from the FMP Team. The SFD is grateful to each of the following individuals:


Jeflus S Sinajin - (Forest Management cum Team Leader)


Dr. Joseph Tangah (Wildlife Ecologist)

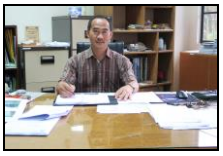

Musa Salleh (Forest Management)


Eyen Khoo (Conservation Biologist)


Dr. Robert Ong (Silviculturist)


Dr. Reuben Nilus (Forest Ecologist)


Jupiri Titin (Soil Science)


John Sugau (Plant Diversity)


Dr. Arthur Chung (Wildlife Diversity)


Paul Leo Lohuji (Forest Engineer)


Rosila Anthony (GIS)


Ricky A Martin (Social Forestry)

Rayner Bili
(Wildlife Ecologist)

Valeria Linggok
(Remote Sensing)

Pilis Malim
(Forest Protection)

Johny Kissing
(DFO Deramakot)

Julsun Joseph Sikui
(Research Officer)

Peter Lagan
(ADFO Deramakot)

Albert Radin
Deputy Director
(Forest Management Enterprise)

Alexander Hastie
(Conservation Biologist)

CHAPTER 1: INTRODUCTION, VISION, MISSION, POLICY STATEMENTS AND MANAGEMENT OBJECTIVES

1.0 INTRODUCTION

Traditionally, the Sabah Forestry Department (SFD) approached management by seeking to optimize timber production and protect forests from illegal logging, encroachment, pests, diseases and fire. Today, however, the SFD has taken a leadership role in sustainable forest management (SFM) by finding a balance between the ecological, economic and social values that the public defines. In seeking this balance, key priorities are to sustain and conserve the forest ecosystems, to apply the Forest Stewardship Council (FSC) principles and to address the consequences of social and economic demands on our resources. These have taken place in Deramakot Forest Reserve (55,507 ha) during the past one decade.

The Deramakot Forest Reserve (DFR) adventure started in September 1989 through a collaboration project with the German Agency for Technical Cooperation (GTZ) which ended in 2000. It began with a high research component and rapidly developed into the objective of practicing SFM in a logged-over forest, a first attempt in Sabah. In 1995, the first 10-Year Medium Forest Management Plan (1995 – 2004) for DFR was prepared and implemented through intensive forest management. In 1997, DFR became the world's first tropical forest to be certified as a well-managed forest under the gold standard of the FSC and thus, provided the model of success and the expansion of the SFM concept throughout Sabah.

But, in spite of what have been accomplished and implemented in DFR during its first Forest Management Plan (FMP), SFM continued to evolve with endless discussions due to the public's growing environmental awareness and changes in society's values. In other words, SFM is an exercise in making decisions when not all the information is available. The complexity of ecosystems, economic conditions and societal values always limit our knowledge and understanding. Consequently, SFM in DFR was like an experiment. The SFD made predictions about future forest conditions based on peoples' values, technical knowledge and proposed management actions. These predictions were coupled with a monitoring program. Therefore, for SFM to be successful, the SFD viewed SFM as a continuous and ongoing learning process rather than an end in itself. This process is referred to as adaptive management, which is a key component of SFM. This requires a more comprehensive approach especially when society's demands on forests have diversified beyond simple permanent timber production (sustained yield). The major part of those demands is biodiversity to forest conservation, which has moved to the top of the political agenda. These demands, however, do not become markets where the SFD can obtain economic rewards for producing public goods and services to pay for their production and management. This is one of the crucial concerns affecting SFM investment decisions. But whatever it is, the SFD considered SFM as very complex, dynamic and generally with higher costs involved.

In the pursuit of SFM and further guidance on forest management in DFR that can balance the ecological, economic and social functions, the second 10-Year Forest Management Plan (2005 – 2014) was formulated. Throughout the period of the second FMP, the SFD continued to

implement (not without constraints) all activities in accordance with the plan, based on sustained yield and with full integration of social and ecological conditions following the FSC principles of which, the SFD was closely audited by the third-party auditor – the SGS-Forestry Malaysia. Of course there was significant progress made in SFM in DFR during the second FMP. Examples of this progress can be referred to in Part III of this third FMP. And because of this significant progress, the SFD has every reason to be proud in terms of its management in DFR. This was amplified by the success of DFR in receiving another five-year certification under the FSC's certification scheme as a well-managed forest in accordance to FSC principles. The re-certification covers the period between 31st October, 2014 and 30th October, 2019, which is for the fourth cycle since 1997, making DFR the longest continuously certified rainforest area in the world to be certified under the FSC scheme.

Meanwhile, the final year of the 2nd FMP of DFR was in December, 2014. Hence, an interdisciplinary DFR FMP planning team was formed in early 2014 to undertake a more comprehensive review of the 2nd FMP. The forest management planning was carried out based on a forest policy and legal framework that has key elements of sustainability, public and community involvement through consultation and review and ecosystem management. The FMP Team also had considered all resource uses and thus, stakeholders (see list in **Appendix 1**) were consulted and to seek their views, as well as, to make consensus-based recommendations about how DFR should be managed by taking into consideration society's demands on forests. The recognition of the hopes and aspirations of the many stakeholders interested in the future of DFR is a positive step forward.

The results of the final review of the SFD's effectiveness in management performance, against the objectives, prescriptions, implementation schedules and budgets over the past twelve months of planning and the assessment of the values related to different goods and services, constituted the platform for the preparation and completion of this 3rd FMP. In addition, all comments received when the draft FMP was circulated to the stakeholders for comments and inputs were considered in the development of the final FMP. The comments were important and helpful for the FMP planning team in assessing the clarity of the plan, public understanding of what was being proposed or prescribed and in assessing whether or not there were important aspects that the public thought were missing or not completely dealt with when the draft FMP was drafted. The comments were also essential for meeting the public and communities' consultation requirements of Forest Stewardship Council (FSC) forest certification standards.

The SFD believes that in order to work effectively and maintain its reputation as a leader in practicing SFM, this 3rd FMP has to prescribe more strategic directions and effective approaches such as, the increasing value of SFM for society, which is an additional incentive to improve forest practices in DFR as compared to the 2nd FMP. In addition, research and development (R&D) have been emphasized during the planning period due to the many commitments in the strategic directions outlining the need for greater scientific knowledge and technological innovation in the forestry sector. The FSC Principles as the framework for measuring and assessing Deramakot's progress, as a well-managed forest, would provide further coherent direction for SFM in DFR.

1.1 What's New in this Third FMP?

This 3rd FMP includes a number of key changes from the 2nd FMP. These are:

- Two new areas with a total size of 368 ha were constituted and classified as a Commercial Forest Reserve (Class II) to be known as Deramakot Forest Reserve (extension) adding to the former DFR area and thus, increased the total area of DFR from 55,139 ha to 55, 507 ha. The total number of compartments also increased from 135 to 136.

- Approximately 2,018.4 ha from the existing NFM areas have been set aside for conservation. These new conservation areas consist of various habitats and forest types, namely, "Extreme" Lowland Dipterocarp Forest, Lowland Dipterocarp Forest, Seasonal Freshwater Swamp Forest and Kerangas (Heath) Forest. The Freshwater Swamp Forest and Heath Forest were not listed as conservation areas in the previous FMP.

- The SFD has added value to its management in DFR by adopting the concept of HCVs, as prescribed in Chapter 4 of this 3rd FMP. This documentation on the distribution of various wildlife species and forest types, offers a focus for monitoring and subsequent actions in the operationalisation of this 3rd FMP.

- A **re-delineation of compartments** was done to reflect on the actual boundary on the ground and thus, there **were changes (decrease or increase)** on the gross area of all compartments, which also affected the total gross areas of the different land-uses from the previous FMP.

1.2 What has been excluded in this 3rd FMP?

Recreation/Ecotourism –. To commence forest recreation/ecotourism activities in DFR, there are many basic requirements, which also need to be taken into consideration and/or put in place for these activities to function. These requirements will either need to be planned in detail separately or planned for in combination with the various proposed forest recreational activities respectively. This includes roads and access, accommodation, food and beverage provision, transport services, water and electricity supply, telecommunications, waste disposal, safety regulations and emergency procedures, information and interpretive services, and promotions that require investment resources (financial and expertise) of which, the SFD was unable to fulfill some of them during the tenure of the 2nd FMP. Therefore, eco-tourism development is excluded in this 3rd FMP but it will be reviewed and considered on a "step by step" approach during the tenure of this plan. Meanwhile, the facilities and infrastructure that are already available in DFR will continue to be utilized by visitors organized by eco-friendly tour guide such as, Adventure Alternative Borneo.

1.3 Legal Authority and Period of Operation

This plan is called the "3rd 10-Year Forest Management Plan" for Deramakot Forest Reserve. It is the intent of this plan that all forest resources and services within DFR (Forest Management Unit 19A) are managed on a sustained yield basis for total optimization of economic, social and environmental benefits to the State. The Deramakot District Forestry Officer will administer this plan. The term of this plan will be ten (10) years commencing on 1st January, 2015 and concluding on 31st December, 2024. The plan will be reviewed in 2019.

1.4 Vision Statement

The SFD has adopted the following vision for DFR:
DFR will maintain a sustainable balance of environmental, economic and social values desired by society.

1.5 Mission Statement

The SFD mission statement for DFR is:
To manage, conserve, enhance and use the forest ecosystems of DFR to ensure its sustainability and productivity with the appropriate balance of values desired by society.

1.6 Policy Statements

The SFD recognizes the vital role of the forests in DFR in maintaining the ecosystems especially that they are increasingly important for timber and fauna and flora conservation. Therefore, the following are the policy statements on **significant issues** impacting the direction of forest management in DFR:

i. **Timber Resources and Silviculture** - DFR will be managed to provide a sustained yield of high quality timber and other wood products to optimize economic returns to the State on a long-term basis by maximizing utilization and efficient use of raw materials. In addition, every effort would be undertaken by the SFD to demonstrate and promote forest rehabilitation and silvicultural practices that jointly sustain ecological and economic forest values.

ii. **Fauna Resources** – The SFD will ensure that the conservation of a diversity of wildlife particularly for orang-utans (*Pongo pygmaeus*), Pygmy elephants (*Elephas maximus*), and Tembadaus (***Bos javanicus*****)** and the provision of suitable habitats for them and others in DFR will be undertaken and managed.

iii. **Flora Resources** - DFR serves as an example in promoting the conservation and restoration of native flora and therefore, the SFD will continue to manage DFR in order to provide habitats that support a diversity of native plant communities and species.

iv. **Water Resources** - Water resources management involves all water resources, values, uses, functions, and delineations. The SFD will manage water resources in DFR within the context of adaptive management, considering the wide range of potential impacts, issues and opportunities relating to water resources.

v. **Ecological Considerations/High Conservation Value Forests (HCVF) –** The SFD will ensure that conserving populations of rare, unique and endangered species, as well as, other ecologically significant populations and examples of all native plant communities in DFR will be aggressively undertaken. In addition, the SFD will protect selected areas of special scientific, scenic or ecological significance in DFR. Forest fragmentation, connectivity and patch distribution will be considered in management decisions affecting resources in DFR.

vi. **Research –** The SFD and other research institutions will continue to be involved in research programs directed toward improving ecosystem management and SFM in DFR.

vii. **Environment –** In addition to what is prescribed in current legislations, regulations and conditions concerning the environment, all possible environmental improvement initiatives will be taken which are ecologically motivated, technically feasible and commercially viable. The SFD would continue to demonstrate to all relevant stakeholders, national, and international clients, on its efforts towards quality environmental management in DFR. The SFD's internal and external auditors shall monitor this.

viii. **Capturing Known Values** – The SFD will expand current efforts on issues related to appropriate mechanisms for capturing known values related to different goods and services supplied by the forests in DFR, including environmental services such as, carbon sequestration, biological diversity, watershed protection and ecotourism potentials.

ix. **On the Social Aspect** - The SFD would continue to provide job opportunities and socio-economic development activities, particularly to the local communities living adjacent to DFR, so as to improve their living standard.

1.7 Management Objectives

The overall objective and the management objectives of managing DFR in this 3rd FMP have no significant changes from the previous plans.

1.7.1 Overall Objective

It is stressed that forest management must systematically address the full range of issues. Therefore, the overall objective of forest management in DFR is to have a multiple-use forest for economic, social and environmental purposes, while ensuring that the productive capacity of the forests for both goods and services is maintained and/or enhanced.

1.7.2 Specific Management Objectives

1.7.2.1 Timber Resources

a) To sustain production and revenue of high value timber based on an annual allowable cut (AAC) of 17,600 m³ and reduced impact logging (RIL), while maintaining a high degree of species and structural diversity.

b) To carry out timber stand improvement (11,000 ha) during the plan period, in areas where sufficient natural regeneration and potential commercial species are present for the purpose of liberation and enhancement of their growth performance.

c) To restore 563.4ha using indigenous species in compartments 108, 109 and 136.

1.7.2.2 Fauna Resources

a) To protect and secure special conservation/management areas and habitats for Orang-utans, Pygmy elephants, Tembadaus and other specific wildlife species.

b) To manage DFR in order to provide diverse and productive wildlife habitats and habitat components.

c) To protect species of special concern (Orang-utans, Pygmy elephants and Tembadaus) and manage them to sustainable levels.

1.7.2.3 Flora Resources

a) To provide and improve habitats for a diversity of flora that represent some of the richest stands of Dipterocarp forests in Sabah.

b) To protect listed endangered plant species and habitats critical to their survival.

1.7.2.4 Water Resources and Soil

a) To protect and enhance water resources of the five main rivers in DFR namely, Sg. Rawog Besar, Sg. Tabalion Besar, Sg. Tangkulap Kecil, Sg. Balakung and Sg. Deramakot.

b) To protect, manage and enhance riparian ecosystems.

c) To protect, manage and enhance aquatic ecosystems.

d) To manage water resources for "in-stream" values and functions such as, recreation, aesthetic enjoyment, and habitats for aquatic ecosystems.

e) To protect water catchments.

f) To ensure that soil erosion and damage to soils are minimized in all future activities and interventions in DFR.

1.7.2.5 Ecological/HCVs

a) To conserve and/or enhance the biological diversity in DFR.

b) To protect areas of scenic, historic, geological or ecological significance through the establishment of natural forest areas that will remain in an undisturbed state, with development and maintenance being limited to that required for public health and safety.

c) To maintain and restore the full array of ecological functions within and around DFR, through maintaining and restoring forest connectivity.

d) To explore offsets & tradable credits associated with carbon emissions and biodiversity both from an ecological and social perspective.

1.7.2.6 Research & Development

a) To strategize and promote research programs to support SFM in DFR.

1.8 Legal Framework and Management Guidelines

Laws and regulations on forest legislation are the legal instruments, which are necessary in the implementation of the objectives of a forest policy. Forest legislation reflects the principles of sustainability in order to support implementation of forest policy. Management guidelines, on the other hand, provide advice and promote more extensive application of forest management practices. In this context, the following are the legal framework and management guidelines, which the SFD would refer to:

i. State Forest Policy, 1954;
ii. Forest Enactment, 1968;
iii. Forest Rules, 1969;
iv. Environmental Protection Enactment, 2002;
v. Park Enactment, 1984;
vi. Wildlife Conservation Enactment, 1997;
vii. Land Ordinance, 1930;
viii. Water Resources Enactment, 1998;
ix. Cultural Heritage (Conservation) Enactment, 1997;
x. Sabah Conservation Strategy, 1992;
xi. Biodiversity Enactment, 2000;
xii. Environmental Quality Act, 1974;
xiii. MC&I;
xiv. FSC Principles;
xv. RIL Guidelines, 1998
xvi. Sabah Labour Ordinance;
xvii. The Employment Act; and
xviii. Health and Safety Regulations.

1.9 Management Constraints

The plan is subject to the following constraints:

- Low AAC. This is due to low growing stock, many hollow trees, and heterogeneous stand conditions.

- Erratic weather. The weather has been erratic over the years in DFR causing logging less efficiently thus, resulting in unachieved AAC. This weather pattern is expected to continue throughout the period of the 3rd FMP.

- Financial outlays. There is no doubt that SFM is complex and generally of higher cost to manage. Over the years and especially during the last years of the 2nd FMP, it was apparent that the government funding (the main source of funding) was getting lower in its distribution. This resulted in limitations on activities implementation. It is anticipated that this trend will continue during the 3rd FMP unless the SFD has other alternative sources of funding.

- Elevating operational costs. This is due to the ever increasing staff salaries, contractors' fees, , fuel and equipment prices, Goods and Services Tax (GST) coupled with the evolution of the certification requirement standards, which may result in enhanced applications on affected activities in terms of acquiring the latest system, technologies, personnel acquirement, etc.

CHAPTER 2 GENERAL INFORMATION

2.0 NAME, LOCATION, AND LEGAL STATUS

This third FMP is prepared for DFR, which is a Class II Commercial Forest Reserve covering an area of 55,507 ha. DFR is within Forest Management Unit (FMU) 19A, located in the central part of Sabah. It is situated between Longitude 117º 20' E and 117º42' E and between Latitude 5º 19' N and 5º 20' N (see Figure 2.1). DFR has been administered as a forest reserve since 1961, and in 1984, it was re-constituted as part of the permanent forest estate as a Commercial Forest Reserve - Class II.

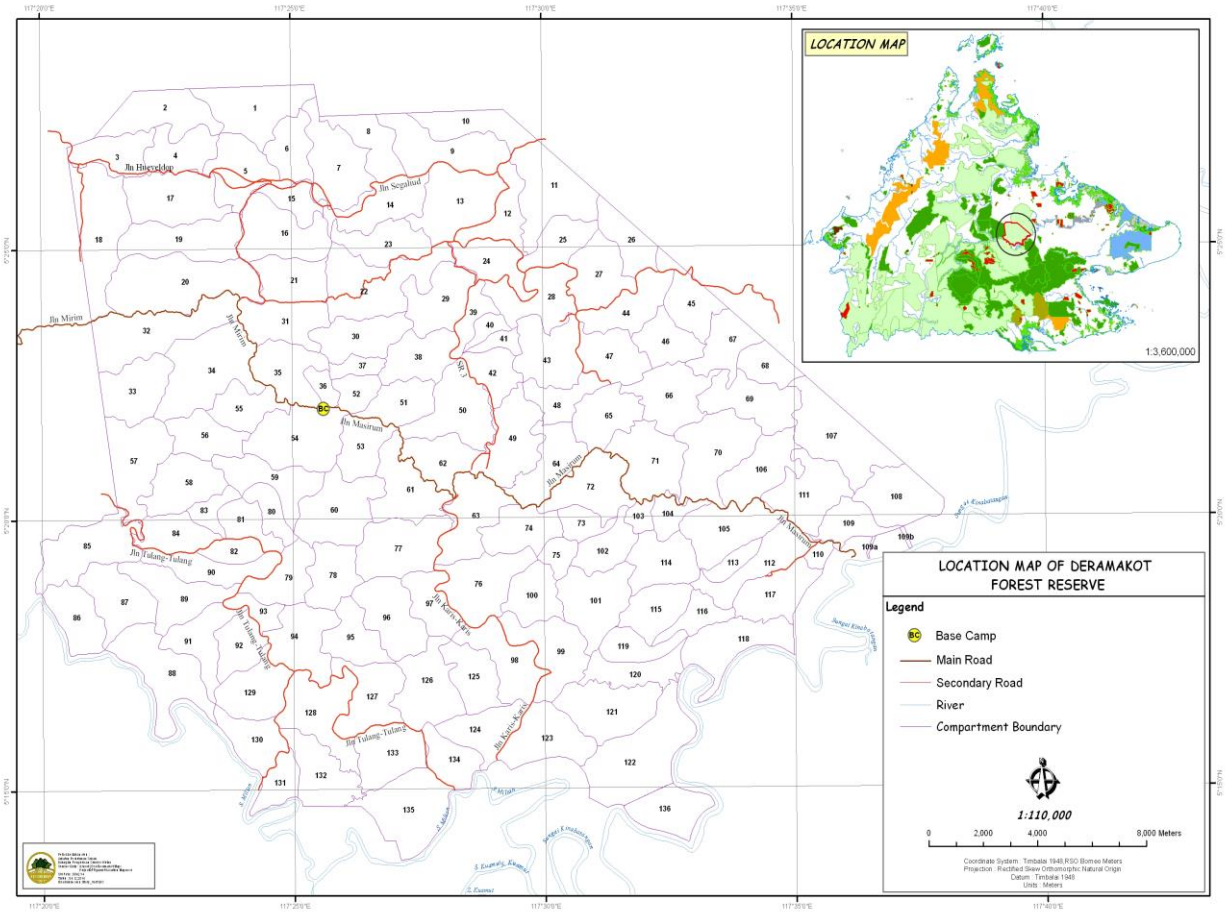


Figure 2.1: Location of Deramakot Forest Reserve

2.1 Climate

Sabah experiences a wet tropical climate that is largely controlled by the Indo-Australian monsoon system. In general, northerly winds occur from December to March that brings rains to the east coast of Sabah, and winds from the southwest dominate from May to October, which brings rains to the west coast. During the transitional months, around the equinoxes, winds tend to be light and variable. Usually, during the transitional months, precipitation is less than normal and under extreme conditions, it manifests into seasonal droughts. DFR is located in the eastern part of Sabah; therefore, the climatic condition is very much influenced by the northeast monsoon.

2.1.1 Rainfall

Generally, Sabah receives between 2,500 –3,500 mm of rainfall annually although some localities get much lower rainfall due to coastal influence, large land-mass or ranges. Figure 2.2 shows the distribution of rainfall patterns in Sabah, with 500 mm intervals from 1,000 mm to above 3,500 mm; and through this, a fairly clear pattern of mean annual rainfall subjected to the geographic position and topographic features can be determined.

Seasonal Rainfall Variation

The seasonal variation of rainfall in Sabah can be divided into four main types:

a) The northeast experiences a rainfall regime of one maximum and one minimum. While the maximum rainfall occurs during January, the minimum rainfall occurs in April. Under this regime, much of the rainfall is received during the northeast monsoon months of December to March.

b) The northwest coastal areas of Sabah experience a rainfall regime of which two maxima and two minima can be distinctly identified. The primary maximum occurs in October and the secondary one in June. The primary minimum occurs in February and the secondary one in August. While the difference in the rainfall amounts received during the two months corresponding to the two maxima is small, the amount received during the month of the primary minimum is substantially less than that received during the month of the secondary minimum. In some areas, the difference is as much as four times.

c) In the central parts of Sabah where the land is hilly and sheltered by mountain ranges, the rainfall received is relatively lower than other regions and is evenly distributed. However, two maxima and two minima can be noticed, though somewhat less distinct. In general, the two minima occur in February and August while the two maxima occur in May and October.

d) Southern Sabah has evenly distributed rainfall. The annual rainfall total received is comparable over the central part of Sabah. The period February to April is, however slightly drier than the rest of the year.

Geographically, DFR is located at the eastern part of Sabah. Therefore, it has a rainfall pattern that is under the influence of weather pattern as described in (a) above.

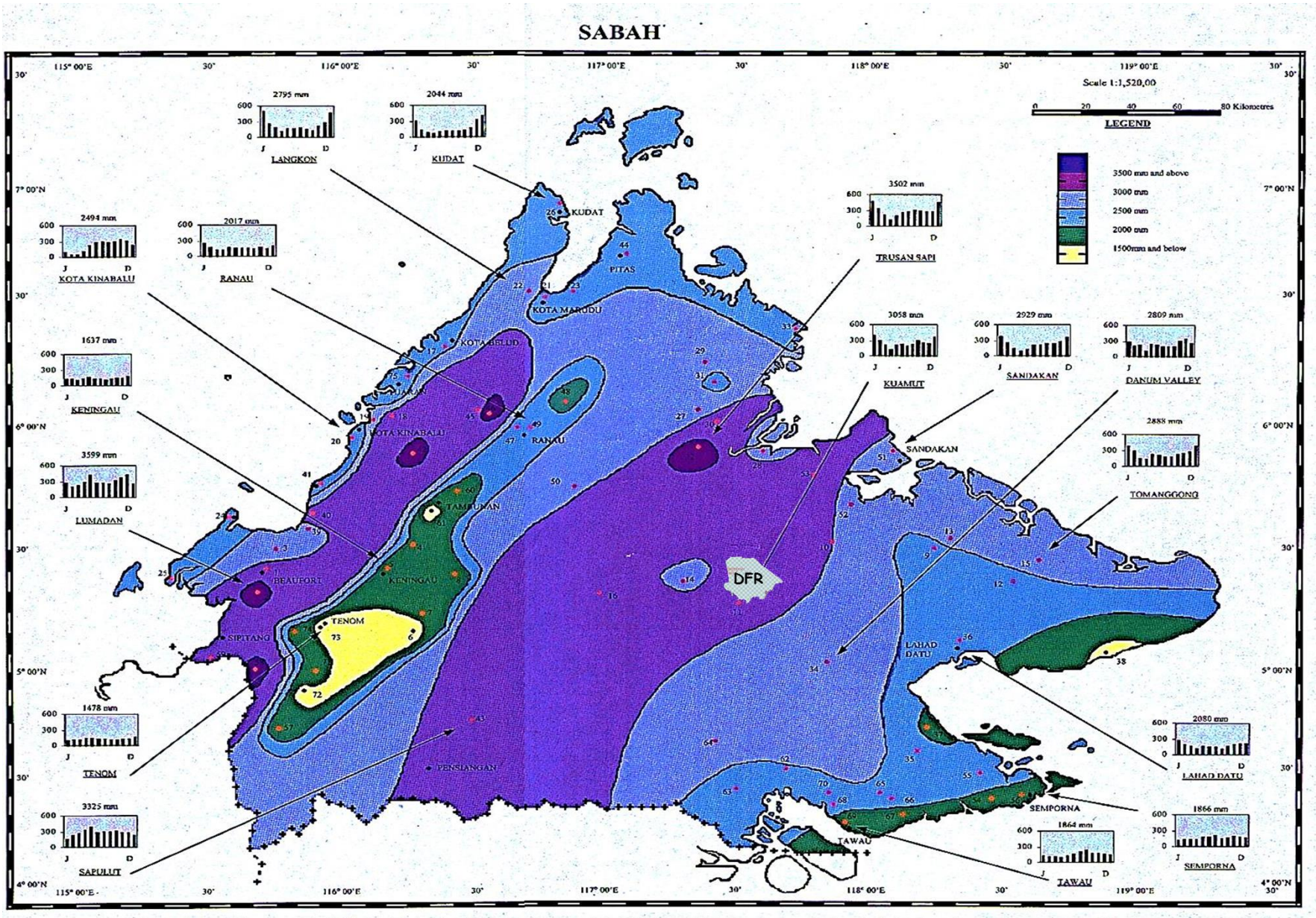


Figure 2.2: State wide distribution of rainfall pattern

As shown in Table 2.1 and Figure 2.3, during the first planning period (1991-2000) DFR received between 1,700 mm to 3,700 mm total rainfall annually and the ten-year average is 2,960mm. During the second planning period (2000-2013), DFR recorded 2,700mm to 5,700mm of annual total rainfall with an average of 3,566mm - see Table 2.2 and Figure 2.4. However, in spite of the obvious differences in the annual total and average amount of rainfall, the differences in annual rainfall distribution between the two planning period appeared insignificant.

Table 2.1: Annual Total and Yearly Monthly Rainfall for the Period 1991 to 2000

Year	MONTH												
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
	Volume of Rainfall (mm)												
1991	554.0	207.0	44.0	202.5	282.0	347.0	365.0	134.5	249.0	413.5	529.5	380.0	3,708.0
1992	28.5	92.5	56.5	24.0	131.5	NA	133.0	212.5	325.5	296.5	163.0	314.0	1,777.5
1993	195.0	234.0	288.0	204.5	60.5	124.5	317.0	172.0	253.0	298.5	334.0	352.5	2,833.5
1994	157.5	213.5	181.0	187.0	280.0	266.0	135.0	354.5	246.5	210.5	164.5	272.0	2,668.0
1995	326.0	248.0	172.5	42.0	342.0	388.0	760.3	411.7	249.0	342.0	168.0	331.0	3,280.5
1996	501.0	572.5	95.5	235.5	361.5	190.5	140.5	196.0	186.0	443.5	123.0	412.5	3,458.0
1997	250.5	463.0	142.5	93.0	257.5	37.5	163.0	342.0	127.3	403.0	172.0	230.5	2,682.5
1998	114.0	43.5	33.0	34.0	109.5	138.0	204.0	289.0	207.3	253.5	396.0	149.5	1,971.5
1999	211.5	381.5	281.0	384.0	554.5	194.5	145.0	405.0	191.5	240.5	180.5	294.5	3,464.0
2000	440.0	230.0	490.0	350.0	430.0	200.0	250.0	40.0	90.0	290.0	130.0	300.0	3,240.0

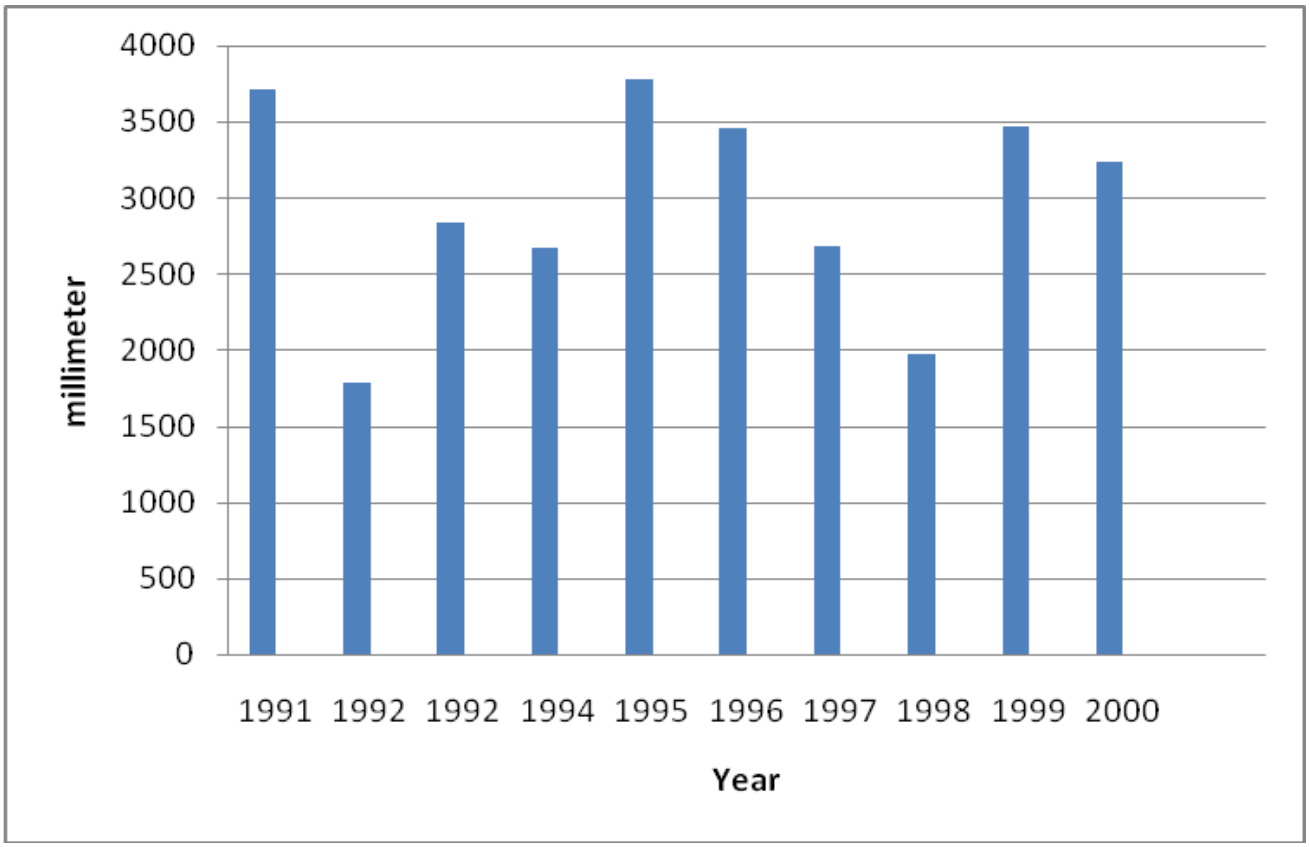


Figure 2.3: Annual total rainfall pattern for the year 1991 - 2000

Table 2.2: Annual Total and Yearly Monthly Rainfall for the Period 2002 to 2013

MONTH	YEAR											
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
J	203	336	492	297	223	461	624	286	389	347	474	411
F	192	454	140	82	673	220	248	426	85	362	186	308
M	155	206	361	346	121	81	356	275	21	87	275	73
A	368	115	58	33	137	142	204	259	254	163	199	207
M	589	78	263	408	223	649	473	554	92	304	372	268
J	442	156	96	271	331	221	692	217	74	168	125	278
J	329	298	480	204	243	257	241	408	239	72	274	266
A	519	341	123	229	303	160	842	235	99	85	151	366
S	435	391	501	233	268	265	349	197	171	272	205	213
O	630	143	153	323	411	395	915	288	203	198	243	222
N	198	229	89	217	283	259	415	194	342	279	360	285
D	196	1,105	545	224	285	303	348	499	749	494	507	248
TOTAL	**4,256**	**3,852**	**3,301**	**2,867**	**3,501**	**3,413**	**5,707**	**3,838**	**2,718**	**2,831**	**3,371**	**3,145**

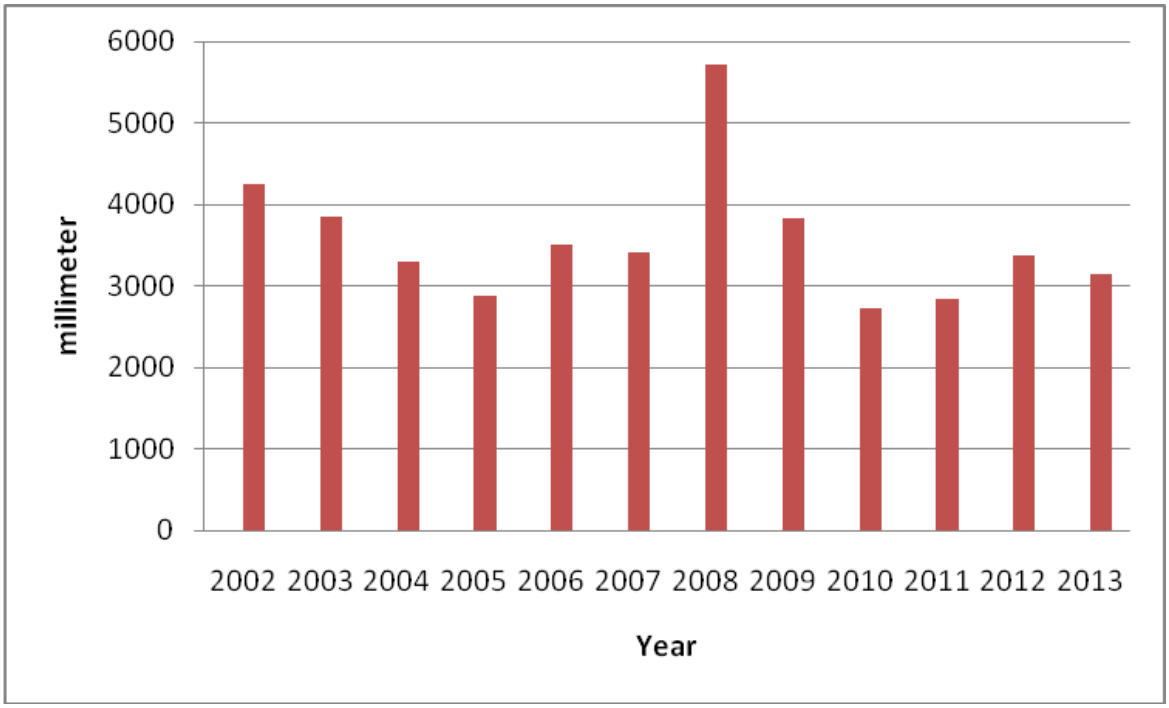


Figure 2.4: Annual Total Rainfall Pattern for the Year 2002 - 2013

Based on the statewide rainfall pattern distribution, it shows that DFR cuts across two rainfall belts that receive 2,500mm and 3,000mm total precipitation annually as can be visualized in Figure 2.5. Though DFR receives high amount of rainfall in general, irregular pattern is evident as shown in Figure 2.6 and Figure 2.7 respectively. Low rainfall occurred in the months of March and April and excessively high rainfall was received in the months of December and January.

2.1.2 Temperature

Being geographically located within the equatorial region, Sabah has uniform temperatures throughout the year. However, seasonal climatic variation does have some influence on the atmospheric temperature and causes it to fluctuate. The recorded average annual temperature is about 27°C with average maximum and minimum temperatures of 31°C and 23°C respectively.

The hottest months are associated with the dry season which also coincide with the inter monsoon period. Based on the climatic data provided by the Meteorological Services, atmospheric temperatures showed a visible variation but no observable abnormal patterns. Such condition is probably due to the influence of natural forests which are known to have significant role in climatic stability. However, the daily temperature range is large, that is, from 5°C to 10°C at the coastal areas and from 8°C to 12°C in the inland areas.

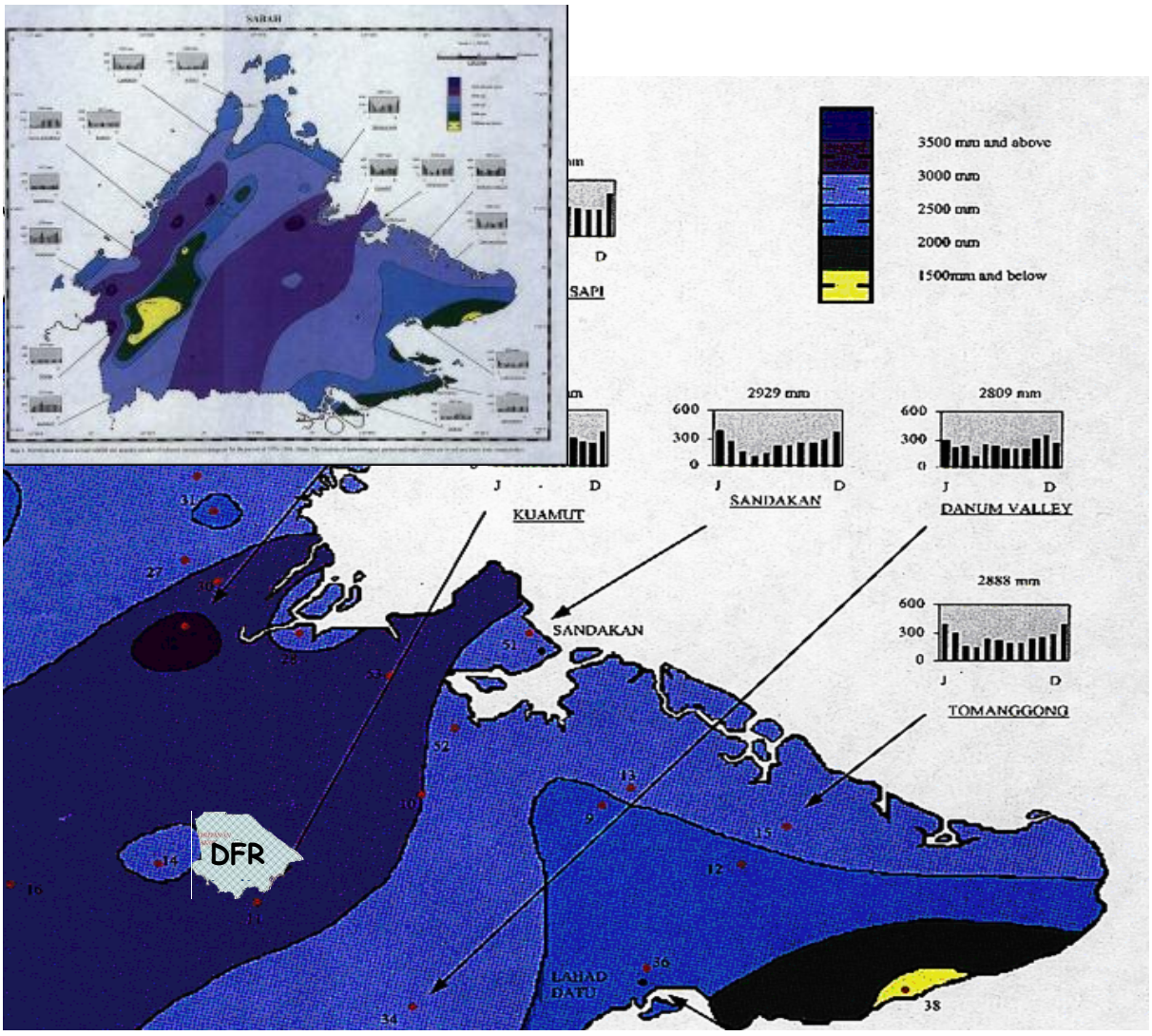


Figure 2.5: DFR in relation to distribution pattern of annual rainfall of Sabah

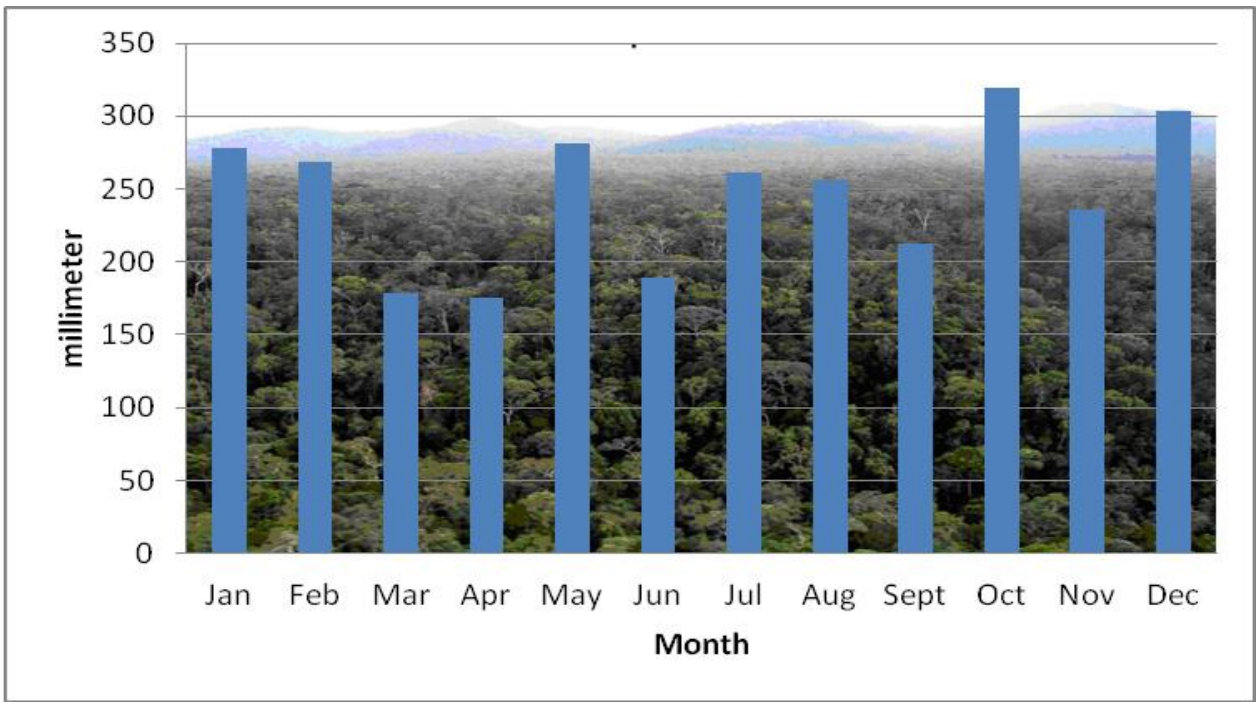


Figure 2.6: DFR monthly average rainfall pattern for a period 1991 - 2000

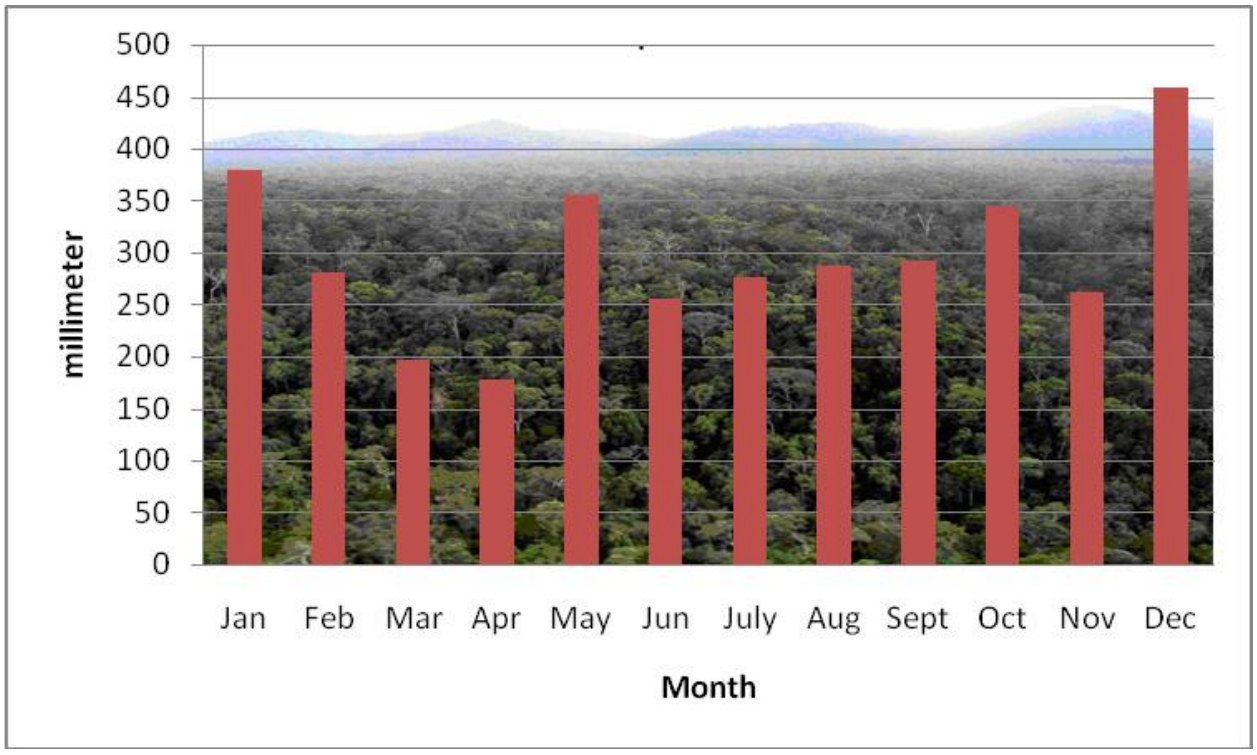


Figure 2.7: DFR monthly average rainfall pattern for a period 2002 - 2013

2.1.3 Relative Humidity

Sabah has a mean monthly relative humidity of between 70 to 90%, varying from place to place and from month to month. As in the case of temperature, the diurnal variation of relative humidity is much greater as compared to the annual variation. The mean daily minimum can be as low as

42% during the dry months and reaches as high as 70% during the wet months. The mean daily maximum, however, does not vary much from place to place and is always 94%.

2.1.4 Sunshine and Solar Radiation

Being close to the equator, Sabah naturally has abundant sunshine and thus solar radiation. However, it is extremely rare to have a full day with completely clear sky even in periods of severe drought. The cloud cover cuts off a substantial amount of sunshine and thus solar radiation. On the average, Sabah receives about 6 hours of sunshine per day. Solar radiation is closely related to the sunshine duration. Its seasonal and spatial variations are thus very much the same as in the case of sunshine.

2.1.5 Evaporation

Among all the factors affecting the rate of evaporation, cloudiness and temperature are two of the most important parameters. These two factors are however inter-related. A cloudy day will mean less sunshine and thus less solar radiation resulting in a lower temperature.

Cloudy or rainy months are the months with lower evaporation rate while the dry months are the months with higher rate. For highland areas where the air temperature is substantially lower, the evaporation rate is about 2.5 mm per day which is proportionally lower. While lowland areas have an annual average evaporation rate of 4 to 5 mm per day. Therefore, being located in the lowland area, the evaporation rate in the project area is expected to be between 4 to 5 mm per day.

2.2 Topography

DFR is located on land with elevations of 200m rising to a maximum of 1,079m above sea level (a.s.l). A large part of the area is on elevation ranging from 250m to 700m a.s.l (see Figure 2.8). The landforms are mainly undulating (71% of the area) with slopes varying from 6º to 24º. The higher elevation and steep slopes (>25º), which cover 5% of the area, are mostly located on the southeast and southwest of the reserve. The rest of DFR (approx. 24%) is flat (< 5º slope) – see slope map Figure 2.9.

2.3 Hydrology

2.3.1 Drainage System

Low hills and undulating terrain predominates the DFR natural landscape of which five main tributaries of the major Kinabatangan River flow from the reserve, namely Sg. Rawog Besar, Sg. Tabalion Besar, Sg. Liningkong, Sg. Deramakot and Sg. Tangkulap Kecil. Eventually all the waters from these rivers drain to the Sulu Sea. The largest portion (approximately 189.95 km²) is the catchment of Sg. Rawog Besar located at the northern part of DFR (see Table 2.3 and Figure 2.10). The second largest catchment with approximately 80.08 km2 is Sg. Tabalion Besar that drains toward east of DFR into Kinabatangan through Segaliud FR. Sg. Liningkong and Sg. Tangkulap catchment, on the other hand, with approximately 69.65 km^2 and 50.72 km^2 are located in the western part of DFR, respectively. Sg. Deramakot catchment is located at the south and is approximately 63.51 km^2. There are few smaller rivers namely Sg. Arawon (22.05 km^2), Sg. Rago-rago (19.43 km^2), Sg. Balat River (16.91 km^2), Sg. Kukon Besar (11.88 km^2), Sg. Tiu-tiu (4.84 km^2), Sg. Karis-karis (3.81 km^2), Sg. Going Up (0.85 km^2) and several short un-named tributaries of Milian

River (4.54 km^2) and Kinabatangan River (16.86 km^2), that are equally important in providing water to Kinabatangan and Milian Rivers.

Table 2.3: The 17 sub-catchment areas in relation to the forest management zones in DFR

No.	Water Catchment Area (River Name)	Protection (Ha)	Production (Ha)	Community (Ha)	Total Area (Ha)
1	Arawon	1,145	1,060		2,205
2	Balat	1	1,673	18	1,691
3	Deramakot	1,323	5,028		6,351
4	Going Up		85		85
5	Karis-Karis		381		381
6	Kukon Besar		1,187		1,187
7	Liningkong	944	6,021		6,965
8	Rago-Rago		1,943		1,943
9	Rawog Besar	1,225	17,771		18,995
10	Tabalion Besar	601	7,407		8,008
11	Tangkulap Kecil	89	4,983		5,072
12	Tiu-Tiu		483		483
13	Milian T1		130		130
14	Milian T2		237		237
15	Milian T3		87		87
16	Kinabatangan T1		1,453		1,453
17	Kinabatangan T2	233			233
Total Area		**5,561**	**49,928**	**18**	**55,507**

2.3.2 Water Quality

Environmental baseline sampling was carried out to characterize the water quality of 5 rivers in DFR, namely Sg. Rawog, Sg. Mannan, Sg. Tangkulap Kecil, Sg. Balat and Sg. Deramakot as of 24th June 2014 (see Table 2.4). A total of 5 sampling points represent the DFR watershed and its sub-catchment areas, which predominantly drain through DFR. These sampling points are labelled D1 to D5. Their geographical locations and distribution and site descriptions can be referred to in Figure 2.10 and Table 2.4 respectively.

