インドネシア国泥炭・森林における
火災と炭素管理プロジェクト
終了時評価調査報告書
（科学技術）

平成 26 年 2 月
（2014 年）

独立行政法人国際協力機構
地球環境部

環境
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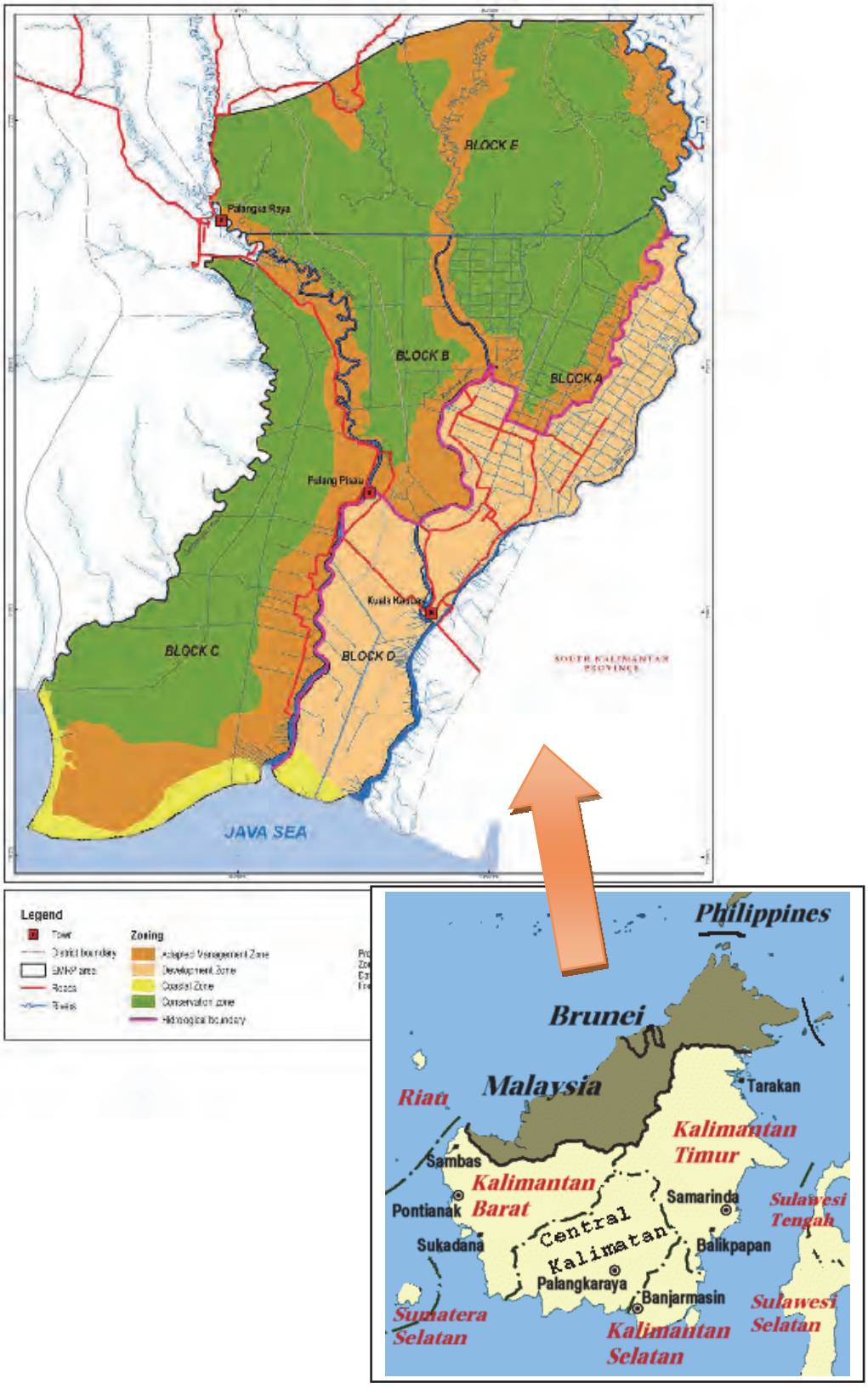
目　　次

付属資料

1. 合同運営委員会及び合同調整委員会協議議事録（Minutes of Meeting）
2. 合同運営委員会及び合同調整委員会協議議事録（追加事項）
3. レビュー報告書
4. 収集資料一覧

プロジェクトの位置図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BLOCK D
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Legend
Zoning
Philippines
Brunei
Malaysia
Riau
Tarakan
Kalimantan Timur
Sambas
Kalimantan Barat
Pontianak
Samarinda
Sulawesi Tengah
Central Kalimantan
Sukadana
Balikpapan
Palangkaraya
Banjarmasin
Sumatera Selatan
Kalimantan Selatan
Sulawesi Selatan

写　　真

パランカラヤ大学学長表敬

中部カリマンタン州泥炭地帯の火災跡

炭素評価コンポーネントの観測機器と
泥炭地の森林

炭素評価コンポーネントの観測タワー

炭素管理コンポーネントの
植林事業サイト

合同調整委員会

略　語　表

（本文中に使用される略称のうち、重要なものを以下に示す。）

略語	正式名称	和名
BPPT	Badan Pengkajian dan Penerapan Teknologi	技術評価応用庁
BSN	Badan Standardisasi Nasional/National Standardization Agency	国家標準機構(国家標準局)
C/P	Counterpart	カウンターパート
DNPI	National Council for Climate Change	国家気候変動協議会
F/S	Feasibility Study	実現可能性調査、フィージビリティ・スタディ
FORDA	Forestry Research and Development Agency	林業省森林研究開発庁
IBSAP	Indonesian Biodiversity Strategy and Action Plan	生物多様性戦略及び行動（活動）計画
IPCC	Intergovernmental Panel on Climate Change	気候変動に関する政府間パネル
ISO	International Organization for Standardization	国際標準化機構
JCC	Joint Cordinating Committee or Joint Cordination Committee	合同調整委員会
JICA	Japan International Cooperation Agency	国際協力機構
JSC	Joint Steering Committee	合同運営委員会
JST	Japan Science and Technology Agency	科学技術振興機構
LAPAN	Lembaga Penerbangan dan Antariksa Nasional ：National Institute of Aeronautics and Space	国家航空宇宙局
LIPI	Indonesian Institute of Sciences	インドネシア科学院
LULUCF	Land use, Land-use change and Forestry	土地利用、土地利用変化及び林業部門
MRV	Measurement, Reporting and Verification	計測・報告・検証
PM	Peatland Management	統合的泥炭地管理プログラム
R/D	Record of Discussions	討議議事録

REDD+	Reducing Emissions from Deforestation and Forest Degradation in developing countries; and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries	開発途上国における森林減少・劣化等に由来する排出の削減等（開発途上国における森林減少・劣化に由来する排出の削減並びに森林保全、持続可能な森林経営及び森林炭素蓄積の増加の役割）
SATREPS	Science and Technology Research Partnership for Sustainable Development	地球規模課題対応国際科学技術協力
SBSTA	Subsidiary Body for Scientific and Technological Advice	科学及び技術の助言に関する補助機関
UKP4	The presidential working unit for development supervision and control	大統領開発管理調整ワーキングユニット
UNFCCC	United Nations Framework Convention on Climate Change	気候変動枠組み条約
UNPAR	Universitas Katolik Parahyangan	パランカラヤ大学

評価調査結果要約表

１．案件の概要		
国名：インドネシア共和国		案件名：泥炭・森林における火災と炭素管理プロジェクト
分野：環境・エネルギー		援助形態：地球規模課題対応国際科学技術協力（SATREPS）
所轄部署：地球環境部森林・自然環境グループ		協力金額（評価時点）：4.5 億円
協力期間	（R/D）：2009 年 12 月～2014 年 3 月	先方関係機関：国家標準機構（BSN）、技術評価応用庁（BPPT）、国家航空宇宙局（LAPAN）、インドネシア科学院（LIPI）、林業省森林研究開発庁（FORDA）、パランカラヤ大学（UNPAR）
	（延長）：	日本側協力機関：北海道大学、科学技術振興機構（JST）、国際協力機構（JICA）
	（F/U）：	他の関連協力：

１－１　協力の背景と概要

インドネシア共和国（以下、「インドネシア」と記す）の低湿地には広範囲な熱帯泥炭が存在しており多量の炭素が蓄積されているが、20 世紀末の大規模な運河掘削と熱帯泥炭林の伐採の結果、火災や微生物分解による大気中への炭素放出が急速に進んでいる。熱帯泥炭の分布は東南アジアで 68%と圧倒的に多く、その 85%はインドネシアに存在する。1997 年から 1998 年に発生したエルニーニョ現象による火災では、泥炭を中心とする火災でインドネシア全体から 0.81Gt から 2.57Gt の炭素が発生したと推定されている。

泥炭湿地から発生する炭素の管理の重要性が指摘され、昨今の気候変動をめぐる国際世論も相まって、泥炭湿地の管理の重要性が広く認識されるようになった。また、地球規模での環境問題に加え、泥炭地周辺の住民への健康被害、泥炭劣化に伴う雨期における土砂災害も深刻な状況である。

衛星を用いた火災検知と火災予想モデルの開発、泥炭や森林の高精度測定、効率的水管理及び泥炭のクリーン開発メカニズム（CDM）化や REDD 化の提言をするプロジェクトの要請が日本政府に承認された。2009 年 3 月に詳細計画策定調査を実施し、SATREPS 協力の枠組みにつき協議・合意し、同年 12 月 10 日に討議議事録（R/D）の署名を行い、プロジェクトが開始された。

プロジェクト終了を 2014 年 3 月に迎えることから、終了時評価調査を実施することになったものである。なお、本評価調査には JST からの参加も得て実施した。

１－２　協力内容

（1）プロジェクト目標

泥炭・森林における火災と炭素管理を行うモデルが構築される。

（2）成果

1）　火災検知及び火災予測システムが構築される。
2）　炭素量評価システムが構築される。
3）　炭素管理システムが構築される。
4）　統合的な炭素管理を行うための基盤が整備される。

（3）投入（評価時点）

日本側：総投入額　4.5 億円

長期専門家派遣	2 名	機材供与	約 8,960 万円
短期専門家派遣	239 名	ローカルコスト負担	約 8,086 百万ルピア（約 7,120 万円）
研修員受入	20 名		

相手国側：

1）カウンターパート（C/P）配置： UNPAR、LIPI、LAPAN、BSN、BPPT、FORDA
2）事務所スペース・設備（BSN、UNPAR）及び各実施機関によるプロジェクト活動費（職員の国内旅

費等)。例えばLIPIは675百万ルピア割り当て。		
２．評価調査団の概要		
調査者	神内圭（総括）JICA 地球環境部森林・自然環境保全第一課長 三戸森宏治（評価計画）JICA 地球環境部森林・自然環境保全第一課 齋藤哲也（評価分析）日本工営株式会社 中村牧生（JST評価）JST地球規模課題国際協力室 主任調査員	
調査期間	2013年10月13日～2013年10月31日	評価種類：終了時評価
３．評価結果の概要		

３－１　実績の確認

（1）（成果1）火災検知及び火災予測システムが構築される。

（指標1）：1-1　1km^{2}以上の森林火災において、3つのモデル・コミュニティが16時間以内に火災情報を得る。また、延焼予測情報を8時間以内に受け取る。

1-2　森林火災探知精度が80%以上となる。

1-3　森林延焼予測の精度が50%以上となる。

成果1はほぼ達成されている。

目標である1km^{2}以上の火災を80%の確度で検知し、16時間以内に周辺のターゲット村落に情報を伝達すること、また50%以上の確度での火災延焼予測システムが構築され、試験も実施されている。プロジェクト終了時までに、予測モデルの精度に関する確認を更に進める必要がある。

（2）（成果2）炭素量評価システムが構築される。

（指標2）：中央カリマンタン州の炭素量評価モデルが20%以下のエラー発生率で作成される。

成果2はほぼ達成されている。

炭素量評価は1）航空レーザー計測、2）年間CO_2収支と地下水位の相関関係分析、3）陸域生態系モデルから行われている。1）及び2）については完成し、3）についてはモデルを開発中である。成果2の指標である誤差20%については、プロジェクト終了時点までに3）が完成した際に達成される見込みである。

（3）（成果3）炭素管理システムが構築される。

（指標3）：3-1　対象地70km^{2}において、適切な水位レベルのモデルが開発される。

3-2　3-1のモデルを用いて、植生回復計画が開発される。

3-3　地下水が質・量ともに明確となり、インフラストラクチャー整備計画を含んだ火災対策戦略が開発される。

成果3はほぼ達成されている。

1）70km^{2}の対象地域において、広域地下水流動モデル（MODFLOW）が開発され、水路の建設以前やダムの建設後の地下水位分布が明らかとなった。また適正な水位レベルを50mメッシュの地図上で示した。

2）炭素排出の削減には、適正水位の管理とともに、i）火災管理、ii）泥炭地の回復、及びiii）再植林の有効性が明らかになった。

3）泥炭層での汲み上げ調査により消火活動に十分な地下水量が確認され、水質についても調査が行われた。また、プロジェクトで考案したコンパクト消防設備を私設消防団に貸与し、現在試行している。中古の消火ホースを日本の企業から供給する体制を構築した。この消火システムを国家防災庁（BNPB）に提案する予定である。

（4）（成果4）総合的な炭素管理を行うための基礎が整備される。

（指標4）：4-1　調査データや情報が活用される。

4-2　炭素量評価モデルが20%以下のエラー発生率で作成される。

4-3　総炭素排出量を1/3から1/5へ削減するための炭素管理システムが開発される。

4-4　泥炭・森林における火災と炭素管理システムが、政策形成や制度構築プロセスに導入される〔例　気候変動に関する政府間パネル（IPCC)、国際標準化機構（ISO)、開発途上国における森林減少・劣化等に由来する排出の削減等（REDD+）プロジェクト実施等)。

成果4はほぼ達成されている。

多くの研究成果の公表及びデータベースの構築が行われた。

1）56本の原著論文が発表された。現在も複数が投稿中、並びに執筆中の段階にある。インパクトファ

クターが高い学術誌に掲載された論文が複数あることに加え、成果が国際レベル及び日本・インドネシア両国における地域レベルで多くの会議、セミナー等で発表された。

地理情報システム（Web-GIS）が北海道大学のサーバーにインストールされ、データベースのプロトタイプが開発された。プロジェクトで購入及び作成したさまざまな衛星画像や主題図等が統合されている。

2）誤差 20%以下の炭素収支モデルの構築については、プロジェクト終了までに成果 2 に関する取り組みを進めることにより達成される予定である。さらに、簡易性及び省コスト性の両者を満たすような統合計測・報告・検証（MRV）システムを提案するため、ハイパースペクトル解析、土壌沈下計測などさまざまな手法が比較検討された。

3）炭素排出量を 1/3 から 1/5 に削減するための炭素管理手法の開発については、プロジェクト終了までに主に成果 3 に関する活動によって達成される予定である。

4）2009 年にエジプトで開催された ISO の技術委員会 207（環境管理）において、BSN は森林破壊についての国際規格を提案した。以後、インドネシア政府は国際社会に向けて森林破壊についての国際規格を設定するための働きかけを続けている。インドネシア国内での規格の設定についても BSN を中心に議論が進められており、プロジェクト終了までに規格案が策定される見込みである。プロジェクトが主催した国際セミナーやワークショップは、国際的研究者のネットワーク構築に貢献したほか、MRV についての円卓会議がインドネシア国家気候変動協議会（DNPI）との共催で継続的に開催された。

（5）プロジェクト目標の達成度

プロジェクト目標である泥炭森林管理手法の構築は、成果 1 から 4 の活動によりプロジェクト終了までに達成される見込みである。

なお、炭素排出量を 1/3 から 1/5 へ削減するための炭素管理手法はほぼ完成しており、最終的に定量的な検討を加える段階にある。またプロジェクトが提案する泥炭森林管理手法は、国際的にもインドネシア国内でも注目を浴びており、プロジェクトによるさまざまな発信の成果が現れてきている。

一方で、社会実装に向けた炭素削減方法及び統合的 MRV システムについて、プロジェクト終了までに成果の翻訳及び調整、モデル化やパッケージ化につなげていく努力が引き続き必要である。

3－2　評価結果の要約

（1）妥当性

妥当性は非常に高い。

1) 2008 年 DNPI が、気候変動緩和に関する国家政策、プログラムの策定及び炭素取引のためのメカニズム形成等を担う機関として設置された。2009 年の気候変動枠組み条約（UNFCCC)第 15 回締約国会議（COP15）では、インドネシア大統領が、温室効果ガスの削減目標として対 BAU（Business as usual）[1]比で 2020 年までに自国のみで 26%削減、国際的な支援を受けて更に 41%まで削減することを表明した。インドネシアにおける温室効果ガスの排出源は 60%以上が土地・森林セクターであることから、DNPI は削減ポテンシャルの 75%以上が土地利用、土地利用変化及び林業部門（LULUCF)、泥炭での取組みによるものとしている。

2) 2010 年には、UKP4 大統領開発管理調整ワーキングユニット（UKP4）と開発途上国における森林減少・劣化等による温室効果ガス排出量の削減（REDD+）タスクフォースが設置され、2013 年に REDD+庁が設立された。さらに 2013 年には、自然林と泥炭地を対象とした 2 年間のモラトリアム（新規森林コンセッションの発給停止）が更新された。

3) 中央カリマンタン州は、2010 年に REDD+活動のパイロット州に選定され、中央カリマンタン州 REDD+タスクフォース（KOMDA REDD+）が設置された。

4) 本プロジェクトのすべての C/P 機関は、泥炭地及び森林からの炭素排出削減を進めることについて強い意志を有している。

5) 日本の対インドネシア共和国国別援助方針（2012 年）において、「環境保全・気候変動等の地球規模課題への対応能力（中略）の向上に寄与するための支援等を行う。」と明記されており、2013 年に両国は二国間クレジット制度に関する署名を終えた。また、JICA が REDD+を推進するための日本インドネシア REDD+実施メカニズム構築（IJ-REDD）プロジェクトを西及び中央カリマンタン州で開始した。

[1] 特段の対策活動をしない場合の将来予測値

（2）有効性

有効性は中程度から高いと評価される。

1) 2013 年 10 月時点で各成果の進捗状況はおおむね高いと評価された一方、プロジェクト目標及び 4 つの成果の指標が完全には満たされていないこと（特に定量的な指標）、また成果が関係者に十分に説明されていない。
2) 定量的指標を設定することは説明責任を果たす上で有効な一方で困難を伴う挑戦でもあったが、プロジェクト関係者は、指標が意味すること及びその検証の方法を一層検討し、プロジェクト目標に関する相互理解を深める必要がある。
3) 全体的には、各成果の活動において綿密かつ先進的な研究が行われており、プロジェクト終了時点で各成果が達成される見込みである。
4) インドネシア側からは、政策及び意思決定にプロジェクトの成果を十分に活用するために、成果の全体的な統合が必要であるとのコメントがなされている。

（3）効率性

現時点までの本プロジェクトの効率性は高いと評価される。

1) プロジェクトの円滑な実施と効果的な運営に向けての日本人専門家の努力は、C/P にもよく認識されている。プロジェクトにより供与された資機材は適切に使用されている。
2) 人的資源の投入は、C/P 機関から専門性、投入の時期及び期間のいずれについても効率的であったと評価された。資機材の投入についても、C/P 機関のニーズに合致しており効率的であったと評価された。
3) 日本での研修等は、C/P 機関から高く評価された。研修に参加した C/P 機関職員は、研修後、プロジェクトに効果的に貢献したと評価された。
4) 日本側（北海道大学）とインドネシア側（UNPAR）が 1983 年以降長期にわたり関係を築き、貴重な情報の蓄積を続けてきたことは特筆すべきである。本プロジェクトはこれまでの研究データの蓄積を成果として取りまとめるための重要な契機となった。
5) プロジェクト関係者間におけるコミュニケーション向上の必要性は、中間レビューに引き続いて指摘された。プロジェクト目標、成果及び活動が広範囲にわたるため、C/P 機関は目標、成果、活動及びその相互の関連性について明確に理解できていない。また、プロジェクトの実施体制は、中間レビュー後に改善が図られたが、コミュニケーション向上に対しての貢献は限定的であった。
6) インドネシア側の投入は、事務所スペースや設備の提供を含む現物による貢献のほか、泥炭森林の実地活動に対する UNPAR スタッフの貢献が大きくあった。一方、C/P 予算の不足が生じた実施機関もみられた。

（4）インパクト

本プロジェクトがもたらしているインパクトは極めて大きい。

1) BSN においては、環境管理のための ISO への提案文書（土壌劣化と森林減少に対する取組みの優良事例ガイドラン）の作成が、プロジェクトからの支援を得て進められている。
2) プロジェクトリーダーである大崎満教授は、「第 5 次 IPCC ガイドライン」の湿地（泥炭地を含む）に関する章の主要執筆者に選出された。またドイツのボンで開催された UNFCCC の科学および技術の助言に関する補助機関（SBSTA）38 で本プロジェクトの成果である統合 MRV（測定・報告・検証）システムについて招待講演を行った。
3) プロジェクトの成果は日本の経済産業省及び環境省の支援で実施された 3 件の REDD+に関する実現可能性調査にも活用されており、大崎満教授は、これら調査の技術顧問を務めている。
4) 永年観察プロットにおける調査で明らかにされた 394 種の植物のインベントリー情報は、インドネシア生物多様性戦略・活動計画（IBSAP）の策定に活用された。
5) 泥炭火災管理の重要性に対する認識の高まりから、（一社）北海道消防設備協会より 3,000 本の消火用ホースと 50 個のノズルがプロジェクトに対して寄贈された。
6) プロジェクトからの支援を受けて、カリマンタン 5 州の大学間連携により統合的な炭素管理・教育研究ネットワークを目指す「カリマンタン大学ネットワーク」が設立された。この試みは今後国家レベルでも取り入れられる見込みである。
7) 日本においては、2013 年 10 月に日本泥炭地学会が設立され、大崎満教授が初代学会長に選出された。本学会を通じ国際泥炭地学会及びインドネシア泥炭地学会と今後より一層の協調を進めていくことが期待される。
8) UKP4 や DNPI に対して、プロジェクトより情報提供や提言が適宜行われている。
9) プロジェクトにより組織されたインドネシア国内専門家ワーキンググループが中部カリマンタン州の

REDD+実施に関わる活動計画案の骨子となる「REDD COE Kalteng」（文書などのリスト）を取りまとめた。

10) 本プロジェクトを通じ開発された計測データ遠隔転送システム（SESAME システム）はジャカルタ近郊のダムの水位情報の測定、伝送のために活用されている。

11) 多数の組織及び専門家の参加を通じ、既存のリソースをつなぎ、意見交換を行い、今後の協力を広げるための場として本プロジェクトが機能した。

（5）持続性

自立発展性の現時点での見込みは高いと評価される。

近年大きく変化を続けてきたインドネシアにおける REDD+の状況に対応するため、プロジェクトが取り組んだ点は評価できる。

1) インドネシア大統領とインドネシア政府からは、泥炭森林における炭素管理に向けて実効性のあるコミットメントが表明されており、同国において REDD+の実施体制が整備されつつある。

2) プロジェクトを通じ、日本で学ぶ機会を得た C/P 20 名は、帰国後 C/P 機関の能力向上に貢献している。

3) プロジェクトの供与資機材は、適切に利用されている。持続性の面で鍵となるメンテナンス技術の習得のために、機材供与に合わせた利用・メンテナンスの研修が実施された。さらに、新規の資機材によってもたらされる効果を維持するためには、資機材利用計画の作成と利用状況のモニタリング・管理が重要となる。より環境の良い設置場所の検討が必要な精密機械も見られた。

4) プロジェクトを通じ、さまざまな課題に適用可能な多くの発見や技術開発がなされている。今後これら新しい知見や技術の利活用が期待されるが、自立発展性のためには、潜在利用者のための技術の翻訳、マニュアルやパンフレットの作成と広報、関連技術のパッケージ化などが必要である。

5) プロジェクトの実施機関である北海道大学は、UNPAR や LIPI と長期にわたる協力関係にある。現在、北海道大学は中央カリマンタン州における研究協力を続けるためにさまざまな資金ソースへの申請を進めているが、これらの取り組みが自立発展性に貢献することが期待される。また、UNPAR は、プロジェクトの成果を活用し、泥炭地に関する一般教養教育プログラムの実施を計画している。

6) IJ-REDD プロジェクトが 2013 年から 3 年間の事業として開始された。西カリマンタン州でパイロット活動、中央カリマンタン州で州政府の能力強化活動を行う予定であり、同プロジェクトの実施は本プロジェクトの自立発展性向上に繋がっている。

３－３　効果発現に貢献した要因

（1） 計画内容に関すること

これまでの長年にわたる北海道大学の現地での研究協力の蓄積が、本プロジェクトによる集中的な投入を経て、効率的な成果達成に結びついている。

（2） 実施プロセスに関すること

1) インドネシアにおいて、近年 REDD＋に関連する制度及び組織体制は大きく変化してきているが、プロジェクトはその変化に対応する形でさまざまな機関と連携し、国際社会に向けて積極的に働きかけたことで、極めて高いインパクトがあった。

2) 多くの関係者が協働したネットワークの構築及び研修や共同研究、機材供与を組み合わせた投入によりインドネシア側の能力向上と自立発展性の確保に貢献した。

３－４　問題点及び問題を惹起した要因

（1） 計画内容に関すること

プロジェクト完了時までには達成の見込みであるものの、終了時評価時点では、中間レビュー時に設定された成果の指標、特に定量的な指標についてプロジェクト関係者間での共通認識が不十分で、達成されていない指標の存在が確認された。

（2） 実施プロセスに関すること

インドネシア側との協調を進めるためには、多岐にわたる成果をインドネシア側が理解可能な形で統合し、泥炭地の炭素排出を削減するモデルや MRV の方法論について、関係者が議論する必要がある。インドネシア側から、社会実装につながる成果が分かりにくいとの声も聞かれており、プロジェクト終了時までに、成果をモデル化、パッケージ化し、分かりやすく提示することが望まれる。

３－５　結論

プロジェクト目標達成に向けて 4 つのコンポーネントから多くの研究成果を出していることを評価する。

また、研究成果を国際的に発信しており、「熱帯泥炭湿地林の炭素収支に対する攪乱の影響」等は高い評価を得ている。プロジェクトの適切な管理体制が構築されており、大人数かつ多機関が関わるプロジェクトを適切に運営している。

