

**Deramakot Forestry District
Deramakot Forest Reserve (FMU 19A)
SABAH FORESTRY DEPARTMENT**



**MID TERM REVIEW
2ND FOREST MANAGEMENT PLAN
(2005 - 2014)**



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I. Background

Deramakot Forest Reserve (DFR) is managed by the Sabah Forestry Department (SFD) that consists of 55,139 hectares of Mixed Dipterocarp Forest. Due to previous logging using conventional technique, only 20% of the area is considered well stocked and more than 30% is covered by very poor forest with virtually no mature growing stock left. SFD has undertaken the objective to manage DFR based on sustainable systems in line with certification requirements of the Forest Stewardship Council (FSC). DFR was certified as Well Managed under the FSC accredited QUALIFOR program in July 1997 and has maintained the certification ever since.

The overall goal of the SFD in managing DFR is to have a multiple-use forest for economic, social and environmental purposes. The long-term objectives are as follows:

- To sustain production 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.
- To carry out silvicultural tending (10,000 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.
- To restore 2,000 ha during the plan period, in the southern part of DFR where stand stockings are absent or inadequate by using indigenous species, subject to financial constraints.
- To integrate all forest operational activities within the concept of conservation and protection so as to reduce the impact to the environment from fire and unauthorized encroachment by third parties.
- To maintain the ecosystem diversity at all levels for wildlife habitats, education, research, and eco-tourism purposes.
- To develop recreation and tourism within DFR and maximise economic, social and environmental benefits from them.
- To maintain and enhance HCVFs sites.
- To involve and increase the participation of the local communities in forestry activities particularly, social forestry activities in areas or compartments, which have been designated for them.

SFD manages Deramakot Forest Reserve (DFR) based on 10 year plans as well as annual / compartment operational planning. The second 10-Year Forest Management Plan (FMP) was prepared as a further guide on forest management in DFR from January 1, 2005 to December 31, 2014. The plan is an adaptation and continuation of planning processes that have been in place since the first FMP. DFR has several main areas for management: Commercial harvesting using Reduced Impact Logging (RIL) systems and silvicultural treatments aims to enhance the productivity of the residual forest areas. Part of the requirements for FSC Certification is a mid term review of the management planning system which will be detailed within this document.

II. Scope

The scope of this review is to summarize the operations during the initial 5 years of the current management plan relevant to the objectives and targets outlined in the FMP.

- √ Evaluate & provide an overview of the harvesting operations over the past 5 years
 - Production based on area & volume / Volume extracted vs AAC
 - Rate of extraction & extent of area vs 40-year harvest cycle
 - Evaluate harvest yields PSP & CFI data against sustainability & MAI / AAC
- √ Evaluate restoration & silviculture activities
- √ Evaluate social & environmental elements
- √ Evaluate CARs from SGS - addressed & outstanding in 2008/2009
- √ Document overview of monitoring results
- √ Evaluate economic review
- √ Provide recommendations
 - Harvesting system
 - Restoration
 - Economics
 - Social & environmental / HCVF

III. Overview of Harvesting Operations (2005-2009)

The total number of compartments in DFR is 135 with 118 compartments (51,666 ha) for natural forest management (NFM) and 17 compartments for conservation/protection (3,473 ha). However taking into account areas within the production compartments that cannot be logged for environmental reasons the net production area is approximately 42,845 ha, the total protection area would increase to 11,355 ha or 21% of the total area of DFR (Table 12 FMP).

Based on FMP Table 12: the net production area is further calculated to be:

Area Designation	Area (ha)
Gross Production Area	51,648
Less: Permanent Infrastructure	921
Riparian Reserves *	3,550
Slope > 25°	4,332
Net Timber Production Area	42,845

Production based on area & volume:

According to the FMP 2005-2014, yield regulation is calculated using a 40-year cutting cycle with a minimum economic cut of 45 m³ha⁻¹ to determine when a compartment is adequately stocked to justify a harvest. This translates to about 9 extracted trees ha⁻¹ of trees between 60 cm to 80 cm DBH. However, experience showed that only about 60% of trees marked for harvesting are actually removed due to defects and operational constraints. Therefore, a compartment is considered ready for harvest when it has at least 15 trees/ha to get 9 extractable trees/ha.

The annual area to be harvested within the estimated net production area of 42,845 ha in DFR would be approximately 1,000 ha based on a 40-year harvest cycle. However, based on inventory results only 86 compartments covering a total of 36,695 ha will be eligible for harvesting within a 40-year cycle. Thus the average annual area to be harvested on a sustained yield system must be reduced to 917 ha.

The FMP 2005-2014 has allotted an Annual Allowable Cut of 17,600 m³ based on estimated average logging on 48% of the compartment area with a minimum economic extraction rate of 40m³/ha.

Compartment stocking data (FMP Table 9) for planned harvesting 2005-2014

Compartment	Harvest Year	Size (ha)	DBH 40 - 60cm	DBH 60 - 80cm	DBH 80 - 120cm	Trees/ha 60+ cm	Volume 60+cm m ³ /ha
87	NS	460	5.7	18.5 (77.0)	2.2 (16.9)	20.7	93.9
48	2008	263	7.1	17.7 (75.3)	1.2 (9.1)	18.9	84.4
62	2007	333	18.1	12.1 (50.9)	2.9 (20.5)	15.0	71.4
85	2005	580	8.0	10.8 (44.2)	3.1 (20.9)	14.9	65.1
49	2008	501	7.8	12.1 (52.2)	2.2 (15.2)	14.3	67.4
57	2005	557	6.8	9.6 (39.0)	2.6 (11.2)	12.2	50.2
42	2008	255	10	9.1 (37.5)	3.9 (25.8)	13.0	63.3
56	2006	339	12.2	10.9 (44.6)	1.8 (9.0)	12.7	53.6
33	2006	451	3.3	11.9 (48.2)	1.3 (7.2)	13.2	55.4
1	2007	510	4.7	11.3 (47.5)	2.0 (14.3)	13.3	61.8
76	2009	554	6.1	6.5 (28.2)	4.8 (34.3)	11.3	62.5
28	2012	474	3.6	11.6 (50.5)	1.5 (10.7)	13.1	61.2
63	2009	500	8	11.0 (46.2)	1.0 (6.2)	12.0	52.4
60	2010	582	13.3	9.7 (41.2)	2.0 (12.3)	11.7	53.5
43	2012	493	5.8	11.2 (46.4)	1.4 (9.4)	12.6	55.8
47	NS	375	5.3	10.4 (43.6)	0.7 (5.6)	11.1	49.2
104	2011	178	8.8	9.1 (39.2)	1.3 (9.2)	10.4	48.4
25	2013	298	6.1	9.2 (39.0)	1.9 (13.4)	11.1	52.4
77	2010	591	11.2	6.3 (26.8)	2.4 (17.6)	8.7	44.4
108	NS	150	4.8	11.4 (47.3)	1.4 (10.9)	12.8	58.2
72	2011	503	4.9	11.0 (47.8)	0.6 (3.6)	11.6	51.4
4	NS	399	5.7	4.4 (19.6)	4.6 (34.6)	9.0	54.2
17	2014	577	6.6	10.1 (41.1)	1.3 (8.9)	11.4	50.0
107	NS	704	5.9	9.2 (38.2)	1.4 (8.9)	10.6	47.1
11	2013	666	6.9	8.8 (37.3)	1.2 (8.5)	10.0	45.8
71	2011	512	7.8	9.2 (38.9)	0.8 (5.9)	10.0	44.8
27	2013	425	5.6	9.4 (39.0)	0.1 (0.9)	9.5	39.9
20	2014	840	10.2	6.2 (26.0)	2.0 (15.3)	8.2	41.3
		13,070					