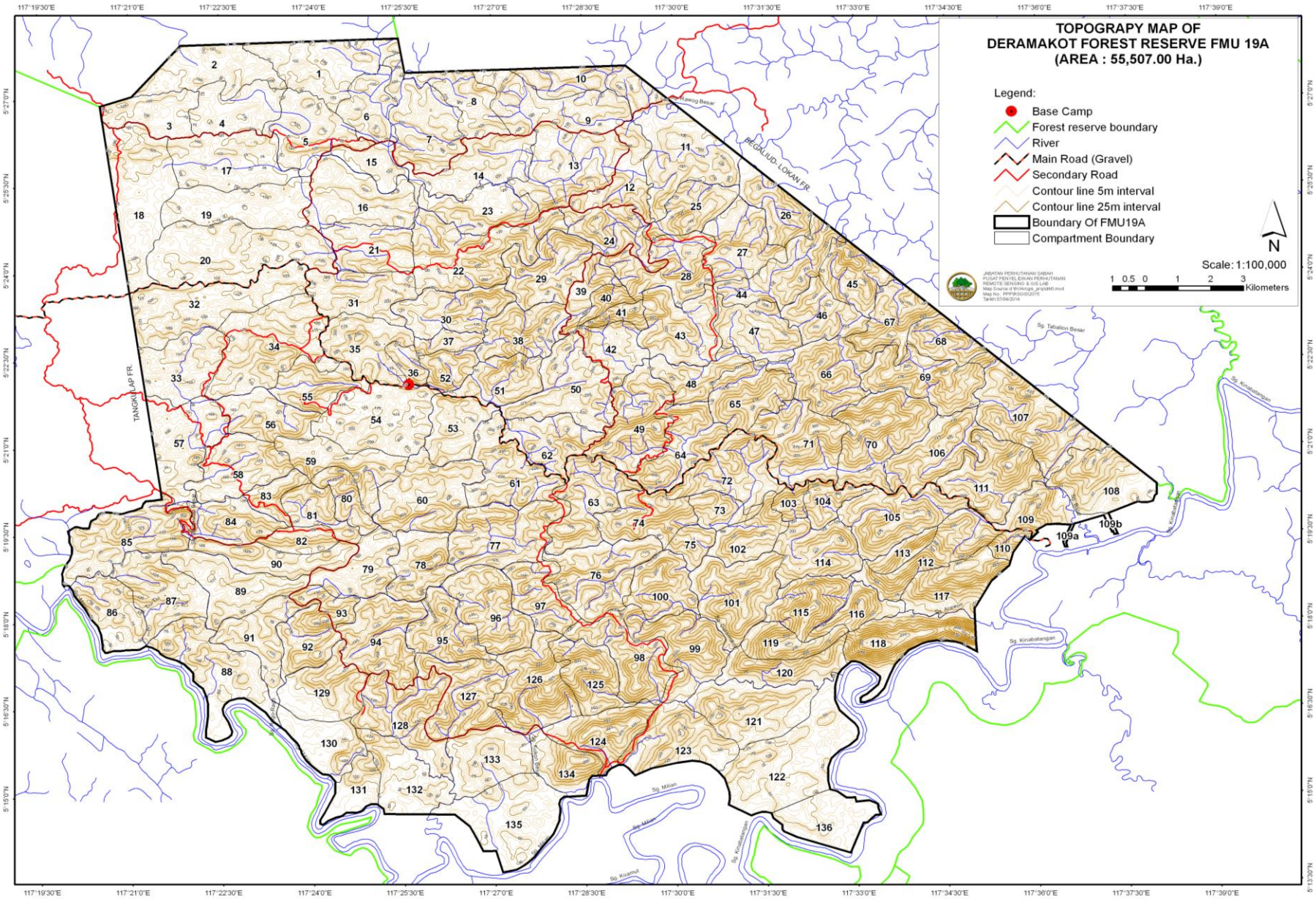


Figure 2.8: Topography of DFR

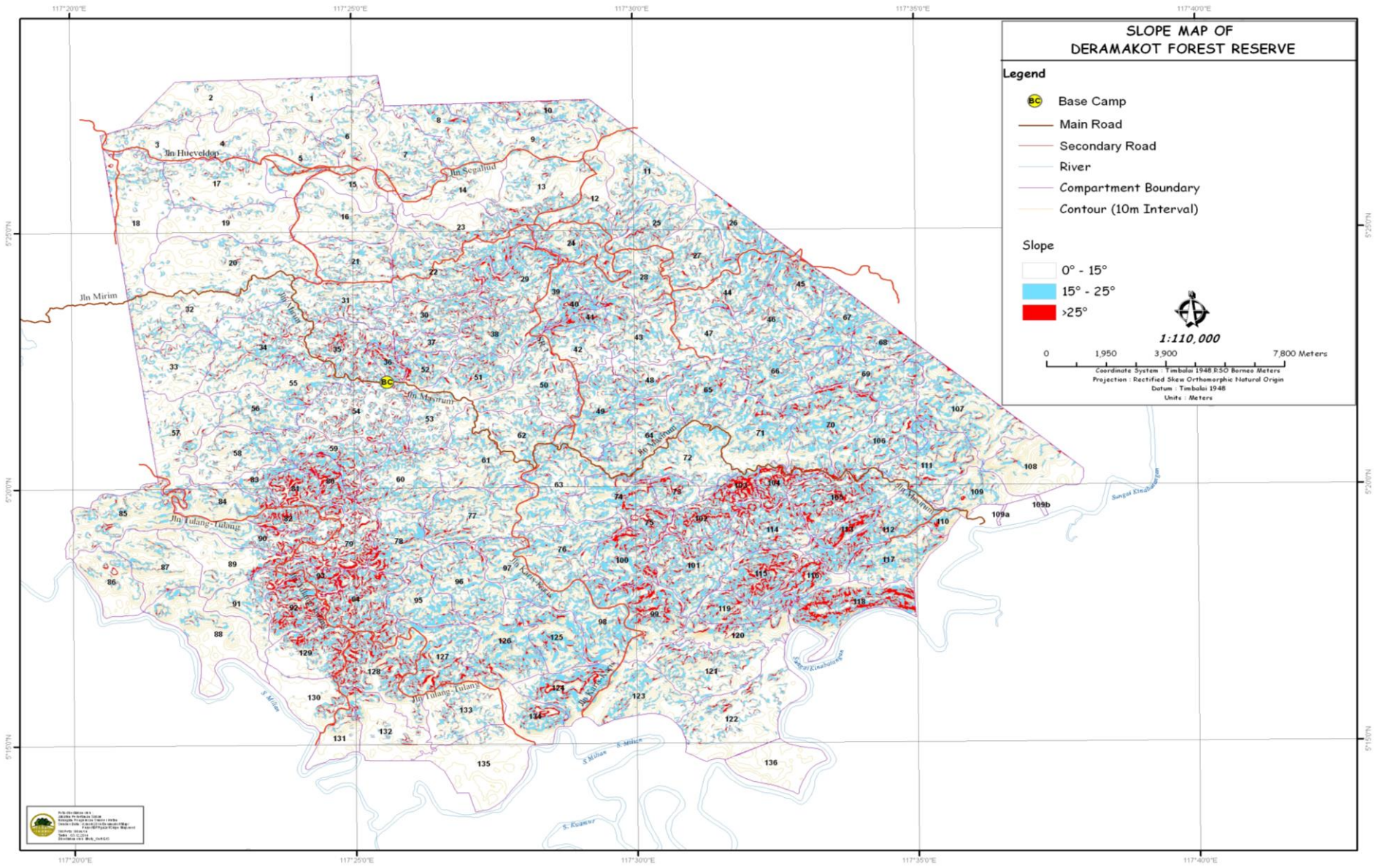


Figure 2.9: Slope map of DFR

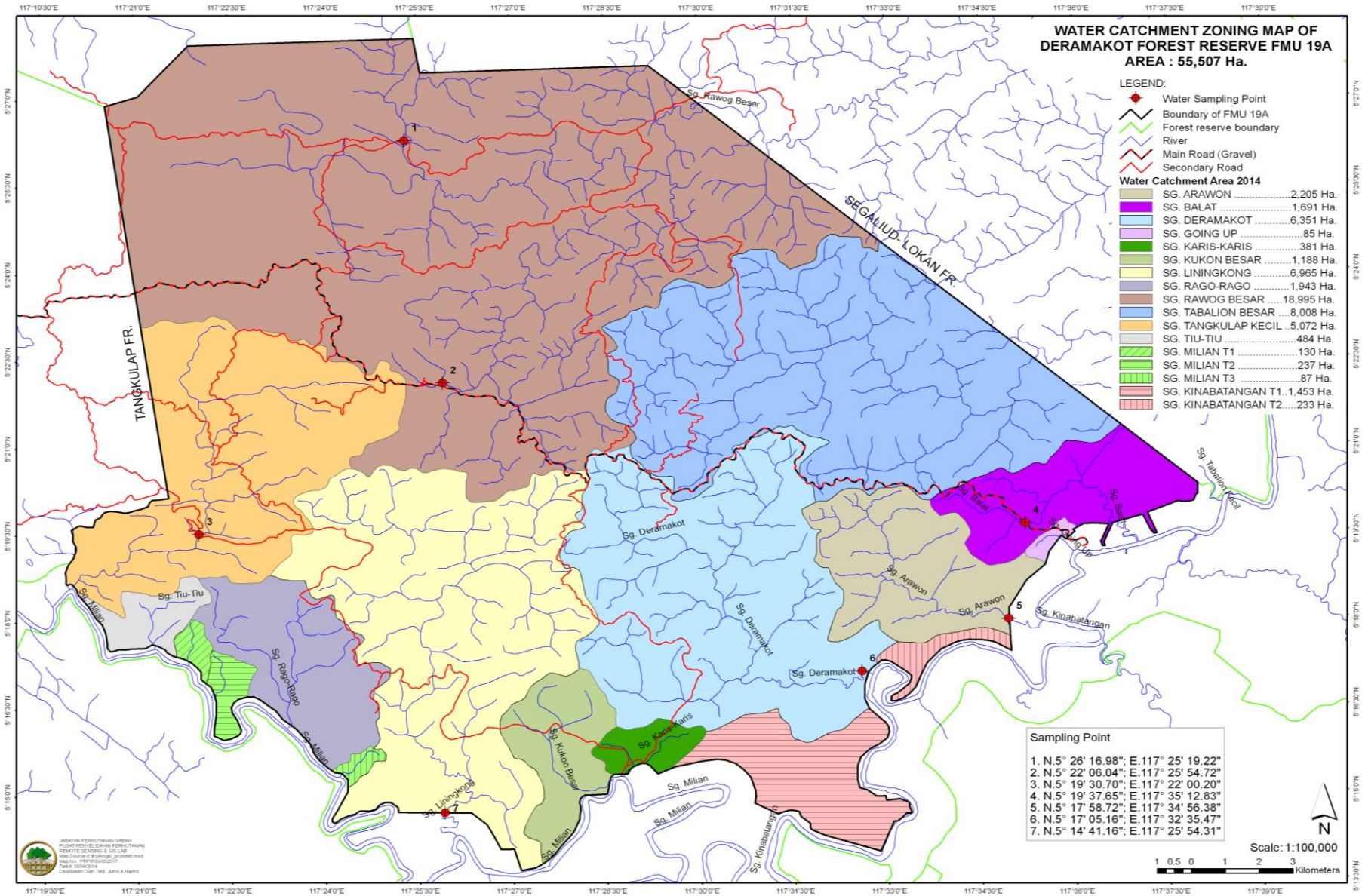


Figure 2.10: The distribution of 17 minor catchments found in Deramakot Forest Reserve

Table 2.4: The geographical location and site description of water quality sampling in DFR

Sample Point No.	Location	Surrounding Condition	Prevailing Weather conditions (24 hours)	Date of Sampling	GPS Location	
					North	East
D1	Rawog River	Secondary forest	Clear weather during sampling, but raining heavily for duration of 1 hour, 15 hours prior to sampling period.	24/06/2014	05°26.223'	117°25.559'
D 2	Mannan River (Base Camp)	Secondary forest		24/06/2014	05°21.955'	117°26.239'
D 3	Tangkulap Kecil River	Secondary forest		24/06/2014	05°19.445'	117°22.113'
D 4	Balat River	Secondary forest		24/06/2014	05°19.556'	117°35.351'
D 5	Deramakot River	Secondary forest		24/06/2014	05°17'05.16"	117°32'35.47"

All the headwaters of these rivers derive from within DFR itself, except for part of Rawog River, which derives from adjacent oil palm estates in the north.

Meanwhile, the chemical analyses and water quality classes for all parameters tested for the sampling points D1, D2, D3, D4, and D5 were carried out; and the results can be referred to in **Appendix 2**.

2.3.3 Managerial Implications of Topography and Hydrology

In general, the tests for water quality sampled from the various local rivers show that it is considerably clean. All rivers indicated no trace of oil and grease and harmful levels of ammonium nitrate (indicator of extreme use of fertilizer). Total suspended solid levels and pH values generally complied with the standards set for water under Class I of the National Water Quality Standards for Malaysia (NQWSM), indicating impact of soil erosion is at the minimal level. No indications of organic pollution in all sampling points as the Biological Oxygen Demand (BOD) for all sampling points are under Class I of NQWSM.

Although part of Rawog River is derived from adjacent oil palm estates, there is no indication of excessive usage of ammonia rich fertilizers, shown by Ammoniacal- Nitrogen (as N_3-N) result, which complied with the standards under Class I of the National Water Quality Standards for Malaysia.

The research results also showed that the RIL system practiced in DFR does not show a significant impact on water pollution to the five main rivers stated above.

2.4 Geology, Rock and Soil

The geology of DFR is dominated by sedimentary formations namely Kulapis Formation which was laid down in the mid to late tertiary period. The most prominent rock types are red calcareous sandstone, mudstone and shale. Smaller patches of ultrabasic igneous rocks like serpentinite are reported to occur in the western portion of the area. The big valleys of the Rawog River (in the northern part) and the Kinabatangan River (in the southern part) are made up of old alluvial deposits. Gravel and stone beds are found along the banks of both rivers to respectable depths. The soils derived from these rocks are infertile with limited stocks of plant-available nutrients.

Lokan association is the most extensive soil in the area (Figure 2.11). It covers about 89% of the area which consist of high hills formed of interbedded sandstone and mudstone. The main soil units are Orthic Acrisol of Kapilit and Tanjong Lipat family and Dystric Cambisol of Laab family. Soils of Sook and Kinabatangan association occur in low lying areas with its parent materials derived from alluvium. The dominant soil of these associations are poorly drained Gleyic Acrisol of the Inanam family. Leptosols found on steep slopes are shallow, limiting root penetration. Generally these soils are dry due to high rock content. More than 99% of the soils in DFR have less than 5,000 kg/ha of exchangeable macro-nutrients and can be classified as poor to very poor.

2.5 Managerial Implications of Geology and Soils

In general, most of the soils are acidic with low nutrients content. Acrisols developed on old land surfaces and prolong weathering lead to a general loss of nutrients. Moreover, they are easily erodable. These two factors are the major serious limitations to any type of land management. Since Leptosols found on steep slopes limit root penetration, and they are dry due to high rock content, logging is restricted in these areas because erosion may wash away the already thin soil layer. Surface erosion becomes a particular concern in steep terrain when intense forestry practices are conducted, which result in the removal or destruction of significant portions of the top soil which contain nutrients and organic carbon. However, the RIL technique adopted in DFR would reduce the occurrence of soil degradation and compaction in the area.

2.6 Forest Ecosystems in DFR

2.6.1 Natural Vegetation

The vegetation of DFR can be generally categorized into two broad vegetation classes, i.e., old growth forest and secondary growth vegetation (Table 2.4). The forest consists of various climax forest formations including Lowland Mixed Dipterocarp Forest (LMDF), Lowland Mixed Dipterocarp and Kerangas Forest (LMD&KF), Lowland Seasonal Freshwater Swamp Forest (SFSF) and Lowland Ultramafic Forest (UF). The natural vegetation of DFR is very much affected by past timber extraction activities that exposed it to 3 decades of conventional logging before the introduction of sustainable forest management that requisitely following reduced impact logging guidelines. Aside from this, history of the occurrence of forest fires in the northern and southern parts of DFR during the significant drought events in 1982/1983 had degenerated a portion of the old growth forest into secondary vegetation.

The old growth forest is represented by closed canopy with high density and medium density stands that cover at least 25 % and 51 % of the total DFR area respectively. Whereas, the secondary vegetation with open canopy of late secondary re-growth and early secondary re-growth cover about 20 % and 4 % are expected to be in pristine and disturbed conditions respectively (see Table 2.5 - Source: Forest Resource Management, Sabah Forestry Department; Ong *et al*, 2013). The disturbance that had affected the forest quality could be caused by past timber harvesting and forest fire.

Table 2.5: Current vegetation cover and relative extent of forest-cover type in DFR

Forest Types	Area (Ha)	Relative Extents of Forest Cover Types			
		Closed Canopy, High Density	Closed Canopy, Medium Density	Open Canopy	Open Canopy, Re-growth
Lowland Mixed Dipterocarp Forest	51,908	24%	48%	19%	4%
Lowland Mixed Dipterocarp & Kerangas Forest	2,100				
Lowland Ultramafic Forest	30				
Lowland Seasonal Freshwater Swamp Forest	1,469	1%	3%	1%	<1%
Total	**55,507**	**25%**	**51%**	**20%**	**4%**

2.6.1.1 Lowland Mixed Dipterocarp Forest

The original coverage of Lowland Mixed Dipterocarp Forest (LMDF) is estimated as 51,908 ha or 93% of the total DFR area (Table 2.4 and Figure 2.12). The Dipterocarp tree family dominates the forest with at least 15–60 and 36–60 % of the total tree density and basal area, respectively. The dipterocarps are also well represented in most of the canopy layers in the forest, i.e. the upper, middle storey and under storey canopies. The tree families Lauraceae, Alvaceae, Euphorbiaceae and Anacardiaceae represent other important groups of trees.

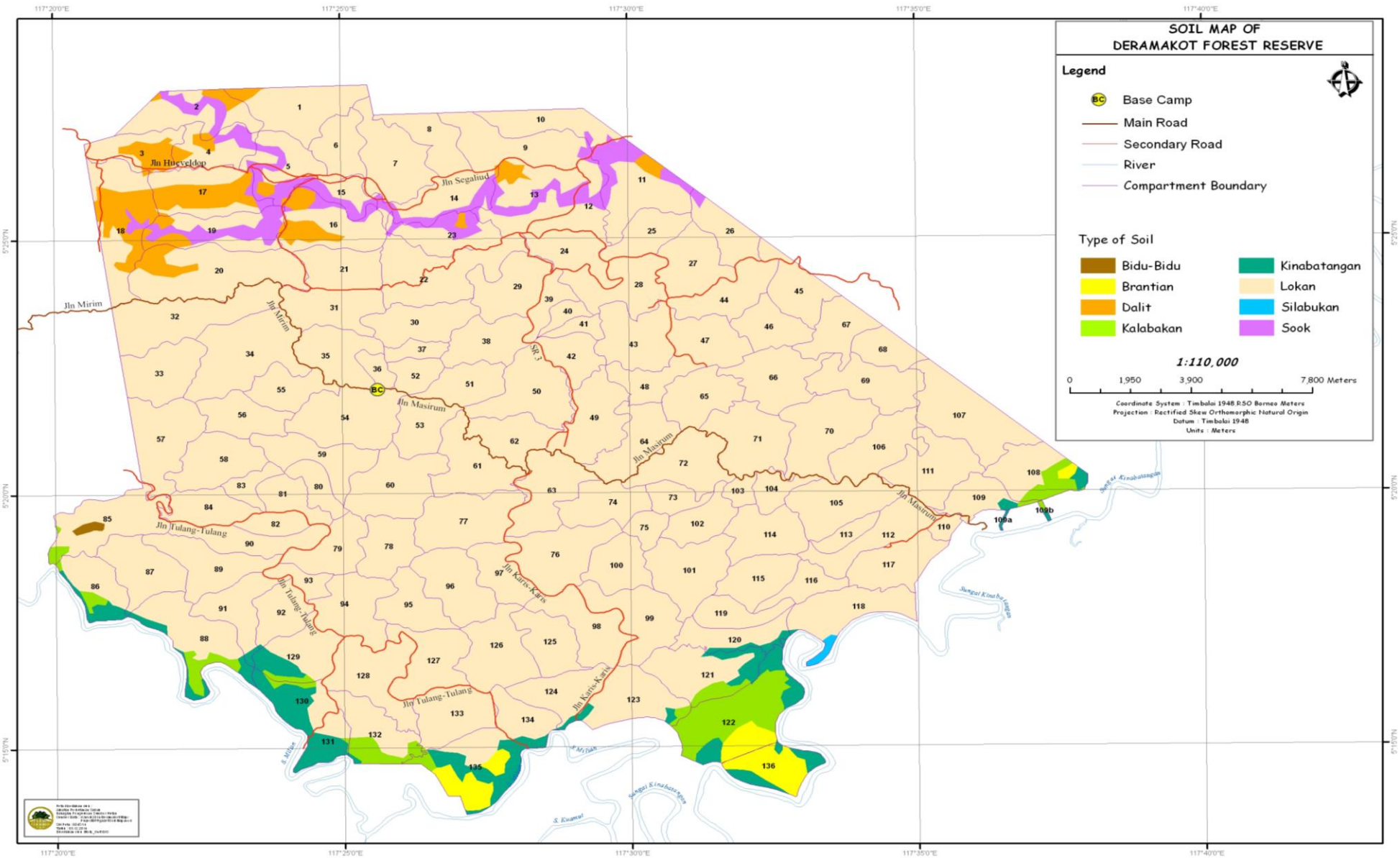


Figure 2.11: Soil Association Map of DFR

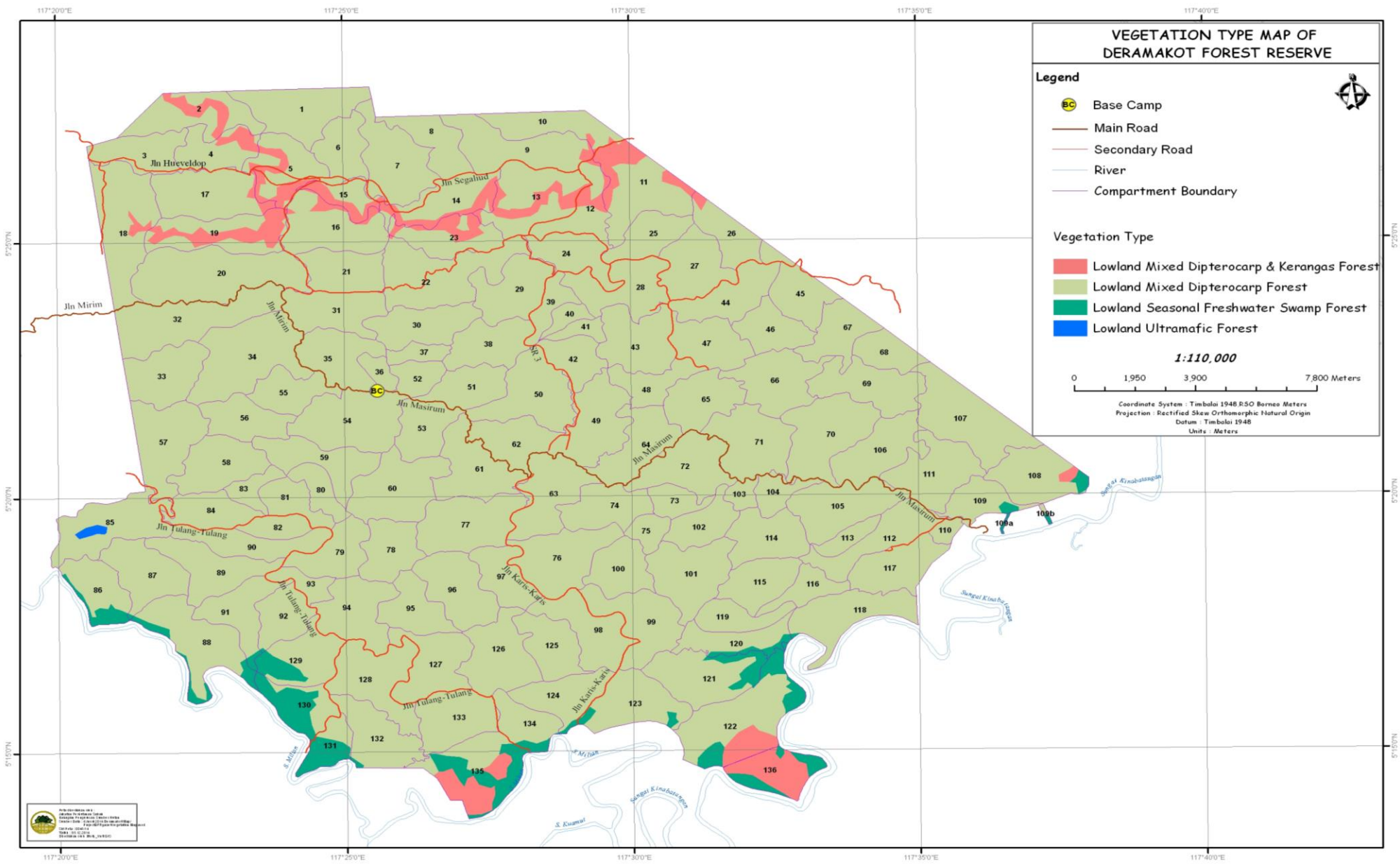


Figure 2.12: Current vegetation map of DFR

The main canopy of LMDF consists of mature trees with diameters of >50 cm and they can attain heights to about 50–60 m. The common trees found in this canopy layer are *Parashorea malaanonan, Dipterocarpus garcilis, Dryobalanops lanceolata, Hopea wyatt-smithii, Shorea fallax, Shorea johorensis, Shorea parvifolia, Shorea superba* from the family Dipterocarpaceae; *Durio grandiflorus, Pentace adenophora, Scaphium* sp.1 from the tree family Malvacaea; *Eusideroxylon zwagerii* (Lauraceae); *Instia palembanica* (Leguminosae); *Koordersiodendron pinnatum* (Anacardiaceae); *Mezzettia* sp. (Annonaceae); and *Teijmanniodendron simplicifolium* (Lamiaceae).

The middle storey forest structure consists of trees with a diameter range of 20–50 cm but rarely exceed 40 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as, *Parashorea tomentella*, *Shorea atrinervosa*, *Shorea gibbosa*, *Shorea ovalis*, *Shorea pilosa* and *Shorea smithiana* (Dipterocarpaceae); *Diospyros frutescens*, *Diospyros macrophylla* and *Diospyros tuberculata* (Ebenaceae); *Macaranga* spp and *Mallotus* spp (Euphorbiaceae); *Diplodiscus parviflorus* and *Pentace laxiflora* (Malvaceae); *Artocarpus kemando* and *Ficus racemosa* (Moraceae); *Lithocarpus* spp (Fagaceae); *Teijmanniodendron pteropodum* (Lamiaceae); *Hydnocarus woodii* (Achariaceae); *Barringtonia scortechinii* (Lecythidaceae); *Dialium indum* (Leguminosae); *Aglaia* sp.2 (Meliaceae); *Neolamarckia cadamba* (Rubiaceae); *Nephelium mangayi* (Sapindaceae); *Madhuca malaccensis* (Sapotaceae); and *Quassia borneensis* (Simaroubaceae).

The understorey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside understorey treelets with diameter of <20 cm. Common trees in this understorey canopy are *Aglaia* sp.1, *Aglaia simplicifolia*, *Aglaia edulis*, *Chisocheton* spp and *Dysoxylum* sp.1 (Meliaceae); *Mallotus peltatus*, *Mallotus korthalsii* and *Aporosa* spp (Euphorbiaceae); *Knema laurina* and *Horsfieldia sp.1* (Myristicaceae); *Litsea* spp (Lauraceae); *Hopea nervosa* (Dipterocarpaceae); *Rinorea bengalensis* (Violaceae); *Urophyllum arboreum* (Rubiaceae); *Streblus macrophyllus* (Moraceae); *Microcos* spp (Malvaceae); *Garcinia* spp (Clusiaceae); *Fordia splendidissima* (Leguminosae); *Dilllenia excelsa* (Dilleniaceae); *Cubilia cubili* (Sapindaceae); and *Arthrophyllum diversifolium* (Araliaceae).

Meanwhile, the tree species composition and assemblages growing on ultrabasic substrates is similar to those found in the LMDF. Therefore, the analyses of the data are included in this section documentation.

2.6.1.2 Lowland Mixed Dipterocarp and Kerangas Forest

The Lowland Mixed Dipterocarp and Kerangas Forest (LMD&KF) covers about 2,100 ha or 4% of the total DFR area. The dominant group of trees is the dipterocarps that represent up to 60 % and 52 % of the total density and basal area of the forest, respectively. Other important tree families are Apocynaceae, Myrtaceae, Rubiaceae and Hypericaceae.

The main canopy consists of mature trees with diameter of > 50 cm and which can attain heights to about 40–50 m. The main canopy is dominated by the typical upland species, namely *Dryobalanops beccarrii*, *Shorea macroptera*, *Shorea ovalis*, *Dipterocarpus tempehes*, *Dipterocarpus confertus*, *Shorea acuminatissima*, *Shorea mecistopteryx* and *Shorea smithiana* from the tree family Dipterocarpaceae; *Syzygium incarnatum* and *Syzygium borneense* from the tree family Myrtaceae; and *Durio graveolens* (Malvaceae).

The middle storey forest structure consists of trees with a diameter range of 20–40 cm but rarely exceed 40 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as, *Lithocarpus leptogyne* and *Lithocarpus* spp. from the tree family Fagaceae; *Elaeocarpus brunnescens* (Elaeocarpaceae); *Santiria tomentosa* (Burseraceae); *Alstonia spatulata* (Apocynaceae); *Neolamarckia cadamba* (Rubiaceae); *Koompassia malaccensis* (Leguminosae); and *Cleistanthus myrianthus* (Euphorbiaceae).

The understorey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside understorey treelets with diameter of < 20 cm. Common trees in this understorey canopy are *Macaranga gigantean*, *Macaranga* spp., *Glochidion rubrum*, *Brownlowia peltata* and *Croton oblongus* (Euphorbiaceae); *Madhuca hirtiflora* (Sapotaceae); *Dacroydes rubiginosa* (Burseraceae); *Mangifera magnifica* (Anacardiaceae); *Nauclea subdita* (Rubiaceae); *Pternandra coerulescens* (Melastomataceae); *Litsea* spp. (Lauraceae); *Cratoxylum formosum* (Hypericaceae); and *Xylopia elliptica* (Annonaceae).

2.6.1.3 Seasonal Freshwater Swamp Forest (SFSF)

Originally, the Seasonal Freshwater Swamp Forest (SFSF) covered an estimated area of 1,469 ha or 2% of the total DFR (Table 2.4). This particular forest formation is found in the floodplain area in the southern part of the reserve along the Kinabatangan River and has been logged in the past. Currently, large secondary trees from the family Malvaceae and Euphorbiaceae dominate the forest. This forest could have tree density and basal area of 488–588 individuals/ha and 22–28 m^2, respectively.

The main canopy consists of mature trees with > 50 cm dbh and can attain a height about 20–30 m. The main canopy is dominated by the typical freshwater swamp species, namely *Pterospermum subpeltatum* and *Kleinhovia hospita* (Malvaceae); *Nauclea subdita* and *Ludekia borneensis* (Rubiaceae); *Macaranga hypoleuca* (Euphorbiaceae); *Parkia speciosa* (Leguminosae); *Harpullia arborea* (Sapindaceae); *Dacrydes rugosa* (Burseraceae); and *Alstonia scholaris* (Apocynaceae).

The middle storey forest structure consists of trees with a diameter range of 20–50 cm but rarely exceed 20 m in height. It is partly represented by the main canopy trees, as well as other medium-sized mature trees, such as *Aglaia edulis* and *Aglaia edulis* (Meliaceae); *Cananga odorata* (Annonaceae); *Diospyros tuberculata* (Ebenaceae); *Dracontomelon dao* (Anacardiaceae); *Oroxylum indicum* (Bignoniaceae); and *Parashorea tomentella* (Dipterocarpaceae).

The understorey of this forest is represented by most of the trees found in the main and mid-canopy layers, alongside understorey treelets with diameter of < 20 cm. Common trees in this understorey canopy are *Beilschmiedia* spp., *Dehaasia* sp.1 and *Caryodaphnopsis tonkinensis* (Lauraceae); *Dillenia excelsa* and *Dillenia indica* (Dilleniaceae); *Dracontromelon costatum* (Anacardiaceae); *Homalium foetidum* (Salicaceae); *Mallotus peltatus* (Euphorbiaceae); *Melicope lunu-ankenda* (Rutaceae); and *Microcos crassifolia* (Malvaceae).

2.6.2 Secondary Vegetation

This secondary vegetation developed after the occurrence of severe disturbance event, such as, very disruptive timber extraction in the past or occurrence of forest fire. In open areas, vines or woody climbers such as, *Croton cordata* (Euphorbiaceae), *Merremia* sp. (Convolvulaceae), *Smilax borneensis* (Melastomataceae), and *Uncaria* sp. (Rubiaceae), scramble on the ground or smother many other secondary plants. The regenerating trees are mostly pole- and medium-sized pioneer trees that are usually established in clumps. The common secondary trees are *Macaranga pearsonii* (Euphorbiaceae); *Neolamarckia cadamba* (Rubiaceae); *Calicarpa farinosa* (Verbenaceae); *Pterospermum elongatum* (Sterculiaceae); *Duabanga moluccana* (Sonneratiaceae) and *Octomeles sumatrana* (Datiscaceae). A number of secondary treelets, namely, *Fagraea cuspidata* (Loganiaceae), *Ficus septica* (Moraceae), *Leea indica* (Leeaceae), *Melicope luna-ankenda* (Rutaceae), *Dillenia orientalis* (Dilleniaceae), *Callicarpa longifolia* (Verbenaceae), *Pternandra* sp. (Melastomataceae), *Homalanthus populneus* and *Glochidion* sp. from the family Euphorbiaceae, are also found to establish in the matrix of secondary vegetation.

In previously burnt areas that are fertile and contain high moisture content, a ginger member, *Etlingera brevilabrum*, establishes and forms impenetrable thickets. The invasive nature of the ginger growth and establishment potentially enables it to outcompete other regenerating secondary plant species.

The late secondary forest is largely represented by pioneer tree species from the families Euphorbiaceae, Rubiaceae and Dasticaceae. About 40–60% of the basal area is represented by medium- and large-sized pioneers mainly contributed by *Neolamarckia cadamba* and *Neonauclea artocarpioides* (Rubiaceae); *Macaranga pearsonii*, *Macaranga gigantea* and *Macaranga hypoleuca* (Euphorbiaceae); *Octomeles sumatrana* (Datiscaceae); *Pterospermum elongatum* (Sterculiaceae); and *Duabanga mollucana* (Sonneratiaceae). Relics of representatives of main canopy climax trees of the Dipterocarpaceae, Burseraceae and Fabaceae are found regenerating in clumps. The under storey and middle storey specialists can still persist but in low abundance. The density of pioneer woody climbers and climbing bamboos in silviculturally non-treated forest is also high.

2.6.3 Forest Recovery and Regenerative Status

Most of the disturbed areas classified as old growth forest in all the forest formations have the potential to revert back into their original forest structure and diversity. In this forest condition, mother trees are available in large quantity to guarantee continuous seed supply for forest regeneration. However, there are patches in this area that are heavily invaded by pioneer species. The establishment of pioneer species, such as pioneer trees, woody vines, climbing bamboos and other secondary species may hamper forest regeneration. Therefore, timber stand improvement by removing impeding secondary species is needed to release most of the regenerating climax species.

The late secondary forest contains irregular regenerating patches of main canopy climax species. Most of the regeneration occurs in clumps within the vicinity of surviving seeding trees. However, there are also areas with no regeneration of the main canopy climax species. Therefore, mixtures of silvicultural treatment by removing impeding secondary species and reintroduction or enrichment planting of canopy climax species are required.

Low stature secondary vegetation contains the lowest number of regenerating canopy climax species, especially in previously burnt areas infested with wild ginger. In this area, restoration of forest structural diversity is required and may involve intensive restoration activities, such as physical and biological amelioration of the site before reintroducing or planting of multi-species. This area will present the greatest challenge among all the forest restoration activities prescribed in this plan.

2.7 Forest Ecosystem Conservation Status

Retaining the whole DFR under the natural forest management activities is the best effort in maintaining the forest ecosystem functions as forest corridors for plant dispersal and wildlife movement. With the application of RIL, rigorous forest silvicultural exercise and forest structural diversity restoration activities, it is envisaged that the forest ecosystem function for the physical and biological environment will be maintained or perhaps become better over time.

Considerable areas of LMDF in the northern and southern parts of DFR have been reduced to secondary vegetation due to past timber extraction activities and wildfire (Figure 2.12). This vulnerable habitat could recover to its original state through natural regeneration since intact old growth forests are still within their vicinity. However, the natural regeneration processes will take a longer time due to limitation of climax species dispersal mechanism.

In sustainable forest management, the concept of High Conservation Value (HCV) is adamantly applied (see Chapter 4). Based on the rationale address during the recent HCV assessment, the management team has increased the forest conservation zone from the previously 3,734 ha to 9,115 ha that equates to 17% of the DFR being conserved. Previous and newly designated conservation zones consist of representation of major forest formations namely LMDF, LMD&KF and Lowland SFSF. The rationale for the increase in size also includes the important findings of unique forest community assemblages and also the presence of various habitat types that contain high biological diversity, including the occurrence of high conservation value species, both endemics and endangered flora and fauna.

2.8 Flora of DFR

From the collections (herbarium and voucher specimens) made during the recent High Conservation Value (HCV) survey and additional data retrieved from plant database (BRAHMS) and other research plots, a total of 900 taxa (identified to specific and infraspecific level) were recorded from the reserve. These are represented by 1 lycophyte family, 8 ferns, 1 gymnosperm, 12 angiosperms (Monocotyledon) and 89 angiosperms (Dicotyledon) – see Table 2.6.

Table 2.6: Number of plant taxa according to plant groups from DFR

Plant group	No. of families	No. of taxa
Lycopyhtes	1	3
Ferns	8	10
Gymnosperm	1	3
Angiosperm:		
Monocotyledon	12	73
Dicotyledon	89	811
Total	**111**	**900**

The ten most speciose families are Malvaceae with 93 taxa, Diperocarpaceae (74), Fabaceae (53), Euphorbiaceae (42), Phyllanthaceae (42), Lauraceae (40), Meliaceae (38), Annonaceae (35), Anacardiaceae (28) and Sapotaceae (28) - see Figure 2.13.

From the 900 plant taxa recorded from DFR, 232 plant species are endemic to Borneo, including 26 to Sabah but none is endemic to DFR.

In total, there is a record of 77 tree families spanning over 261 genera, thus making this category the main contributing group towards the total families recorded for DFR. Trees that were identified down to the species level (737 species) comprise of 77 tree families and 246 genera, with a total of 26 species identified to sub species or varieties. In compiling the primary data obtained from the HCV assessment and the secondary data compiled from previous studies, there is a total of 186 tree species recognized as endemics, representing about 25% of tree species known from within DFR. A total of 166 tree species are Borneo endemic, with 19 Sabah endemics. Trees recognized as Bornean endemics were highly represented by the Dipterocarpaceae with 35 species, represented by six genera namely *Dipterocarpus* (9 species), *Dryobalanops* (2 species), *Hopea* (2 species), *Parashorea* (2 species), *Shorea* (23 species) and *Vatica* (5 species). The low number of *Hopea* species recorded within DFR potentially reflects on the difficulties in identification of these often infrequent and sparsely distributed tree species.

A total of 11 endemic tree species are currently protected under Schedule 1 of the Forest Rules 1969, 9 Bornean endemic from 6 families ranging from the commercially valuable Dipterocarpacae and fruit treess from the Burseraceae (*Santiria grandiflora*), Malvaceae (All *Durio spp*), Moraceae (*Artocarpus tamaran*), Fabaceae (*Sympetalandra borneensis*) and Phyllanthaceae (*Baccaurea angulata*). Only 1 Sabah endemic is currently protected under Schedule 1 of the Forest Rules 1969 that is a fruit-tree (*Nephelium aculeatum*) from the Sapindaceae family.

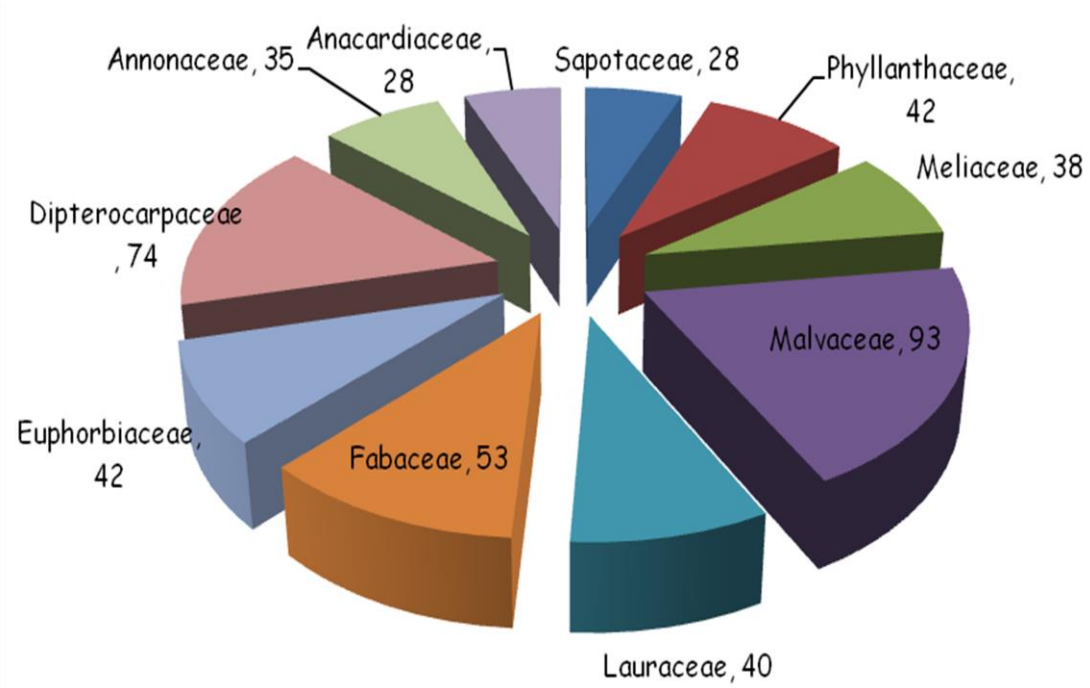


Figure 2.13: The ten most speciose plant families in Deramakot Forest Reserve

Palms

There are 7 palm tree species identified in DFR. Endemic palms were represented by 2 Bornean endemics. However, this may not represent the species richness for this group due to the limited collections or sampling which has principally been assessed within the 9 HCV plots laid. None of the endemics characterized as palms were formally protected under any national or state laws.

Shrubs

Shrubs are woody plants that have a single stem but having side branches that may be erect or may lay close to the ground and usually have shorter height (< 2 m tall). There are 15 shrubs species. A single shrub was identified as a Bornean endemic (*Eranthemum borneense*). None of the endemic shrubs are formally protected under any national or state laws.

Climbers

Climbers are long and weak stemmed plants that grow upwards by attaching itself on other plants or objects which they use as support for their vertical growth. They normally have specialized climbing structures, such as hooks or tendrils, which enable them to attach to another plant. There are 85 climber species in DFR. A total of 13 species of climbers were listed as endemics, of which 12 species are Bornean endemics, and 3 Sabah endemics. These include the climbing bamboo, *Dinochloa prunifera* and *D. sublaevigata*. None of the endemic climbers are formally protected under any national or state laws. However, this may not represent the species richness for this group due to the limited collections or sampling which has principally been assessed within the 9 HCV plots laid.

Grasses

Grasses are monocotyledons, usually herbaceous plants with narrow leaves growing from the base. The true grasses include cereals, bamboos and the grasses of lawns and grassland of the family Poaceae. There are 3 species of grasses recorded in DFR. However, this may not represent

the species richness for this group due to the limited collections or sampling which has principally been assessed within the 9 HCV plots laid.

Herbaceous Plants

Herbs are plants that have succulent leaves and without persistent woody stems above ground. There are 32 herbs species recorded in DFR. A total of 3 species of herbaceous plants were listed as Bornean endemics. However, this may not represent the species richness for this group due to the limited collections or sampling which has principally been assessed within the 9 HCV plots laid. None of the endemic herbs are formally protected under any national or state laws.

Sedges

Sedges are a family of monocotyledonous graminoid flowering plants, which superficially resemble grasses but can be distinguished by their triangular stems in cross-sections and leaves that are spirally arranged in three ranks. There are 8 sedges species in DFR. A single sedge grass identified (*Mapania graminea*) is a known to be a Bornean endemic. However, *Mapania graminea* is not formally protected under any national or state laws.

Lycophytes and Ferns

Ferns and lycophytes are green plants that lack flowers. They reproduce by microscopic spores, rather than by seeds as in flowering plants. Ferns can be distinguished from lycopytes by having highly divided fronds with branching veins and spore-bearing structures on the margins or undersides whereas, in lycophytes their sporangia are on the upper surface of small leaves with unbranched veins. There are 3 species of lycophytes and 10 ferns. None of the ferns or lycophytes identified within DFR was found to be endemic to either Borneo or Sabah. However this may not represent the species richness of this group, due to the limited collections or sampling for this plant group which has principally been assessed only within the 9 HCV plots laid.

Further information on the flora can be referred to in Sub-chapters 4.1.2.1 and 4.1.3.1 of this plan, while more details can be found in the HCV Report entitled "***High Conservation Values in Deramakot Forest Reserve:*** *Assessment Report and Management Recommendations*" by the SFD Team. This HCV Report is available with the DFO of Deramakot.

2.9 Wildlife Resources in DFR

2.9.1 Wildlife as Part of SFM

Wildlife is a crucial and an integral part of forest ecosystems. Animals ensure functions central to maintaining the integrity of natural processes and necessary for the maintenance of healthy forests (Ancrenaz, 2013). DFR consists mainly of lowland and freshwater swamp forests and provides an imperative habitat for various wildlife species. As highlighted by Samejima *et al*. (2013), distribution and abundance of wildlife species in a Forest Management Unit (FMU) is significant information for the SFM. Such information will contribute to the establishment of conservation areas within the FMU, to evaluate performance of current management schemes, and to improve the effectiveness and efficiency of the management.

2.9.2 Scope of Wildlife Surveys

Wildlife inventories and assessments are primarily conducted through literature reviews, rapid field surveys, interviews and community consultation. They provide baseline data upon which a monitoring programme can be developed and implemented.

Based on the Wildlife Monitoring System guidelines in DFR (Mannan *et al*., 2003), the following monitoring components are still being implemented and will continue:

- Saltlick (before, during and after harvesting operation);
- Orang-utan aerial nest count (twice a year);
- Elephant (opportunistic sightings); and
- Other opportunistic sightings (daily).

In the recent wildlife survey by Bili (2013), methods that were used were direct and indirect sightings through line transect, night spotting, camera trapping and Orang-utan nest counts. Details of various methods in wildlife surveys are discussed in depth by Ancrenaz (2013). This is a comprehensive field manual for monitoring large terrestrial mammals in Sabah which includes wildlife strategy planning, data collection and wildlife population assessment.

2.9.3 Wildlife Surveys and Diversity

2.9.3.1 Mammals

Surveys in the past have revealed that DFR harbours a remarkable mammal diversity. About 75% of mammals in Sabah can be found in DFR (SFD, 2014), including six of the seven terrestrial Totally Protected Species under the Sabah Wildlife Conservation Enactment (WCE) 1997, namely Orang-utan (Chart 2.1), Bornean Pygmy Elephant (Chart 2.2), Sun Bear (Chart 2.3), Clouded Leopard (Chart 2.4), Tembadau (Chart 2.5) and Proboscis Monkey (Chart 2.6), which were recorded by Matsubayashi *et al*. (2005). Based on the 2nd FMP, it was reported that there were at least 75 species of mammals (excluding bats), 220 species of birds and over 100 species of reptiles, amphibians and fish were recorded in DFR. At least nine medium to large mammal species (including sub-species) recorded in DFR (Matsubayashi *et al*., 2005 and SFD, 2011) are endemic, namely Red Leaf Monkey (*Presbytis rubicunda*), Bornean Gibbon (*Hylobates muelleri*), Proboscis Monkey (*Nasalis larvatus*), Orang-utan (*Pongo pygmaeus morio*), Thick-spined Porcupine (*Thecurus crassispinus*), Bornean Pygmy Elephant (*Elephas maximus borneensis*), Bornean Yellow Muntjac (*Muntiacus atherodes*), Clouded Leopard (*Neofelis diardi borneensis*) and Bay Cat (*Pardofelis badia*). Small carnivore diversity found in DFR includes the Leopard cat, Marbled cat, Malay badger, Yellow-throated marten, several species of Civet, Smooth otters and the Hairy-nosed otter (*Lutra sumatrana* – see Chart 2.7), which was encountered in 2008 by camera traps.

In addition, the Four-striped Ground Squirrel (*Lariscus hosei*) is a Bornean endemic small mammal that was recorded in DFR (Mannan *et al*. 2003).

A few census of wildlife, especially mammals in DFR were conducted. The latest brief wildlife survey in DFR was conducted by Bili (2013) and he has recorded more than 15 species of mammals and five of them are listed as Endangered Species on the IUCN Red List of Threatened Species (Bornean Pygmy Elephant, Bornean Gibbon, Tembadau, Proboscis Monkey and Orang-utan). Two

species are listed as Near Threatened on the IUCN Red List of Threatened Species, namely (i) Large Flying Fox and (ii) Long-tailed Macaque. Four carnivore species were identified during the survey period (namely Leopard Cat, Malay Civet, Common Palm Civet and Small Toothed Palm Civet).

Both results of the recent and past mammal surveys in DFR indicate a high diversity with significant populations and they can be generally summarized as follows:

- Different **Cervidae** species (deer) living in DFR are mostly solitary individuals. However, it is possible to encounter groups of small sizes at certain places like natural mineral sources. They are common in degraded habitats and gentle slope terrain. They are mostly seen along roads, skid trails and skyline corridors. There were 183 sightings of Sambar deer (Chart 2.8) in DFR in 2012 (SFD, 2013).

- The **Bearded Pigs** are widespread in DFR, and migration occurs according to fruit availability and season. Their population in DFR is still high with a total of 194 sightings of Bearded Pigs in DFR in 2012 (SFD, 2013).

- **Tembadau** population (<50 individuals) in DFR consists of several small groups (females and their young: 5-10 individuals) and solitary males. They are attracted to natural saltlicks (up to 11 individuals). There were 9 sightings of Tembadau in 2012 (SFD, 2013).

- A population of approximately 100 individuals of the **Bornean Pygmy Elephant** is found within DFR. Groups usually consist of 3-40 individuals. Groups split and merge, but usually comprise of one or more adult females with young of both sexes and various ages. There were 90 elephant sightings in DFR in 2012 (SFD, 2013).

- A population of a few hundred **Orang-utans** lives in DFR. Significantly high number of nests was sighted in the southern part of DFR (disturbed habitat). This is because fruit productivity is higher in degraded habitats than in more intact forests. Aerial surveys on Orang-utan nests are carried out twice a year. The census in December 2012 recorded 1.85 individuals/km^2 or 1,020 individuals in DFR (SFD, 2013).

- All five Bornean **Cat** species are found in DFR, including Bornean endemic Bay Cat and Clouded Leopard, and the rare and elusive Flat-headed Cat and Marbled Cat, as well as the common Leopard Cat (Mohamed *et al*., 2009).

More details on wildlife can be referred to in CHAPTER 4 of this plan and also in the HCV Departmental Report, 2014.

Chart 2.1: Orang-utan

Chart 2.2: Pygmy elephants

Chart 2.3: Sun bear

Chart 2.4: Clouded leopard

Chart 2.5: Tembadaus

Chart 2.6: Proboscis monkey

Chart 2.8: A hairy-nosed otter

Chart 2.7: Sambar deer

Chart 2.9: Storm's stork

2.9.3.2 Birds

Generally, the bird fauna found in DFR is very rich and diverse. All eight species of Bornean hornbills are found in DFR. Among the globally threatened bird species found within DFR are the Helmeted Hornbill, Storm's Stork (Chart 2.9), Bornean Peacock-pheasant and Crested Fireback.

Based on direct and indirect sightings by Bili (2013), at least 147 species of birds were identified within the study areas and some of them are listed as Endangered Species, such as Storm's Stork and the Helmeted Hornbill. Based on the bird distribution map by Phillipps & Phillipps (2014) at least 18 (or 31%) of the 59 Bornean endemic bird species can be found in DFR, as listed in Table 2.7. Some were recorded in the recent survey by Bili (2013). The world's smallest raptor, Bornean White-fronted Falconet (*Microhierax latifrons*) was also recorded in DFR (SFD, 2014).

Table 2.7: Bornean endemic bird species that can be found in Deramakot Forest Reserve, based on Phillipps & Phillipps (2014)

No.	Common name	Species	Sightings / other records
1.	Bornean Crested Fireback	*Lophura ignita*	
2.	Bulwer's Pheasant	*Lophura bulweri*	Bili (2013)
3.	Bornean Peacock-pheasant	*Polyplectron schleiermacheri*	
4.	Bornean Necklaced Partridge	*Arborophila graydoni*	
5.	Bornean White-fronted Falconet	*Microhierax latifrons*	SFD (2014)
6.	Bornean Banded Kingfisher	*Lacedo melanops*	
7.	Blue-banded Pitta	*Pitta arguata*	Bili (2013)
8.	Black-headed Pitta	*Pitta ussheri*	
9.	Bornean Banded Pitta	*Pitta schwanerii*	
10.	Blue-headed Pitta	*Pitta baudii*	Bili (2013)
11.	Bornean Black Magpie	*Platysmurus atterimus*	
12.	Bornean Bristlehead	*Pityriasis gymnocephala*	Bili (2013)
13.	Bornean Ibon	*Oculocincla squamifrons*	
14.	White-crowned Shama	*Copsychus stricklandi*	Bili (2013)
15.	Bornean Blue Flycatcher	*Cyornis superbus*	
16.	Yellow-rumped Flowerpecker	*Prionochilus xanthopygius*	Bili (2013)
17.	Bornean Spiderhunter	*Arachnothera everetti*	
18.	Dusky Munia	*Lonchura fuscans*	

2.9.3.3 Reptiles & Amphibians

Compared to mammals and birds, not much data have been procured for reptiles, and perhaps none at all for amphibians. Thus far, documentation was only based on opportunistic sightings. Based on SFD (2013), the most commonly encountered reptile in DFR was the Monitor Lizard (*Varanus salvator*), followed by the Reticulated Python (*Python reticulatus*), Estuarine Crocodile (*Crocodylus porosus*) and Black Cobra (*Naja sumatrana*). Crocodiles have been sighted in the Upper Rawog Besar River and there has been a marked increase in crocodile sightings at the Kinabatangan River south of this reserve (SFD, 2011). Other snakes, land tortoises, lizards as well as frogs were sighted (some with photos taken) but they were not scientifically identified.

2.9.3.4 Fish

There is a high concentration of freshwater fish, particularly Pelian (*Tor duoronensis*) and Kaloi (*Osphroremus goramy*) in the Upper Rawog Besar River which flows through six compartments within DFR (SFD, 2011). Pelian can reach 40 cm in length and it is a highly esteemed fish for food (Inger & Chin, 2002).

2.9.3.5 Insects

Insects are ecologically important in DFR in view of their high diversity (Chung, 2013). Many of the forest trees rely on insects for pollination and dispersal of seeds while some insects are nutrient recyclers and decomposers. Others are used as environmental indicators. Many of the insects are also pests, causing damage to timber trees in DFR. Various studies on insects and other invertebrates have been conducted in DFR. These include flying insects (Akutsu & Chey, 2006), ants (Bruhl, 2001), moths (Chey, 2002), soil beetles (Chung, 2004), stingless bees (Eltz *et al.,* 2003), butterflies (Mohd. Fairuz, 2000) and decomposers (Hasegawa *et al.,* 2013). Most of the studies on insects focused on the impact of forest disturbance on the insect assemblage. Chey (2002) reported a new moth record for Borneo, *Ceira ordgara* (Notodontidae) and 14 Bornean endemics from 336 moth species sampled from DFR.

2.9.4 Threats to wildlife

There are various threats to wildlife diversity and population in DFR as well as other forest reserves. These include forest fire, poaching, forest harvesting, adjacent land-use changes and even road-kills.

Forest fire remains a major threat as the impact can be very severe and it will take decades for the burnt area to recover its wildlife diversity. Indiscriminate slash-and-burn agricultural activities in the adjacent areas and poaching (indiscriminate actions by poachers and cigarette butts) may lead to forest fire, especially during the dry period. Poaching can also adversely affect the wildlife population, especially mammals if there are no strict surveillance and enforcement.

2.9.5 Managerial Implications of Wildlife Relationships With Natural Forests

For large mammal populations, habitat contiguity in the form of natural forest cover is critical in determining the long-term prospects of viable populations. A rule of thumb of area required for large mammal population viability, for example, elephants, is approximately 70,000 - 100,000 ha. DFR is fortunate because it shares a common boundary with Segaliud Lokan FR (on the east) and Tangkulap FR (on the west), which provide better habitat contiguity. The RIL method, together with small areas (less than 800ha) to be logged every year resulted in no significant impact on the reduction of the wildlife populations in DFR. However, there can be a temporarily displacement and loss of food supplies, which are serious risks throughout the harvesting process. Therefore, it is of utmost importance that sustainable forest management and guidelines and the Standards of Procedures (SoP) – see the list in **Appendix 3**, are to be effectively practiced/followed and enforced in order to minimize the adverse impact on wildlife in DFR. The mitigations on the impacts of forest management activities on wildlife in DFR can be referred to in Chapter 4.3.1.

2.10 Social Impact Assessments

2.10.1 Introduction

The impacts of forestry operations occur in different forms. While significant benefits result for society, the local communities living within and adjacent to the forest concerned may often bear the brunt of adverse impacts. This can happen, for example, when they are forced to bear all negative impacts if forest operations are not carried out in accordance with SFM principles. There is now a growing concern over the fate of these affected communities. This has given rise to the need to understand beforehand the implications of adverse forestry impacts so that mitigation plans could be put in place in advance. So, the FMP Team recognizes the need to carry out social impact assessment (SIA)[1] in DFR as part of the preparation of the 3rd DFR FMP, as well as, it helps in understanding the positive or negative social impacts (if any) due to forestry operations that are to be carried in DFR for the next 10 years.

2.10.2 Objectives

A SIA survey was conducted in four (4) villages adjacent to the southern border of DFR. The objectives in undertaking the SIA are:

- To identify local communities that are directly associated with the DFR forestry operations;
- To predict the social impacts on individuals, groups and communities as a result of changes arising from forestry operations in DFR; and
- The information obtained from the SIA is used to develop and implement mechanisms that will mitigate against the identified adverse social impacts (if any).

The key elements explored in the SIA include the following:

- Community conservation values (or HCV values 4, 5 and 6) of which, the results of the survey can be referred to in CHAPTER 4;
- Population and land ownership;
- Community livelihoods (subsistence and economic); and
- Cultural aspects (shared beliefs, customs, values and language or dialect) & social impacts, needs and aspirations for their future and the future of their children.

2.10.3 Methodology

The SIA has been undertaken based primarily on the responses obtained from participating communities.

The SIA Team (SFD and Global Forestry Services staff) utilized a SIA survey checklist to explore potential social impacts2 of forestry operations in DFR and to mitigate against any negative impacts on individuals, groups and communities. The collection of information and viewpoints were recorded from villagers (both men & women) that were interviewed during formal meetings.

[1] Social impact assessment (SIA) in this context refers to assessment of social consequences or repercussions, both positive and negative that are likely to follow from forestry operations undertaken in DFR.

[2] Social impacts cannot be measured but one can always find an indicator. It may be qualitative or quantitative, but each will have an indicator.

There were two types of checklist being used:

i. The SIA checklist for communities / village (**Appendix 4**)
ii. A checklist for households (**Appendix 5**) to collect information based on social structure below:

a. Village Leader (Village Head, JKKK Head, etc.),
b. Men (31 to 55 years old),
c. Women (31 to 55 years old),
d. Young Adults (18 to 30 years old) and
e. Government & Private Sector Officers.

The current status of the communities with respect to basic needs such as health, education, infrastructure/access, livelihood, and conservation value was also evaluated under the SIA survey. The SIA Team (the SFD & GFS staff), conducted the SIA from 09 to 12 July, 2013. The SIA took place in the community hall in each village where all members of the communities were invited to participate.

- 09 July 2013 - Kampung Balat
- 10 July 2013 - Kampung Desa Permai (morning)
- 10 July 2013 - Kampung Tulang-tulang (afternoon)
- 11 July 2013 - Kampung Kuamut / Tungkuyan (as part of Kampung Kuamut)

The survey included as many people as possible from each village. The household checklist was used during the village meetings to obtain information on individual households based on Procedure #2 - SIA. In total, 36 villagers were interviewed from four villages using the household checklist.

The field data was compiled for each village and analyzed. The analysis results were compiled based on the HCV 4, 5 & 6 elements that were defined under the HCVF Toolkit for Malaysia. The HCVF Toolkit for Malaysia (1st Edition - October 2009) was also used as a guideline to evaluate social impacts on individuals, groups and communities due to forestry activities in DFR. The SIA report entitled *"Social Impact Assessment at Kg. Balat, Kg. Desa Permai, Kg. Tulang - Tulang & Kg. Kuamut, and Part of High Conservation Value Forest (Criteria: 4,5 & 6) Assessment for FMU 19A"*, which was prepared by GFS, is quite comprehensive; and is available with the DFO Deramakot. The gist of the report is presented in this 3rd FMP.