さらに、プロジェクト内容はインドネシア政府の温室効果ガス削減に関する政策等と関連しており、REDD+に関する議論の進展も本プロジェクトの妥当性を高めた。

活動成果を泥炭における炭素測定手法として確立し、インドネシア政府の関連機関に広く認知され、政策策定に資することが期待される。 ついては、本プロジェクトはプロジェクト期間内に終了することが適切である。

３－６　提言

（1） プロジェクト成果に対するインドネシア政府関係者の理解は必ずしも十分でなく、政策策定や意思決定に利用する段階には至っていない。泥炭森林管理手法やMRVシステム等のプロジェクト成果を政策策定者が活用するために、わかりやすく翻訳することが必要であり、簡明な提案書を政策決定権限者に提示することを提言する。

（2） 将来の土地利用変化を予測することが中央カリマンタン州の主要関心事項であることが確認されたことに代表されるように、プロジェクト目標である泥炭森林における火災と炭素管理を行うモデル構築のためにはインドネシアの社会経済的側面を考慮した上で事業を進めることが重要である。

（3） プロジェクト終了後にプロジェクト成果を引き継ぐ組織を確定する必要がある。また、泥炭火災対策、植林等の事業実施マニュアルがプロジェクト終了時までに準備される必要がある。

（4） プロジェクトのPDMで設定した指標の達成度を確認したところ、プロジェクトから十分な情報が提供されていない箇所があることから、プロジェクト終了時点までに改めて定量指標の達成度について確認し、取りまとめることを提言する。

（5） 供与機材の使用状況・管理状況は、調査団が確認した範囲ではおおむね適当であった。一方で、大学が直接購入し、日本から輸送した供与機材は適切に機材管理簿に記載されていないものがあったので、早急な対応を求める。

３－７　教訓

（1） プロジクト成果を社会実装する際、土地利用政策等の社会経済的側面を考慮することが極めて重要であり、類似の科学技術協力を実施するにあたっては案件形成段階において社会実装の具体的な姿を想定したうえで、自然科学分野に加えて社会経済側面についても十分に検討することが重要である。

（2） 多数の関係者が関与するSATREPSプロジェクトにおいては、プロジェクト内容について十分に理解し、関係者との良好なコミュニケ―ションをとれる事務担当者を、日本側及び相手国側双方に配置することが、プロジェクトの円滑な実施や成果の最大化に重要な役割を果たす。

Summary of Terminal Evaluation

<table>
<tr><td colspan="3">I. Outline of the Project</td></tr>
<tr><td colspan="2">Country: Indonesia</td><td>Project title: Wild Fire and Carbon Management in Peat-Forest in Indonesia</td></tr>
<tr><td colspan="2">Issue/Sector: Environment and Energy</td><td>Cooperation scheme: Science and Technology Research Partnership for Sustainable Development (SATREPS)</td></tr>
<tr><td colspan="2">Division in charge: Global Environment Dept.
Forestry and Nature Conservation Division 1</td><td>Total cost: 450 million Japanese Yen</td></tr>
<tr><td rowspan="2">Period of Cooperation</td><td rowspan="2">(R/D): Dec.2009 to Mar. 2014
(Extension):
(F/U) :
(E/N, Grant Aid):</td><td>Partner Country’s Implementing Organization：National Standardization Agency (BSN)、Agency for the Assessment and Application of Technology (BPPT)、National Institute of Aeronautics and Space (LAPAN)、Indonesian Institute of Sciences (LIPI)、Forestry Research and Development Agency (FORDA)、University of Palangka Raya (UNPAR)</td></tr>
<tr><td>Supporting Organization in Japan: Hokkaido University、Japan Science and Technology Agency（JST）、Japan International Cooperation Agency（JICA）</td></tr>
<tr><td colspan="3">Related Cooperation:</td></tr>
<tr><td colspan="3">1. Background of the project
In marsh area in Indonesia, there is a wide range of tropical peatland. As a result of large scale development in the late 20th century with channeling canals and cutting tropical peat forest, peat degradation has been occurred, and carbon gas emission has been rapidly increasing due to microbial degradation and fires.
The distribution of the tropical peatland in the South East Asia covers 68 % of its total area in the world, and 85 % of the South East Asia’s distribution is found in Indonesia. It is estimated that 0.81 Gt to 2.57Gt of carbon was released into the atmosphere from Indonesia, by peat-fire which is linked to El Niño occurred in 1997 and 1998.
The situation above indicates the importance of carbon emission control in peatland, and the importance of the peatland management has become widely recognized by public with the increase of international interest in the climate change and global warming issues. In addition to these environmental issues, health problems to local people caused by the fire and landslides in rainy season caused by soil erosion have become serious problems in the peatland area.
Indonesian government requested Japanese government to conduct technical cooperation project, which includes the development of a wild fire detection system and model for wildfire prediction by using satellite data, a high accuracy measurement of peat and forest area, and an effective water management and a Clean Development Mechanism (CDM), also includes making a recommendation for the adoption of REDD+.
Following the detailed planning survey on this project that carried out in March, 2009, Japanese and Indonesian Governments discussed and agreed the framework of SATREPS cooperation. The project was launched after the Record of Discussions (R/D) was signed on 10 December, 2009.
The master plan of this project was agreed when the R/D was signed, reviewed and updated in Mid-term Review held in November 2011.
Before the Project termination, the joint terminal evaluation team was formed by Indonesian and Japanese sides.

2. Project Overview

(1) Project Purpose: Peat-forest management method to reduce carbon emission is developed.

(2) Outputs
1) Fire Detection and Fire Prediction System. are established
2) Carbon Assessment System is established
3) Carbon Management System is established.
4) Integrated Peatland Management System is developed.</td></tr>
</table>

(3) Inputs (as of October 2013)

1) Japanese side 450 Million JPY

Long-term Expert: 2 persons
Short-term Expert: 239 persons in total
Trainees received: 20 persons
Equipment: 91.9 Million USD (89.6 Million JPY)
Local operation cost: 73.0 Million USD (8,086 Million IDR)

2) Indonesian side

Project counterpart personnel: UNPAR, LIPI, LAPAN, BSN, BPPT, and FORDA
Local operation cost: Personnel expenses for the government and university officers involved
Facilities: Two office rooms (One in BSN, the other in UNPAR).

II. Evaluation Team

Members of Evaluation Team	• Mr. Kei Jinnai (Leader): Director, Forestry and Nature Conservation Division1, Forestry and Nature Conservation Group, Global Environment Department, JICA • Mr. Koji Mitomori (Evaluation Planning): Deputy Director, Forestry and Nature Conservation Division 1, Forestry and Nature Conservation Group, Global Environmental Department, JICA • Mr. Tetsuya Saito (Evaluation and Analysis): Nippon Koei Co. Ltd,. • Mr. Makio Nakamura (JST Project Evaluation): Japan Science and Technology Agency	
Period of Evaluation	From 13 October 2013 to 31 October 2013	Type of Evaluation: Terminal Evaluation

III. Results of Evaluation

3-1. Summary of Achievements

1) Achievement of the project outputs

Major achievements to date for each output are as follows.

(Output 1)"Fire Detection and Fire Prediction System are established

The project has almost achieved the target of output 1 The fire detection and fire prediction system was established and the trial installation of the systems have already been made. Further accuracy test needs to be carried out on the prediction models by the end of the project period.

(Output 2) Carbon Assessment System is established

The project has almost achieved the target of output 2. Carbon assessment was conducted by 1) aerial laser survey, 2) the analysis of correlation between net-annual CO^2 balance and groundwater level, and 3) terrestrial ecosystem model. The assessment 1) and 2) are completed, and 3) is under development utilizing the monitoring data collected by the project as soon as completion of indicator 2.

(Output 3) Carbon Management System is established

The project has almost achieved the target of output 3..

・A modular three-dimensional finite-difference ground-water flow model (MODFLOW) was developed in the target area of 70km^2, and which clearly simulates the distributions of groundwater level before or after the construction of canal or dam. According to the MODFLOW, the distribution map of appropriate water level was compiled (50m mesh).

・It was revealed that the implementation of 1) fire control, 2) peatland restoration, and 3) reforestation are effective along with for the appropriate water level control for the reduction of carbon emission.

・The amount of groundwater under the peat layer was measured by pumping test, as a result, the adequate amount of water for firefighting was confirmed. When its water quality was analyzed, it revealed that this water contains humic acid and is not suitable to drink unless water clarification system is improved. In addition, a compact firefighting system was proposed and under trial in the target local firefighting teams. Supply route of used fire hoses from Japanese companies was initiated. The system will be proposed to National Agency Disaster Management (BNPB).

(Output 4) Integrated Peat Management System is developed

The project has almost achieved the target of output 4..

Many research outputs were published and the database of the research was developed.

・56 original articles were published and many others have already been submitted to journals for review. Some articles were published in journals with high impact factor, and the outputs were presented in many international and local (both in Indonesia and in Japan) conferences and seminars.

The Web GIS was installed to the server of Hokkaido University to develop the prototype of the database, in which various image data has been integrated such as satellite images and thematic maps produced and obtained during the project. Based on the wide variety of field works and long-term observations, the researchers of Japan and Indonesia concluded that the carbon balance assessment in peatland needs monitoring on following 8 factors; 1) carbon dioxide flux, 2)observation of hotspot, 3) mapping of forest degradation and inhabitant species, 4)changes in deforestation and biomass, 5)groundwater level and soil water, 6)identification of peat dome and thickness of the peat layer, 7)peat subsidence, and 8)water soluble organic carbon This is the first proposal of comprehensive monitoring system for the management of the peatland carbon balance.

・2) The carbon balance model of which error rate is less than 20%, will have been established when the activities of output 2 are completed by the end of the project. In addition, various measures such as hyperspectral remote sensing and subsidence monitoring are considered and compared to propose the integrated Measurement, Reporting and Verification (MRV) system fulfilling both the easiness and cost efficiency.

・3) Carbon management method which can contribute to the reduction of total carbon emission into 1/3 to 1/5 will be developed by the end of the project mainly based on the results from output 3

・4) BSN suggested to set an international standard for deforestation at the technical committee 207 (Environmental Management) of International Organization for Standardization (ISO/TC) - held in Cairo, Egypt in June, 2009. After this, the Indonesian Government has approached the international society to establish the standard for deforestation. The effort on the establishment of national standard for deforestation in Indonesia was initiated by BSN and the draft standard will be prepared by the end of the project. International seminars and workshops were organized to form an international researchers' network, and series of roundtable on MRV were held with National Council for Climate Change (DNPI).

2)Achievement towards the Project Purpose

To establish a peat-forest management model in Indonesia will be accomplished from output 1 to 4 by the end of time of project termination.

The carbon assessment models which reduce the amount of the carbon emission level from 1/3 to 1/5 are assumed to be established. The carbon reduction method and integrated MRV system for the actual application to society need further effort on interpretation and moderation of the outputs into a model or package by the end of the project.

1-3. Five Criteria Evaluation

(1) Relevance:

The relevance of the project is very high.

・At the COP 15 of the United Nations Framework Convention on Climate Change (UNFCCC) in December 2009, the President of Indonesia stated that the country will reduce greenhouse gas (GHG) emission by 26% from Business as usual (BAU) by 2020 with domestic resources, and will reduce by 41% with the support of international community. More than 60% of GHG emission is caused by land use change and forestry sector in Indonesia, it is therefore considered in the DNPI report (2010) that more than 75% of the reduction potential of the GHG emission is attributed the activities on Land use, Land-use change and Forestry (LULUCF) and peatland.

・In 2010, Presidential Working Unit for Supervision and Management of Development (UKP4) and Indonesia REDD+ Task Force were established, and REDD+ Agency was established in 2013. Moreover, the president signed a decree on two-year moratorium in May 2013 for the conservation of primary forests and the peatland.

・The Central Kalimantan was designated as a pilot province for REDD+ activities in December 2010, in association with this activity, Central Kalimantan REDD Task Force (KOMDA REDD+) was established as the implementing agency of Central Kalimantan REDD+ activities.

・With regard to the implementing agencies of the project, all of them have strong willingness for promoting the carbon reduction in the peatland and the forest.

・Regarding Japanese side, Country Assistance Policy for the Republic of Indonesia published by Ministry of Foreign Affairs of Japan in April, 2012 states that "Japan will offer assistance for Indonesia to address global issues such as environmental conservation and climate change." Japan and the Republic of Indonesia signed the bilateral document to start Joint Crediting Mechanism (JCM) on August 26th, 2013. Japan and Indonesia

have also agreed to promote REDD+ in Indonesia and started IJ-REDD project in West and Central Kalimantan Province.

(2) Effectiveness:
The effectiveness of the project is evaluated to be medium to high.
・The effectiveness of the project is evaluated medium to high, based on the revised master plan after the mid-term review. This is because the indicators of the project purpose and the four outputs were not fully verified (especially quantitative figures) or explained to the stakeholders as of the Terminal Evaluation in October 2013.
・Although the establishment of quantitative indicators was considerable challenge while it is effective in achieving the accountability of the project, the project still needs further examination on the meaning of the indicators and the method of the verification, for the mutual understandings of the project target.
・In general, under the activities of four outputs in-depth and innovative research activities were conducted and each output is assumed to be achieved by the end of the project in March 2014.
・However, Indonesian side commented that the overall integration of the outputs (Output 4 and Project Purpose) are not clear enough, resulting in facing difficulties for them to apply the achievements of the project into policy and decision-making process.

(3) Efficiency:
The efficiency of the project is high.
・Activities of Japanese experts are well recognized by the counterparts for their smooth implementation and effective management. The equipment provided through the project has been used for the activities such as measuring the data and improving wild-fire control.
・The input of human resources is evaluated as efficient by the counterpart agencies, in terms of expertise, and the timing and durations of the input. The input of equipment was also evaluated as efficient because it meets the needs of the counterpart agencies.
・A number of training programs in Japan were highly appreciated by the counterpart agencies. The trainees were evaluated by the contribution to the project after they returned to Indonesia.
・It is noted that Japanese side (Hokkaido University) and Indonesian side (Palangka Raya University) have been building a relationship since 1983 and have been working together to collect precious field data continuously. This project provides opportunities to boost the accumulation, compilation and publication of the previous research's outcomes.
・It is indicated that the communication among the project participants needs to be improved. The project purpose, outputs and activities of the project are so broad that many of Indonesian counterparts could not understand these things or the relationships among them clearly. In addition, the implementation structure of the project has not been clear enough, though some effort was made by the project after the mid-term review. As a result, developing a common understanding of the project and clarifying roles and responsibilities of counterparts were not evaluated as efficient despite some improvement.
・Inputs from Indonesian side are mostly in-kind contribution including the provision of office space and equipment. In particular, it is noted that inputs and efforts of UNPAR staff were significant in terms of staff and time to execute actual implementation of activities on the ground. Some projects members commented the shortage or lack of counter-budget of their agencies.

(4) Impacts:
The impact of the project is very high.
・BSN is preparing the proposal of environmental management for ISO, which titled "Guideline for good practical approach against the soil degradation and the deforestation".
・Prof. Osaki, the leader of the project, was selected to the one of the lead authors of wetland section in the 5th Guideline of The Intergovernmental Panel on Climate Change (IPCC), also invited to make a presentation on the integrated MRV system studied in the project, in SABSTA 38 held in Bonne, Germany under UNFCCC
・The output from the project is applied in three feasibility study (FS) projects on REDD+ supported by the Ministry of Economy, Trade and Industry and the Ministry of the Environment of Japan and Prof. Osaki takes the role of technical advisor for these 3 FS projects.
・The inventory information on 394 flora species was derived from permanent observation plots, and were

shared and utilized to develop the Indonesian Biodiversity Strategy and Action Plan (IBSAP).

・Since the public awareness on the importance of the fire control in the peatland had been increasing, Hokkaido Association for Fire Defense Equipment donated 3,000 fire hoses and 50 nozzles to the project.

・At the local level, Kalimantan University Network was formed with the support of the project, which aims to establish an integrated carbon management, education, and research network among five universities in Kalimantan. This idea is planned to be expanded to the national level.

・"Japan Society of Peatland" was established in October 2013 and Prof. Osaki was appointed to the first .president of the society. This society expected to extend the collaboration with "International Peat Society" and "Indonesian Peat Society".

・The project also provides information and advice to UKP4 and DNPI.

・A working group of local experts organized by the project prepared "REDD COE Kalteng", an outline of an activity plan for REDD+ implementation in Central Kalimantan Province. The outline was submitted to KOMDA REDD+ in August, 2011.

・The International field data transmission system (SESAME system) was developed through the project, and was evaluated as useful and applicable to other projects. This system was installed in a dam near Jakarta for the measurement of water level and data transmission.

・The project performed important functions to link existing resources, to have an exchange of view, and to enhance cooperation by the large participation of organizations and experts. Consequently, the project has left a positive impact.

(5) Sustainability:

The sustainability of the project is high.

The project has worked to catch up with the current situation of REDD+ in Indonesia, which had been changing drastically in these years, and the effort of the project is recognized.

・The president and the government of Indonesia expressed strong commitments on the carbon management in peat forest. Furthermore, the institutional structures of REDD+ in Indonesia is being developed.

・Through the project, 20 staff of the counterpart organizations took training in Japan. Since the capacity improvement of these organizations is recognized after their participation of the training in Japan, further improvement is expected in the future. This capacity development is expected to contribute to sustainability.

・The utilization of equipment provided by the project are confirmed as appropriate. The maintenance of the equipment is inevitable to ensure the sustainability, the training for the maintenance therefore was carried out. The monitoring and management of the equipment utilization is also important to sustain the enhanced capacity by new equipment. Some precision equipment need to be installed under the decent condition for it From the human resource aspect, the number of staff who can handle the equipment is limited, thus further effort on capacity development and manual preparation is needed. From the financial aspect, UNPAR should continue to participate research projects and to utilize the equipment effectively so that the activities of REDD+ and the peatland will continue to attract international interests in the future. There are many findings and technology developments by the project which can be applied in many issues. However, these can be utilized later on, followings will be required to enhance the sustainability, such as interpretation of such technologies for the potential users, preparation of manuals and brochures together with public information, packaging the related technologies as one system, and so on.

・Hokkaido University, the implementing agency of this project, has worked with UNPAR and LIPI for many years. Currently, Hokkaido University is proposing to various budget sources to continue the collaboration work in Central Kalimantan Province, and this effort greatly contributes to the sustainability of the project. UNPAR is planning to launch an education program on peatland that based on the project outcomes.

・IJ-REDD project was started in 2013 as 3-year project, and pilot activities in West Kalimantan Province and the activities of capacity development for the government of Central Kalimantan Province will be conducted. This IJ-REDD Project will also contribute to the sustainability.

2. Factors that promoted realization of effects

(1) Factors concerning to Planning
The long-term relationship and stored data between Hokkaido University and UNPAR contributes greatly to the high-efficiency of achievements through the concentrated inputs by the Project.

(2) Factors concerning to the Implementation Process
Although the institutions and organizations related to REDD+ in Indonesia which is changing drastically in these years, the Project collaborated with various organizations and appealed to international society following these changes, which contributed to high positive impact.
The networking of many stakeholders and integrated the inputs of training, collaborative research, and equipment procurement contributed to the capacity development of Indonesian side and sustainability of the Project.

3. Factors that impeded realization of effects

(1) Factors concerning to Planning
Although the indicators for each output are expected to be achieved by the end of the Project, it was indicated that the evaluation indicators set through the midterm review were not clearly recognized by the Project members and some quantitative indicators were not yet met as of the terminal evaluation.

(2) Factors concerning to the Implementation Process
To promote further collaboration with Indonesian side, integration of the various achievements from the Project is required so that Indonesian side can discuss more on the carbon reduction model for peatland and integrated MRV system. By the end of the Project, it is recommended to conduct packaging and moderating for better understanding of stakeholders in Indonesia to enhance social applicability.

4. Conclusion
The project has been pursuing the project purpose with various outcomes from four research components. The international exposure of project outputs, e.g. “Effects of disturbances on the carbon balance of tropical peat swamp forest, is regarded as a notable achievement of the project. Since the good management system of the project has been established both in Indonesian and Japanese side, the project is being properly implemented with collaboration among various researchers and institutions.

The project is in line with the policy directions of Indonesian government so that the relevance is rated high. International interest to REDD+ further increased the relevance of the project. To pave the way for social application of the project outcomes toward the relevant policies in Indonesia, the project is expected to integrate the research outputs into “management system/method” in the rest of the project period. It is concluded that the project must be completed by the end of the project term as planned.

5. Recommendations
The team found that Indonesian government expects a lot to the project outcomes, but their understanding of the project results does not reach the stage to utilize them for policy/decision-making process. The team recommends that the project has to be translated and moderate to policy- formulators how to apply research outcomes, e.g. peat-forest management method and MRV system, by the end of the project. It is also recommended that the project will prepare official brief policy paper for conveying the project outcomes to policy/decision makers.

The land use planning is the key to the decision-making of the carbon management of the Province of Central Kalimantan. Simulating future land use change is one of the major concerns of national and provincial governments of the Indonesia. In that context, the team would like to re-emphasis the importance of the socio-economic aspects to achieve the project purpose, i.e. “management method”, in considering socio-economic research has made under several components.

The organization which will take over each research component after the project should be designated, and

the operation manuals of activities, e.g. peat-fire control and tree planting, should be prepared by the end of the project.

The verifiable indicators set in the mid-term evaluation helped to clarify the project purpose and outputs. The team found that the achievements of some quantitative indicators are not well verified and recommended to prepare the evidence of the quantitative indicators by the end of the project.

The evaluation team confirmed the proper utilization and maintenance of research equipment that provided by the project. Some of the equipment that Hokkaido University had directly bought and sent to Indonesia was not on the list of the equipment record. The team hence requested to add the equipment on the list immediately.

5. Lessons Learned

The project of science and technology cooperation, SATREPS, should take into account the socio-economic aspects such as relationship to land use policy, as well as natural science aspect, to apply the outcomes of the cooperation into the implementation by the society.

In the SATREPS project which has quite a number of stakeholders, assigning of administrative officers who have good understandings of the project and good communication with project members, is crucial to implement the project smoothly and to maximize its outcomes.

第１章　評価調査の概要

１－１　調査の背景

インドネシア共和国（以下、「インドネシア」と記す）の低湿地には広範囲な熱帯泥炭が存在しており多量の炭素が蓄積されているが、20 世紀末の大規模な運河掘削と熱帯泥炭林の伐採の結果として、火災や微生物分解による大気中への炭素放出が急速に進んでいる。熱帯泥炭の分布は東南アジアで 68％と圧倒的に多く、その 85％はインドネシアに存在する。1997 年から 1998 年に発生したエルニーニョ現象による火災では、泥炭を中心とする火災でインドネシア全体から 0.81Gt から 2.57Gt の炭素が発生したと推定されている。

泥炭湿地から発生する炭素の管理の重要性が指摘され、昨今の気候変動問題、地球温暖化問題といった国際世論も相まって、泥炭湿地の管理の重要性が広く認識されるようになった。また、地球規模での環境問題に加え、泥炭地周辺の住民への健康被害、泥炭劣化に伴う雨期の土砂災害も深刻な状況である。

このような状況から、インドネシアの科学技術担当大臣府（State Ministry of Research and Technology : RISTEK）やインドネシア科学院（Indonesian Institute of Sciences : LIPI）等の関係機関と北海道大学では、泥炭湿地が広範囲に存在し、大規模な運河掘削と熱帯泥炭林の伐採が行われているインドネシアカリマンタンのメガライス（100 万 ha イネ栽培）計画地域を対象に、熱帯泥炭の脆弱性や泥炭開発と地球温暖化の関係に係る研究をこれまで実施してきた。これまでの研究成果を踏まえ、衛星を用いた火災検知と火災予想モデルの開発、泥炭や森林の高精度測定、効率的水管理及び泥炭湿地でのクリーン開発メカニズム（Clean Development Mechanism : CDM）化や開発途上国における森林減少・劣化に由来する排出の削減（Reducing Emissions from Deforestation and Forest Degradation in Developing Countries : REDD）化の提言をするプロジェクトの要請がインドネシア政府より出され、2009 年 3 月に詳細計画策定調査を実施し、地球規模課題対応国際科学技術協力（Science and Technology Research Partnership for Sustainable Development : SATREPS）協力の枠組みにつき協議・合意し、同年 12 月 10 日に討議議事録（Record of Discussions : R/D）の署名を行い、プロジェクトが開始された。

プロジェクト終了を 2014 年 3 月に迎えることから、終了時評価調査を実施することになったものである。なお、本評価調査には科学技術振興機構（Japan Science and Technology Agency : JST）からの参加も得て実施することとなった。

１－２　調査の目的

プロジェクト活動の実績、成果を確認し、評価 5 項目（妥当性、有効性、効率性、インパクト、自立発展性）の観点から、インドネシア側と合同で評価を行う。また、プロジェクトの残り期間の課題及び今後の方向性について確認し、同結果を終了時評価報告書として取りまとめたうえで、合同調整委員会（Joint Coordinating Committee : JCC）、合同運営委員会（JSC : Joint Steering Committee : JSC）において内容を合意することを目的とする。

１－３　対象プロジェクトの概要

１－３－１　協力期間

2009 年 12 月～2014 年 3 月　（2009 年 12 月 10 日署名 R/D による）

１－３－２　事業実施体制（実施機関／C/P）

国家標準機構（Badan Standardisasi Nasional : BSN）、技術評価応用庁（Badan Pengkajian dan Penerapan Teknologi : BPPT）、国家航空宇宙局（Lembaga Penerbangan dan Antariksa Nasional : LAPAN）、LIPI、林業省森林研究開発庁（Forestry Research and Development Agency : FORDA）、パランカラヤ大学（Universitas Katolik Parahyangan : UNPAR）

１－３－３　プロジェクトサイト／対象地域名

中部カリマンタン州パランカラヤ市にあるメガライスプロジェクト跡地 Block C 及び一部 Block B 地域（総面積約 63 万 ha）

１－３－４　プロジェクト構成概要

プロジェクト目標

泥炭・森林における火災と炭素管理を行うモデルが構築される。

指標：炭素排出を現在の 1/3 から 1/5 へ削減するための炭素管理手法が提案される。
泥炭森林管理手法が国際的及び二国間オフセットメカニズム開発に係る政策決定に活用される。
研究論文等の成果が適切な数及び量で発表される。