*NS = Not Selected

Volume Extracted vs AAC

Schedule of Harvesting Activities 2005-2009:

Year	Compartment #	Compartment Area (Ha)	Total Area (Ha)	Estimated Volume (m ³)
2005	57 & 85	557 & 580	1137	13,196.5
2006	56 & 33	339 & 451	790	12,942.5
2007	1 & 62	510 & 333	843	20,408.2
2008	42, 48 & 49	255, 263 & 501	1,019	16,694.1
2009	63 & 76	500 & 554	1,054	18,938.3
Total			4,887	70,379.6
Avg			977.4	14,075.9

Based on the above data the approximate extraction rate would be about 14.4 m³/ha, which is far below the objective of 40-45 m³/ha. SFD estimated a total volume of logs from 2005-2008 to be 63,241 m³ from a total gross production area of 3,789 ha that would average 16.7 m³/ha. However, based on previous experience only about 50% of the compartment areas is actually utilized for logging making the estimated net production area to be 488 ha/yr resulting in an average extraction rate to be 28.8 m³/ha.

Compartment harvest record data 2005-2009

Year	Compartment	Area (ha)	Net Harvest Area (ha)	Planned m ³	Actual m ³	M ³ /ha Net area
2005-2006	86 (85)*	580	350.00	15,008.00	9,449.69	27.00
2005	47 (33)*	451	270.33	8,786.89	8,295.99	30.69
2006-2007	64 (57)*	557	255.07	9,859.90	9,914.66	38.87
2006-2008	61 (56)*	339	176.89	8,521.32	8,663.73	48.98
2008-2009	78 (83)*	151	57.76	1,960.56	192.75	3.34 (incomplete)
2007-2008	71 (58)*	443	229.20	9,820.65	8,712.36	38.01
2008-2009	69 (62)*	333	195.94	10,669.33	6,114.69	31.21
Total		2,854	1,535	64,626.65	51,343.87	
			54%		79.4%	Avg =35.8

Based on actual harvest data from 2005-2008 the average harvesting intensity was 35.8 m³/ha from the net production areas of each of the harvested compartments. A total of 51,343.9 m³ was extracted from DFR from 2005-2008 that averages 12,836 m³/yr. The logging contractor was able to log an average 54% of the total area of each compartment using crawler tractors based on net area mapped within the harvesting block recorded in the CHP over the 4-year period. Thus DFR achieved 81.2% of the total planned volume and was 27% below the AAC of 17,600 m³/year.

Rate of extraction & extent of area vs 40-year harvest cycle

Based on a recent report by Gobilik et al that summarized harvesting data from 1995-2006 in DFR, the net harvest area was on average only 27.8% of the compartment area based on an estimated 30m access on either side of the pre-planned skid trails under Reduced Impact Logging (RIL) system using crawler tractors. As such, the estimated net production area is significantly less than the CHP net production area that would directly affect the average volume extracted/ha. The paper also has indicated a concern for under utilizing the harvest area within each compartment that can affect the sustainability of the forestry operation over the 40-year cutting cycle.

Compartment #	Compartment area (ha)	CHP - Net Production Area	Paper - Net Production Area
47	451	270.33	122
86	580	350.00	158
64	557	255.07	115

DFR is using a harvest cycle of 40 years to harvest compartments that have about 15 or more commercial trees per ha above 60cm DBH. One of the critical issues is the actual net harvest area within the compartment using crawler tractors, which is limited to a 30m reach from either side of the skid trail. Skid trails are pre-planned for RIL systems to minimize damage by machinery to extract the felled trees. DFR is now utilizing a Logfisher long distance cable winching system, which has the ability to pull logs for over 200m to a pre-determined skid trail or feeder road. SFD as of 2009 has started using a Logfisher in compartment 85 Block B. By using a Logfisher SFD should be able to significantly improve their ability to access most of the harvestable areas within each compartment.

DFR is planning to harvest 11,026 ha over the 10-year management plan from 2005-2014. This is slightly above the 9,170 ha estimated as sustainable by area calculations.

Forest Growth

To evaluate sustainability and growth of the forest stand SFD has implemented monitoring by using Permanent Sample Plots (PSP) & Continuous Forest Inventory (CFI) plots. PSPs were established in compartments 12, 25, 33 & 86.

PSPs were established prior to logging then monitored each year following logging to enable DFR to evaluate the damage from logging as well as growth of the residual forest stand. The PSPs are circular plots with a radius of 15m (0.071 ha). Tree volumes were calculated by using an allometric equation developed from 160 trees ranging from 10 to 120 cm diameter that were cut and measured for merchantable volume. The equation resulting from the 160 tree sample is:

$$\text{Volume (m}^3\text{)} = 0.000205 * \text{DBH (cm)} ^{2.3874}$$

Based on the allometric formula tree volumes were calculated for each tree in the PSP then totaled for the plot. The plot volume was then divided by the plot area (0.071 ha) to calculate tree volume per ha. The total tree volumes for each plot were recorded annually

that was used to calculate % damage based on reduction in volume in the year following logging. Forest growth was calculated as the mean annual increment (MAI) over the period following logging to the last measurement.

√ **PSP Summarized Data - Plots in Yellow have questionable or missing data**

Compartment 12			Compartment 25			Compartment 33			Compartment 86		
Plot	% Damage	MAI	Plot	% Damage	MAI	Plot	% Damage	MAI	Plot	% Damage	MAI
1	0	-8.2	1	20.0	5.5	2	42.3	20.1	1	0	0.4
3	0	8.9	2	0	-8.0	3	0	5.2	2	0	1.1
4	0	8.3	3	39.0	21.0	4	45.6	12.9	3	0	12.0
5	0	18.8	4	0	-4.6	5	11.4	9.8	4	68.2	10.3
6	0	8.7	5	37.3	-0.34	6	46.2	12.6	5	0	6.7
7	0	7.3	6	13.7	9.3	7	0	6.1	6	47.8	3.1
8	0	2.9	7	0	11.0	8	43.5	5.0	7	0	10.7
9	12.3	6.1	8	19.0	1.3	9	44.6	14.4	8	2.9	2.6
10	22.4	8.2	9	0	10.6	10	20.5	13.6	9	15.8	18.6
			10	100	0				10	48.3	16.1
Avg	3.9	6.8	Avg	22.9	4.9	Avg	28.2	11.0	Avg	16.4	8.2

√ **Continuous Forest Inventory**

Continuous Forest Inventory (CFI) is an essential part of yield regulation. The idea behind the establishment of CFI is to create a system of monitoring the development of the growing stock by repeated inventories of permanent plots or inventory lines in each compartment. The main objective of CFI is to compare 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.

The establishment of the inventory lines was carried out beginning in 2005. Five compartments were inventoried each year and up to 2008, 18 compartments were inventoried except for compartment 47, which was not carried out due to inaccessibility. In each compartment, 3 inventory lines were established at three different stratum. A portion of the inventory lines in each compartment will serve as permanent inventory lines, and will be repeatedly inventoried every 5 to 10 years. An important benefit of CFI is that it will make unnecessary to carry out a major inventory for the entire FMU for every new planning period.