2.10.4 Village Locations

There are four (4) villages, which are located at the southern boundary of DFR (see Table 2.8 and Figure 2.14). Kg. Kuamut is located not far from the bank of the Kuamut River. Kg. Kuamut consists of three sub-villages, namely, Kg. Tungkuyan, Kg. Kuamut Dalam and Kg. Kuamut Tengah. Kg. Desa Permai and Kg. Tulang-Tulang are situated adjacent to the Milian River, while Kg. Balat is adjacent to the Kinabatangan River. All villages are located within stateland. Amongst the four villages, Kg. Balat is situated right at the border of DFR.

Table 2.8: Location of the villages adjacent to DFR

No.	Villages	GPS location
1	Kg. Balat	N 05°19' 17.8", E 117°36' 56.1"
2	Kg. Desa Permai	N 05°13' 58.5", E 117°29' 38.3"
3	Kg. Tulang-Tulang	N 05°15' 04.1", E 117°29' 43.0"
4	Kg. Kuamut	N 05°13' 23.8", E 117°29' 16.0"

2.10.5 Populations, Ethnicity & Religion

Kg. Balat

At present, there are 320 people living in Kg. Balat. The village consists of 47 households with an average of 7 people per household. The population of this village is about the same as it was 10 years ago (approx. 315 people, 45 households). The ethnic background is Orang Sungai (People of the river). Majority of the villagers are Muslims.

Kg. Desa Permai

Kg. Desa Permai is located more than an hour's boat ride from Kg. Balat. Kg. Desa Permai is now combined with Kg. Pagar, which was located only 300m from Kg. Desa Permai. Kg. Pagar has been abandoned since the villagers moved out to Bukit Garam or Kg. Kuamut in 2011. The population of Kg. Desa Permai has dropped drastically over the past 10 years from approximately 200 people and 100 households to the current 48 people living in 10 households. This significant drop was due to many factors. Amongst them are communication (lack of better access such as roads), limited basic facilities and lack of job opportunities within the village. Most of the villagers have moved out to Bukit Garam for a better life or moved out to Kg. Kuamut through marriages. Kg. Desa Permai villagers are of Sungai ethnic group. More than 90% of the villagers are Muslims, while the rest are Christians (Anglican denomination) where their church is located at Kg. Kuamut.

Kg. Tulang-Tulang

There are currently 158 people living in Kg. Tulang-Tulang that comprise of 30 households @ 5 people per household. The population has increased by 50% during the past 10 years. Kg. Tulang-Tulang is about 5 minutes boat ride from Kg. Desa Permai. Their ethnic group is Sungai Sinabu. More than 90% of the villagers are Christians.

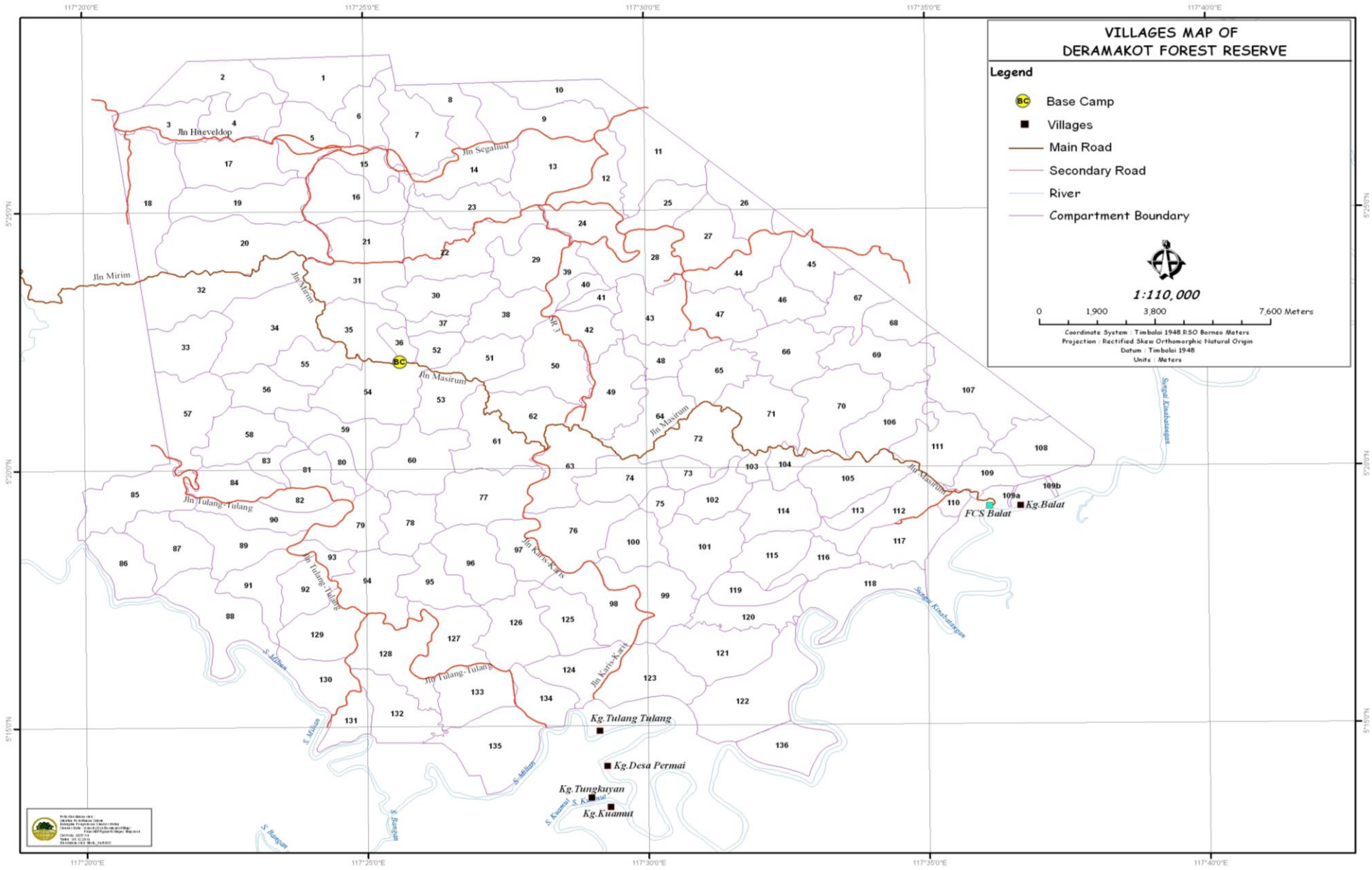


Figure 2.14: Location of villages surveyed

Kg. Kuamut

Kg. Kuamut (incorporates with Kg. Tungkuyan) is located adjacent to Sg. Kuamut and is a 5 - minute boat ride from Sg. Kinabatangan junction. At present, there are 353 people living in Kg. Kuamut with 62 households (about 5 people per house) compared to 280 people (31 households) 10 years ago. The ethnic group of these villagers is Orang Sungai. The villagers are a mixture of Christians (mostly in Kg. Tungkuyan) and Muslims.

2.10.6 Infrastructure, Facilities & Social Services

Kg. Balat

Out of the four main villages, only Kg. Balat has better and direct access to Telupid or Sandakan town. They have access roads via Deramakot FR road or the oil palm plantation road on the other side of the Kinabatangan River. Kg. Balat villagers traditionally use boats to commute from one place to another. There is an old mosque and one primary school in Kg. Balat. The nearest clinic facility is located at Kg. Kuamut and the secondary school is at Bukit Garam. Clean water for daily usage is sourced from Ulu Sg. Balat, which is inside DFR (Compartment 109) through a gravity pipe system. The latter was installed with the help from Geelong Grammar School, Australia through Adventure Alternative Borneo, the Sabah Forestry Department, PACOS TRUST, and Kg. Balat communities. A majority of the villagers have their own diesel generator to generate electricity.

Kg. Desa Permai

Kg. Desa Permai villagers use boats to commute from one place to another as they do not have direct road access. There is a mosque and a primary school, while the nearest clinic is available at Kg. Kuamut. The children would have to continue their secondary education at Bukit Garam. Most of the villagers use diesel generators to generate electricity. The villagers do not have gravity pipe water. They depend on rainwater during the rainy season and obtain water from Kinabatangan River during the dry season.

Kg. Tulang-Tulang

Kg Tulang-Tulang villagers traditionally use boats to commute from one place to another. They do not have direct road access from the village. They had requested to build a road from Kg. Tamoi to their village of which, there is no positive reply from the state government. There is a church in the village, while the nearest clinic is located at Kg. Kuamut. The primary school children are sent to SK Desa Permai and continue their secondary education in Bukit Garam. Most of the villagers are using diesel generators to generate electricity. The villagers do not have gravity pipe water. They also depend on rainwater during the wet season and the Kinabatangan River as a source of clean water supply during the drought season. They have requested the SFD in October 2011 via the DFR Social Forestry Committee to construct a gravity pipe for their village but it was found out that the main source is located very far from the village. The cost of construction was found to be very expensive. Its practicality is also doubtful.

Kg. Kuamut

Kg. Kuamut does not have direct road access to other villages. Traditionally, the villagers would have to use boats to commute from one place to another. However, there is a logging road (on the other side of the Kuamut River) that provides them better access to the main Telupid - Sandakan highway. There is one mosque and a clinic with a medical assistant in Kg. Kuamut. A doctor visits

the clinic about 3 times a year. The nearest hospital is located at Kota Kinabatangan. There is a church in Kg. Tungkuyan and a primary school in Kg. Kuamut. Like other villages, the students continue their secondary studies in Bukit Garam. Kg. Kuamut has a solar system installed by the local government for electricity supply.

2.10.7 Economic Activities

2.10.7.1 Employment Patterns

The patterns of employment depend on the quality of workforce available in the villages and to some extent the availability of work nearby.

In Kg. Balat, there are 25 people in the village that are employed, either in the government (teachers, SFD boatman, SFD labourers, village administration, etc.) or at neighbouring oil palm estates. The rest of the villagers are fishermen and farmers by planting vegetables or agriculture crops such as, oil palm and recently, cocoa, which the latter is actively promoted by the National Cocoa Board.

Similar pattern is also found in Kg. Desa Permai where 5 people are employed while the rest in the village live by growing paddy and vegetables, fishing or working part time on whatever odd jobs are found nearby or at the nearest town. However, it should be noted that most of the villagers here, particularly those from the abandoned Kg Pagar, are also residing and own a house at Bukit Garam, where potential for employment is better.

In Kg. Tulang-tulang, there are about 4 people being employed in the same work aspects and the rest carry out their self-sufficient agriculture. The village is also targeted by the National Cocoa Board for cocoa planting where there are already several villagers who have planted cocoa on their lands.

About 50 people in Kg. Kuamut are employed where one-third of them are working in government agencies in the village or nearby towns, while two-thirds are working in the nearby oil palm estates.

2.10.7.2 Sources of Income

Kg. Balat villagers do not depend entirely on sales of vegetables or fish for their livelihood. They also make handicrafts from *Salingkawang* leaves (a fern), which are collected along the roadside between Kg. Balat and Deramakot Base Camp. Their handicrafts are displayed for sale at Wisma Siliu-liu, Deramakot Base Camp or in Bukit Garam. The total sales of handicrafts are about RM 125/per month. For most youths, they normally look for any paid jobs at Bukit Garam, Kota Kinabatangan, and Sandakan or in other districts.

For some Kg. Desa Permai villagers, fishing can bring additional income of RM 150 per trip (depending on the season) in the market at Bukit Garam. Occasionally, the villagers sell vegetables at Bukit Garam too but the total sales are minimal (< RM50 per month).

Other than the 4 employed villagers of Kg Tulang-Tulang, the rest are selling vegetables and occasionally doing various odd jobs. Their monthly income is about RM 200.00 - RM300.00. Fishing

provides them an additional income between RM 50.00 and RM100.00 per trip, depending on the season. The fishes and vegetables are sold either in Kg. Kuamut or Bukit Garam.

Apart from the 50 people in Kg. Kuamut that are employed, others earn their income of about RM 150-250 per month by selling fishes and vegetables, doing odd-jobs or carrying out part-time works.

Kg. Tulang–Tulang villagers had planted cocoa in 2012 and rubber trees six (6) years ago. The rubber trees are ready for tapping. In the case of Kg. Kuamut villagers, they had planted rubber and cocoa since a year ago. The rubber seedlings were provided by the Sabah Rubber Industry Board while, the cocoa seedlings were obtained from the National Cocoa Board. Both rubber and cocoa are expected to be the villagers' future potential sources of income.

2.10.8 Current Programs and Income Opportunities in DFR

Since year 2000, the SFD carried out its forest restoration program in the southern DFR (see Figure 2.15). The project created alternative income for the local communities through planting and maintenance of trees. Besides that, the local communities were also enjoying paid jobs that were opened-up by the SFD especially for them such as, boundary marking and maintenance and timber stand improvement. As shown in Table 3.6 (Page 67), their average monthly income (2005- 2014) was RM1,250.00.

Since 2010 (see Table 2.9), all four villages were actively involved in southern part of DFR boundary re-brushing and marking. The southern border of DFR was divided into 4 zones and the employed villagers worked at the nearest zone assigned to them. Some villagers, especially from Kg. Balat, were also actively participating in the tree planting and maintenance programs located in compartments near the Balat FCS.

Figure 2.15: Local communities involved in forest restoration project in DFR

Table 2.9: Boundary re-brushing and marking records from 2010 – 2014

Date	DFR Boundary Section	Assigned To
30/5/2014 20/06/2014 31/05/2014 04/07/2014	Sg. Tabalion – Sg. Deramakot Sg. Deramakot – Sg. Karis Karis Sg. Karis Karis – Sg. Rago Rago Sg. Rago rago – Sg. Tangkulap Kecil	Kg. Balat Kg. Desa Permai & Kg. Kuamut Kg. Tulang-Tulang Kg. Tulang -Tulang & Kg. Desa Permai
3 April 2013	Sg. Tabalion to Sg. Deramakot	Kg. Balat
18 Oct 2012	Sg. Deramakot to Sg. Karis-Karis	Kg. Desa Permai and Kg. Kuamut
3 May 2012	Sg. Karis-Karis to Sg. Tabalion Sg. Karis –Karis to Sg. Rago-Rago Sg. Rago-Rago to Sg. Tangkulap Kecil	Kg. Balat Kg. Tulang-Tulang Kg. Tulang-Tulang & Kg. Desa Permai
23 Feb 2012	Sg. Kalam Badan to Sg. Tulang-Tulang	Kg. Tulang-Tulang
20 Oct 2011	Sg. Tabalion to Sg. Deramakot	Kg. Balat
20 Jan 2011	Sg. Deramakot	Kg. Desa Permai
17 Feb 2010	Sg Tulang-Tulang to Sg Tangkulap Kecil	Kg. Tulang-Tulang

2.10.9 Land Resources

The total agricultural area (farming / planting agricultural crops) in Kg Balat is approximately 121 ha of which, 8 families with a total area of 16.2 ha have planted oil palm. However, all the areas, which have been developed by the villagers, do not have an official land title. The villagers also have applied for an additional 117 ha of agricultural land located next to their village.

The total agricultural area that was reported by Kg. Desa Permai is 161 ha with Native Titles (NT). They also applied for some additional areas, for which their applications are yet to be approved by the relevant government agencies.

In Kg. Tulang-Tulang, the total agricultural area is about 40 ha but all are without official land titles. Kg Kuamut, on the other hand, has over 485 ha with NTs while, an additional 1,618 ha are still under the Land Application status.

2.10.10 Land Claims and Other Issues in DFR

The villagers recognized the DFR boundary. This was realized through good public relations and good relations with the local people through the DFR Social Forestry Committee. As a consequence, they have not encroached or submitted any formal land claims on DFR. However, there is an old durian "orchard" located at Compartment 88 (117) that belongs to Kg. Desa Permai. This issue was brought up to the attention of the auditors during the February 2011 surveillance audit. Since then, the SFD has developed a SoP to allow Kg. Desa Permai villagers to enter Cpt. 88 just to collect the durian fruits during the fruiting season.

Meanwhile, Kg. Desa Permai, Kg. Tulang-Tulang and Kg. Kuamut villagers' main concern is to have direct road access from their village to any nearest main road so they can gain market access for their agricultural crops. Kg. Kuamut preferred route is through the estates and Malua FR in the east, which is connected to the Lahad Datu – Sandakan highway. On the other hand, Kg Desa Permai and Kg. Tulang-Tulang preferred the old logging road traversing through DFR and connected to the DFR main road in Tangkulap FR. This proposal, however, is under consideration by the SFD. It is subject to funds availability and security.

Nevertheless, the SFD had demonstrated support for the villagers through soliciting funds from the Federal or other governmental bodies for other developments (infrastructure and/or agriculture) in the villages. The SFD also sought the support from local non-governmental organizations such as PACOS & WWF for human capacity building and mitigating wildlife conflicts.

2.10.11 DFR and Its Importance for the Local Communities

The importance of DFR for the four villages based on the assessment using HCVF Toolkit and on results of the SIA can be referred to in CHAPTER 4 of this plan. More details can also be referred to in the HCV Departmental Report, which was prepared by the HCV Team. This report is available at the Deramakot DFO office.

2.10.12 Impacts and Opportunity Assessments

2.10.12.1 Economic Impacts

Findings from the SIA indicated that there is a minimal wealth gap between households in all villages surveyed; but that the introduction of the forestry programs in DFR and the subsequent employment created thereof resulted in larger wealth gaps between wage earning and non-wage earning households. For example, for those who have actively participated in the DFR programs, their average monthly income was RM1,250.00 – see Table 3.6 (Page 67). This indicates that the role of DFR and forestry as a contributor to economic activity and to sustain the livelihoods of the villagers is very important.

Apparently, the villagers are very supportive and cooperative with the DFR management but very frank to reveal their unhappiness because not all of them were given equal opportunities to participate in the programs provided by the SFD. However, they were quite aware and understood that the budgets allocated by the SFD for the community programs were limited. On the other hand, the positive environmental impact due to a reduction in erosion when it is translated into social and economic terms, i.e., into impacts on them, e.g., through avoidance of loss of on-site production values and clean water supply means a lot for their welfare, which cannot be expressed in monetary terms.

2.10.12.2 Social and Cultural Impacts

The SIA results show that forestry operations carried in DFR during the 2nd FMP do not show any signs of severe and adverse social and cultural impacts on the local communities in the four villages. The issue of loss of land, which normally can have profound social, cultural and spiritual ramifications, does not arise since their lands are located outside DFR.

The local communities also responded to the SIA team, that so far, there are no threats to them, whether through destruction caused by forestry development in DFR or through environmental degradation associated with logging operations since there is no logging operation carried out near to their villages. Besides, they were quite aware that logging operations in DFR is based on reduced impact logging, which is eco-friendly and thus, does not cause any anguish and fear to the local communities.

On the positive side, the SFD had implemented quite a number of development programs for the local communities such as, the expansion or enhancement of social services, health, housing and capacity building. The additional incomes generated by resource development in DFR also generated positive social and cultural effects. Local communities' access to well-paid jobs has added to individual self-esteem. Wage income can also support maintenance or reinvigoration of traditional hunting and fishing and of cultural activity.

2.10.12.3 Social Structures Impacts

The SIA results show that there is no impact on social structures associated with forestry operations in DFR since all operations are kept to a small-scale. Normally large-scale resource development can, especially where it continues over extended periods of time, have significant impacts on the social structures of the local communities; but not in the case of DFR.

2.10.13 Local Communities Perspectives on Potential Opportunities Associated with DFR Management

The local communities did not identify many potential negative impacts from DFR forestry operations. However, they recognized that there could be many potential opportunities (short-term and long-term) for them in DFR. These opportunities, many of which are interrelated, include participation in environmental management and conservation activities, increased educational and training opportunities, employment, business opportunities including tourism, additional support for youths, improved service delivery and infrastructure, and support for cultural pursuits.

In this case, the DFR Social Forestry Committee in collaboration with NGOs would further identify possible strategies that could be adopted to help ensure that such opportunities can be realized.

2.10.14 Community and the Action Process

The need for the local communities' participation to meet the challenges facing their communities is becoming increasingly important. At the same time, the SFD is more frequently faced with the task of establishing community programs with different preferences and needs and consequently, provides a more comprehensive approach to community development, which reflects the SFD commitment to the local communities although often met with budget constraints. Therefore, some of the important programs specifically for the local communities that need to be carried out by the SFD during the plan period are being highlighted in Chapter 6.6 of this plan.

2.11 Infrastructure in DFR

2.11.1 Buildings

A base camp is located at the northern part of Compartment 54 (formerly known as Compartment 60). It consists of 9 Detached Living Quarters, 2 Guesthouses, an office with a conference room, a Workshop, a Nursery, and Recreational and Camping Grounds. Two outposts are in place in Kg. Balat and kilometer 41, Main Road 1. An additional outlying building known as the "white house" is located in Compartment 14 (formerly known as Cpt. 16). One unit of new Reception Center was constructed in 2013 and four (4) new chalets were constructed in 2014. The complete list of physical facilities and utilities in DFR can be referred to in Table 3.1 (Page 58).

The base camp is equipped with:

- A Generator shed with 2 IVECO80 KW and 60 KW generators
- Water filtration system with 10,000 litres water holding tanks
- Water tank (15,000litres)water distribution by gravity
- Pump house with 15 HP electrical pump
- 30,000 litres diesel tank with concrete containment
- Store room

Equipment:

Machineries	5 tractors/bulldozers; 2 Excavator; 2 Vibrating Compactor; 2 Motor grader; 2 Backhoe; and 4 Dump Trucks;
Vehicles	2 Toyota Hilux Double Cabin; 4 Toyota Vigo Double Cabin; and 4 Toyota Vigo Single Cabin Pick Up
Boats	2 Fiberglass Launch 25'ter; 3 Fiberglass Boat 15'ter; 3 Yamaha Outboard Engines. - These boats are placed at Kg. Balat guard post.

2.11.2 Forest Roads

In general, the basic road network in DFR has improved and is in a better condition since 1997, that is, after DFR was certified by FSC as a well-managed forest. The main road (Jln. Mirim) is from Tangkulap FR to the Base Camp and then to Kg. Balat (Jln Masirum). It has a total distance of approximately 49.40 Km (see Table 2.10). In addition, there are secondary and feeder roads with a total distance of 184km. The majority of the operational road networks have been constructed during logging operations. The main and secondary roads are regularly maintained by the SFD using the machineries it has as listed above. The present conditions of the access road in DFR are shown in Table 2.11.

Table 2.10: Road Classification in DFR

Forest Road Type	Length (km)	Density (%)	Density (m/ha)
Main Road	49.40	0.0896	0.8959
Secondary Roads	97.28	0.1411	1.7643
Feeder Roads (comprises of 25 Compartments)	86.57	0.0942 (average)	1.5701 (average)

Table 2.11: Conditions of access roads in DFR

Name / Location	Distance (Km)	Present Conditions
Main Road 1 (Jln. Mirim) to Base Camp	14	Usable all year round
Balat Road (Main Road 2 – Jln. Masirum)	32	Usable all year round
Rawog-Segaliud Lokan Road (Secondary Road 1A – Jln. Hueveldop)	23	Passable up to 14Km from the Base Camp. Soon after that, there are at least 6 collapsed bridges.
Rawog-Tangkulap Estate Road (Secondary Road 1B – Jln. Segaliud)	11	Usable all year round
Compartment 29 Road (Secondary Road # 3)	9	Usable all year round
Karis-Karis Road (to Kg. Tulang-Tulang)	19	One bridge collapsed, usable only until 12km
Tangkulap Kecil-Tulang-Tulang Road (Secondary Road # 7)	32	Usable only until Compartment 85 (Quarry) which is about 13.5km. Tulang-Tulang road unpassable (not recently surveyed)

2.11 Manpower

DFR was under the jurisdiction of the Sandakan District Forestry Officer from 1995 to 1998. However, in 2nd April, 1999, DFR was placed under the Deramakot District Forestry Officer, with a new DFO, based in Deramakot Base Camp. The strength of DFR personnel in 2014 was as follows:

DFO	:	1	Driver + Authorized Driver	:	2
ADFO	:	3	General Worker	:	34
Chief Clerk	:	1	Technician	:	1
Forest Ranger	:	3	Mechanic	:	4
Forester	:	12	**Total**	**:**	**62**
Boatman	:	1			

The majority of the staff (59) is attached at the base camp. The organizational set-up of Deramakot Forestry Office in 2014 is depicted in Figure 2.16.

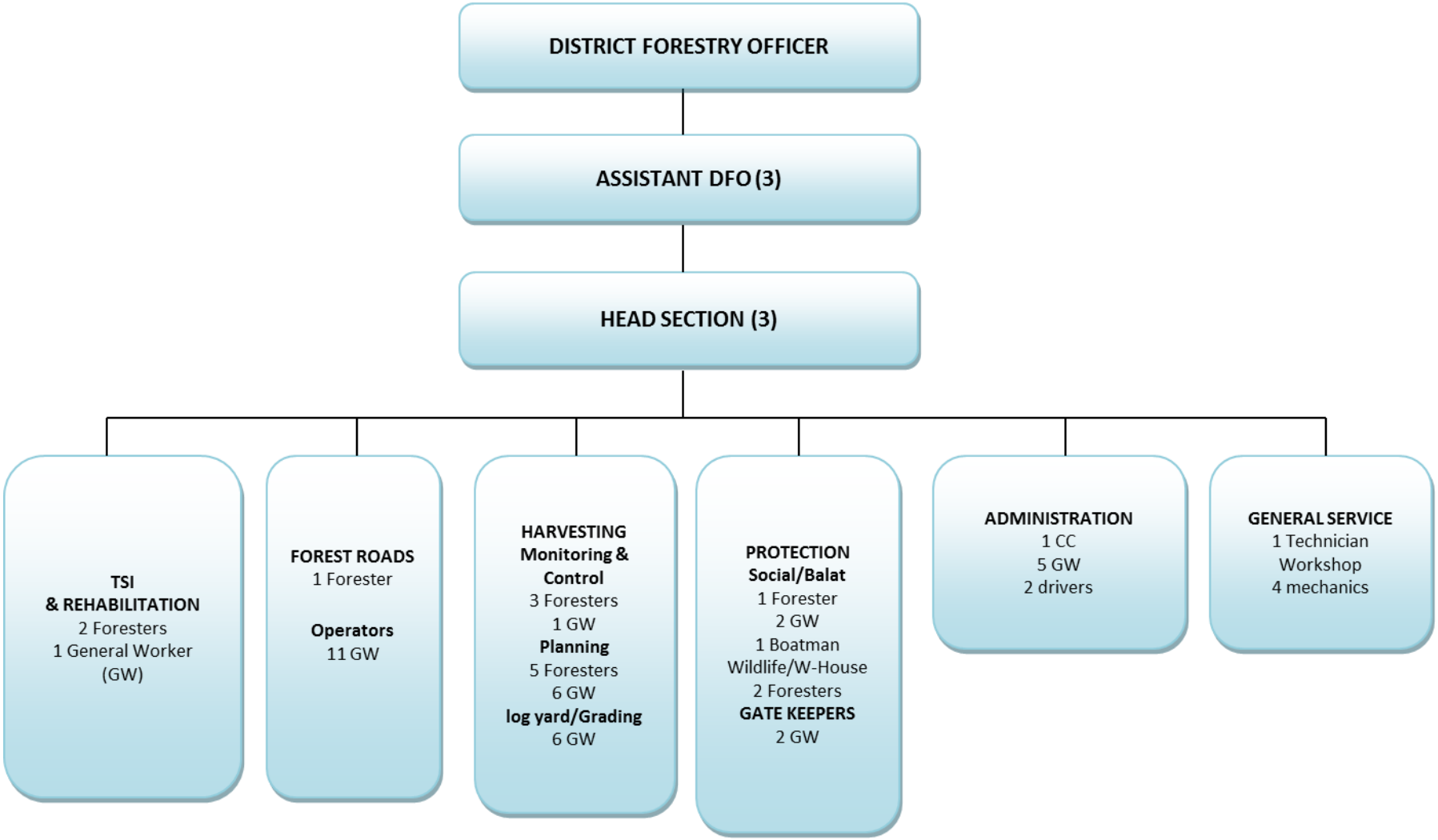


Figure 2.16: Organization Chart of Deramakot District Forestry Office in 2014

CHAPTER 3: REVIEW OF PAST MANAGEMENT (2ND FMP: 2005-2014)

3.0 INTRODUCTION

Deramakot Forest Reserve (DFR) covers 55,507 ha mostly comprising of LMDF. DFR was logged under short-term licences (Form I Licence and Special Licence/concessions) from 1955 to 1989. The minimum diameter for harvesting was 60cm dbh and the felling cycle, 60 years. Loggers ignored the rule when it was more convenient, attractive and profitable. Variable cutting intensities of past management practices have resulted in an extremely heterogeneous condition of the residual forests. Only 20% of DFR is considered well stocked with harvesting trees >60 cm dbh while more than 30% are covered by very poor forest with virtually no mature growing stock left.

However, for the period 1989 – 2000, the Sabah Forestry Department (SFD), in collaboration with the German Technical Agency, GTZ, implemented the Malaysian-German Sustainable Forest Management Project, which was made up of 4 phases. These were:

- 1989 – 1992: A strong research emphasis with a component for management planning.
- 1992 – 1994: Management planning, training and consolidation.
- 1995 – 1998: Institution building, human resource and development, consolidation/implementation and extension
- 1999 – 2000: Consolidation, planning and human resource development.

A first medium-term (10 years) Forest Management Plan (FMP) for DFR, covering the period, 1.1.1995 – 31.12.2004, was developed over a period of 5 years (1990 – 1994) through the project and was ready for implementation in 1995. Towards the end of the term of the 1st FMP (final year), a more comprehensive review of the operation of the plan was undertaken, including forest inventory, and subsequently a 2nd Medium-Term FMP (2005 – 2014) was developed. The FMP was the blueprint for operational work in DFR up to today.

3.1 The Gist of the 2nd FMP

Deramakot Forest Reserve was managed in accordance with sustainable forest management (SFM) principles and a multiple-use approach to natural forest management (NFM). Amongst other things, the plan specifies that:

- Not more than 17,600 $m^3$are to be harvested each year (the annual allowable cut or AAC);
- 1,000 hectares are to be silviculturally treated each year;
- 2,000 hectares of rehabilitation planting is to be carried out from 2007 to 2011 @ 400 ha/yr on degraded sites;
- Harvesting shall follow RIL (reduced impact logging) guidelines;
- Infrastructure will be improved;
- Variety of social programs will be organized;
- Wildlife protection and monitoring will be effectively implemented;
- Research and development will be conducted; and
- Training and human resource development will be emphasized.

Plan implementation for the 3 major activities (harvesting, silviculture tending and rehabilitation planting) was contracted out through the award of service contracts, with supervision by the SFD. Planning, infrastructure development, protection, social forestry and other works were executed by the SFD itself.

3.2 Achievement

The following Chapter highlights the operational achievements, challenges and lessons learned during the tenure of the 2nd FMP in DFR.

3.2.1 Infrastructure

Capital resources or physical infrastructure (e.g., roads, bridges and other physical facilities and utilities) are essential to the management of DFR. Together, these investments constitute the capital basis to facilitate management and field operations and for producing the goods and services that sustain economies of DFR. Therefore, during the last 10 years, the various physical infrastructures (e.g. chalets – Figure 3.1) and roads (Figure 3.2) that were built, maintained, repaired and and/or provided for by the SFD are depicted in Table 3.1.

3.2.2 Timber Production

The annual allowable cut (AAC) in the second FMP was 17,600m³. The AAC was derived based on the calculated average proportion from the previous planning period and the minimum economic cut, i.e., 40 m^3ha^{-1} as the average yield per hectare (see also Chapter 5.2) of this plan.

The area and timber production in DFR during the previous planning period is shown in Table 3.2. From the Table, it shows the actual net areas harvested and the expected volume and number of commercial trees above 60 cm dbh that could be harvested for each compartment as reported in the CHPs. It also shows the actual production and yield/ha based on net area for each compartment. Figure 3.3 (see also Figure 6.2 on page 117) on the other hand, shows the compartments that have been harvested during the 2nd FMP.

Figure 3.1: Chalets constructed in 2014

Figure 3.2: Road maintenance in Jln. Mirim (MR 1)

Table 3.1: Physical infrastructure maintained, repaired, constructed and/or provided during the plan period (2005-2014)

Year	Physical Facilities and Utilities in Base Camp or Other Locations		Roads (Km)					
	Quarters	Others	Secondary Roads		Feeder Roads		Main Roads	
			New	Maintained/ Repaired	New	Maintained/ Repaired	New	Maintained/ Repaired
2005				21.7		15.8		48
2006				6		17.74		48
2007				10		15.28		48
2008				8		22.08		48
2009	One unit of new FCS Balat Outpost was constructed.			3.5		23.46		48
2010						23.86		48
2011	4 units of staff quarters renovated. One unit of new staff quarter constructed.			22		19.34		48
2012	One unit of new 5 rooms Staff Quarters Constructed.	One unit of new FCS Outpost constructed in Balat		22		27.78		48
2013	1 unit of staff quarters renovated	▪ One unit new DFR Reception Center was constructed ▪ One unit new Guardpost Single Storey constructed ▪ One unit Water filtration system and holding tank was installed ▪ Oil & Lube Storage house renovated ▪ Renovation & extension of Resthouse 2 ▪ Electrical connection (posts, street lights and cables) to new staff quarters ▪ New Genset 25KVA for Main Gate installed ▪ Maxis Communication (3G, Fix Line, & Internet)		6		28.34		48

2014		▪ 4 new Chalets constructed ▪ New DFR Office constructed ▪ new 4 in 1 outdoor court (tennis, volleyball, basketball, sepak takraw and futsal) constructed		10	3.56	1.7		48

Table 3.2: Area and volume harvested (2005 – 2014)

Year	Compt. No.*	Gross Area (Ha)	Net Area (Ha)	Planned Based on CHP		Actual		Yield Per Hectare (m^3)	Cpt. Status (as of 2014)
				Volume (m^3)	# of Trees Marked	Volume (m^3)	# of Trees Felled		
2005-2006 2009-2010	86	580	350 (60.3%)	19,539	3,073	12,495.72	1,808	35.70	Closed
2005-2006	47	451	270 (48.5%)	8,786.89	1,578	8,295.99	1,271	30.73	Closed
2006-2007	64	557	255 (45.8%)	9,859.90	1,774	9,914.66	1,500	38.88	Closed
2007-2009	71	443	229 (51.7%)	9,820.65	1,770	9,428.81	1,418	41.17	Closed
2008-2010	69	333	196 (58.9%)	10,669.33	2,225	10,109.94	1,427	51.58	Closed
2006-2008	61	339	177 (52.2%)	8,521.32	1,458	8,655.24	1,250	48.90	Closed
2009-2012	58	501	374 (74.7%)	21,847.68	4,040	23,683.04	3,560	63.32	Closed
2011-2013	46	268	150 (56.0%)	5,810.18	1,125	5,724.76	905	38.17	Closed
2012-2014	76	500	353 (70.6%)	20,768.51	3,656	19,340.77	2,461	54.82	Closed
2012-2014	53	263	196 (74.5%)	8,125.33	1,359	6,759.45	958	34.49	Closed
2014	99	327	239 (73.1%)	11,656.32	2,039	11,257.08	1,730	47.10	Closed
	89	591	169**	8,842.83	1,549	2,125.32**	349	12.58	Open

Total	**12**	**4,562**	**2,958**	**144,247**	**25,650**	**127,780.75**	**18,638**		
		Average***	254 (60.6%)	12,309.56	2,191	11,423.22 (92.80%)	1,663	44.08	

Note: * Based on old Cpt. #

**** Net Area logged and production as of November, 2014.

***** Based on 11 compartments only. Cpt. 89 was excluded because logging is still on-going, which is to be brought forward to 2015.

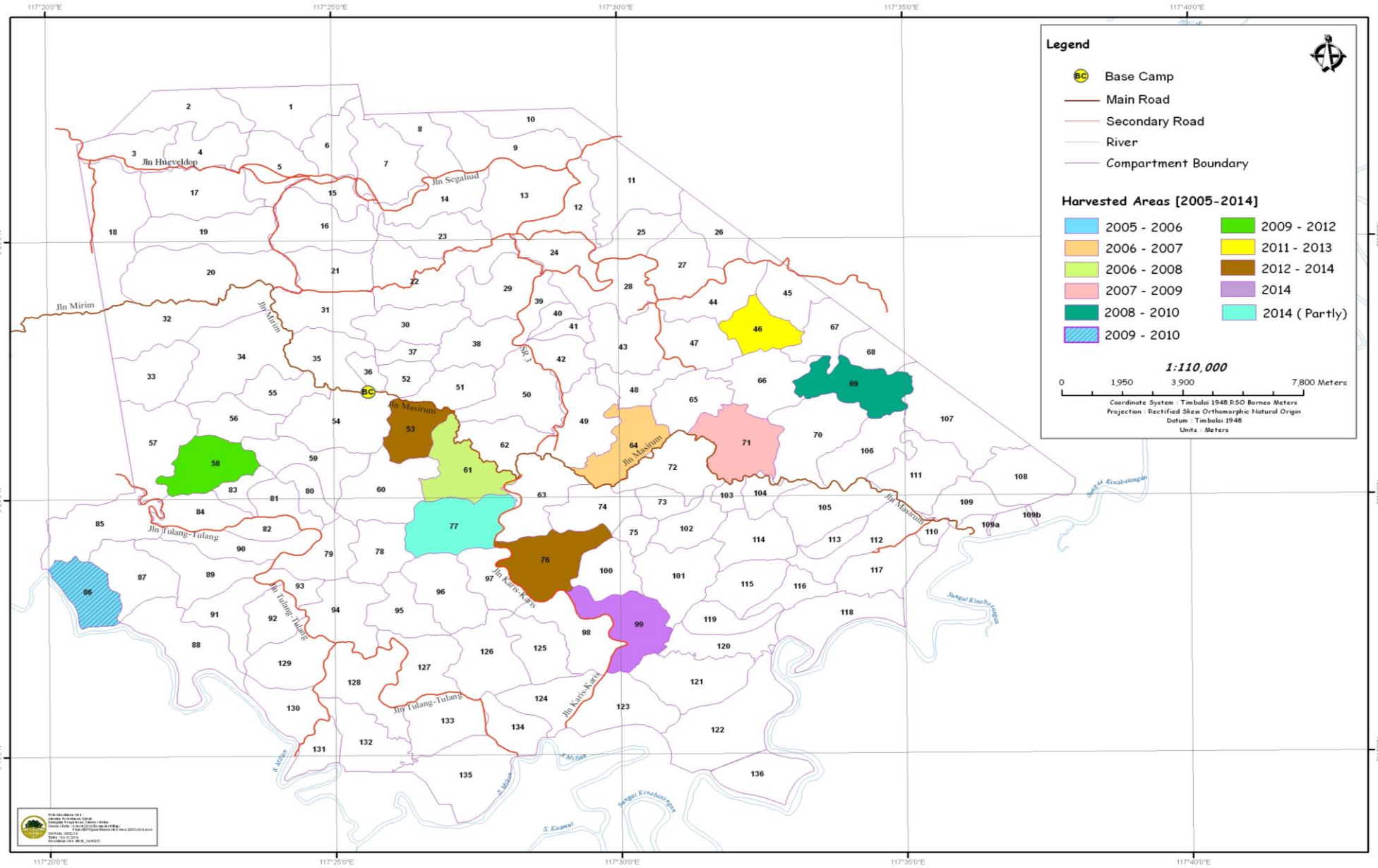


Figure 3.3: Compartments harvested during the 2nd FMP (2005-2014)

From Table 3.2, the average actual net annual area harvested during the plan period was only 254ha, which is only a 61% efficiency. However, the actual volume harvested, on average, was 11,423.22 m³as against a planned volume of 12,309.56 m³ (based on CHP report), or a deficit of approximately 7.2%. However, when it is compared to the AAC (17,600 m³) and actual volume (column 7), on average, the AAC target was not met in spite of the fact that areas (compartments) that were designated for harvesting were almost all harvested with the exception of Cpt 89, which was partly harvested.

The yield has been lower than what had been planned. This is because:

- The AAC as estimated in the 2nd FMP was calculated based on an estimated harvestable net area with an efficiency of at least 75%. However, the actual net area logged, on average, was only 61% of the estimated net harvestable area, which is very low efficiency.

- The stem quality of individual trees marked for felling was not properly assessed. Consequently, hollow trees constitute 30 percent of all trees marked for harvesting. These hollow trees were thus, not felled for safety reasons. For trees that have been felled, in some cases, 4-5 m of the tree is hollow and the rest is solid.

- Some trees marked for harvesting were not harvested due to their distance from the skid trail and the tractor's winching limitation (30m winching distance). It is also uneconomic to harvest when trees marked for felling are sparsely distributed. On the other hand, it was reported by auditors (officers of the SFD Headquarters) that the preparation of the CHPs, in many cases, were carried out in a "rush" by the Deramakot field staff. Consequently, many of the commercial trees with >60 cm dbh were left out/not identified, marked and numbered for harvesting. This resulted more areas being harvested to achieve the AAC.

- Volume estimation was based on the Forestry Department's circular, CF 1/81- the FD Handbook on estimating standing tree volume, which tends to over-estimate volumes by 30%.

- Erratic weather with high precipitation (2,718mm – 5,707mm), hampering the performance and efficiency of harvesting operations and scheduling problems.

- The appointed contractor has difficulty acquiring skilled timber fellers and tractor drivers. Most skilled personnel are non-Malaysians of which apparently most of them went back to their respective home country or were being flushed out by the authority due to expired legal documents.

Meanwhile, the dipterocarps make up about 90 % of the timber produced from DFR during the 2nd FMP period (see Table 3.3). Among the dipterocarps, the Seraya group accounts for the largest proportion of total production, followed by Keruing. This pattern is not expected to deviate much for this current planning period (2015−2024). Among the serayas (red, white, and yellow), the red seraya accounted for about 60 % of this timber group.

Table 3.3: Proportion of total production by timber groups (%)

Timber Group	%
Seraya (red, white, & yellow)	45
Keruing	16
Oba Suluk	12
Kapur	9
Selangan Batu	7
Other timbers	11
	100 %

3.2.3 Continuous Forest Inventory

An essential part of yield regulation is the permanent monitoring of the growing stock by repeated inventories or by the use of permanent plots, a practice known as continuous forest inventory (CFI). The main purpose of this activity is to check the actual growth and development of the growing stock against what was projected in order to avoid discords between what is planned and what can actually be achieved. If large discrepancies are found between actual and projected development of the growing stock, then adjustments will have to be made with regard to harvest scheduling and AAC.

A permanent monitoring and control system has been established over the last management planning period, and repeated inventories were carried out as a routine management activity. Table 3.4 provides a list of 43 compartments where permanent inventory lines have already been established during the plan period. Only 12 compartments have been measured twice. Table 3.5 provides the standing timber stocks for 4 compartments (#1, #9, #105 and #114), which were developed over a five-year period.

Generally, Table 3.5 shows a slight improvement in stocking for all four compartments over a five year period. For instance, the CFI shows 18.3 commercial trees ha^{-1} > 60 cm dbh for Compartment #105 in 2013, an improvement from 14.7 trees ha^{-1} in 2008. Therefore, Compartment #105 is considered sufficiently stocked for an 'economic' harvest (assumed at ≥ 15 trees > 60 cm dbh). The other three compartments, on the other hand, are still considered inadequately stocked after five years. Monitoring stocking development in this way provides continuous feedback for timber management.

Table 3.4 Compartments in DFR where continuous forest inventory has been established during the 2nd FMP

Cpt. #	Establishment Year	Re-measurement
10	2005	2010
34	2005	2010
52	2005	2010
55	2005	2010
74	2005	2010
17	2006	2011
57	2006	
64	2006	
85	2006	
1	2007	2013
14	2007	2012
33	2007	2012
56	2007	
86	2007	
9	2008	2013
62	2008	
105	2008	2013
114	2008	2013
42	2009	
48	2009	
49	2009	
64	2009	
16	2010	
50	2010	
63	2010	
76	2010	
43	2011	
54	2011	
61	2011	
64	2011	
97	2011	
8	2012	
51	2012	
53	2012	
77	2012	
31	2013	
62	2013	
71	2013	
72	2013	
104	2013	
70	2014	
106	2014	
111	2014	

Table 3.5: Standing timber stocks for 4 compartments

Compartment # 1 (Trees/Ha)											
SPECIES CLASSIFICATION	SPECIES GROUP	Year 2008 Diameter Class (cm)					Year 2013 Diameter Class (Cm)				
		30-<40	30-<40	40-<50	50-<60	60-<80	30-<40	30-<40	40-<50	50-<60	60-<80
	PIONEER		1.1	0.1				2.3	0.7		
	LARAN		0.3								
	NON-DIPT	3.2	7.3	5.3	3.2	1.7	10.8	4.3	3.7	3.3	1.9
	Total	**3.2**	**8.6**	**5.4**	**3.2**	**1.7**	**11.8**	**6.5**	**4.4**	**3.3**	**1.9**
	HOPEA		0.8	0.4				0.8	0.4		
	KAPUR		0.3	0.6	1.2	0	0.5	0.4	0.8	1.2	
	KERUING		0.9	1.9	1.8	0.9	0.9	0.1	2.1	2.2	0.9
	SELANGAN	1.4	0.3	0.1	0.4	0.8	0.5	0.5	0.8	1.7	1.6
	SERAYA	0.5	2.2	2.3	1.7	0.7	0.3	0.1	0.1	0.3	0.4
	WHITE SERAYA	0.3	0.1	0.5		0.4	5.2	1.3	1.6	1.9	0.5
	VATICA		0.1	0.1			0.4	0.1	0.3	0.1	
	Total	**2.2**	**5.0**	**6.5**	**5.1**	**2.8**	**8.5**	**2.7**	**4.0**	7.2	**3.4**
COMMERCIAL Total		***5.4***	***13.6***	***11.9***	***8.3***	***4.5***	***20.3***	***9.2***	***11.4***	***9.2***	***5.3***
PROHIBITED	NON-DIPT		1.4	0.3	3.1			0.5	0.1	1.6	0.5
	SERAYA		0.5	0.3	0.9		0.8	0.4	0.3	0.4	0.4
PROHIBITED Total				***1.9***	***0.5***	***4.1***	***0.8***	***0.9***	***0.4***	***2.0***	***0.9***
Grand Total			***5.4***	***15.5***	***12.4***	***12.4***	***21.2***	***10.1***	***11.8***	***11.5***	***6.2***
Compartment # 9 (Trees/Ha)											
	PIONEER		0.2	0.2			3.5	2.2		0.2	
	LARAN		0.2		0.4						
	NON-DIPT	0.7	4.5	2.1	2.0	0.7	6.0	4.8	4.5	3.0	1.5

	OTHERS		0.4	0.2	0.0					0.0	
	Total	**0.7**	**5.2**	**2.5**	**2.3**	**0.7**	**9.5**	**7.0**	**4.5**	**3.2**	**1.5**
	HOPEA						0.8				
	KAPUR	0.4	0.7	0.7	0.5	0.7	0.8	0.3	1.3	0.7	0.8
	KERUING		0.2	0.7	0.2	0.4	0.5	0.2	0.3	0.5	0.3
	SELANGAN		0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2
	SERAYA	1.1	1.8	2.0	2.5	0.9	4.0	2.5	2.2	3.2	1.3
	WHITE SERAYA	0.7	0.9	0.7	1.3	0.5	1.7	0.8	0.8	1.3	0.7
	VATICA		0.2		0.2		0.5		0.2	0.2	
	Total	**2.2**	**3.9**	**4.3**	**4.8**	**2.7**	**8.5**	**3.8**	**5.0**	**6.0**	**3.3**
COMMERCIAL Total		**2.9**	**9.1**	**6.8**	**7.1**	**3.4**	**18.0**	**10.8**	**9.5**	**9.2**	**4.8**
PROHIBITED	NON-DIPT		1.1	0.4	0.9	1.1		0.3	0.8	0.8	1.2
	SERAYA		0.2	0.2	0.5		1.7		0.3	0.5	0.3
PROHIBITED Total			**1.3**	**0.6**	**1.4**	**1.1**	**1.7**	**0.3**	**1.2**	**1.3**	**1.5**
Total		**2.9**	**10.4**	**7.3**	**8.6**	**4.5**	**19.7**	**11.2**	**10.7**	**10.5**	**6.3**
Compartment # 105 (Trees/Ha)											
	PIONEER	0.3	1.1	0.3			0.0	0.2	0.3		
	LARAN	1.3	2.5	1.6	0.2						
	NON-DIPT	3.1	7.0	4.2	3.0	0.5	7.7	8.0	9.7	4.7	0.8
	Total	**4.7**	**10.6**	**6.1**	**3.8**	**0.5**	**7.7**	**8.1**	**10.0**	**4.7**	**0.8**
	HOPEA						0.3	0.2			
	KAPUR	0.6	0.6		0.5	0.3	0.2	0.5	0.2	0.2	0.5
	KERUING	0.9	0.5	0.3	0.9	0.3	1.3	0.6	0.2	1.1	0.3
	SELANGAN		0.2	0.2	0.9	0.2	0.5	0.2		1.1	0.2
	SERAYA	5.0	5.9	4.5	3.9	1.9	4.8	6.9	4.2	4.7	2.8
	WHITE SERAYA	0.6	1.1	0.8	0.6	1.4	3.6	1.3	0.9	0.9	1.1
	VATICA			0.2			0.2		0.2		
	Total	**7.2**	**8.3**	**5.9**	**6.9**	**4.2**	**10.8**	**9.5**	**5.6**	**8.0**	**4.8**
COMMERCIAL Total		**11.9**	**18.9**	**12.0**	**10.1**	**4.6**	**18.4**	**17.7**	**15.6**	**12.7**	**5.6**
PROHIBITED		0.8	0.5	0.6	0.6		0.3	0.2	0.3	0.9	0.6
		0.5		0.3			0.3	0.9	0.2	0.3	0.2
PROHIBITED Total			**1.3**	**0.5**	**0.9**	**0.6**	**0.6**	**1.1**	**0.5**	**1.3**	**0.8**
Total		**11.9**	**20.2**	**12.5**	**11.0**	**5.2**	**19.1**	**18.8**	**16.1**	**13.9**	**6.4**
Compartment # 114 (Trees/Ha)											
	PIONEER	0.3	1.1	0.4	0.6		1.7	1.5	0.4	1.1	0.1
	LARAN	1.7	4.0	1.7	1.0	0.1					
	NON-DIPT	1.4	5.1	2.4	1.8	0.7	7.2	6.1	7.9	6.0	1.1
	OTHERS			0.1							
	Total	**3.3**	**10.3**	**4.6**	**3.3**	**0.8**	**8.9**	**7.6**	**8.3**	**7.1**	**1.3**
	HOPEA						0.3				
	KAPUR	0.3		0.1	0.6	0.3				0.6	0.4
	KERUING		0.4	0.1	0.7	0.4	0.6	0.6	0.4	0.4	0.6
	SELANGAN				0.4	0.3				0.3	0.4
	SERAYA	2.5	3.1	2.6	4.7	2.6	7.5	3.6	2.4	5.1	3.3
	WHITE SERAYA	0.6	0.6	0.8	1.1	0.8	3.2	1.1	0.7	1.0	1.3
	VATICA			0.1			0.4	0.1	0.1		
	Total	***3.3***	***4.0***	***3.9***	***7.5***	***4.4***	***11.9***	***5.4***	***3.6***	***7.4***	***6.0***
COMMERCIAL Total		**6.7**	**14.3**	**8.5**	**10.8**	**5.3**	**20.8**	**13.1**	**11.9**	**14.4**	**7.2**
PROHIBITED	NON-DIPT		0.6	0.4	1.0	0.1		0.6	0.3	0.7	0.4
	SERAYA		0.6	0.4	0.7	0.7	1.7	0.4	0.3	0.8	0.8
PROHIBITED Total			***1.2***	***0.8***	***1.7***	***0.8***	***1.7***	***1.0***	***0.6***	***1.5***	***1.3***
Total											

3.2.4 Rehabilitation Planting

During the 2nd FMP, forest rehabilitation with Laran and Binuang (see Figure 3.4 and Table 3.7 on page 69) was carried out by the local communities within parts of compartments 108 (100 ha) and 109 (134.58 ha) where these compartments were virtually devoid of forest cover as a result of forest fires. During the 1st FMP, approximately 1,147.85ha involving 15 compartments were partly rehabilitated (see Figure 6.4 on page 120).

Figure 3.4: Binuang planted in Cpt. 109 in 2007

3.2.5 Timber Stand Improvement

Timber Stand Improvement (TSI)[3] in this context are the blanket cutting of climbing bamboos and woody vines/climbers up to 5 cm dbh, liberation thinning of selected PCTs and rehabilitation planting. The achievement in DFR for blanket cutting of bamboos and woody vines during the past 10 years was relatively high as shown in Table 3.6. For 2008, the treated areas reached 2,000 ha, a

[3] The term "Timber Stand Improvement" (TSI) is used here instead of "silviculture Treatment" because the latter is a very general term that refers to a range of activities such as, fertilising, pruning, pre-harvest climber cutting, and even logging. It can also refer to many forest plantation activities. Timber stand improvement on the other hand, is a term used in NFM and refers to activities such as, refinement treatments, liberation thinning, and enrichment planting.

Refinement is a post-harvest silviculture treatment that focuses on the 'negative' elements of a forest stand such as, the removal of weedy species, vines cutting, removal of defective trees, and in the past, also the removal of non-commercial species. Liberation thinning on the other hand focuses on the 'positive' elements, i.e., the liberation of PCTs and commercial species. So what the SFD did in DFR was a combination of both, but largely just vines cutting.

record achievement. The compartments treated during the plan period are shown in Figure 3.5 (see also Figure 6.4 on page 120), while Figure 3.6 shows an aerial view of Cpt. 77 (partly), which was treated in 2013.

Table 3.6: Compartments treated under TSI (2005 – 2014)

Year	CPT #	Net Area Treated (ha)	Cost/ha (RM)	Contractor	
				Name	Origin
2005	55,85	1,000	250	Masirum Rundi	Sabah
2006	85,33,57	1,000	250	Masirum Rundi	Sabah
2007	57,56,58,83	1,000	250	Masirum Rundi	Sabah
2008	21,63,20,62	2,000	250	Masirum Rundi	Sabah
2009	42,48,76	1,000	250	Masirum Rundi	Sabah
2010	76,64,74,72	1,000	250	Masirum Rundi	Sabah
2011	72	363	250	Masirum Rundi	Sabah
2012	72,65,48	821	250	Fresh Mumus Ent.	Sabah
2013	60,77	1,173	250	Hussein Enterprise	Sabah
2014	60,71,104,1	1,268	350	Hussein Enterprise	Sabah
Total	**23**	**10,625**			

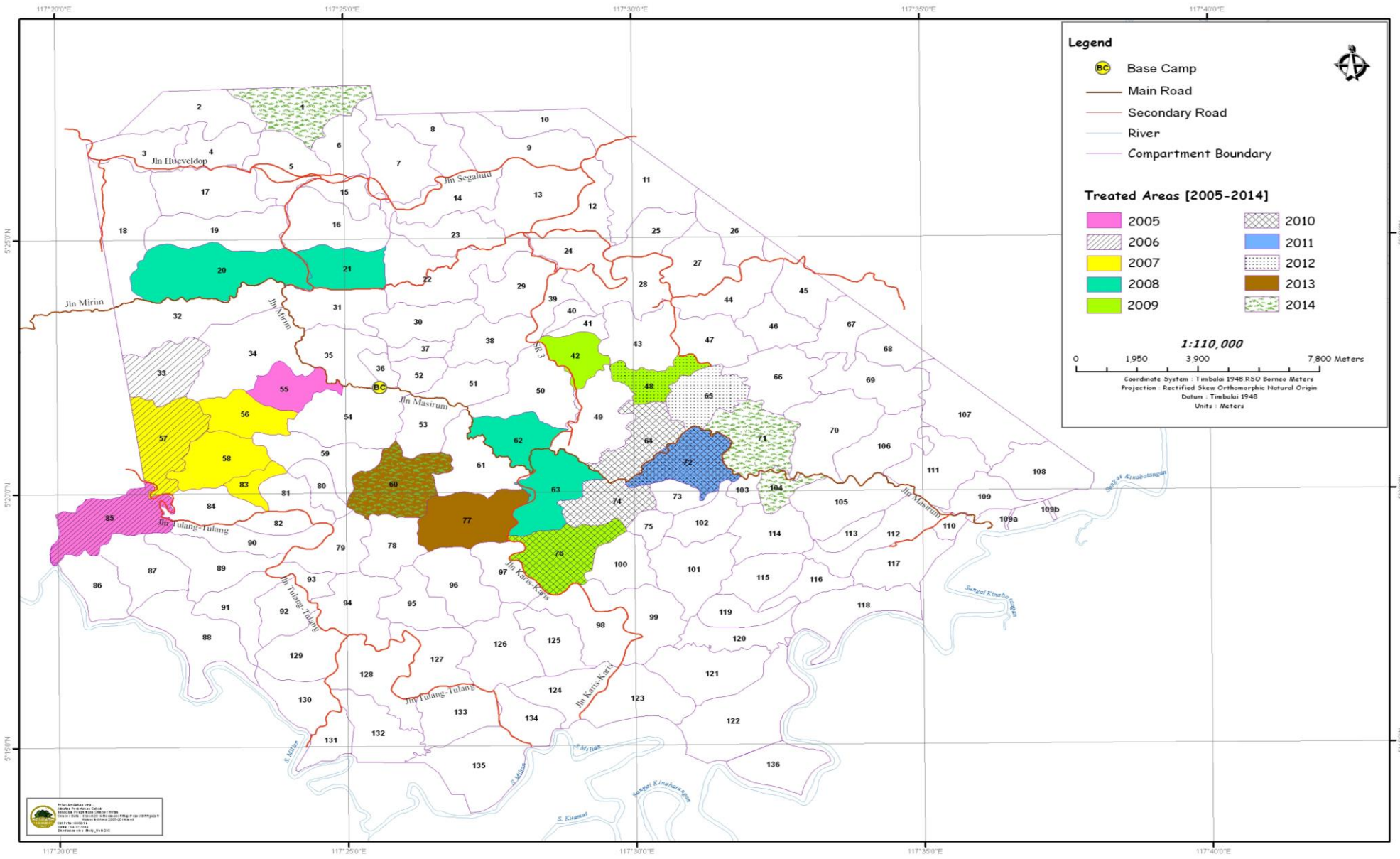


Figure 3.5: Compartments treated under TSI during the 2nd FMP

Figure 3.6: Post-harvesting TSI in Cpt. 77

3.2.6 Community Forestry

One of the basic principles of SFM is local participation, which is also one of the key challenges to be addressed in the course of implementing SFM. Community forestry promotes improved livelihoods of rural communities, especially those which have a traditional dependency upon forests. Throughout the plan period, the SFD worked closely with the local communities in Kg. Balat, Kg. Kuamut, Kg. Desa Permai and Kg. Tulang-Tulang through the DFR Social Forestry Committee. The programs and other collaboration works that have been promoted amongst the local communities throughout the 2nd FMP period are listed down in Table 3.7.