成果と想定される活動（あるいは調査項目）と指標

成果１：火災検知及び火災予測システムが構築される。

指標１：

1-1　1km^{2}以上の森林火災において、3 つのモデル・コミュニティが 16 時間以内に火災情報を得る。また、延焼予測情報を 8 時間以内に受け取る。
1-2　森林火災探知精度が 80%以上となる。
1-3　森林延焼予測の精度が 50%以上となる。

活動１：

1-1　火災ホットスポット検出アルゴリズムを改良する。
1-2　異なる生態系の中で燃焼するバイオマスの炭素排出量を推定する。
1-3　現場の火災情報を各地域へ伝達する。
1-4　森林火災発生予測モデルを構築する。
1-5　水変動モデルを構築する。
1-6　土地被覆図・土地利用変化図を作成する。
1-7　調査地域において植物と土壌水分のスペクトルラルライブリーを構築する。

成果２：炭素量評価システムが構築される。

指標２：

2-1　中央カリマンタン州の炭素量評価モデルが 20%以下のエラー発生率で作成される。

活動２：

2-1　さまざまな熱帯泥炭生態系における炭素収支を推定する。
2-2　バイオマス及び泥炭中の炭素量を推定する。
2-3　泥炭分解及び有機炭素消失を評価する。
2-4　異なる手法を用いて生態系の炭素収支量を交差検定する。

成果３：炭素管理システムが構築される。

指標３：

3-1　対象地 70km^{2}において、適切な水位レベルのモデルが開発される。
3-2　3-1 のモデルを用いて、植生回復計画が開発される。
3-3　地下水が質･量ともに明確となり､インフラストラクチャー整備計画を含んだ火災対策戦略が開発される。

活動３：

3-1　植生と水文環境を調査する。
3-2　水文環境をコントロールする。
3-3　森林火災予防計画を作成する。
3-4　植林を行う。
3-5　気候変動に対する植生の反応と回復を推定する。
3-6　水位に対する水質と水生生物群集の反応を推定する。

成果４：泥炭炭素イニシアティブ及び国際的ネットワークを構築する。

指標４：

4-1　調査データや情報が活用される。
4-2　炭素量評価モデルが 20%以下のエラー発生率で作成される。
4-3　総炭素排出量を 1/3 から 1/5 へ削減するための炭素管理システムが開発される。
4-4　泥炭・森林における火災と炭素管理システムが、政策形成や制度構築プロセスに導入される（例　IPCC、ISO、REDD+プロジェクト実施等)。

活動４：

4-1　統合的な炭素―水収支モデルを開発する。
4-2　統合的な土地管理モデルを開発する。
4-3　炭素会計手法を導入する。
4-4　地域社会参加型の活動を行う。
4-5　環境教育・研修のカリキュラムを作成する。

本プロジェクトのマスタープランは、2009 年 12 月の討議議事録（R/D）締結時に合意し、2011 年 11 月の中間レビュー時に改訂している。

１－４　調査団構成

１－４－１　日本側

氏名	分野	所属	期間
神内　圭	総括	JICA 地球環境部　森林・自然環境グループ　森林・自然環境保全第一課　課長	10 月 20 日 ～10 月 31 日
三戸森宏治	評価計画	JICA 地球環境部　森林・自然環境グループ　森林・自然環境保全第一課	10 月 20 日 ～10 月 31 日
齋藤　哲也	評価分析	日本工営株式会社　環境事業部	10 月 13 日 ～10 月 31 日
中村　牧生	JST 評価	JST　地球規模課題国際協力室　主任調査員	10 月 24 日 ～10 月 31 日

１－４－２　インドネシア側

氏名	所属	役職
Prof. Kumpiady Widen	University of Palangka Raya	Vice Rector
Prof. Tukirin Partomihardjo	Indonesian Institute of Sciences（LIPI）	Professor
Dr. Joeni Setijo Rahajoe	Botany Division, Indonesian Institute of Sciences（LIPI）, Research Center for Biology	Head
Dr. Laode Alhamad	Indonesian Institute of Sciences（LIPI）	Researcher
Mr. Bendjamin B. Louhenapessy	Cooperation and Evaluation for Research Division, National Standardization Agency	Head
Mr. Nasrudin Irawan, M.	National Standardization Agency	Inspector

１－５　日程

月日	曜日	行程	宿泊
10 月 13 日	日	移動：成田→ジャカルタ（斉藤団員）	ジャカルタ
10 月 14 日	月	JICA 事務所打合せ、関係者打合せ	ジャカルタ
10 月 15 日	火	移動: ジャカルタ → パランカラヤ サイト視察（4 カ所） プロジェクト業務調整員との協議	パランカラヤ
10 月 16 日	水	インタビュー：UNPAR	パランカラヤ
10 月 17 日	木	インタビュー：UNPAR 火災予防コンポーネント対象地域訪問 移動：パランカラヤ→ジャカルタ	ジャカルタ
10 月 18 日	金	インタビュー：LIPI インタビュー：LAPAN インタビュー：BPPT インタビュー：PUSPITEK（国立科学技術センター）	ジャカルタ

10 月 19 日	土	評価報告書準備 神内団長、三戸森団員ジャカルタ着	ジャカルタ
10 月 20 日	日	資料整理、団内打合せ	ジャカルタ
10 月 21 日	月	8:30 BPPT（Dr.Bambang Setiadi）表敬 11:00 林業局表敬（Mr.Agus haryanto, Mr.KATSURA） 14:00 JICA 事務所打合せ	ジャカルタ
10 月 22 日	火	9:30 インドネシア側評価メンバーとの協議（BSN, LIPI,UNPAR） 15:00 BNPI との協議（Mr.Farhan Helmy）	ジャカルタ
10 月 23 日	水	9:00 BAPPENAS（RAN-GRK Secretariat）との協議 10:30 IJ-REDD+（高原専門家）との協議 12:30 BSN（Mr.Nyoman）聞き取り 移動：ジャカルタ→パランカラヤ （中村団員　ジャカルタ着）	パランカラヤ
10 月 24 日	木	（中村団員合流） 9:00 UNPAR 学長（Prof.Dr.Fredinand）表敬 10:00 UNPARC/P 聞き取り 13:00 サイト視察	パランカラヤ
10 月 25 日	金	9:30 中央カリマンタン州 BAPPEDA（Mr. Herson Aden）表敬 11:30 UNPAR Prof. SUidoSuwido H. Limin との協議 14:00 KOMDA REDD+との協議 午後　評価報告書の協議	パランカラヤ
10 月 26 日	土	終日　サイト視察 評価報告書作成	パランカラヤ
10 月 27 日	日	移動：パランカラヤ→ジャカルタ 午後　評価報告書準備	ジャカルタ
10 月 28 日	月	10:00 合同評価調査団内協議 午後　評価報告書準備	ジャカルタ
10 月 29 日	火	9:00 UNORCID（久保氏）との協議 10:00 ICCC （Ms.Eli）との協議 午後　評価報告書準備	ジャカルタ
10 月 30 日	水	10:00 JCC（合同調整委員会）/ JSC（合同運営委員会） 15:00 在インドネシア日本大使館への報告 深夜　ジャカルタ発	機中泊
10 月 31 日	木	成田着	

第２章　レビューの方法

２－１　調査の流れ

今回のレビューは、『JICA 事業評価ガイドライン改訂版』「プロジェクト評価の実践的手法」及び『新 JICA 事業評価ガイドライン（第 1 版）』に準拠して行った。レビューの基になるマスタープランは平成 21 年 3 月実施の詳細計画策定調査時に作成し、平成 23 年 11 月実施の中間レビュー調査時に改訂し、インドネシア側と合意したものを使用した。レビューに先立ち、プロジェクト関係文書（事前調査報告書、研究代表機関である北海道大学作成の報告書、セミナー・シンポジウム資料等）を整理・分析し、プロジェクト関係者への事前質問票調査及びインタビュー調査、また現地視察を行い、情報を収集した。これらの結果を基に、レビュー報告書案を作成し、JCC 及び JSC を経て、報告書を完成させた。

２－２　調査項目

２－２－１　プロジェクトの実績の確認

R/D、マスタープランに沿ってプロジェクトの投入、アウトプット、プロジェクト目標が達成された度合いを検証する。

２－２－２　実施プロセスの検証

プロジェクトの実施過程全般を見る視点であり、活動が計画どおり行われているか、またプロジェクトのモニタリングやプロジェクト内のコミュニケーションが円滑に行われているかを検証する。

２－２－３　レビュー項目ごとの分析

(1) 妥当性：プロジェクトが目指している効果（プロジェクト目標や上位目標）が、評価を実施する時点において妥当か〔インドネシアの国家開発計画及び日本の政府開発援助（Official Development Assistance：ODA）政策との整合性はあるか、受益者のニーズに合致しているかなど〕、プロジェクトの戦略･方法は妥当か等を評価する。
(2) 有効性：プロジェクト目標達成の見込みはあるか、プロジェクト目標に対しアウトプットは適切か、目標達成の貢献・阻害要因はあるか等を評価する。
(3) 効率性：投入に見合ったアウトプットが産出されているか、活動スケジュールと投入のタイミング･質・量はアウトプット産出には適切だったか等を評価する。
(4) インパクト：上位目標達成の見込みはあるか、その他、プラスのインパクトはあるか（予測されるか）、予期していなかったマイナスのインパクトはあるか（予測されるか）、マイナスのインパクトがある場合、それに対する対策は講じられているかを評価する。
(5) 自立発展性：現時点において、プロジェクトで発現した効果が持続する見込みについて、組織制度面、財政面、技術面から評価する。

２－３　情報収集・入手手段

現地調査に先立ち、プロジェクトの投入実績に関する情報提供を依頼するとともに、主としてプロジェクトの実施プロセスに関する質問票を英語で作成し配布した。現地調査においては、指標及び目標値設定、実施プロセスの確認と評価 5 項目に関する補足情報を収集するために、インドネシア側関係者と日本側研究者に対し、インタビュー及び質問票調査を実施した。

第３章　プロジェクトの実績と現状

３－１　投入実績

マスタープランに沿って、日本側、インドネシア側の双方からプロジェクトに対しての投入がなされている。ただし、日本国内のプロジェクト活動に対する JST からの投入実績については、この終了時評価の対象外とした。なお、以下の添付番号はレビュー報告書中の Annex No.を指す。

【日本側】

３－１－１　日本人専門家の派遣

プロジェクトの業務調整及び管理のための長期専門家は合計 2 名で、1 名が 2010 年 2 月から 2013 年 1 月の 3 年間派遣され、もう 1 名は 2013 年 1 月から 2014 年 3 月の予定で派遣中である。2013 年 10 月時点での短期専門家の派遣実績は、2010 年度に 74 名、2011 年度に 70 名、2012 年度に 56 名、2013 年度に 39 名であり、派遣日数の合計としてはそれぞれ 1,380 日、1,476 日、1,078 日、527 日である。これまでの総派遣日数は 4,461 日（148.7MM）であり、各成果の内訳をみると、衛星による火災・炭素センシングプログラム（FF）426 日、炭素量評価プログラム（Carbon Assessment : CA）310 日、炭素管理プログラム（Carbon Management : CM）2,488 日、統合的泥炭地管理プログラム（Peatland Management：PM）1,237 日となっている。

３－１－２　本邦研修

日本における研修・スカラーシッププログラムへの参加者は現時点で 20 名（長期 10 名、短期 10 名）であり、その内訳は JICA カウンターパート（Counterpart：C/P）研修として長期 5 名（博士課程 3 名、修士課程 2 名）及び短期 10 名、文部科学省 JST 奨学金から長期 4 名（博士課程 4 名）、北海道大学私費留学生特待制度から長期 1 名（博士課程 1 名）である。派遣元の内訳は UNPAR から 6 名、LIPI から 5 名、BSN から 1 名、BPPT から 4 名、LAPAN から 1 名、FORDA から 1 名、中央カリマンタン政府から 1 名となっている。

３－１－３　資機材の供与

2013 年 10 月時点での資機材調達費の合計は 8,958 万 8,395 円である。（1US ドル=97.5 円、1 ルピア＝0.0088 円として換算）

３－１－４　現地業務費

2013 年 10 月時点での現地業務費の合計は、約 8,086 百万ルピア（約 7,120 万円）である。内訳には、航空賃 1,116 百万ルピア、日当宿泊費 955 百万ルピア、その他委託費（commission contract）360 百万ルピア等の費用が含まれている。

【インドネシア側】

３－１－５　C/P 配置

R/D 及び中間レビュー時の M/M で合意されたとおり、UNPAR、LIPI、LAPAN、BSN、BPPT、FORDA がプロジェクト実施機関となっている。インドネシア側実施機関と日本側からの代表者が JSC と JCC のメンバーを構成し、JSC は BSN のプロジェクト・スーパーバイザーが、JCC は UNPAR のプロジェクト・ディレクターがそれぞれ議長を務めている。

３－１－６　事務所スペース・設備及びプロジェクト活動費の提供

BSN と UNPAR は日本人専門家に事務所スペースと事務設備を提供している。インドネシア側の投入の大部分はこうした現物による投入であり、加えて、各実施機関の職員の国内旅費については、通常の技術協力プロジェクトと同様に各実施機関が負担している。

例えば、LIPI は 4 年間で C/P 予算として 675 百万ルピアを本プロジェクト実施に割り当てている。UNPAR は、プロジェクト事務所の電話及びインターネット、プロジェクト活動のための職員の日当などを投入している。

３－２　プロジェクトの進捗と実績

３－２－１　成果レベルの実績

各成果における現時点までの主な活動実績は、次のとおりである。

（成果 1）火災検知及び火災予測システムが構築される。
（指標）1-1　1km^2 以上の森林火災において、3 つのモデル・コミュニティが 16 時間以内に火災情報を得る。また、延焼予測情報を 8 時間以内に受け取る。
1-2　森林火災探知精度が 80%以上となる。
1-3　森林延焼予測の精度が 50%以上となる。

成果 1 はほぼ達成されている。火災検知及び火災予測システムは構築され、試験も実施されている。プロジェクト終了時までに、予測モデルの精度に関する確認を進める必要がある。

(1) 1km^2 以上の火災が発生した時には、対象 4 村落（タルナジャヤ、トゥンバンヌサ、ピラン及びジャビレン村）は 13 時間から 16 時間で火災発生情報を得ることができる（内訳：衛星画像の撮影間隔が平均 6 時間から 8 時間、ホットスポット解析に 4 時間、火災検出に 1 時間、SMS 送信時間に 2 時間から 3 時間）。火災予測については、対象村落が必要とする半径 2km 以内について、簡易延焼モデルにより 4 時間以内の予測が可能となった。現時点では村から半径 2km で火災予測範囲を設定しているが、今後同範囲の拡大や縮小も可能である。MODIS 火災ホットスポットマップ、土壌水分分布マップについては、ウェブサイト上での公開も行っていた。
(2) 改良アルゴリズムで判別された 2009 年 7 月のすべてのホットスポット（10 カ所）及び 2012 年 9 月の火災時のホットスポット（2 カ所）のすべてが火災跡地、または進行形の火災であることが無人航空機（Unmanned Aerial Vehicle：UAV）による観測により確認された（検出率 100%）。統計的解析のために更なるモニタリングデータの蓄積が必要であるものの、オミッションエラー及びコミッションエラーを考慮し、目標である検出率 80%は達成できる見込みである。
(3) 簡易延焼モデルでは、1km^2 のホットスポットを半径 1/2km の内接円または半径√内接円もしくは外接円で近似できる。ホットスポットの中心が移動する速度が毎分 2m 以下の場合、延焼予測の誤差率は 50%以下を達成した（改良アルゴリズムでは、毎分 2m 以下の速度の場合、現在の衛星画像の撮影間隔では隣接するエリアにしか火災が移動しないため、延焼と判別できる。それ以上の速度の場合は、別の火災と判別される）。

（成果 2）炭素量評価システムが構築される。
（指標）中央カリマンタン州の炭素量評価モデルが 20%以下のエラー発生率で作成される。

成果 2 はほぼ達成されている。炭素量評価は 1）航空レーザー計測、2）年間 CO_2 収支と地下水位の相関関係分析、3）陸域生態系モデルから行われている。1）と 2）については完成し、3）についてはプロジェクトによるモニタリングデータを活用しモデルを開発中である。成果 2 の指標である誤差 20%については、プロジェクト終了時点までに 3）が完成した際に達成される見込みである。

(1) 現地観測によるデータ収集は達成され、モニタリングが継続実施されている。熱帯泥炭生態系は、人為的撹乱のない森林（UF）、排水の影響を受けた森林（DF）、火災跡地（DB）のいずれもが CO_2 排出源であることが明らかになった。人為的撹乱のない森林（UF）、排水の影響を受けた森林（DF）及び火災跡地（DB）について、炭素換算の CO_2 収支の年平均（2004 年 7 月～2008 年 7 月の 4 年間）はそれぞれ 174±203, 328±204 and 499±72 gC m-2 y-1 であった。炭素排出は撹乱の大きさに対応して増加することが明らかとなった。またそれぞれの生態系における炭素収支は主に地下水位により決まることが明らかになった。炭素換算の年間 CO_2 収支は地下水位に対し線形的な相関関係を示した。プロジェクトによって、同相関により地下水位が 0.1m 下がるたびに年間の CO_2 排出が 79−238 gC m^{-2} 増加することが予測され、これはおそらく酸化により泥炭の分解が進むためと考えられることが明らかになった。
(2) 生態系モデルについては、国立環境研究所を中心として、熱帯泥炭生態系の炭素循環を詳細にシミュレートするプロセスベースモデルが開発されている。同モデルのパラメーターの設定と検証のために、本プロジェクトで蓄積した CO_2 フラックス（二酸化炭素交換量）や、気象及び水文の観測データ等が活用されている。ただし、現時点で参照排出レベルは設定されていないため、中央カリマンタン全域等の、広域レベルでのモデルによる推定の不確実性を評価することは難しい。よって、プロジェクトは 3 つの

アプローチ、すなわち 1）航空レーザー計測、2）年間 CO_2 収支と地下水位の相関関係分析、3）陸域生態系モデルによる評価結果を比較することによってモデルの精度を明らかにする計画とした。

(3) 相関関係分析を用いた年間の CO_2 収支評価の結果は、小規模な実測結果と比較し、目標である 20%以内の差異（12%～18%）となった。2014 年 3 月までに生態系モデルが完成した段階で、上記 3 つのアプローチの比較から誤差の定量分析を行う予定であり、プロジェクト終了までに成果 2 は達成される見込みである。

（成果 3）炭素管理システムが構築される。

（指標） 3-1 対象地 70km^2 において、適切な水位レベルのモデルが開発される。

3-2 3-1 のモデルを用いて、植生回復計画が開発される。

3-3 地下水が質・量ともに明確となり、インフラストラクチャー整備計画を含んだ火災対策戦略が開発される。

成果 3 はほぼ達成されている。現地測定を通じ広域地下水流動モデル（MODFLOW）が構築され、地下水位分布のシミュレーションが可能となった。炭素排出の削減方法については、適正水位の管理と 1) 火災管理、2）泥炭地の回復、及び 3）再植林を組み合わせることが有効であることを定量的に示した。火災管理については地下水の賦存量が十分であることを明らかにし、プロジェクト考案のコンパクト消防設備を私設消防団に貸与し試行を開始した。

(1) 70km^2 の対象地域において、広域地下水流動モデル（MODFLOW）が開発され、水路の建設以前やダムの建設後の地下水位分布が明らかとなった。また適正な水位レベルを 50m メッシュの地図上で示した。

(2) 炭素排出の削減には、適正水位の管理とともに、1）火災管理、2）泥炭地の回復、及び 3）再植林を行うことの有効性が明らかになった。

1）適正水位の管理＋火災管理なし：76%に減少
適正水位の管理＋火災管理：38%に減少

2）泥炭地を火災跡地（DB）から人為的撹乱のない森林（UF）の状態に回復することで、炭素収支の純生態系交換量（NEE）を以下のとおり減少させることができる。

a)ケース A（地下水位が-0.2m から-0.1m になった場合）：16%に減少
b)ケース B（地下水位が-0.1m の場合）：19%に減少
c)ケース C（地下水位が-0.2m の場合）：60%に減少

3）再植林

a)フタバガキ科の *Shorea balangeran* の植林を地下水位-0.1m の火災跡地（DB）に植えた場合：89%に減少（5 年後）
b)加えて、泥炭地における地下水位毎の植物群落や植生の調査を通じ、主要 31 種の情報が蓄積された。3 つの植生タイプ（フタバガキ林、熱帯ヒース林及び熱帯泥炭林）について、自然回復及び遷移モデルを開発し比較する予定である。
c)上記の成果より、火災の起きやすい道路、水路及び農地近傍では *Shorea balangeran* による森林回復を優先すべきであり、火災が起きにくく日常的な管理が難しい遠隔地では自然遷移を中心に検討すべきである。
d)降水量から求めた泥炭火災指数（Peat Fire Index）が泥炭火災発生の危険性、被害量の推定に有効であることが明らかになった。

(3) 泥炭層の地下水量について、汲み上げ調査により消火活動に十分な地下水量が確認された。その一方で、泥炭地の地下水中にはフミン酸が多く含まれるため、浄水システムを改善しなければ、飲用には不適切であることが明らかになった。また、プロジェクトで考案したコンパクト消防設備を私設消防団に貸与し、現在試行している。中古の消火ホースを日本の企業から供給する体制を構築した。この消火システムを国家防災庁（BNPB）に提案する予定である。

（成果 4）総合的な炭素管理を行うための基礎が整備される。

（指標） 4-1 調査データや情報が活用される。

4-2 炭素量評価モデルが 20%以下のエラー発生率で作成される。

4-3 総炭素排出量を 1/3 から 1/5 へ削減するための炭素管理システムが開発される。

4-4 泥炭・森林における火災と炭素管理システムが、政策形成や制度構築プロセスに導入される〔例：気候変動に関する政府間パネル（IPCC）、国際標準化機構（ISO）、開発途上国における森林減少・劣化等に由来する排出の削減等（REDD+）プロジェクト実施等〕。

成果4はほぼ達成されている。多くの研究成果が公表され、またデータベースが構築された。

(1) 56本の原著論文が発表された。現在も複数が投稿中、また執筆中の段階にある。成果のうちには、インパクトファクターが6.91（2012年）と高いGlobal Change Biologyに掲載された「熱帯泥炭湿地林の炭素収支に対する撹乱の影響」などが含まれている。また、プロジェクトの成果は国際レベル及びまた日本・インドネシア両国における地域レベルで多くの会議、セミナー等で発表された。学術誌に掲載された論文には、謝辞に本プロジェクトの貢献を取り上げているものもある。

(2) Web-GISが北海道大学のサーバーにインストールされ、データベースのプロトタイプが開発された。プロジェクトで購入、また作成した各種衛星画像や主題図等が統合されている。さまざまな現地調査及び1997年から続く長期観測成果に基づき、日本・インドネシア両国の研究者は、泥炭地における炭素収支の評価のために8つの要素をモニタリングする必要があることを結論づけた。これは泥炭地の炭素収支管理に関する初めての統合的モニタリングシステムの提案である。

【8つの要素】（1）二酸化炭素フラックスと濃度、（2）ホットスポットの観測、（3）森林劣化及び構成種のマッピング、（4）森林減少、森林バイオマス変化、（5）地下水位及び土壌水分、（6）泥炭ドームの判別と泥炭層の厚さ、（7）泥炭の沈下、（8）水溶性有機炭素

(3) 誤差20%以下の炭素収支モデルの構築については、プロジェクト終了までに成果2の活動が了することにより達成される予定である。さらに、簡易性及び省コストの統合MRV[2]システムを提案するため、ハイパースペクトル解析、土壌沈下計測などさまざまな手法が比較検討された。

(4) 炭素排出量を1/3から1/5とする炭素管理手法の開発については、プロジェクト終了までに主に成果3による成果から達成される予定である。

(5) 2009年6月にエジプト、カイロで開催されたISOの技術委員会207（環境管理）にて、BSNは森林破壊についての国際規格を作ることを提案した。これ以降、インドネシア政府は国際社会に向けて森林破壊についての国際規格を設置するために働きかけを続けている。インドネシア国内での規格の設置についてもBSNを中心に議論が進められており、プロジェクト終了までに規格案が作成される予定である。プロジェクトが主催した国際セミナーやワークショップは国際的研究者のネットワーク構築に貢献しており、またMRVについての円卓会議をインドネシア国家気候変動協議会（National Council for Climate Change：DNPI）との共催で継続的に開催した。

３－２－２　プロジェクト目標に向けた達成度

（プロジェクト目標）泥炭・森林における火災と炭素管理を行うモデルが構築される。

プロジェクト目標である泥炭森林管理手法の構築は、成果1から4の活動によりプロジェクト終了までに達成される見込みである。

なお、炭素排出を現在の1/3から1/5へ削減するための炭素管理手法はほぼ完成しており、最終的に定量的な検討を加える段階にある。またプロジェクトが提案する泥炭森林管理手法は、IPCC、気候変動枠組み条約（United Nations Framework Convention on Climate Change：UNFCCC）の科学及び技術の助言に関する補助機関（Subsidiary Body for Scientific and Technological Advice：SBSTA）、ISOにおける国際的な議論や、インドネシア国内における重要なアクターであるDNPI、インドネシア気候変動センター（Indonesian Climate Change Center：ICCC）、国連森林減少・劣化に起因する温暖化ガスの排出とその抑制方策計画（United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries：UN-REDD）、BSNなどにも注目を浴びており、プロジェクトによるさまざまな発信の成果が現れている。一方で、社会実装に向けた炭素削減方法及び統合的MRVシステムについては、インドネシア側の理解をより一層深めるために、プロジェクト終了までに、プロジェクトの成果を翻訳、調整しモデル化やパッケージ化につなげていく努力が引き続き必要である。

[2] 計測・報告・検証（Measurement, Reporting and Verification：MRV）

第４章　評価５項目に沿ったレビュー結果

４－１　妥当性

本プロジェクトの妥当性は非常に高い。

(1) 2010 年 11 月に UNFCCC へ提出されたインドネシア第 2 回国別報告書によると、2005 年のインドネシアにおける温室効果ガスの主要排出部門は土地利用、土地利用変化及び林業部門（Land use, Land-use change and Forestry : LULUCF）（38%）であり、次いで泥炭火災（25%）、エネルギー（21%）、廃棄物（9%）、農業（4%）、産業（3%）となっている。また DNPI による 2010 年の調査では、インドネシアにおける温室効果ガスの排出源として、LULUCF が 40%、泥炭地が 38%とされている。