IV. Restoration & Silviculture Activities

Planned and actual silvicultural activities from 2005-2009

Year	Compartment No.	Planned (Ha)	Compartment #	Actual (Ha)
2005	34 and 55	1,000	55, 85	1,000
2006	57 and 85	1,102	85, 33, 57	1,000
2007	33 and 56	774	57, 56, 58, 83	1,000
2008	1 and 62	840	21, 63, 20, 62	2,000
2009	42, 48 and 49	992	62, 76, 53, 42	1,000
Total		4,708		6,000

Silvicultural treatments for climber cutting and liberation thinning are ahead of planned schedule.

Enrichment planting records for 2005-2009

Compartment	Year planted	Planned (ha)	Area planted (ha)
117	2008	56	34.58
109	2008	100	42
	2009		30.80
108	2009	100	20
TOTAL		256	127.38

Based on PSP data acquired before and after logging the percentage of Dipterocarps remained fairly constant with the forest containing 29% Dipterocarps and 71% non-Dipterocarps, before logging and, 28% Dipterocarps and 72% non-Dipterocarps, after logging. However, SFD would like to increase the percentage of Dipterocarp trees in the forest to about 40% that would require a tree improvement program for enrichment planting and silvicultural treatments to favour Dipterocarp species.

V. Social Elements

Apart from some small human settlements that are located at the fringes of the Reserve, the entire forest area is uninhabited. SFD has procedures for continual communication of the local communities where by meetings are held several times per year.

Year	Meeting #	Participant	Social needs / Issues raised
26 Mar 2009	Siri 1/2009	All	<ul style="list-style-type: none"> ✓ Women's social development ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes installation in Karis-karis ✓ Courses ✓ Extraction of NTFP for villagers (own use)
Action taken by SFD: <ul style="list-style-type: none"> - Silvicultural and tree planting job opportunities in DFR for Year 2010 are open to villagers - Water gravity pipes installation in Karis-karis still pending, waiting for a location map to determine the distance between the water source to the village - Several activities for villages are suggested: tree planting course, first aid course and forest fire talk - Handicraft course will be held anytime by PACOS - DFR welcome the NTFP application from villagers 			
7 Aug 2008	Siri 2/2008	All	<ul style="list-style-type: none"> ✓ Women's social development ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes maintenance in Balat ✓ Forest fire talk ✓ Home stay programme (eco-tourism)
Action taken by SFD: <ul style="list-style-type: none"> - At least one female representative from each village. - Courses suggested for women's activities: no feedback from government agencies - Silvicultural, boundary brushing, tree planting activities in DFR for Year 2009 is open for villagers application - Water gravity pipe maintenance for Kg Balat accomplished - Forest fire talk still pending due to rainy season - Committee suggested to conduct visit to Sukau to learn about home stay programme 			
23 Apr 2008	Siri 1/2008	All	<ul style="list-style-type: none"> ✓ Women's social development ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes maintenance schedule for Balat and pipe distance survey for Karis- karis ✓ Forest fire talk ✓ Home stay course
Action taken by SFD: <ul style="list-style-type: none"> - Social development activities for women are suggested: handicraft, sewing course etc - No application from villagers for silvicultural jobs in DFR - Last phase of boundary brushing (from Cpmt 118-123; 15.5km) will start in May 2008 - Planting job under HSBC tree planting project in Cpmt 109 are available, each village is given 20 ha to plant. Jobs have to involve female too - Pipes and parts for water gravity in Kg Balat and Karis-karis are available, maintenance for Kg Balat will start in May 2008 - Water gravity pipe locations for Kg. Karis-karis and Tulang-tulang are inspected by DFR staffs and villagers - Forest fire talk still pending, date will be informed - Home stay course need to refer to Ministry of Tourism- stated by WWF 			
13 Dec 2007	Siri 3/2007	All	<ul style="list-style-type: none"> ✓ Women's representatives from each village ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes progress in Balat and Karis-karis ✓ Forest fire talk ✓ Home stay programme ✓ Illegal felling found (1 tree is felled at Sg. Makka)

Action taken by SFD:			
<ul style="list-style-type: none"> - Each village need to have a woman representatives to attend the committee meeting, names have to be submitted to the committee - Boundary brushing accomplished - Laran tree planting will be carried forward to year 2008 and lead by officers from SFM - Tree planting jobs for the balance area - 18ha at the DFR extension land will be opened for other villagers - Pipe purchasing is done, inspection for the gravity pipe location will be done soon by DFR and villagers - Home stay proposal has been submitted to WWF, however, no feedback yet - Illegal felling - co-operation from villagers is needed to overcome this matter 			
3 Oct 2007	Siri 2/2007	All	<ul style="list-style-type: none"> ✓ Job opportunities (tree plantings, boundary brushing) ✓ Water gravity pipes in Balat and Karis-karis ✓ Home stay course (in progress)
Action taken by SFD:			
<ul style="list-style-type: none"> - Silvicultural work for year 2008 in DFR is available until 31/12/2007 - Boundary brushing at the southern part of DFR is accomplished - Laran tree planting at the southern part of DFR cannot be done this year; postpone to year 2008 - Pipe purchasing for Balat and inspection for the gravity pipe location for Karis-karis are not able to carry out due to planting activities in Cpmt 135 - Proposal for home stay course for the villagers will be submitted to WWF Malaysia for further action 			
25 Apr 2007	Siri 1/2007	All	<ul style="list-style-type: none"> ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes in Balat and Karis-karis ✓ Forest fire prevention
Action taken by SFD:			
<ul style="list-style-type: none"> - Job opportunity with silvicultural contractor is still open until May - Boundary brushing, tree planting at the DFR extension area (56 ha) and the southern part of DFR will start in May 2007 - Pipe purchasing and maintenance of water gravity for Kg Balat will be done in May; re-confirm the length and location of the pipe for Karis-karis ✓ Forest fire talk by Kota Kinabatangan forestry District will be held in July 2007 			
13 Sept 2006	Siri 3/2006	Kg. Balat and Kg. Tangkong	<ul style="list-style-type: none"> ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes maintenance in progress ✓ Forest fire talk
Action taken by SFD:			
<ul style="list-style-type: none"> - Binuang planting at the southern part of DFR will start in Feb 2007 - Job opportunity for Tangkulap silvicultural treatment still open for all villagers living nearby DFR - New pipes to replace damaged/leaky water gravity pipes will only be sent over if the road from DFR to FSC Balat can be accessed. Date for maintenance is suggested to be in November 2006. The water sources for Karis-karis will need to be identified and marked on the map for further discussion. Trekforce volunteers will do the construct this activity - Forest fire prevention talk still pending, however pamphlet regarding this issue has already been distributed to villagers 			
23 Apr 2006	Siri 2/2006	All	<ul style="list-style-type: none"> ✓ Job opportunities (tree planting, boundary brushing) ✓ Water gravity pipes installation and maintenance
Action taken by SFD:			
<ul style="list-style-type: none"> - Signing contract ceremony for Phase II DFR boundary brushing (southern part) is on 10th May 2006 - Follow up to Silvicultural jobs in Tangkulap - Phase I for tree planting at the southern part of DFR will be done by villagers from Kg. Balat - DFO will write a proposal to PACOS regarding water gravity pipe installation in Karis-karis - Water gravity pipe and dam maintenance in Balat will be done together with villagers from Kg. Balat. Water gravity pipe (6 km) construction for Kg Desa Permai and Kg Tulang-tulang needs co-operation from PACOS and Raleigh Int. 			