Table 3.7: Community liaison programmes & community participation during the 2nd FMP

Year	# of Dialogues	Types of Activities Organized or Implemented (Beside Dialogue)	# of Natives Employed		Av. Monthly Income (RM)
			Logging	TSI	
2005	1	1. SOUTHERN BOUNDARY MAINTENANCE	16	39	1,200.00
2006	3	**1.** Southern Boundary Maintenance	17	44	1,200.00
2007	3	1. Southern Boundary Maintenance 2. Planting works in an extension area of 56 ha	21	41	1,200.00
2008	2	1. Southern Boundary Maintenance 2. Planting works in cpt 108, 109 & an extension area of 56 ha	15	32	1,200.00
2009	2	1. Southern Boundary Maintenance 2. Planting works in cpt 108 & 109 3. SK Balat student visit to DFR Base Camp.	11	31	1,200.00
2010	1	1. Southern Boundary	07	19	1,200.00

		Maintenance 2. Planting works in cpt 108 & 109			
2011	2	1. Southern boundary maintenance 2. Planting maintenance in cpt 108, 109 & extension area of 56 ha 3. 3 Kampung people absorbed to work full time with FMU 19A management.	16	14	1,200.00
2012	3	1. Southern Boundary Maintenance 2. Planting Maintenance in Compartment 108, 109 & extension area – 56ha. 3. MERCY Malaysia Sabah Chapter 4. Gravity piping & TASKA building maintenance in collaboration with Geelong Grammar School of Australia/PACOS/Adventure Alternative Borneo/FMU 19A management. 5. Courses on : a. Emergency & CPR b. Handicraft c. Safety & Health 6. 3 Kampung people absorbed to work full time with FMU 19A and 2 involved in contractual work.	04	38	1,300.00
2013		1. Southern Boundary Maintenance 2. Planting Maintenance in Compartment 108, 109 & extension area – 56ha. a. Courses on Emergency & CPR b. HCVF & Wildlife Road Show 3. 3 Kampung people absorbed to work full time in DFR and 2 involved in contractual work. 4. Donation of 1 set of computer for TASKA Balat usage by KTA Plantation Sdn Bhd.			1,300.00
2014					

3.2.7 Forest Resource Protection

DFR is a FSC- certified forest and under SGS surveillance and thus, the SFD cannot compromise and be complacent in its forest protection from forest fire and unwanted activities such as illegal logging, illegal hunting, forest encroachment, etc. Hence, forest protection was an important activity carried out by the SFD throughout the tenure of the 2nd FMP. The SFD had instituted strategies to protect DFR and its resources efficiently and effectively. The SFD strategies include:

- Increase the skill levels of DFR staff in prevention, detection and monitoring programs.

- Involve the local communities in Kg. Balat, Kg. Kuamut, Kg. Desa Permai and Kg. Tulang-Tulang through information and dialogues to prevent violations and damage to DFR.
- Clear standard of procedures.
- Systematic monitoring programs for forest resource protection including regular planned actions using helicopter surveillance, river and ground monitoring.

Although there was a firm and lasting commitment and appropriate actions taken by the SFD to effectively protect DFR from the threats and unwanted activities, there were still cases of forest encroachments that took place in DFR as can be seen from the statistic records shown in Table 3.8. These forest encroachments happened in 2008 and 2012, of which both cases involved the collection of Gaharu (*Aquilaria malaccensis*).

Table 3.8: Records of unwanted activities in DFR during the plan period (2005-2014)

Year	Unwanted Activities				Remarks
	Fire	Illegal logging	Illegal Hunting	Forest Encroachment	
2005	-	-	-	-	-
2006	-	-	-	-	-
2007	-	-	-	-	-
2008	-	-	-	1 case detected	Three (3) foreigners were charged in court for suspected of collecting Gaharu in CPT 86. There was no record of Gaharu trees felled but Gaharu equipments found in possession of the 3 culprits were suffice to apprehend and charge them in court for illegal encroachment in DFR.
2009	-	-	-	-	-
2010	-	-	-	-	-
2011	-	-	-	-	-
2012	-	-	-	1 Case detected	1 Gaharu tree felled inside Cpt. 3 and 2 tress in Cpt. 15. Culprit(s) undetected.
2013	-	-	-	-	-
2014	-	-	-	-	-

3.2.8 Surveillance Audits

According to the Director of Forestry, somebody has to "keep an eye" on the SFD to ensure that the latter is on the straight and narrow as promised in the 2nd FMP. This close scrutiny ensures compliance on the SFD's part and provides an independent third party assessment to maintain the SFD's credibility.

Throughout the 2nd FMP period, Société Générale de Surveillance (SGS) – (an international company that provides certification services) had carried out eight (8) Surveillance Audits (see Table 3.9). During the plan period, a total of 8 major and 37 minor Corrective Action Requests (CARS) have been meted out. There were also 16 observations.

Table 3.9: Records of CARS issued by SGS during the 2nd FMP period

Type Of CARS	# Of CARS Issued								Total
	2004	2005	2007	2009	2010	2011	2012	2013	
Major				3				5	8
Minor	2	2	6	4	3	3	6	11	37
Observation			3	2	3	3	4	1	16

DFR was meted out with 5 major and 11 minor CARS during the major re-assessment of the 4th re-certification of DFR. The 2 major CARS were under Principle 3, that is, Indigenous Peoples' Rights (Criterion 3.1 and 3.3) and 1 major CAR each on Principle 4 - Community Relations and Worker's Rights (Criterion 4.2), Principle 6 – Environmental Impact (Criterion 6.5) and Principle 9 – Maintenance of High Conservation Value Forests. The 3 major CARS meted out in 2009 were concerning Principle 6 – Environmental Impact under Criterion 6.1, Criterion 6.6 and Criterion 6.10. Please refer the details in Appendix 6.

3.2.9 Research and Development

Forest management is not static. On the contrary, it is highly dynamic and dependent on the aspirations and needs of the people. In this light, it must be supported by an appropriate R & D programme; and the existence of a relevant and coordinated Research and Development **(**R & D) programme is critical to the realisation of the desired sustainable forest management. This is especially so in the case of DFR. Throughout the 2nd FMP period, there were a number of R & D activities (applied research, basic research and academic research) that have been carried out in DFR during the tenure of the 2nd FMP. The number of published research papers can be referred to in Table 3.10 below; while the complete list of research papers can be referred to in **Appendix 7**.

Table 3.10: Number of published research papers based on the three research types in DFR during the 2nd FMP period

Types of Research	Number of Published Papers										Total
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Applied	-	2	2	1	2	1	2	2	1		**13**
Basic	2	1	1		2	2	1	4	2	2	**17**
Academic				3	1		1				**5**
Total	**2**	**3**	**3**	**4**	**5**	**3**	**4**	**6**	**3**	**1**	**35**

3.3 Lessons Learned and Management Implications for 3rd FMP

After 10 years (2005 – 2014) of intensive management in DFR, what are the basic lessons that the SFD has learned, to make things better and to make things happen?

i. <u>Under harvesting and AAC not achieved</u>

Comprehensive harvest planning (CHP) is essential in order to set the stage properly to enable sustainable harvesting practices to be followed, and also to reconcile the need for greater technical control during harvesting with the need to reduce harvesting costs simultaneously but at the same time, optimizing harvesting production rates. However, the harvesting production rates in DFR during the 2nd FMP period in most cases were not

achieved on what actually was determined in the CHP; and because of this, the AAC in DFR was never achieved but the areas/compartments being set aside were harvested. Therefore, the SFD must improve their efficiency in CHP preparation and avoid the practice of "rush" preparation. The appointed logging contractor, on the other hand, should acquire new machineries and the welfare of their skilled workers must be well looked into so that the production will be maximized with less area (compartments) logged.

ii. Compartments scheduled to be harvested

Based on the forest inventory results as presented in Table 9 in the 2nd FMP, specific compartments had been identified for (i), year ready for harvest and (ii), year scheduled for harvest. However, referring to Table 3.2 in this plan, the SFD did not strictly follow as planned in the 2nd FMP (Table 9) due to the following reasons:

a. Prior harvesting, the CHP carried out in compartments next to the compartments that have been logged (which were projected not to have sufficient stocks; and therefore, not scheduled for logging in the 2nd FMP) were actually reported to have good/sufficient forest stocking.

b. The compartments that were supposed ready to be harvested and/or scheduled to be harvested the following year as shown in Table 9 of the 2nd FMP are located quite far from each other. Therefore, logging operations in these compartments were not carried out as scheduled because of practicality and operational costs, which are too expensive.

Based on the above lessons learned, the FMP Team agreed that the decision to determine the compartments to be harvested in the 3rd FMP period should be based on the following:

- Latest stratum map;
- 100% ground truthing;
- CHP results;
- Compartments that are already treated; and
- One contiguous block.

In this case, timber stand improvement (TSI) must be carried out at least 6 – 12 months ahead of harvesting, preparation and completion of the CHP must be carried out at least six (6) months ahead, and road planning and construction should be carried out at least one year earlier.

iii. Dwindling funds and escalating cost of goods and services

All activities and targets as prescribed in the 2nd FMP were planned with the assumption that sufficient funding from the government was available. However, over the years and especially during the last few years of the 2nd FMP, it was apparent that the government funding was dwindling, resulting in some of the activities as prescribed in the 2nd FMP and the Annual Work Plans (AWP) were either postponed or partially implemented. Besides that, the prices of fuels and equipment have escalated. This resulted in high operational costs and limitations on activities implementation and purchasing of equipments or the latest

technology, etc. The DFR management proved to run effectively on a minimum average budget of RM5.5 million per year. However, following the 2nd FMP experience, where the approved allocations were lower than RM5.5 million, all activities that are to be prescribed in the 3rd FMP, where possible, will be based on clear available resources.

There was also this classical government bureaucracy - the rigidity of a bureaucratic system and the wastes that are inherent, which the project has to pay for, adding to the cost of managing DFR. So long as DFR is run by a classical government department, it is unlikely that costs could be reduced significantly.

iv. The "promised" green premium for certified timber

Over the years, the management had experienced the evolution on the certification requirement standards that resulted in higher costs. However, the SFD did not obtain a financial reward for their efforts; there was no real premium compared to export prices of logs or log prices in Peninsular Malaysia, with the exception of one species, Selangan Batu. Nevertheless, forest certification in DFR brought the SFD the following benefits:

- Prestige - it has been proven independently that in Sabah, natural forests can actually be well managed;
- The "CARS" keep the SFD's management on its toes and therefore focused to the tasks and responsibilities, "promised" in the FMP, AWP etc.; and
- Shield of credibility – it ensures non-interference and the SFD is left to do what it thinks is best.

v. Deramakot is about natural forest management (NFM)

NFM implies, as much as possible, the natural stand is retained, with modifications restricted to the loss of some big trees, primarily during harvesting. Due to the low-intensity logging practices and strict compliance of RIL techniques and SoPs, the forest structure remains; its landscape very little modified and there is no real danger of biodiversity loss or genetic erosion, particularly of the flora. Disturbance is short-term and localized, thus providing an opportunity for the orang-utans and other big mammals to seek temporary shelter nearby and to re-invade the "disturbed" area thereafter. The crucial point is that the forest remains a natural forest, which orang-utans and other wildlife must have, to ensure their survival.

vi. Timber Stand Improvement

Timber stand improvement through liberation treatment to increase crown illumination of selected dipterocarp trees in the lowland dipterocarp forests of DFR, was found to be effective in promoting tree diameter growth. According to Ong (2006), gains in diameter increment were especially pronounced for trees in the size class ≤ 20 cm dbh, for which an increase of more than 100 % over unliberated trees was recorded. Therefore, Ong strongly recommended that liberation treatment is to be continued in DFR where a large proportion of future harvest trees are expected to come from the ≤ 20 cm dbh size class. Treatment potentially shortens cutting cycles by up to 18 years. From a financial perspective, based on

the use of discounted cash flow criteria, liberation treatment improves NPV, and therefore is more beneficial than leaving a forest untreated.

It is also acknowledged that pre-felling treatment (one or two years in advance of cutting) in the form of climber cutting is very pertinent to be undertaken by the SFD. This will facilitate the directional felling of trees so that there will be less damage to the residual trees. The study carried out in DFR (see Chapter 5.2) for post-harvesting TSI showed that the volume of standing trees damaged by logging was estimated at 14.4m³/ha, which is quite significant.

vii. FSC Certification

The lesson learned so far indicates that DFR is well-managed in accordance with the FSC Principles. Forest management certification improves the working standards in DFR in all different aspects, as all three pillars of sustainability are included in the list of the most common problems found. Except for the issue concerning indigenous peoples' rights, of which the SFD would strive to close the gap, the improvement can be seen that fewer problems or issues are identified through time, meaning that forest management is improving in DFR than when it was first certified. Additionally, it is likely that certification will have a large impact on the long-term sustainability of forest management in DFR mainly because the SFD would improve their monitoring system (especially on HCV issues) and to incorporate the results of the monitoring system into their management practices.

viii. Research & Development

Biodiversity conservation in DFR

Throughout the 10 years of management in DFR, various biodiversity studies have been conducted, mostly focusing on the flora and fauna. Many of these studies have yielded interesting information on the rich biodiversity in DFR and provided up-to-date information and status on rare, endemic and threatened species in Sabah. Some of the notable and iconic wildlife species include Orang-utan, Tembadau, Bornean Pygmy Elephant and Proboscis Monkey. All these data would contribute significantly in further enhancing biodiversity conservation, as well as, to enhance SFM in DFR. Such research would have to be continued in order to assess the status of biodiversity in DFR in the future.

The role of DFR as a carbon sink

Much research on carbon sequestration has been conducted in DFR through a five-year collaboration between the SFD and Centre for Ecological Research, Kyoto University (CERKU) under Professor Kitayama. International publications and presentations (see list in **Appendix 7**) from this collaboration have put DFR in the forefront in studies on climate change and the role of forests as carbon sinks. From this collaboration, Professor Kitayama has developed a monitoring, reporting and validation (MRV) system known as BOLEH (Biodiversity Observation for Land Ecosystem Health), which supports the implementation of REDD+ in Sabah. Such collaboration should be continued to further promote the role of forests (not only DFR) as carbon sinks.

CHAPTER 4: HIGH CONSERVATION VALUES

4.0 INTRODUCTION

The High Conservation Value Forest (HCVF) concept was initially developed by the Forest Stewardship Council (FSC) and first published in 1999. HCVF identification and conservation is one of the Principles of SFM certification by FSC. Under Principle 9 for FSC certification, forest managers are required to identify any High Conservation Values (HCVs) that occur within their forest management units and manage them in order to maintain or enhance the values identified, and to monitor the success of this management. What this means is that logging should be restricted in such a forest – otherwise they would lose their conservational value. If logging operations are allowed, they must be carried out with good logging practice and management.

The HCVs in DFR are congruent to the assessment, management and monitoring of forest conservation from a global, national and local perspective based on Forest Stewardship Council principle 9. The assessment of HCV in DFR, which was executed from 9th to 20th of July 2013 by a team of various biological and social experts followed the national standards as prescribed in the High Conservation Value Forest Toolkit for Malaysia in 2009 (Table 4.1, Departmental Report, 2014).

Table 4.1: HCVs as described in the HCVF Toolkit for Malaysia (2009)

HCV	Elements
1	Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values
1.1	Protected areas
1.2	Threatened and endangered species
1.3	Endemic species
1.4	Critical temporal use
2	Globally, regionally or nationally significant large landscape-level forests
3	Forest areas that are in or contain rare, threatened or endangered ecosystems
4	Forest areas that provide basic services of nature in critical situations
4.1	Forests critical to water catchments
4.2	Forests critical to erosion control
4.3	Forests providing barriers to destructive fire
5	Forest areas fundamental to meeting basic needs of local communities (e.g. subsistence, health)
6	Forest areas critical to local communities' traditional cultural identity

The results of their assessments were later evaluated and later reviewed by stakeholders, including local and international experts through consultative processes. Their findings were later presented in the Departmental 2014 HCV Report entitled "*Deramakot HCV Assessment Report*". The findings emphasized the importance of maintaining selected sites as HCVF or Areas within DFR that include unique or threatened ecological areas, habitats of high conservation significant species and/or areas of cultural significance that must be managed so as to maintain the value of the attributes. The SFD also emphasized that HCV forests and areas will not be converted to other land-use types and degrade the attributes' conservation values. What have been incorporated in this plan are just the gist of the main HCV Departmental Report.

4.1 High Conservation Values in DFR Landscape

4.1.1 HCV 1.1 - Protected Areas

Definition

All forest areas that have been legally gazetted as Protected Areas under Malaysia legislation (either federal or state), are HCV 1.1. The Master List of Protected Areas in Malaysia, commissioned by the Ministry of Natural Resources and Environment, has listed all areas that fall under this category, and should therefore be the first point of reference. However, it is noted that in Sarawak there is no overlap between FMUs and TPAs.

Site perspective

Tangkulap FR is classified as Class I Protected Forest Reserve. It is located directly adjacent to DFR (north-west of DFR).

Rationale for HCV boundary delineation

A buffer strip of 50 m inside the boundary of DFR is categorised as HCV 1.1 to mitigate any environmental impact that may exert to the new protected forest, Tangkulap FR (Figure 4.1).

4.1.2 HCV 1.2 - Threatened and Endangered Species

Definition

Any species categorized as either Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) on the IUCN Red List, Appendix I of CITES or listed as protected under Malaysian legislation (federal or state), is HCV 1.2. However, for practical reasons forest managers may want to limit field surveys of fauna to mammals (particularly large ones, over 20kg in weight), birds and herpetofauna, unless literature indicates that there are other species in the area which require specific attention. This does not mean that other taxa are unimportant, and wherever possible, if the expertise and survey protocols are available there should be covered too. It is also recommended to cross check the IUCN Red list with the Malaysian Red Data Book, once that is available. Where there may be differences between the Malaysian Red Data Book and the IUCN Red List, the Malaysian Red Data should always take precedence.

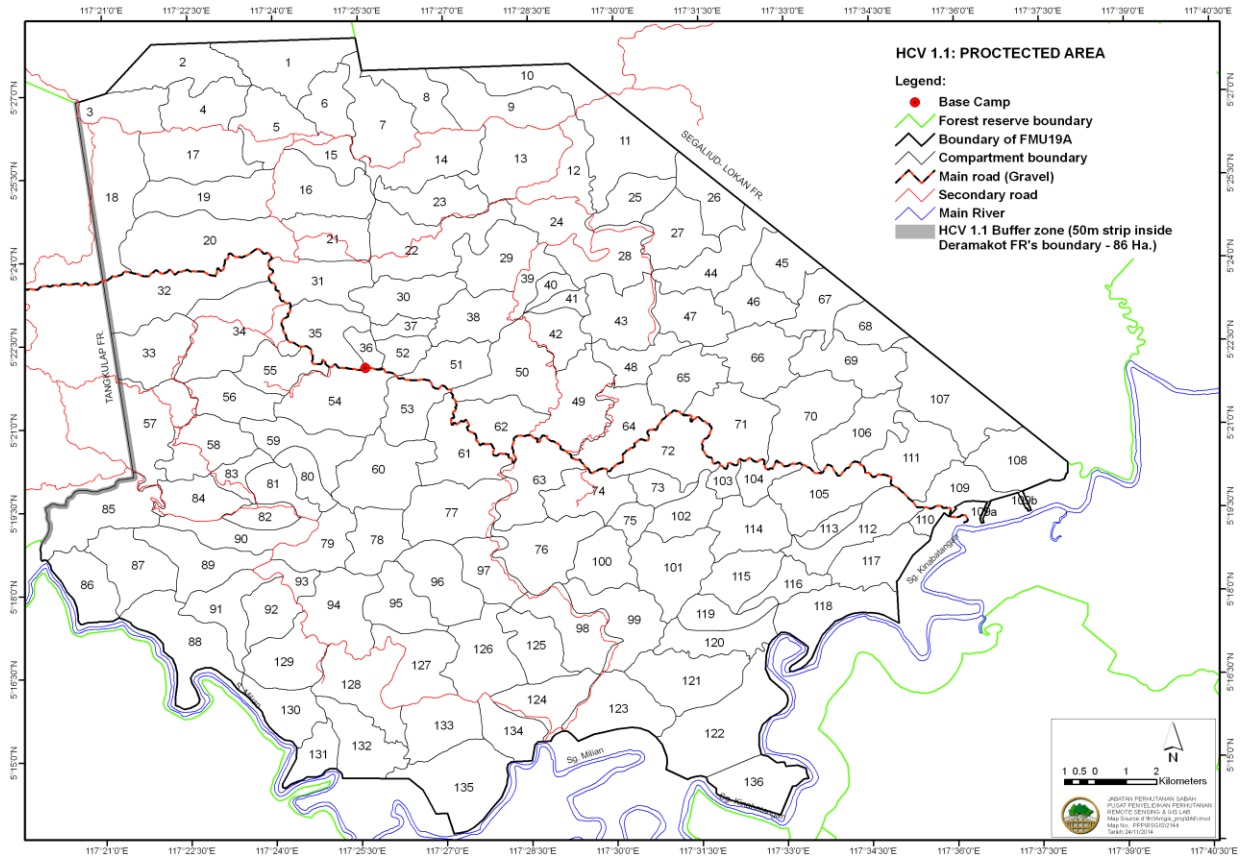


Figure 4.1: The location of HCV 1.1, a buffer strip of 50 m inside DFR boundary providing barriers from environmental impact that may exert to Tangkulap FR (Class I).

4.1.2.1 Flora

Site perspective

The HCV flora assessment that were conducted on various forest formations, namely Extreme Lowland, Lowland Mixed Dipterocarp Forest (LMDF), Lowland Mixed Dipterocarp and Kerangas Forest (LMD&KF), Lowland Ultramafic Forest (LUF) and Lowland Seasonal Freshwater Swamp Forest (LSFSF), recorded approximately 500 plant species that arederived from 98 families ranges from various plant group, i.e. trees, shrubs, sedges, fern and herbaceous plants. With the incorporation of secondary data derived from plot work conducted by Imai *et al.* (2009), departmental research work on "Carbon stocks assessment in sustainable forest management at Sabah" funded by the Ministry of Nature Resources and Environment under the 9th Malaysian Plan Federal Development Programme and the continuous forest inventory of DFR timber stock up to 2013, a total of 119 plant families, 361 plant genera and 900 taxa were observed covering grasses, herbaceous plants, climbers, palm trees, shrubs and trees.

In total, 82 tree families spanning over 261 genera were recorded, thus making this plant group the main contributor towards the total families recorded for DFR. Trees that were identified down to the species level (750 species) comprise of 77 tree families and 246 genera, with a total of 26 species identified to sub species or varieties. Of the 750 species identified, 15.2% (114 spp) has been assessed globally according to the IUCN criteria with 7.2% (54 spp) of tree species listed as globally threatened under IUCN as Vulnerable to Critically Endangered. By just studying the Dipterocarps, which makes up a major bulk of the tree species identified, if the secondary data is included, the total number of Critically Endangered Dipterocarp species is 31 (see Table 4.2).

At present, the national level conservation assessment under the Malaysian Plant Red List project mainly covers the Dipterocarpaceae family and other shared plant families found in both West and the East Malaysia. However, IUCN status for the other Bornean plant taxa and families are currently under studies. A total of 11 species assessed would have its global threat category downgraded to reflect the national conservation status (Departmental Report 2014: Appendix 5a, Table 6.2).

Based on Schedule 1 of the Forest Rules 1969, a total of 54 tree species from 11 tree families are strictly prohibited (Departmental Report 2014: Appendix 5, Table 2) from harvesting within gazetted forest reserves (FR).The prohibited species includes 14 tree species that have been assessed globally and its IUCN status assigned. This include 7 species listed as globally Vulnerable, 2 species listed as globally at Lower Risk – Conservation Dependent, and 5 species listed as globally at Lower Risk – Least Concern. The remaining 40 tree species that were identified to be protected under Schedule 1 of the Forest Rules 1969 have yet to be assessed using the IUCN criteria. Even though there are species that have been assessed as Least Concerned in the global IUCN assessment, the state's legislation and enactment will have to take precedence for such species.

Two species that were recorded in DFR are listed under CITES Appendix II. The species were from the Thymelaeaceae family, namely *Aquilaria beccariana* and *Aquilaria malaccensis*, and categorised as Vulnerable under IUCN and are totally protected under Schedule 1 of the Forest Rules 1969 from harvesting within gazetted forest reserves (FR).

In addition, two potential host plants for *Rafflesia* spp, such as *Tetrastigma diepenhorstii* and *Tetrastigma lanceolarium* were found during the HCV assessment. Though no record of finding any *Rafflesia* spp. in DFR, these climbers or host plants presence will be taken note as any species of the *Tetrastigma* , which are listed as totally protected under Schedule 1 of the Sabah Wildlife Conservation Enactment 1997.

Table 4.2: Identified tree species assessed according to the Global IUCN Categories

IUCN Red List Status	Species List	
Critically Endangered	*Dipterocarpus applanatus* *Dipterocarpus costulatus** *Dipterocarpus globosus* *Dipterocarpus gracilis** *Dipterocarpus kerrii** *Dipterocarpus tempehes** *Dryobalanops aromatica** *Dryobalanops keithii* *Hopea beccariana** *Hopea ferruginea** *Hopea nervosa** *Hopea pentanervia* *Hopea wyatt-smithii* *Parashorea malaanonan* *Shorea acuminatissima* *Shorea almon*	*Shorea falciferoides* *Shorea gibbosa** *Shorea hypoleuca* *Shorea inappendiculata** *Shorea johorensis** *Shorea leptoderma* *Shorea seminis* *Shorea slootenii* *Shorea smithiana* *Shorea superba* *Shorea symingtonii* *Shorea waltonii* *Shorea xanthophylla* *Vatica cf. chartacea* *Vatica sarawakensis*
Endangered	*Anisoptera costata* *Dryobalanops beccarii* *Dryobalanops lanceolata* *Shorea agamii* *Shorea argentifolia*	*Shorea faguetiana* *Shorea leprosula* *Shorea pauciflora* *Dacrydium sp (pectinatum)*
Vulnerable	*Aglaia densisquama* *Aquilaria beccariana* *Aquilaria malaccensis* *Cynometra inaequifolia* *Delonix regia* *Durio cf. kutejensis* *Durio grandiflorus* *Eusideroxylon zwageri*	*Gonystylus bancanus* *Gonystylus consanguineous* *Gonystylus keithii* *Horsfieldia fragillima* *Mangifera pajang* *Shorea macrophylla*
Conservation Dependent	*Koompassia excelsa; Koompassia malaccensis*	
Least Concerned	(HCV Departmental Report 2014: APPENDIX 3 *Raw Data*)	
Near Threatened	*Aglaia cf. hiernii* *Aglaia foveolata* *Aglaia foveolata* *Aglaia grandis* *Aglaia leptantha* *Aglaia luzoniensis*	*Aglaia macrocarpa* *Aglaia multinervis* *Aglaia oligophylla* *Aglaia sexipetala* *Aglaia silvestris* *Dimocarpus longan*
Data Deficient	*Pentaspadon motley,* *Sindora beccariana,* *Cinnamomum parthenoxylon,* *Ochanostachys amentacea*	

Note that species indicated with (*) were assessed under the Malaysian Plant Red List project for national level. The HCV 1.2 (Threatened and Endangered Species) focuses on the timber tree species, considering DFR is a production forest. Analysis of the results has shown that there are marked differences in terms of IUCN Red List assessment outcomes, primarily between the global and national red list, which indicates potential differences in the interpretation of the level of threat across geopolitical boundaries. Therefore, the harvest of threatened species within the DFR might want to take into consideration of the current status and species distribution on forested

lands (habitats) within the network of Permanent Forested Estates (PFE) in Sabah, and the potential for populations to be safe-guarded within Totally Protected Areas (TPA's). Generally, the dipterocarps represents at least 90% of the total timber volume that are harvested within DFR and are regulated by a restriction of diameter felling (60–120 cm) limit within gazetted forest reserves (with the exception of Shorea macrophylla as it is listed as prohibited from felling under Schedule 1 of the Forest Rules 1969). In reference to the interesting flora diversity present within the DFR, the conservation area within DFR has been expanded in this 3rd FMP. Areas highlighted to be put aside for conservation are highlighted in HCV 3 Section.

Rationale for HCV boundary delineation

The management indicates that the whole area of LMDF and LMD & KF are categorised as HCV 1.2 that are important habitats for threatened and endangered flora in Deramakot FR (see Figure 4.2).

4.1.2.2 Fauna

Site perspective

Since the 2nd FMP of DFR, efforts to enhance wildlife management system by the DFR team have been one of the main management activities. In this respect, a wildlife expert has been consulted to provide guidance in enhancing the existing wildlife management system. Collectively, from the HCV fauna assessment, past monitoring by Deramakot team and research findings by Dr. Matsubayashi (University Malaysia Sabah), about 47 species of mammals that are derived from 21 families and at least 147 species of birds that are derived from 35 families were recorded (Departmental Report, 2014).

About 5 species of mammals are listed as "Endangered Species" in the IUCN Red List of Threatened Species, namely Bornean pygmy elephant, Bornean gibbon, Banteng, Proboscis monkey and Orang-utan; 2 species are listed as "Near Threatened" on the IUCN Red List of Threatened Species, namely Large flying fox and Long tailed macaque; 4 carnivore species, namely Leopard cat, Malay civet, Common palm civet and Small toothed palm civet. Sambar deer and Bearded pig that are frequently encountered at the roadside are classified as Vulnerable in the IUCN Red List and are protected under Schedule III in WCE 1997. Hunting for these 2 species requires licence application from the Sabah Wildlife Department.

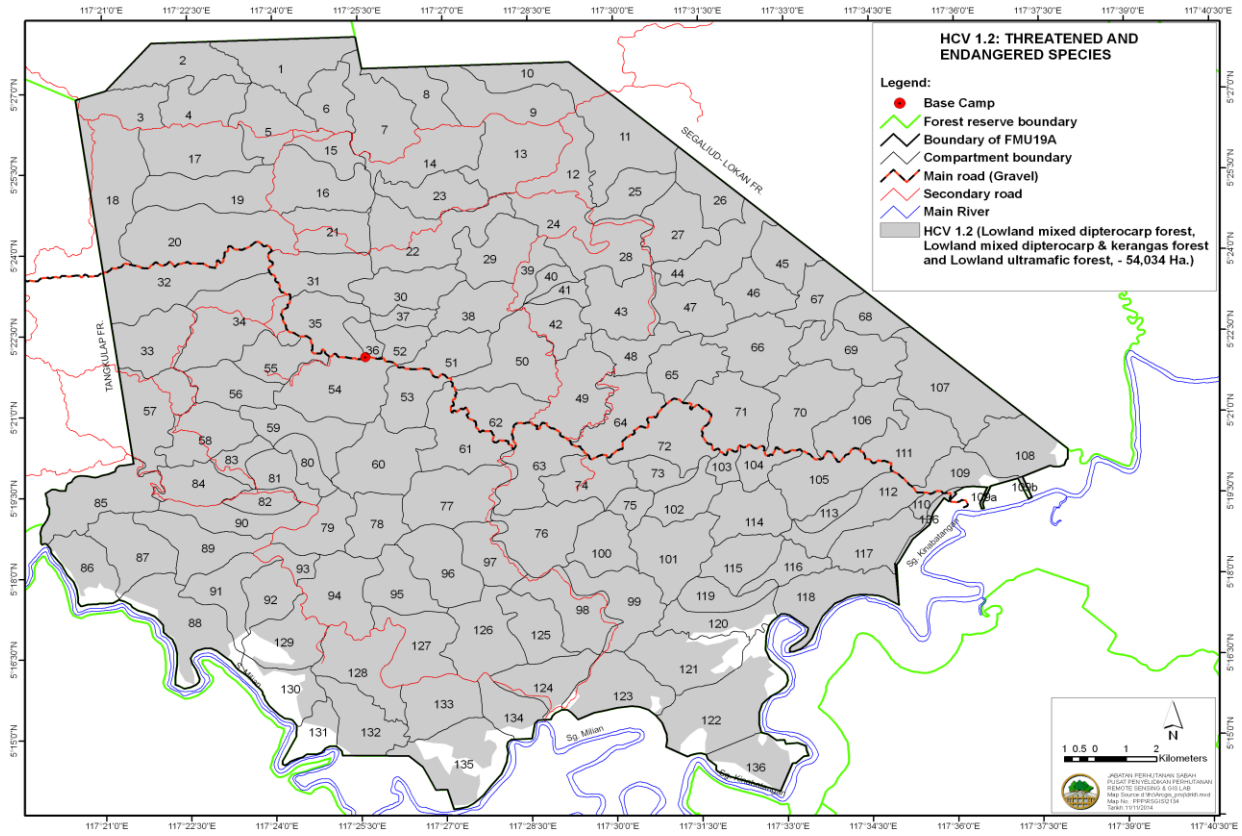


Figure 4.2: The LMDF and LMD & KF are categorised as HCV 1.2 areas that are important habitats for threatened and endangered for flora and fauna in DFR

Under the IUCN Red List Conservation Status, about 43% of the total mammals recorded are listed as Least Concerned; 28% as Vulnerable; 19% known as Endangered and 6% Data Deficient (Figure 4.3).

The birds are mostly observed at the Southern and Eastern part of DFR. Most of the species spotted are listed in the IUCN Red List Conservation Status as either Least Concerned (96 species) or Near Threatened (43 species). There are 5 species that are classified as Vulnerable and one that is classified as Endangered. The Storm Stork is the Endangered species recorded. It is a scarce local resident. As described in the IUCN Status listing, the population of this species is decreasing due to the loss of habitat. The 5 vulnerable species are the Great Slaty/Woodpecker, Blue Banded Kingfisher, Large Bill Flycatcher, Blue Headed Pitta and the Bulwer's Pheasant. The first 3 species are basically scarce local residents within the DFR, whereas the latter two species are Borneo endemics. Though endemic the Blue Headed Pitta is a common bird, in contrast to the Bulwer's Pheasant, which is quite rare in the area.

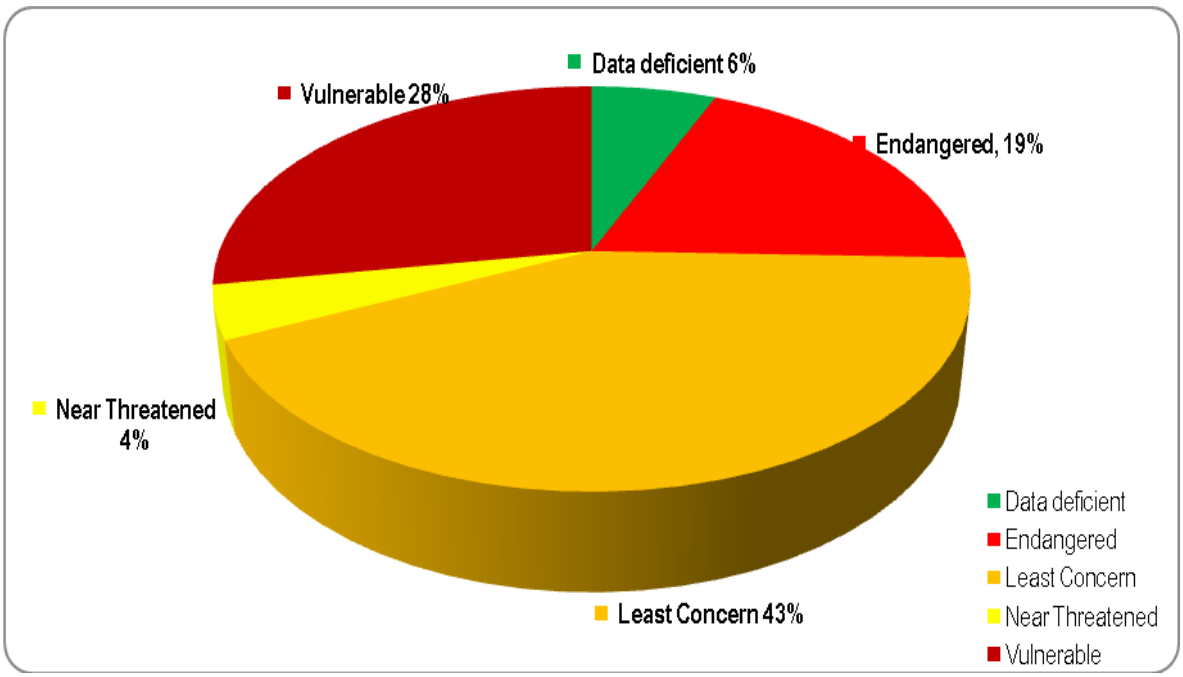


Figure 4.3: Summary of the IUCN Red List Status of the wildlife species (mammals) recorded in HCV assessment and past research

Rationale for HCV boundary delineation

The management indicates that the whole area of LMDF and LMD & KF are categorised as HCV 1.2 areas that are important habitats for threatened and endangered fauna in Deramakot FR (Figure 4.2).

4.1.3 HCV 1.3 - Endemic Species

Definition

Any forest containing endemic species as identified by FRIM, MNS, SFC, Forestry Departments and published literature, particularly in high concentration or highly restricted distribution, can be considered HCV 1.3.

4.1.3.1 Flora

Site perspective

Based on the compilation data set, a total of 176 tree species are recognized as endemics, representing about 24% of tree species known from within the management unit. A total of 163 tree species are endemic to Borneo, and 13 species endemic to Sabah.

Trees recognized as Bornean endemics were highly represented by the Dipterocarpaceae with a total of 43 tree species, which are represented by six genera, namely *Dipterocarpus* (9 species), *Dryobalanops* (2 species), *Hopea* (2 species), *Parashorea* (2 species), *Shorea* (23 species), and *Vatica* (5 species) (Khoo & Hastie, 2014: APPENDIX 5a: *Table 2*).

Under Schedule 1 of the Forest Rules 1969, 9 Bornean endemics from 6 families ranging from the commercially valuable Dipterocarpacae and fruit trees from the Burseraceae (*Santiria grandiflora*), Malvaceae (all *Durio spp*), Moraceae (*Artocarpus tamaran*), Fabaceae (*Sympetalandra borneensis*) and Phyllanthaceae (*Baccaurea angulata*) are listed. Only 1 Sabah endemic is currently protected

under Schedule 1 of the Forest Rules 1969 that is a fruit-tree (*Nephelium aculeatum*) from the Sapindaceae.

Of the 176 endemic tree species identified, an estimated 58 species could attain commercially harvestable sizes (>60cm dbh) and about 41 species are from the Dipterocarpaceae family. The remaining endemic tree species are either treelets or of mature sizes below the minimum diameter-cutting limit set by the SFD. They are consisting of fruit trees and other main canopy associates across 24 tree families. From the list of species that are of harvestable size, 11 species are protected under Schedule 1 of the Forest Rules 1969. Based on the International Union for Conservation of Nature (IUCN) assessment, trees such as *Canarium latstipulatum* (Burseraceae) - endemic to Borneo and rare, *Shorea waltonii* (Dipterocarpaceae) – endemic to Sabah and rare, *Shorea symingtonii* (Dipterocarpaceae) – endemic to Sabah and rare and *Diploknema subifera* (Sapotaceae)- endemic to Borneo and rare. These species are, therefore, to be protected from logging in DFR except if they are found next to secondary roads of which, they can be felled but subject to approval from the Director.

Endemic species such as climbers and herbaceous plants are considered at low risk to loss within the management unit, due to the sivilculture systems employed. Since the late 1950s, Sabah has adopted the Modified Malayan Uniform System. A prerequisite requirement of the system is the prescription of pre-harvesting treatment of climbers, via a blanket treatment or a total removal of climbers. In DFR, a pre-harvesting treatment is to be introduced in the 3rd FMP, that is, between 6 to 12 months prior to harvesting. – see details in Chapter 6.2.5. This measure is employed to reduce incidental damage that might result from harvesting operations to neigbouring trees that were intertwined by climbers. This treatment is expected to provide additional benefits, which include in increasing light quality for the desirable crop trees and consequently improving their growth, enhancing natural regeneration of the site, and as well as to reduce climber regeneration in the site though not necessarily eliminating them. Even though a “blanket” treatment is applied to climbers, the focus of the prescribed treatment is the removal of high density climbing bamboos, such as *Dinochloa scabrida* and *D. trichogona* (Poaceae), that proliferate in abundance in areas that were once severely disturbed by past logging activities. Furthermore, the management is also taking steps to avoid removal of climbers for example *Uncaria* spp (Rubiaceae) and *Willughbia* spp (Apocynaceae) that are important food source for wildlife, especially for primates. Further elaboration on this issue can be referred to in Chapter 6.2.5.

Rationale for HCV boundary delineation

The HCV Team indicates that the whole area of LMDF, LMD & KF, and LSFSF are categorised as HCV 1.3 areas that are important habitats for endemic fauna in DFR (Figure 4.4).

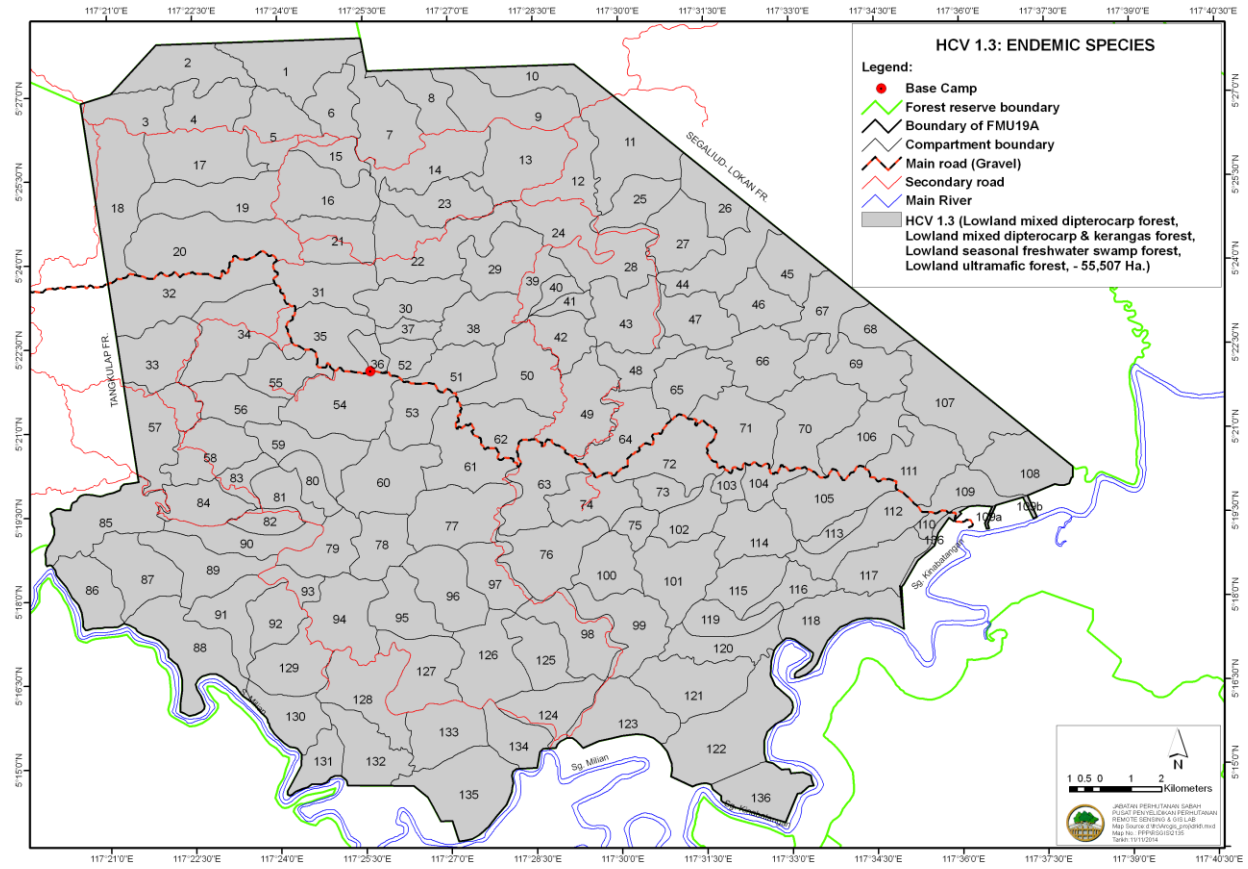


Figure 4.4: The LMDF and LMD & KF categorised as HCV 1.3 areas that are important habitats for endemic flora and fauna in DFR

4.1.3.2 Fauna

Site perspective

A total of 3 mammals and 6 bird species recorded in DFR are endemic to Borneo (Tables 4.3 & 4.4). For the mammals, both Proboscis monkey and Orang- utan are listed as Endangered; and the management has set a monitoring process to evaluate their ecological status. However, ecological information on Thomas Flying squirrel is still lacking as like any other of the many medium to small size mammals found in Sabah. As for birds, few of the listed Endemic species are known to be rare and some are known to be decreasing in numbers. One of the common features shared by these endemic species is the decrease of available habitats, nesting and breeding grounds. All these factors would have probably driven them to become either endangered or rare.

Table 4.3: List of Bornean endemic mammal species found in DFR

Family	*Scientific Name*	Common Name	WCA [SWD]	Status CITES	IUCN red list
Cercopithecidae	*Narsalis larvatus*	Proboscis Monkey	I	Listed in Cites	Endangered
Hominidae	*Pongo pygmaeus*	Orang Utan	I	Listed in CITES	Endangered
Petauristinae	*Aeromys thomasi*	Thomas flying squirrel	II	Not listed	Data Deficient; Population trend: unknown
Elephantidae	*Elephas*	Borneo	I	Not listed	Not evaluated

	maximus borneensis	Pygmy Elephant			

Table 4.4: List of Bornean endemic bird species found in DFR

Family	*Scientific Name*	Common Name	Note	IUCN red list
Dicaeidae	*Prionochilus xanthopygius*	Yellow rumped flower pecker	Endemic in Borneo	Least Concern Pop. trend: stable
Pelicanidae	*Lophura bulweri*	Bulwer's pheasant	Rare and endemic in Borneo	Vulnerable A2cd+3cd+4cd; C2a Pop. trend: decreasing
Picuminae	*Pitta arguata*	Blue Banded pitta	Rare and endemic in Borneo	Least Concern Pop. trend: stable
Pittidae	*Pitta baudii*	Blue headed pitta	Locally common and endemic in Borneo	Vulnerable A2c+3c+4c Pop. trend: decreasing
	Pityriasis gymnocephala	Bornean bristlehead	Scarce endemic in Borneo	Near Threatened Pop. trend: decreasing
Turdidae	*Copsychus stricklandi*	White crowned shama	Common endemic	Not evaluated

4.1.4 HCV 1.4 - Critical Temporal Use

Definition

Any forest area which is important to wildlife for feeding, nesting, roosting, and migration or contains saltlicks is HCV 1.4.

Site perspective

The DFR management has marked out on the ground areas that contain saltlicks, which are located in Compartments 42, 49, 63, 112, 120, 122 and 130. This is a regular exercise during the preparation of CHP in any new compartment. Generally, the saltlicks are found within the wetland or swamp forest areas. These areas are protected and wildlife management system is implemented. A buffer area of 50 m radius is set-up that prohibits any form of timber extraction activities. Camera traps are installed at the identified saltlicks area. Recent studies have shown that 78.4% of the known mammals species present within the DFR were known to have visited the saltlicks (Matsubayashi et al., 2006).

Recent HCV assessment has indicated potential nesting sites for winter migratory species, namely the Black capped kingfisher, Indian cuckoo and the Common Sandpiper in the northwestern part of DFR. In the global context, these species are listed as least concern according to the IUCN Red List, though population decreases are beginning to appear.

Rationale for HCV boundary delineation

The HCV Team indicates that several critical temporal use by wildlife such as, the saltlick areas in Compartments 42, 49, 63, 112, 122, 130 & 120 of DFR are categorised as HCV 1.4 (Figure 4.5). Nesting sites for winter migratory birds will be identified.

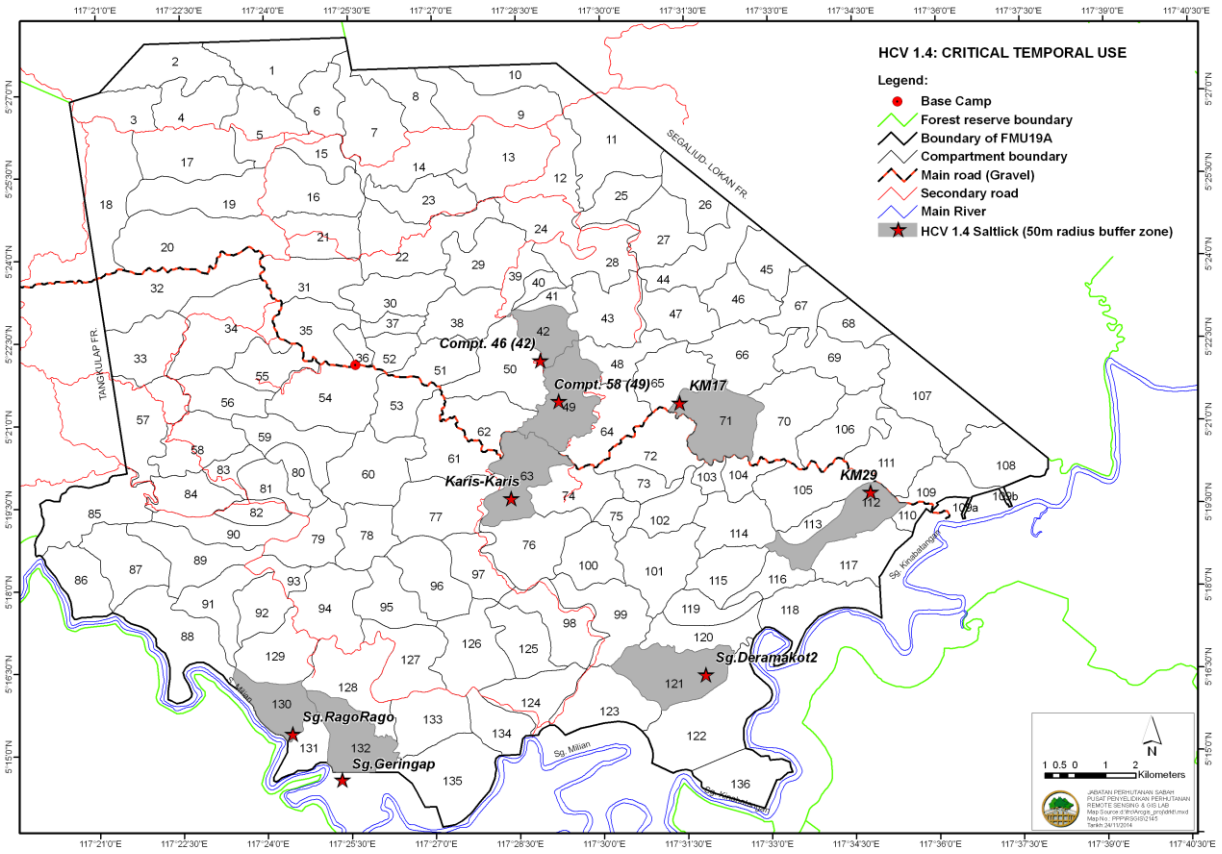


Figure 4.5: The locations of HCV 1.4 that indicate salt-lick areas (red star) in DFR

4.1.5 HCV 2 - Globally, Regionally or Nationally Significant Large Landscape-Level Forests

Definition

Forest area contains or is part of a globally, regionally or nationally significant large landscape level forest where significant populations of most if not all naturally occurring wildlife species exist in natural patterns of distribution and abundance.

Any forest area that forms or is part of a linkage between larger forest complexes, and can thus provide connectivity between fragments or act as a wildlife corridor for the movement of animals from one complex to another, is considered HCV 2. This HCVF can serve as a buffer zone to protected areas. Its identification and management should be tailored towards the needs of umbrella species i.e. sensitive, wide ranging wildlife that are particularly susceptible to forest fragmentation and human population pressures.

Site perspective

At the landscape level, DFR is part of Class II Production FR with Telupid FR on the nort-west, Tangkulap FR in common border in the west, Segaliud Lokan FR in the east, and Malubuk, Ulu Segama, Malua and Kuamut FRs in the south, that form a large contiguous forest at central Sabah. Segaliud Lokan FR was previously found to have the highest density of elephants at 1.41 individual/km^2 and considered to be an important habitat area for the species in the North Kinabatangan range (Raymond et al., 2011).

DFR is also noted to contain the highest Orang utan density in Sabah (Acrenaz *et al*, 2010) and also an important habitat for some of Sabah's key wildlife such as, Elephants, Tembadau, Sun bear,

Clouded leopard, Bay cat and etc. In view of the close proximity of FRs with such variety of wildlife existence, Deramakot FR would inevitably become a crictical link from the aspect of wildlife migratory pathways between the different forest complexes. Previous studies on radio-collared elephants have shown that the species prefers to use riverine forests or logging tracts/roads as part of their migration paths. Local communities from adjacent villages frequently spotted Orang utans, Elephants, Tembadaus and Proboscis monkeys that are moving in and out of the DFR along Sg. Arawon and Sg. Tabalion. The Tembadaus are usually in groups of 3 or 5, while elephants are in a herd of 5 to 7.

Rationale for HCV boundary delineation

The management indicates that the whole Deramakot FR is categorised as HCV 2 due to its location in the midst of continuous natural forested landscape in Sabah (Figure 4.6).

4.1.6 HCV 3 - Forest Areas That Are In or Contain Rare, Threatened or Endangered Ecosystems

Definition

Forest area that is in or contains rare, threatened or endangered ecosystem. Any forest area that contains an ecosystem/habitat type identified as a priority for protection by National Conservation Strategy (NCS), PERHILITAN Ecosystem Assessment report, Forestry Departments, FRIM or SFC, and/or is confirmed as such by current expert opinion, is HCV 3. Some ecosystems are naturally rare, but some others are becoming increasingly threatened by pressure from human activities. Due to rapid changes, existing data may be outdated and some particularly threatened ecosystems may already need to be considered Priority 1. A good example of this would be Lowland Dipterocarp Forests, Peat Swamps Forests and Limestone Habitats. Always refer to current expert opinion for confirmation.