(2) インドネシアの生物多様性戦略及び行動計画（Indonesian Biodiversity Strategy and Action Plan : IBSAP）2010-2020）（改訂作業中）は、REDD+に関する内容が含まれる予定であり、プロジェクトの活動はこれら内容と深く関連している。また、プロジェクトは、生物多様性条約の愛知目標の目標 15（2020 年までに、劣化した生態系の少なくとも 15%以上の回復を含む生態系の保全と回復を通じ、生態系の回復力及び二酸化炭素の貯蔵に対する生物多様性の貢献が強化され、それが気候変動の緩和と適応及び砂漠化対処に貢献する。）にも貢献する。

(3) 2011 年に、大統領令 No.61/2011 で温室効果ガス排出削減に係る国家アクションプラン（Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca：RAN-GRK）が策定され、その中で各州政府が州温室効果ガス削減行動計画（Rencana Aksi Daerah Penurunan Emisi Gas Rumah Kaca：RAD-GRK）を策定することが義務付けられた。

(4) 上記 RAN-GRK において、「森林と泥炭地」が温室効果ガスを削減するための 6 セクターのうちの 1 つとされた。同セクターは、他のセクターに比べはるかに炭素排出削減に寄与する割合が大きい。

(5) 2009 年 12 月に開催された UNFCCC-COP15 では、インドネシア大統領が、温室効果ガスの削減目標として、対 BAU（Business As Usual）[3]比で 2020 年までに自国のみで 26%削減、国際的な支援を受けてさらに 41%まで削減することを表明した。インドネシアにおける温室効果ガスの排出源は 60%以上が LULUCF であることから、DNPI は 2010 年の報告書において、同国における削減ポテンシャルの 75%以上は LULUCF・泥炭での取組みによるものとしている。

(6) インドネシアの温室効果ガス削減目標の達成に向けては、泥炭地における火災及び炭素管理の取組みに対する必要性が一層認識されつつある。2010 年 9 月には、大統領令（No19）により大統領開発管理調整ワーキングユニット（The presidential working unit for development supervision and control : UKP4）が発足し、また、大統領令（No10）により REDD+タスクフォースが設置された。REDD+タスクフォースについては、1 年後の大統領令（No.25/2011）により、REDD+庁と MRV 庁の設立準備活動のため再設置されている。大統領令（No.62/2013）により、まず REDD+庁が設置された。さらに、2013 年 5 月には、自然林と泥炭地を対象とした 2 年間のモラトリアム（新規森林コンセッションの発給を停止）更新に大統領が署名した。

(7) 中部カリマンタン州は、2010 年 12 月に REDD+活動のパイロット州に選定され、中央カリマンタン州 REDD+タスクフォース（KOMDA REDD+）が中部カリマンタンの REDD+活動の実施機関として設立された。中部カリマンタンでは、州・コミュニティレベルにおいても火災・泥炭管理に対する認識は高まっており、消火隊が 2 年前から活動を開始したほか、国際的な非政府組織（Non-Governmental Organization : NGO）との協力により泥炭からの流水を防ぐための水路堰の建設などが進められている。

(8) 本プロジェクトのすべての C/P 機関は、以下のとおり、泥炭地及び森林からの CO_2 排出削減を進めることについて強い意志を有している。

1) BSN：森林破壊についての国家規格の策定を計画している。
2) LAPAN：組織の目標として、土地利用の変化に係るデータ/情報の提供、より正確なホットスポット検知アルゴリズムの構築、ホットスポットの検知が含まれている。
3) LIPI の生物学研究センターは 2010 年～2014 年と 2015 年～2019 年の活動計画に気候変動と REDD+の研究を行うことの重要性について記載している。
4) UNPAR：UNPAR のビジョンには熱帯泥炭湿地の発展に焦点をあてることとある。

(9) 日本側については、2012 年 4 月に外務省が策定した対インドネシア共和国国別援助方針において、「環境保全・気候変動等の地球規模課題への対応能力（中略）の向上に寄与するための支援等を行う。」と記載さ

[3]特段の対策活動をしない場合の将来予測値

れている。
(10) 日本とインドネシアは2013年8月26日に二国間クレジット制度に関する署名を終えた。
(11) 日本はまた、インドネシアにおけるREDD+を推進することについて二国間で合意し、技術協力「日本インドネシアREDD+実施メカニズム構築（IJ-REDD）プロジェクト」を西及び中央カリマンタン州で開始した。

４－２　有効性

本プロジェクトの有効性は中程度から高いと評価される。
(1) 中間レビュー時に改訂されたマスタープランと比較し、プロジェクトの有効性の達成見込みは中程度から高いと評価される。これは、2013年10月時点でプロジェクト目標及び4つの成果の指標が完全には満たされていないこと（特に定量的な指標）、また成果が関係者に十分に説明されていないためである。
(2) 定量的指標を設定することは説明責任を果たすうえで有効であり、一方で難しい挑戦でもあったが、プロジェクトは指標が意味することとその検証の方法を一層検討し、プロジェクト目標に関する相互理解を深める必要がある。
(3) 現時点までの主要なプロジェクトの達成内容は３－２に記載されている。改訂マスタープランに沿った各活動レベルの進捗状況を、合同評価レポート（Joint Terminal Evaluation Report）のAnnex A.11として詳細に整理した。これに基づき各成果の進捗状況はおおむね、成果1：80%、成果2：90%、成果3：80%、成果4：85%と考えられる。
(4) 各成果の活動において綿密かつ先進的な研究が行われており、2014年3月のプロジェクト終了時点で各成果が達成される見込みである。
(5) しかしながら、インドネシア側からは成果の全体的な統合（成果4及びプロジェクト目標）について明確になっておらず、政策及び意思決定にプロジェクトの成果を十分に活用することができていないというコメントがなされている。

４－３　効率性

現時点までの本プロジェクトの効率性は高いと評価される。
(1) 現時点までのプロジェクトの投入は３－１に記載したとおりである。プロジェクトの円滑な実施と効果的な運営に向けての日本人専門家の努力は、C/Pにもよく認識されている。プロジェクトにより供与された資機材は、データ測定や火災制御の向上などに適切に使用されている。
(2) 人的資源の投入は、C/P 機関から専門性、投入の時期及び期間のいずれについても効率的であったと評価された。資機材の投入についても、C/P機関のニーズに合致しており効率的であったと評価された。
(3) 数多く実施された日本での研修とスカラーシッププログラムについては、C/P 機関から高い評価の声が聞かれた。また、これらのプログラムに参加したC/P機関職員は、プログラム終了後に所属機関に戻った後、プロジェクトに効果的に貢献したと評価された。
(4) 日本側（北海道大学）とインドネシア側（UNPAR）が1983年以降長期にわたり関係を築き、貴重な情報の蓄積を続けてきたことは特筆すべきである。本プロジェクトはこれまでの研究データの蓄積から成果を取りまとめるためのきっかけとして大きく貢献した。
(5) プロジェクト参加者間におけるコミュニケーション向上の必要性が中間レビューに引き続いて指摘された。プロジェクト目標、成果及び活動が広範囲にわたるため、C/P機関は目標、成果、活動及びその相互の関連性について明確に理解できていない。中間レビューによる指摘を受けてプロジェクトの実施体制の改善が図られるなど、プロジェクトの共通認識の醸成及びC/P 機関の役割と責任の明確化について、改善はされたものの不十分であったと評価された。
(6) インドネシア側の投入は、事務所スペースや設備の提供を含む現物による貢献のほか、特に、泥炭森林の実地活動に対するUNPARスタッフの努力、貢献、時間的な投入については、特記されるべきである。また、LIPI以外のいくつかの実施機関においてはC/P 予算の不足が指摘され、これはプロジェクトにおける研究者間の共同活動・情報共有などの機会の損失につながる可能性がある。

４－４　インパクト

本プロジェクトがもたらしているインパクトは極めて大きい。
(1) BSNにおいては、環境管理のためのISOへの提案文書（土壌劣化と森林減少に対する取組みの優良事例ガイドラン）の作成が、プロジェクトからの支援を得て進められている。
(2)『第5次IPCCガイドライン』の湿地（泥炭地を含む）に関する章の主要執筆者に、プロジェクトリーダ

ーである大崎満教授が選出され、2011 年 11 月に開催された執筆者の第 1 回会合以降、関連する会合に参加している。

(3) 2013 年 6 月に、プロジェクトリーダーである大崎満教授はドイツのボンで開催された気候変動枠組み条約（UNFCCC）の SBSTA38 で招待講演を行った。大崎満教授は統合 MRV システムについての講演を行い、本プロジェクトの経験と発見から提案される MRV システムについて国際社会の協力を要請した。

(4) 日本の経済産業省及び環境省の支援により、REDD+に関する実現可能性調査（Feasibility Study：F/S）が実施されており、中央カリマンタン州では日本企業が 3 件を実施した。経済産業省からの補助を受けて住友商事・住友林業は、UNPAR にて炭素排出量を地上測定しているが、中部カリマンタンを F/S 実施地に選んだ理由として北海道大学が当地で既に研究を進めていたことを挙げている。また、環境省からの補助を受けて三菱 UFJ リサーチ&コンサルティングが、アジア・太平洋電気通信共同体からの補助を受けて（一社）情報通信技術委員会が、泥炭管理における情報通信技術（Information and Communication Technology：ICT）の適用等の F/S を実施している。プロジェクトリーダーである大崎満教授は、中部カリマンタンで実施されているこれら 3 件の F/S の技術顧問を務めている。

(5) 三菱総合研究所は、（財）資源・環境観測解析センター（Earth Remote Sensing Data Analysis Center：ERSDAC）[4]からの支援を受けて、中部カリマンタン泥炭地における森林劣化と溶存有機炭素のモニタリングにハイパースペクトラル情報を適用するためのプロジェクトを実施している。中部カリマンタンが実施地に選ばれたのは、北海道大学とインドネシア側関係機関による長年の実地観測の実績があったためである。

(6) 永年観察プロットにおける調査で明らかにされた 394 種の植物のインベントリー情報は、IBSAP の作成に際して共有、活用された。

(7) 泥炭火災管理の重要性に対する認識の高まりから、（一社）北海道消防設備協会より 3,000 本の消火用ホースと 50 個のノズルがプロジェクトに対して寄贈された。泥炭では消火用ホースが損傷を受けやすいことから、多くのホースの安定的な供給が望まれる。

(8) プロジェクトからの支援を受けて、カリマンタン 5 州の大学間連携により統合的な炭素管理・教育・研究ネットワークを目指す「カリマンタン大学ネットワーク」が設立された。この試みは今後国家レベルでも取り入れられる見込みである。

(9) 日本においても、2013 年 10 月に日本泥炭地学会が設立され、大崎満教授が初代会長に選出された。本学会を通じ国際泥炭地学会及びインドネシア泥炭地学会と今後より一層の協調を進めていくことができる見込みである。

(10) UKP4 や DNPI に対して、プロジェクトより情報やアドバイスの提供が適宜行われている。MRV に関する技術レベルのラウンド・テーブル会合が DNPI と共同で既に 8 回開催され、そこでは MRV システムに関する提案も示されている。

(11) 中部カリマンタン州の REDD+実施機関である中央カリマンタン州 REDD+タスクフォース（KOMDA REDD+）に関しては、プロジェクトが組織したインドネシア国内専門家ワーキンググループが、REDD+実施に関わる活動計画案の骨子となる「REDD COE Kalteng」（文書などのリスト）を取りまとめて、2011 年 8 月に KOMDA REDD+に提出した。本骨子は、中部カリマンタン州における炭素管理を行う実施体制整備に直接に関係するものである。

(12) さらにプロジェクトからは、日本とインドネシアの二国間オフセットメカニズム構築に向けた情報・データ等を、外務省、経済産業省、環境省、林野庁、民間企業などに提供している。

(13) 本プロジェクトを通じ開発された計測データ遠隔転送システム（SESAME システム）は本プロジェクト以外にも有効であり適用可能であると評価された。同システムは、平成 25 年度政府開発援助海外経済協力事業委託費による「案件化調査」を活用し、ジャカルタ近郊のダムの水位情報の測定、伝送のために設置が開始された。

(14) 多数の組織及び専門家の参加を通じ、既存のリソースをつなぎ、意見交換を行い、今後の協力を広げるための場として本プロジェクトが機能した。これはプロジェクト実施による良いインパクトの 1 つである。

４－５　持続性

本プロジェクトの持続性にかかる現時点での見込みは高いと評価される。近年大きく変化を続けてきたインドネシアにおける REDD+の状況に追いついていくため、プロジェクトが努力したことは評価されるべきである。

(1) インドネシア大統領とインドネシア政府からは、泥炭森林における炭素管理に向けて強いコミットメントが表明されている。加えてインドネシアにおいて REDD+の実施体制が整備されつつある。そのため、イン

[4] 2012 年 3 月 30 日、宇宙システム開発利用推進機構へ統合。

ドネシアにおいてREDD+政策に大きな変更がなければ、特に泥炭地における炭素管理は一層重要となる。

(2) プロジェクトを通じ、C/P機関のスタッフ20人が日本で学ぶ機会を得た。彼ら研修や留学の参加者が日本から戻ったことでC/P機関の能力が向上しており、また将来参加者の更なる帰国に伴い向上していくことが期待される。この能力向上がプロジェクトの自立発展性に貢献すると見込まれる。またイオンクロマトグラフィー、全有機炭素（TOC）分析計、スペクトロメーターのように、資機材の供与と資機材の利用・メンテナンスのトレーニングを組み合わせて実施したことは特筆される。人的資源と資機材の両面から能力強化を行うことは自立発展性への貢献が評価できる。

(3) プロジェクトの供与資機材は、適切に利用されていると確認された。持続性の面で鍵となるのはメンテナンスである。新規の資機材によって強化された能力を維持するためには、資機材利用計画の作成と利用状況のモニタリング・管理が重要となる。いくつかの精密機械については、より環境の良い設置場所の検討が必要である。人的資源の面からは、これら新規の資機材を利用管理できる人材の人数が限られているため、更なる能力強化と、マニュアルの準備が必要である。資金面からは、今後もREDD+や泥炭地は国際的な関心をひくと期待されるため、UNPARは研究プロジェクトへ積極的に参加し、資機材の利活用を続けていくことが求められる。

(4) プロジェクトを通じ、さまざまな課題に適用可能な多くの発見や技術開発がなされている。今後これら新しい知見や技術の利活用が期待されるが、自立発展性のためには、潜在利用者のための技術の翻訳、マニュアルやパンフレットの作成と広報、関連技術のパッケージ化などが必要である。

(5) プロジェクトの実施機関である北海道大学は、UNPARやLIPIと長期にわたる協力関係にある。現在、北海道大学は中央カリマンタン州における協力を続けるためにさまざまな資金ソースへの申請を行っており、この努力は自立発展性に貢献する。また、UNPARは、プロジェクトの成果を活用し、泥炭地に関する一般教養教育プログラムの開始を計画している。

(6) IJ-REDDプロジェクトが2013年から3年間の事業として開始された。西カリマンタン州でパイロット活動、中央カリマンタン州で州政府の能力強化活動を行う予定であり、同プロジェクトの実施は本プロジェクトの自立発展性向上につながっている。

第５章　結論

プロジェクト目標達成に向けて４つのコンポーネントから多くの研究成果を出していることを評価する。また、研究成果を国際的に発信しており、「熱帯泥炭湿地林の炭素収支に対する攪乱の影響」等は高い評価を得ている。プロジェクトの適切な管理体制が構築されており、大人数かつ多機関が関わるプロジェクトを適切に運営している。

また、プロジェクト内容はインドネシア政府の温室効果ガス削減に関する政策等と関連しており、REDD+に関連した議論の進展も本プロジェクトの妥当性を高めた。

４つのコンポーネントの成果を統合し、泥炭における炭素測定手法として確立し、その手法がインドネシア政府の関連機関に認知され、政策策定等において活用されることにより、インドネシアの気候変動対策に資することが期待される。ついては、本プロジェクトはプロジェクト期間内に終了することが適切である。

第６章　提言と教訓

６－１　提言

(1) プロジェクト成果に対するインドネシア政府関係者の理解は必ずしも十分でなく、政策策定や意思決定に利用する段階には至っていない。泥炭森林管理手法やMRVシステム等のプロジェクト成果を政策策定者が活用するために、わかりやすく翻訳することが必要であり、簡明な提案書（Policy brief）を政策決定権限者に提示することを提言する。

(2) 将来の土地利用変化を予測することが中央カリマンタン州の主要関心事項であることが確認されたことに代表されるように、プロジェクト目標である泥炭森林における火災と炭素管理を行うモデル構築のためにはインドネシアの社会経済的側面を考慮したうえで事業を進めることが重要である。

(3) プロジェクト終了後にプロジェクト成果を引き継ぐ組織を確定する必要がある。また、泥炭火災対策、植林等の事業実施マニュアルがプロジェクト終了時までに準備される必要がある。

(4) プロジェクトのプロジェクト・デザイン・マトリックス（Project Design Matrix：PDM）で設定した指標の達成度を確認したところ、プロジェクトから十分な情報が提供されていない箇所があることから、プロジェクト終了時点までに改めて定量指標の達成度について確認し、取りまとめることを提言する。

(5) 供与機材の使用状況・管理状況は、調査団が確認した範囲ではおおむね適当であった。一方で、大学が直接購入し、日本から輸送した供与機材は適切に機材管理簿に記載されていないものがあったところ、早急な対応を求める。

６－２　教訓

(1) 協力の成果を効果的に社会実装につなげるためには、科学技術協力プロジェクトでは、プロジェクト形成段階において自然科学分野に加えて、土地利用政策との関係等の社会経済面を十分に考慮し、プロジェクトデザインに入れる必要がある。

(2) 多数の関係者が関与するSATREPSプロジェクトにおいては、プロジェクト内容について十分に理解し、関係者との良好なコミュニケ―ションをとれる事務担当者を、日本側及び相手国側双方に配置することが、プロジェクトの円滑な実施や成果の最大化に重要な役割を果たす。

第７章　特記事項

本レビュー調査に関し、特に記載をしておいたほうがよいと思われる事項及びJSTから参加した団員の評価所感については以下のとおりである。

(1)プロジェクト成果のインパクトについて

本プロジェクトは研究代表者の大崎満教授等のリーダーシップにより、多数の成果を出している。大崎満教授は、『第5次IPCCガイドライン』（2013年）の湿地セクションの執筆、今年6月のSBSTA38でのプレゼンテーションなど、国際的な発信を積極的に行っている。研究成果の代表例としては、平野教授が1）攪乱がなく、地下水が未排水の湿地林においても正味でCO_2の排出源となっていること，2）CO_2排出量は環境撹乱が進むにしたがって大きくなること，3）エルニーニョが発生した年にはCO_2排出量が大きくなること，などを世界で初めて実証するなど、顕著な研究成果を出している点を高く評価した。

(2)合同調整委員会での協議について

終了時評価報告書を提出した合同調整委員会において研究代表者大崎満教授より、「プロジェクト目標である統合的MRVシステムの構築を了しているため、有効性の評価をより上げるべきである」とのコメントがあった。調査団より、関連するC/P機関への聞き取りや合同評価チームとしての協議の結果として同評価に至ったこととを説明するとともに、合同調整員会での協議内容はミニッツ（Minutes of Meeting：M/M）として残すことを確認した（協議内容は、Annex3のとおり）。

(3)JST中村団員所感

本プロジェクトは、インドネシアの熱帯泥炭地〔中部カリマンタン州にあるメガライスプロジェクト（Mega Rice Project：MRP）地域・約100万ha〕を対象として、泥炭地からの炭素排出量が現状の1/3から1/5以下となる炭素管理手法の開発と中央・地方政府・地域コミュニティへの提案を行い、インドネシアの温室効果ガス排出量を削減するとともに、REDD+事業あるいは二国間カーボン・オフセットメカニズムとして実施された際それを日本の貢献としてカウントされることを目指したものであった。

総じていえば、北海道大学をはじめとする日本とインドネシアの200人以上にのぼる研究グループは、それぞれの活動をよく展開し、十分な成果を挙げたといえる。次から次へと参加する研究者、追加される研究項目が相次ぎ、一時は取り組みが広がりすぎて収拾がつかないのではないか、という懸念があった。しかし、PMグループがMRVにおける目指すべきアウトプットの8つのコンポーネントを示し、複数の計測する手段と組み合わせたマトリクスを整理するに至り、各個人が取り組んできた研究が何に帰結するのかかが見えてきたようだ。結果的にインドネシアの国や州政府の政策決定者に説明する段階まで達したことは、大きな成功と言えよう。

本プロジェクトは中間評価の段階で、新たに多くの数値目標が確認され明示された。衛星による火災・炭素センシングプログラムでは、既存の火災検知アルゴリズム（MOD14）と比較し、検出精度80%、誤検出10%低減のアルゴリズムを開発し、24時間以内に誤差50%以内で延焼予測を行うことにした。炭素量評価プログラムでは、熱帯泥炭生態系のCO_2収支定量化モデルを誤差20%以内で開発することが盛り込まれた。これだけ多くの具体的に示された目標を短期間で達成できたことは、SATREPSの他のプロジェクトの模範となるといえる。

一方、JICA調査団は、推奨すべき事項として、政策の意思決定者に向けた情報発信を挙げたが、これは今後の社会実装を確実なものとするために重要と考えられる。研究グループとJICAは2014年1月、パランカラヤで「泥炭SATREPS&IJ-REDD合同ワークショップ」を開催した。中央カリマンタン州の泥炭地のREL作成方法、MRV手法等にかかる政策的意思決定者（中央カリマンタン州計画局・環境局、KOMDA REDD+メンバー等）が協議し、SATREPSの研究成果をもとに開発された泥炭地の炭素管理に関するMRV手法、Integrated Peat Management System等を州政府レベルで活用していく方針を確認することになる。

UNFCCC-COP16におけるカンクン合意で示されたREDD+のフェーズドアプローチでは、第2段階の実施フェーズに、戦略・行動計画の実施があり、実証活動を含んでいる。このなかで州政府レベルでも成果を活用できれば、州政府のプロジェクトレベルのカーボンオフセットクレジットから出発して、段階的にナショナルレベル、国際社会レベルへとステップアップする道筋が示されることになる。日本政府が探る、科学的な知見を生かした二国間 オフセット・クレジット制度（Joint Crediting Mechanism：JCM）実現の方針とも一致し、大崎満教授が苦労して続けてきた国際機関へのアピールも現実味を帯びてくるのではないか。

付　属　資　料

MINUTES OF MEETINGS
BETWEEN
TERMINAL EVALUATION TEAM
AND
JOINT COORDINATING COMMITTEE
FOR THE PROJECT
ON
THE PROJECT FOR THE WILD FIRE AND CARBON MANAGEMENT IN PEAT-FOREST IN INDONESIA

Japan International Cooperation Agency (JICA), Japan Science and Technology Agency (JST) and Government of Indonesia jointly organized the Terminal Evaluation Team (hereinafter referred to as "the Team"), headed by Mr. Kei Jinnai, for the purpose of conducting terminal evaluation from 13 October to 30 October 2013 for the technical cooperation project entitled "The Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia" (hereinafter referred to as "the Project").

The Team has carried out intensive study and analysis of the activities and achievements of the project, and prepared the Terminal Evaluation Report attached hereto, and presented it to the Joint Coordinating Committee (JCC) Meeting held on 30 October, 2013.

The Project has confirmed the contents of the Terminal Evaluation Report and agreed to consider it for implementation of the Project in the remaining period.

Jakarta, October 30, 2013

Mr. Kei JINNAI
Team Leader
The Terminal Evaluation Team
Japan International Cooperation Agency

Prof. Kumpiady Widen
for Project Director
Vice Rector I
Palangka Raya University

Prof. Mitsuru OSAKI
Project Leader
Hokkaido University

MINUTES OF MEETINGS BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND THE PROJECT
ON
THE PROJECT FOR THE WILD FIRE AND CARBON MANAGEMENT
IN PEAT-FOREST IN INDONESIA

Japan International Cooperation Agency (JICA), Japan Science and Technology Agency (JST) and Government of Indonesia jointly organized the Terminal Evaluation Team (hereinafter referred to as "the Team"), headed by Mr. Kei Jinnai, for the purpose of conducting the review from 13 October to 30 October, 2013 for the technical cooperation project entitled "The Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia" (hereinafter referred to as "the Project").

Based on the discussion at 6th Joint Coordinating Committee (JCC) Meeting which was held on 30 October, 2013 at Jakarta, the Project has confirmed the contents of the Terminal Evaluation Report and agreed to consider it for implementation of the Project in the remaining period.

Jakarta, 30 October, 2013

Prof. Mitsuru OSAKI
Project Leader
Research Faculty of Agriculture
Hokkaido University

Prof. Kumpiady Widen
for Project Director
Vice Rector I
Palangka Raya University

Endorsed by

Mr. Kei Jinnai
Director, Forestry and Nature ConservationDivision1,
Global Eivironment Department
Japan International Cooperation Agency

Mr. Juliantino MM
Head of Research and Development Center for Standarization, National Standardization Agency

MINUTES OF MEETING

The 6th Joint Coordinating Committee (JCC) Meeting and
Joint Steering Committee (JSC)
on the Project for Wild Fire and Carbon Management
in Peat-Forest in Indonesia

Jakarta, October 30th, 2013
BSN Office, Jakarta

Prof. Mitsuru OSAKI
Project Leader
Research Faculty of Agriculture
Hokkaido UniversityPalangka Raya University

Prof. Kumpiady Widen
Project Director
Vice Rector I

Attached Document

I. Opening Speech from **Prof. Mitsuru Osaki** (Hokkaido University)
- This project, which started from 2008, has developed many technologies and made a great progress
- How to manage and develop peatlands
- How to control fire
- The project has started to discuss how the technology could be transferred to Indonesia (BPPT)

II. Opening Address from **Mr. Y. Kristianto Widiwardono** (BSN)
- This meeting is very important because the participants will hear the report of the project's Terminal Evaluation.
- The outcomes of this project are production of data and information, tools, methodology, and technology (through research on peatland management).
- For BSN, the project's methodology provided a basis of developing a monitoring system of peatlands and to make standards for peat management.