25 Jan 2006	Siri 1/2006	Kg. Balat	<ul style="list-style-type: none"> ✓ Job opportunities (tree planting, boundary brushing) ✓ Gravity pipes maintenance in Kg Balat
<p>Action taken by SFD:</p> <ul style="list-style-type: none"> - Phase I boundary brushing from Sg. Tabalion Kecil (CPT 75) to Sg. Deramakot (CPT116)- 21,027 meter are accomplished by Kg. Balat villagers. Phase II will start on 15 Feb 2006, 18,000m, from Sg. Deramakot to Kg. Tulang-tulang. This task will be given to Kg Tangkong villagers - Phase I of the tree planting (800 seedlings) at the southern part of DFR will be done by Kg. Balat villagers - Few villagers who work for Bumi Hijau created problems for the contractor few years ago. However, DFO still trying to apply silvicultural jobs (20 teams is needed, 4000ha area in Tangkulap) with the contractor - AJK Kg Balat are suggested to form a committee to handle the gravity pipe maintenance as there's always no gravity water supply especially during the raining season. A gravity pipe maintenance list will be needed for further action 			
22 Apr 2005	Siri 1/2005	All	<ul style="list-style-type: none"> ✓ Job opportunities (tree planting, boundary brushing) ✓ Gravity pipes installation and maintenance ✓ Course: WWF- Conflicts between human being and wildlife ✓ Eco- tourism places for the area nearby Balat villages
<p>Action taken by SFD:</p> <ul style="list-style-type: none"> - No job vacancy (silvicultural) in DFR. However, an area of 1,500 ha of silvicultural jobs are available in the future. DFO will try to apply jobs for 20 people (quota) with the company for villagers - Funding from Japanese Consulate, KK for gravity pipes installation at Karis-karis still pending. A proposal will be sent to Mr Ricky A. Martin regards to this matter - DFR needs to inspect parts and pipes need to be repaired/ maintained for Kg Balat - The WWF course will be held on 23 Apr 2005, 10am 			

** All – Kg. Balat, Kg. Desa Permai & Kg. Pagar, Kg. Tangkong, Kg. Kuamut, Kg. Tulang-tulang

VI. Environmental Elements

SFD maintains wildlife monitoring through support of Japanese and European researchers from Universities working on wildlife projects throughout DFR and Tangkulap FR. SFD also conducts aerial surveys using helicopters to count Orangutan nests every 6 months. Based on the accumulated data acquired since the start of the surveys in 1999 show a steady state in the estimated population of Orangutan in DFR.

Orangutan (*Pongo pygmaeus*) commonly build nests on Laran and Binuang trees, which grow along the streams. Orangutan nest surveys have been conducted in a portion of Tangkulap FR every 6 months since 2003 with the last survey conducted in May 2008 using helicopters to count nests along fixed transects in both DFR and FMU 17 A. SFD has established up to 10 transect lines running north-south covering both DFR & Tangkulap FR where 2 observers count nests with a maximum sighting distance of 100m from each side of the helicopter. The Orangutan density is estimated using the methods & formulas developed by Ancrenaz et al., (2004 & 2005) to extrapolate nest counts along aerial transects using helicopters flying over the tree canopy:

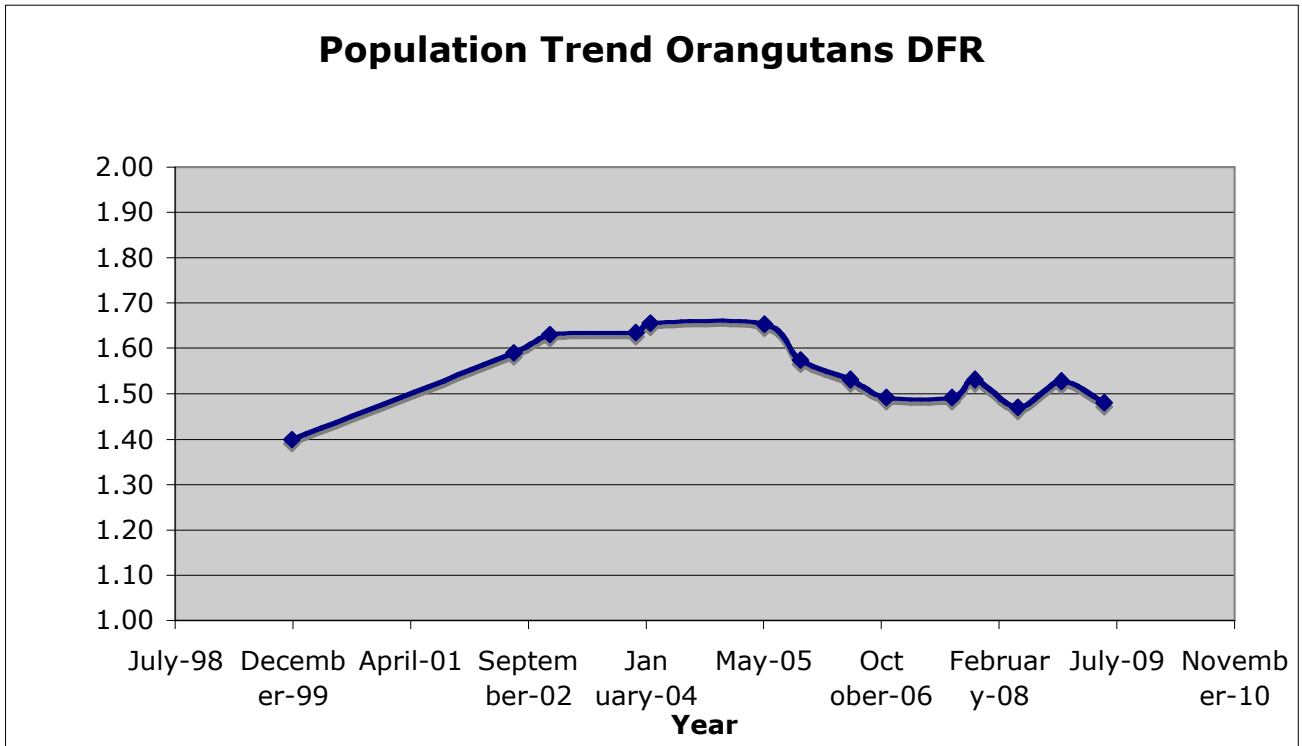
$$\begin{aligned} \text{Aerial Index} &= \# \text{ of nests counted} / \text{length of transect (km)} / 2 \\ D_{\text{nests/km}^2} &= \exp(4.7297 + 0.9796 * \text{Ln}(\text{AI})) \\ D_{\text{Orangutan/km}^2} &= D_{\text{nests/km}^2} / \text{prt} \end{aligned}$$

With p, the proportion of nest builders in a population (p=0.9 in Sabah); r, the daily rate of nest production (r=1.084 in Sabah) and t the nest decay rate (t=286.3 in Sabah,).

The aerial surveys on Orangutan nest census are taken about every six months in efforts to establish a long-term trend in Orangutan populations. The results are subject to a number of elements such as weather conditions, average altitude of flight path over canopy, speed of helicopter and canopy leaf fall of Laran trees thus resulting in variable estimates over time and fairly large confidence intervals. The results of Orangutan surveys since 2005 is presented in Figure 6.1. The May 2008 survey is lower than previous survey counts primarily due to flight path was higher than normal and Laran trees were defoliating whereby the nests were poorly visible.

The long term data (Fig 6.1) does not show any clear population trend but rather indicates a steady state of the population. As such the forestry operations and activities do not show any negative impacts to the populations of Orangutans in DFR.