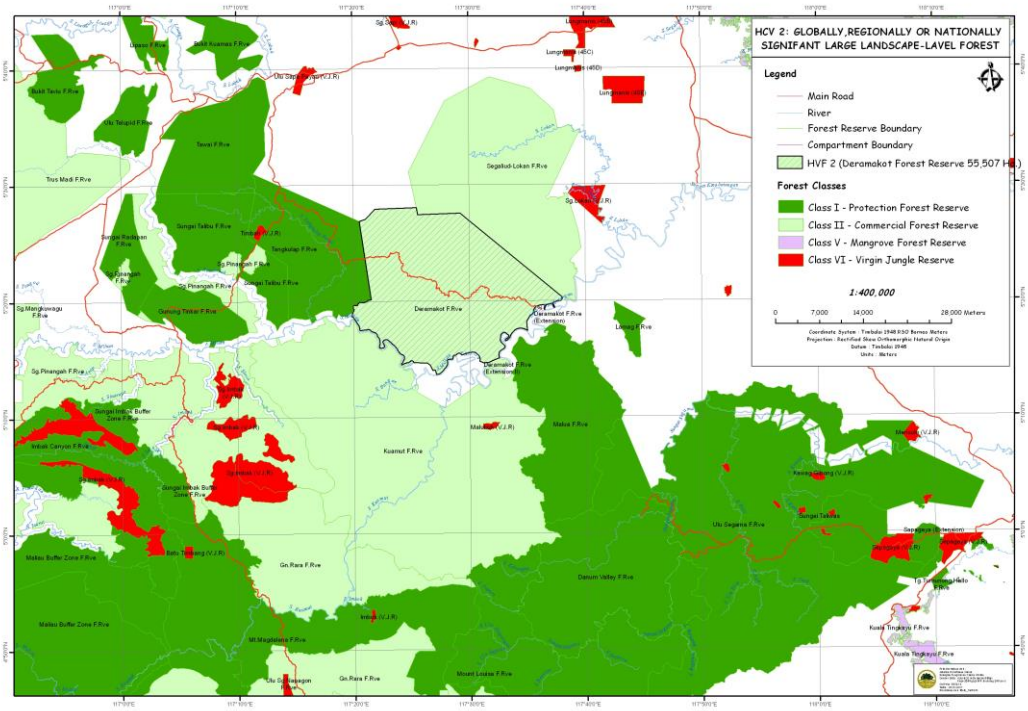


Figure 4.6: Map showing DFR categorised as HCV 2

Site perspective

Based on the HCV assessment, DFR contains LMDF, LMD & KF, SFWSF and LUF. In relation to the National Conservation Strategy (NCS) listing, 85% of DFR falls into the Extreme Lowland category, thus giving lowland forest types a high priority for conservation (Figure 4.7). The SFWSF is located at the southern part of DFR. The forest still remains intact with much flora and fauna diversity. In view of the fact that NCS has classified this forest type as high priority, there will be a need for good management practices and monitoring programmes to be installed for this particular forest area.

Though NCS categorised both KF and LMDF as medium priority in this region, the presence of both formations mixed intermittently creates a unique ecosystem that deserve sound conservation measures. The flat areas have been severely logged in the past. This has rendered the forest to be uneconomic for timber harvesting yet harbours conservation significant floristic assemblages. Wildfire may have affected the condition of the forest, therefore, detection and prevention of forest fire is important to safeguard this ecosystem.

The lowland ultramafic forest is only about 30 ha and the species assemblages have strong similarity with the typical LMDF.

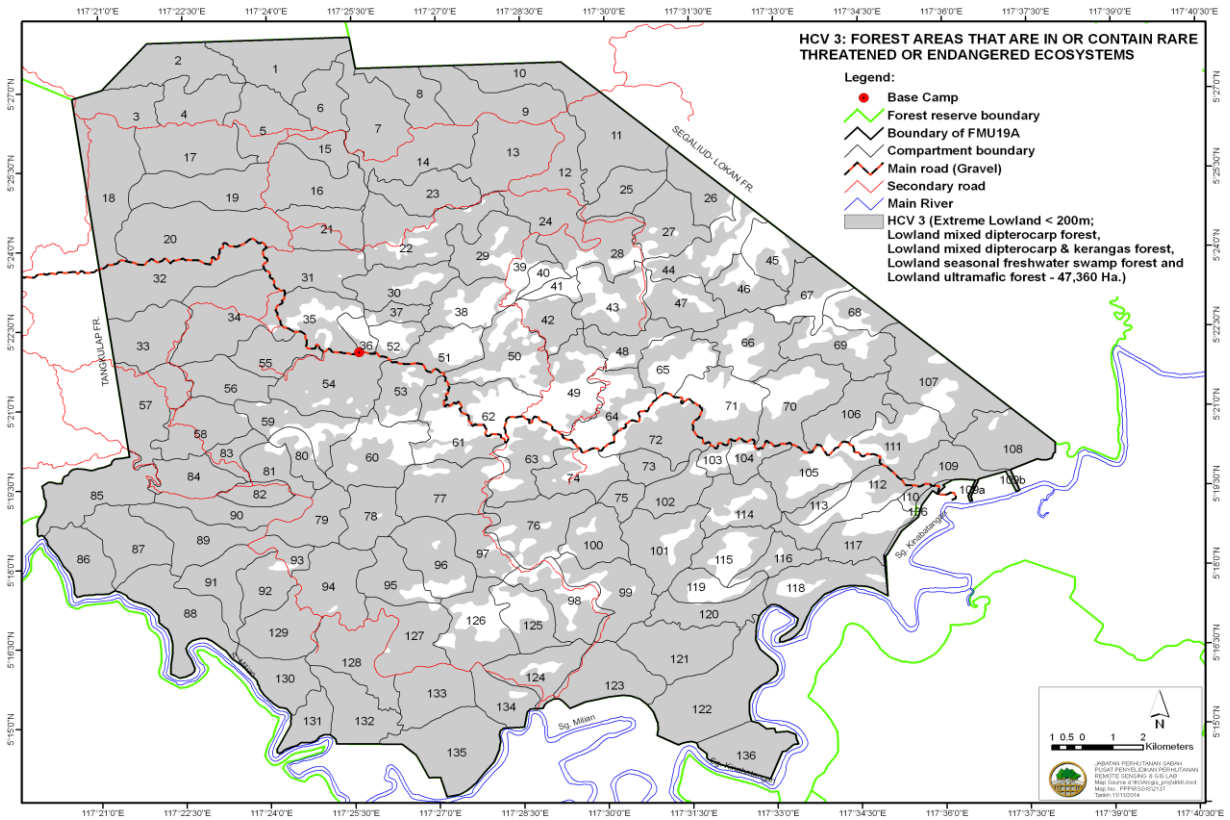


Figure 4.7: The location of extreme lowland forests that are categorised as HCV 3a in DFR

Rationale for HCV boundary delineation

The HCV Team indicates that the forested areas below 200 m a.s.l (Figure 4.7); and LSFMSF and LMD 7KF within DFR are important forest ecosystems and thus, categorised as HCV 3 (Figure 4.8).

4.1.7 HCV 4.1 - Forests Critical to Water Catchments

Definition

Forest area provides basic services of nature in critical situations.

Site perspective

Within DFR, there are no catchment areas that are gazetted under the Sabah Water Resource Enactment 1998. However, a catchment area in Compartment 109 has been designated by the SFD to serve as a water source for the Kg. Balat communities. Throughout the last FMP period, the other villages mainly rely on rainwater, Sg. Kinabatangan and Sg. Kuamut as their water sources. Recently, the communities in all the other three villages namely Kg. Tulang-Tulang, Kg. Desa Permai and Kg. Kuamut have requested for gravity pipes from the SFD; and a consultative approach has been engaged in the DFR Social Forestry Committee Meeting to address this matter.

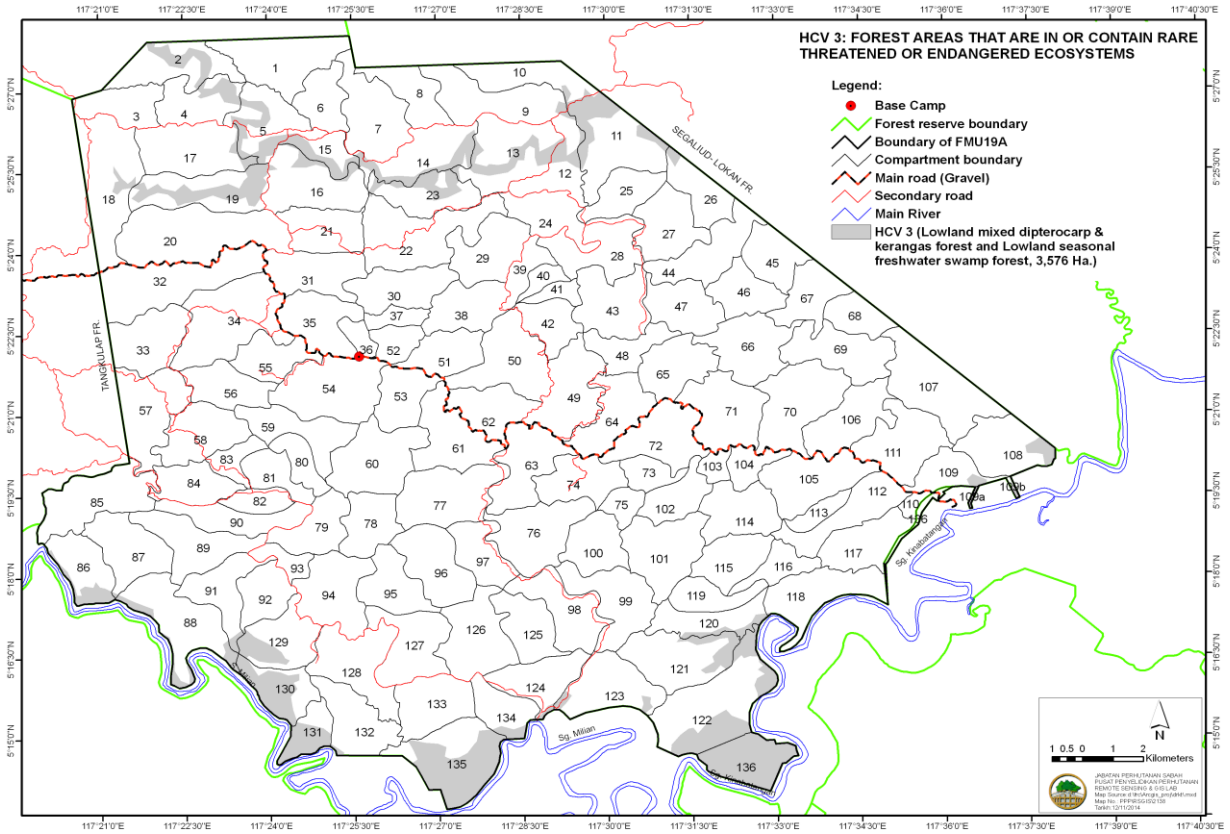


Figure 4.8: The location of SFWSF and LMD & KF that are categorised as HCV 3b in DFR

Rationale for HCV boundary delineation

Compartment 109 of DFR is categorised as HCV 4.1, which is important as a catchment area for the communities residing at Kg. Balat (Figure 4.9).

4.1.8 HCV 4.2 Forests Critical to Erosion Control

Definition

Forest areas that have been legally facetted for soil protection or conservation under federal and state laws e.g. the National Forestry Act 1984 (Peninsular Malaysia), forest areas, situated on slopes over 25 degrees (Sabah), areas classified as Terrain Class 4 in First Schedule: Forest Management Plan, Forest Timber License, and riparian areas covered under the DID (Department of Irrigation and Drainage) guidelines.

Site perspective

In general, past conventional logging activities induced heavy compaction of the soil that resulted in low water infiltration capacity and increased surface run-off, hence promoted soil erosion processes. This compaction also led to the reduction of vegetation regeneration and establishment that eventually promoted lesser forest productivity and diversity. To mitigate against this impact, the SFD has practiced the RIL system and avoided timber extraction activities over 25° in slopes. Any compartment that predominantly have dissected and steep slopes of over 25°, have been designated as conservation areas. In total, 19 compartments (10% of the total area of DFR) have been designated as conservation areas. These compartments are generally located in the southeast and southwest of the DFR. Furthermore, in the preparation of the Compartment Harvesting Plan (CHP), any localised steep areas with more than 25° slopes are marked and protected from any forestry activities especially forest harvesting. Moreover, as part of the RIL practices, the SFD has designated 30 m wide buffer areas on both sides of the permanent waterways within the production zone as riparian reserves.

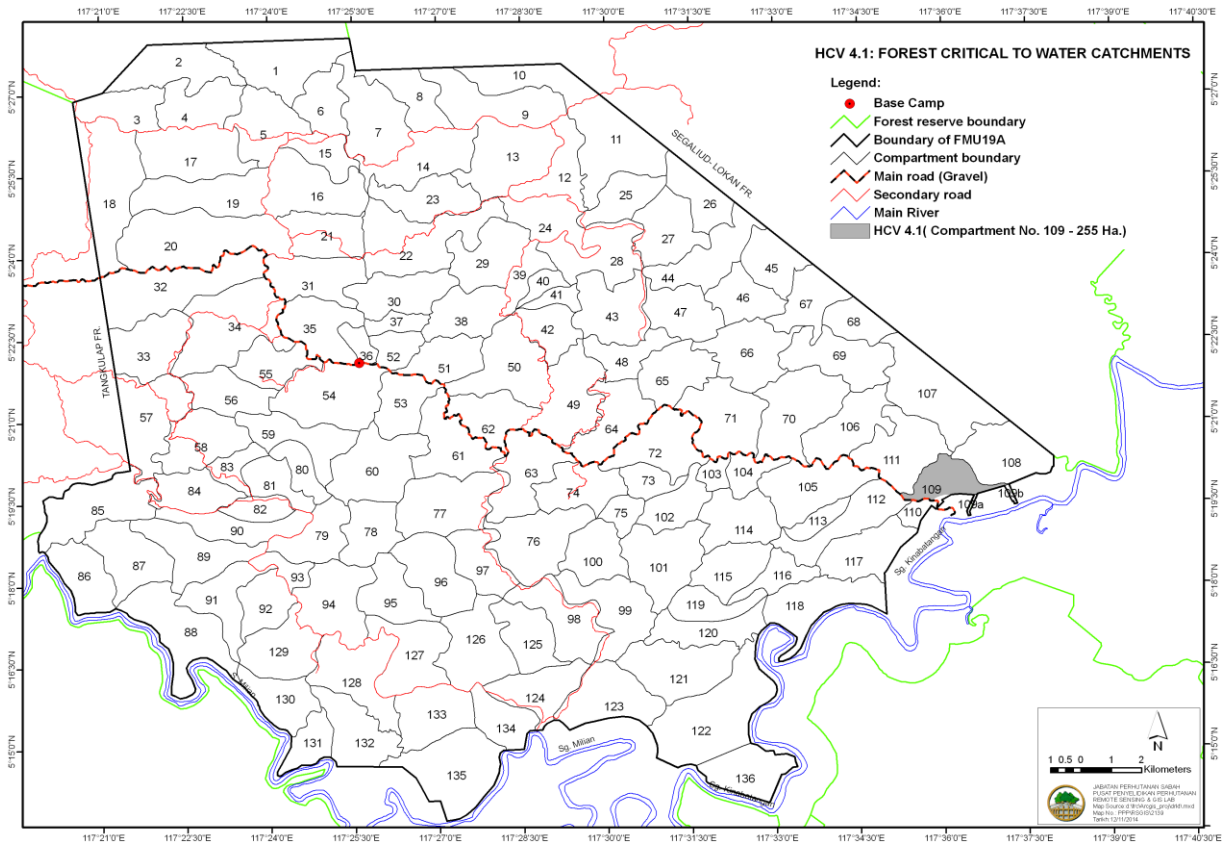


Figure 4.9: The location of HCV 4.1 as a catchment area for community in DFR

Rationale for HCV boundary delineation

Compartments predominantly having steep slopes of more than 25° and 30 m river buffer are categorised as HCV 4.2 (Figure 4.10).

4.1.9 HCV 4.3 - Forests Providing Barriers to Destructive Fire

Definition

Any specific areas that can act as barriers to provide protection of forests, especially forests with high conservation values, from fire, in areas that are generally fire prone and where the consequences are potentially severe, can be considered HCV 4.3.

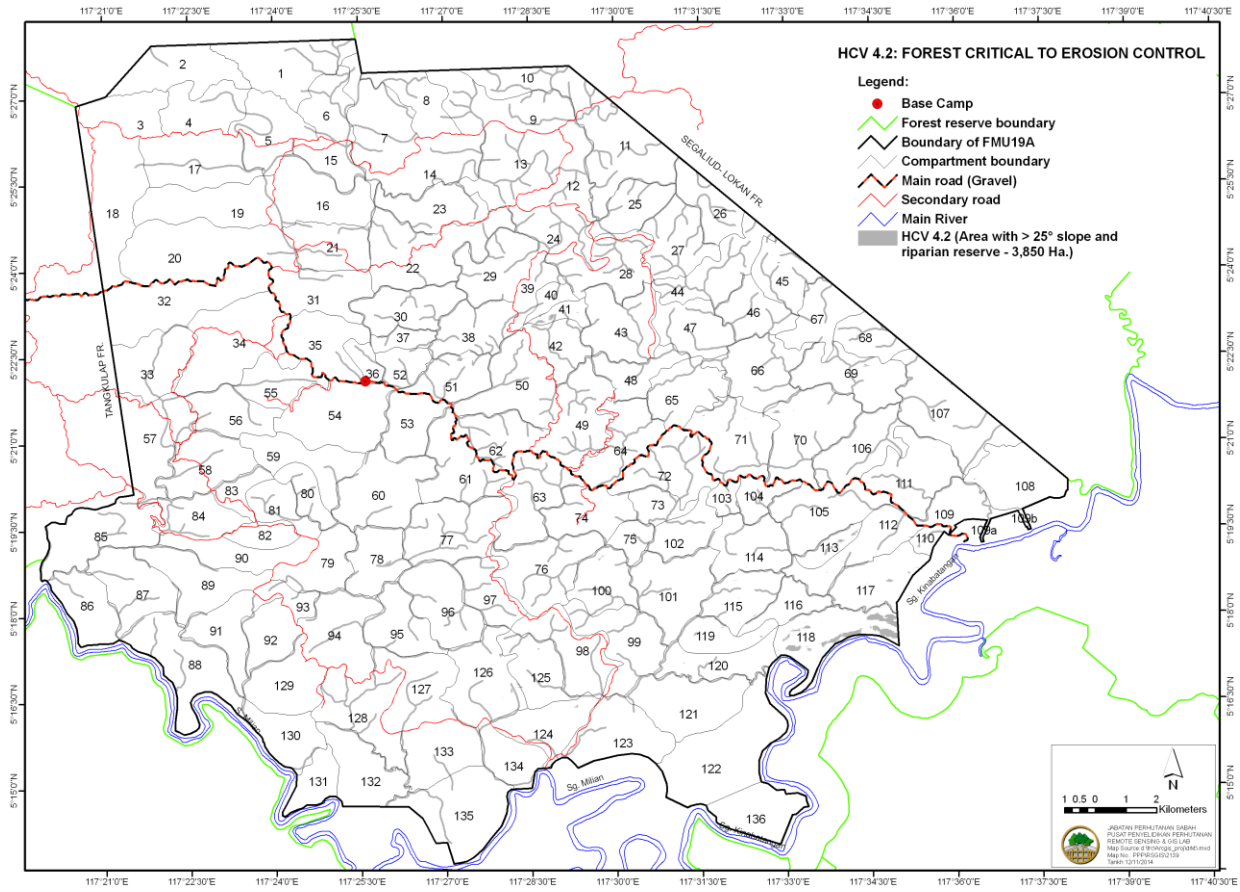


Figure 4.10: The location of HCV 4.2 as critical to erosion control in DFR

Site perspective

A portion of the southern and the northern parts of DFR, bordering local communities and oil palm estates, respectively, were impacted by wildfires during the significant *El Niño* drought events in 1982/83 and 1997. It was likely that the forest fires were anthropogenic by nature and had impacted the previous vegetation back then, which was the logged-over forest. These devastating outcomes had reduced logged over forest into low productivity condition or low structure secondary forest. It is known that secondary forest is more susceptible to fire in comparison to pristine forest (Woods, 1989). Therefore, the SFD has developed Forest Fire Management Plan that outlines certain measures to overcome forest fire in DFR (Solibun & Lagan, 1998). One outpost was established in Kg Balat for the prevention and control of forest fires during the drought season.

Rationale for HCV boundary delineation

Buffer strips of natural forest with 250 m inside DFR southern boundary that border local communities land and northern boundary bordering oil palm estates are categorised as HCV 4.3 (Figure 4.11).

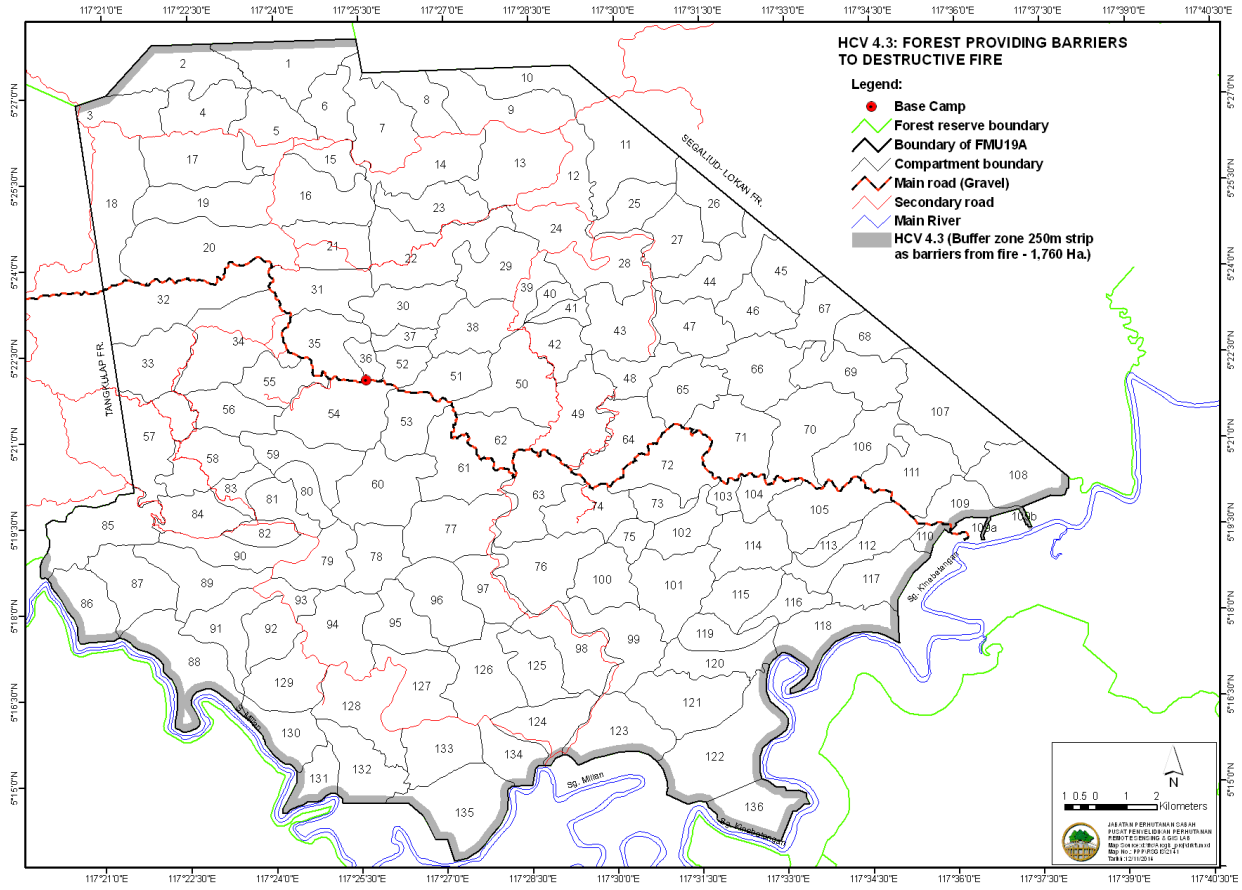


Figure 4.11: The locations of HCV 4.3 inside DFR boundary

4.1.10 HCV 5 - Forest Areas Fundamental to Meeting Basic Needs of Local Communities

Definition

Forest area is fundamental to meeting basic needs of local communities.

Site perspective

There are no villages located within the DFR. However, 4 villages are located just south of DFR boundary along Sg. Kinabatangan-Millian namely, Kg. Balat, Kg. Desa Permai, Kg. Tulang-Tulang and Kg. Kuamut (Table 4.5). Kg. Kuamut is made-up of 3 smaller villages that is, Kg. Tungkuyan, Kg. Kuamut Dalam and Kg. Kuamut Tengah. Kg. Desa Permai is combined with Kg. Pagar as the villagers from the latter have either move out to Bukit Garam or Kg. Kuamut. People of the Sungei ethnic group predominantly inhabit the villages. Nevertheless, other ethnic groups are present, mainly through mixed marriages. Kg Kuamut has the biggest population among the 4 villages and provided better infrastructure than its surrounding neighbours. River remains as the main mode of transportation for villages that do not have access roads such as Kg. Desa Permai and Kg. Tulang-Tulang.

Table 4.5: Location of villages and population adjacent to southern boundary of DFR

Villages	GPS Location	No. of Villagers	No. of Households
Kg. Balat	N05^{0}19'17.8", E117^{0}36'56.1"	320	47
Kg. Desa Permai (includes Kg.Pagar)	N05^{0}13'58.5", E117^{0}29'38.3"	48	10
Kg. Tulang-Tulang	N05^{0}15'04.1", E117^{0}29'43.0"	158	30
Kg. Kuamut	N05^{0}13'23.8", E117^{0}29'16.0"	353	62

The local communities do not rely on the DFR for firewood or wild meat for their dietary needs, as those are past practices. The villagers used to rely on the saltlicks by the boundary of DFR as a main source of salt procurement. Since salt has been made easily available now, they no longer return to the salt licks to obtain salt. The practice of harvesting salt from salt licks was done over 40 years ago. Meanwhile, the decrease of dependence of some of the villages on forest produce could be due to dwindling number of local population within the villages.

Of all the villages, Kg. Balat is the only one that still relies on DFR for Non Timber Forest Produce (NTFP) such as, Tongkat Ali (Compartment 117) and ferns. The villagers also collect Salinkawang leaves along the road from Kg. Balat to Deramakot (Km 24, 23, 17 and 15) that will be used to produce handicrafts to be sold at the Kinabatangan market. The collection was actively carried out in 2011 to 2012 but handicraft production was discontinued. Another NTFP that is regularly harvested by the villagers is rotan. There are three (3) rattan collection sites: Compartment 108, Sg. Karis-karis and another is on state land own by the villagers from Kg. Balat adjacent to DFR. From the onsite verification, it was noticed that the rattan owned by the villagers from Kg. Balat has grown into the boundary of DFR, taking up an area of 30 m^2. The rattans are sold to the general public upon request. As for medicinal plants, villagers from Kg. Desa Permai and Kg. Tulang-Tulang are harvesting along Sg. Rago-Rago and Sg. Karis-Karis in negligible numbers and for personal use only. According to the villagers, there have yet to be written records of the medicinal plants collected.

In terms of land ownership, much of the current land claims are for areas located within the state land. The villagers from the previous generations inherited the land area and agricultural plantations. Over time, more villagers are moving out to the town areas due to provision of better infrastructures and facilities such as schools, medical facilities and job opportunities. For instance, due to better infrastructure availability, there is still a high population in Kg. Kuamut whereas, in Kg Pagar and Kg. Desa Permai, a drastic drop of household numbers combined together from 100 into 10 in the last 10 years was observed. In Kg. Balat, it was noticed that some of the villagers are slightly well off than the others. Through the interviews, it was found out that aside from having 6 persons working for the SFD in DFR, some of the villagers are working as secondary school teachers (N=4), police force (N=2), security (N=3), factory workers (N=15), contractors in Kota Kinabalu (N=5) and estate workers (N=3).

At the time of the survey, 10% of the villagers are dependent on employment either with the government agencies or private sectors, while the rest depend on fishing and agricultural produce. Fishing activities are generally conducted along Sg. Deramakot, Sg. Arawon, Sg. Balat, Sg. Tabalion

Besar (closer to Segaliud FR) and fringes of Sg. Kinabatangan, Sg. Tabalion Kecil, Sg. Liningkong, Sg. Rago-Rago and Kuala Sg. Bangan (Figure 4.12). Generally, two types of fish known locally as ikan tapa and baung are caught and sold in the surrounding oilpalm estates and the township of Bukit Garam.

In view of the fact that there are few upper catchments for some of the above mentioned rivers, it is important that the rivers are protected from any form of pollution while, the water quality of the rivers is to be assessed periodically.

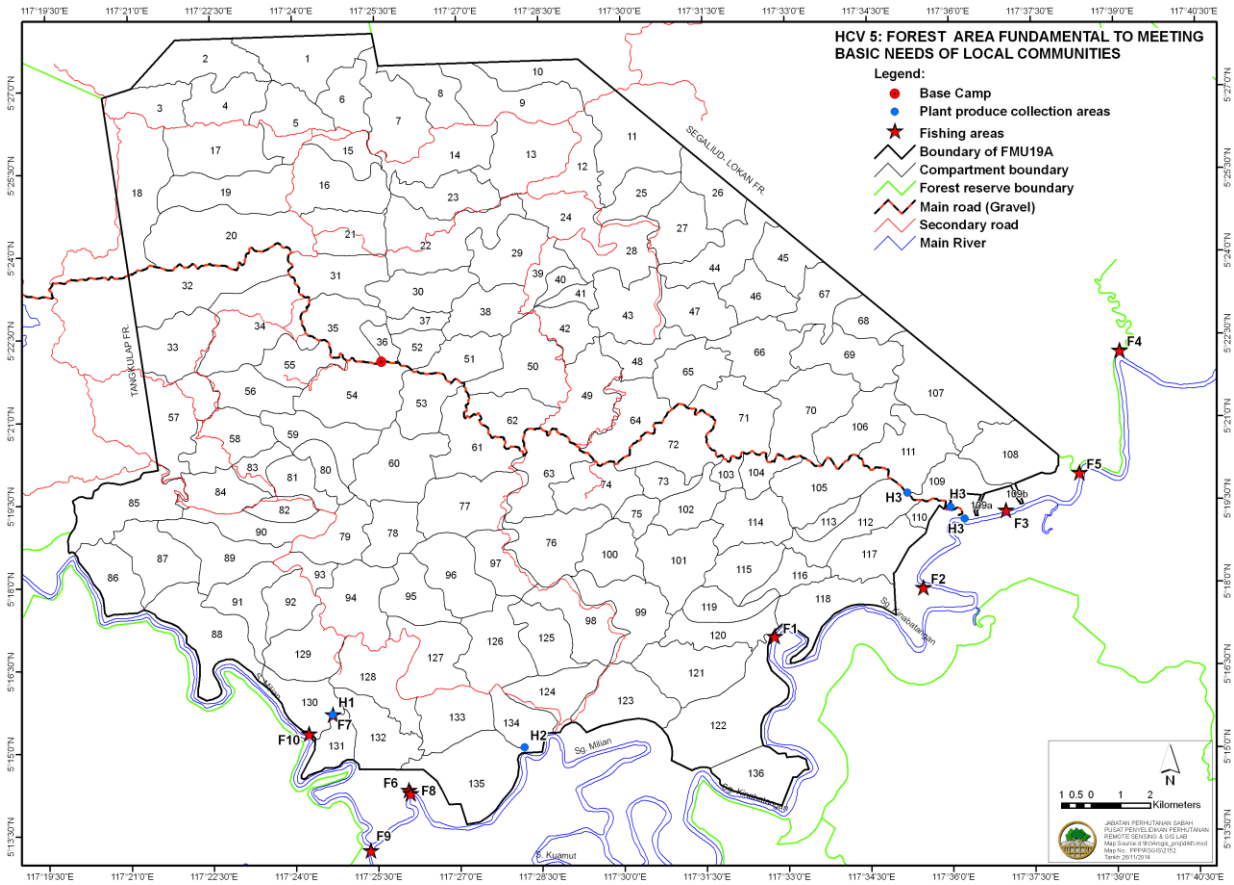


Figure 4.12: The location of HCV 5 attributes within Deramakot FR

Notes: Fishing Areas F1, Sg. Deramakot; F2, Sg. Arawon; F3, Sg. Balat; F4, Sg. Tabalion Besar; F5, Sg. Tabalion Kecil; F6, Sg. Liningkong; F7, Sg. Rago Rago; F8, Sg. Liningkong; F9, Sg. Bangan; F10, Sg. Rago Rago; and Plant produce collection areas H1, medicinal plant at Sg. Rago Rago; H2, rattan and medicinal plant at Sg. Karis Karis; H3, fern stem for handicraft materials.

It is a prerequisite for the local communities to participate in the DFR management. The DFR management team has formed a DFR Social Forestry Committee since 2000, which comprises of local communities residing adjacent to DFR, other governmental agencies and Non Governmental Organisations (NGOs) that look into encroachment issues and economic capabilities of the communities. Various infrastructure and facilities were set up to help to improve the communities' quality of life such as the formation of the Handicraft Committee in Kg. Balat, installation of new gravity pipeline and refurbishment of a kindergarten.

Rationale for HCV boundary delineation

All the attributes on community used area within DRF for collection of NTFP such as, rattan, traditional herbal medicine, handicraft raw materials and fishing grounds are still actively utilised and categorised as HCV 5 (Figure 4.12).

4.1.11 HCV 6 Forest Areas Critical to Local Communities' Traditional CUltural Identity

Definition

Forest area is critical to local communities' traditional cultural identity.

Site perspective

The active cultural or burial sites of the villages are found to be located on state land and none within DFR. Generally, all these graveyards and sacred sites are located along rivers and streams like Sg. Sogid, Sg. Bangan, Sg. Segitan, Sg. Malung, Sg. Naosakodan, Sg. Bungkuk and Sg. Langung. These sites are located far from the DFR boundary.

There are also non-active graveyards that are located adjacent to the DFR boundary. These burial grounds are no longer in use for burial purposes or visitation for over 50 years, such as, that at Morondom (located 10m away from the DFR boundary); Linunsut (300m away from DFR boundary); while others are more frequently visited graveyards either across the river or 1 km away from the boundary of DFR belonging to Kg Balat communities like in Lobong, Samang, JPT and an old site of Kg Deramakot. Kg Desa Permai has a few graveyards that are located 100m away from the DFR boundary, which is separated between the Christian and Chinese graveyards.

There are rows of graves located along the boundary of DFR such as, that near Sg. Deramakot, whereby three durian trees and ten rubber trees were planted beside the graveyards. The graveyards were established 30 years ago where some workers of a logging company who previously conducted logging operations in DFR died and were buried in the area. The surrounding vegetation has become overgrown ever since logging ceased.

Even though the villagers know that there are caves located within the DFR in Compartments 129 and 105, they are not of any religious or of cultural purposes to the villagers. Previously those caves were harvesting grounds for swiftlet nests but were abandoned about 10 years ago due to fire set by arsonists. Since then, no swiftlets have returned to the caves.

An old durian orchard belonging to Kg. Desa Permai communities are located in Compartment 88. The Deramakot management team has acknowledged their claim and had allowed entry and harvesting of the durian fruits. Recently, the people of Kg. Tulang-Tulang claimed their ancestral graveyards around the Sg. Baka area. The verification of the claim is still pending and under investigation through standard operating procedures by the Deramakot management team.

Rationale for HCV boundary delineation

Only the old durian orchard located in compartment 88 of DFR is categorised as HCV 6 (Figure 4.13).

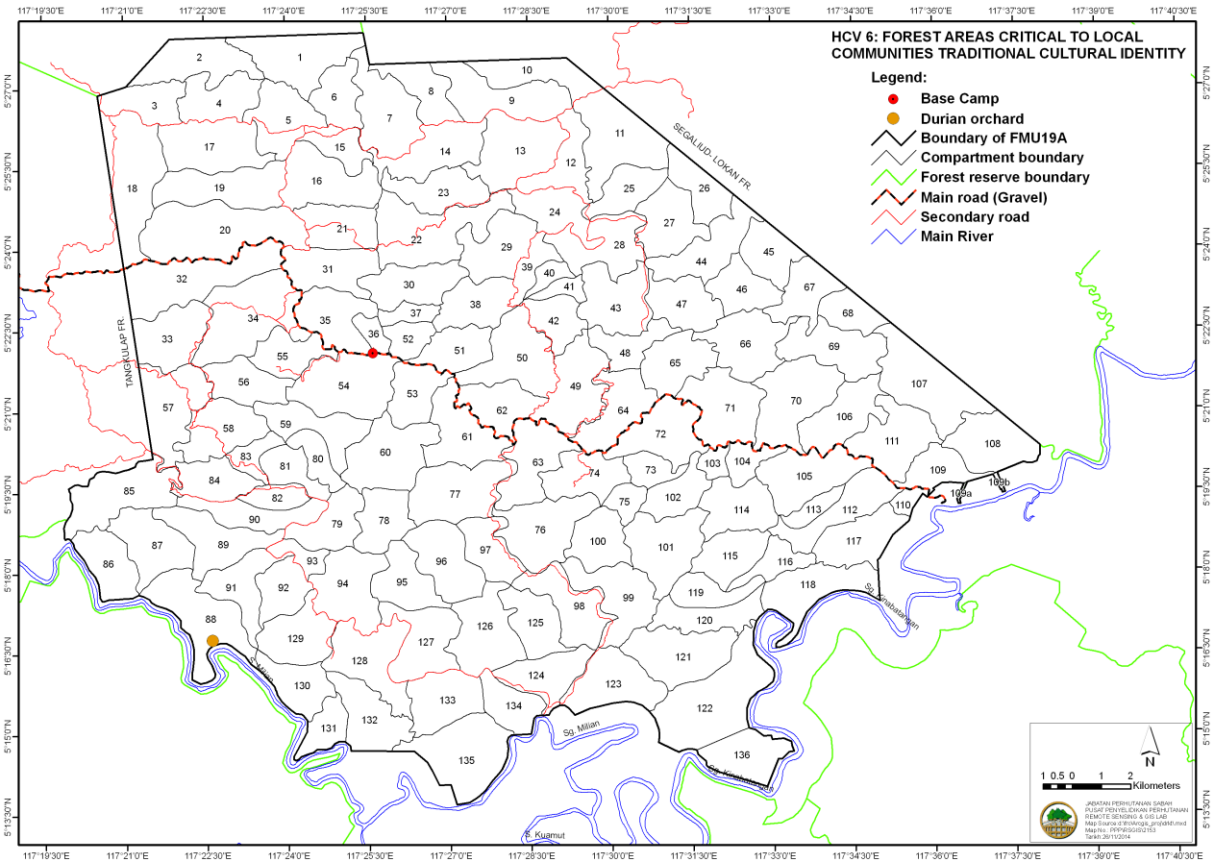


Figure 4.13: The location of HCV 6 attributes within DFR

4.2 Summary of HCV Areas in DFR

The designated HCVs areas for DFR are summarized in Table 4.6. Most of the designated HCVs overlap with each other.

Table 4.6: Forest function areas with designated HCVs in DFR

HCV Category	HCV area (Ha)	Conservation (Ha)	Production (Ha)	Community (Ha)	% Overlap With Other HCVs
HCV 1.2	54,033	3,730	50,297	6	100
HCV 1.3	55,507	3,733	51,756	18	100
HCV 1.4					
HCV 2	55,507			18	100
HCV 3 a	47,360			18	100
HCV 3 b	3,576	2	3,562	12	100
HCV 4.1	255		255		100
HCV 4.2	3,850	334	3,416		100
HCV 4.3	1,760	160	1,582	18	100
HCV 5					
HCV 6					

4.3 Management, Monitoring and Research

4.3.1 Management

The HCV management prescription emphasizes the maintenance and even enhancement consistent with the precautionary approach to minimize the risk of irreversible loss of the identified critical environmental and social values. The management regime consists of management restrictions and/or requirements during implementation of harvesting, silviculture, restoration, community engagement, nature recreation and biodiversity monitoring activities. The main options for management are prescribed in the following sub-chapters.

4.3.1.1 Protection of Critical Values

- All designated HCV areas are to be managed under natural forest management and no conversion of forests is permitted.

- Timber extraction is permitted in all designated HCV areas except HCV 1.1, 1.4, 4.1, 4.2, 5 and 6 areas.

- Demarcation of HCV boundaries on the ground and installing clear signages along existing road, foot trails and navigable rivers/streams indicating critical values, especially 50 m buffer zone of protected area (HCV 1.1), 50 m radius buffer zone of saltlick areas (HCV 1.4), 250 m strip firebreak of natural forest (HCV 4.3), and 30 m strip riparian reserve along both side of the rivers (HCV 4.2). The HCV boundaries should also be clearly indicated on the CHP map.

- Conduct periodic patrolling and surveillance in all designated HCV areas to curb illegal activities such as encroachment and poaching.

- Establish a long term biodiversity monitoring system for critical forest ecosystem, flora and fauna (HCV 1.2, 1.3 and 3).

- The trees listed in the prohibited list, significant fruit trees or nesting sites for wildlife, annotated IUCN red list species found in DFR should be clearly marked on the ground and on the CHP maps (HCV 1.2).

- Migratory pathway of wildlife on logging roads, along streams or wildlife trails in the forest should be marked on the map and kept to ensure wildlife are able to use it for movement within and between forest reserves (HCV 1.2, 1.3 & 2).

- The five (5) rivers located within the DFR, namely Sg. Rawog, Sg. Mannan, Sg. Tangkulap Kecil, Sg. Balat and Sg. Deramakot are to be assessed periodically as all these rivers are connected to the major Sg. Kinabatangan. This is done to ensure water quality is protected, considering that there are water catchment areas along the Kinabatangan River. This is to prevent a cascading effect as social studies conducted have indicated some of the villagers rely on fishing for livelihood; and they frequently fish down river from DFR around the state land areas.

- The forest area in Compartment 109 is the main water source that gravity feeds to Kg. Balat (HCV 4.1) and, therefore, to be protected from harvesting.

- The Forest Fire Management Plan implemented has to be updated periodically (HCV 4.3).

- DFR management team is to constantly conduct meetings with the village representatives to mitigate any potential issues pertaining to the management of HCV 5 and 6.

- DFR Management acknowledges communities usage of NTFP collected within DFR for their own consumption (HCV 5).

- Boundary of the durian orchard Compartment 88 and burial site located in DFR should be clearly marked on the ground and on the CHP maps (HCV 6).

4.3.1.2 Modifications or Constraints on Operations

- Any threats to the HCVs, especially related to HCV 1.2 & 1.3, that may be posed by operations or other activities in the forest will need to be identified and documented. Furthermore, the operation constraints in managing HCV areas and also addressing potential threats to the HCVs should also be examined.

- The decision to adopt any particular operation must be made based on the precautionary approach whereby sufficient data and analyses should be carried out to maintain critical values.

4.3.1.3 Enhancement Efficiency and Effectiveness

- Field staff are required to attend training courses on plants and wildlife to further enhance their botanical and wildlife knowledge on species that are currently listed in the threatened, endemic and forestry prohibited lists to ensure they do not harvest or damage them and also for monitoring purposes (HCV 1.2 & HCV 1.3).

- Update current biodiversity conservation status to the DFR team of the upgrade or downgrading of threat status locally and globally (HCV 1.2 & HCV 1.3).

4.3.1.4 Restoration

- Forest restoration of indigenous tree species as part of the remedial action to increase forest structural diversity and mitigate against any forest fire incidence spreading into DFR's core area (HCV 4.3).

4.3.2 Monitoring

- Periodic monitoring and control should be carried out to prevent encroachments in the buffer zone. Any signs of encroachment should be reported and dealt with immediate actions (All HCVs).

- Quarterly Progress reports in reporting of the progress of activities as prescribed in the approved Annual Work Plan (AWP), encompassing reporting of monitoring results of known HCV attributes.

- Periodical monitoring by conducting re-enumeration of the trees in the permanent sample plots to be conducted once every three years to get an indication of changes in tree structure and species assemblages (HCV 1.2, 1.3, 2 & 3).

- Periodical monitoring of endangered, endemic and migratory wildlife species will be practiced using DFR Wildlife Management System. Any changes in terms of population counts or migratory pathways observed by researchers or ground staff, must alert the DFR management team. Similarly, this monitoring prescription also applies to endangered and endemic plants (HCV 1.2, 1.3 & 2).
- Long term monitoring of DFR landscape using remote sensing technology and to be conducted once every three years to detect changes within the reserve and also vicinity areas. If threats are detected, precautionary approaches will be taken and potential mitigation measures will be incorporated in the management plan (HCV 2).

- Ensure that all fire prevention procedures (monitoring, fire drills, public awareness campaign and etc) to be practiced on a regular basis (at least once a year) especially during the drought season (HCV 4.3).

- The designated HCV 5 and 6 should be jointly monitored and maintained by the DFR management team and local communities.

4.3.3 Research and Development

- DFR Wildlife Management System to be enhanced through collaboration with wildlife experts such as HUTAN, the Leibniz Institute for Zoo and Wildlife Research (IZW, Germany) and other research institutes.

- Results obtained from research studies (if available) regarding harvesting effects on soil erosion should be taken into consideration by the DFR management team in the FMP.

CHAPTER 5: TIMBER RESOURCE BASE

5.0 FOREST INVENTORY

An important prerequisite for sound decision-making in forest management is accurate information on forest conditions, such as regeneration status, standing timber stock, factors inhibiting growth, prospects for harvesting, etc. Such information is usually derived from a field inventory.

The last comprehensive inventory of timber resources for DFR was conducted in October 2002 to July 2003, that is, during the preparation of the 2nd FMP. The inventory covered all production compartments. The inventory method used plots arranged continuously along a linear strip. All trees > 40 cm dbh were enumerated on 10 x 20 m plots along the strip, while potential crop trees (PCT) were selected within a nested 10 x 10 m plots. Each compartment was inventoried independently, resulting in stand table and stock tables for each individual compartment.

It was agreed by the FMP Team that the inventory results (see Table 5.1) as presented in the 2nd FMP, although having an explicit information requirement, can only be used as a guide for the 3rd FMP. The actual forest stocking for each compartment will be very much guided by the CHP results.

Table 5.1: Inventory results showing number of sound commercial trees/ha and their estimated volume in m^3/ha (given in parenthesis) for individual compartments in DFR

Cpt #	Block #	Gross Area (Ha)	DBH Class (Cm)			
			40 - 60	60 - 80	80 - 120	> 120
87		460	5.7	18.5 (77.0)	2.2 (16.9)	0.3 (4.3)
48		263	7.1	17.7 (75.3)	1.2 (9.1)	0.4 (4.8)
62		333	18.1	12.1 (50.9)	2.9 (20.5)	0.3 (4.6)
85		580	8.0	10.8 (44.2)	3.1 (20.9)	
49		501	7.8	12.1 (52.2)	2.2 (15.2)	0.1 (1.9)
57		557	6.8	9.6 (39.0)	2.6 (11.2)	0.3 (1.8)
42		255	10	9.1 (37.5)	3.9 (25.8)	0.1 (1.3)
56		339	12.2	10.9 (44.6)	1.8 (9.0)	
33		451	3.3	11.9 (48.2)	1.3 (7.2)	0.6 (7.3)
1		510	4.7	11.3 (47.5)	2.0 (14.3)	0.5 (7.1)
76 ***		554	6.1	6.5 (28.2)	4.8 (34.3)	0.2 (3.2)
28		474	3.6	11.6 (50.5)	1.5 (10.7)	0.1 (1.4)
63		500	8	11.0 (46.2)	1.0 (6.2)	0.1 (1.3)
60		582	13.3	9.7 (41.2)	2.0 (12.3)	
43		493	5.8	11.2 (46.4)	1.4 (9.4)	0.1 (1.0)
47 ***		375	5.3	10.4 (43.6)	0.7 (5.6)	
104		178	8.8	9.1 (39.2)	1.3 (9.2)	
25		298	6.1	9.2 (39.0)	1.9 (13.4)	
77		591	11.2	6.3 (26.8)	2.4 (17.6)	0.1 (1.4)
108	A	150	4.8	11.4 (47.3)	1.4 (10.9)	0.2 (2.2)
72		503	4.9	11.0 (47.8)	0.6 (3.6)	
4		399	5.7	4.4 (19.6)	4.6 (34.6)	1.5 (22.8)
7		480	6.6	10.1 (41.1)	1.3 (8.9)	

107		704	5.9	9.2 (38.2)	1.4 (8.9)	0.1 (0.7)
11		666	6.9	8.8 (37.3)	1.2 (8.5)	
71 ***		512	7.8	9.2 (38.9)	0.8 (5.9)	
27		425	5.6	9.4 (39.0)	0.1 (0.9)	
20		840	10.2	6.2 (26.0)	2.0 (15.3)	0.2
52		174	12.8	4.8 (19.7)	2.1 (15.4)	0.2
74		383	8.2	5.2 (23.1)	1.8 (12.8)	
86 ***		362	4	8.3 (35.2)	1.8 (13.3)	
117		449	9.6	4.4 (19.5)	2.1 (17.3)	0.5
114		413	10.6	7.1 (29.0)	0.1 (0.7)	
3		257	10.3	6.7 (28.3)	1.4 (9.1)	
64 ***		413	8.6	4.0 (17.0)	2.2 (15.7)	0.1
2	A	179	10.4	6.5 (27.8)	1.4 (9.0)	
105		550	9.4	5.4 (23.0)	0.6 (4.0)	
9		564	12.6	4.6	0.2	
60		582	13.3	2.7		
50 *		592	7.3	12	5.1	0.5
16		550	5.8	6.7	1.5	
54 *		661	9	5.4	1.4	0.1
97		319	9.4	5.1	0.1	
61 **		505	15	7.3	3.2	0.2
51 *		315	14.7	6.9	3.3	0.3
8		320	4.5	3	3.9	1
53 **		329	7.8	8.1	5.3	0.3
31 *		431	17.4	6.9	0.8	
29 *		440	6	14	1.4	0.6
24		338	2.9	8.4	1	
101		549	4.1	7	0.9	
26		305	6.1	7.6		
35 *		429	8.1	4.1	2	
96		480	9.4	3.9		
30 *		410	7	16	1.6	0.2
22 *		732	6.3	9.8	2.3	0.5
32 *		701	12.2	10.2	1.4	
83		151	8.1	6.5	0.2	
38 *		384	9	10.5	5.2	1.1
44		450	5	5.3	1.6	
12		296	4.9	5.4	1.3	0.3
91		370	10.1	3.4		
55 *		291	13.8	6.1	1.7	
34 *		770	7.4	7.5	4.3	0.2
112		416	6.3	3.9	1.4	
65		392	6.1	2.6	0.9	0.4
121		573	1.5	4.3	2.9	0.5
89		466	9.4	2.1		
95		359	3.9	5	1.4	
88		635	3.8	5.5	0.8	
19		545	6	4	0.3	
23		381	2.7	2.2	2.9	1.1
21		369	4	3.8	1.3	
78		341	9.1	4.1		
100		340	2.4	4.1	1.1	

59 *		400	8.5	3.4		
93		131	2.6	3.3	1.4	
2	B	218	17.3	1.9	3.8	
79		345	2.6	3.7	0.9	
67		328	7.5	2	1.6	
10		359	7.8	2.1		
66		497	2.8	5.1	0.5	
98		452	1.8	3.3	0.8	
70		627	3.4	3.3	1.3	
90		355	3.2	2.7	0.4	
73		171	5.5	2.6	1.9	
106		454	2.7	3.2	0.8	
15		191	3.1	2.5	0.8	
7		600	2.4	2.7	0.6	
84		315	2.4	3	1.1	
69 ***		490	2.8	4.1	0.1	
99 ***		509	2.8	2.3	0.7	
111		496	2.9	1.8	0.9	
58 ***		443	5.7	2.2	0.5	
13		608	6.8	2	0.4	
120		335	2.3	0.2		
125		358	7.8	2.3		
126		535	7.1	2	0.1	
68		234	1.5	1.8	0.2	
109		265	5.3	0.7	0.7	
124		375	5.6	0.7	0.7	
6		308	5.3	1.4	0.2	
46 ***		312	7	1.1	0.3	
133		453	1.4	1.1	0.3	
128		566	3.9	1.4		
127		473	4.5	1.3		
135		669	0.6	0.6	0.4	
5		466	6.4	0.4	0.3	
45		315	7.3	0.6	0.2	
122		870	1.5	0.7	0.1	
131		216	2.3	0.7		
132		438	1.3	0.2	0.2	
134		289	3.6		0.2	
130		333	1.8	0.2		
129		444	2	0.1		
123		499	2.8			
108	B	319	3.1			

Note: * indicates compartments harvested during the 1st FMP (1995–2004)

** indicates compartments where logging was not completed during the 1st FMP and was continued in the 2nd FMP

*** indicates compartments harvested during the 2nd FMP (2005 – 2014)

Cpt 136 - new compartment (additional area of DFR) excluded

Gross Area is based on the 2nd FMP

5.1 Annual Allowable Cut

The Annual Allowable Cut **(**AAC) calculation in DFR (see Table 5.2) is based on the standard approach, that is, a combination of area, volume and felling cycle. The formula is as follows:

$$AAC = \left[\frac{V \times A}{N} \right] \times E \times S$$

Where:

V = Nett Volume per ha of commercial species above the specified diameter set
A = Available net productive areas (estimate) that can be harvested
N = The length of the felling cycle, in years
E = Exploitation factor to provide for losses in volume due to stem breakage, decay and other harvesting losses
S = Safety factor to provide for damage to the residual stand during logging

Table 5.2: Calculation of annual allowable cut for the planning period 2015 –2024

Forest Land-Use	Harvestable Nett Area* (Ha) (A)	DBH Limit (cm)	Exploitation Factor (E)	Safety factor (S)	Net Vol. (m^3/ha) (V)	Year (N)	AAC (m^3)
NFM	41,200	60	0.60	0.8	40.0	40	**17,800**
Note: * Based on estimated areas that have been assumed to have a minimum economic cut of 40 m^3/ha with 90% efficiency in forest harvesting.							

Based on the formula above, the calculated AAC is approximately 17,800 m^3. However, based on the past planning record production (see Table 3.2), the average annual production was 11,423.22 m^3 of which, the estimated AAC of 17,600 m^3 as set in the 2nd FMP was not met due to various reasons as explained in Chapter 3.2.2 of this plan. **Therefore, the estimated AAC of 17,600 m^3 as set in the 2nd FMP will be maintained for the current planning period (3rd FMP)**. This means that the total harvest for the entire planning period should not exceed 176,000 m^3 while, an average annual harvest area is 935 ha, which is expected to sustain continuously throughout one cutting cycle (40 years). There will be no re-entry of all harvesting compartments, which have been logged for the first time since 1989 - see Chapter 6.2.3 for further details.

5.2 AAC Verification

In order to verify the sustained yield or AAC (refer Chapter 5.1), the measurement of harvest damage and growth of residual stands were analyzed based on the 30 permanent sample plots (refer Chapter 3.2.3) established by the Forest Research Centre Team from 2002 to 2007. These permanent sample plots (PSP) were established prior to logging. The physical conditions of the trees were also assessed prior to logging and after logging. A year after logging, the physical conditions and growth of the trees were again assessed and measured for a period of 4-5 years. The measurements were used within a growth simulation program (Myrlin – Methods of Yield

Regulation with Limited Information) based on measuring basal area growth developed by Alder, Baker & Wright (2002). The results of the data analysis can be referred to in **Appendix 11**.

Based on the PSPs inventory data analysis, the overall mean annual increments (MAI) of bole volume of residual trees over 10 cm dbh in DFR was estimated at 3.54m³/ha/yr. The volume of standing trees damaged by logging was estimated at 14.4m³/ha. This amount included the volume of injured trees, which died four or five years after logging. So based on these results, the estimated volume of timber generated in DFR as estimated in the 2nd FMP was approximately 151,463m³/yr (42,789 ha x 3.54m³/ha/yr) or 6,058,520 m³ for 40 years (one cutting cycle), while estimated volume of standing trees damaged by logging was 3,658m³ (14.4m³/yr x 254ha) or 1,320,160 m³[4] for the whole net productive area. As described in Chapter 3.2.2, timber harvesting in DFR (over the 2nd FMP period) has not gone over the allocated AAC of 176, 000m³ of logs. The actual total volume produced was 127,780.75 m³ **(**see Table 3.2**).** This being the case, the balance between these figures is **4,610,579 m³** (6,058,520 m³ – 1,320,160 m³- 127,780.75 m³), which indicates that the volume harvested and standing trees damaged by logging during the 2nd FMP period was not more than the volume increment in the forest within a harvest cycle of 40 years.

For this 3rd FMP, due to some adjustments on the land-uses, the net production area was reduced from 42,789 ha to 41,572 ha. However, the AAC of 17,600 m³/yr is maintained. This means that the volume harvested and standing trees damaged by logging will not be more than the volume increment in the forest, which is sustainable yield.

5.3 Yield Regulation

The main purpose of yield regulation is to determine an AAC or prescribed annual yield for the planning period. For this, growth projections of the inventory data were made to determine when a compartment is likely to yield an economic harvest. Although the management-planning period spans over a period of 10-years, growth projections were made for one cutting cycle, in order, to ensure that harvesting is sustainable over the long-term.