III. Report of the Evaluation Result to JSC/JCC (Based on the hardcopy)

1. Report from **Mr. Kei Jinnai**, Leader of the Terminal Evaluation Team about the outline of the Project for Wild Fire and Carbon Management in Peat-Forest in Indonesia and the outline of the terminal evaluation.

   - Chapter 1: Outline of the Terminal Evaluation
   - Chapter 2: Outline of the Project

2. Report from **Mr. Tetsuya Saito**, the consultant for Evaluation and Analysis of the Terminal Evaluation Team, explained about the major findings and evaluation results.

   - Chapter 3: Achievement and Implementation Process
   - Chapter 4: Evaluation by Five Criteria

3. Report from **Mr. Koji Mitomori**, the team member in charge of Evaluation Planning, presetnted on the Results of Evaluation.

   - Chapter 5: Results of Evaluation

4. Report from **Mr. Tetsuya Saito**, Evaluation and Analysis of Terminal Evaluation Team about ...
   - Annexes

IV. Discussion

1. **Dr. Bambang Setiadi** (BPPT)
   - Cooperation between Japan and Indonesia on peatland and carbon management is very important because Indonesia considers as one of the weakness of the country in terms of research.
   - It is not only about a project but it is about a vision about peatland and carbon management. This cooperation is very important because the outcome of this research is a real monitoring system. This system will be a standard system and this is very easy to be understood.
   - This philosophy came from our cooperation between Japan and Indonesia. It is not always about a vision, because this is a result from tens of views based on science.
   - Our cooperation is a vision-based cooperation. If this project is not to be continued, we will not get anything and that means it will be nothing.

2. **Prof. Sulmin Gumiri** (UNPAR)
   - Recomendation about social and economic aspects :
     "I think research on social and economic aspects will be more reasonable if we continue as other activities, for example as a reasearch topic for the next project (JST/JICA Project)"

3. **Dr. Joeni Setijoe Rahajoe** (LIPI)
   - How important this project outcomes can be included, not only for the REDD purposes but also for the Indonesian Biodiversity Strategy and Action Plan (IBSAP). Some Flora diversity from this project are used for the update of IBSAP.
   - This Project has benefit to LIPI, Since 2 students were graduated from Hokkaido University and 1 Student for short term visit to study about wetland forest management.
   - The social aspect research during discussion mentioned that each component concern some research topics in social aspect before last evaluation, but during this evaluation, there were no social aspect expert who explained and have been interviewed by the evaluator therefore, the social aspect research seem low in the impact valuable to this project, but it does not mean that social aspect research not good results in this project, but have to informed again that social aspect research have been done with the result…… as informed at previous evaluation and We did some social aspect research related to the Biodiversity and ecosystem services and published in one International Journal, collaboration with SGLP and United Nation University. But our main subject was the affect of the land use change to the Biodiversity and the ecosystem services.

4. **Mr. Kustiyo** (LAPAN)
   - Lapan gained much benefit because Lapan's activities are also in line with this project.

- We will show for providing remote sensing, support monitoring facilities and it is according to Undang-Undang no. 21 tahun 2013 which is mentioning about Lapan’s responbility to support remote sensing.
- We hope that data are used to monitor peatland activities.

5. **Mr. Takahara Shigeru** (IJ-REDD+)
   - Evaluation from JICA Evaluation Team is very useful and IJ-REDD+ Project will support the next project.
   - Carbon Management in peatland is very important issue lately.

6. **Prof. Osaki Mitsuru** (Hokkaido University)

The evaluation result on "Effectiveness in Chapter 4: Review by the Five Criteria", which is assumed to be “medium to high” is not acceptable. Evaluation of Effectiveness should be high to very high, due to the reasons as follows; 1) we have already developed an "Integrated MRV System" which can provide maps of a) peat depths and amount of carbon stocks, 2) water table levels, 3) CO_2 flux by inputting coefficient of NEE and WTL into WTL map, 4) CO_2 emission by fire by inputting coefficient of CO_2 emission by fire index and WTL into WTL map, and 5) peat fire frequency by inputting coefficient of fire index and WTL into WTL map. These kinds of maps are obtained by integrating Four Groups’ Results, which indicate that "setting quantitative indicators" was completed, and as these maps were obtained first in the world, UNFCCC SBSTA has been estimateing as MRV for TIER 3, because UNFCCC SBSTA invited us to present our "Integrated MRV System" at SABSTA 38 and UNFCCC Workshop on "technical and scientific aspects of ecosystems with high-carbon reservoirs not covered by other agenda items under the Convention".

JICA’s comments on Evaluation of Effectiveness to explain to the stakeholders was out of points, because this project has been targeting on high level government organizations for establishing model or criteria on MRV for REDD+. On this point, we have had so many discussions with key- stakeholders such as UKP4, DNPI, ICCC, UNDP, UNORCID, and so on, and we organized so many workshops together with these stakeholders. Also many documents were prepared together. Thus, this project directly inputs our research outcomes into high-level policies and decision-making processes, if we compare with many other foreign agencies. We also support local governments for RAD-GRK, PDD on REDD COE, but local government is not the main stakeholder in this project. Local government’s interest to our project though they are not stakeholders of the project indicates the Evaluation of Effectiveness should be marked high even at the local gorvernment level.

Thus, it is very difficult to accept the following conclusion of the report as "However, there were several comments given from Indonesian side that the overall integration of the outputs (Output 4 and Project Purpose) are not clear enough, resulting in facing difficulties for them to apply the achievements of the project into policy and decision making process."

7. **Prof. Hirano Takashi** (Hokkaido University)
   The report points out the importance of socio-economic aspects in the last page. I understand the comment well and remember that such aspects were included in this project at least until mid-term evaluation. However, the socio-economic aspects were excluded according to suggestion by the mid-term evaluation report.

8. **Mr. Yuki Arai** (JICA Indonesia Office)
   I believe that all the terminal evaluation team members agree with the fact that the project has been making tremendous efforts in developing the "Integrated MRV System" and to share the research outcomes with numerous stakeholders including various policy and decision makers. This point must be evaluated properly. However, as I accompanied the mission, unfortunately it was also true that the decision makers in the institutions such as DNPI, BAPPENAS (RAN-GRK Secretariat), UNORCID, BAPPEDA, BLH, and KOMDA of Central Kalimantan Province, still have an impression that they are facing difficulties in applying the project's research outcomes in implementing peatland MRV in the field. Although we all fully respect the project's enormous efforts, it is still necessary to further promote interpretation and explanation of the research outcomes toward the decision makers of Indonesia.

V. Final Comments from **Mr. Kei Jinnai** (Leader of the study team / JICA)
   Althogh it is not able to chnage the rating of the Joint Evaluation Report, I will record the comments of project members.

VI. Closing Speech from **Dr. Bambang Setiadi** (BPPT)
   I would like to thank JICA, BSN, Hokkaido University, UNPAR, BPPT, LIPI, LAPAN and all Japanese friends for organizing the research cooperation, sharing knowledge and experience, initiating and participating in this meeting.

VII. Closing Address from **Prof. Kumpiady Widen** (UNPAR)
   1. Social and economic aspects exist in 4 components (CA,CM, FF, PM) even though they aren't included explicitly.
   2. Transfer of knowledge in the components of Fire Detection and Fire Prediction by the experts, for example:
      - To detect a wildfire with IT (Information Technology)
      - Information about agricultural techniques without using fire
   3. Advice:
      - Funds can be allocated for making a draft material for a program study, especially for UNPAR student
      - The research materials of 4 components (CA, CM, FF, PM)

Attachment

Joint Terminal Evaluation Report
on
the Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia

October 2013

Joint Terminal Evaluation Team

1

Abbreviations

BAU	Business as usual
BAPPEDA	*Badan Perencanaan Pembangunan Daerah*
BNPB	National Agency for Disaster Management
BSN	*Badan Standardisasi Nasional* (National Standardization Agency)
BPPT	*Badan Pengkajian dan Penerapan Teknologi* (Agency for the Assessment and Application of Technology)
C/N ratio	Carbon to Nitrogen ratio
C/P	Counterpart
CDM	Clean Development Mechanism
CIMTROP	Center for International Cooperation in Sustainable Management of Tropical Peat-land, UNPAR
COE	Center of Excellence
DNPI	*Dewn Nasional Perubahan Iklim* (National Council on Climate Change)
FORDA	Forestry Research and Development Agency
FS	Feasibility Study
GHG	Greenhouse Gas
GIS	Geographic Information System
ISO	International Organization for Standardization
IPCC	Intergovernmental Panel on Climate Change
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JSC	Joint Steering Committee
JST	Japan Science and Technology Agency
KALTENG	East Kalimantan Government
KOMDA	Regional Commissions for REDD+ in Central Kalimantan
LAPAN	*Lembaga Penerbangan dan Antariksa National* (National Institute of Aeronautics and Space)
LIPI	Indonesian Institute of Sciences
LUCF	Land Use Change and Forestry
LULUCF	Land Use, Land Use Change and Forestry
M/M	Minute of Meeting
MODIS	The Moderate Resolution Imaging Spectroradiometer
MRV	Measuring, Reporting and Verification
OECD-DAC	Organization for Economic Cooperation and Development – Development Assistance Committee
R/D	Record of Discussions
RAD-GRK	Regional Action Plan for Greenhouse Gas Reduction
RAN-GRK	National Action Plan for Greenhouse Gas Reduction
REDD	Reducing Emissions from Deforestation and Forest Degradation
REDD+	(REDD extended by sustainable forest management)
RISTEK	State Ministry of Research and Technology
SATREPS	Science and Technology Research Partnership Program
SESAMI	Sensory Data Transmission Service Assisted by Midori Engineering
TOC	Total Organic Carbon
UAV	Unmanned Aerial Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
UNPAR	University of Palangka Raya
UKP4	*Unit Kerja Presiden bidang Pengawasan dan Pengendlian Peinbangunan* (President Delivery Unit for Development Monitoring and Oversight)
WWF	Wild Wide Fund for Nature

Contents

Chapter 1: Outline of the Terminal Evaluation

1.1. Background of the Terminal Evaluation

In marsh area in Indonesia, there is a wide range of tropical peatland. Many of diseases such as malaria have been found there, but land use value is low that strong attention for development has not been paid to peat area. Meanwhile, rapid development project in the late 20th century developed large-scale farmland with irrigation and drainage canals. As a result, peat degradation occurs most rapidly and massively, because of fires, drainage, and deforestation of swamp forests coexisting with tropical peat and amount of carbon gas has been released into the atmosphere due to a fire and microorganism decomposition.

About 68% of Tropical peatland area locates in South Asia. Among them, it is said around 85% exists in Indonesia. It is estimated that 0.81 Gt to 2.57Gt carbon was released into the atmosphere by peat fire from Indonesia when El Nino happened in 1997 and 1998. The emission amount is said to be equivalent to 2.4-7.6 times of total annual emission in Japan in 2000.

In the situation above, importance of carbon management in peatland is realized by Indonesian Government. In addition to climate change and global warning issues which has been paid attention to by international communities, there have been growing recognition and understanding for importance of carbon management in peatland. Furthermore, local people living near peatland suffer from health problems caused by fire, and damage from landslide in rainy season is also serious situation.

Hokkaido University has conducted scientific studies for nearly 20 years in cooperation with RISTEK , LIPI and others concerned in Central Kalimantan (100 million ha of peat marsh land) where mega-rice project was implemented in 1997.

Indonesian government fully recognized the importance of coping with carbon management issues and requested Japanese government to conduct technical cooperation project on wild fire and carbon management in peat-forest. The request included establishment of some systems such as fire detection and control system, carbon assessment system, carbon management system.

Through the detailed planning survey in March, 2009, Japanese government and Indonesian Government agreed outline and components of the Project under the framework of JICA-JST Science and Technology Research Partnership Program (SATREPS). Record of Discussions (R/D) was signed by both sides in December, 2009, and the Project started.

The master plan agreed in R/D was reviewed and updated in Mid-term Review held in November 2011.

Since the Project will be ended in 5 months, joint terminal evaluation team was formed by Indonesian and Japanese sides.

1.2. Objective of the Terminal Evaluation

The objectives of the terminal evaluation are as follows:

1) Examine the extent of achievements of the project in terms of the project purpose and outputs.
2) Discuss various issues of the project as well as the way forward for the last months of the project.
3) Prepare and agree on the terminal evaluation report based on the findings of the evaluation.

1.3. Members of the Terminal Evaluation Team

The joint terminal evaluation was conducted by the following members of the Terminal Evaluation Team (hereinafter referred to as "the Team").

Name	Title	Occupation
Mr. Kei Jinnai	Leader	Director, Forestry and Nature Conservation Division1, Forestry and Nature Conservation Group, Global Eivironment Dpartment, JICA
Mr. Koji Mitomorii	Evaluation Planning	Deputy Director, Forestry and Nature Conservation Division 1, Forestry and Nature Conservation Group, Global Environmental Department, JICA
Mr. Tetsuya Saito	Evaluation and Analysis	Nippon Koei Co., Ltd.
Mr. Makio Nakamura	JST Project Evaluation	Japan Science and Technology Agency

Name	Title	Occupation
Prof. Kumpiady Widen	Vice Rector	University of Palangka Raya

Prof. Tukirin Partomihardjo	Professor	Indonesian Institute of Sciences (LIPI)
Dr. Joeni Setijo Rahajoe	Head	Botany Division, Indonesian Institute of Sciences(LIPI), Research Center for Biology
Dr. Laode Alhamad	Researcher	Indonesian Institute of Sciences (LIPI)
Mr. Bendjamin B. Louhenapessy	Head	Cooperation and Evaluation for Research Division, National Standardization Agency
Mr. Nasrudin Irawan, M.	Inspector	National Standardization Agency

1.4. Process and Schedule of the Terminal Evaluation

As a framework of evaluation, Progress Grid (Annex 11) was prepared, based on available document on the project. Questionnaire for C/P was used to efficiently conduct interviews. The grid was filled with the findings and information from the interviews, questionnaire and relevant reports. The schedule of the evaluation and the list of interviewees are attached as Annex 3 and Annex 4, respectively.

1.5. Methodology of the Evaluation

1.5.1 Examination of the achievements of the project

1) Examine the inputs from Japanese side and Indonesian side
2) Examine the extent of achievements of project purpose and outputs
3) Examine the extent of each activities
4) Examine the progress of activities against the Plan of Operation (PO)

Review Points	Review Questions
Verification of the achievements	・ Are inputs provided as per planned in PO? ・ Are outputs produced as per planned? ・ Is the project purpose achievable by the end of project period?
Verification the implementation process	・ Are activities conducted as per planned? ・ Are technologies being transferred effectively? ・ Implementation arrangements of the project (monitoring, communication) ・ Awareness of the project by implementing agencies and C/P ・ Promoting and hindering factors of the project

1.5.2 Evaluation Criteria

The terminal evaluation is conducted in accordance with "the JICA New Guideline for Project Evaluation, Ver. 1 (June 2010)" , which mainly follows "the Principles for Evaluation of Development Assistance, 1991" issued by OECD-DAC.

Criteria	Evaluation Questions
1. Relevance	・ Are the Objectives of the Project still relevant? (Do they meet with the needs of beneficiaries?) ・ Is the Project consistent with the development policy of the partner country? ・ Is the Project consistent with Japan's foreign and policy and JICA's plan for country-specific program implementation?
2. Effectiveness	・ Is the Project purpose specific enough? ・ Has the Project purpose been achieved? ・ Did the achievement result from outputs? ・ Is there any influence of important assumption on attainment of the Project purpose?

3. Efficiency	・ Is the output production adequate? ・ Were the activities sufficient to produce the output? ・ Was the input of an adequate quantity and quality performed at the right time to conduct the activities? ・ Does the output justify the invested cost compared to similar project?
4. Impact	・ What are the social, economic, technical, environmental and other effects on individuals, communities, and institutions as a result of the Project? ・ Is there any influence of important assumption on attainment of overall goal? ・ Is there any unexpected positive or negative influence including ripple effects?
5. Sustainability	・ Are the outcomes (activities and effects) of the Project likely to be maintained after the Project period? ・ Institutional, technical, human resource, and financial aspect, etc.

Chapter 2: Outline of the Project

The Master Plan of the project which was updated and agreed on "Mid-term Review Report on the Project for the Wild Fire and Carbon Management in Peat-Forest in Indonesia" in November 2011 is as follows:

2.1 Project Purpose

Peat-forest management method to reduce carbon emission is developed.

2.2 Outputs

1) Fire Detection and Fire Prediction System are established.
2) Carbon Assessment System is established.
3) Carbon Management System is established.
4) Integrated Peat Management System is developed.

2.3 Activities

1) Fire Detection and Fire Prediction Component (FF: Fire Detection and Fire Prediction)
   - 1-1 Improve the hotspot algorithms
   - 1-2 Estimate carbon emission by biomass burning among different ecotypes
   - 1-3 Transfer in-situ fire information to each region
   - 1-4 Construct prediction model of wild fire occurrence
   - 1-5 Construct model of water regime
   - 1-6 Make map of land cover/land use change
   - 1-7 Establish spectral library (plant / soil) in investigation area
   - 1-8 Validate established system Improve the hotspot algorithms
2) Carbon Assessment Component (CA: Carbon Assessment)
   - 2-1 Estimate carbon balance in various tropical peatland ecosystems
   - 2-2 Estimate amount of carbon in biomass and peat
   - 2-3 Assess peat decomposition and organic carbon loss
   - 2-4 Validate ecosystem carbon balance using different approaches
   - 2-5 Develop carbon balance assessment model Estimate carbon balance in various tropical peatland ecosystems
3) Carbon Management Component (CM: Carbon Management)
   - 3-1 Examine the outflow of groundwater from peat layer
   - 3-2 Based on the above 3.1 and after the verification, propose a method to restore the hydrological conditions
   - 3-3 Develop plan for peat fire control
   - 3-4 Develop manual for peat fire control
   - 3-5 Quantify the carbon stock amount of above-ground vegetation

- 3-6 Measure parameters on vegetation growth
- 3-7 Explicate the process of vegetative restoration after disturbance
- 3-8 Examine the characteristics of soil organic matter and its impact on the environment
- 3-9 Examine the relations between water level and water qualities
- 3-10 Examine the discharge and decomposition process of organic matter in soil
- 3-11 Examine the changes of aquatic community caused by fire
- 3-12 Develop technologies to restore forest Survey vegetation and hydrological conditions

4) Integrated Peat Management Component (PM: Peat Management)
- 4-1 Establish a proto-type for database system to integrate the research/survey results
- 4-2 Operate the database management of the research/survey results
- 4-3 Support the institutional arrangement of carbon management
- 4-4 Establish a carbon balance model
- 4-5 Assess the effect of carbon control based on carbon management system
- 4-6 Introduce an economic analysis model
- 4-7 Propose methodology on deforestation for International Standardization
- 4-8 Organize workshop/symposium/seminar towards establishing international network and information/ knowledge dissemination to the public
- 4-9 Recommend project proposals to government authorities

Chapter 3: Achievement and Implementation Process

3.1. Results of Inputs

In accordance with the Master Plan, inputs were provided to the project activities from JICA and Indonesian sides. Inputs from JST to project activities conducted in Japan are not covered by this evaluation.

(Japanese side)

1) Dispatch of Japanese experts (Annex 5)

Two long-term experts were assigned for project coordination and administration, one for three years from Feb 2010 to Jan 2013, and the other for 1year from Jan. 2013 to Mar. 2013. The number of short-term experts dispatched to the project is 74 in 2010, 70 in 2011, 56 in 2012, 39 2013 working days in total are 1,380, 1476, 1078, 527 respectively. The total input of short-term experts to date is 4,461 days (FF :426 days, CA :310 days, CM :2,488 days ,PM :1,237 days) which means 149 MM.

2) Training of Indonesian personnel in Japan (Annex 6)

The number of personnel participating in training and scholarship program in Japan were 5 long term (3 PhD and 2 Master) and 10 short term by JICA counterpart training, 4 long term (4 PhD) by MEXT-JST scholarship and 1 long term (1 PhD) by Special Grant Program for International Students of Hokkaido University. In total: 6 from UNPAR, 5 from LIPI, 1 from BSN, 4 from BPPT, 2 from LAPAN, 1 from FORDA and 1 from East Kalimantan Government (KALTENG).

3) Provision of Machinery and Equipment (Annex 7 and 8)

. The total of procurement costs as of October 2013 is 89,588,395 yen.
(Exchange rate: 1USD=97.5 yen, 1IDR= 0.0088 yen)

4) Local Costs (Annex 9)

The total amount of local costs, or operation expenses, as of October 2013 is 8,086 million Rupiah, which is about 71.2 million Japanese Yen. The breakdown for local costs: is 1,116 million for air fare, 955 million for travel allowance and 360million for contracts in Rupiah.

(Indonesian side)

1) Assignment of Counterpart Personnel (Annex 10)

Executing agencies of the project are UNPAR, LIPI, LAPAN, BSN, BPPT and FORDA as agreed in the

RD. Representatives from the executing agencies and Japanese experts compose the JSC and JCC; JSC is chaired by the Project Supervisor from BSN and JCC is chaired by the Project Director from UNPAR.

2) Provision of office space, facilities and running expenses for the Project

BSN and UNPAR provided the office space and facilities for the Japanese experts. Large part of inputs from Indonesian sides is in-kind contribution. In addition, as normally is the case, domestic travel costs of counterparts are borne by each agency.

For example, LIPI allocated 675 million rupiah for 4 years in total as the counterpart budget. UNPAR allocated budget for internet and telephone for the project office, and staff allowance for the project activities.

3.2. Progress and Achievements of the Project (Annex 11)

1) Achievement of the Project outputs

Major achievements to data for each output are as follows.

(Output 1) "Fire Detection and Fire Prediction System are established"

Target has been achieved at 80% completion level. Fire detection and fire prediction system was established and tried. Further calculation of accuracy of models will be elaborated by the end of the project period.

- 1) In the event of a fire with more than 1 km2 coverage, 4 target communities (Tarunajaya, Tumbang Nusa, Pilang and Djabiren) can obtain fire information at an average of 13-16 hours (Average satellite detection time is 6-8 hours, hotspot data analysis time is 4 hours, fire information data production time is 1 hour and SMS data transmission time is 2-3 hours). Fire spread prediction time for 2km area from the target villages is about 4 hours applying simplified fire-extension model in accordance with the needs of villages. This current radius (2km) of fire alert target area is adjustable in accordance with demand. MODIS hotspot map and ground water table map are available at http://jica-jst.lapanrs.com/
- 2) All record of 10 hotspot data (July 2009) and 2 current firing hotspot data (September 2012) detected by the improved algorithm were confirmed to be burnt or burning area by UAV photographs (100%). Considering both omission and commission errors, hotspot detection accuracy is assumed to be able to achieve 80% level though further monitoring is required for statistic accuracy.
- 3) By using the simplified fire-extension model, 1km square hotspot is approximated by either an inscribed circle with the radius 1/2 km or a circumscribed circle with the radius $\sqrt{2}/2$ km. Considering the interval of satellite image acquisition, predicted fire spread coverage error becomes within 50% if the velocity of hotspot center is less than 2m/min (if it is faster than that, it is detected as different fire, not the extension of the same fire by this algorithm).

(Output 2) "Carbon Assessment System is established"

Target has been achieved at 90% completion level. Carbon assessment was conducted by 1) aerial laser survey, 2) empirical equations between net CO_2 balance and groundwater level and 3) the terrestrial ecosystem model. The 1) and 2) are completed and3) is under development utilizing the monitoring data collected by the project. The target rate of errors (20%) is assumed to be achieved after 3) is completed by the end of the project period.

- Data collection from field observation is sufficiently completed and the continuous monitoring has been conducted. It was revealed that the tropical peat ecosystems, including a relatively intact peat swamp forest with little drainage (UF), a drained swamp forest (DF) and a drained burnt swamp forest (DB), functioned as net carbon sources. Mean annual NEE (± a standard deviation) for four years from July 2004 to July 2008 was 174±203, 328±204 and 499±72 gC m-2 y-1, respectively, for the UF, DF and DB sites. The carbon emissions increased according to disturbance degrees. It was found that the carbon balance of each ecosystem was chiefly controlled by groundwater level (GWL). The net ecosystem CO2 exchange (NEE) showed a linear relationship with GWL on an annual basis. The relationships suggest that annual CO_2 emissions increase by 79–238 gC m^{-2} every 0.1 m of GWL lowering probably because of the enhancement of oxidative peat decomposition.
- As for ecosystem modeling, a research group, lead by National Institute for Environmental Studies (NIES), is developing a process-based model, which simulates carbon cycles in tropical peat

ecosystems in detail, using observation data of CO_2 flux and environmental variables related to meteorology and hydrology for parameterization and verification. In any case, because we have no reference at present, it is quite difficult to evaluate uncertainties in model estimates on a large scale, such as whole Central Kalimantan. Thus, it is planned to assess uncertainties by comparing estimates from three different approaches: 1) aerial laser survey, 2) empirical equations between net CO_2 balance and groundwater level and 3) the terrestrial ecosystem model.

- The annual CO_2 balance using the empirical equations was estimated within 20% (12~18%) difference from observations on a small scale. After the ecosystem model is completed by March 2014, difference will be quantitatively estimated using several method developed in the above mentioned researches namely 1) aerial laser survey and 2) empirical equations between net CO_2 balance and groundwater level. By the end of the project period, the ecosystem model is expected to achieve the output 2.

(Output 3) "Carbon Management System is established"

Target has been achieved at 80% completion level. Carbon assessment was conducted by 1) aerial laser survey, 2) empirical equations between net CO_2 balance and groundwater level and 3) the terrestrial ecosystem model. The 1) and 2) are completed and3) is under development utilizing the monitoring data collected by the project. The target rate of errors (20%) is assumed to be achieved after 3) is completed by the end of the project period.