Fig. 6.1 Population Trend of Orangutan 1999-2009



Camera Trapping for Wildlife:

Camera trapping is currently being conducted in FMU 19A and sections of FMU 17A under SFD & Center for Ecological Research Kyoto University Japan. Preliminary results from camera trapping over a period of about 400 days in 2006 showed that the total number of records of animals sighted per camera day for DFR was 0.277 while for Tangkulap was 0.105. A total of 18 species were recorded for DFR and 11 species were recorded in Tangkulap Forest Reserve.

Fig. 6.2: Camera trapping FMU 19A & FMU 17A (Hiromitsu Samejima - Center for Ecological Research, Kyoto University)

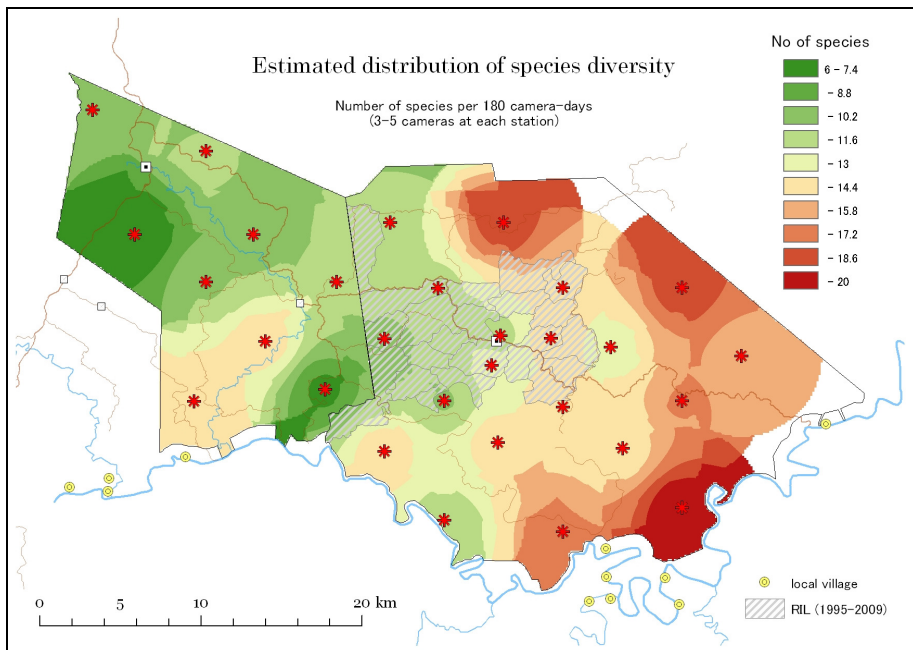


Table 6.1 The frequencies and occupancies of middle-large mammals and terrestrial birds captured by the camera traps during 180 camera-days census. (Hiromitsu Samejima - Center for Ecological Research, Kyoto University)

		Frequency		Occupancy	
		Averaged number of individuals captured in 180 camera-days		Proportion of census points captured in 180 camera-days	
		FMU17a	FMU19	FMU17a	FMU19
Mammals					
Moon Rat	<i>Echinosorex gymnurus</i>	3.78	2.25	0.56	0.70
Pangolin	<i>Manis javanica</i>	–	0.15	–	0.15
Western Tarsier *	<i>Tarsius bancanus</i>	0.89	0.15	0.44	0.10
Long-tailed Macaque *	<i>Macaca fascicularis</i>	0.22	0.25	0.11	0.20
Pig-tailed Macaque	<i>Macaca nemestrina</i>	4.00	4.15	1.00	0.90
Orang-utan *	<i>Pongo pygmaeus</i>	0.89	0.40	0.44	0.30
Common Porcupine	<i>Hystrix brachyura</i>	1.89	2.15	0.56	0.50
Long-tailed Porcupine	<i>Trichys fasciculata</i>	4.00	3.90	0.78	0.75
Thick-spined Porcupine	<i>Thecurus crassispinis</i>	0.11	0.50	0.11	0.25
Sun Bear	<i>Helarctos malayanus</i>	0.11	0.70	0.11	0.50
Yellow-throated Marten	<i>Martes flavigula</i>	0.11	0.30	0.11	0.20
Teledu / Malay Badger	<i>Mydaus javanensis</i>	0.89	2.15	0.56	0.55
Oriental Small-clawed Otter	<i>Aonyx cinerea</i>	0.44	–	0.33	–
Malay Civet / Tangalung	<i>Viverra zibetha</i>	0.33	3.00	0.22	0.80
Binturong / Bearcat	<i>Arctictis binturong</i>	–	0.05	–	0.05
Common Palm Civet *	<i>Paradoxurus hermaphroditus</i>	0.11	0.65	0.11	0.40
Banded Palm Civet	<i>Hemigalus derbyanus</i>	1.00	2.30	0.33	0.75
Banded Linsang	<i>Prionodon linsang</i>	–	0.25	–	0.10
Short-tailed Mongoose	<i>Herpestes brachyurus</i>	–	0.40	–	0.25
Clouded Leopard	<i>Neofelis nebulosa</i>	0.11	0.15	0.11	0.10
Marbled Cat	<i>Felis marmorata</i>	–	0.10	–	0.10
Leopard Cat	<i>Felis bengalensis</i>	0.11	0.05	0.11	0.05
Asian Elephant	<i>Elephas maximus</i>	0.11	0.25	0.11	0.10
Bearded Pig	<i>Sus barbatus</i>	4.44	3.05	0.89	0.85
Lesser Mouse-deer	<i>Tragulus javanicus</i>	8.33	15.35	1.00	1.00
& Greater Mouse-deer	& <i>T. napu</i>				
Bornean Yellow Muntjac	<i>Muntiacus atherodes</i>	1.11	6.90	0.33	0.90
Samber	<i>Cervus unicolor</i>	0.67	1.55	0.33	0.70
Tembadau	<i>Bos javanicus</i>	0.11	0.20	0.11	0.10
Birds					
Great Argus	<i>Argysianus argus</i>	1.89	5.65	0.56	0.95
Crested Fireback	<i>Lophura erthrophthalma</i>	0.44	2.05	0.44	0.45
Scaly-breasted Partridge	<i>Arborophila charltoni</i>	–	1.30	–	0.60
No. of mammalian species		23	28		
No. of terrestrial avian species		2	3		

*: Species known as basically aboreal

VII. CARs from SGS

Main Assessment 2007

CAR	Status	Description
01	closed	DFR Forest Manager has not taken reasonable measures to ensure that all activities within DFR are carried out through appropriate approval activities
02	closed	Inadequate implementation of communication system with local communities through DFRSFC.
03	closed	Inadequate training to forest workers and local communities involved in forestry operation
04	closed	Forest management plan (2005 - 2014) does not clearly describe the system to verify sustained yield through measurement of harvest damage and growth of residual stands and growth of the strata.
05	closed	DFR management has not adequately implemented RIL method of combination system of ground skidding and cable yarding.
06	closed	Inconsistent implementation of guidelines for forest road lay-out and construction particularly on drainage requirements.
07	closed	Accommodation for the patrol team near Kg Balat is not consistent with meeting management objectives

All CARs issued by SGS during the main assessment were closed out. During surveillance 01 SGS identified 3 minor CARs of which one was not appropriate as it was issued prematurely and should be addressed by this mid term review. Analysis of data on costs and revenues for Deramakot is presented in section 9 and the evaluation of measures taken for HCVF 7 & environmental protection are highlighted in sections 6 & 8.