For the purpose of yield regulation, a 40-year cutting cycle is assumed for this management plan and a minimum economic cut of 40 m^3/ha is used to determine when a compartment is adequately stocked to justify a harvest. The main purpose of yield regulation is to determine an annual allowable cut (AAC) or prescribed annual yield for the planning period. As described in Chapter 3.2.3, an essential part of yield regulation is the permanent monitoring of the growing stock by repeated inventories or by the use of permanent plots, a practice known as *continuous forest inventory* (CFI). Based on the results of the CFI on the 4 compartments (#1, #9, #105, #114) that have been developed over a five year period in DFR (see Chapter 3.2.3), it was reported that there was a slight improvement in stocking for all four compartments. For instance, the CFI shows 18.3 commercial trees ha^{-1} > 60 *cm* dbh for Compartment #105 in 2013, an improvement from 14.7 trees ha^{-1} in 2008. Therefore, Compartment #105 is considered sufficiently stocked for an 'economic' harvest (assumed at ≥ 15 trees > 60 cm dbh).

[4] This amount of damage can be reduced with improved efficiency in logging practices.

CHAPTER 6: MANAGEMENT STRATEGIES, ACTIONS AND IMPLEMENTATION

The previous chapters of this plan described the basic information and resource base, which have direct relevance to the management of DFR. In this chapter, specific management prescriptions are directly related to achieve each of the management objectives listed in Chapter 1.3.

6.0 FOREST ZONING

DFR (FMU 19A) was re-zoned and divided into 136 compartments and two (2) sub-compartments - see Table 6.1 and Figure 6.1**.** The list of compartments and sub-compartments with their respective functions can be referred in **Appendix 8**. The relevant land-use or function has been ascribed to these compartments based on site degradation risks, actual growing stock conditions, potential for water catchment, and socio-economic requirements, particularly for those residing in Kg. Balat.

Table 6.1: Land use classification based on forest functions in DFR

Total Area (Ha)	Forest Function		
	Conservation (Ha)	Production (NFM) (Ha)	Community Forestry (Ha)
55,507	5,548.6	49,941.6	16.7
%	9.99	89.98	0.03

Note:

Conservation:	Slopes > 25º (e.g. protection of water resources)
	Slopes < 25º (e.g. HCVs)
Production:	Slopes ≤ 25º
Community Forestry:	Areas adjacent to human settlement
	Suitable for community based land-use

From Table 6.1, it is noted that approximately 5,548.6 ha in DFR are designated as conservation areas, which is an additional of 2,018.4 ha from the previous FMP. The designated conservation compartments comprise mostly hilly terrain with slopes above 25º and special forest types (e.g. Kapur paya species in Cpts. 17, 18, 19 and 20). On the other hand, a gross area of 49,941.6 ha is set aside for production, while the “two legs” [sub-compartments 109 (A) and (109 (B)] located in the south - east of DFR, have been designated for community needs. Some areas identified for HCVs are located in the conservation and production areas. These areas have not been specifically set- aside but they will be protected and monitored during the harvesting operations.

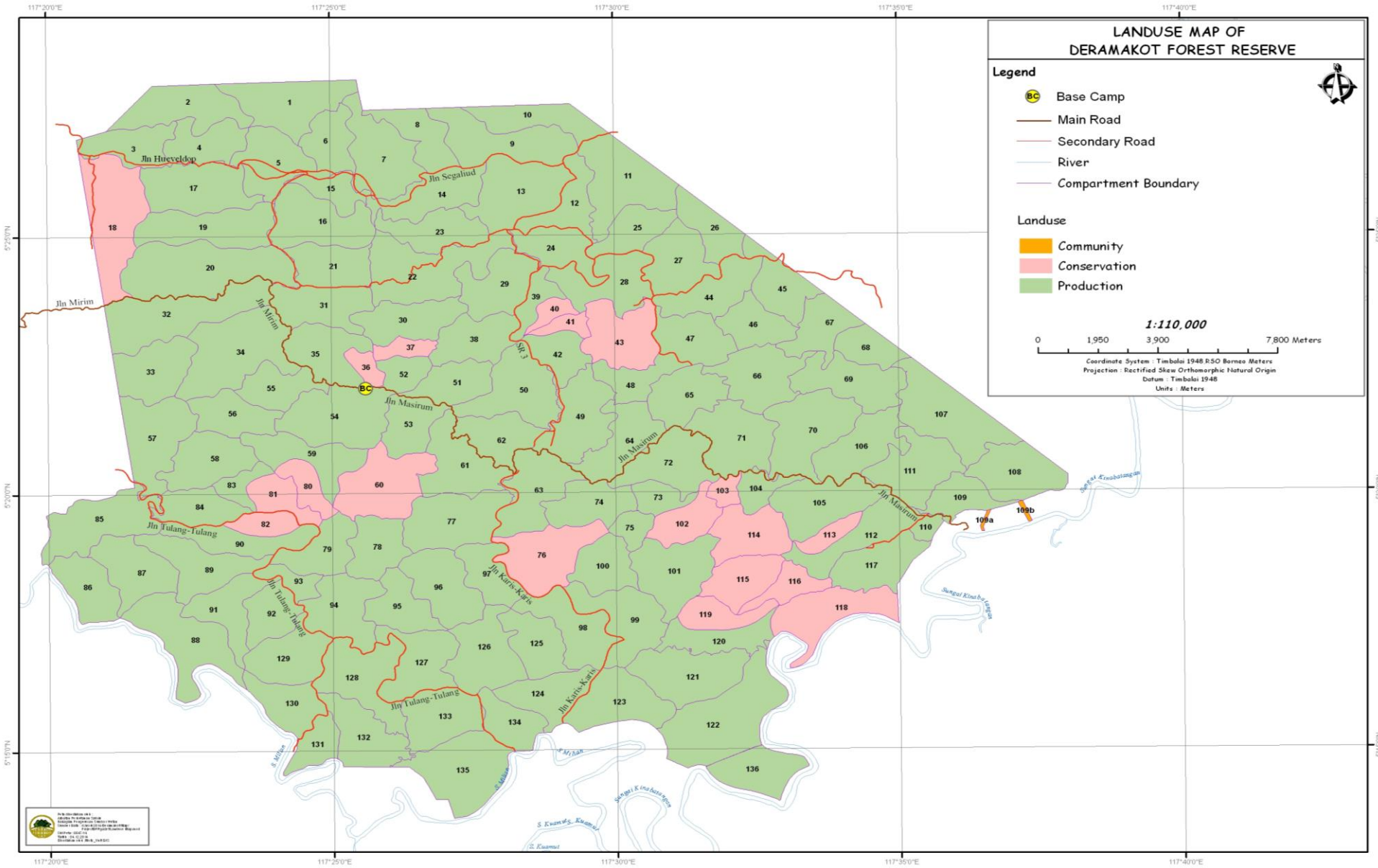


Figure 6.1: Forest Land-use in DFR

6.1 Conservation Areas

6.1.1 Management Objectives

There are 19 compartments with a gross area of 5,548.6 ha that have been designated for protection/conservation (see Table 6.1 and Figure 6.1). These areas are mostly steep areas with slopes >25° that form part of the catchment areas. In addition, there could be another approximately 7,449 ha within the production area that have been identified for conservation areas (see Table 6.2). These areas comprise of slopes >25°, riparian reserves and HCVs. Therefore, the total protection/conservation area in DFR is 12,998 ha or 23.4% of the total area of DFR.

The steep areas are protected from forestry operations particularly logging, to prevent site degradation and soil erosion. The protection of the riparian reserves, on the other hand, is important because they are used to maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed (see Chapter 2.3.1, Figure 2.9 and Table 2.3).

6.1.2 Focus of Management

Management will be confined to habitat and biodiversity conservation, boundary protection and the prevention and monitoring of any unwelcome activities such as, timber harvesting, illegal encroachment and hunting. Riparian reserves of 30 m wide on each side of the permanent watercourses will be protected in all compartments within the production areas. Sites should be revisited periodically as part of the overall monitoring program. Forest fire prevention, which may disturb the natural succession of the existing vegetation and wildlife populations, is also the management direction of the conservation areas. A Forest Fire Management Plan has been prepared and is currently being implemented in DFR.

6.2 Timber Production

6.2.1 Net Timber Production Area

Not all areas within the production area are for timber production. Therefore, the net timber production area is derived by deducting permanent infrastructure (such roads and buildings), riparian reserves, HCVs and community needs from the gross production area. This is shown in Table 6.2.

From Table 6.2, the gross area of about 49,941.6 ha comprising 117 compartments in DFR is designated for timber production by selective harvesting. Forest harvesting is confined to the net production area of approximately 41,571.9 ha. Prior to harvesting, the timber resources have been assessed of its stocking level through forest inventory (refer Chapter 5) and also based on the comprehensive harvest plan (CHP) report.

Table 6.2: Net timber production area in DFR

Area Designation	Area (Ha)
Gross Production Area	49,941
Less: Permanent Infrastructure	921
Riparian Reserves *	204.7
Slope > 25º	4,067.4
HCVs	3,176.7
Net Timber Production Area	**41,571.9**
Note: * Riparian Reserves – areas on 30m wide along both sides of the permanent watercourse measuring not less than 5m in width.	

6.2.2 Management Objective

The long-term objective of natural forest management (NFM) in general is to sustain production of high value timber for revenue generation based on the AAC limit while maintaining a high degree of species and structural diversity. Considering the importance of forest resource sustainability and timber quality, emphasis within this planning period is given to the improvement of growing stock based on the following regimes:

- **Natural regeneration** – these are the areas whereby the forest stockings are still high and the resources are to be managed sustainably.

- **Silviculture inputs** – the harvestable stock in these areas may be low, but existing growing stock is high. These areas require various levels of silvicultural measures before the forests could be restored of its sustainability.

- **Forest Restoration** – these are the areas where there is no or insufficient natural regeneration and needs to be restored by planting with fast growing indigenous tree species.

6.2.3 Forest Harvesting and Schedule

Forest harvesting will be based on an area-control yield regulation and the AAC of 17,600 m³. During the tenure of this 3rd FMP (2015–2024), logging will be carried out in compartments as listed in Table 6.3 and shown in Figure 6.2. There are twenty five (25) compartments covering an area of about 10,581 ha scheduled for harvesting in the planning period. All the 25 harvesting compartments are to be logged for the first time since 1989.

Table 6.3: Harvest schedule for the planning period 2015 – 2024

Year of Harvest	Cpt. No	Gross Area (Ha)	DBH Class (cm)					Inventory Year
			30-40	40-50	50-60	60-80	>80	
			# of Trees/Ha					
2015	72	482.6	18.9	13.7	8.3	8.9	3.3	2013
	73	166.7	17.8	13.5	10.5	8.4	2.8	Projected stocking
	77*	572.3						
Sub-Total		**1,221.6**						
2016	64	425.8	16.1	7.8	5.6	7.6	6.4	2011

	65	395.9	14.9	11.8	10.8	8.3	2.3	2012
	104	170.2	20.4	19.5	14	10	5	2013
Sub-Total		**991.9**						
2017	66	490.2	18	16.2	8.8	12.8	1.4	2013
	71	545.1	21.1	15.4	8.7	9	4.5	2013
Sub-Total		**1,035.3**						
2018	70	629.9	15.1	13.1	14	14.1	5.7	2014
	106	454.2	15.8	15.6	10.8	9.5	5.7	2014
Sub-Total		**1,084.0**						
2019	105	531.7	18.5	17.6	15.6	12.7	5.6	2013
	111	511.3	20.8	18.6	13.8	13.6	6.6	2014
Sub-Total		**1,043.0**						
2020	109	260.3	19.5	15.6	6.6	6.3	1.4	100 ha planted with Laran; Projected stocking
	112	418.6	16.6	14	13.1	7.4	0.6	Projected stocking
	117	394.6	13.8	12.7	7.8	6.5	0.7	Projected stocking
Sub-Total		**1,073.5**						
2021	97	314.5	20	15.4	10.6	7.8	3	2011
	100	333.5	15	13	9.4	7.1	0.7	Projected stocking
	125	358.0	14.5	10.2	5.3	7.9	3.1	2012
Sub-Total		**1,006.0**						
2022	98	451.2	20.4	15.8	9.4	8.7	1.2	Projected stocking
	99	519.4	22	15.6	9.1	9.5	5	2013
Sub-Total		**970.6**						
2023	123	501.1	11	9.3	8.5	6.3		Projected stocking
	124	375.4	13.6	11.6	9.9	7.4		Projected stocking
	134	289.1	14.8	10.7	9.6	8.6	0.4	Projected stocking
		1,165.7						
2024	126	525.6	17.7	17.5	8.5	9.3	4.4	Projected stocking
	127	463.9	16	15.4	8.6	8.9	2.7	Projected stocking
Sub-Total		**989.5**						
Grand Total		**10,581.1**						

Note:

1. * Harvesting not completed in 2014.
2. Inventory (see Chapter 6.2.4) is yet to be carried out in Compartments shaded in blue. Stocking was projected based on the inventory results carried out in 2002- 2003.

The gross area that has been identified to be harvested annually ranges in size, that is, from 970.6 ha to 1,221.6 ha, giving an estimated annual yield of between 15,000 and 20,000 m^3.

The number of trees/ha as indicated in the Table were determined based on the forest inventory results as indicated in column 9 of the Table. Where inventory is yet to be carried out, the stocking was determined based on projection. Nevertheless, the actual number of commercial trees (above 60 cm dbh) and volume that are to be harvested in each compartment can only be determined once a CHP is carried out. The CHP of which individual commercial trees are identified, marked for logging and quantified will provide reliable estimates of production for each compartment and this

will enable the DFR Team to be well informed that harvesting should not exceed the production (AAC).

Forest harvesting will be carried out based on reduced impact logging (RIL), which is eco-friendly. Logging is only allowed in areas with slopes 0° ≤ 25°. The machineries use in logging is a combination of crawler tractor and log-fisher (see Figure 6.3) - a modified excavator with long cable. The log-fisher in combination with the crawler tractor has given rise to a more environmental friendly and efficient ground based system. Nevertheless, the RIL guidelines shall be strictly followed during forest harvesting.

The SFD's trained contractor will carry out the logging operations, while the staff of the SFD will do the preparation of the Comprehensive Harvesting Plan (CHP).

6.2.4 Continuous Forest Inventory

As described in Chapter 3.2.3, an essential part of yield regulation is the permanent monitoring of the growing stock by repeated inventories or by the use of permanent plots - a practice known as *continuous forest inventory* (CFI). The main purpose is to check the actual growth and development of the growing stock, against the projected growing stock, in order to avoid any serious discords between what is planned and what can actually be achieved. If large discrepancies are found between actual and projected development of the growing stock, then adjustments will have to be made with regard to the harvest scheduling.

A permanent monitoring and control system will be established during this management planning period, and repeated inventories will be carried out as a routine management activity. A portion of the former inventory lines of each compartment will serve as permanent inventory lines, and will be repeatedly inventoried every 5 to 10 years. A major benefit of continuously updating inventory data in this manner is that it will no longer be necessary to carry out a major inventory for the entire DFR for every new planning period. Table 6.4 provides a schedule for the re-enumeration of selected compartments for the 10-year planning period.

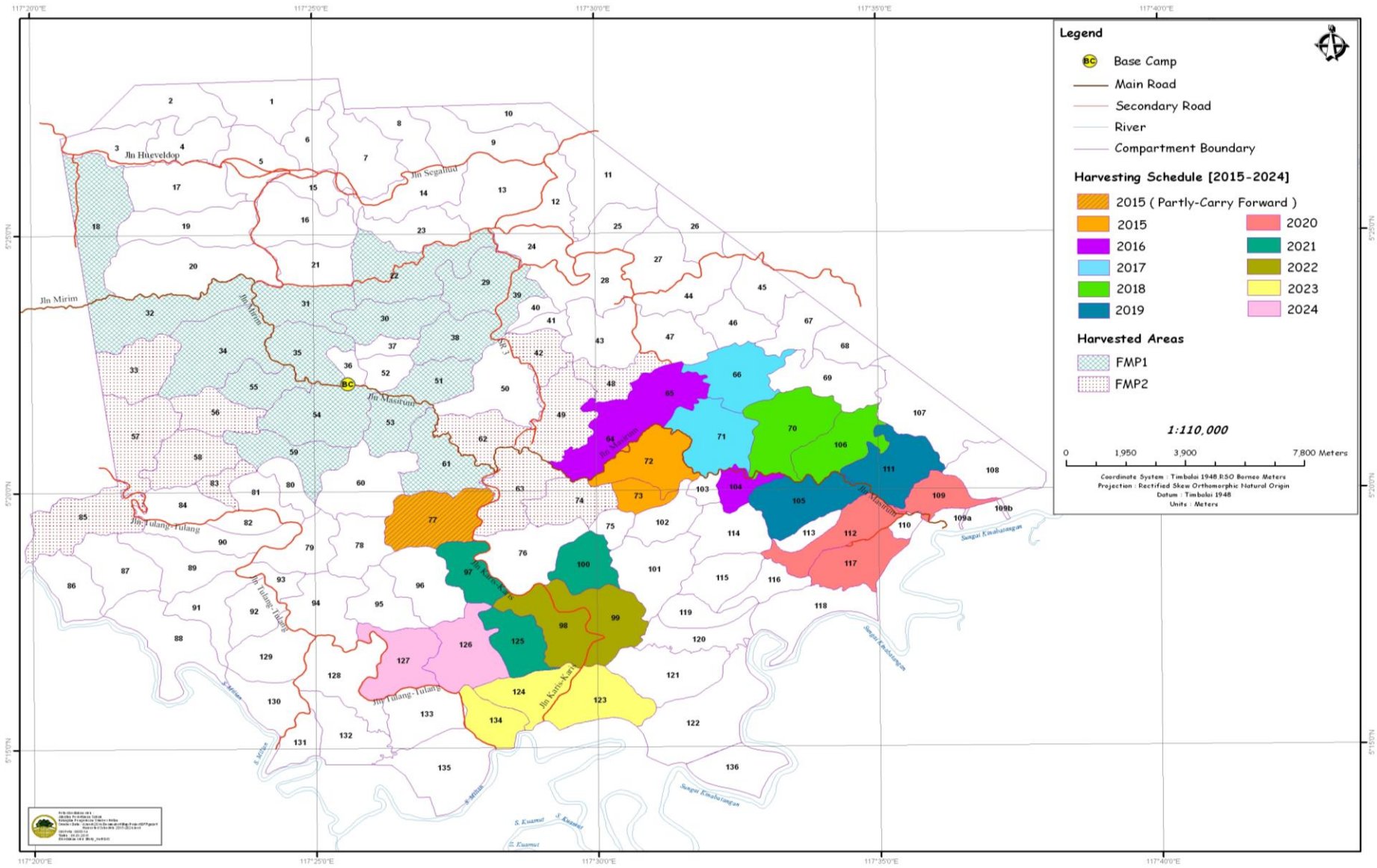


Figure 6.2: Harvested areas (1st FMP and 2nd FMP) and harvesting schedule for the planning period 2015-2024 (3rd FMP)

Figure 6.3: Log-fisher - ideal for RIL under all terrain conditions in DFR

Table 6.4: Schedule for the establishment and measurement of permanent inventory lines (2015-2024)

Year	Compartment #
2015	42, 48, 49
2016	16, 50, 63,76
2017	101,102, 103
2018	78, 95, 96
2019	60, 128, 133

Year	Compartment #
2020	45, 46, 67
2021	68, 69, 107
2022	11, 12, 13, 64
2023	84, 86, 87
2024	89, 90, 91

6.2.5 Timber Stand Improvement

Approximately 32,000 hectares in DFR have been treated since 1997. Timber stand improvement (TSI) in DFR is essential because:

- The overall stocking of desirable commercial tree species is relatively low;
- Infestation of climbing bamboos and woody vines is high. Therefore, the removal of the woody vines/stranglers and climbers that usually strangle the residual trees (PCTs) can reduce mortality of the residual trees;
- It reduces residual damage during harvesting; and
- It promotes growth and assists in natural vegetation by increasing canopy gaps in order to increase volume recovery in time for the next cutting cycle.

TSI in DFR is mainly blanket cutting of climbing bamboos and woody vines up to 5 cm dbh. During the 2nd FMP, TSI was carried out after logging (post-harvesting) mainly because of better accessibility for the crews. However, in this 3rd FMP, this operation will be carried out at least 6 – 12 months ahead of logging (pre-harvesting) because of the following:

i. It facilities extraction of timbers especially by log-fisher that can extract/pull timber logs up to 150 m through the stand, thus reducing damage to the residual trees; and

ii. The removal of the woody vines/climbers that twining or winding round the tree's trunk can facilitate directional felling thus, reduce damage to the residual trees.

In the current planning period, about 11,037 ha covering 26 compartments are scheduled for timber stand improvement (see Table 6.5 and Figure 6.4).

Table 6.5: List of compartments scheduled for TSI (2015-2024)

Year	Compartment No.	Gross Area (Ha)	Year	Compartment No.	Gross Area (Ha)
2015	70, 73 and 106	1,251	2020	98, 124 and 125	1,185
2016	66 and 105	1,022	2021	126 and 127	990
2017	109, 111 and 102	1,052	2022	132, 133 and 134	1,195
2018	97, 100 and 117	1,043	2023	128 and 135	1,265
2019	99 and 123	1,021	2024	129, 130 and 131	1,013
				Total	**11,037**

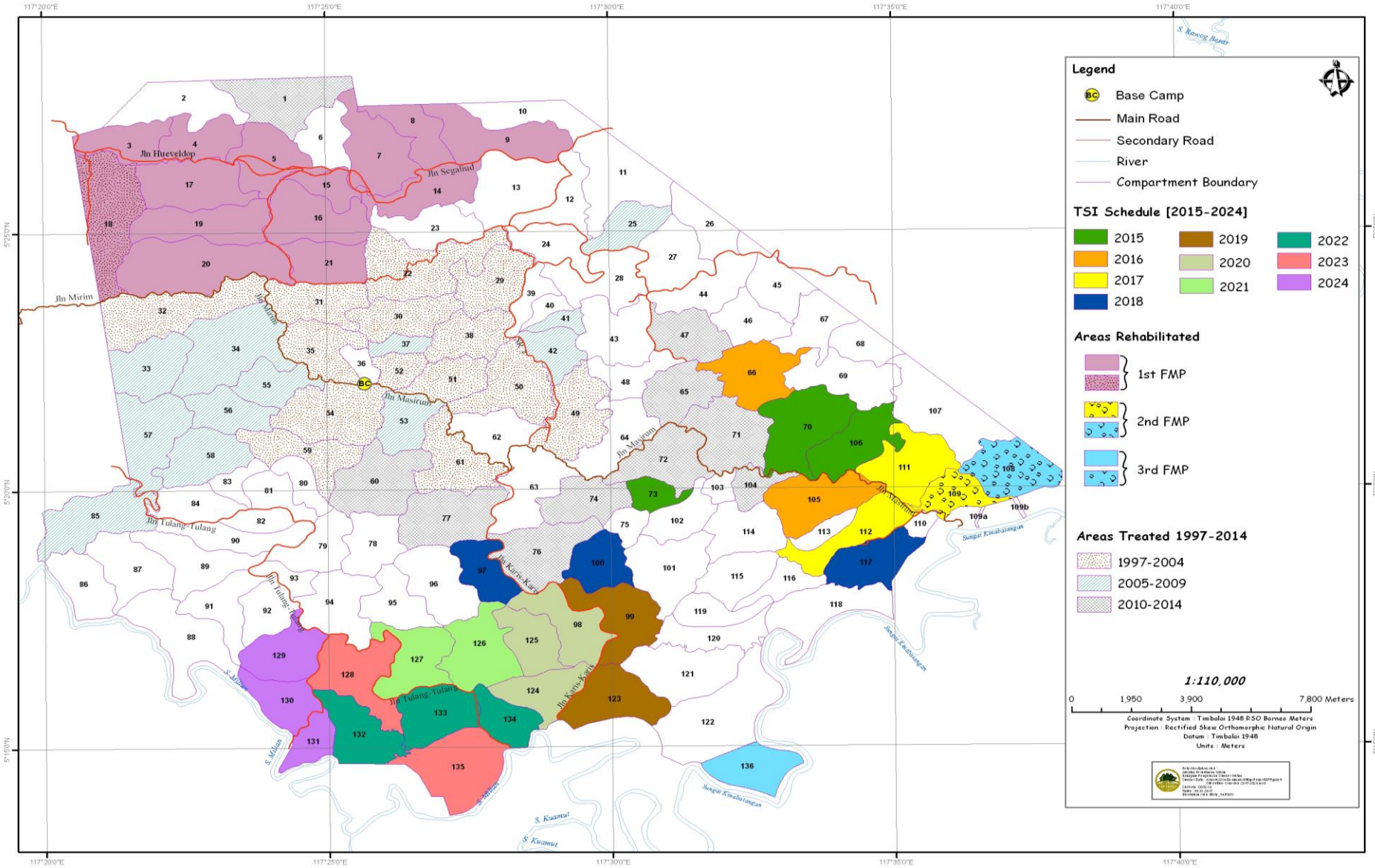


Figure 6.4: Compartments treated and rehabilitated (1997-2014) and to be treated and rehabilitated during the planning period (2015-2024)

6.2.6 Rehabilitation Planting

Rehabilitation planting with Laran (Anthocephalus cadamba) and Binuang (Octomeles sumatrana) was carried out over 200 ha within parts of compartments 108 (100 ha) and 109 (100 ha) where they were virtually devoid of forest cover as a result of forest fire. In this planning period, an additional 200 ha within Compartments 108 and 363.4 ha in Cpt 136 will be allocated for rehabilitation planting at a cost of about RM 4,000 per hectare. The species being considered for planting are Laran and Binuang, Planting is scheduled in the first half of the planning period as funding becomes available.

Due to the proximity of these compartments to village communities living along the Kinabatangan River, every effort will be made to engage these communities in the planting and maintenance operations (see Chapter 6.6).

6.3 Infrastructure Management

6.3.1 Roads

At present, the main and secondary roads within DFR (see Table 3.1) are well maintained. However, the major job during the planning period will be the upgrading of the Balat road (Jln. Masirum – MR 2) following the Jln Mirim's (MR 1) standard, that is, it will be upgraded and maintained at a density of 7m per hectare with a maximum gradient of 10%, a 20 m right of way and a surface width of 10 m. The thickness of gravel is 15 cm. This is in accordance with the RIL guidelines. The upgrading is expected to commence in 2016 subject to budget availability (see Table 6.6).

Meanwhile, sections of MR 1 and secondary roads (see Table 6.6) will require regular maintenance and/or repair. The secondary roads are maintained at a density of 14 m per hectare with a maximum gradient of 12%. They are 8 m wide with 6 m graveled to 10 cm thick. This is long-term priority management strategy to be put in place in DFR in order to have good access to the basecamp and compartments that are to be treated, harvested and rehabilitated. This is also to facilitate mobilization of silviculture crews and ground monitoring.

The construction of new roads will be kept to a minimum to reduce costs, as well as, to lower the environmental impact on DFR as a whole. Where necessary, old skid trails will be used. Feeder road maintenance will be carried out at least six months ahead of forest harvesting scheduled in the respective compartments. Given that road construction and maintenance are some of the major cost hurdles to overcome, skills will be developed "in-house" (within the SFD) to build and maintain roads, bridges, culverts and drainage. Considerable attention will also be focused on R & D on alternative cost-effective methods of permanent bridge construction.

Table 6.6: The program to improve, repair and maintain existing roads during the plan period (2015 – 2024)

Year	Road ID	Location	Distance (km)	Purpose
2015	MR 1		14	Maintenance
	MR 2		30	Repair, maintenance
	SR Karis-Karis		3.6	Maintenance
	FR	C77	1.7	Maintenance
2016	MR 1		14	Repair , maintenance
	MR 2		30	Upgrading
	SR Pikat		4	Maintenance
	FR			Repair
2017	MR 1		14	Maintenance
	MR 2		30	Upgrading
	SR			Repair, maintenance
	FR			Repair, maintenance
2018	MR 1		14	Maintenance
	MR 2		30	Upgrading and maintenance
	SR			Repair, maintenance
	FR			Repair, maintenance
2019	MR 1		14	Maintenance
	MR 2		30	Maintenance
	SR			Repair, maintenance
	FR			Repair, maintenance
2020	MR 1		14	Repair, maintenance
	MR 2		30	Repair, maintenance
	SR			Repair, maintenance
	FR			Repair, maintenance
2021	MR 1		14	Maintenance
	MR 2		30	Maintenance
	SR Karis-Karis		15	Repair, maintenance
	FR			Repair, maintenance
2022	MR 1		14	Maintenance
	MR 2		30	Maintenance
	SR Karis-Karis		15	Repair, maintenance
	FR			Repair, maintenance
2023	MR 1		14	Maintenance
	MR 2		30	Maintenance
	SR Karis-Karis		15	Repair, maintenance
	FR			Repair, maintenance
2024	MR 1		14	Maintenance
	MR 2		30	Maintenance
	SR			Repair, maintenance
	FR			Repair, maintenance

Note: MR – Main Road; SR – Secondary Road; FR – Feeder Road

6.3.2 Buildings and Basic Facilities

The current buildings and basic facilities in DFR (see Chapter 2.10.1) are adequate at least for the next five years. If there are plans to construct additional buildings or provide basic facilities in the future, they will be looked into during the mid-term review of the plan, which is scheduled in 2019.

6.4 Forest Protection

6.4.1 Control of Boundaries

An important requirement of long-term sustainable management is the security of DFR. DFR is porous in the west where it shares a common boundary with Tangkulap FR, and in the south along the Kinabatangan River. Two outposts are emplaced in Kg. Balat and Sg. Liningkong as a deterrent against illegal logging and also the prevention and control of forest fires during the drought season through a systematic mobilization of ground and river patrols as indicated in Table 6.7. The local communities are also encouraged to participate in the prevention and control of forest fire (see Chapter 6.6).

Table 6.7: Ground and river patrols for boundary control and surveillance

Guard Post	Area of Surveillance (Coverage)	
	Main River	Tributary
Kg. Balat	Sg. Kinabatangan	Tabalian Besar; Tabalian Kecil Deramakot; Balat; Arang; Arawon; and Goingob
Sg. Liningkong	Sg. Kinabatangan Sg. Milian	Ragu-Ragu Besar; Ragu-Ragu Kecil; Tiu-Tiu; Kara-Kara; Liningkong; Tangkulap Kecil; Kukon; Baka; Karis-Karis; and Kalang Badan
Base Camp	Northern/Eastern/Western Boundary of DFR	

Besides ground patrol, forest protection through aerial surveys will be carried out twice a year. These aerial surveys will be carried out together with Orang-utans census (see Chapter 6.7).

6.4.2 Forest Encroachment by Outsiders

At present, there are no human settlements within DFR except those along the Kinabatangan River, which are outside DFR. Regular dialogues with them via the Deramakot Community Forestry Committee will be continued. Employment opportunities for the local communities in forest operations particularly in forest restoration programs will be continued. By incorporating the local communities into the forestry activities, the SFD hopes to secure the cooperation from them in preventing encroachments into DFR for cultivation, settlement and prevention of fire.

A Daily Patrol Record for forest encroachment is currently emplaced in DFR. The SFD will continue to control all access points and patrol the area. The “Bona Fide” movements of the local communities will not be impeded in any way.

6.4.3 Forest Fire

A **Forest Fire Management Plan** (FFMP) has been developed separately for DFR. The plan is comprehensive and currently being implemented to effectively protect the forest from fires, which may occur due to agricultural land clearings adjacent to DFR. Amongst others, the plan specifies the following:

- Fire Management Map with a scale 1: 50,000;
- Fire Prevention;
- Fire Preparedness and Suppression;
- Fire Management Zones - access routes by vehicle, road and track network;
- Location of existing water points;
- Equipment resources statement and specifications for procurement of new equipment; and
- Fire Management Organization.

The existing FFMP, which was developed in November, 1998 is long overdue. Therefore, the SFD will revise the plan in 2015.

6.5 Soil Protection and Watershed Management

There are 19 compartments or 10% of DFR, which have been designated as protection/conservation areas. Logging will be prohibited in these compartments. Apart from these designated compartments, riparian reserves of 30 m wide on each side of the permanent watercourses within the production areas will be protected during harvesting operations.

All road constructions must follow the road specifications set in the Reduced Impact Logging (RIL) Guidelines, as well as, the Pre-Harvest Planning Standard of Procedures for tree harvest mapping and road alignment, which is available in DFR. All areas to be harvested will have a CHP. Areas having high site degradation risks will be demarcated on the CHP, as well as, on the ground. Other mitigation measures are already prescribed in Sub-chapter 4.3.1.1.

6.6 Community Development Programmes

The four villages, namely Kg. Balat, Kg. Kuamut, Kg. Desa Permai and Kg. Tulang-Tulang, all which are located along the major rivers, namely, Kinabatangan River, Kuamut River and Milian River, will continue to be involved in various community development programmes through the DFR Social Forestry Committee. The programmes are aimed at assisting the local communities to improve their socio-economic, environmental awareness, capacity building and to some extent, village development.

The DFR Social Forestry Committee was formed in 2000. The committee is chaired by the Deramakot Forestry Officer and assisted by the Kota Kinabatangan District Forestry Officer. For each village, three representatives are elected, comprising of two men and a woman. The men are represented by the Head of Village and the JKKK Chairman or any active young village leader of the respective village, while a village woman representative was selected amongst the active women leaders in the village. The committee meets 2-4 times a year depending on necessity.

With the formation of the DFR Social Forestry Committee, the implementation of the SFD's community development programmes (or social forestry programmes) in DFR was carried out smoothly. Through the committee, appropriate forest rules and regulations have been communicated, elaborated and monitored by the SFD. As a consequence, illegal logging, poaching and encroachments along the riparian reserves of Kinabatangan River, Kuamut River, Milian River and their tributaries within DFR were effectively prevented.

All community programmes that have been implemented or yet to be implemented during the 2nd FMP period will be continued in this 3rd FMP period. These community programmes are briefly described in the following sub-chapters.

6.6.1 Employment

During the period of the 2nd FMP, DFR has managed to employ many competent villagers for the various management and labor jobs in DFR. Attributable to the success of the activities, the efforts would be continued in the 3rd FMP period, for various types of works such as:-

- Daily Wage Works - Continue to employ the villagers in boundary clearing, tree planting, tree maintenance, landscape maintenance and other potential daily wage works.

- Annual Contract Works - Continue to employ dependable villagers as contract workers for the various works at the Base Camp such as, gardening, rest house assistants, cooks, office assistants, assistant mechanics, security guards, etc.

- Temporary or Permanent Employment - Depending on budget and availability of suitable candidates, the villagers can be taken to fill in any opening on temporary or permanent jobs in DFR.

6.6.2 Communal Forest Fire Prevention

In most cases, the DFR staff is stationed at the Base Camp, even during the drought season. Therefore, it is important to continue to involve the local communities in forest fire prevention such as the following:

- Community Forest Fire Prevention and Suppression Training - can be organized annually by the SFD in all villagers particularly in Kg. Kuamut and Kg. Tungkuyan. The villagers from these two villages frequently travel by boat along the Deramakot southern border and may render important support whenever forest fire occurs within or near DFR.

- DFR Auxiliary Forest Fire Team - could be set up in every village taking advantage of the villagers trained by the SFD. The auxiliary team can be trained to monitor and report on any fire incidence or even farm open-burning activities so that proper preparation can be done by the DFR staff. The team may also join the DFR staff in conducting regular border monitoring and patrols particularly at highly sensitive areas during the drought season.

- Public talks and awareness campaign - can be conducted continuously among the villages to raise the importance of preventing forest fire. Awareness or educational tools such as

pamphlets, banners and others can be distributed in schools, clinics and community halls in order to spread the knowledge and instill the awareness particularly to the younger generations, women and also community at large.

6.6.3 Controlling Forest Encroachments & Illegal Felling

The length of the southern border of DFR which runs along Kinabatangan and Milian Rivers is approximately 90km. Along the border, there are several rivers and streams originating from DFR. The wide border is open to encroachment threats such as, illegal collections of fruits, handicraft plants, gaharu (*Aquilaria* sp.), honey, wildings, seeds and medicinal plants; illegal fishing along the inland rivers, hunting, and riparian tree felling. It is impossible to secure or fully monitor the long stretch without the support or cooperation from the local communities. Therefore, specific cooperation and mitigating measures below need to be continued or initiated by DFR:-

- To allow and control the restricted collection of specific NTFPs for local communities own consumption with the approval (SOP) from the DFR Management.

- To generate public awareness programs and cooperation among the local communities to reduce the issue of illegal encroachments in DFR.

- To mark out on the ground and in the respective CHP maps any fruit orchards belonging to certain local communities that are officially approved by the SFD in order to prevent any potential conflicts during harvesting.

6.6.4 Human Resource Development

Depending on budget, the SFD through the SF Committee will continue to organize necessary training and courses to the local communities particularly in forestry operations. For some courses, the SFD might not have the expertise, but will invite experts from other organizations or NGOs. Training or courses related to forestry that had been requested by the local communities are:-

- Handicraft Course – favored by the women particularly from Kg Balat and Kg Kuamut.

- Nursery Management Course – beneficial for the local communities who may raise seedlings and sell them to the SFD for its forest restoration program.

- Tree Planting & Tending Course – this training will enhance the skills and knowledge of villagers who participate in the tree and maintenance program thus, reducing mortality rates.

6.6.5 Community Welfare Program

The SFD will continue to promote the goodwill of forestry to the local communities by extending various community welfare programs, or better known as CSR (Corporate Service Responsibility). Not limited to the three activities below, but depending on availability of funds, such programs can be extended or expanded to involve other villagers or villages.

- Gravity Water System – has been successful for Kg Balat. Other villagers had voiced their interest and done some initial planning. The SFD will continue this effort for the welfare of the local communities.

- Sporting Event – involving popular sports such as football, volleyball, sepak takraw or badminton. This activity is beneficial for both the DFR staff and local communities, not only in fostering friendship but also for health.

- Study Visits to the Base Camp – this is a popular event that the villagers often want. They wanted to know the various SFM operations implemented by the SFD or for some, simply want to know what is happening in the Base Camp - an ex-logging camp, which they called 'Batu 20' before.

6.6.6 Agro-Forestry Programs

Agro-forestry can be beneficial for the local communities due to its capability to generate desired products and income within a small land area. Some agro-forestry activities that can be implemented are:-

- Multi-purpose Tree & Shrub Lot – this activity can be carried-out at the two DFR 'legs' located at Compartment 109A and 109B. Needed trees and shrubs for medicinal, handicraft and even certain jungle fruit trees can be systematically planted by the community of Kg. Balat for their own use. Rattan may be incorporated at some parts of the land.

- Apiculture (bee-keeping) with trees – This activity can be promoted in Kg Desa Permai and Kg Tulang-Tulang due to the abundance of fruit trees, particularly durian.

6.7 Wildlife Protection and Monitoring

Chapter 4.3 of this plan has prescribed some wildlife protection measures to be taken by the DFR management team to protect wildlife in DFR. In addition to what had been prescribed, it is also important for the Deramakot DFO to remind all forest visitors through signboards by highlighting the banning of illegal hunting and poaching activities, the prohibition of fishing, fish poisoning and bombing, and its penalties or fines as prescribed under relevant laws. Beside visitors, close communication with oilpalm owners bordering the DFR would also be emphasized and to be conducted regularly.

Although the wildlife monitoring system is already in-placed and being implemented in DFR, it is still important that further steps are to be taken by the SFD to design a comprehensive Wildlife Monitoring Strategy for DFR that will be carried out by an established Wildlife Unit (WU). The only

responsibility of this WU will be to conduct wildlife surveys to ensure longer term monitoring. The activities of the WU should be supervised by a full-time wildlife biologist/ecologist with extensive experiences in the design and data analysis of wildlife surveys.

As not one survey method allows studying "all" wildlife species simultaneously, the following monitoring activities should be conducted in parallel by the WU. Note that the following list is not exhaustive, but gives only the minimum types of activities that need to be included in the Wildlife Monitoring Strategy; and additional monitoring activities may need to be implemented:

i. Bi-annual aerial surveys of Orang-utans. Training and implementation will be carried out together with HUTAN – an NGO.

ii. River Monitoring along the Kinabatangan (once per month along the entire river stretch south of DFR). Training and implementation will be carried out together with HUTAN.

iii. Night spotlight surveys along the three main roads from the Station (road to Balat, to Tangkulap, to the White house, every months 3 surveys on each road → 9 nights). Training and implementation will be carried out together with IZW (Institute for Zoo and Wildlife).

iv. Every 3-5 years a comprehensive camera-trapping study should be carried out throughout DFR. These surveys should be standardized throughout the years and should be conducted together with experienced scientists. Training and implementation will be carried out together with IZW.

In addition to these long-term studies resulting in a standardized monitoring system, the impacts of the logging activities should also be evaluated on a finer scale. Repeated surveys should be conducted 1 year before logging activities start in a compartment, during logging and 1 year and 5 years after the logging. Within the next 10 years, at least 5 compartments should be monitored with the following methods (at minimum):

i. Line transects surveys: Three 2 km line transects (1 day work for each transect) should be surveyed every six weeks in each compartment to look for orangutan nests. Each transect needs to be surveyed 5 times (Week 0, 6, 12, 18, 24. The WU should also record mammal sightings and hornbills along the transects. Training and implementation will be carried out together with HUTAN.

ii. Before the line transects, gibbon call counts should be conducted in the morning. Training and implementation will be carried out together with HUTAN.

iii. Five camera-traps should be set up in each surveyed compartment for the 24 weeks of the line transect activities. Training and implementation will be carried out together with IZW.

6.8 Research & Development (R&D)

As described in Chapter 3.2.9 of this plan, there were already many research programmes that have been carried out in DFR. However, many commitments in the SFD strategic directions outline the need for greater scientific knowledge and technological innovation in the forest sector. In particular, the SFD must increase its understanding of the impacts of human and natural disturbances on forest ecosystems, develop appropriate forest management tools and techniques, and enhance the forest sector's international competitiveness. Structuring research and development in this way, enables experts from diverse disciplines, to focus on complex problems and supports the development of more integrated techniques and approaches to resource management. This process brings in various disciplines in the natural and social sciences, as well as, traditional knowledge.

Therefore, research will continue to be carried out in DFR in this 3rd FMP, as it is part of an on-going process in further understanding the tropical rain forest ecosystem. Data from R&D will contribute towards sustainable forest management in DFR. Long-term monitoring studies on the population of Orang-utan, Tembadau, as well as, other selected species will be incorporated as part of research as these studies will contribute towards better understanding of the population ecology and well-being of the selected fauna in DFR. Other research, such as flora and fauna diversity, forest ecology, restoration, forest management, harvesting and forest economy will be carried out on an ad hoc basis by university lecturers, students and also researchers from relevant institutions, in collaboration with the Sabah Forestry Department.

Research on carbon sequestration in DFR will continue, at least for the next three years. This research is jointly undertaken by Professor Kanehiro Kitayama with his team from Kyoto University, Japan and the Sabah Forestry Department. The collaboration with Prof Kitayama will focus on a monitoring, reporting and validation (MRV) system, known as BOLEH (Biodiversity Observation for Land Ecosystem Health) which supports the implementation of REDD+ in Sabah that further promotes the role of forests as carbon sinks. The system will also evaluate quantitative biodiversity additionality.

6.9 Manpower Requirement at DFR

The DFO and the ADFO will be responsible for all operational works in DFR, including reporting (see CHAPTER 9). The required strength of staff and organization chart for DFR during the plan period are shown in Table 6.8 and Figure 6.5 respectively.

Utilizing contractors, particularly in silviculture, harvesting and other field operations, can achieve greater efficiency. Therefore, the SFD will continue to contract out to qualified contractors to carry out forest related activities in DFR. The contractors are required to give priority to recruit local communities living adjacent to DFR. These contractors would only be allowed to recruit workers elsewhere if the workers around DFR prove inadequate or are reluctant to participate.

Table 6.8: Manpower requirement in DFR 2015-2024

Forest Activities	Position	Year									
		1	2	3	4	5	6	7	8	9	10
Forest Management	DFO	1	1	1	1	1	1	1	1	1	1
	ADFO	1	1	1	1	1	1	1	1	1	1
Silviculture	Forest Ranger	1	1	1	1	1	1	1	1	1	1
	Forester	1	1	1	1	1	1	1	1	1	1
	General Worker	6	6	6	6	6	6	6	6	6	6
Harvesting • Planning – CHP • Monitoring • Grading	Forest Ranger	2	2	2	2	2	2	2	2	2	2
	Forester	5	5	5	5	5	5	5	5	5	5
	General Worker	22	22	22	22	22	22	22	22	22	22
Forest Restoration Nursery	Forest Ranger	1	1	1	1	1	1	1	1	1	1
	Forester	1	1	1	1	1	1	1	1	1	1
Forest Protection	Forester	2	2	2	2	2	2	2	2	2	2
	Boat men	2	2	2	2	2	2	2	2	2	2
	Gate Keeper	2	2	2	2	4	4	4	4	4	4
	General Worker	6	6	6	6	6	6	6	6	6	6
R&D											
Wildlife Protection & Monitoring	Forester Ranger	1	1	1	1	1	1	1	1	1	1
	Forester	2	2	2	2	2	2	2	2	2	2
Community Forestry	Forest Ranger	1	1	1	1	1	1	1	1	1	1
	Forester	1	1	1	1	1	1	1	1	1	1
	Committee Member										
	HQ										
Construction and Maintenance – Roads and Bridges	Forest Ranger	1	1	1	1	1	1	1	1	1	1
	Forester	1	1	1	1	1	1	1	1	1	1
	Operator	8	8	8	8	8	8	8	8	8	8
	General Worker	6	6	6	6	6	6	6	6	6	6
CFI or PSP	Same set up as in "Silviculture"										
Administration	Forest Clerk	1	1	1	1	1	1	1	1	1	1
	Typist/Filing	3	3	3	3	3	3	3	3	3	3
Store: Fuel/Lubricant/ Hardware/Genset/Water Pump	Store Keeper	2	2	2	2	2	2	2	2	2	2
Workshop	Mechanic	2	2	2	2	2	2	2	2	2	2
	General Worker	1	1	1	1	1	1	1	1	1	1
Landscaping Garbage Disposal Eco/Management Trail Maintenance	General Worker	4	4	4	4	4	4	4	4	4	4
TOTAL		87	87	87	87	87	87	87	87	87	87

Note: Year 1 starts in 2015

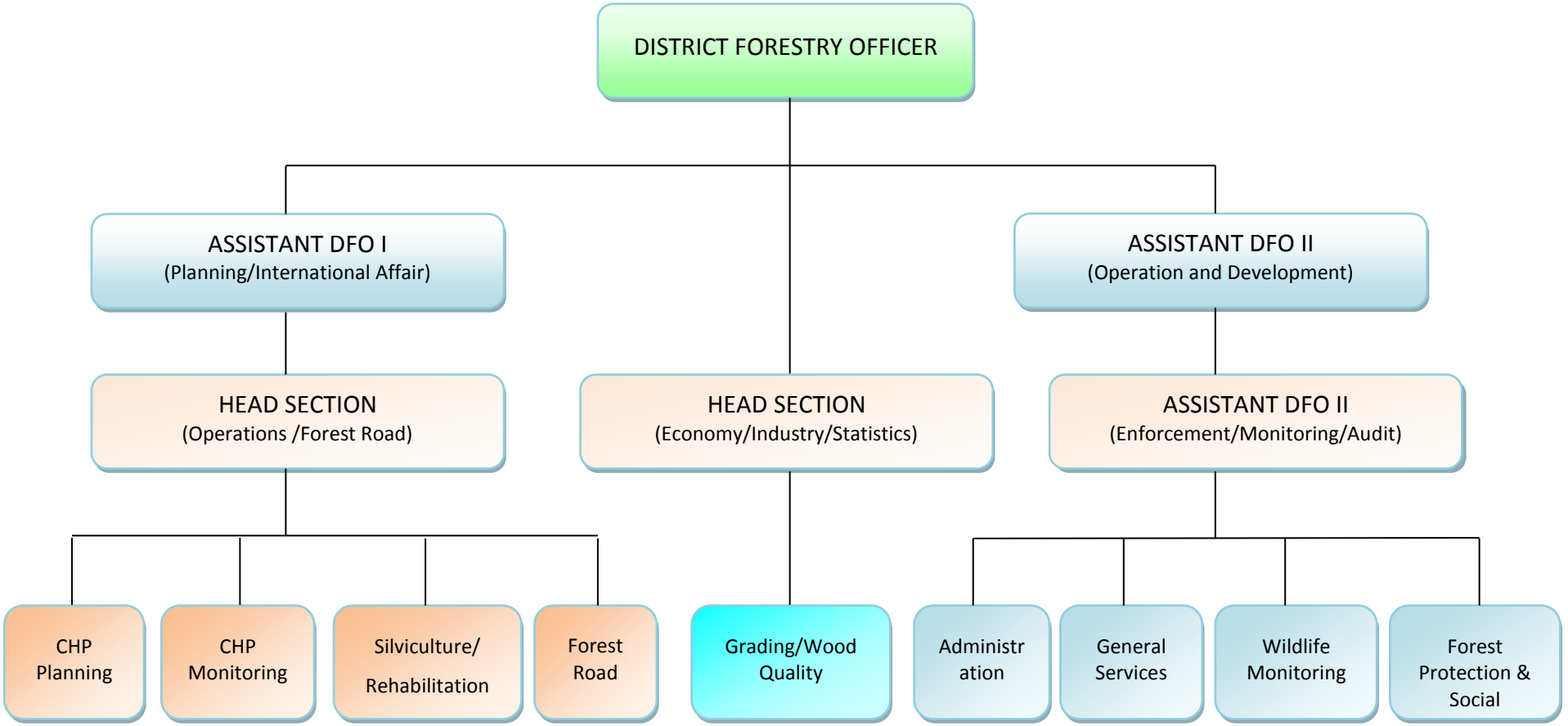


Figure 6.5: Organization Chart of Deramakot District Forestry Office (2015-2024)

CHAPTER 7: BUDGET AND FINANCIAL ANALYSIS

7.0 BUDGET ALLOCATION

A proper long term budgeting plan can help to alleviate an unnecessary escalation of expenses and not to erode potential revenue from a given resource annually. It also allows operational planning to be made in the least costly way and to ensure that the SFM operations in DFR remain viable. For this purpose, an estimated budget plan for the next 10 years has been prepared for DFR – see Figure 7.1 and Table 7.1 respectively. More than half of the total budget is being allocated for forest harvesting (33%) and on personnel salary and allowance (30%).

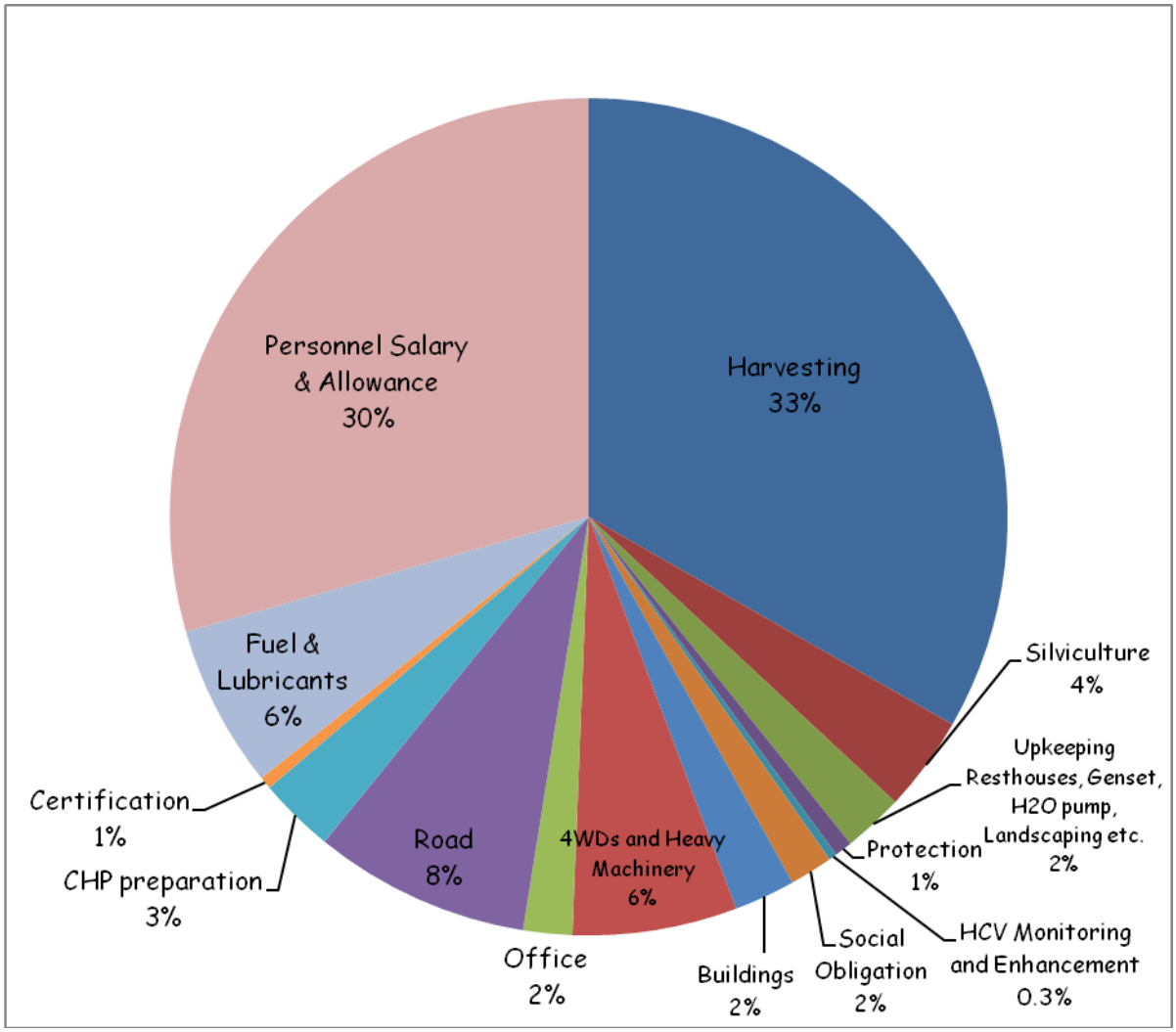


Figure 7.1: DFR budget breakdown for the planning period (2015-2024)

Table 7.1: DFR budget allocation for the planning period (2015-2024)

ACTIVITIES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Contract Fee Harvesting (RM180/m3)	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	3,168,000	31,680,000
Contract Fee Silviculture (RM350/ha)	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	350,000	3,500,000
Contract Fee - Upkeeping Resthouses, Genset, H20 pump, Landscaping, etc	175,864	184,657	193,890	203,583	213,762	224,450	235,673	247,457	259,830	272,822	2,211,988
Protection (Aerial Survey, Boats, Fuel, etc,)	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	650,000
HCV Monitoring & Enhancement (OU nest census, cameras, etc)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	300,000
Social Obligation (jobs, planting/maintenance contract, boundary brushing, etc)	200,000	200,000	200,000	200,000	130,000	130,000	130,000	130,000	130,000	130,000	1,580,000
Buildings (construction/maintenance)	900,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	2,250,000
Purchase/Maintenance/Repair of 4WDs & Heavy Machinery	450,000	450,000	450,000	450,000	450,000	2,000,000	450,000	450,000	450,000	450,000	6,050,000
Office (Papers, Films, Auction ads, Phone Bills, Copy Machine, Field Equipment, etc,)	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	1,800,000
Road Construction/Maintenance	392,200	359,960	1,736,190	492,950	359,960	1,849,030	347,870	327,720	1,679,770	408,320	7,953,970
CHP Preparation	280,000	280,000	280,000	280,000	280,000	280,000	280,000	280,000	280,000	280,000	2,800,000
Forest Certification (Annual Audits & Recertification)	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	45,000	450,000
Fuel & Lubricants	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	6,000,000
Personnel Salary & Allowance	2,243,291	2,361,396	2,481,852	2,604,828	2,730,177	2,858,670	2,989,987	3,090,071	3,264,663	3,405,096	28,030,031
Grand Total	**9,079,355**	**8,424,013**	**9,929,932**	**8,819,361**	**8,751,899**	**11,930,150**	**9,021,530**	**9,113,248**	**10,652,263**	**9,534,238**	**95,255,989**

7.1 Financial Analysis and SFM Viability in DFR

7.1.1 Assumptions

The main assumptions underlying the financial analysis are the log prices, timber production, costs and revenues as clarified below:

i. Log Prices

The data of DFR timber prices for the year 2010 to 2014 were used to estimate the timber prices. The average timber prices by species are presented in Table 7.2. The timber prices in this 3rd FMP are in real term with year 2014 as the base year.

Table 7.2: Timber prices

Species Group	Average Timber Price (RM/m³)
Kapur	713
Kembang	492
Keruing	605
Kembang Semangkuk	492
Mix Timber	374
Melapi	509
Nyatoh	492
Oba Suluk	575
Panggiran	492
Selangan Batu	910
Red Seraya	575
White Seraya	509
Yellow Seraya	509

ii. Timber Production, Revenues and Species Group

The projected timber production and revenues during the plan period (see Table 7.3) were calculated based on the forest resource based as stated in Table 6.3 and harvesting schedules as prescribed in Sub-Chapter 6.2.3. The proportion of production by species group is shown in Table 7.4.