- 1) In 70km2 target area, MODFLOW simulation model was developed and distributions of groundwater level before canal construction and after the dam construction are clearly shown. The suitable water level was estimated on the map.
- 1) In 70km2 target area, MODFLOW simulation model was developed and distributions of groundwater level before canal construction and after the dam construction are clearly shown. The suitable water level was compiled to be shown in the distribution map (50m mesh)
- 2) It was revealed that suitable water level control together with 1) fire control, 2) peatland restoration, and 3) reforestation will contribute to the reduction of carbon emission as follows.
  - i) Suitable water level control without fire control: reduced to be 76%
    Suitable water level control with fire control: reduced to be 38%
  - ii) NEE: by restoring peatland from drained burnt swamp forest (DB) to intact peat swamp forest with little drainage (UF),
    - Case A (GWL:from -0.2m to -0.1m: reduced to be 16%
    - Case B: GWL -0.1m: reduced to be 19%
    - Case C: GWL: -0.2m: reduced to be 60%
  - iii) Reforestation
    - Shorea balangeran plantation in DB, GWL -0.1m will contribute to reduction to be 89% (in 5 years)
    - In addition, current plant community and vegetation in different water level in peatland were investigated and data for 31 major species are collected. For the three vegetation types (mix-dipterocarpus forest, heath forest, and peatland forest), natural restoration and succession model is under development for comparison.

  From the findings as above, it is considered that the forest restoration by Shorea balangeran can be prioritized in the fire prone area near roads, canals and farmlands, while natural succession can be applied more in remote area where daily management is difficult and is not fire prone.
- 3) The amount of groundwater underneath of the peat layer was measured with pumping up test. The amount of groundwater is enough to use firefighting. On the other hand, it was proved that groundwater is not suitable for drinking without improved treatment system due to high humic acid content in groundwater in the peatland. In addition, the compact firefighting system was proposed and under trial in the target local firefighting teams. Supply route of used fire hoses from Japanese companies was initiated. The system will be proposed to BNPB (National Agency Disaster Management).

(Output 4) "Integrated Peat Management System is developed"

Target has been achieved at 85% completion level. Many research outputs were published and database was

developed.

- 1) 56 original articles are published including "Effects of disturbances on the carbon balance of tropical peat swamp forests" published in Global Change Biology (Impact Factor is high, 6.91 in 2012) and others. Also, outputs were presented in many international and local (both in Indonesia and in Japan) conference and seminars. Some published original articles have already acknowledged the project.
  The Web GIS was installed to the server in Hokkaido University and the prototype database was established, into which various data has been integrated such as satellite images and thematic maps produced and obtained in the Project. Based on the wide variety of field works and long-term observations since 1997, Japanese and Indonesian scientists concluded that eight elements should be monitored to assess carbon balance in peatland. This is the first proposal of comprehensive monitoring system for peatland carbon balance management.
  [Eight key elements](1) CO2 Flux and concentration, (2) Hotspots detection, (3) Forest degradation and species mapping, (4) Deforestation, forest biomass change, (5) Water level and soil moisture, (6) Peat dome detection and peat thickness, (7) Peat subsidence and (8) Water soluble organic carbon.
- 2) The rate of errors less than 20% will be achieved by completing the output 2 by the end of the project. In addition, various measures such as hyperspectoral remote sensing and subsidence monitoring are considered and compared in order to propose the integrated MRV system fulfilling both the easiness and cost efficiency.
- 3) Carbon management method which can contribute to the reduction of total carbon emission into 1/3 to 1/5 will be developed by the end of the Project mainly based on the results from output 3
- 4) BSN initiated the discussion on the international standard for deforestation in ISO/TC (technical committee) 207 – Environmental Management in Cairo, Egypt in June, 2009. After this, Indonesian Government has been approaching the international society to establish standard for deforestation. The effort on the national standard for Indonesia was initiated. Seminars and international workshops were organized to form an international researchers' network, and series of roundtable on MRV were held jointly with DNPI.

2) Achievement towards the Project Purpose
Basic data and elements to establish a peat-forest management model in Indonesia are being accumulated from each output utilizing various sensors at field level, remote sensing and simulation models.
By the end of the project, fire detection system, carbon assessment models are assumed to be established. With regard to the carbon reduction method, and integrated MRV system for the actual application to society, need further effort on interpretation and moderation of the outputs into a model or package by the end of the Project.

Chapter 4: Review by the Five Criteria

4.1 Relevance

The relevance of the Project is very high.

- Indonesia's Second National Communication (November 2010) indicates that the main contributing sectors of national GHG emission in 2005 were LUCF (38%), followed by peat fire (25%), energy (21%), waste (9%), agriculture (4%) and industrial process (3%). A recent study from DNPI (2010) suggests that 40% of total GHG emission in Indonesia was from LULUCF and 38% from peatland.
- Revision of Indonesian Biodiversity Strategy and Action Plan (IBSAP: 2010 - 2020) has been under process and will have a scope of Climate Change and REDD+ which relates to the project activities. The Project will also contribute to CBD's Aichi Target 15.
- In 2011, by Presidential Regulation No.61/2011 on the national action plan for greenhouse gas reduction (RAN-GRK) was issued and this regulation also stipulates each provincial government to prepare regional action plan for greenhouse gas reduction (RAD-GRK).
- In RAN-GRK, "forestry and peatland" is one of six sectors to reduce greenhouse gases and this sector contributes much more to the carbon reduction compared with other sectors.

- DNPI was established in July 2008 by the Presidential Decree No 46/2008 to facilitate development of national policies and planning of program and activities for climate change mitigation as well as development of a mechanism for carbon trade. At COP 15 in December 2009, the President announced the statement to reduce Indonesia's GHG emission by 26% from BAU by 2020 with domestic resources, and by 41% with the support of international community. With more than 60% of Indonesia's GHG emitted from land use and forestry sector, DNPI in 2010 indicated that more than 75% of the GHG emission reduction potential resides in activities on LULUCF and peatland.
- As above, importance of wild fire control and carbon management in peatland has been increasing in order to achieve the GHG reduction target in Indonesia. With the Presidential Decree No 10/2010, the Indonesia REDD+ Task Force was established, and re-established with No 25/2011, to carry out activities for the preparation of REDD+ Agency and MRV Agency. With the Presidential Decree No 62/2013, REDD+ Agency was established. Also, the President signed a decree on two-year moratorium in May 2013 for the conservation of primary forests and peatland.
- With the Central Kalimantan selected as a pilot province for REDD+ activities in December 2010, KOMDA REDD+ (Central Kalimantan REDD Task Force) was established as the implementing agency of Central Kalimantan REDD+ activities. Local government and community in Central Kalimantan have also become more aware of the importance of wild fire and peatland management; the fire fighter team has established two years ago and small dams in collaboration with NGOs have constructed at canals to stop drainage from peatland.
- With regard to the implementing agencies of the project, all of them have strong willingness for promoting the carbon reduction from peatland and forest as follows.
  - BSN: Planning to establish national standard for deforestation
  - LAPAN: Providing data/information on land cover/land use change, refined fire hotspot algorithm, fire hotspot detection, are included in LAPAN's objectives
  - LIPI: Biology research center states the importance on conduct researches on global climate change and REDD in its Action Plan 2010-2014 and 2015-2019.
  - UNPAR: Vision of UNPAR mentions "focusing on the development of tropical peat swamp area"
- Regarding Japanese side, Country Assistance Policy for the Republic of Indonesia published by Ministry of Foreign Affairs of Japan in April, 2012 states that "Japan will offer assistance for Indonesia to address global issues such as environmental conservation and climate change."
- Japan and the Republic of Indonesia signed the bilateral document to start JCM on August 26th, 2013.
- Japan also has a bilateral agreement with Republic of Indonesia to promote REDD+ in Indonesia and started IJ-REDD project in West and Central Kalimantan Province.

4.2 Effectiveness

The effectiveness of the Project is assumed to be medium to high.

- The effectiveness of the project is assumed to be evaluated medium to high, based on the revised master plan after the mid-term review. This is because the indicators on the project purpose and four outputs were not fully verified (especially quantitative figures) and explained to the stakeholders as of the Terminal Evaluation in October 2013.
- Although setting quantitative indicators was challenging and good in terms of accountability, it should be required for the project team members to elaborate further on the meanings of indicators and their means of verifications for the mutual understandings on the project target.
- Major achievements of the project, to date, are summarized at the above section 3.2, progress and achievement of the Project. In accordance with the revised master plan, details of progress including those of activity level are described in Annex 13, where the overall rating of progress at each output level is evaluated as 80% for output 1, 90% for output 2, 80% for output 3 and 85% for output 4.
- In general, under the activities of four outputs in-depth and innovative research activities were conducted and each output is assumed to be achieved by the end of the project in March 2014.
- However, there were several comments given from Indonesian side that the overall integration of the outputs (Output 4 and Project Purpose) are not clear enough, resulting in facing difficulties for them to apply the achievements of the project into policy and decision making process.

4.3 Efficiency

The efficiency of the Project is high.

- Inputs of the project, to date, are summarized in the above section 3.1, Results of Inputs. Activities of Japanese experts are well recognized by counterparts for smooth implementation. The equipment provided through the Project has been used for activities such as measuring the data and increasing wild fire control.
- The input on human resources in terms of expertise, timing and durations are evaluated efficient by the counterpart agencies. The input on equipment was also evaluated efficient and in accordance with the needs of the counterpart agencies.
- A number of training and scholarship programs in Japan are highly appreciated by counterpart agencies. The trainees were evaluated to have contributed well to the project after they return to Indonesia.
- It is noted that Japanese side (Hokkaido University) and Indonesian side (Palangka Raya University) have a long relationship since 1983 and collected precious field data continuously. This project provided a chance to boost previous research's outcomes, and achieved a lot to use and compile these data.
- It is indicated that the communication among the project participants needs to be improved. It needs to be recorded that the project objective, outputs and activities under the project are so broad that many of Indonesian counterpart were not aware them and relationships among them clearly. In addition, the implementation structure of the project has not been clear enough, though some effort was made by the project after the mid-term review. As a result, developing a common understanding of the project and clarifying roles and responsibilities of counterparts was not very smoothly done.
- Inputs from Indonesian side are mostly in-kind contribution including the provision of office space and equipment. In particular, it is noted that inputs and efforts of UNPAR were big in terms of staff and time to execute actual implementation of activities on the ground. Besides LIPI, some projects members commented the shortage or lack of counter-budget of their agencies. The shortage of the counterpart budget may have missed opportunities of joint activities and information sharing for their staff with the project.

4.4 Impacts

The impact of the Project is very high.

- With the inputs from the project, the preparation of a proposal to ISO on environmental management – good practice guideline on combating land degradation and desertification – is underway at BSN to be presented to ISO TC 207.
- The leader of the Project, Prof. Osaki, was selected as one of lead authors for wetland section in the 5th IPCC Guideline 2013. Prof. Osaki was recommended by the Japan Ministry of Environment to write the chapter 1, which will cover the wetland including peatland, and he attended the 1st meeting in November 2011.
- In June 2013, the leader of the Project, Prof. Osaki, was invited to make a presentation in SABSTA 38 held in Bonne, Germany under UNFCCC. He presented the integrated MRV system and requested the international society to collaborate on the integrated MRV system which Prof. Osaki can propose from the experiences and findings from the project.
- The Japan Ministry of Economy, Trade and Industry and Japan Ministry of Environment have supported Feasibility Study (FS) projects on REDD+ in Indonesia. This year, 3 out of 4 adopted FS projects are being implemented in the peatland of Central Kalimantan and one of the FS projects include the measurement of carbon emission with ground-based observation system. The managers of the FS project indicated that the presence of the Hokkaido University in this region is an important reason why they had chosen the Central Kalimantan. Mitubishi UFJ Research and Consulting financed by the Japan Ministry of Environment, and Telecommunication Technology Committee financed by Asia Pacific Telecommunity are also conducting potential study of Information and Communication Technology (ICT) application in Central Kalimantan on peatland management. Prof. Osaki takes the role of technical advisor for these 3 FS projects.
- Mitsubishi Research Institute financed by Erath Remote Sensing Data Analysis Center has conducted a project on the hyperspectral data application for forest degradation monitoring and Dissolved Organic

Carbon (DOC) in peatland of Central Kalimantan. Project site was selected because the long-term ground based observation has been conducted by Hokkaido University and Indonesian Institutes in peatland of Central Kalimantan.

- The inventory information on 394 flora species in the permanent observation plots were shared and utilized also in the preparation of Indonesian Biodiversity Strategy and Action Plan (IBSAP).
- 500 fire hoses and 50 nozzles were donated to the project by Hokkaido Association for Fire Defense Equipment in recognizing the importance of wild fire control in peat-land. As easily damaged in peat-land use, many hoses are required in peat-forest fire and constant supply of these hoses is expected. Further donation of 2,500 fire hoses by the association are been offered to the Project.
- In Kalimantan level, "Trans Kalimantan University Network", a connection among five universities in five Kalimantan provinces, is formed with support by the Project for institutional development of implementation on integrated carbon management, education and research networking. This idea is planned to be expanded to the national level.
- In Japan, "Japan Society of Peatland" was established in October 2013 and Prof. Osaki was appointed as the first .president of the society. This society will be able to extend the collaboration with "International Peat Society" and "Indonesian Peat Society".
- The Project also provides information and advice to Indonesia's UKP4 and DNPI. MRV Technical Roundtable was jointly organized 8 times with DNPI and a proposal on system for MRV was discussed with DNPI.
- "REDD COE Kalteng", a document which would be a basis for drafting an activity plan on REDD+ implementation in Central Kalimantan Province, was prepared by a working group organized by the Project and submitted to KOMDA REDD+ in August 2011. This draft plan would be directly related to an institutional arrangement of REDD+ implementation in Central Kalimantan Province.
- The Project has provided Japanese organizations and authorities - such as Ministry of Foreign Affairs, Ministry of Economy, Trade and Industry, Ministry of Environment, Forestry Agency and private companies - with information and data that would be useful for development of a bilateral off-set mechanism between Japan and Indonesia.
- The SESAMI system (International field data transmission system) developed through the project was evaluated useful and applicable not only for this project. The new application of this system was started utilizing other budget on supporting small and medium companies and installed in a dam to measure and transmit the information on the water level..
- Considering the large number of participating organizations and experts, the project offered a place for connecting the existing resources, exchanging views and collaborating for the future, which was also a positive impact through the project.

4.5 Sustainability

The sustainability of the Project is High.

The prospect for sustainability is assumed to be high. It is noted that the project tried hard to catch up with the circumstances around REDD+ in Indonesia which kept changing drastically in these years.

- There are strong commitments expressed by the President and the government on carbon management in peat forest. And the institutional structures for REDD+ in Indonesia has been under development. Thus, as far as there is no drastic change in policy toward REDD+ in Indonesia, the importance on carbon management especially in peatland will be the same or even more.
- Through the project, 20 staff of counterpart organizations had chances to study abroad in Japan. It is expected that the capacity of these organizations has been and will be strengthened when they return from Japan. This capacity development is expected to contribute to sustainability. It is also noted that equipment procurement to Indonesia and equipment utilization and maintenance training in Japan were coordinated such as for an ion chromatography, a TOC analyzer, a spectrometer and so on. This harmonized capacity development both in human resource and in equipment is evaluated to have improved sustainability.
- The project procured the various kind of equipment and they are evaluated to be utilized by the project appropriately. Considering the sustainability, the maintenance is the key. Monitoring and management of equipment utilization, together with maintenance plan is important to sustain the enhanced capacity by the

new equipment. For some precision equipment, better conditioned room will be required. From the human resource aspect, the number of staff who can handle such equipment is limited, thus further effort on capacity development and manual preparation will be needed. From the financial aspect, it is expected that REDD+ and peatland will continue to attract international projects and especially UNPAR is required to arrange such projects for utilization of equipment procured by the project in the future.

- There are many findings and technology developments by the project which can be applied in many issues. Although these can be utilized later on, followings will be required to enhance the sustainability, such as interpretation of such technologies for the potential users, preparation of manuals and brochures together with public information, packaging the related technologies as one system, and so on.
- Considering the sustainability, the final project achievement, namely the method to reduce carbon emission, should be understandable widely and In this sense, it was evaluated that the current progress is not meeting the requirement since the major component technologies have not been integrated as one package.
- The implementing agency of this project, Hokkaido University has been working together with UNPAR and LIPI for many years already. Currently, Hokkaido University is proposing to various budget sources for continuing the collaboration in Central Kalimantan Province, which will greatly contribute to the sustainability. UNPAR is planning to have general education program for students on peatland based on the project outcomes.
- IJ-REDD project is already started in 2013 as 3-year project. Pilot activities are implemented in West Kalimantan Province, and provincial capacity development activities will be conducted in Central Kalimantan Province. This IJ-REDD Project will also be contributing to the sustainability.

Chapter 5: Results of the Evaluation

5.1 Conclusion

The project has been pursuing the project purpose with various outcomes from four research components. The international exposure of project outputs, e.g. Effects of disturbances on the carbon balance of tropical peat swamp forest, is regarded as a notable achievement of the project. With good project management both in Indonesian and Japanese side, the project has been implemented with collaboration among various researchers and institutions.

The project is in line with the policy directions of Indonesian government so that relevance is rated high. International interest to the REDD+ further increased relevance of the project. To pave the way for social application of the project outcomes to the relevant policies in Indonesia, the project is expected to integrate research outputs firmly into "management system/method" in the rest of the project period.

5.2 Recommendation

The Team recommends the project as follows.

- The team found that Indonesian government expects a lot to the project outcomes, but their understanding of the project results does not reach the stage to utilize them for policy/decision making process. The team recommends that the project has to interpret and moderate to policy formulators how to apply research outcomes, e.g. peat-forest management method and MRV system, by the end of the project. It is also recommended that the project will prepare official brief policy paper for conveying the project outcomes to policy/decision makers.

- The project is expected to address land use of peatland in presenting its outcomes to the policy/decision makers. The land use planning is the key to the decision making of the carbon management of the Province of Central Kalimantan. Simulating future land use change is one of the major concerns of national and provincial government s of the Indonesia. In that context, the team would like to re-emphasis the importance

of the socio-economic aspects in order to achieve the project purpose, i.e. "management method", in considering socio-economic research has made under several components.

- The organization taking over each research component after the project term should be decided, and operational manuals for activities, e.g. peat fire control and forest planting, should be prepared by the end of the project.

- The verifiable indicators set in the mid-term evaluation helped to clarify the project purpose and outputs. The team found that the achievements of some quantitative indicators are not well verified and explained by the project at the time of the terminal evaluation. It is recommended that the project will prepare the evidence of quantitative indicators by the end of the project.

- The project provided research equipment to Indonesian side and they are functioning and maintaining well by Indonesian counterparts. Some of equipment needs spare parts and specimens for continuous research activities. To secure budget for maintenance of experimental equipment is crucial for the sustainability of the project activities. The list of provided equipment should be prepared soon and shared with Indonesian counterparts.

5.3 Lessons Learned

When it comes to the expectations of national and local governments for social application of the project outcomes, implication to the land use policy is inevitably important for decision making process in this project. For similar type of SATREPS projects, it is important that socio-economic aspects are carefully incorporated into project design, and integrated to outcomes, which are to be applied by the society. For example, similar project would include development of methods to change the local community's cultural behavior, like as slash and burn agriculture to alternative way, to secure social application of project outcomes.

The SATREPS projects need a lot of administrative works to support project implementation; so that, assigning of administrative officers, who have good understanding of the project and good communication with project members, is crucial to the success of the project.

A.1 Master Plan

【Project Purpose】

Peat-forest management method to reduce carbon emission is developed.

Indicator:
1) Carbon management method which can contribute to carbon reduction of 1/3 to 1/5 amount compared to current level in peatland is proposed.
2) Peat-forest management method is utilized in policy decision in developing international rules and bilateral off-set mechanism.
3) Results of researched are published (Number and quality of research papers is good enough).

【Output 1】 Fire Detection and Fire Prediction System are established.

Indicator:
1) In the event of a fire with more than 1 km^2 coverage, 3 target communities can obtain fire information within 16 hours, and moreover they can obtain information on fire spread prediction within 8hours.
2) Fire detection accuracy can reach the level of more than 80%.
3) Rate between predicted fire spread coverage and real fire coverage can reach the level of more than 50%.

Activity
1-1 Improve the hotspot algorithms
1-2 Estimate carbon emission by biomass burning among different ecotypes
1-3 Transfer in-situ fire information to each region
1-4 Construct prediction model of wild fire occurrence
1-5 Construct model of water regime
1-6 Make map of land cover/land use change
1-7 Establish spectral library (plant / soil) in investigation area
1-8 Validate established system

【Output 2】 Carbon Assessment System is established.

Indicator :
Carbon balance assessment model within the error of less than 20% for central Kalimantan province is developed.

Activity :
2-1 Estimate carbon balance in various tropical peatland ecosystems
2-2 Estimate amount of carbon in biomass and peat
2-3 Assess peat decomposition and organic carbon loss
2-4 Validate ecosystem carbon balance using different approaches
2-5 Develop carbon balance assessment model

【Output 3】 Carbon Management System is established.

Indicator :
1) In 70km^2 target area, model of suitable water level is developed.
2) Vegetation restoration plan is developed based on model of suitable water level.
3) Amount and quality of groundwater becomes clear, and then firefighting strategy including infrastructure plan is developed.

Activity:
3-1 Examine the outflow of groundwater from peat layer

3-2 Based on the above 3.1 and after the verification, propose a method to restore the hydrological conditions
3-3 Develop plan for peat fire control
3-4 Develop manual for fire control
3-5 Quantify the carbon stock amount of above-ground vegetation
3-6 Measure parameters on vegetation growth
3-7 Explicate the process of vegetative restoration after disturbance
3-8 Examine the characteristics of soil organic matter and its impact on the environment
3-9 Examine the relations between water level and water qualities
3-10 Examine the discharge and decomposition process of organic matter in soil
3-11 Understand the changes of aquatic community caused by fire
3-12 Develop technologies to restore forest

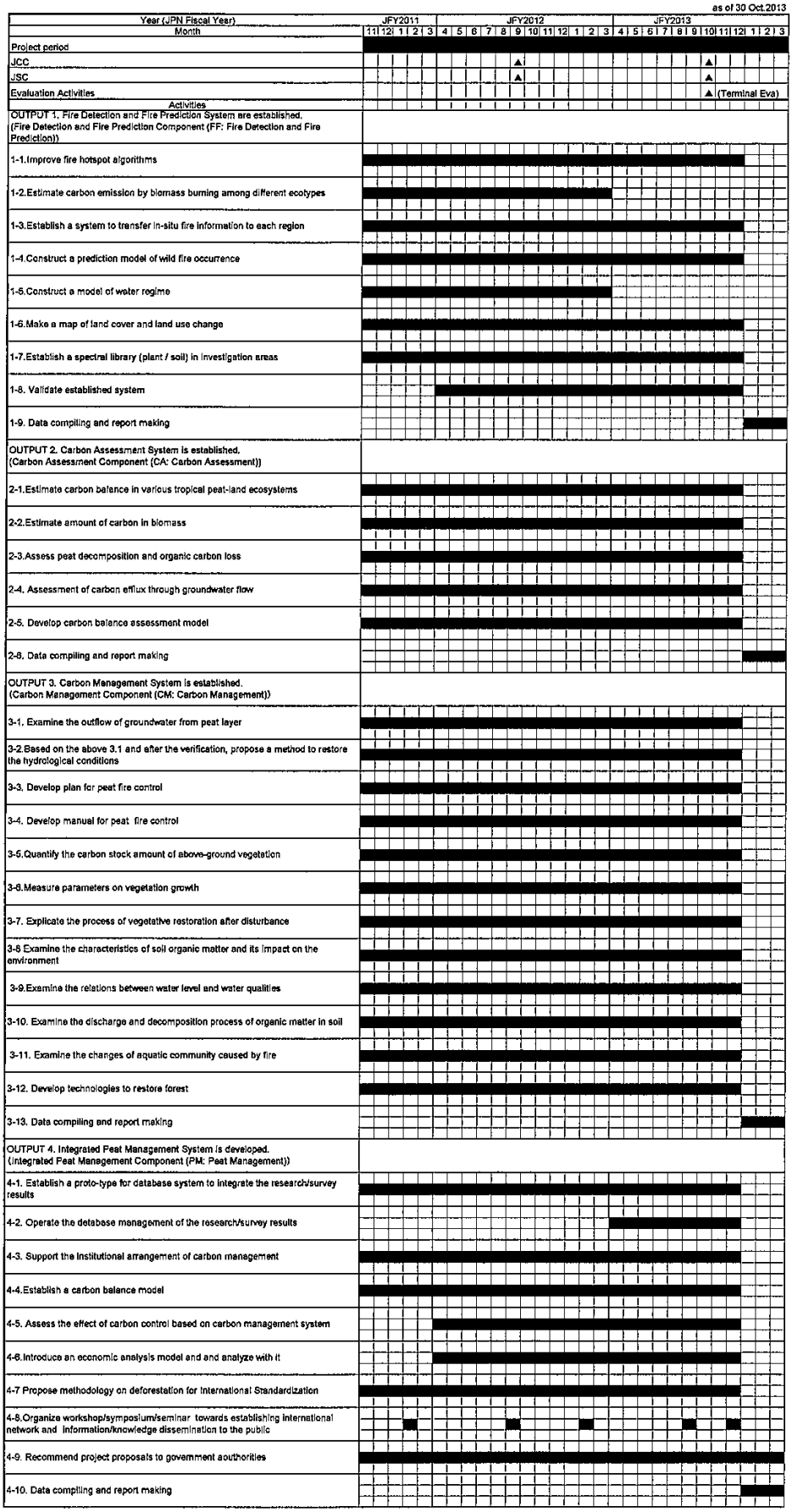
【Output 4】 Integrated Peatland Management System is developed.

Indicator :
1) Research data and information is utilized.
2) Rate of errors for established carbon balance model is less than 20%.
3) Carbon management system design which can contribute to reduction of 1/3 to 1/5 of total carbon emission is developed.
4) Integrated Peat Management System is introduced in policy formulation and institutional arrangement process (ex. IPCC, ISO, REDD+ activity) .