Surveillance 01 - 2008

CAR	Description	Actions
12	Lack of review of the FMP that should include (7.2.2):	This review should address the CAR 12, <i>however the CAR is not valid as it was issued in 2008 & review is due in 2009 or 2010</i>
13	Inadequate analyses data on the costs, productivity and efficiency of forest management activities; the results of such analyses are incorporated into plans (8.2.9)	The review has included a summary analysis of costs, revenue and a brief description of productivity in respect to harvesting intensity of 35.8m ³ /ha which is adequate for economic viability and sustained yield. The current use of the Logfisher system should increase efficiency and productivity.
14	Lack of assessment on the effectiveness of the measures in the management of HCVFs (9.4.1).	Effectiveness of management can only be measured by trends. Trends of Orangutan populations are stable according to evaluation of nest counts from 1997-2009. In addition, camera trapping surveys shows populations of a number of RTE spp. occurring in DFR.

VIII. Summary Monitoring Results

Resource Monitoring:

Data from 38 PSP plots set up prior to logging assessed 1 year following logging to evaluate damage then monitored annually to measure growth of the residual stand. Results show that SFD RIL using crawler tractors averaged 18.4% damage to the stand based on volume reduction within the net production area. The mean annual increment (MAI) of stands following logging was 7.7 m³/ha/yr. As such SFD can demonstrate sustained yield based on an estimated average growth of 308 m³/ha for all species over a 40-year harvest cycle, which is significantly greater than the average extraction rate of 35.8 m³/ha that includes the average stand reduction of 18.4 %.

Social Monitoring:

SFD conducts regular meetings with local communities that borders the concession (see Section V). SFD generally meets with communities 2-3 times per year and maintains formal records of each meeting. The main topics of meetings focus on employment or project opportunities as well as social development for women. There is also active discussion and development of gravity feed water supplies to several villages from the DFR concession. SFD is actively supporting the establishment of water supplies from DFR to those communities. SGS has raised one CAR in 2007 assessment on implementation of social communication system that has been closed in 2008.

Environmental Monitoring:

The main environmental (HCVF) element associated with DFR is for the provision to provide adequate habitat and protection to maintain viable populations of wildlife and RTE species. SFD has been actively monitoring wildlife through several methods as well as through collaborative research with universities from Japan & Germany that use camera trapping methods to capture data on animals within the concession. In addition, DFR staff conduct regular monitoring of Orangutan using helicopter surveys to fly along set transect lines to count nests built by Orangutans. The data that has been collected from 1997 to 2009 indicates a stable population of Orangutan in DFR (Section VI).

A basic method used for evaluating trends in populations is through maintaining and compiling records of incidental sightings of wildlife by field staff during inventory work, silvicultural work, forestry operations, etc.

Table 8.1 Opportunistic sightings of wildlife by SFD staff from 2004-2008

	WILDLIFE SPECIES	Year / frequencies of accidental sightings & calls				
		2004	2005	2006	2007	2008
1	Orangutan (<i>Pongo pygmaeus</i>)	49	51	63	67	45
2	Pygmy Elephant	84	174	210	253	220
3	Tembadau / Banteng (<i>Bos javanicus</i>)	6	10	17	5	6
4	Clouded Leopard (<i>Neofelis diardi</i>)	13	11	8	3	4
5	Proboscis Monkey (<i>Nasalis larvatus</i>)	10	18	15	25	58
6	Borneon Gibbon (<i>Hylobates muelleri</i>)	16	20	35	52	52
7	Sun Bear (<i>Helartos malayanus</i>)	5	5	6	15	10
8	Red Leaf Monkey (<i>Presbytis rubicunda</i>)	4	27	21	6	5

9	Helmeted Hornbill (<i>Rhinoplax vigil</i>)	8	66	60	55	46
10	Storm Stork	2	1	3	2	4
11	Sambar deer (<i>Cervus unicolor</i>)	70	163	155	278	312
12	Bornean yellow muntjac (<i>Muntiacus atherodes</i>)	39	40	34	31	25
13	Bearded pig (<i>Sus barbatus</i>)	106	174	187	293	250
14	Lesser mouse-deer (<i>Tralulus javanicus</i>)	19	24	45	63	66
15	Greater mouse-deer (<i>Tragulus napu</i>)	24	48	55	60	55
16	Flat-headed cat (<i>Felis planiceps</i>)	2	10	12	9	5
17	Leopard cat (<i>Felis bengalensis</i>)	30	32	40	31	45
18	Marbled cat (<i>Felis marmorata</i>)				2	3
19	Bay cat (<i>Felis badia</i>)				1	1
20	Malay civet (<i>Viverra zangalunga</i>)	12	35	55	203	195
21	Common palm civet (<i>Paradoxurus hermaphroditus</i>)	12	23	33	76	105
22	Malay badger (<i>Mydaus javanensis</i>)	10	35	25	55	54
23	Oriental small-clawed otter (<i>Aonyx (Amblonyx) cinerea</i>)	1	5	8	17	10
24	Long-tailed macaque (<i>Macaca fascicularis</i>)	4	26	38	88	76
25	Pig-tailed macaque (<i>Macaca nemestrina</i>)	5	32	48	79	56
26	Moonrat (<i>Echinosorex gymnurus</i>)	7	7	14	13	25
27	Thick-spined porcupine (<i>Thecurus crassispinis</i>)	9	34	43	23	26
28	Pangolin (<i>Manis javanica</i>)	3	8	16	18	9
29	Rhinoceros Hornbill (<i>Buceros rhinoceros</i>)	9	42	55	56	89
30	Pied Hornbill (<i>Anthracoceros coronatus</i>)	6	10	39	46	78
31	Crocodile (<i>Crocodylus porosus</i>)	76	24	39	77	56
32	Argus Pheasant	9	19	33	46	98
33	Reticulated Python	5	11	15	18	20
34	Masked Palm Civet	1	3	7	3	8
35	Flying Lemur (<i>Cynocephalus variegates</i>)	6	13	13	4	3
36	Crested Serpent-Eagle (<i>Spirtonis cheela</i>)	10	20	44	56	67
37	Black Eagle (<i>Ictinaetus malayensis</i>)	10			34	55
38	Bay Owl (<i>Phodilus badius</i>)	1	9	19	3	3
39	Buffy Fish-owl (<i>Ketupa ketupu</i>)	3	26	35	16	10
40	Oriental darter		11	27	46	34
41	Hill Myrna (<i>Gracula religiosa</i>)		12	19	15	10
42	Flying fox (<i>Pteropus vampyrus</i>)		6	21	37	12
43	Crested Fireback		21	15	28	15
44	Black cobra		13	10	4	4
45	Monitor lizard		57	61	56	60
46	Binturong or Bear cat (<i>Arctictis binturong</i>)		2	4	3	16
47	Brown wood-owl (<i>Strix leptogrammica</i>)		3		7	12
	Totals	686	1,381	1,702	2,378	2,418

	Locally threatened
	Common

Results of the 5-year data set of incidental sightings indicate that the populations of wildlife are stable or possibly growing. There are of course additional reasons for increased sightings over time as staff become more aware of the wildlife and have improved skills to identify wildlife seen, heard or by signs. According to the data set a total of 47 species have been observed to inhabit DFR with 14 species being locally threatened.

WATER QUALITY MONITORING

Stream water quality monitoring in Deramakot Forest Reserve FMU 19 was conducted since August 1998.

The objectives are:

1. To study the effect of logging activities with applied Reduced Impact Logging method (RIL)
2. To investigate the soil erosion sedimentation rate in the water, as a stream water pollutant.
3. To study how long the pollution takes for water in these waterways to regain their quality after watershed has been logged.