Table 7.3: Projected Timber Production and Revenues

Year	Area (Ha)	Production (m³)	Revenues (RM)
2015	1221.6	20,319	14,314,574
2016	991.9	16,499	11,622,975
2017	1035.3	17,221	12,131,531
2018	1084.1	18,032	12,703,364
2019	1043	17,349	12,221,759
2020	1073.5	17,856	12,579,154
2021	1006	16,733	11,788,197
2022	970.6	16,144	11,373,384
2023	1165.6	19,388	13,658,372
2024	989.5	16,459	11,594,852
TOTAL	**10,581.1**	**176,000**	**123,988,161**

Table 7.4: Proportion of timber production by species groups (%)

Species Group	>60 cm dbh
Seraya (red, white, & yellow)	41%
Keruing	22%
Oba Suluk	8%
Kapur	11%
Selangan Batu	9%
Other timbers	10%
Seraya (red, white, & yellow)	41%

iii. Costs

All costs (management, establishment and operational costs) are shown in Table 7.5. They have been projected based on the costs incurred during the 2nd FMP.

Table 7.5: The management, establishment and operational costs

Activities	Total (RM)
Contract Fee Harvesting (RM180/m^3)	31,680,000
Contract Fee Silviculture (RM350/ha)	3,675,000
Contract Fee - Upkeeping Resthouses, Genset, H20 pump, Landscaping, etc	2,211,988
Protection (Aerial Survey, Boats etc,)	650,000
HCV Monitoring & Enhancement (OU nest census, cameras, etc)	300,000
Social Obligation (jobs, planting/maintenance contract, boundary brushing, etc)	1,050,000
Buildings (construction/maintenance)	2,250,000
Purchase/Maintenance/Repair of 4WDs & Heavy Machinery	6,050,000
Office (Papers, Films, Auction ads, Phone Bills, Copy Machine, Field Equipment, etc,)	1,800,000
Forest Certification (Annual Audits & Recertification)	630,000
Fuel & Lubricants	7,700,000
Personnel Salary & Allowance	28,030,031
Total	**86,027,019**

Meanwhile, a financial analysis using the discounted cash flow method has been used to assess the following elements:

i. **Profitability** - its ability to earn income and sustain growth in both the short and long-term;
ii. **Liquidity** - its ability to maintain positive cash flow, while satisfying immediate obligations; and
iii. **Stability** - the SFD's ability to remain in business in the long run, without having to sustain significant losses in the conduct of its SFM implementation in DFR.

The SFD would require approximately **RM 86** million to implement all SFM activities as prescribed in this 3rd FMP, while generated gross revenue is projected **at RM 124** million and net revenue at **RM 38** million at current price (see **Appendix 9 and Appendix 10**).

7.1.2 Results of Financial Analysis

The financial analysis project's worth is measured in terms of Net Present Value (NPV), and Benefit-Cost Ratio. Sensitivity analysis was also conducted to examine changes in returns with possible changes in the main variables.

Based on the estimated cost of operations and revenues in DFR, it shows that SFM in DFR is viable at 7% and 10% interest rate. The computed Net Present Value (NPV) for the implementation of SFM at 7 % interest rate is RM 27,434,393, while
at 10 % interest rate, the NPV is RM 24,283,648. The benefit-cost ratio is 1.46; both at 7% and 10% interest rate (see Table 7.6).

Table 7.6: Returns on investment

Items		
Total Revenue (RM)		123,988,160.86
Total Expenditure (RM)		86,027,018.94
Net Revenue (RM)		37,961,141.92
NPV at 7%	(RM)	RM 27,434,393.37
NPV at 10%	(RM)	RM 24,283,648.26
B/C Ratio at 7%		1.46
B/C Ratio at 10%		1.46

7.2 Sensitivity Analysis - Changes in Timber Price and Costs

A sensitivity analysis has been computed for a different range of scenarios, which can seriously affect the returns of investment namely on a possible decline in projected timber prices, and an increase in the cost at 7% interest rate. Timber price was decreased or increased by -20%, -15%, -10%, -5%, +5%, +10%, +15% and +20%, while cost was increased by 5%, 10%, 15% and 20%. The NPV obtained from these changes were then compared to the base case.

The results of the sensitivity analysis of timber prices and operational costs on the impact of changes in NPV are presented in Table 7.7 and Table 7.8 respectively. Based on the analysis, SFM is not viable if the timber price decreases by 20% at base costs, or if the cost increases by 20% and the log timber price decreases by 5%, both at 7% and 10% interest rates. This suggests that the SFD should avoid costs increment, while it strives to have higher log prices to avoid losses.

7.3 Break-Even Analysis

Break-even analysis was also carried out to determine the minimum volume of timber that must be exceeded in order for the DFR to make profit and to avoid losses in implementing SFM in accordance with the SFM principles. In this case, the following are required to be considered:

i. Fixed Costs

Fixed costs are the costs associated with the expenditures to implement SFM that have to be paid regardless of the volume of timber sales. All costs associated with revenues generated from other than timber products are considered as fixed costs (refer Table 7.9).

Table 7.7: Sensitivity analysis at 7% interest rate: NPV at various timber prices and costs (Thousand RM)

CHANGE IN COST	TIMBER PRICE FLUCTUATION								
	-20%	-15%	-10%	-5%	Base Case	5%	10%	15%	20%
20%	-13748	-10102	-6456	-2810	836	4482	8128	11774	15420
15%	-10744	-7098	-3452	194	3840	7486	11132	14778	18424
10%	-7741	-4095	-449	3197	6843	10489	14135	17781	21427
5%	-4737	-1091	2555	6201	9847	13493	17139	20785	24431
Base Case	-1734	1912	5558	9204	12850	16496	20142	23788	27434
-5%	1270	4916	8562	12208	15854	19500	23146	26792	30438
-10%	4273	7919	11565	15211	18857	22503	26149	29795	33441
-15%	7277	10923	14569	18215	21861	25507	29153	32799	36445
-20%	10280	13926	17572	21218	24864	28510	32156	35802	39448

Table 7.8: Sensitivity analysis at 10% interest rate: NPV at various timber prices and costs (Thousand RM)

CHANGE IN COST	TIMBER PRICE FLUCTUATION								
	-20%	-15%	-10%	-5%	Base Case	5%	10%	15%	20%
20%	-11776	-8579	-5382	-2186	1011	4207	7404	10600	13797
15%	-9154	-5957	-2761	436	3632	6829	10025	13222	16419
10%	-6532	-3336	-139	3058	6254	9451	12647	15844	19040
5%	-3910	-714	2483	5679	8876	12072	15269	18465	21662
Base Case	-1289	1908	5104	8301	11497	14694	17891	21087	24284
-5%	1333	4529	7726	10923	14119	17316	20512	23709	26905
-10%	3955	7151	10348	13544	16741	19937	23134	26330	29527
-15%	6576	9773	12969	16166	19362	22559	25756	28952	32149
-20%	9198	12394	15591	18788	21984	25181	28377	31574	34770

Table 7.9: Fixed costs

Cost Center	Cost (RM)
Contract Fee Silviculture (RM350/ha)	3,675,000
Contract Fee – Up-keeping Rest houses, Genset, H20 pump, Landscaping, etc	2,211,988
Protection (Aerial Survey, Boats etc,)	650,000
HCV Monitoring & Enhancement (OU nest census, cameras, etc)	300,000
Social Obligation (jobs, planting/maintenance contract, boundary brushing, etc)	1,050,000
Buildings (construction/maintenance)	2,250,000
Purchase/Maintenance/Repair of 4WDs & Heavy Machinery	6,050,000
Office (Papers, Films, Auction ads, Phone Bills, Copy Machine, Field Equipment, etc,)	1,800,000
Forest Certification (Annual Audits & Recertification)	630,000
Fuel & Lubricants	7,700,000
Personnel Salary & Allowance	28,030,031
Total	**54,347,019**

i. Variable Costs
Variable costs are directly related to timber production only, i.e. the harvesting contract fee, which is RM 180/m3.

ii. Profits
Profits are the revenue generated from timber sales only.

7.3.1 Break-Even Point

The result of the analysis shows that DFR must produce at least 103,621 m^3 (refer Figure 7.2) of timber which requires harvesting a total area of 6,229.7 ha during the planning period in order to avoid losses.

In comparison with the projected volume of timber production in the FMP (see Table 7.3), it is estimated that DFR exceeds the break-even point by about 72,379 m^3 of timber production within the implementation period. It demonstrates that the amount of timber to be harvested as prescribed in the FMP is adequate and economically feasible.

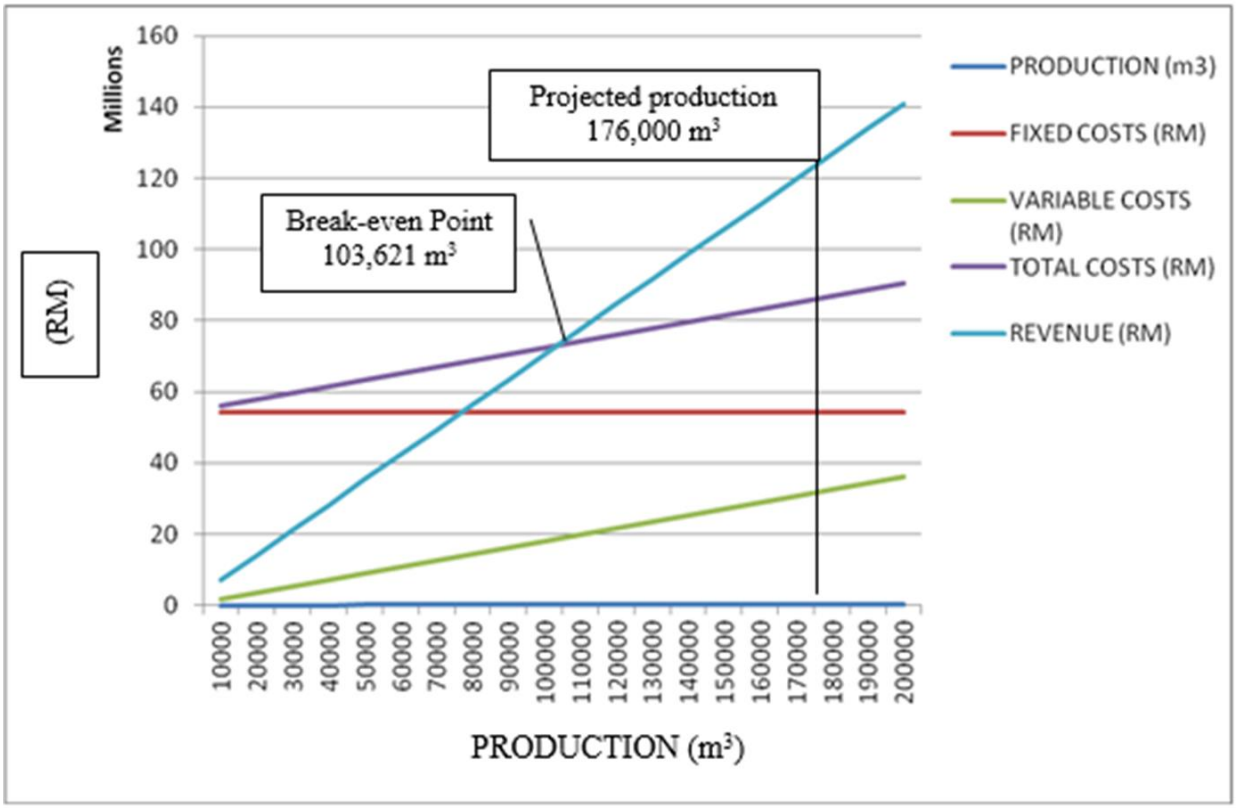


Figure 7.2: Break-even point of SFM in DFR

CHAPTER 8: EIA AND FOREST MANAGEMENT STANDARDS

8.0 ENVIRONMENTAL IMPACT ASSESSMENT

The forest management system in DFR is on an experimental basis and thus, exempted from having to obtain an EIA by the Environmental Protection Department (see letter in **Appendix 12**). Nevertheless, the forest management system in DFR fully meets the ecological and socio-economic requirements of an Environmental Impact assessment (EIA) mandated by the ***Conservation of Environment (Prescribed Activities) Order 1999***. The forest management system also has been assessed under the QUALIFOR Programme and was certified by FSC as fulfilling all the requirements of a well-managed forest. The SFD is committed to maintain this reputation and, therefore, will continue to safeguard and protect the ecology and all the forest functions and services for society by implementing the eco-friendly harvesting approach. All management operations including the development of forest restoration undertaken in DFR will fully meet the EIA requirements.

8.1 Management Standards

All forestry operations undertaken in DFR under this plan will adhere to pre-defined standards (**see Table 8.1**) and the following Standards of Procedures, which are available in DFR:

- Pre-Harvest Planning (Tree Harvest Mapping & Road Alignment);
- Post-Harvest (Closing Inspection); and
- Disposal of Solid/Non-Solid Waste.

8.2 Environmental Mitigation

In the process of implementing the various activities as prescribed in this plan, some mitigation measures will have to be undertaken in order to safe guard the environment in DFR. **Table 8.2** summarizes the environmental mitigation measures, which are relevant to the area.

Table 8.1: List of Management Standards

ACTIVITY	ASPECT	INDICATOR	STANDARD
Forest Zoning	1. Forest functions 2. Management restrictions	▪ 1:50,000 scale functional compartment map ▪ Topography ▪ Soil ▪ Stand ▪ Wildlife	✓ Land-use planning according to ecological restrictions and society needs ✓ Slope Classification based on terrestrial surveys ✓ Site Classification ✓ Refer to ASSESSMENT OF SILVICULTURAL STATUS ✓ According to Sabah Conservation Strategy
Assessment of Silviculture Status	1. Structural diversity 2. Species composition	▪ Diameter distribution ▪ Diversity index	✓ Number of immature and mature commercial trees and regeneration is adequate to maintain the forest's ability to self-regulation and economic productivity

			✓ Ratio of diversity indices of managed and virgin forests
Yield Regulation	1. Total timber stocks 2. Productivity 3. Timber yield	▪ Number of trees and volume/ha ▪ Volume increment ▪ (v/ha/a) ▪ AAC	✓ SE of standing commercial timber volume derived from terrestrial sampling inventories ✓ Representative for the actual forest condition of the FMU ✓ Based on scientifically proven growth parameters ✓ AAC < annual commercial volume increment ✓ AAC derived from harvesting/growth simulations
Forest Tending	1. Type 2. Intensity 3. Operational	▪ Tree size class subject to tending ▪ Number of trees removed ▪ Type of equipment or chemical used	✓ Liberation/release by removing immediate competitors only ✓ Minimum intervention ✓ Trees which cannot be removed mechanically are to be treated with bio-degradable chemicals
Timber Harvesting	1. Tree selection 2. Felling 3. Yarding	▪ Tree size ▪ Number ▪ Species ▪ Location ▪ Residual stand damage ▪ Area losses (%)	✓ Diameter limits ✓ Maximum gap size and reserve growing stock ✓ Species list ✓ Tree marking exclusively on production sites ✓ Ratio of crop tree number pre-felling/post felling ✓ Ratio of tree Number pre-yarding/post-yarding ✓ Ratio of pre-harvesting/post-harvesting net production
Forest Conversion	1. Pre-conversion site and stock condition 2. Conversion planning 3. Type	▪ % of area disturbed ▪ Soil fertility ▪ Slope gradient ▪ Diameter distribution ▪ See above ▪ Site preparation method ▪ Species selection	✓ Area assessment based on field survey ✓ Conversion only, if the forest cannot regenerate naturally in acceptable time frames ✓ -Operation according to “Planting Manual
Road	1. Loss of area	▪ Road density	✓ Opening-up according to technical

Construction	2. Road quality	▪ Gradient ▪ Width ▪ Drainage system ▪ Bridge conditions	requirements of harvesting system ✓ Construction and maintenance according to Guidelines for road constructions as specified in RIL Guidelines
Protection	1. Forest fires 2. Pest & Diseases 3. Wildlife habitat 4. Watershed management	▪ Forest losses (ha ▪ Forest losses (ha) ▪ 10 year work area (ha) ▪ Protection area ▪ Erosion rates (t/ha/a)	✓ Operations according to Fire Prevention Plan ✓ Early warning system ✓ Forest tending according to "Silviculture Guidelines" ✓ ¾ of total area unaffected by management at any one time ✓ According to Nature Conservation Framework Plan ✓ Covered by Standards for "Forest Zoning" and "Road Construction"

Table 8.2: Mitigation of environmental impact of forest management activities

Forest Function	Activity	Objective of Mitigation	Mitigation of Impact
PROTECTION	Watershed management	Reduction of accelerated run off and sedimentation	• Forest zoning by forest function • Delineation of protection compartments according to management restrictions • Natural forest management: no clear felling, long harvesting cycles, natural regenerations • RIL • No ground skidding across streams • Alignment of roads away from key habitats • Road constructions during dry season only • Stabilization of road banks
	Wildlife protection	Minimum disturbance of habitats of endangered mammals	• Forest zoning • NFM • Road construction and harvesting according to standards given above
PROTECTION	Fire control	Reduction of fire hazard	• Fire management plan for the forests based on prevention, detection and suppression

	Pest & disease control	Prevention of contamination of soils and vertebrate fauna with pesticides	• Application of bio-degradable pesticides • Restriction of use only during non-breeding season of insectivorous animals • Restriction of use to production compartments only Safe disposal of waste
TIMBER PRODUCTION	Forest tending (Silvicultural operation)	Minimum disturbance of natural succession and bio-diversity	• Elimination of immediate competitors of commercial trees only • No eradication of weeds; only liberation of commercial regeneration • Use of bio-degradable chemicals
	Rehabilitation (Enrichment planting)	Minimum disturbance of natural succession and bio-diversity	• Removal of vegetation only along planning lines • Planting of indigenous timbers/high value exotics
Conversion to industrial tree plantation	Reduction of accelerated soil erosion and safeguarding minimum water quality	▪ Forest zoning according to site suitability (slope, depth, nutrients) ▪ No blading of top soil ▪ Prescribed burning ▪ No terracing ▪ Apply slow-release fertilizer	
TIMBER PRODUCTION	Harvesting	Safeguarding of future forest stands at compartment level	• Felling of trees based on silvicultural tree marking • Directional felling • Employment of low impact yarding systems
	Road construction	Reduction of accelerated soil erosion	• Minimizing road density by employment of LDCCS • Road gradient, width, drainage system and stabilization of banks according to minimum standards
COMMUNITY NEEDS	Community forestry	Prevent encroachment	• Awareness campaigns • Provision of employment through long-term forest

			operations • Issuing of licences for timber felling and hunting according to management plan
RECREATION/ ECOTOURISM	Conversion of forest for recreation	Minimum disturbance of natural succession and bio-diversity	• Conserving the forest and forest resources for recreational; purposes with minimum disturbances to the natural habitat

CHAPTER 9: MONITORING, REPORTING AND REVIEW

9.0 RESPONSIBILITY FOR IMPLEMENTATION

The DFO is responsible for the implementation of the activities as set out in this 3rd FMP and are further described in the Annual Work Plan (AWP). The DFO is also responsible to submit progress reports to HQ once in three months.

9.1 Monitoring and Auditing

9.1.1 Internal

Regular internal monitoring and control and recording achievements of all forest operations will be carried out by the DFO to ensure compliance and early recognition of problems and to take meaningful corrective actions immediately. This is an essential practical aspect of forest management that forms the basis for compliance and transparent accountability of operational activities.

The SFD at HQ and FRC level will carry out periodic and continuous formal and systematic internal auditing to be carried out by experienced forestry officers who are specialized in one or more of the following fields of forestry:

> Forest Management
> Silviculture Management
> Social Forestry
> Economics
> Timber Harvesting
> Forest Restoration Management
> Forest Protection

9.1.2 External

DFR has been assessed as a well-managed forest under the FSC system, and is certified under the QUALIFOR Program. The Société Générale de Surveillance (SGS), which is an international inspection organization, is responsible to carry out surveillance, inspection and assessment of SFM implementation in DFR under the FSC system. This is done every six (6) months, so that continued compliance with the QUALIFOR Program requirements can be verified.

9.2 Reporting

9.2.1 Responsibility

The information generated by a monitoring system is to be reported regularly by the DFO to HQ. Reporting should be both written and oral, in order that specific problems, unexpected achievements or any other aspects of management can be discussed and any necessary action that is required can be taken quickly. The DFO shall summarize each periodic report and transmit the findings and recommendations to HQ.

9.2.2 Reporting Frequency

The frequency of reporting should be related to the nature of the topic being reported on. Reporting should be at least monthly, weekly or even daily, in case of timber harvesting where close control of output, location of logging and trees being cut should be followed closely. If

logistics and staff are not readily available, reports can be prepared quarterly or annually depending on the sensitivity of the key topics.

9.2.3 Reporting Formats

A convenient way of reporting achievements for many forest operations is to use a tabular format that summarizes operational prescriptions on one side of the form and operational achievements on the other. Photos and maps are to be included in the report.

9.3 Compartment Register Book

This serves as a permanent record of site and stand condition, management prescriptions and activities undertaken in each compartment. The Register Book for DFR is in placed and updated regularly.

9.4 FMP Review

The plan comes into operation on 1st January, 2015 and continues to operate until 31st December, 2024. During the period of the plan, new information from monitoring, auditing and adaptive management and other sources will result in progressive refinement of the proposed actions. This refinement will be done during the mid-term review, which will be in 2019. As many of the requirements of the plan are complex, the various parts of the overall plan will be implemented progressively according to available resources or level of funding.

REFERENCES

Akutsu K. & Chey V.K. (2006). Assessment of bioindicator values of flying insects at a higher taxonomic level for different logging schemes in the lowland tropical rain forests of Deramakot, Sabah, Malaysia. In Lee Y.F., Chung, A.Y.C. & Kitayama, K. (eds) Proceedings of the 2nd Workshop on Synergy between Carbon Management and Biodiversity Conservation in Tropical Rain Forests. Sabah Forestry Department & DIWPA. Pp. 71-78.

Ancrenaz. M, Ambu. L, Sunjoto. I, Ahmad. E, Manokaran. K, et al. (2010) Recent Surveys in the Forests of Ulu Segama Malua, Sabah, Malaysia, Show That Orang-utans (P. p. morio) Can Be Maintained in Slightly Logged Forests. PLoS ONE, 5(7): e11510. doi:10.1371/journal.pone.0011510.

Ancrenaz, M. (2013). Field manual: monitoring large terrestrial mammals in Sabah. Sabah Forestry Department. 153 pp.

Bili, R. (2013). Report on wildlife survey within Deramakot Forest Reserve, Sabah. Unpublished report for Sabah Forestry Department. 28 pp.

Bruhl, C. A. (2001). Leaf litter ant communities in tropical lowland rain forests in Sabah, Malaysia: effects of forest disturbance and fragmentation. Dissertation, University of Wurzburg, Germany.

Chey, V.K. (2002). Comparison of moth diversity between lightly and heavily logged sites in a tropical rain forest. *Malayan Nature Journal* 56(1): 23-41.

Chung, A.Y.C. (2004). Effect of Reduced Impact Logging (RIL) on soil beetles in Deramakot Forest Reserve. Paper presented at the Workshop on Synergy between Carbon Management & Biodiversity Conservation in Tropical Rain Forests. Sandakan, Sabah, 24 November, 2004.

Chung, A.Y.C. (2013). Insect diversity and forest management in the tropics. In Kitayama, K. (ed.) *Co-benefits of sustainable forestry – ecological studies of a certified Bornean rain forest*. Springer, Japan. Pp. 83-84.

Departmental Report (2014). Deramakot HCV Assessment Report. Sabah Forestry Department.

Eltz, T., Bruhl, C.A., Imiyabir, Z. & Lisenmair, K.E. (2003). Nesting and nest trees of stingless bees (Apidae: Meliponini) in lowland dipterocarp forests in Sabah, Malaysia, with implications for forest management. *Forest Ecology and Management* 172: 301-313.

Grace, J.R. (2003). State Forest Resource Management Plan. DCNR, Bureau of Forestry, Harrisburg, Pennsylvania.

Henry Solibun & Peter Lagan (1998). *Fire Management Plan Deramakot Forest Reserve*. Departmental Technical Report, Sabah Forestry Department.

Hasegawa, M., Chung, A.Y.C., Yoshida, T., Hattori, T., Sueyoshi, M., Ito, M.T. & Kita, S. (2013). Effects of reduced-impact logging on decomposers in the Deramakot Forest Reserve. In Kitayama, K. (ed.) *Co-benefits of sustainable forestry – ecological studies of a certified Bornean rain forest*. Springer, Japan. Pp. 63-88.

Imai N, Samejima H, Langner A, Ong RC, Kita S, et al. (2009). Co-Benefits of Sustainable Forest Management in Biodiversity Conservation and Carbon Sequestration. *PLoS ONE*, 4(12): e8267. doi:10.1371/journal.pone.0008267.

Inger, R.F. & Chin, P.K. (2002). *The fresh-water fishes of North Borneo*. Natural History Publications (Borneo), Kota Kinabalu, Sabah. 268 pp.

Mannan, S., Awang, Y., Radin, A., Abi, A., Suparlan, S. & Lagan, P. (2003). Conservation of Orang-utan and forest management units: the Deramakot model. Paper presented at the Workshop on Orang-utan Conservation in Sabah, Kota Kinabalu. 25-27 August, 2013.

Matsubayashi, H., Lagan, P., Majalap, N., Tangah, J., Abd. Sukor, J. & Kitayama, K. (2005). Diversity of mammalian species at natural licks in rain forest of Deramakot and their conservation. In Lee, Y.F., Chung, A.Y.C. & Kitayama, K. (eds.) Proceedings of the 2nd Workshop on Synergy between Carbon Management and Biodiversity Conservation in Tropical Rain Forests. Sabah Forestry Department & DWIPA. Pp. 61-70.

Matsubayashi. H., Lagan. P., Majalap. N., Tangah. J., Sukor. J.R.A., Kitayama. K. (2006). Importance of natural licks for the mammals in Bornean inland tropical rain forests. *Ecological Research*, doi 10.1007/s11284-006-0313-4.

Mohamed, A. Samejima, H. & Wilting, A. (2009). Records of five Bornean cat species from Deramakot Forest Reserve in Sabah, Malaysia. *CATnews* 51: 12-15.

Mohd. Fairus, J. (2000). The potential of fruit feeding nymphalid butterflies (Papilionoidea: Nymphalidae) as biological indicators for forest quality. M.Sc. Thesis, Universiti Malaysia Sabah, Kota Kinabalu.

Ong, R. C. 2006. Key Aspects of the Silvicultural Management of Logged Dipterocarp Forests in Sabah, Malaysia. PhD Thesis, University of Aberdeen. 161 p

Ong, R.C., Langner, A., Imai, N. & Kitayama, K. (2013). Management history of the study sites: The Deramakot and Tangkulap Forest Reserves. In Co-benefits of Sustainable Forestry: Ecological Studies of a Certified Bornean Rain Forest, Kitayama, K. (Ed), Springer. 161 p.

Phillipps, Q. & Phillipps, K. (2014). *Phillipps' field guide to the birds of Borneo*. John Beaufoy Publishing, UK. 372 pp.

Raymond. A., Laurentius. A, Senthilvel K. S. S. N. and Benoit G. (2011) Current Status of Asian Elephants in Borneo Gajah 35 (2011) 29-35

Samejima. H., Ong. R., Lagan. P., Kitayama., K. (2012). Camera-trapping rates of mammals and birds in a Bornean tropical rainforest under sustainable forest management. *Forest Ecology and Management*, 270, 248–256.

Samejima, H., Lagan, P. & Kitayama, K. (2013). Impacts of two different management practises on the abundance of mammals. In Kitayama, K. (ed.) *Co-benefits of sustainable forestry – ecological studies of a certified Bornean rain forest*. Springer, Japan. Pp. 89-112.

SFD (2011). *Forever green: a sustainable future with Deramakot*. Sabah Forestry Department. 138 pp.

SFD (2013). Annual report 2012. Sabah Forestry Department. 370 pp.

SFD (2014). Deramakot Forest Reserve. http://www.deramakot.sabah.gov.my/

Woods, P. (1989). Effect of logging, drought, and fire on structure and composition of tropical rain forest in Sabah, Malaysia. *Biotropica* 21: 290–298.

APPENDIX 1: LIST OF DFR STAKEHOLDERS

No	Stakeholders	Address
1	**NGOs**	
A	WWF Malaysia	6th Floor, CPS Tower, Centre Point Complex No. 1, Jalan Centre Point 88800 Kota Kinabalu Sabah, Malaysia Tel No.:088 262420/Fax No.:088 242531 E-mail: contactus@wwf.org.my
B	HUTAN	D61, Taman Kinanty, Lorong Angsa 12, 88300 Kota Kinabalu, Sabah, Malaysia. ngo_hutan@yahoo.com Fax No.: +6088-244502
C	PACOS TRUST	P.O.BOX 511, 89507 Penampang, Sabah. Tel No. 088 712518/Fak No.: 088-718669 admin@pacostrust.org
2	**AUTHORITIES**	
A	Kinabatangan Police	Polis Diraja Malaysia, Ibu Pejabat Polis Daerah, 90200 Kinabatangan. Email: Kinabatangan@rmp.gov.my Tel No.:089-561890/Fax No.:089561559
B	Kinabatangan District Office	Pejabat Daerah, Bangunan Urus Setia, W.D.T. No. 1, 90200 Kinabatangan. Emel: kbn.kplb@sabah.gov.my Tel no.: 089-561811/812,/Fax No.: 089-561009.
C	Kinabatangan District Council	W.D.T. No. 8, 90200 Kinabatangan, Tel. No.: 089-560101/Fax No.: 089-560100
D	Wildlife Department (Kinabatangan District)	Pegawai Penguasa Pejabat Hidupan Liar Kinabatangan, D/a W.D.T No. 169, 90200 Kinabatangan. Fax No.: 089-561523
E	Sabah Health Department (Kinabatangan & Tongod Districts)	Hospital Kinabatangan, W.D.T. 200, 90200 Kinabatangan, Email: Pengarah.kinabatangan@sbh.moh.gov.my Tel No.: 089-561858/Fax No.:089-561854
F	Environment and Protection Department	Pejabat Wilayah Sandakan, Tingkat 4, Bangunan Urus Setia Negeri, Batu 7, Jalan Labuk, Beg Berkunci No.9, 90500 Sandakan.

		Emel: Jomius.joseph@sabah.gov.my Tel No.: 089-673530/Fax No.: 089-672806
3	**WORKERS' UNIONS**	
A	Persatuan Sukan, Rekreasi Dan Kebajikan Jabatan Perhutanan Sabah (FORESS)	Pengerusi FORESS Ibu Pejabat Jabatan Perhutanan Sabah, Beg Berkunci 68, 90009 Sandakan
B	Majlis Bersama Jabatan (MBJ)	Pengarah Perhutanan Ibu Pejabat Jabatan Perhutanan Sabah, Beg Berkunci 68, 90009 Sandakan
4	**VILLAGERS (DFR Social Forestry Committee)**	
A	Kg. Balat	Pengerusi Jawatankuasa Kemajuan Dan Keselamatan Kampung Balat, 90200 Kinabatangan
B	Kg. Tangkong	Pengerusi Jawatankuasa Kemajuan Dan Keselamatan Kampung Tangkong, 90200 Kinabatangan
C	Kg. Kuamut	Pengerusi Jawatankuasa Kemajuan Dan Keselamatan Kampung Kuamut, 90200 Kinabatangan
D	Kg. Desa Permai & Kg. Pagar	Pengerusi Jawatankuasa Kemajuan Dan Keselamatan Kampung Desa Permai & Kampung Pagar, 90200 Kinabatangan
E	Kg. Tulang-Tulang	Pengerusi Jawatankuasa Kemajuan Dan Keselamatan Kampung Tulang-Tulang, 90200 Kinabatangan
5	**LOCAL AND INTERNATIONAL UNIVERSITIES**	
A	Universiti Malaysia Sabah	Sekolah Perhutanan Tropika Antarabangsa, Universiti Malaysia Sabah, Beg Berkunci 2073, 88300 Kota Kinabalu, Sabah Tel. No. 088-320000,samb. 8583, 8772, 8880 Fax No.: 088-320876
B	Center For Ecological Research, Kyoto University, Japan (CERKU)	Profesor Dr. Kanehiro Kitayama Email:kanehiro@kais.kyoto-u.ac.jp/ kitayama@ecology.kyoto-u.ac.jp
C	Universiti Putra Malaysia	Fakulti Sains Pertanian & Makanan, Jabatan Sains Perhutanan, Universiti Putra Malaysia, Kampus Bintulu, Jln. Nyabau, Peti Surat 396,

		97008 Bintulu, Serawak, Malaysia Tel: 086-855209/5263/5311 Fax No.: 086-855255
6	**CONTRACTORS**	
A	Lancar Niaga Sdn Bhd	Lot 7, Block A, 1st Floor, Utama Place 1, Mile 5, North Road, Sandakan, Sabah
B	Sentosa Jaya Fruit Farm Sdn. Bhd	1st Floor, Lot 2, Block 31, Jalan Seroja, P.O.Box 60447, 91114 Lahad Datu. Fax No.: 089-888758 Dr. Teo Yan Hock (019-8839058)
C	Kontraktor Malaysia	MDLD 3688, 1st Floor, Jalan Urus Setia Kecil, P.O.Box 60447, 91114 Lahad Datu. Fax No.: 089-888758 Dr. Teo Yan Hock (019-8839058)
7	**OIL PALM PLANTATION/COMPANY**	
A	KTS Plantation Sdn. Bhd.	KTS Plantation Sdn. Bhd., 1st, Blok 5, Bt. 4, Jalan Utara, Bandar Pasaraya, 90000 Sandakan, Sabah Fax No.:089-271600
B	Yapidmas Plantation Headquarters	Main Office : 089-271163 Main Estate Manager : Mr. Borhan Mohd. Nor (017-8938488)
C	IOI Plantation (Tangkulap Estate)	Tangkulap Estate Office: 089-509101/509102 Manager : Mr. Thomas Soo (019-8838796)

APPENDIX 2: SUMMARY RESULTS OF CHEMICAL ANALYSES AND WATER QUALITY CLASSES OF 5 RIVERS IN DFR

Environmental baseline sampling was carried out to characterize the water quality of 5 rivers in Deramakot FR, namely Sg. Rawog, Sg. Mannan, Sg. Tangkulap Kecil, Sg. Balat and Sg. Deramakot as of 24th June 2014 (Table 1).

Table 1: The geographical location and site description of water quality sampling in Deramakot SFM Project Area.

Sample Point No.	Location	Surrounding Condition	Prevailing Weather conditions (24 hours)	Date of Sampling	GPS Location	
					North	East
D1	Rawog River	Secondary forest	Clear weather during sampling, but raining heavily for duration of 1 hour, 15 hours prior to sampling period.	24/06/2014	05°26.223'	117°25.559'
D 2	Mannan River (Basecamp)	Secondary forest		24/06/2014	05°21.955'	117°26.239'
D 3	Tangkulap Kecil River	Secondary forest		24/06/2014	05°19.445'	117°22.113'
D 4	Balat River	Secondary forest		24/06/2014	05°19.556'	117°35.351'
D 5	Deramakot River	Secondary forest		24/06/2014	05°17'05.16"	117°32'35.47"

A total of 5 sampling points represent the project watershed and its sub-catchment areas, which predominantly drain through the project site. These sampling points are labelled D1 to D5 (Figure 1). All the headwaters of these rivers derived from within Deramakot itself, except for part of Rawog River, which derives from adjacent oil palm estate in the north. The chemical analyses and water quality classes for all parameters tested for the sampling points in the project area are listed in Table 2 and the results are as follows:

i. **pH Value -** The concentration range of hydronium ions suitable for the existence of most biological life is narrow, typically between pH 6 to 9. The water pH levels for all five sampling points in Deramakot were ranged between 6.89 to 7.52 and could be classified under Class I water for the National Water Quality Standards for Malaysia (Table 2).

ii. **Suspended Solid -** Suspended solid (SS) is an indicator of the amount of land disturbance within the catchment area and relates to the erosion that took place nearby sampling area or upstream. All sampling point D2, D3, D4 and D5 registered SS levels categorized as Class I under the National Water Quality Standards for Malaysia (Table 2). Only D1 sampling point registered the highest SS levels and categorized as Class IIA. Part of the upper catchment of D1 is originated from oil palm estate that can be elucidated having low structural diversity that eventually may influence increase surface runoff and soil erosion during rainy season (Figure 1).

iii. Biological Oxygen Demand (BOD) - This parameter is a measure to indicate the presence of organic waste in the river. All sampling points registered BOD levels within Class I under the National Water Quality Standards for Malaysia (Table 2).

iv. Chemical Oxygen Demand (COD) - This parameter is an indicator of organics in the water and usually used in association with BOD. Four (4) sampling points registered COD levels as Class IIA under the National Water Quality Standards for Malaysia. Only D4 sampling point is classified under Class I (Table 2).

v. **Dissolved** Oxygen **(DO) -** DO is an essential indicator in supporting aquatic life. It measures the amount of oxygen (O_2) that is dissolved in the water. Four (4) sampling points registered DO levels as Class IIA and one point (D4) under Class I as stipulated under the National Water Quality Standards for Malaysia (Table 2).

vi. Ammoniacal-Nitrogen (as N3-N) - This parameter is an indicator of pollution from excessive usage of ammonia rich fertilizers and often used as a measure of the health of water in natural bodies such as rivers or lakes, or in manmade water reservoirs. All sampling points registered AN levels as Class I under the National Water Quality Standards for Malaysia (Table 2).

vii. **Oil and Grease -** The presence of oil and grease in water bodies leads to the formation of oil layer, which causes significant pollution problem such as reduction of light penetration and photosynthesis. It further hinders oxygen transfer from atmosphere to water medium and this leads to decreased amount of dissolved oxygen (DO) at the bottom of the water thus adversely impacted of aquatic life in water. This parameter aims to test whether in general there has been indiscriminate dumping of oils or oily waste in to the water bodies. All five (5) sampling points in Deramakot showed levels of oil and grease below measurable ranges (<1.5 mg/l) that indicates near natural background levels (Table 2).

viii. **Total Coliform Count (TCC) -** The term total coliform count (TCC) refers to a numerical count that generally includes both fecal and non-fecal coliforms, and is used to highlight bacterial contamination of the waters. Four (4) sampling points in Deramakot registered TCC levels under Class IIB and one point (D4) under Class I as stipulated under the National Water Quality Standards for Malaysia (Table 2).

ix. **Fecal Coliform Count (FCC) -** The term refers to a subset numerical count of total coliform, primarily comprising fecal coliform bacteria that originates from the guts of warm-blooded animals and humans, and is used as an indicator of fecal matters. All the five (5) sampling points registered FCC levels for water under Class IIB of the National Water Quality Standards for Malaysia (Table 2).

In general, the tests for water quality sampled from the various local rivers are considerably clean (Table 3). All rivers indicated no trace of oil and grease and harmful level of ammonium nitrate (indicator of extreme used of fertilizer). Total suspended solid levels and pH values generally complied with the standards set for water under Class I of the National Water Quality Standards for Malaysia, indicating impact of soil erosion is at the minimal level. No indications of organic pollution in all sampling point as the BOD for all sampling point are under Class I of NQWSM. The COD correlates with the DO and this shown in the result where four (4) sampling points are Class IIA and only one (D4) sampling point in Class I for both COD and DO result. Although part of Rawog River derived from adjacent oil palm estate, there is no indication of excessive usage of ammonia rich fertilizers, shown by Ammoniacal- Nitrogen (as N_3-N) result which complied with the standards under Class I of the National Water Quality Standards for Malaysia. Based on the total and faecal coliform counts, the bacterial contamination level in all sampling points are low and showing no sewerage problem especially in sampling point D2 where the Deramakot forestry office and living quarters are located. These results should be expected for rivers draining from catchment areas without forest harvesting activities. This favourable finding may elucidate that sustainable forest management practices in Deramakot could maintain or enhance environmental quality of the area even with timber extraction activities is on-going periodically. The water quality test will be conducted twice a year as monitoring tool for evaluating ecosystem services provided by the FMU.

Table 2: The results of chemical analyses and water quality classes for all parameter tested for sampling location D1, D2, D3, D4, D5 in Deramakot Project Area.

Parameters Tested	**Sampling Location**					**NWQSM ***
	D1	**D2**	**D3**	**D4**	**D5**	
Biological Oxygen Demand (BOD in mg/l)	<1.00	<1.00	<1.00	<1.00	<1.00	Class I for all sampling points
Suspended Solid (SS in mg/l)	57	8	33	7	31	D1: Class IIA D2 – D5 : Class I
Chemical Oxygen Demand (COD in mg/l)	25.6	25.6	25.6	19.2	32.0	D1,D2,D3& D5 : Class IIA D4 : Class I
Ammoniacal- Nitrogen (as N_3-N in mg/l)	<0.20	<0.20	<0.20	<0.20	<0.20	Class I for all sampling points
Dissolved Oxygen (DO in mg/l)	5.71	6.43	5.98	7.30	6.03	D1,D2,D3,D5 : Class IIA D4 : Class I
Oil & Grease (mg/l)	<1.50	<1.50	<1.50	<1.50	<1.50	Class I for all sampling points
Total Coliform Count (MPN/100mL)	9200	16000	9200	3500	9200	D1,D2,D3,D5 : Class IIB D4 : Class I
Fecal Coliform Count (MPN/100mL)	5400	1400	1700	3300	2400	Class IIB
pH value	7.07	6.89	7.26	7.52	7.14	Class I

Note:
(BOD in mg/l), Chemical Oxygen Demand (COD in mg/l), Ammoniacal Nitrogen (AN in mg/l), Suspended Solid (SS in mg/l), Dissolved Oxygen (DO in mg/l), fecal coliform (MPN/100mL), total coliform (MPN/100mL), and oil & grease (mg/l).

Table 3: The water quality index (WQI) for D1 to D5 sampling points in Deramakot Project Area.

Attributes	**Sampling Point**				
	D1	**D2**	**D3**	**D4**	**D5**
DO%	69.1	77.81	72.37	88.34	72.97
BOD	1	1	1	1	1
COD	25.6	25.6	25.6	19.2	32.0
SS	57	8	33	7	31
pH	7.07	6.89	7.26	7.52	7.14
NH3-NL	0.2	0.2	0.2	0.2	0.2
SIDO	77	87	81	96	82
SIBOD	96	96	96	96	96
SICOD	68	68	68	74	61
SIAN	80	80	80	80	80
SISS	69	93	80	93	81
SIpH	99	99	98	97	99
WQI	81	87	83	90	83
CLASS	**II**	**II**	**II**	**II**	**II**
WQ STATUS	**Clean**	**Clean**	**Clean**	**Clean**	**Clean**

Note: DO % saturation values were calculated based on dissolved oxygen saturation factor of 8.26 mgL^{-1} at temperature 25° C).

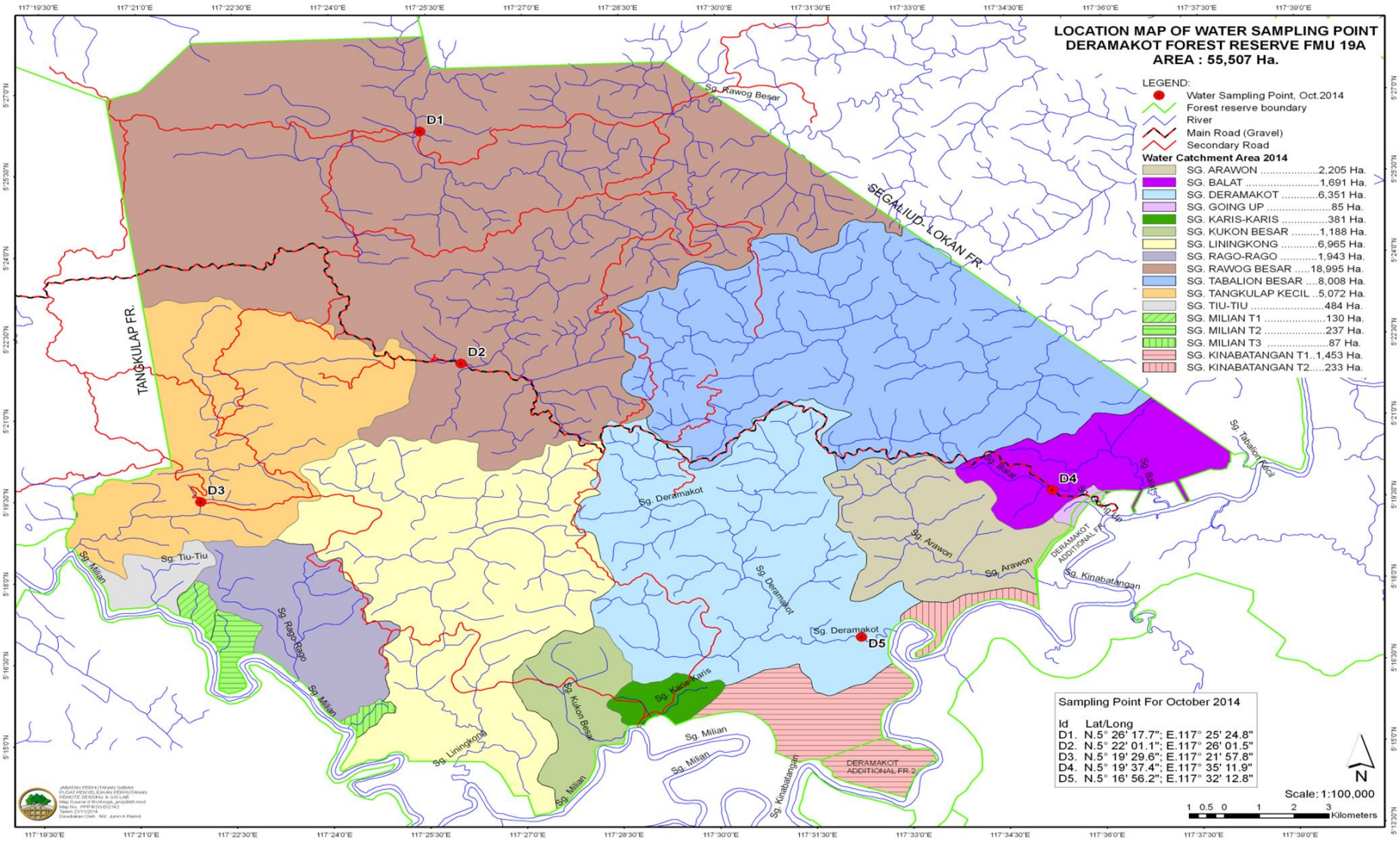


Figure 1: The distribution of 17 minor catchments found in Deramakot Forest Reserve

APPENDIX 3: LIST OF STANDARDS OF PROCEDURES (SOP) IN DFR

1. Workers' Safety SOP
    i. Handling of Fertilizer Application (Manabur Baja) - SFD/DFR/SOP – 017
    ii. Planting Maintenance (Penyelenggaraan Tanaman) - SFD/DFR/SOP - 016
    iii. Silviculture Treatment (Rawatan Silvikultur) - SFD/DFR/SOP - 014
    iv. Forest rehabilitation (Rehabilitasi Hutan) - SFD/DFR/SOP - 015
2. Social Assessment - Document No: SFD/DFR/SOP – 001
3. Accidents Record Form - SFD/DFR/SOP-009
4. Harvest Tree Mapping - Document No.: SFD/DFR/SOP - 002
5. Harvest Tree Planning Guideline - Document No.: SFD/DFR/SOP - 003
6. Roads, Skid Trails & Log Landings - Document No.: SFD/DFR/SOP - 004
7. Monitoring - Document No.: SFD/DFR/SOP – 005
8. Timber Stand Improvement - Document No.: SFD/DFR/SOP - 006
9. Resource Protection - Document No.: SFD/DFR/SOP – 007
10. Chemicals & Fuel - Document No.: SFD/DFR/SOP – 008
11. Procedures – Safety & Training - Document No.: SFD/DFR/SOP – 009
12. Campsites & Health - Document No.: SFD/DFR/SOP – 010
13. Procedures – Communication Dispute - Document No.: SFD/DFR/SOP – 011
14. Forest Inventory Guidelines - Document No.: SFD/DFR/SOP – 012
15. Compartment Restoration Plan - Document No.: SFD/DFR/SOP – 013
16. Transportation and Sales of Logs - Document No.: SFD/DFR/SOP – 014
17. Quarrying of Hard Rocks & Excavation of Gravel Pits - Document No: SFD/DFR/SOP – 015
18. Managing Spillage (Fuel and Lubricant) - Document No.: SFD/DFR/SOP - 016

GLOBAL FORESTRY SERVICES (M) SDN. BHD.

Kuala Lumpur : 31-9-1, Bangsar Heights, Jalan Kaloi, 59100 Kuala Lumpur, Malaysia.
Tel : +6089 226 857 Fax : +603 2283 5070
Sabah Branch : Block B, Ground Floor, Lot No. 6, Phase IIA, Taman Grandview, 90000 Sandakan, Sabah.
Tel : +6089 226 857 Fax : +6089 227 857
Email : gfs@gfsinc.biz Website : www.gfsinc.biz

FOREST SUPPORT PROGRAM

APPENDIX 4 – SIA CHECKLIST

COMMUNITY ASSESSMENT CHECKLIST

VILLAGE:_____ Date:_____
KAMPUNG **Tarikh**

Contact: _____ _____ _____

Name of Villager interviewed Position / Title Phone

Nama Penduduk yang ditemubual **Jawatan / Pangkat** **Telefon**

A. PHYSICAL ATTRIBUTES
CIRI-CIRI FIZIKAL

<table>
<tr><td>Location (GPS: N_____E_____)
Lokasi</td><td>Number of households per village
Bilangan (keluarga/rumah) dalam kampung

Total villagers in this village:
Jumlah orang dalam kampung:</td></tr>
<tr><td>Number of household per village 10 years ago:
Bilangan (keluarga/rumah) dalam kampung 10 tahun yang lalu:

Total villagers in this village 10 years ago:
Jumlah orang dalam kampung 10 tahun lalu:</td><td>Area of town & agriculture / cultivated
Kawasan pekan & pertanian / penanaman

<table>
<tr><td>Activity
Aktiviti</td><td>Agriculture
Pertanian</td><td>Planting
Penanaman</td></tr>
<tr><td>Area
Luas</td><td></td><td></td></tr>
<tr><td>GPS Location
Lokasi GPS</td><td>N:
S:</td><td>N:
S:</td></tr>
</table></td></tr>
<tr><td>Average persons / house
Purata penduduk / rumah</td><td>Associations with Tribes
Persatuan dengan suku kaum

Tribe:
Kaum
Existence of tribe association: Yes/ No
Ada persatuan atau tidak: Ya / Tidak</td></tr>
<tr><td>River Access (small boats or large commercial boats)
Laluan Sungai (bot kecil atau bot komersil besar)

Small boat/ Big Commercial Boat
Bot kecil/ Bot Komersil Besar</td><td>Road Access (motorbike, truck, bus)
Laluan Jalanraya (motorsikal, trak, bas)

Motorbike/Truck/Bus/4WD/Walking/Car
Motorsikal/Trak/Bas/4WD/Jalan Kaki/ Kereta</td></tr>
<tr><td colspan="2">Land Tenure (Application and date)
Hak Pemilikan Tanah (Pemohonan dan tarikh)
Existence of land tenure rights: Yes / No</td></tr>
</table>

Hak pemilikan tanah:	**Ada / Tiada**
Application: **Pemohonan :** Year applied: **Tahun memohon:**	Yes / No **Ada / Tiada**

B. LIVELIHOOD
PENDAPATAN

	% Annual Income **Pendapatan Tahunan**	% Subsistence **Saraan hidup**	Remarks **Catatan**
Employment / Contract work **Bekerja / Kerja Kontrak**	Total employed: **Jumlah yang bekerja:** Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total unemployed: **Jumlah yang tidak bekerja:**	State in types of jobs referred: **Catatkan jenis pekerjaan:**
Fishing **Memancing**	Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	
Farming – Rice **Pertanian – Padi**	Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	Identify on map **Identifikasi atas peta**
Other Agriculture **Lain-lain pertanian**	**Total Income per month/year/contract:** **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	Identify on map **Identifikasi atas peta**
Hunting **Memburu**	Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	Identify on map **Identifikasi atas peta**

Collection Rattan / NTFP **Pengumpulan rotan / NTFP**	Total Income per month/year/contract : **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	Identify on map **Identifikasi atas peta**
Timber harvesting **Penuaian balak**	Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	**Total / month** **Jumlah / bulan**	Identify on map **Identifikasi atas peta**
Cottage Industries **Industri desa**	Total Income per month/year/contract: **Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:**	Total / month **Jumlah / bulan**	Types of handicrafts at home **Jenis Kraf tangan dalam rumah**

C. CULTURAL ASPECTS (HCVF-6)
ASPEK KEBUDAYAAN (HCVF-6)

	Location (GPS/map location) **Lokasi (GPS/lokasi peta)**	Area (hectares) **Luas (hektar)**
Religious Sites **Tapak Keagamaan**	Have /Don't Have **Ada / Tiada** State the religious site **Nyatakan kawasan tapak keagamaan**	**GPS:** **(N_____E_____)**
Burial Grounds **Tanah Perkuburan**	Have /Don't Have **Ada / Tiada** State the burial ground **Nyatakan kawasan tanah perkuburan**	**GPS:** **(N_____E_____)**
Sacred Places, Ancestral and Historical Sites **Kawasan Keramat, Nenek-moyang dan Tapak Bersejarah**	Have /Don't Have **Ada / Tiada** State the sacred area **Nyatakan kawasan keramat**	**GPS:** **(N_____E_____)**
Hunting/Fishing Grounds **Kawasan Memburu/Memancing**	Have /Don't Have **Ada / Tiada** State location / area **Nyatakan lokasi / kawasan**	**GPS:** **(N_____E_____)**

D. SOCIAL NEEDS
KEPERLUAN SOSIAL

<table>
<tr><td></td><td>Description
Penerangan</td></tr>
<tr><td>Education primary/secondary
Pelajaran rendah/menengah</td><td>Have /Don’t Have
Ada / Tiada
<table><tr><td>Primary School
Sekolah Rendah</td><td>Secondary School
Sekolah Menengah</td></tr><tr><td></td><td></td></tr></table>If don’t have, where is the nearest school?
Jika tiada, sekolah mana yang terdekat?</td></tr>
<tr><td>Clinics/hospitals
Klinik/hospital</td><td>Distance / time from village
Jarak / masa dari kampung

Accessible / not?
Senang dikunjungi / tidak</td></tr>
<tr><td>Employment Opportunities
Peluang Pekerjaan</td><td>Long term / seasonal
Jangkamasa panjang / Bermusim

In village / outside village
Dalam kampung / Luar Kampung</td></tr>
<tr><td>Transport by roads
Pengangkutan melalui jalanraya</td><td>Quality good or bad
Kualiti baik atau tidak
All year long/ Seasonal?
Sepanjang Tahun/ Bermusim</td></tr>
<tr><td>Transport by river
Pengangkutan melalui sungai</td><td>Quality good or bad
Kualiti baik atau tidak
All year long/ Seasonal?
Sepanjang Tahun/ Bermusim??</td></tr>
<tr><td>Market Access
Pasaran Hasil Tempatan</td><td>Have /Don’t Have
Ada / Tiada

Buyers/ Customers:
Pembeli/ Pelanggan:</td></tr>
<tr><td>Electricity / Water
Elektrik / Air</td><td>Have /Don’t Have
Ada / Tiada</td></tr>
<tr><td>Women’s issues
Isu-isu kewanitaan</td><td>
1.
2.</td></tr>
</table>

E. COMMUNITY CONSERVATION VALUES OF THE FOREST (HCVF)
NILAI PEMULIHARAAN KOMUNITI TERHADAP HUTAN (HCVF)

Hunting / Wildlife / Fishing (HCVF-5) **Memburu / Hidupan Liar / Memancing (HCVF 5)**	Identify on map **Identifikasi atas peta** **GPS: (N_____E_____)** Importance: high/low **Kepentingan: tinggi/rendah**
Drinking Water (HCVF 4) (importance: high/low) **Air Minuman (HCVF 4) (Kepentingan: tinggi/rendah)**	Identify on map **Identifikasi atas peta** **GPS: (N_____E_____)** Importance: high/low **Kepentingan: tinggi/rendah**
Collection of Rattan, Fruits, Medicinal Plants (HCVF-5) **Pengumpulan Rotan, Buah-buahan, Tumbuhan Perubatan (HCVF 5)**	Identify on map **Identifikasi atas peta** **GPS: (N_____E_____)** Importance: high/low **Kepentingan: tinggi/rendah**
Other **Lain-Lain**	Identify on map **Identifikasi atas peta** **GPS : (N_____E_____)** Importance: high/low **Kepentingan: tinggi/rendah**

F. OTHER ISSUES
LAIN-LAIN ISU

GLOBAL FORESTRY SERVICES (M) SDN. BHD.