Activity:
4-1 Establish a proto-type for database system to integrate the research/survey results
4-2 Operate the database management of the research/survey results
4-3 Support the institutional arrangement of carbon management
4-4 Establish a carbon balance model
4-5 Assess the effect of carbon control based on carbon management system
4-6 Introduce an economic analysis model
4-7 Propose methodology on deforestation for International Standardization
4-8 Organize workshop/symposium/seminar towards establishing international network and information/knowledge dissemination to the public
4-9 Recommend project proposals to government authorities

A.2 Plan of Operation

as of 30 Oct.2013



A.3 Schedule of Evaluation Mission

Date	Day	Item	Stay	Remarks
13-Oct	Sun	Consultant (Mr. Saito) move from Narita to Jakarta	Jakarta	
14-Oct	Mon	Meeting with JICA Office	Jakarta	
15-Oct	Tue	Move: Jakarta → Palangka Raya (Morning Flight) Site Visit 1(4 sites), Meeting with Project Coordinator	Palangka Raya	National holiday
16-Oct	Wed	Interview to Palangka Raya University	Palangka Raya	
17-Oct	Thu	Interview to Palangka Raya University, Visit to Village FF/CA Team Move: Palangka Raya→Jakarta (Evening Flight)	Jakarta	
18-Oct	Fri	Interview to LIPI(09:00), LAPAN(13:00),BPPT:PUSPITEK(15:00)	Jakarta	
19-Oct	Sat	Preparation for Drafting Evaluation Report JICA mission members (Mr Jinnai and Mr Mitomori) arrive at Jakarta	Jakarta	
20-Oct	Sun	Team internal meeting	Jakarta	
21-Oct	Mon	8:30 Courtesy Call to BPPT(Dr.Bambang Setiadi), 10:00 Min Forestry(Mr.Agus Haryanto, Mr.KATSURA) 14:00 Meeting JICA Office	Jakarta	
22-Oct	Tue	9:30 Joint Terminal Evaluation Team Meeting with Representatives of BSN, LIPI,UNPAR at JICA Office, 15:00 DNPI (Mr.Farhan Helmy, join Mr.ICHIHARA)	Jakarta	
23-Oct	Wed	9:00 Interview to BAPPENAS (RAN-GRK Secretariat) 10:30 IJ-REDD+(Mr.TAKAHARA 11:00), 12:30 BSN(Mr.Nyoman) Move: Jakarta→Palangka Raya (Afternoon Flight) (Mr. Nakamura JST arrive Jakarta)	Palangka Raya (Jakarta)	
24-Oct	Thu	9:00 Courtesy Call to Rector UNPAR (Prof.Dr.Ferdinand) 10:00 Interview to Palangka Raya University 13:00 Site Visit 2 (Tarna Jaya, Tanjung Tarna Prof.TAKAHASHI will attend) Meeting on Evaluation Report (Morning, Mr. Nakamura, JST, arrive at Palangka Raya)	Palangka Raya	Prof. Takahashi joined the team.
25-Oct	Fri	9:30 Central Kalimantan Provincial Government (BAPPEDA, Mr. Herson Aden), 11:30 Interview to UNPAR (Prof. Suwido H. Limin) 14:00 KOMDA (Regional Commissions for REDD+ in Central Kalimantan) Meeting on Evaluation Report	Palangka Raya	
26-Oct	Sat	Site Visit 3(Kelapangan: Stia Alam Dr.HIRANO) Drafting Evaluation Report	Palangka Raya	
27-Oct	Sun	Move: Palangka Raya→Jakarta Drafting Evaluation Report	Jakarta	
28-Oct	Mon	10:00 Meeting on Evaluation Report (Joint Terminal Evaluation Team, JICA Indonesia)	Jakarta	
29-Oct	Tue	Visit to UNORCID (Mr.Kubo:9:00), ICCC (Ms.Eli:10:00), Finalizing Evaluation Report	Jakarta	
30-Oct	Wed	10:00 JCC/JSC, Signing of Evaluation Report Report to JICA office, Report to Embassy of Japan Leave Jakarta	On Board	
31-Oct	Thu	Arrive at Narita		

only for Consultant

A.4 List of Interviewees

1 Indonesian Side	
National Standardization Agency (BSN)	
Mr.I Nyoman Supriyatna	Head, Standardization Formulation
Mr. Ir Nasrudin Irawan	Kepala Inspectorat
Mr. Bendjamin B. Lauhenapessy	Head, Cooperation and Evaluation for Research Division
Agency for the Assessment and Application of Technology (BPPT)	
Dr. Bambang Setiadi	Senior Researcher
Dr. Ir. Muhamad Sadly	Director, Technology of Natural Resources Inventory
Dr. Muhammad Evri	Deputy Director, Technology of Natural Resources Inventory
University of Palangka Raya (UNPAR)	
Prof. Dr. Ferdinand	Rector
Prof. Drs. Kumpiady Widen	Vice Rector
Mr. Ici Piter Kulu	Lecturer/Secretariat Officer
Dr. Adi Jaya	Head of Program, Natural Resources and Environmental Management
Mr. Untung Darung	Lecturer/Senor Researcher, Department of Agronomy, Faculty of Agriculture
Mr. Kitso Kusin	Instructor for eco-education / Senior Researcher, CIMTROP
Prof. Dr. Sulmin Gumiri	Director, International Office, UNPAR
Mr. Sampang Gaman	
Mr. Yuda Prawira	
Dr. Suwido H. Limin	Agronomist, Faculty of Agriculture/Director, CIMTROP
Indonesian Institute of Sciences (LIPI)	
Prof. Dr. Tukirin Partomihardjo	Council of Research Professors
Dr. Joeni Setijo Rahajoe	Head of Botany Division
Mr. Laode Alhamd	Researcher, Botany Division
Ms. Siti Sundari	Researcher, Botany Division
Indonesian National Institute of Aeronautics and Space (LAPAN)	
Dr. Orbita Roswintiarti	Director, Remote Sensing Data Center
Mr. Andy Indradjad	Staff
Mr. Marendra Eko Budiono	Staff
National Council on Climate Change – Indonesia (DNPI)	
Mr. Farhan Helmy	Secretary of Mitigation Working Group
Ministry of Forestry	
Mr. Agus Haryanto	
Secretariat of National Action Plan for GHG Emission Reduction (RAN-GRK)	
Ms. Febyana Suryaningrum	Liaison Officer
Mr. Budhi Setiawan	Staff
Indonesia Climate Change Center (ICCC)	
Ms. Eli Nur Nirmansari	Coordinator, Peatland and Peatland mapping Cluster
Bappeda of Central Kalimantan Province	
Mr. Herson B. Aden	Head
KOMDA REDD+ / Department of Environment, Central Kalimantan Province	
Mr. Mursid Marsono	Head
2 Japanese Side	
Project Team	

Dr. OSAKI Mitsuru	Professor, Hokkaido University
Dr. HIRANO Takashi	Professor, Hokkaido University
Dr.HONMA Toshihisa	Professor, Hokkaido University
Dr.TAKAHASHI Hidenori	Visiting Prof. Hokkaido University
Mr.HIROSE Kazuyo	Deputy Director, Japan Space Systems
Mr.IZUMI Mamoru	Project Coordinator
Ms.MOMOTA Eriko	Research Associate, Center for Sustainability Science (CENSUS), Hokkaido University
Dr.Hendrik Segah	Associate Professor, Center for Sustainability Science (CENSUS), Hokkaido University
Dr.SAITO Hideyuki	Assistant Professor, Hokkaido Univeristy
Mr. SHIGENAGA Yukihisa	CEO, Midori Engineering Laboratory

3 Development Organization/Project	
Mr. KUBO Hideyuki	Head of Thematic Advisory Unit, UNORCID
4 JICA Office or Expert	
Mr. ARAI Yuki	Representative, JICA Indonesia Office
Mr. TAKAHARA Shigeru	Chief Advisor / Forest&REDD+ Policy, IJ-REDD Project
Mr. KOBAYASHI Hiroshi	Project Coordinator / Biodiversity Conservation, IJ REDD Project
Ms MORIZANE Junko	Climate Change-Mitigation, Project of Capacity Development for Climate Change in Indonesia
Dr. ICHIHARA Jun	Chief Advisor, Technical
Mr. KATSURA Tamotsu	Chief Advisor / Organizational Development, Program of Community Development of Fires Control in Peatland Area

A.5 List of Input (Short-term Experts dispatched in 2013)

Area		Name	Expertise	FY 2013 Duration (Days)										Total Days
				1st		2nd		3rd		4th		5th		
				(6th) (11th)		(7th)		(8th)		(9th)		(10th)		
FF		HONMA Toshihisa	Simulation	7/10 - 7/14	5	9/22 – 9/26	5	9/29 – 9/30	3	10/1 – 10/3	3	10/28–10/31	4	20
		SHIMIZU Daisuke	Remote Sensing	9/23 – 9/27	5									5
		NAKAU Koji	Remote Sensing	9/23 – 9/25	3									3
		Total												28
CA		HIRANO Takashi	Environmental Informatics	6/1 - 6/9	9	6/13 - 6/18	6	7/10 - 7/14	5	8/25 – 8/27	3	9/23 – 9/26	4	33
				10/25–10/30	6									
		INOUE Gen	Atmospheric Chemistry	6/12 - 6/27	16	7/10 - 7/17	8	9/17 – 9/28	12					28
		INUBUSHI Kazuki	Soil Science	9/22 – 9/25	4									4
		MIZUNO Kosuke		8/21 – 8/27	7									7
		KAWASAKI Masahiro		9/17 – 9/28	12									12
		YAMADA Hiroyuki	Environmental Informatics	9/22 – 9/26	5									5
		Total												89
C M	Watershed Management	TAKAHASHI Hidenori	Bio-climate	4/22 - 4/30	9	6/5 - 6/23	19	7/10 - 7/16	7	8/25 – 8/26	2	9/18 – 9/30	13	50
				10/1 – 10/3	3	10/13 – 10/30	18							21
		FUKAMI Koji	Peat Science	9/22 – 9/27	6									6
		ISHII Yoshiyuki	Hydrology	9/22 – 9/27	6									6
		HAMADA Yohei	River Technology	4/22 - 4/30	9	5/26 - 6/23	29	8/25 – 9/5	12					50
		SungGi Hu	River Technology	5/20 - 5/27	8									8
		YAMAMOTO Kouichi	River Technology	9/21 – 9/27	7									7
		HAYASHI Hirochika		9/21 – 9/28	8									8
	Fire Management	NOGUCHI Izumi	Precipitation Chemistry	9/22 – 9/26	5									5

		HAYASAKA Hiroshi	Fire Science	9/19 – 9/27	9									9
	Terrestrial Ecology	YABE Kazuo	Ecology & Environment	9/22 – 9/26	5									5
		SHIODERA Satomi	Plant Ecology	9/22 – 9/26	5									5
	Aqua-share Ecology	KURAMITSU Hideki	Analytical Chemistry	9/23 – 9/25	3									3
		KAMIYA Mitsuhiko	Analytical Chemistry	9/21 – 9/28	8									8
		SHIGENAGA Yukihisa	Analytical Chemistry	4/28 – 4/30	3									3
		HARAGUCH Akira	Analytical Chemistry	9/22 – 9/26	5									5
		HOSOKAWA Toshiyuki	Environment Physiology	9/23 – 9/26	4									4
	Reforestation	SASAKI Yasutaka	Mechanics	9/20 – 9/29	10									10
		TAMAI Hiroshi	Resource Biology	6/29 - 7/5	7									7
		TANGE Takeshi	Silviculture	9/23 – 9/26	4									4
		TOKURA Seiichi	Polymer Science	9/20 – 9/29	10									10
		URAKI Yasumitsu	Forest Chemistry	9/20 – 9/29	10									10
		Total												244
PM		OSAKI Mitsuru	Project Leader/ Plant Nutrition	4/21 – 4/29	9	6/13 – 6/17	5	7/11 – 7/15	5	8/25 – 8/28	4	9/23 – 9/26	4	27
				10/19–10/22	4	10/30-10/31	2							6
		KOBAYASHI Noriyuki	REDD	6/13 - 6/18	6									6
		KOBAYASHI Shigeo	Safe guard	7/13 - 7/16	4	9/23 – 9/27	5							9
		HIROSE Kazuyo	CDM &REDD	4/23 - 4/26	4	6/13 - 6/18	6	9/23 – 9/26	4					14
		MISHIMA Yoshio	Peat Mapping	4/22 - 4/30	9	9/22 – 9/27	6							15
		TSUJI Noriyuki	Integrated Peat Management System	4/22 - 4/30	9	6/11 - 6/23	13	7/9 - 7/16	8	8/24 - 8/26	3	9/23 – 9/27	5	38
		KURIHARA Junichi	Information Management	9/23 – 9/27	5	10/20 – 10/24	5							5
		TAKAHASHI Yukihiro	Information Management		1									1

	MOMOTA Eriko	REDD	4/21 - 4/30	10	6/11 - 6/19	9	7/10 - 7/16	7	8/20 – 8/27	8	9/20 – 9/27	8	45
			10/29-10/31	3									
	Total												166
													527

A.5 List of Input (Short-term Experts dispatched in 2012)

Area		Name	Expertise	FY 2012 Duration (Days)								Total Days		
				1st		2nd		3rd		4th		5th		Total Days
				(6th) (11th)		(7th) (12th)		(8th) (13th)		(9th)		(10th)		
FF		HONMA Toshihisa	Simulation	6/24 - 6/28	5	7/10 - 7/19	10	7/31 - 8/4	5	9/5 - 9/21	17	10/27 - 11/4	9	52
				3/22 - 3/27	6									
		KAKU Kazuya	Remote Sensing	9/4 - 9/10	7									7
		TANI Hiroshi	Remote Sensing	9/6 - 9/15	10									10
		TOKUNO Masami	Remote Sensing	9/11 - 9/15	5									5
		NAKAU Koji	Remote Sensing	9/2 - 9/9	8	9/12 - 9/15	4	10/27 - 11/3	8					20
													Total	94
CA		HIRANO Takashi	Environmental Informatics	5/26 - 6/1	7	8/25 - 9/1	8	9/10 - 9/26	17	11/23 - 11/30	8	2/28 - 3/8	9	49
		INOUE Gen	Atmospheric Chemistry	6/26 - 6/28	3	7/30 - 8/3	5							8
		SUETA Tatsuhiko	Atmospheric Chemistry	6/25 - 6/29	5	7/30 - 8/2	4	9/10 - 9/16	7					16
		YAMADA Hiroyuki	Environmental Informatics	2/28 - 3/8	9									9
														82
C M	Watershed Management	TAKAHASHI Hidenori	Bio-climate	5/24 - 6/3	11	6/14 - 6/30	17	7/15 - 8/2	19	9/3 - 9/22	20	11/13 -11/24	12	79
				2/5 - 2/12	8	3/3 - 3/8	6							14
		SHIMADA Sawahiko	Environment Information	8/28 - 9/9	13									13
		TAKADA Masayuki	Peat Science	9/10 - 9/13	4									4
		FUKAMI Koji	Peat Science	9/8 - 9/16	9									9
		KOIZUMI Ken	Peat Science	9/8 - 9/16	9									9
		YAMAMOTO Kouichi	River Technology	4/28 - 5/8	11	9/14 - 9/24	11							22
		ISHII Yoshiyuki	Hydrology	9/8 - 9/16	9									9
		NAKATSUGAWA Makoto	River Technology	7/2 - 7/8	7	1/5 - 1/12	8							15

		SUGIMOTO Hikaru	River Technology	7/3 - 7/8	6	1/6 - 1/12	7							13
		SHIMOKURA Hiroshi	River Technology	7/18 - 7/28	11									11
		INOUE Takashi	Agricultural Hydrology	2/18 - 2/24	7									7
		SungGi Hu	River Technology	4/10 - 4/26	17	5/18 - 5/26	9	6/9 - 6/16	8	9/11 - 9/19	9			43
		KOMAI Yukio	Basin Environment	8/6 - 8/14	9	3/24 - 3/31	8							17
		TAKI Kazuo	Water Environment	8/6 - 8/14	9	3/24 - 3/31	8							17
	Fire Management	NOGUCHI Izumi	Precipitation Chemistry	8/28 - 9/7	11									11
		HAYASAKA Hiroshi	Fire Science	8/28 - 9/7	11	9/12 - 9/21	10							21
		KIYONO Tatsuyuki	Fire Science	9/13 - 9/19	7									7
		SEKISHITA Nobumasa	Air Flow	8/12 - 8/30	19									19
	Terrestrial Ecology	YABE Kazuo	Ecology & Environment	9/11 - 9/24	14									14
		SHIODERA Satomi	Plant Ecology	8/21 - 10/13	54	11/3 - 11/26	24	2/2 - 3/2	29					107
	Aqua-share Ecology	KURASAKI Masaaki	Environment Remediation	9/9 - 9/16	8									8
		KURAMITSU Hideki	Analytical Chemistry	9/9 - 9/13	5									5
		KAMIYA Mitsuhiko	Analytical Chemistry	7/15 - 7/28	14	9/12 - 9/22	11							25
		OCHI Noriyoshi	Analytical Chemistry	7/20 - 7/28	9									9
		SHIGENAGA Yukihisa	Analytical Chemistry	5/26 - 6/1	7	9/3 - 9/16	14	3/3 - 3/8	6					27
		HARAGUCH Akira	Analytical Chemistry	9/12 - 9/20	9	3/21 - 3/27	7							16
		TANAKA Syunitsu	Environment Remediation	9/9 - 9/16	8									8
		HOSOKAWA Toshiyuki	Environment Physiology	9/9 - 9/16	8									8
		SAITO Takeshi	Environment Medicine	9/9 - 9/16	8									8

	Reforestation	OGAWA Masato	Mechanics	2/19 - 2/28	10									10
		SAITO Hideyuki	Silviculture	9/9 - 9/21	13	12/6 - 12/17	12							25
		SASAKI Yasutaka	Mechanics	9/22 - 9/28	7									7
		TAMAI Hiroshi	Resource Biology	7/30 - 8/3	5	9/22 - 9/28	7	2/16 - 2/24	9					21
		URAKI Yasumitsu	Forest Chemistry	2/19 - 2/28	10									10
		KOIZUMI Akio	Timber Engineering	9/12 - 9/20	9									9
		Total												657
PM		OSAKI Mitsuru	Project Leader/ Plant Nutrition	4/7 - 4/14	8	4/18 - 4/22	5	5/9 - 5/15	7	6/14 - 6/19	6	6/25 - 6/30	6	32
				7/6 - 7/13	8	7/28 - 8/3	7	8/30 - 9/23	25	9/25 - 9/29	5	10/23 - 11/2	11	56
				11/10 - 11/23	14	2/1 - 2/7	7	2/24 - 3/1	6					27
		KOBAYASHI Noriyuki	REDD	9/10 - 9/21	12									12
		HIROSE Kazuyo	CDM &REDD	5/10 - 5/15	6	8/31 - 9/4	5							11
		SAITO Seiichi	Integrated Peat Management System/ Remote Sensing-MRV	4/17 - 4/24	8									8
		TSUJI Noriyuki	Integrated Peat Management System	6/24 - 6/30	7	9/11 - 9/21	11	2/4 - 2/12	9					27
		MATSUNAGA Ryuji	advisor	9/12 - 9/15	4									4
		TAKAHASHI Yukihiro	Information Management	4/18 - 4/20	3	6/25 - 6/29	5	7/31 - 8/3	4	9/10 - 9/12	3	3/6 - 3/9	4	19
		KURIHARA Junichi	Information Management	9/12 - 9/15	4	10/26 - 11/2	8							12
		SAKAMOTO Yuji	Information Management	6/26 - 6/30	5									5
		MOMOTA Eriko	REDD	4/17 - 4/23	7	6/24 - 6/29	6	7/29 - 8/3	6	9/11 - 9/16	6	2/2 - 2/8	7	32
		Total												245
														1,078

A.5 List of Input (Short-term Experts dispatched in 2011)

Area	Name	Expertise	FY 2011 Duration (Days)										Total Days
			1st		2nd		3rd		4th		5th		
			(6th) (11th)		(7th)		(8th)		(9th)		(10th)		
FF	HONMA Toshihisa	Simulation	7/28 - 8/1	5	9/18 - 9/26	9	11/1 - 11/11	11	11/14 – 11/17	4	11/29 - 12/4	6	35
			2/14 - 2/19	6									6
	ONO Atsushi	Remote Sensing	9/21 - 9/25	5									5
	KAKU Kazuya	Remote Sensing	7/28 - 7/30	3	9/19 - 9/26	8	2/14 - 2/17	4					15
	KUSHIDA Keiji	Remote Sensing	9/18 - 9/26	9									9
	SATO Atsushi	Remote Sensing	9/23 - 9/26	4									4
	SHIMIZU Daisuke	Remote Sensing	9/19 - 9/26	8									8
	TAKEUCHI Wataru	Remote Sensing	7/24 - 7/27	4	9/21 - 9/23	3							7
	HAYASHI Kazuhiko	UAV&Ground Truth	9/19 - 9/26	8									8
	TANABE Seiji	UAV&Ground Truth	9/19 - 9/26	8									8
	TANI Hiroshi	Remote Sensing	7/9 - 7/17	9									9
	TOKUNO Masami	Remote Sensing	9/19 - 9/24	6									5
	NAKAU Koji	Remote Sensing	7/27 - 8/9	14									14
	Yan Geo	Remote Sensing	5/25 - 6/5	12	7/2 - 7/20	19	9/12 - 9/28	17					48
	Noh Dong Ku	Remote Sensing	9/22 - 9/25	4									4
	FUKUDA Masami	Natural Environment	2/16 - 2/18	3									3
							Total						188
CA	HIRANO Takashi	Environmental Informatics	6/1 - 6/8	8	9/17 - 9/25	9	2/3 - 2/11	9	3/3 - 3/10	8	2/28 - 3/8	9	43
	INUBUSHI Kazuyuki	Soil Science	9/20 - 9/25	6									6

nospheric emistry	2/15 - 2/18	4									4
nospheric emistry	2/14 - 2/18	5									5
l Science	5/31 - 6/12	13	3/4 - 3/9	6							19
vironmental rmatics	6/12 - 6/19	8									8
					Total						85
-climate	5/30 - 6/5	7	7/20 - 8/3	15	8/22 - 8/27	6	9/11 - 10/1	21	10/23 - 11/11	20	69
	11/14 - 11/18	5	1/22 - 1/30	9	2/13 - 2/19	7	3/1 - 3/20	20			41
vironment rmation	8/25 - 9/9	16	3/6 - 3/15	10							26
at Science	5/29 - 6/5	8									8
at Science	9/21 - 9/29	9									9
er chnology	4/27 - 5/8	12	9/20 - 9/30	11	3/2 - 3/9	8					31
drology	9/22 - 9/29	8									8
er chnology	8/14 - 8/21	8	1/5 - 1/12	8							16
er chnology	8/14 - 8/21	8									8
er chnology	2/14 - 2/19	6									6
er chnology	8/14 - 8/24	11	1/5 - 1/14	10							21
er chnology	7/25 - 8/3	10	10/23 - 11/4	13							23
ricultural drology	5/31 - 6/12	13	2/29 - 3/11	12							25
drology	9/21 - 9/29	9									9
er chnology	7/25 - 8/3	10	10/25 - 11/10	17	1/22 - 1/26	5	3/9 - 3/16	8			40
sin vironment	7/31 - 8/9	10	3/24 - 3/31	8							18
pert on drology	9/21 - 9/29	9									9
ater vironment	7/31 - 8/9	10									10
ater vironment	7/31 - 8/9	10									10

Fire Management	NOGUCHI Izumi	Precipitation Chemistry	8/12 - 8/24	13									13
	HAYASAKA Hiroshi	Fire Science	9/11 - 9/25	15	2/23 - 2/29	7							22
	SEKISHITA Nobumasa	Air Flow	8/10 - 8/29	20									20
Terrestrial Ecology	YABE Kazuo	Ecology & Environment	9/7 - 9/19	13									13
	HARAGUCHI Akira	Water Environment	12/23 - 12/28	6	3/23 - 3/29	7							13
	SHIODERA Satomi	Plant Ecology	5/29 - 7/28	61	9/7 - 9/29	23	2/11 - 3/10	28					112
Aqua-share Ecology	KURASAKI Masaaki	Environment Remediation	9/15 - 9/26	12									12
	KURAMITSU Hideki	Analytical Chemistry	9/14 - 9/23	10									10
	TANAKA Syunitsu	Environment Remediation	9/15 - 9/26	12									12
	KAMIYA Mitsuhiko	Analytical Chemistry	10/26 - 11/11	17	3/7 - 3/20	14							31
	SHIGENAGA Yukihisa	Analytical Chemistry	10/22 - 10/29	8	1/22 - 1/30	9							17
	OCHI Noriyoshi	Analytical Chemistry	11/3 - 11/11	9									9
	OKADA Misao	Analytical Chemistry	10/26 - 11/4	10									10
	HOSOKAWA Toshiyuki	Environment Physiology	9/15 - 9/26	12									12
	SAITO Takeshi	Environment Medicine	9/15 - 9/26	12									12
Reforestation	OGAWA Masato	Mechanics	9/20 - 9/30	11									11
	SAITO Hideyuki	Silviculture	4/1 - 4/6	6	7/20 - 7/27	8	9/12 - 9/28	17	2/29 - 3/10	11			42
	SASAKI Yasutaka	Mechanics	9/23 - 9/30	8	2/14 - 2/20	7							15
	TAMAI Hiroshi	Resource Biology	9/23 - 9/30	8	2/14 - 2/20	7							15
	TANGE Takeshi	Silviculture	9/21 - 9/27	7									7
	URAKI Yasumitsu	Forest Chemistry	9/20 - 9/30	11	2/14 - 2/20	7							18
	KOIZUMI Akio	Timber Engineering	9/20 - 9/27	8									8
	Total												821

PM	OSAKI Mitsuru	Project Leader/ Plant Nutrition	4/3 - 4/17	15	5/25 - 5/31	7	7/1 - 7/15	15	7/17 - 7/21	5	7/27 - 8/7	12	54
			9/18 - 10/4	17	11/14 - 11/18	5	12/21 - 12/25	5	1/16 - 1/20	5	3/14 - 3/21	8	40
	KOBAYASHI Noriyuki	REDD	5/25 - 5/29	5	9/21 - 9/26	6	2/14 - 2/20	7					18
	HIROSE Kazuyo	CDM &REDD	4/2 - 4/17	16	5/23 - 6/7	16	7/2 - 7/22	21	7/27 - 8/7	12	8/14 - 8/23	10	75
			9/14 - 10/4	21	10/12 - 10/14	3	12/11 - 12/26	16	1/8 - 1/24	17	1/29 - 2/23	26	83
			2/28 - 3/21	22									22
	MATSUNAGA Ryuji	Advisor	9/17 - 9/25	9	11/7 - 11/16	10							19
	TAKAHASHI Yukihiro	Information Management	11/15 - 11/17	3	1/9 - 1/13	5							8
	FUKUHARA Tetsuya	Information Management	9/21 - 9/26	6									6
	NAKAMOKU Kohei	Integrated Peat Management	2/13 - 2/20	8									8
	IHARA Hiroyoshi	Integrated Peat Management	3/2 - 3/9	8									8
	MOMOTA Eriko	REDD	7/27 - 8/9	14	9/20 - 9/26	7	2/11 - 2/20	10	3/12 - 3/21	10			41
	Total												382
													1,476