DFR FMU 19 consists of 135 compartments. The stream water quality study was done in various compartments based on the DFO Deramakot yearly harvesting schedule, and there are 5 Compartments involved since year 2005 to 2008. Monitoring methodology is normally done within three different phases i.e. Stage 1, *before logging*, Stage 2, *during logging* and, Stage 3 *after logging stopped*. The data are being collected before any logging activities ~~due~~ to obtain intake data for the stream water within each compartment, and ~~the data will be~~ act as a control for comparing purposes of any increasing or decreasing stream water pollution during logging activities and ~~even~~ after logging has stopped.

The stream water quality monitoring on *Turbidity, Temperature, pH, Dissolved Oxygen, Conductivity, Color, Suspended Solids and Total Dissolved Solids* was done specifically to determine the changes during logging activities. The compartments involved are as follows:

√ COMPARTMENT NO. 40 A & B , (Year 2005)

Study of the effects of diameter cutting limits, Block A (dbh 45 cm - 55 cm, non dipterocarp) and, Block B (dbh 60cm - <120 cm, dipterocarp only)

Table 1. Comparison of stream water quality in block A and B After logging

Parameters	Average Block A	Average Block B	Conclusion
Turbidity NTU	673.8	541.03	28.20 % > B
Temperature C	26.0	25.41	2.32 % > B
pH	6.39	6.74	5.47 % > A
Dissolved Oxygen (mg/L)	5.54	3.79	46.00 % > B
Conductivity (ms/cm)	4.68	8.53	82.00 % > B
Color H	688.5	155.59	342.50 % > B
Suspended Solid (mg/L)	418.5	193.56	116.21 % > B
Total Dissolved Solids (mg/L)	159.0	91.0	74.72 % > B
Hydrology			
Stream discharge –m ³ s ⁻¹ km ²	36,156.81	47,951.09	11,794.28 = 32.61%
Sediments – kg km ²	1,033.51	938.81	94.7/0.0947 tons

The stream water *Turbidity, Temperature, pH, DO, Conductivity, Color, SS and TDS* showed a minimum differences ~~values~~ when compared between block A and block B, while **stream water discharge** in block B showed an increase of approximately **32.61%** as compared to block A during storm flow. The **sediments rate** increased ~~an~~ approximately **0.0947 tons** ~~compared~~ between block A and B. (Block A, 33.72 ha/0.3372 km and B, 2.688ha/2.688.0 km)

√ **COMPARTMENT NO. 61 , (Year 2006)**

Results

1. Stream water **turbidity increase** by approximately **17.7%** during logging
2. Temperature, no significant difference
3. pH, **decreases** approximately **5.52%** during logging
4. **Dissolved Oxygen, fairly consistent** before and during logging
5. Conductivity, **decrease** to **46.7 %** during logging
6. **Total Dissolved Solids, no significant difference** (Before logging mean value at 0.1029 mg/L. During logging, mean value at 0.1220 mg/L)

√ **COMPARTMENT NO.71 (Year 2006)**

Results

1. Stream water **turbidity increase** by approximately **207.2%** during logging
2. Temperature, no significant difference
3. pH, no significant difference
4. **Dissolved Oxygen, decreased** during logging by approximately **36.6 %**
5. Conductivity, increased to **81.0 %** during logging
6. Total Dissolved Solids, **no significant difference**. (Before logging mean value at 7.271 mg/L. During logging, mean value at 7.587 mg/L)

√ **COMPARTMENT NO. 64, (Year 2007)- Stream water quality and Hydrology**

Results

1. Stream water **turbidity increase** by approximately **66.2%** during logging
2. Temperature, no significant difference
3. pH, no significant difference
4. Dissolved Oxygen, **decreased** during logging by approximately **47.0 %**
5. Conductivity, **increased** to **75.2 %** during logging
6. Total Dissolved Solids, **increased** by approximately **79.1%** during logging
7. Salinity, fairly consistent (before logging 1.652 ppt, during logging 1.440 ppt)

Hydrology

Stream discharge - **increased** during logging by approximately **98.719 %**

√ **COMPARTMENT NO. 69 (Year 2008) - Stream water quality**

Results

1. Stream water turbidity **increase** by approximately **157.2%** during logging
2. Temperature, no significant difference
3. pH, no significant difference
4. Dissolved Oxygen, **decreased** during logging by approximately **11.9 %**
5. Conductivity, **decreased** to **17.09 %** during logging
6. Total Dissolved Solids. (Before logging mean value at **0.040417 mg/L**. During logging, mean value at **0.064167 mg/L**. **Increased** by approximately **58.7%** during logging)

CONCLUSION

The stream water quality results in Compartments No. 40, 61, 64, 69 and 71 is the real picture of the effect of harvesting with applied Reduced Impact Logging (RIL) technique in DFR. The main effect of logging is siltation of streams that is reflected by Turbidity and Total Dissolved Solids (TDS). There were several discrepancies in readings between Turbidity & TDS where it is believed TDS represents the best measure of siltation. TDS values for compartments 61 & 71 resulted in no significant difference with the control measure while compartments 64 & 69 showed higher TDS values of 79% & 58% respectively. Based on the 4 compartment measured there was an overall average of 34% over the control sites that does not appear to be significant. The impact on each compartment did vary up to 79% that should be improved over time. The values obtained does not include measures of recovery following completion of harvesting.

IX. Economic Summary

DFR has an annual budget for expenditure allocated from the state government that is not directly related to annual sales of timber. The following table summarizes the annual expenditure by SFD on DFR operations.

Cost Category	YEAR & ACTUAL AMOUNT			
	2005	2006	2007	2008
Contract Fee - Harvesting	1,485,260.40	2,096,788.20	1,776,043.10	1,267,517.00
Contract Fee - Planting	112,317.30	112,317.30	56,285.98	12,587.50
Contract Fee - Silviculture	250,000.00	250,000.00	250,000.00	450,250.00
Contract Fee - Upkeeping Resthouses, Genset. Landscaping	56,706.00	244,496.02	183,659.14	261,947.90
Protection (Aerial Survey, Boats, etc.)	19,983.50	19,983.50	63,820.40	93,981.04
Road/Bridge Construction & Maintenance	4,900.00	1,470,840.00	1,959,388.06	1,387,172.09
Maintenance/Repair of 4WDs & Heavy Machinery	505,634.35	447,221.95	500,452.00	243,754.60
Buildings (New, Maintenance & Repairs)	202,741.00	208,405.50	38,722.57	118,981.67
Office Expenses,	287,117.51	309,475.73	74,221.29	87,938.43
Salary & Allowances	1,251,320.06	1,035,743.47	1,214,311.40	1,214,311.40
External auditing for certification	12,850.87	24,621.61	66,841.01	0.0
Skyline parts	39,053.80	0.0	0.0	0.0
Fuel (petrol, diesel & lub)	278,848.96	390,001.52	496,460.19	418,298.00
ACTUAL TOTAL	4,506,733.75	6,609,894.80	6,680,205.14	5,556,739.63
BUDGET	5,000,000.00	6,849,260.76	7,000,000.00	5,303,510.00

Annual revenue earned from auctions is the main income from DFR. Since the area has received FSC Certification the log sale prices tend to be significantly higher than the normal log price in Sabah. SFD sells logs at log auctions held in Sandakan, Sabah when there is adequate volume to attract local and regional buyers of certified tropical logs. The logs are arranged into Lots based on common species such as Selangan batu & Keruing used in making outdoor furniture and YS/WS/MP for plywood. Annual revenue earned from log auction sales are as follows:

Year	Batch #	# Logs	Volume (m3)	Revenue (RM)
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2005	1	937	3,225.23	2,027,007
	2	1299	4,495.77	2,753,883
	3	948	2,950.38	1,811,136
	4	250	753.70	419,185
	Residue			34,653
Total 2005		3,434	11,435.08	7,045,866

Year	Batch #	# Logs	Volume (m3)	Revenue (RM)
2006	1	1550	5,279.81	3,061,783
	2	1479	5,322.76	3,499,550
	3	1,508	5,526.57	4,817,039
	Residue			153,434
Total 2006		4,537	16,129.14	11,531,808

Year	Batch #	# Logs	Volume (m3)	Revenue (RM)
2007	1	1,213	4,149.11	3,579,643
	2	1,427	5,058.82	3,979,529
	3A	523	1,855.48	1,532,115
	3B	574	2,299.37	1,723,966
	Residues			65,466
Total 2007		3,434	11,435.08	10,880,700

Year	Batch #	# Logs	Volume (m3)	Revenue (RM)
2008	1A	1,097	3,388.19	2,290,123
	1B	791	2,428.08	1,753,451
	Resale	68	299	251,235
	Residues			128,107
Total 2008		1,956	5,816.27	4,404,917

Sales of logs are directly based on forest operations that include development of harvest plans; reduced impact logging and transporting of logs to stumping points that are highly dependent on weather conditions. Significant rainfall in 2008 drastically reduced the harvesting operations and transport of material to stumping from log landings in the forest. In addition sales recorded in early 2008 may reflect forestry operations in 2007.

In general the total expenditure recorded for 2005-2008 was RM 23,353,571 while total log sales over the same period was RM 33,863,291 recording a gross profit of RM 10,509,720. The ratio of gross profit over total revenue yields a 31% margin that indicates the overall operations were profitable over the period.

Year	2005	2006	2007	2008
Costs	4,506,733	6,609,894	6,680,205	5,556,739
Volume m ³	11,435	16,129	11,435	5,816
Estimated harvest area (ha)	445	389	300	273
Cost/m ³ (RM/m ³)	394	409	584	955
Costs/ha	9,904	16,161	11,438	20,354

The average extraction rate of 35.8 m³/ha using crawler tractors is adequate for economic viability and should be within sustained yield estimates based on achieving an average MAI of 2.0 or more m³/ha/yr on a 40 year rotation. The use of Logfisher harvesting system should increase the ability to reach areas of the harvesting compartment not available to crawler tractor systems which would increase efficiency of the harvesting operations as the machinery can extract more trees over a wider area of the compartment with less movement.

Costs of production are directly related to volume of logs that can be extracted and sold within the year. As DFR can receive significant rainfall for extended period that hamper production due to use of Reduced Impact Logging systems and FSC Certification requirements, SFD needs to monitor rainfall and report downtime due to adverse weather and field conditions. SFD also needs to evaluate potential additional equipment or systems to support production and transport of logs during periods of moderate rainfall while maintaining environmental standards.

Logfisher: SFD has started to use Logfisher long distance cable system for Reduced Impact Logging (RIL) system. SFD has started in 86 block B which is fairly steep area of compartment 86. The total area of 86B is 214.8 ha with a net loggable area of 157.4 ha which is 73.2% of the block area. A total of 964 trees are marked for felling include 830 Dipts, 127 Non-Dipts, 7 Pioneers and 335 trees are marked for protection based on spp and habitat. Estimated volume of trees to be harvested is 4,530 m³ within a gross production area of 154 ha measure by calculating a 200m cable reach from pre-planned skid trails. The planned extraction for trees within 30 m of each skid trail is 377 trees (1,936 m³) while the Logfisher will pull an additional 514 trees (2,477 m³) from the same skid trails. The estimated extraction rate for using the tractor and Logfisher is 28.8 m³/ha. The use of the Logfisher system should not increase the extraction rate but will increase the net production area within the compartment and the total volume output for each compartment without the need for additional skid trails.

X. Recommendations

Harvesting system

SFD has been successfully operating Reduced Impact Logging system using crawler tractors for the past 5 years, however the system has significant limitations on the ability to access significant portions of compartment areas. SFD is now using Logfisher cable system that can provide a significant improvement in the reach of potential harvest trees without significant damage to the forest quality.

In addition as DFR is not logging in accordance to the prescribed AAC the economics can be improved by enabling SFD to access a higher percentage of the compartment area to become more efficient. SFD will need to set up additional PSP to monitor harvest damage, residual stand conditions and subsequent re-growth under the Logfisher RIL harvesting system.

Based on PSP data the SFD is growing significantly more volume than is being extracted and damaged under the RIL system thus the forest area will be enriched with harvestable trees over the next harvest cycle. However, the percentage of dipterocarps in the forest (29% Before Logging / 28% After Logging) is considered too low by SFD and would like to increase the percentage of Dipterocarp trees to above 40%. To accomplish this objective SFD will need to favor Dipterocarp trees under its various activities such as harvesting, silvicultural treatments and enrichment planting. Thus enrichment planting should predominately use Dipterocarp seedlings. Silvicultural treatments should favor removal of competition from Dipterocarp Potential Crop Trees to enhance re-growth. Harvesting should be planned to cut a greater proportion of non-dipterocarps. This could be accomplished by ensuring the cutting diameter limit for Dipterocarp trees is 10-15cm greater than non-dipterocarps.

Restoration & Silviculture

DFR has some poor quality forest areas that need restoration. Some of the areas are being planted using native species with the support of Donor organizations. DFR is on schedule with silviculture treatments mainly climber cutting prior to harvesting within the compartment to reduce felling damage and potential safety risks. Silvicultural treatments have also been proven to significantly increase growth of potential crop trees by over 100% that is in line with objectives of improved forest management. SFD needs to evaluate the need for restoration of very poor quality forest compartments as well as for silvicultural treatments to improve productivity.

Economics

Results of the summary analysis of the economics of DFR indicate the FMU is economically viable under the current management system. However, DFR needs to be consistent to extract a minimum target volume to ensure economic viability each year of operations that cover both administrative and operational costs. The use of the Logfisher should help to make logging operations more efficient and increase log extraction for each compartment due to increased access. SFD needs to evaluate the number of trees; logs & volumes for both compartments as well as for annual production records to better calculate costs and revenue over annual operations.

Social & environmental / HCVF

SFD has been consistent in holding periodic meetings with local communities to maintain a constant dialogue on issues concerning the communities. The main subject tends to focus on water supply from the forest and on potential for work. SFD needs to maintain this system and summarize the key issues raised and activities undertaken each year.

SFD has endeavored to protect the environmental issues related to DFR by prohibiting hunting, identification and protection of conservation values that includes wildlife habitat, salt licks, use of RIL to minimize impacts of harvesting as well monitoring key wildlife species. The results of monitoring indicate a stable population of Orangutan observed over the past 5 years based on 6 monthly aerial nest counts. Numerous wildlife species observed from incidental sightings and through camera trapping by researchers from Japan and German Universities projects operating in DFR.

SFD will also need to continue monitoring of wildlife following completion of research projects and should look to continue the system of using camera trapping to monitor wildlife within DFR as well as continuing to evaluate populations trends through incidental sightings. As the objective is to manage the DFR FMU for both production and preserving environmental functions of the forest, there should be an emphasis on monitoring trends of populations to monitor any significant decrease that may result from activities by SFD in its management system.