Kuala Lumpur : 31-9-1, Bangsar Heights, Jalan Kaloi, 59100 Kuala Lumpur, Malaysia.
Tel : +6089 226 857 Fax : +603 2283 5070
Sabah Branch : Block B, Ground Floor, Lot No. 6, Phase IIA, Taman Grandview, 90000 Sandakan, Sabah.
Tel : +6089 226 857 Fax : +6089 227 857
Email : gfs@gfsinc.biz Website : www.gfsinc.biz

FOREST SUPPORT PROGRAM

APPENDIX 5 – SIA CHECKLIST (HOUSEHOLD)

COMMUNITY ASSESSMENT CHECKLIST (HOUSEHOLD)

VILLAGE:_____Date:_____
KAMPUNG ***Tarikh***

Contact: _____ _____ _____

Name of Villager interviewed Position / Title Phone **Nama**
Penduduk yang ditemubual **Jawatan / Pangkat** **Telefon**

A. PHYSICAL ATTRIBUTES
CIRI-CIRI FIZIKAL

Location (GPS: N E)
Lokasi

Total Persons per House
Jumlah orang serumah

Gender **Jantina**	Boy **Lelaki**	Girl **Perempuan**
Total **Jumlah**		

Area of agriculture / cultivated
Luas kawasan pertanian / penanaman

Activity **Aktiviti**	Agriculture **Pertanian**	Planting ***Penanaman***
Area **Luas**		
GPS Location Lokasi GPS	N: S:	N: S:

Number of Family member10 years ago
Bilangan ahli keluarga 10 tahun yang lalu

Gender **Jantina**	Boy **Lelaki**	Girl **Perempuan**
Total **Jumlah**		

Associations with Tribes
Persatuan dengan suku kaum

Tribe:
Kaum

Existence of tribe association: Yes/ No
Ada persatuan atau tidak: Ya / Tidak

Land Tenure (Application and date)
Hak Pemilikan Tanah (Pemohonan dan tarikh)
Existence of land tenure rights: Yes / No
Hak pemilikan tanah: Ada / Tiada
Application: Yes / No
Pemohonan : Ada / Tiada

Year applied:
Tahun memohon:

River Access (small boats or large commercial boats)
Laluan Sungai (bot kecil atau bot komersil besar)

Small boat/ Big Commercial Boat
Bot kecil/ Bot Komersil Besar

Road Access (motorbike, truck, bus)
Laluan Jalanraya (motorsikal, trak, bas)

Motorbike/Truck/Bus/4WD/Walking/Car
Motorsikal/Trak/Bas/4WD/Jalan Kaki / Kereta

B. LIVELIHOOD
PENDAPATAN

	% Annual Income Pendapatan Tahunan	% Subsistence Saraan hidup	Remarks Catatan
Employment / Contract work Bekerja / Kerja Kontrak	Total employed: Jumlah yang bekerja: Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total unemployed: Jumlah yang tidak bekerja:	
Fishing Memancing	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	
Farming – Rice Pertanian – Padi	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Identify on map Identifikasi atas peta
Other Agriculture Lain-lain pertanian	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Identify on map Identifikasi atas peta
Hunting Memburu	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Identify on map Identifikasi atas peta
Collection Rattan / NTFP Pengumpulan rotan / NTFP	Total Income per month/year/contract : Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Identify on map Identifikasi atas peta
Timber harvesting Penuaian balak	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Identify on map Identifikasi atas peta

Cottage Industries Industri desa	Total Income per month/year/contract: Jumlah pendapatan untuk 1 bulan/ tahun/ kontrak:	Total / month Jumlah / bulan	Types of handicrafts at home Jenis Kraf tangan dalam rumah

C. CULTURAL ASPECTS (HCVF-6)
ASPEK KEBUDAYAAN (HCVF-6)

	Location (GPS/map location) Lokasi (GPS/lokasi peta)	Area (hectares) Luas (hektar)
Religious Sites Tapak Keagamaan	Have /Don't Have Ada / Tiada State the religious site Nyatakan kawasan tapak keagamaan	GPS: (N_____E_____)
Burial Grounds Tanah Perkuburan	Have /Don't Have Ada / Tiada State the burial ground Nyatakan kawasan tanah perkuburan	GPS: (N_____E_____)
Sacred Places, Ancestral and Historical Sites Kawasan Keramat, Nenek-moyang dan Tapak Bersejarah	Have /Don't Have Ada / Tiada State the sacred area Nyatakan kawasan keramat	GPS: (N_____E_____)
Hunting/Fishing Grounds Kawasan Memburu/Memancing	Have /Don't Have Ada / Tiada State location / area Nyatakan lokasi / kawasan	GPS: (N_____E_____)

D. SOCIAL NEEDS
KEPERLUAN SOSIAL

	Description Penerangan
Education primary/secondary Pelajaran rendah/menengah	Have /Don't Have Ada / Tiada Primary School / Sekolah Rendah | Secondary School / Sekolah Menengah If don't have, where is the nearest school? Jika tiada, sekolah mana yang terdekat?

Clinics/hospitals Klinik/hospital	Distance / time from village Jarak / masa dari kampung Accessible / not? Senang dikunjungi / tidak
Employment Opportunities Peluang Pekerjaan	Long term / seasonal Jangkamasa panjang / Bermusim In village / outside village Dalam kampung / Luar Kampung
Transport by roads Pengangkutan melalui jalanraya	Quality good or bad ? Kualiti baik atau tidak All year long/ Seasonal? Sepanjang Tahun/ Bermusim
Transport by river Pengangkutan melalui sungai	Quality good or bad ? Kualiti baik atau tidak All year long/ Seasonal? Sepanjang Tahun/ Bermusim
Market Access Pasaran Hasil Tempatan	Have /Don't Have Ada / Tiada Buyers/ Customers: Pembeli/ Pelanggan:
Electricity / Water Elektrik / Air	Have /Don't Have Ada / Tiada
Women's issues Isu-isu kewanitaan	1. 2. 3.

E. COMMUNITY CONSERVATION VALUES OF THE FOREST (HCVF)
NILAI PEMULIHARAAN KOMUNITI TERHADAP HUTAN (HCVF)

Hunting / Wildlife / Fishing (HCVF-5) Memburu / Hidupan Liar / Memancing (HCVF 5)	Identify on map GPS: (N_____E_____) Identifikasi atas peta Importance: high/low Kepentingan: tinggi/rendah
Drinking Water (HCVF 4) (importance: high/low) Air Minuman (HCVF 4) (Kepentingan: tinggi/rendah)	Identify on map GPS: (N_____E_____) Identifikasi atas peta Importance: high/low

	Kepentingan: tinggi/rendah
Collection of Rattan, Fruits, Medicinal Plants (HCVF-5) Pengumpulan Rotan, Buah-buahan, Tumbuhan Perubatan (HCVF 5)	Identify on map GPS: (N_____E_____) Identifikasi atas peta Importance: high/low Kepentingan: tinggi/rendah
Other Lain-Lain	Identify on map GPS: (N_____E_____) Identifikasi atas peta Importance: high/low Kepentingan: tinggi/rendah

F. OTHER ISSUES
LAIN-LAIN ISU

APPENDIX 6: RECORDS OF CORRECTIVE ACTION REQUESTS (CARS) ISSUED BY SGS FOR FMU 19A (2004 – 2013)

PRINCIPLES, CRITERIAS & INDICATORS	CORRECTIVE ACTION REQUESTS																								
	2004			2005			2007			2009			2010			2011			2012			2013		
	major	minor	obs	major	minor	obs	major	minor	obs	major	minor	obs	major	minor	obs	major	minor	obs	major	minor	obs	major	minor	obs
Principle 1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES (*Forest management shall respect all applicable laws of the country in which they occur and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria).*																									
Criterion 1.1: Forest management shall respect all national and local laws and administrative requirements																									
Principle 2: TENURE AND RIGHTS RESPONSIBILITIES (*Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established).*																									

Criterion 2.3: Appropriate mechanisms shall be employed to resolve disputes over tenure claims and use rights. The circumstances and status of any outstanding disputes will be explicitly considered in the certification evaluation. Disputes of substantial magnitude involving a significant number of interests will normally disqualify an operation from being certified.																									
Indicator 2.3.5 Dispute resolution procedures shall make provision for the requirement that where the future tenure or use rights of communities may be compromised, forest operations that are, or may be the direct cause of the dispute, will not be initiated or will be suspended until the dispute had been resolved. (Not applicable to SLIMF)																									
Principle 3: INDIGENOUS PEOPLES' RIGHTS ***(The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognised and respected).***																									
Criterion 3.1: Indigenous peoples shall control forest management on their lands and territories unless they delegate control with free and informed consent to other agencies.																									
Criterion 3.2: Forest management shall not threaten or diminish, either directly or indirectly, the resources or tenure rights of indigenous peoples.																									
Criterion 3.3: Sites of special cultural, ecological, economic or religious significance to indigenous peoples [and other sections of the community] shall be clearly identified in co-operation with such peoples, and recognised and protected by forest managers.																									
Indicator 3.3.2 Sites of special cultural, historical, ecological, economic or religious significance are identified, described and mapped in co-operation with affected or interested stakeholders. **SLIMF:** Sites of special cultural, historical, ecological,																									

economic or religious significance have been identified and any special requirements are known.																									
Principle 4: COMMUNITY RELATIONS AND WORKER'S RIGHTS ***(Forest management operations shall maintain or enhance the long-term social and economic well being of forest workers and local communities).***																									
Criterion 4.1: The communities within, or adjacent to, the forest management area should be given opportunities for employment, training, and other services.																									
Indicator 4.1.1 Forest managers provide, where appropriate, support for training, retraining, local infrastructure, facilities and social programs commensurate with the scale and intensity of forest management operations.																									
Indicator 4.1.2 People in local communities are given opportunities in employment, training and contracting. **SLIMF:** Local workers and contractors should be used wherever possible.																									
Indicator 4.1.8 All employees, contractors and sub-contractors must be paid a fair wage and other benefits, which meet or exceed all legal requirements and those provided in comparable occupations in the same region.																									
Indicator 4.1.9 No workers should be engaged in debt bondage or other forms of forced labour.																									
Criterion 4.2: Forest management <u>should</u> meet or exceed all applicable laws and/or regulations covering health and safety of employees and their families.																									

Indicator 4.2.4 Forest Managers have systematically assessed the risk associated with all tasks and equipment and prescribed appropriate safe procedures, the use of personal protective equipment (PPE), emergency procedures and where appropriate, key responsibilities. **SLIMF:** In large scale organisations, compliance with this requirement shall be supported by documentation. All work done in the forest must comply with health and safety laws and regulations.																								
Indicator 4.2.7 All necessary tools, machines, substances and equipment, including appropriate PPE, are available at the worksite and are in safe and serviceable condition.																								
Indicator 4.2.11 Where located and provided on the FMU worker accommodation and nutrition comply, as a minimum, with the ILO Code of Practice on Safety and Health in Forestry.																								
Indicator 4.2.14 Demarcation of hazardous areas and provision of guidelines for storage and handling of hazardous materials.																								
Criterion 4.3: The rights of the workers to organise and voluntarily negotiate with their employers shall be guaranteed as outlined in Conventions 87 and 98 of the International Labour Organisation (ILO).																								
Indicator 4.3.4 Availability of appropriate procedures to address grievances raised by workers and/or their organizations and for conflict resolution.																								
Principle 5: BENEFITS FROM THE FOREST ***(Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits).***																								

Criterion 5.1: Forest management should strive towards economic viability, while taking into account the full environmental, social, and operational costs of production, and ensuring the investments necessary to maintain the ecological productivity of the forest.																									
Criterion 5.2: Forest management and marketing operations should encourage the optimal use and local processing of the forest's diversity of products.																									
Indicator 5.2.1 Application of forest management practices to encourage the optimal use of forest resources.																									
Criterion 5.3: Forest management should minimise waste associated with harvesting and on-site processing operations and avoid damage to other forest resources.																									
Indicator 5.3.5 Harvested and processed wood and/or products processed on-site are transported from the forest before any deterioration occurs.																									
Criterion 5.6: The rate of harvest of forest products shall not exceed levels, which can be permanently sustained.																									
Indicator 5.6.1 Data on forest growth, regeneration and volumes harvested and thinned are reported regularly and analysed in comparison with predicted volumes and growth data (data accuracy is appropriate to scale and intensity of management). SLIMF (Low Intensity Forests): Harvest levels are sustainable over the long term (a period equivalent to the rotation length of the trees harvested). Note that annual harvest levels may vary hugely. SLIMF (Small Forests): Harvest limits are established at sustainable levels, based on conservative estimates of tree growth and yield rates. The harvest limits are stated in the management plan.																									

Principle 6: ENVIRONMENTAL IMPACT ***(Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest).***																									
Criterion 6.1: Assessment of environmental impacts shall be completed - appropriate to the scale, intensity of forest management operations and the uniqueness of the affected resources - and adequately integrated into management systems. Assessments shall include landscape level considerations as well as the impacts of on-site processing facilities. Environmental impacts shall be assessed prior to commencement of site disturbing operations.																									
Indicator 6.1.1 The owner/manager has systematically identified and assessed the potential environmental impacts of all activities (including on-site processing facilities) carried out in the forest; the impacts of forest plans have been considered at the landscape level, taking account of the interaction with adjoining land and other nearby habitats. For large scale organisations, the results of these impact assessments shall be documented. (Not applicable to SLIMF)																									

Indicator 6.1.2 Site-specific assessments of the potential environmental impacts of all forest operations are carried out prior to commencement of site disturbing operations, in a manner appropriate to the scale of the operations and the sensitivity of the site. Where such activities are considered "significant", these site-specific assessments are documented. "Significant" activities shall include, but not be restricted to: (1) The building of new roads or substantial rerouting of existing roads; (2) Any form of flow restriction in streams and rivers; (3) Aforestation; (4) Change in genus in the reforestation of more than 100 ha during the same planting season within an operational/management unit, where an FMU comprises more than one; (5) Recreational activities and associated infrastructure (6) Communication masts and associated infrastructure (7) Power lines (8) Water lines (9) Change of natural vegetation to commercial or any other use (10) Erection of new fences (11) Use of natural areas and products for commercial gain or any other purpose (12) New waste disposal sites; (13) Implementation of new/modified activities/products that may have significant impacts on the environment. SLIMF (Small Forests): Before starting any operation, the possible negative environmental impacts are identified and the operation is designed to minimise them. Assessments do not need to be documented unless legally required. SLIMF (Low Intensity Forests): Before starting any operation, the possible negative environmental impacts at the site and landscape levels are identified and the operation is designed to minimise them. Assessments do not need to be documented unless legally required.																									
Indicator 6.1.5 All potential environmental impacts identified during assessments are considered during operations and planning and ensure that adverse impacts are avoided or mitigated.																									

Indicator 6.1.7 Corrective action requests (CARs) are recorded and closed out appropriately. SLIMF: Timeous corrective actions are taken.																									
Criterion 6.2: Safeguards shall exist which protect rare, threatened and endangered species and their habitats (e.g. nesting and feeding areas). Conservation zones and protection areas shall be established, appropriate to the scale and intensity of forest management and the uniqueness of the affected resources. Inappropriate hunting, fishing, trapping and collecting shall be controlled.																									
Indicator 6.2.9 Forest workers shall be aware of endangered, rare and threatened species of forest flora and fauna found in the PRFs for Peninsular Malaysia and forest management areas for Sabah and Sarawak. Such awareness shall be promoted among local communities.																									
Criterion 6.3: Ecological functions and values shall be maintained intact, enhanced, or restored, including: 1) Forest regeneration and succession. 2) Genetic, species and ecosystem diversity. 3) Natural cycles that affect the productivity of the forest ecosystem.																									
Indicator 6.3.2 The status of the FMU with regard to: a) regeneration and succession; b) genetic, species and ecosystem diversity; c) natural cycles, is known or estimated.																									
Criterion 6.5: Written guidelines shall be prepared and implemented to: control erosion; minimise forest damage during harvesting, road construction, and all other mechanical disturbances; and protect water resources.																									
Indicator 6.5.2 Guidelines developed in terms of indicator 6.5.1 are implemented during operations and planning.																									
Indicator 6.5.3 Buffer zones are maintained along watercourses and around water bodies. These buffer zones are demarcated on maps and comply with specifications made in national and regional best practice guidelines. SLIMF: Buffer zones are maintained along watercourses and around water bodies and																									

comply with national and regional best practice guidelines.																									
Indicator 6.5.4 Operators are aware of and able to implement adequate emergency procedures for clean up following accidental oil and chemical spillages.																									
Indicator 6.5.5 Implementation of reduced/low impact logging to minimize damage to the environment.																									
Criterion 6.6: Management systems shall promote the development and adoption of environmentally friendly non-chemical methods of pest management and strive to avoid the use of chemical pesticides. World Health Organisation Type 1A and 1B chlorinated hydrocarbon pesticides; pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use; as well as any pesticides banned by international agreement, shall be prohibited. If chemicals are used, proper equipment and training shall be provided to minimise health and environmental risks.																									
Criterion 6.7: Chemicals, containers, liquid and solid non-organic wastes including fuel and oil shall be disposed in an environmentally appropriate manner at off-site locations.																									
Indicator 6.7.2 The owner/manager should ensure that waste that cannot be re-cycled, including that generated by contractors working on the FMU, is disposed of in environmentally appropriate ways.																									
Indicator 6.7.3 The owner/manager should ensure that the handling and disposal of chemicals and chemical containers, including that generated by contractors working on the FMU, should comply, as a minimum, with the ILO publications 'Safety & Health in the Use of Agrochemicals: A Guide', and 'Safety in the Use of Chemicals at Work'.																									

Criterion 6.10: Forest conversion to plantations or non-forest land uses shall not occur, except in circumstances where conversion: a) entails a very limited portion of the forest management unit; b) does not occur on high conservation value forest areas; and c) will enable clear, substantial, additional, secure, long-term conservation benefits across the forest management unit.																									
Principle 7: MANAGEMENT PLAN *(A management plan - appropriate to the scale and intensity of the operations - shall be written, implemented, and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated).*																									
Criterion 7.1: The management plan and supporting documents shall provide: a) management objectives; b) description of the forest resources to be managed, environmental limitations, land use and ownership status, socio-economic conditions, and a profile of adjacent lands; c) rationale for rate of annual harvest and species selection; d) provisions for monitoring of forest growth and dynamics; e) environmental safeguards based on environmental assessments; f) plans for the identification and protection of rare, threatened and endangered species; g) maps describing the forest resource base including protected areas, planned management activities and land ownership; h) description and justification of harvesting techniques and equipment to be used.																									
Indicator 7.1.1 There is a management plan (or overview linking different planning documents). SLIMF: Management plans may consist of brief notes and a map.																									
Indicator 7.1.11 Harvesting techniques and equipment are described and justified. SLIMF: The plan describes harvesting methods and silviculture to ensure responsible management.																									

Criterion 7.2: The management plan shall be periodically revised to incorporate the results of monitoring or new scientific and technical information, as well as to respond to changing environmental, social and economic considerations.																									
Indicator 7.2.2 Implementation of procedures to periodically revise the forest management plan, incorporating the results of monitoring or new scientific and technical information, the frequency of which should be appropriate to the scale and intensity of forest management operations, so as to respond to changing environmental, social and economic circumstances.																									
Criterion 7.3: Forest workers shall receive adequate training and supervision to ensure proper implementation of the management plan.																									
Indicator 7.3.3 Forest workers at all levels of skill and responsibility are appropriately educated and trained in the tasks they are assigned to and company policy and procedures. SLIMF: Forest workers at all levels of skill and responsibility are appropriately trained in the tasks they are assigned to.																									
Principle 8: MONITORING AND ASSESSMENT ***(Monitoring shall be conducted - appropriate to the scale and intensity of forest management - to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts).***																									
Criterion 8.1: The scale and intensity of forest management operations as well as the relative complexity and fragility of the affected environment <u>should</u> determine the frequency and intensity of monitoring. Monitoring procedures <u>should</u> be consistent and replicable over time to allow comparison of results and assessments of change.																									

Indicator 8.1.6 Monitoring information is readily available and in a format that facilitates effective auditing and certification by third parties.																									
Criterion 8.2: Forest management <u>should</u> include the research and data collection needed to monitor, at a minimum, the following indicators: a) yield of all forest products harvested; b)growth rates, regeneration and condition of the forest; c) composition and observed changes in the flora and fauna; d) environmental and social impacts of harvesting and other operations; and e) costs, productivity, and efficiency of forest management.																									
Indicator 8.2.1 Forest managers should gather the relevant information, appropriate to the scale and intensity of the forest management operations, needed to monitor the items (a) to (e) listed in Criterion 8.2.																									
Indicator 8.2.9 The owner/manager records and analyses data on the costs, productivity and efficiency of forest management activities; the results of such analyses are incorporated into plans.																									
Criterion 8.3: Documentation shall be provided by the forest manager to enable monitoring and certifying organisations to trace each forest product from its origin, a process known as the "chain of custody."																									
Indicator 8.3.5 Use of the FSC trademark is in accordance with policy and has been approved by SGS Qualifor.																									
Principle 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS ***(Management activities in high conservation value forests shall maintain or enhance the attributes, which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach).***																									

Criterion 9.1: Assessment to determine the presence of the attributes consistent with High Conservation Value Forests will be completed, appropriate to scale and intensity of forest management.																									
Indicator 9.1.2 The FMU has been adequately assessed (in consultation with conservation organisations, regulatory authorities and other local and national stakeholders) and any HCVFs and their biological and/or socio-economic or cultural attributes have been identified. SLIMF: The FMU has been adequately assessed (in consultation with conservation organisations and regulatory authorities) and any HCVFs and their biological and/or socio-economic or cultural attributes have been identified.																									
Criterion 9.4: Annual monitoring shall be conducted to assess the effectiveness of the measures employed to maintain or enhance the applicable conservation attributes.																									
Indicator 9.4.1 Forest managers should conduct, appropriate to scale and intensity of forest management operations, annual monitoring to assess the effectiveness of the measures in the management of the HCVFs in the PRFs for Peninsular Malaysia and forest management areas for Sabah and Sarawak.																									
Total		**2**			**3**			**6**	**3**	**3**	**4**	**2**		**3**	**3**		**3**	**3**		**6**	**4**	**5**	**11**	**1**	

Summary

TYPE OF CARS	# OF CARS ISSUED								TOTAL
	2004	2005	2007	2009	2010	2011	2012	2013	
MAJOR	-	-	-	3	-	-	-	5	8
MINOR	2	2	6	4	3	3	6	11	37
OBSERVATION	-	-	3	2	3	3	4	1	16

APPENDIX 7: LIST OF RESEARCH/STUDY UNDERTAKEN IN DERAMAKOT FOREST RESERVE (2005 – 2014)

PUBLISHED PAPERS

A. Applied Research

1. Co-Benefits of Sustainable Forest Management in Biodiversity Conservation and Carbon Sequestration. *N. Imai, H. Samejima, A. Langner, R. Ong, S. Kita, J. Titin, A.Y.C. Chung, P. Lagan, Y.F. Lee and K. Kitayama (PLOS-ONE – 2009)*

2. Utilisation of Macaranga Trees by the Asia Elephants in Borneo. *H. Matsubayashi, P. Lagan and J. R. A. Sukor (Mammal Study – the Mammalogical Society of Japan, 2006)*

3. Do Certified Tropical Logs Fetch a Market Premium? A Comparative Price Analysis from Sabah, Malaysia. *W. Kollert and P. Lagan (ELSEVIER – 2007)*

4. Sustainable Use of Tropical Forests by Reduced-Impact Logging in Deramakot Forest Reserve, Sabah, Malaysia. *S. Mannan, P. Lagan and H. Matsubayashi (The Ecological Society of Japan, 2007)*

5. Deramakot Forest Shows Positive Conservation Impacts of Reduced-Impact Logging. *S. Mannan, K. Kitayama, Y.F. Lee, A.Y.C. Chung, A. Radin and P. Lagan (ITTO Tropical Forest Update, 18/2, 2008)*

6. Importance of Natural Licks for the Mammals in Borneon Inland Tropical Rainforests. *H. Matsubayashi, P. Lagan, N. Majalap, J. Tangah, J.R.A. Sukor and K. Kitayama (The Ecological Society of Japan, 2006)*

7. Natural-Licks Used by Orangutans and Conservation of their Habitats in Borneon Tropical Production Forest. *H. Matsubayashi, A.H. Ahmad, N. Wakamatsu, E. Nakazono, M. Takyu, P. Lagan, N. Majalap, and J.R.A. Sukor (The Raffles Bulletin of Zoology, 2011)*

8. Ecological Significance of the Patches Dominated by Pioneer Trees for the Regeneration of Dipterocarps in a Borneon Logged-Over Secondary Forest. *R. Aoyagi, N. Imai and K. Kitayama (ELSEVIER, 2012)*

9. RIL Implementation in Sabah: Success and Challenges. *A. Radin, P.L. Lohuji, S.A. Sani, R. Gampiluk, R. Anthony, R. Junaidi, C.C. Ving, J. Kulik and P. Kasun (16th MFC, 2011)*

10. Timber yield from second entry logging in the lowland mixed dipterocarp forest of Deramakot, Sabah. *J. Gobilik, R.C. Ong, S. Suparlan and P. Lagan (15th MFC, 2009)*

11. Options to maximize the benefits of REDD+ in Sabah: Suggestion based on a case study in Deramakot. *K. Kitayama, N. Imai, J. Titin, R. Ong, Arthur C & YF Lee (International Conference on Forest and Climate Change-Decoding and Realising REDD-plus in the HoB, 2010)*

12. Integration of carbon conservation into sustainable forest management using high resolution satellite imagery: A case study in Sabah, Malaysia Borneo. *A. Langner, H. Samejima, R. Ong,*

J. Titin & K. Kitayama. (International Journal of Applied Earth Observation and Geoinformation, 2012)

13. Co-benefits of Sustainable Forestry: Ecological Studies of a Certified Bornean Rain Forest. *K. Kitayama (Ecological Research Monograph, 2013).*

B. Basic Research

1. Chung, AYC (2005) Effect of Reduced Impact Logging (RIL) on soil beetles at different diameter cutting limits and slopes at the Deramakot Forest Reserve, Sabah. Paper presented at the Seminar on Forest Harvesting System (RMK8 Programme), Sepilok, Sandakan. 22 November, 2005.

2. Hasegawa, M., Masamichi, Kanehiro Kitayama, Tatsuyuki Seino & Arthur Y. C. Chung (2005) Logging effects on soil fauna in rain forests of Deramakot Forest Reserve, Sabah, Malaysia. Paper presented at the 2nd APN Workshop, Sepilok, Sandakan, Sabah. 30 November, 2005.

3. Akutsu K, Chey VK (2006) Assessment of bioindicator values of flying insects at a higher taxonomic level for different logging schemes in the lowland tropical rain forests of Deramakot, Sabah, Malaysia. In Lee YF, Chung AYC, Kitayama K (eds) Proceedings of the 2nd Workshop on Synergy between Carbon Management and Biodiversity Conservation in Tropical Rain Forests. Sabah Forestry Department & DIWPA, pp 71-78

4. Comparative Study on Mammalian Fauna in Different Harvesting Intensities with Reduced-Impact and Conventional Logging in Sabah, Malaysia. *G. Onoguchi and H. Matsubayashi (2007 – University of Kyoto)*

5. Records of Five Borneon Cat Species from Deramakot Forest Reserve in Sabah, Malaysia. *A. Mohamed, H, Samejima and A. Wilting (IUCN-CAT NEWS – 2009)*

6. Hasegawa, M., Hattori, T., Sueyoshi, M., Yoshida, S. & Arthur Y.C. Chung (2009). Co-benefits of sustainable forest management in the biodiversity conservation of decomposer communities. Poster presented at the Regional Forum on Enhancing Forest Connectivity & Corridors within the Heart of Borneo in Sabah, 26-27 October, 2009. Kota Kinabalu, Sabah.

7. Distribution of phosphorus in an above-to-below-ground profile in a Bornean tropical rain forest. *N. Imai, K. Kitayama and J. Titin (Journal of Tropical Ecology, 2010)*

8. Report on Wildlife Survey in the Southern Part of Deramakot Forest Reserve, Sabah. *R. Alfred and R. Sanggul (SFD Annual Report 2010)*

9. Ground Survey for Above ground Biomass Estimation at Deramakot Forest Reserve, Sabah. *Esther D.K.M & J. Titin (16th MFC, 2011).*

10. Density of the Vulnerable Sunda clouded leopard. *Neofelis diardi* in Two Commercial Forest Reserves in Sabah, Malaysian Borneo. *A. Wilting, A. Mohamed, L. N. Ambu, P. Lagan, S. Mannan, H. Hofer and R. Sollmann (ORYX – 2012)*

11. Camera-trapping Rates of Mammals and Birds in a Borneon Tropical Rainforest under Sustainable Forest Management. *H. Samejima, R. Ong, P. Lagan and K. Kitayama (ELSEVIER – 2012)*

12. Effects of Logging on Phosphorus Pools in a Tropical Rainforest of Borneo. *N. Imai, K. Kitayama and J. Titin (Journal of Tropical Forest Science, 2012)*

13. Effects of selective logging on tree species diversity and composition of Bornean tropical rain forests at different spatial scales. *N. Imai,T. Seino, S. Aiba, M. Takyu, J. Titin & K. Kitayama. (Plant Ecol.,2012).*

14. Density and Habitat Use of the Leopard cat *Prionailurus bengalensis* in 3 Commercial Forest Reserves in Sabah, Malaysia Borneo. *A. Mohamed, R. Sollmann, H. Bernard, L. Ambu, P. Lagan, S. Mannan, H. Hofer and A. Wilting (Journal of Mammalogy, American Society of Mammalogists – 2013)*

15. Tree Community Composition as an Indicator in Biodiversity Monitoring of REDD plus. *N. Imai, A. Tanaka, H. Samejima, J.B. Sugau, J.T. Pereira, J. Titin, Y. Kurniawan and K. Kitayama (ELSEVIER – 2013)*

16. First Molecular Data on Borneon Banteng Bos javanicus lowi (Cetartiodactyla, Bovidae) from Sabah, Malaysian Borneo *H. Matsubayashi, K. Hanzawa, T. Kono, T. Ishige, T. Gakuhari, P. Lagan, I. Sunjoto, J.R.A. Sukor, W. Sinun and A.H. Hamid (DE GRUYTER, 2014)*

17 The effects of reduced-impact logging practices on soil animal communities in the Deramakot Forest Reserve in Borneo. *Hasegawa M., Ito M.T., Toshida T., Seino T., Chung A.Y.C., Kitayama K. (Journal of Applied Soil Ecology, 2014)*

<u>THESIS</u> (Academic Research)

1. Logging Effect on Tree Species Heterogenity in Litter Fall and Carbon Content in Deramakot Forest Reserve *Lai Jia Woei (B.Sc. Forestry, UMS, 2008)*

2. Soil Organic Carbon Content Between Disturbed and Less Disturbed Forests in Deramakot Forest Reserve, Sabah *Jong Foh Yu (B.Sc. Forestry, UMS, 2008)*

3. A Comparative Study on Leaf Litter Decomposition Rate Between Disturbed and Less Disturbed Forests in Deramakot Forest Reserve *Yap Sue Sem (B.Sc. Forestry, UMS, 2008)*

4. Efficiency of Blanket and Selective Climber Cutting at Deramakot Forest Reserve, Sabah *Yeong Kok Loong (M.Sc. Forestry, UMS, 2009)*

5. Stand Structure, Biomass and Carbon Stocks of Tree Communities of Two Forest Reserves in Sabah *Mashor Bin Mohd Jaini (M.Sc. Forestry, UKM, 2011)*

Summary

Types of Research	Number of Published Papers										Total
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	
Applied Research	-	2	2	1	2	1	2	2	1		**13**
Basic Research	2	1	1		2	2	1	4	2	2	**17**
Academic Research				3	1		1				**5**
Total	**2**	**3**	**3**	**4**	**5**	**3**	**4**	**6**	**3**	**1**	**35**

APPENDIX 8: LIST OF COMPARTMENTS AND ASSOCIATED LAND-USE IN DFR

CPT_ID_new	Function	Area_GROSS	HCVF	Slope 0 - 15	Slope 15 - 25	Slope > 25	Riv_buf30m	Area_NETT
1	Production	553.2		502.9	40.1	10.3	1.8	541.2
2	Production	496.8		459.1	31.1	5.9	0.1	490.7
3	Production	341.5		298.6	36.1	7.0	0.0	334.4
4	Production	332.4	61.6	300.0	26.6	5.9		264.8
5	Production	461.5	142.6	368.4	77.6	15.9	0.7	302.4
6	Production	304.3		256.1	36.8	11.5	1.8	291.0
7	Production	563.5	1.4	454.8	91.6	17.3	1.4	543.5
8	Production	320.2		237.5	63.8	19.1	0.9	300.2
9	Production	565.8	18.1	459.4	91.4	15.3	4.8	527.7
10	Production	355.8	13.5	238.5	88.1	29.5	3.3	309.6
11	Production	653.1	189.2	516.0	111.6	25.6	5.4	432.9
12	Production	310.3	62.6	228.9	65.2	16.3	1.5	229.9
13	Production	606.9	144.7	447.7	122.1	37.4	6.1	418.7
14	Production	443.6	128.7	394.8	40.0	8.9	2.5	303.4
15	Production	193.2	91.1	178.1	10.8	4.3	0.9	96.9
16	Production	548.9	54.9	479.4	58.0	11.7	2.6	479.6
17	Production	564.5	30.3	490.0	61.9	12.9	1.2	520.1
18	Conservation	726.8		642.4	67.4	17.5	0.1	709.2
19	Production	542.8		507.3	30.5	5.2	0.1	537.5
20	Production	886.4		783.7	87.0	16.1	2.4	868.0
21	Production	367.2		273.6	73.7	20.1	1.3	345.9
22	Production	736.2		422.6	237.9	75.9	11.3	649.0
23	Production	377.8		285.3	66.9	25.8	2.0	350.0
24	Production	328.5		170.1	118.2	40.3	1.9	286.4
25	Production	298.9		178.5	93.5	26.9	2.6	269.3
26	Production	297.1		177.7	98.5	20.7	1.9	274.4
27	Production	430.0		274.5	123.9	31.9	4.0	394.1
28	Production	473.9		263.9	163.3	46.9	6.0	421.0

29	Production	442.2		214.6	162.9	65.0	3.0	374.3
30	Production	412.7		227.8	127.8	57.4	2.8	352.5
31	Production	432.2		295.0	104.7	32.7	0.4	399.0
32	Production	725.3		586.9	112.9	25.8	0.1	699.4
33	Production	450.8		371.8	65.4	13.8	0.0	437.0
34	Production	777.0		529.5	186.2	61.7	0.3	715.0
35	Production	427.7		220.7	136.1	71.0	0.1	356.6
36	Conservation	101.4		34.5	41.1	25.8	0.1	75.5
37	Conservation	115.0		67.9	34.9	12.3	0.5	102.2
38	Production	387.9		211.5	130.0	46.6	4.2	337.1
39	Production	167.9		90.3	62.6	15.2	0.4	152.3
40	Conservation	94.9		21.6	53.8	19.6	0.0	75.3
41	Conservation	97.2		30.4	44.5	22.4	0.1	74.7
42	Production	263.2		187.3	59.7	16.3	1.3	245.6
43	Conservation	492.1		314.4	137.0	40.8	3.8	447.5
44	Production	449.8		242.7	165.7	41.6	2.5	405.7
45	Production	315.1		144.5	131.1	39.1	1.2	274.7
46	Production	308.3		184.1	103.8	20.5	1.5	286.2
47	Production	379.0		258.4	103.3	17.4	1.4	360.1
48	Production	263.0		171.7	70.8	20.6	1.8	240.6
49	Production	533.3		303.5	187.5	42.5	7.0	483.8
50	Production	563.4		377.2	143.7	42.8	4.1	516.4
51	Production	317.3		191.0	96.2	30.2	2.2	284.9
52	Production	174.2		85.1	65.0	24.2	0.8	149.2
53	Production	325.7		233.6	74.4	17.9	0.2	307.7
54	Production	649.8		417.6	155.9	76.7	0.8	572.4
55	Production	300.4		196.5	81.2	22.8	0.4	277.2
56	Production	339.5		248.3	77.6	13.8	0.6	325.1
57	Production	568.5		490.3	62.3	16.2	1.1	551.3
58	Production	442.7		347.4	77.8	17.7	0.8	424.3

59	Production	417.0		210.9	139.7	66.5	0.6	349.8
60	Conservation	581.7		352.3	174.1	55.6	3.2	522.9
61	Production	490.9		363.3	106.4	21.4	3.7	465.8
62	Production	348.7		234.7	92.7	21.5	2.7	324.5
63	Production	508.9		335.6	150.5	22.9	3.2	482.9
64	Production	425.8		244.5	143.6	37.9	3.5	384.5
65	Production	395.9		206.6	155.1	34.3	1.1	360.5
66	Production	490.2		255.8	189.1	45.6	3.5	441.1
67	Production	328.2		161.0	140.1	27.0	0.7	300.6
68	Production	234.0		119.7	87.2	27.0	0.8	206.2
69	Production	486.1		261.1	181.2	44.0	3.0	439.2
70	Production	629.9		317.3	238.7	74.0	2.4	553.4
71	Production	545.1		339.9	173.2	32.3	2.3	510.6
72	Production	482.6		338.6	125.1	19.0	1.6	461.9
73	Production	166.7		87.3	55.4	24.1	0.7	142.0
74	Production	374.0		207.2	126.1	40.9	1.0	332.1
75	Production	133.4		43.2	52.2	38.1	0.6	94.8
76	Conservation	545.6		327.8	179.9	38.1	2.1	505.4
77	Production	572.3		376.7	151.5	44.3	5.4	522.6
78	Production	349.9		181.8	117.2	51.0	2.6	296.4
79	Production	348.8		151.1	88.5	109.4	1.6	237.7
80	Conservation	190.5		50.3	77.5	62.8	0.6	127.2
81	Conservation	229.9		69.2	78.4	82.4	0.6	146.9
82	Conservation	163.8		50.8	63.1	49.9		113.8
83	Production	140.7		67.4	55.2	18.1	0.0	122.5
84	Production	301.2		221.6	61.5	18.2	1.1	281.9
85	Production	598.9	29.7	466.7	104.2	27.9	3.0	538.3
86	Production	384.3	101.1	341.7	32.9	9.7	1.1	272.4
87	Production	448.5	2.8	392.0	48.3	8.2	0.9	436.6
88	Production	684.3	127.4	589.1	86.1	9.1	2.9	544.9

89	Production	458.9		376.5	55.8	26.8	0.9	431.2
90	Production	363.0		221.8	91.8	49.4	0.1	313.4
91	Production	371.7	16.5	264.6	72.7	34.5	2.0	318.7
92	Production	299.4	1.8	95.0	107.3	97.2	0.2	200.2
93	Production	138.9		34.4	55.2	49.3	0.2	89.4
94	Production	475.3		158.3	178.2	138.9	1.7	334.8
95	Production	340.2		197.0	122.4	20.8	1.5	317.9
96	Production	488.2		286.6	169.5	32.1	4.5	451.5
97	Production	314.5		202.3	95.0	17.2	1.1	296.1
98	Production	451.2		243.0	180.3	28.1	2.4	420.7
99	Production	519.4		240.1	184.8	94.5	3.0	421.8
100	Production	333.5		129.8	137.6	66.2	1.6	265.8
101	Production	540.4		242.7	218.9	78.8	1.7	460.0
102	Conservation	280.7		88.2	108.9	83.7	0.7	196.2
103	Conservation	92.8		17.9	28.4	46.5	0.1	46.1
104	Production	170.2		39.7	61.3	69.2	0.8	100.2
105	Production	531.7		197.4	215.1	119.5	2.3	409.8
106	Production	454.2		241.8	166.3	46.1	3.1	404.9
107	Production	693.4		456.7	190.9	45.1	2.3	646.0
108	Production	469.1	50.2	432.3	30.8	5.6	0.0	413.4
109	Production	260.3	18.4	193.7	58.7	7.8	0.2	233.8
109a	Community	7.1	7.0	6.7	0.0	0.0	0.0	0.1
109b	Community	9.7	3.6	9.7	0.0	0.0		6.0
110	Production	65.3		25.9	20.7	5.7	0.0	59.7
111	Production	511.3		270.3	190.8	50.3	0.6	460.4
112	Production	418.6		170.7	186.3	61.6	2.3	354.7
113	Conservation	128.5		36.0	47.5	45.1	0.1	83.4
114	Conservation	406.4		158.1	164.8	83.5	3.2	319.7
115	Conservation	349.0		95.7	144.1	109.3	2.1	237.6
116	Conservation	205.6		84.4	71.5	49.7	0.5	155.4

117	Production	394.6		222.6	138.1	33.8	0.9	359.8
118	Conservation	503.4	5.7	173.8	174.3	155.3	0.2	342.2
119	Conservation	243.5		86.2	109.2	48.1	0.5	194.9
120	Production	319.6	52.0	219.2	67.4	33.1	0.6	233.9
121	Production	573.0	100.2	403.1	127.0	42.9	1.1	428.8
122	Production	867.6	318.2	643.7	195.0	29.0	0.1	520.3
123	Production	501.1	32.4	384.2	101.9	15.0	0.7	453.1
124	Production	375.4	11.4	171.6	147.5	55.9	0.7	307.4
125	Production	358.0		193.5	137.9	26.7	0.9	330.4
126	Production	525.6		284.9	193.4	47.4	0.7	477.5
127	Production	463.9		212.2	185.0	66.8	0.7	396.3
128	Production	566.2		271.9	182.9	111.6	2.6	452.1
129	Production	432.4	100.2	238.5	111.0	82.9	1.0	248.4
130	Production	347.3	227.5	305.9	27.9	13.5	0.6	105.7
131	Production	233.7	152.7	205.7	19.6	8.5		72.6
132	Production	452.9	4.2	274.6	157.3	21.1	2.3	425.4
133	Production	452.5	0.0	363.6	71.8	17.1	1.1	434.3
134	Production	289.1	40.0	194.2	68.2	26.7	0.6	221.8
135	Production	698.8	492.4	680.7	13.9	4.1	0.4	201.9
136	Production	363.4	359.0	363.4				4.4
Total		**55,507.0**	**3,193.0**	**36,061.2**	**14,329.7**	**5,115.7**	**223,2**	**46,975.2**

APPENDIX 9: REVENUES AND COSTS PROJECTION FOR 2015 - 2024

ACTIVITIES	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	TOTAL
1. Timber Production											
• *Area (Ha)*	1,222	992	1,035	1,084	1,043	1,074	1,006	971	1,166	990	10,581
• *Production (M3)*	20,319	16,499	17,221	18,032	17,349	17,856	16,733	16,144	19,388	16,459	176,000
• *Revenue (RM)*	14,314,574	11,622,975	12,131,531	12,703,364	12,221,759	12,579,154	11,788,197	11,373,384	13,658,372	11,594,852	123,988,161
2. Contract Fee Harvesting (Rm180/M3)	3,657,492	2,969,766	3,099,706	3,245,815	3,122,760	3,214,078	3,011,982	2,905,994	3,489,827	2,962,580	31,680,000
3. Contract Fee Silviculture (Rm350/Ha)	350,000	350,000	350,000	350,000	350,000	385,000	385,000	385,000	385,000	385,000	3,675,000
4. Contract Fee - Upkeeping Resthouses, Genset, H20 Pump, Landscaping, Etc	175,864	184,657	193,890	203,583	213,762	224,450	235,673	247,457	259,830	272,822	2,211,988
5. Protection (Aerial Survey, Boats Etc,)	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	650,000
6. HCV Monitoring & Enhancement (Ou Nest Census, Cameras, Etc)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	300,000
7. Social Obligation (Jobs, Planting/Maintenance Contract, Boundary Brushing, Etc)	100,000	100,000	100,000	100,000	100,000	110,000	110,000	110,000	110,000	110,000	1,050,000
8. Buildings (Construction/Maintenance)	900,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	150,000	2,250,000
9. Purchase/Maintenance/Repair Of 4wds & Heavy Machinery	450,000	450,000	450,000	450,000	450,000	2,000,000	450,000	450,000	450,000	450,000	6,050,000
10. Office (Papers, Films, Auction Ads, Phone Bills, Copy Machine, Field Equipment, Etc,)	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	1,800,000
11. Forest Certification (Annual Audits & Recertification)	50,000	50,000	50,000	50,000	90,000	60,000	60,000	60,000	60,000	100,000	630,000
12. Fuel & Lubricants	770,000	770,000	770,000	770,000	770,000	770,000	770,000	770,000	770,000	770,000	7,700,000
13. Personnel Salary & Allowance	2,243,291	2,361,396	2,481,852	2,604,828	2,730,177	2,858,670	2,989,987	3,090,071	3,264,663	3,405,096	28,030,031
Total Costs (Rm)	**8,971,647**	**7,660,819**	**7,920,448**	**8,199,226**	**8,251,699**	**10,047,198**	**8,437,642**	**8,443,522**	**9,214,320**	**8,880,498**	**86,027,019**
Nett Benefit (Rm)	**5,342,927**	**3,962,156**	**4,211,083**	**4,504,139**	**3,970,059**	**2,531,956**	**3,350,555**	**2,929,862**	**4,444,052**	**2,714,353**	**37,961,142**

APPENDIX 10: DISCOUNTED CASH FLOW ANALYSIS

Discounted Cashflow Analysis at 7% interest rate

YEAR	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
TOTAL BENEFIT	14,314,574	11,622,975	12,131,531	12,703,364	12,221,759	12,579,154	11,788,197	11,373,384	13,658,372	11,594,852
TOTAL COST	8,971,647	7,660,819	7,920,448	8,199,226	8,251,699	10,047,198	8,437,642	8,443,522	9,214,320	8,880,498
NET BENEFIT	5,342,927	3,962,156	4,211,083	4,504,139	3,970,059	2,531,956	3,350,555	2,929,862	4,444,052	2,714,353
PRESENT VALUE										
DISCOUNT FACTOR	0.9346	0.8734	0.8163	0.7629	0.7130	0.6663	0.6227	0.5820	0.5439	0.5083
BENEFIT	13,378,106	10,151,956	9,902,943	9,691,336	8,713,945	8,382,022	7,341,097	6,619,413	7,429,249	5,894,235
COST	8,384,717	6,691,256	6,465,445	6,255,150	5,883,348	6,694,872	5,254,539	4,914,206	5,011,980	4,514,395
NET PRESENT BENEFIT	4,993,390	3,460,700	3,437,498	3,436,186	2,830,597	1,687,150	2,086,557	1,705,206	2,417,270	1,379,840

Discounted Cashflow Analysis at 10% interest rate

YEAR	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
TOTAL BENEFIT	14,314,574	11,622,975	12,131,531	12,703,364	12,221,759	12,579,154	11,788,197	11,373,384	13,658,372	11,594,852
TOTAL COST	8,971,647	7,660,819	7,920,448	8,199,226	8,251,699	10,047,198	8,437,642	8,443,522	9,214,320	8,880,498
NET BENEFIT	5,342,927	3,962,156	4,211,083	4,504,139	3,970,059	2,531,956	3,350,555	2,929,862	4,444,052	2,714,353
PRESENT VALUE										
DISCOUNT FACTOR	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855
BENEFIT	13,013,249	9,605,764	9,114,599	8,676,569	7,588,751	7,100,605	6,049,209	5,305,767	5,792,483	4,470,317
COST	8,156,043	6,331,255	5,950,750	5,600,181	5,123,656	5,671,381	4,329,844	3,938,965	3,907,771	3,423,817
NET PRESENT BENEFIT	4,857,206	3,274,509	3,163,849	3,076,387	2,465,095	1,429,223	1,719,365	1,366,802	1,884,712	1,046,501

APPENDIX 11: MONITORING REPORT OF PERMANENT SAMPLE PLOTS IN DERAMAKOT

Sabah Forestry Department, Locked Bag 68, 90009 Sandakan, Sabah.

Background

Since 1997, Deramakot was certified under the Forest Stewardship Council (FSC) certification scheme as a well-managed forest. Under this scheme, the management activities of Deramakot are regularly assessed by an independent organization to ensure that they meet the standards required by FSC. In 2008, Deramakot was re-assessed. One minor comment was '*measurement on harvest damage and mean annual increment growth of the residual stand from permanent sample plots were not incorporated in the revision of the forest management plan to clearly demonstrate that the volume harvested is not more than the growth within a harvest cycle*.' This comment is addressed in the present report.

Plot Establishment

In 2002/2003, the Deramakot managerial committee had established permanent sample plots in compartment 25, 33 and 12. In each compartment, one suitable area was selected. In this area, nine circular plots of 15-m radial were established before the compartment was logged in 2003/2004. The plots were located in a straight line at 10 m interval and at 5 m distance from the logging road edge. In these plots, trees ≥10 cm diameter-at-breast-heights (DBH) were identified and measured. The physical conditions of the trees were recorded either as sound (no sign of sickness and uniformly straight and round clear bole) or defected (crooked clear bole, broken branches, or attacked by pest). After logging, the physical conditions of the trees were re-assessed. A year after logging (2003/2004), the DBHs and physical conditions of the trees were again measured and assessed. These re-assessments activities were repeated every 12 months until 2006/2007. In fact, these activities are to be carried out annually within the 10-year period management plan of Deramakot.

Data Analysis

Data on DBH of trees in the plots from 2002/2003 until 2006/2007 were analyzed to estimate the mean annual increments (MAI) of bole volume of residual trees and to estimate volume of standing trees damaged by logging. Tree volume was estimated from its DBH using the formula as follows: $0.0015086*DBH^{1.882311}$ (Paul L. Lohuji, Sabah Forestry Department Forest Engineer, *personal communication*).

Results

The overall MAI of bole volume of residual trees over 10 cm DBH in Deramakot was estimated 3.54 m^3/ha/year (Table 1). A year after logging, five of the study plots had negative MAIs. Three to four years after logging, two of the MAIs became positive but three remained negative. At the same time, four other positive MAIs turned negative, which brought the total plots of negative MAIs in 2006/2007 census to seven.

The volume of standing trees damaged by logging was estimated 14.4 m^3/ha (Table 1). It was only 4.2% of the total volume of standing trees (average=345.3 m^3/ha) in the plots before logging. This amount included the volume of injured trees, which died four or five years after logging.

Table 1. Mean annual increments (MAI) of bole volume of residual trees over 10 cm DBH, volume of standing trees damaged by logging, and timber stock in the 27 permanent sample plots in Deramakot. Compartment 25 and 33 were logged in 2003 and compartment 12 was in 2004.

Comp.	Plot	Timber Stock (m^3/ha; Vol=0.0015086*DBH$^{1.882311}$)						MAI	Destroyed
		2002	2003	2004	2005	2006	2007	(m^3/ha/yr)	(m^3/ha)
12	1		453.58	474.92	474.92	420.01		-11.19	1.68
12	3		396.04	410.77	420.06	425.93		9.96	6.91
12	4		351.76	376.88	383.77	389.35		12.53	3.16
12	5		514.61	527.96	549.23	573.34		19.58	0.00
12	6		337.62	353.82	362.25	366.62		9.67	0.00
12	7		267.84	276.53	283.79	286.57		6.24	7.42
12	8		292.02	293.33	301.72	281.52		-3.50	16.90
12	9		488.72	406.96	395.19	396.82		-30.63	101.73
12	10		418.00	348.98	357.97	362.27		-18.58	1.76
25	1	177.50	133.15	135.41	136.96	164.78	178.96	0.29	50.70
25	2	217.54	217.65	228.15	233.49	236.83	185.05	-6.50	0.00
25	3	345.27	169.92	175.61	180.41	348.99	387.45	8.44	119.77
25	4	610.68	636.54	623.19	632.35	589.24	608.55	-0.43	16.26
25	5	525.75	347.19	332.26	353.96	328.35	351.89	-34.77	62.49
25	6	409.32	421.71	422.46	436.08	459.83	458.66	9.87	0.00
25	7	320.38	337.43	355.20	363.30	378.23	391.23	14.17	0.00
25	8	331.24	353.35	360.92	369.23	405.32	377.85	9.32	0.00
25	9	223.73	236.50	267.23	279.29	298.55	303.55	15.96	0.00
33	2	331.74	344.18	360.04	369.46	411.13	420.16	17.68	0.00
33	3	379.88	393.90	400.69	415.06	376.02	382.42	0.51	0.00
33	4	270.24	281.65	304.28	308.58	322.63	332.57	12.47	0.00
33	5	233.38	252.38	248.73	255.28	273.28	284.15	10.15	0.00
33	6	241.69	250.68	262.28	272.97	283.27	295.72	10.81	0.00
33	7	160.34	164.18	172.07	178.98	180.02	186.81	5.29	0.00
33	8	131.21	138.52	143.58	137.42	148.45	159.03	5.56	0.00
33	9	190.93	200.57	207.98	216.05	225.48	241.62	10.14	0.00
33	10	288.86	298.00	306.69	313.33	336.77	351.93	12.62	0.00
Average		**299.43**	**322.14**	**325.07**	**332.63**	**343.32**	**327.64**	**3.54**	**14.40**

Discussion

The total productive area in Deramakot is 42,789 ha (Deramakot Forest Management Plan, 2005–2014). Therefore, the volume of timber generated in Deramakot annually is estimated as 151,473 m^3/year (3.54 m^3/ha/yr multiplied by 42,789 ha). This amount of timber is 12 times greater than the volume harvested and damaged by logging in Deramakot a year. From 2002/2003 to 2006/2007, the average net area logged in Deramakot was 165.9 ha/yr and the average volume of timber harvested was 61.2 m^3/ha (based on Table 1 in Gobilik *et al*. 2008). Therefore, the average volume of timber harvested a year is 10,153 m^3/yr and that was damaged by logging is 2,389 m^3/yr (14.4 m^3/ha from Table 1 multiplied by 165.9 ha/yr), of which the total is 12,542 m^3/yr. In 40 years, the expected amount of timber generated in Deramakot and the expected amount of timber harvested and damaged by logging are 6,058,920 m^3 and 501,680 m^3, respectively. The balance between these figures is 5,557,240 m^3 and it indicates that for Deramakot, the volume harvested and damaged by logging is not more than the volume increment in the forest within a harvest cycle.

References

Deramakot Forest Management Plan, 2005–2014. Ten-year Forest Management Plan for Deramakot Forest Reserve. Sabah Forestry Department, Sandakan, Sabah.

Gobilik, J., Ong, R.C., Suparlan, S. & Lagan, P., 2008. Timber yield from second entry logging in the lowland mixed dipterocarp forest of Deramakot, Sabah. Paper in the 16th Malaysian Forestry Conference Proceedings, 20–25 October, Kuching, Sarawak.

APPENDIX 12: LETTER OF EIA EXEMPTION FROM EPD

JABATAN PERLINDUNGAN ALAM SEKITAR
(ENVIRONMENT PROTECTION DEPARTMENT)
Tingkat 1 - 3, Wisma Budaya
Jalan Tunku Abdul Rahman
Beg Berkunci 2078
88999 Kota Kinabalu, Sabah, Malaysia
No. Tel. : 088-251290/251291/267572/268572
No. Faks : 088-238120/238390 E-mel : jpas@sabah.gov.my
http://www.sabah.gov.my/jpas
(Sila catatkan **Rujukan fail Jabatan ini** *apabila menjawab)*

RUJUKAN : JPAS (S)/PK/100-1/1 KLT. 7 (11)
TARIKH : 2 Julai 2014

Pengarah
Jabatan Perhutanan
Km 11, Jalan Utara
Beg Berkunci 68
90009, SANDAKAN **Faks.: 088-672579**

Yang Berbahagia Datuk,

REQUEST FOR EXEMPTION UNDER SECTION 36, ENVIRONMENT PROTECTION ENACTMENT 2002: THE HARVESTING OF TREES IN DERAMAKOT FOREST RESERVE

Dengan hormatnya, saya merujuk surat Yang Berbahagia Datuk bil: JPHTN/PP (S) 100-1/1/1/ (KLT.34)/13 bertarikh 18 Jun 2014 mengenai perkara di atas. Surat pengecualian terdahulu dari jabatan ini rujukan JKAS (S)/PK/100-1/1 Klt. 5 (40) bertarikh 23 Disember 2008 adalah berkaitan dan dirujuk.

2. Selaras dengan seksyen 36, Enakmen Perlindungan Alam Sekitar 2002 jabatan ini bersetuju untuk meneruskan pemberian pengecualian pengemukaan dan kelulusan Laporan EIA ke atas aktiviti-aktiviti pengambilan dan penumbangan kayu balak di Hutan Simpan Deramakot.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA DENGAN BERSIH, CEKAP DAN AMANAH"

(YABI YANGKAT)
Pengarah

YAY/daa...

PEMULIHARAAN ALAM SEKITAR KE ARAH HIDUP YANG SEIMBANG

P.K. 0297 (L) - 2012