A.5 List of Input (Short-term Experts dispatched in 2010)

Area		Name	Expertise	FY 2010 Duration (Days)										Total Days
				1st (6th) (11th)		2nd (7th) (12th)		3rd (8th) (13th)		4th (9th) (14th)		5th (10th)		
FF		HONMA Toshihisa	Simulation	5/30 - 6/3	(5)	9/21 - 10/1	(11)	2/25 - 3/2	(6)	3/15 - 3/18	(4)			(26)
		ONO Atsushi	Remote Sensing	9/26-9/30	(4)									(4)
		KAKU Kazuya	Remote Sensing	9/25-10/3	(8)									(8)
		KUSHIDA Keiji	Remote Sensing	9/21-9/29	(8)									(8)
		SHIMUZA Daisuke	Remote Sensing	2/26-3/2	(4)									(4)
		TANABE Seiji	UAV & Ground Truth	9/23-9/29	(6)	2/26-3/2	(4)							(10)
		TANI Hiroshi	Remote Sensing	9/25-10/7	(12)									(12)
		TOKUNO Masami	Remote Sensing	9/26-10/2	(6)									(6)
		NAKAU Koji	Remote Sensing	9/26-10/1	(5)									(5)
		FUKUDA Masami	Natural Environment	9/21-9/28	(7)	3/14-3/19	(5)							(12)
		WATANABE Manabu	Remote Sensing	9/22-9/28	(6)									(6)
		Yan Gao	Remote Sensing	3/9-3/19	(10)									(10)
		Heonshik Shin	Sensor Network, Algorithm & Ground Truth	9/23-9/28	(5)									(5)
														(116)
CA		HIRANO Takashi	Environmental Informatics	6/12 - 6/20	(9)	9/5-9/12	(8)	12/12-12/15	(4)	2/23-3/3	(9)			(30)
		INUBUSHI Kazuyuki	Soil Science	9/26-10/1	(5)									(5)
		INOUE Gen	Atmospheric Chemistry	5/30-6/2	(3)	7/16-7/19	(3)	9/29-10/1	(5)					(11)
		YAMADA Hiroyuki	Environmental Informatics	6/12-6/20	(8)									(8)
														(54)
CM	Watershed Management	TAKAHASHI Hidenori	Bio-climate	5/23-6/2	(11)	6/18-6/27	(10)	8/21-8/29	(9)	9/22-10/4	(13)	11/15-12/7	(23)	(91)
				2/23-3/19	(25)									
		SHIMADA Sawahiko	Environment Information	11/19-11/24	(5)									(5)
		TAKADA Masayuki	Peat Science	6/18-6/24	(6)									(6)

		NAGARE Hideaki	Water Environment	3/9-3/15	(6)									(6)
		FUKAMI Koji	Hydrology	7/24-7/30	(6)	9/25-10/4	(9)	3/9-3/18	(9)					(24)
		YAMAMOTO Koichi	River Technology	6/26-7/1	(5)	9/23-9/30	(7)							(12)
		ISHII Yoshiyuki	Hydrology	5/23-5/31	(8)	7/24-7/30	(6)	3/9-3/18	(9)					(23)
		NAKATSUGAWA Makoto	River Technology	1/8-1/16	(8)									(8)
		WATANABE Yasuharu	River Technology	1/8-1/16	(8)									(8)
		SUGIMOTO Hikaru	River Technology	6/20-6/27	(7)	1/9-1/16	(7)							(14)
		ARISAWA Tomoyuki	River Technology	11/27-12/7	(10)	3/5-3/15	(10)							(20)
		KOIZUMI Ken	Expert on Hydrology	9/25-10/4	(9)	3/9-3/18	(9)							(18)
		OKADA Misao	Hydrology	3/6-3/15	(9)									(9)
		ITAKURA Tadaoki	River Technology	6/20-6/27	(7)									(7)
		KAMIYA Mitsuhiko	Geotechnology	11/27-12/7	(10)	3/5-3/15	(10)							(20)
		KOMAI Yukio	Basin Environment	8/16-8/24	(8)	3/21-3/28	(7)							(15)
		TAKI Kazuo	Water Environment	8/15-8/24	(9)	3/23-3/31	(8)							(17)
		TACHIBANA Harukuni	Water Environment	8/15-8/24	(9)	3/21-3/31	(10)							(19)
		SHIGENAGA Yukihisa	Hydrology	11/15-11/23	(8)	2/14-2/20	(6)	3/13-3/20	(7)					(21)
	Fire Management	NOGUCHI Izumi	Precipitation Chemistry	9/17-9/26	(9)									(9)
		HAYASAKA Hiroshi	Fire Science	9/17-10/1	(14)	3/9-3/17	(8)							(22)
		SEKISHITA Nobumasa	Air Flow	9/15-9/24	(9)	3/5-3/12	(7)							(16)
	Terrestrial Ecology	KOHYAMA Takashi	Plant Ecology	9/25-9/30	(5)									(5)
		HARAGUCHI Akira	Water Environment	11/24-12/1	(7)	3/14-3/19	(5)							(12)
		SEINO Tatsuyuki	Ecology & Environment	11/23-12/5	(12)									(12)
		YABE Kazuo	Ecology & Environment	9/17-9/27	(10)	3/21-3/31	(10)							(20)

		SHIODERA Satomi	Plant Ecology	5/21-6/25	(35)	7/13-8/24	(42)	9/11-10/10	(29)	11/21-12/10	(19)	2/16-2/27	(11)	(157)
				3/9-3/30	(21)									
	Aqua-share Ecology	KURASAKI Masaaki	Environment Remediation	8/4-8/12	(8)									(8)
		KURAMITSU Hideki	Analytical Chemistry	9/19-10/1	(12)									(12)
		TANAKA Syunitsu	Environment Remediation	8/4-8/12	(8)									(8)
		HOSOKAWA Toshiyuki	Environment Physiology	8/4-8/12	(8)									(8)
		SAITO Takeshi	Environment Medicine	8/4-8/12	(8)									(8)
	Reforestation	OGAWA Masato	Mechanics	9/19-9/30	(11)	2/14-2/27	(13)							(24)
		SAITO Hideyuki	Silviculture	9/23-10/3	(10)	2/19-3/2	(11)							(21)
		SASAKI Yasutaka	Mechanics	9/19-9/30	(11)	2/14-2/27	(13)							(24)
		TAMAI Hiroshi	Forest Resource Biology	7/25-7/28	(3)	9/19-9/21	(2)	2/13-2/20	(7)					(12)
		TANGE Takeshi	Silviculture	9/25-9/30	(5)									(5)
		TOKURA Seiichi	Polymer Science	9/19-9/30	(11)									(11)
		URAKI Yasumitsu	Forest Chemistry	9/19-9/30	(11)	2/14-2/27	(13)							(24)
		KOIZUMI Akio	Timber Engineering	2/25-3/2	(5)									(5)
														(766)
PM		OSAKI Mitsuru	Project Leader/Plant Nutrition	5/27-6/3	(8)	6/25-6/29	(5)	7/14-7/23	(10)	8/1-8/11	(11)	9/18-10/11	(24)	(102)
				11/3-11/10	(8)	11/18-11/22	(5)	12/14-12/19	(6)	1/10-1/14	(5)	2/22-2/27	(6)	
				3/8-3/21	(14)									
		ISHIMURA Gakushi	Environmental Education	3/13-3/19	(6)									(6)
		EZAWA Tstsuhiro	Restoration of Peat	8/1-8/11	(10)									(10)
		OMURA Makiko	Development Economics	8/22-8/29	(7)	3/1-3/6	(5)							(12)
		OGAWA Iwao	Applied Biology	11/22-11/30	(8)	3/2-3/9	(7)							(15)
		OGAWA Koichiro	Environmental Education	11/22-11/30	(8)	3/2-3/9	(7)							(15)
		KOBAYASHI Noriyuki	REDD	9/25-9/29	(4)	11/18-11/21	(3)	3/12-3/20	(8)					(15)
		TAKAHASHI Yukihiro	Remote Sensing	3/13-3/17	(4)									(4)
		TAKAHI Sachiko	Environment Policy &	9/13-9/21	(8)									(8)

		Education											
	TAKEUCHI Kenji	Environment Economics	6/20-7/4	(14)									(14)
	TACHIBANA Towa	Development Economics	6/207/4	(14)									(14)
	TANAKA Shingo	Environmental Education	3/13-3/25	(12)									(12)
	HATA Hiroshi	Animal Production	6/7-6/15	(8)	10/6-10/12	(6)							(14)
	HIROSE Kazuyo	CDM & REDD	4/19-4/30	(12)	5/19-6/3	(16)	6/16-6/30	(15)	7/12-7/28	(17)	8/16-8/31	(16)	(167)
			9/18-10/11	(24)	11/2-11/15	(14)	11/16-11/17	(2)	11/22-11/24	(3)	12/14-12/22	(9)	
			1/9-1/17	(9)	1/30-2/5	(7)	2/20-2/27	(8)	3/7-3/21	(15)			
	FUKUSHIMA Takashi	Environmental Policy	5/27-6/2	(6)									(6)
	TAKAHASHI Makoto	Grazing System	6/7-6/15	(8)									(8)
	MOMOTA Eriko	REDD	9/25-10/2	(7)	2/22-2/27	(5)	3/9-3/19	(10)					(22)
													(444)
													(1,380)

A.6 List of Input (Counterpart Training and Scholarship Program)

As of 30 October 2013

Scheme	Term	Name	Institution	Period	Course
JICA counterpart training	Long-term	Ms.Nina Yulianti	UNPAR	Apr.2010-Sep.2013	Ph.D
		Ms.Yustiawati Syawal	LIPI	Apr.2010-Mar.2013	Ph.D
		Mr.Haiki Mart Yupi	UNPAR	Oct.2010-Mar.2014	Ph.D
		Mr.Dulbert Tampubolon	BSN	Oct.2010-Sep.2012	Master
		Ms.Febrina Natalia	KALTENG	May.2012-Mar.2014	Master
	Short-term	Mr.Edi Mirmanto	LIPI	Oct.2010-Mar.2011	Researcher (earned Ph. D in Mar 2011)
		Mr.Untung Darung	UNPAR	Jan.2011-Mar.2011 Jan.2012-Mar.2012 Jan.2013-Mar.2013	Researcher
		Ms. Linda Wulandari	UNPAR	Oct.2011-Jan.2012 Oct.2012-Dec.2012 Aug 2013-Nov. 2013	Researcher
		Ms. Rosana Elvince	UNPAR	Jan.2012-Mar.2012	Researcher
		Ms. Dewi Susan	LIPI	Oct.2012-Dec.2012	Researcher
		Mr. Gandharum Laju	BPPT	Jan.2013-Mar.2013	Researcher
		Mr. Firman Prawiradisastra	BPPT	Aug 2013-Oct. 2013	Researcher
		Mr.Yoke Faizal Oktofan	BPPT	Aug 2013-Oct. 2013	Researcher
		Mr. Irwan Priyanto	LAPAN	Oct.2013-Nov. 2013	Researcher
		Mr. Bustanul Arifin	LAPAN	Aug 2013-Oct. 2013	Researcher
MEXT-JST Scolarship	Long-term	Ms.Ina Winarni	FORDA	Oct.2010-Sep.2013	Ph.D
		Ms.Tika Dewi Atikah	LIPI	Oct.2010-Sep.2013	Ph.D
		Mr.Rony Teguh	UNPAR	Oct.2011-Sep.2014	Ph.D
		Ms. Fiolenta Marpang	BPPT	Oct.2013-Sep.2016	Ph.D
Special Grant Program for International Students of Hokkaido University	Long-term	Ms.Siti Sundari	LIPI	Oct.2009-Sep.2012	Ph.D

A.7 List of Input (Equipment Procured in Japan, 2011-2013)

Equipment procured in Japan, by Hokkaido University, and delivered to the Project from April 2011 to September 2013

No.	Item	No of Unit	Activity	Allocation	Total Cost		Time of delivery	Remarks
1	plate	2	CM	UNPAR	10,500	JY	2011.10	
2	laser distance meter	1	CM	UNPAR	39,900	JY	2011.10	
3	lithium battery	2	CM	UNPAR	25,200	JY	2011.10	
4	field data recording equipment	4	CM	UNPAR	1,211,480	JY	2011.09	
5	Thermo Mix Shaker	1	CA	LIPI	53,800	JY	2012.02	
6	Thermo Mix Shaker Block	3	CA	LIPI	1,060,930	JY	2012.02	
7	measure	3	CM	UNPAR	119,553	JY	2012.02	
8	caliper	1	CM	UNPAR	29,568	JY	2012.02	
9	pipetman	8	CM	UNPAR	218,715	JY	2012.02	
10	styrol box	4	CM	UNPAR	72,240	JY	2012.02	
11	logger	2	CM	UNPAR	301,140	JY	2012.03	
12	T type thermostat couple	1	CM	UNPAR	61,740	JY	2012.03	
13	tube	1	CM	UNPAR	472,500	JY	2012.02	
14	spectroradiometer	1	FF	UNPAR	8,998,500	JY	2012.09	
15	pomp	2	CA	UNPAR	46,410	JY	2012.06	
16	pH meter	2	CA	UNPAR	53,800	JY	2012.06	
17	EC meter	2	CA	UNPAR	49,800	JY	2012.06	
18	pressure sensor	10	CA	UNPAR	265,000	JY	2012.06	
19	tunable filter	1	FF	UNPAR	746,130	JY	2012.06	
20	TDR sensor	1	CA	UNPAR	136,500	JY	2012.06	
21	flash card	1	CA	UNPAR	7,560	JY	2012.06	
22	cable	1	CA	UNPAR	42,000	JY	2012.06	
23	lamp	1	CM	UNPAR	3,675	JY	2012.06	
24	sample cup	1	CM	UNPAR	4,515	JY	2012.06	
25	cap	10	CM	UNPAR	62,318	JY	2012.06	
26	hand-operated auger boring	1	CM	UNPAR	77,700	JY	2012.06	
27	cutter for the hand-operated auger boring	1	CM	UNPAR	231,000	JY	2012.06	
28	cable for battery	1	CM	UNPAR	31,500	JY	2012.09	
29	hand-operated auger boring	1	CM	UNPAR	29,400	JY	2012.09	
30	battery	2	CM	UNPAR	9,765	JY	2012.09	
31	battery charger	1	CM	UNPAR	4,305	JY	2012.09	
32	USB base station	1	CM	UNPAR	8,280	JY	2012.09	
33	turbidimeter	1	CM	UNPAR	463,050	JY	2012.07	
34	balloon	1	CM	UNPAR	87,150	JY	2012.08	
35	Piston sampler	1	CM	UNPAR	73,500	JY	2012.09	
36	Thin wall liner	1	CM	UNPAR	92,400	JY	2012.09	
37	Piston extension rod	2	CM	UNPAR	32,655	JY	2012.09	
38	ling hook	1	CM	UNPAR	840	JY	2012.09	
39	turn buckle	1	CM	UNPAR	1,785	JY	2012.09	

40	knocking head	1	CM	UNPAR	18,900	JY	2012.09	
41	boring rod	1	CM	UNPAR	13,650	JY	2012.09	
43	scales	2	CM	UNPAR	101,462	JY	2012.08	
44	sensor for temperature	3	CM	UNPAR	70,039	JY	2012.08	
46	sensor for temperature and humidity	2	CM	UNPAR	113,022	JY	2012.09	
47	caliper	1	CM	UNPAR	29,568	JY	2012.09	
48	GPS antenna	2	CM	UNPAR	31,500	JY	2012.09	
49	GSM antenna	1	CM	UNPAR	15,750	JY	2012.09	
50	SUPPLY OZEKI NG SMS GATEWAY	1	FF	LAPAN	43,235	JY	2012.09	
51	SUPPLY GSM MODEM WAVECOM	1	FF	LAPAN	129,706	JY	2012.09	
52	SUPPLY THINKCENTER EDGE71	1	FF	LAPAN	105,926	JY	2012.09	
53	regent	14	CM	LIPI	269,624	JY	2013.02	
54	Infrared thermography	2	FF	UNPAR	658,000	JY	2012.10	
55	increment borer	1	CM	UNPAR	65,898	JY	2013.02	
56	filter folder	1	CM	UNPAR	122,850	JY	2013.06	
57	SD card	2	FF	UNPAR	2,920	JY	2012.10	
58	SD card case	2	FF	UNPAR	2,720	JY	2012.10	
59	bottle	1	CA	UNPAR	55,816	JY	2013.03	
60	cold box	1	CA	UNPAR	17,200	JY	2013.03	
61	flash meter	1	CM	UNPAR	147,000	JY	2013.02	
62	sampler	2	CA	UNPAR	197,600	JY	2013.02	
63	Eh electrode	2	CA	UNPAR	162,000	JY	2013.02	
64	non treatment microplate	1	CA	UNPAR	43,000	JY	2013.02	
65	stainless cylinder	1	CA	UNPAR	87,500	JY	2013.02	
66	board	1	CM	UNPAR	69,460	JY	2013.02	
67	CO2 probe	4	CA	UNPAR	2,070,000	JY	2013.06	
68	Indication instrument	4	CA	UNPAR	1,020,000	JY	2013.06	
69	adapter and PC kit	1	CA	UNPAR	42,000	JY	2013.06	
70	flange	4	CA	UNPAR	126,000	JY	2013.06	
72	CO2 analyzer	1	CA	UNPAR	1,596,000	JY	2013.03	
73	caliper	1	CM	LIPI	40,634	JY	2013.02	
74	pin set	7	CM	LIPI	20,013	JY	2013.02	
75	electric balance	1	CM	LIPI	42,525	JY	2013.02	
77	spoon	2	CM	LIPI	2,457	JY	2013.02	
78	board	2	CM	LIPI	74,466	JY	2013.02	
79	digimac caliper	1	CM	LIPI	40,634	JY	2013.02	
80	hand scale	4	CM	LIPI	15,288	JY	2013.02	
81	digital camera	4	PM	UNPAR	400,546	JY	2013.06	
82	lens	1	PM	UNPAR	4,880	JY	2013.06	
83	filter	1	PM	UNPAR	108,000	JY	2013.06	
84	portable DVD drive	1	PM	UNPAR	4,850	JY	2013.06	
85	film	1	CM	LIPI	2,362	JY	2013.02	

86	thermos cup logger	1	CM	UNPAR	159,600	JY	2013.02	
87	pendant logger	1	CM	UNPAR	93,900	JY	2013.02	
88	thermos cup	1	CM	UNPAR	31,920	JY	2013.02	
90	carrying case	1	CM	LIPI	6,615	JY	2013.02	
91	engineer pocket	1	CM	LIPI	16,640	JY	2013.02	
92	laptop	2	PM	UNPAR	400,546	JY	2013.06	
93	carbon pole	1	CM	UNPAR	258,300	JY	2013.02	
94	thermography camera	1	FF	UNPAR	332,000	JY	2013.06	
95	SDXC card	1	FF	UNPAR	33,800	JY	2013.06	
96	CF card	1	FF	UNPAR	29,800	JY	2013.06	
97	slingshot	1	CM	LIPI	5,600	JY	2013.06	
98	rubber for slingshot	1	CM	LIPI	2,600	JY	2013.06	
99	binoculars	1	CM	LIPI	50,800	JY	2013.06	
100	charge controller	1	CA	UNPAR	73,500	JY	2013.02	
101	air filter	1	CA	UNPAR	79,800	JY	2013.02	
102	air pomp	1	CA	UNPAR	88,200	JY	2013.02	
103	adapter and PC kit	1	CA	UNPAR	42,000	JY	2013.06	
104	flange	2	CA	UNPAR	21,000	JY	2013.06	
105	Mini zalto	1	CM	UNPAR	18,800	JY	2013.01	
106	faucet	1	CM	UNPAR	21,000	JY	2013.01	
107	meteorological instrumentation system	1	CA	UNPAR	530,000	JY	2013.01	
108	water checker	1	PM	FORDA	31,290	JY	2013.01	
109	pH sensor for water checker	1	PM	FORDA	34,965	JY	2013.01	
110	sensor for water checker	1	PM	FORDA	48,300	JY	2013.01	
111	GPS	1	PM	FORDA	44,625	JY	2013.01	
112	o-ling	1	CM	LIPI	39,200	JY	2013.02	
113	monitoring equipment for the atmospheric CO2	1	CA	UNPAR	800,000	JY	2013.01	
114	monitoring equipment for the ground CO2	1	CA	UNPAR	868,000	JY	2013.01	
115	compaction recorder	1	CA	UNPAR	294,600	JY	2013.01	
116	compaction recorder	1	CA	UNPAR	108,271	JY	2013.01	
117	water level sensor	1	CM	UNPAR	252,000	JY	2013.02	
118	sensor cable	2	CM	UNPAR	23,205	JY	2013.02	
119	battery pack	1	CM	UNPAR	7,140	JY	2013.02	
120	external antenna	1	CM	UNPAR	8,925	JY	2013.02	
121	external temperature sensor	1	CM	UNPAR	30,344	JY	2013.03	
122	solar panel	1	CM	UNPAR	19,635	JY	2013.03	
123	memory card	1	CM	UNPAR	28,770	JY	2013.03	
124	box	2	CM	UNPAR	1,339	JY	2013.03	
125	satellite data	1	PM	UNPAR	409,857	JY	2013.06	
133	check sheet	1	CM	UNPAR	112,980	JY	2013.02	
134	Mini pump	1	CA	UNPAR	103,950	JY	2013.06	
135	bags	1	CA	UNPAR	17,010	JY	2013.06	

136	GEN FastDNA SPIN Kit for Soil(50 preps)	1	CA	UNPAR	54,526	JY	2013.09	
137	GEN Lysing MarixE 6914-050 (50tubes)	1	CA	UNPAR	31,941	JY	2013.09	
138	GEN SPIN Module 2080-800 (100pieces)	1	CA	UNPAR	25,137	JY	2013.09	
139	kit for water level and water temperature	1	CM	UNPAR	182,700	JY	2013.09	
140	hyetometer	1	CM	UNPAR	315,000	JY	2013.09	
141	external antenna	1	CM	UNPAR	63,000	JY	2013.09	
142	water level recorder	1	CM	UNPAR	756,000	JY	2013.09	
143	battery pack	1	CM	UNPAR	50,400	JY	2013.09	
144	commander	1	CM	UNPAR	60,900	JY	2013.09	
145	solar panel	1	CM	UNPAR	155,610	JY	2013.09	
147	tape	1	CM	UNPAR	2,055	JY	2013.09	
148	silica gel	1	CM	UNPAR	9,450	JY	2013.09	
149	blender	1	CM	UNPAR	78,750	JY	2013.09	
150	soil pH meter	1	CM	UNPAR	141,750	JY	2013.09	
151	inner hook ling	1	CM	UNPAR	4,200	JY	2013.09	
152	inner rod	1	CM	UNPAR	13,440	JY	2013.09	
153	coupling	1	CM	UNPAR	49,770	JY	2013.09	
154	tongs	1	CM	UNPAR	6,636	JY	2013.09	
155	hook wrench	1	CM	UNPAR	5,250	JY	2013.09	
156	rod	2	CM	UNPAR	23,940	JY	2013.09	
157	compaction recorder	1	CM	UNPAR	1,862,700	JY	2013.09	
158	box for compaction recorder	1	CM	UNPAR	52,500	JY	2013.09	
159	plastic base	1	CM	UNPAR	3,150	JY	2013.09	
160	Oligo(dt)12-18 Primer	1	CM	UNPAR	27,406	JY	2013.09	

FF Total	11,082,737	JY
CA Total	10,270,851	JY
CM Total	10,137,396	JY
PM Total	1,487,859	JY
Total	32,978,843	JY

A.7 List of Input (Equipment Procured in Japan, 2010)

Equipment procured in Japan, by Hokkaido University, and delivered to the Project from February 2010 to March 2011

No.	Item	No of Unit	Activity	Allocation	Total Cost		Time of delivery	Remarks
1	Data logger	1	CA	UNPAR	548,624	JY	Jun-2010	
2	Compact flash module	1	CA	UNPAR	113,716	JY	Jun-2010	
3	Lure fitting (10 sets)	2	CA	UNPAR	5,880	JY	Jun-2010	
4	PP tube joint (10 sets)	1	CA	UNPAR	180	JY	Jun-2010	
5	Silicon tube	1	CA	UNPAR	1,470	JY	Jun-2010	
6	I-boy wide-mouthed bottle (100 bottles)	1	CA	UNPAR	45,000	JY	Jun-2010	
7	Horiba Compact pH meter	1	CA	UNPAR	53,800	JY	Sept-2010	
8	Horiba Compact EC meter	1	CA	UNPAR	49,800	JY	Sept-2010	
9	Syringe with wings 50 ml (with 20 sets of syringes without wings)	1	CA	UNPAR	30,000	JY	Sept-2010	
10	Plastic holder (6 sets)	1	CA	UNPAR	15,200	JY	Sept-2010	
11	Wattman Glass fiber filter	1	CA	UNPAR	53,000	JY	Sept-2010	
12	Manual vacuum pump	1	CA	UNPAR	67,500	JY	Jun-2011	
13	High precision portable pressure sensor	1	CA	UNPAR	106,000	JY	Mar,Jun-2011	
14	Air pump	1	CA	UNPAR	77,800	JY	Feb-2011	
15	Air filter (10 sets)	1	CA	UNPAR	79,800	JY	Feb-2011	
16	Sony Blue Ray Recorder	1	CM	UNPAR	110,460	JY	Feb-2010	
17	Thermo Shot	1	CM	UNPAR	498,750	JY	Feb-2010	
18	DL/N70 water gauge with logger	1	CM	UNPAR	3,200,610	JY	Jun-2010	
19	Interface cable	1	CM	UNPAR	35,280	JY	Jun-2010	
20	Absolute pressure type water gauge S&DLmini (5m)	1	CM	UNPAR	3,587,220	JY	Jun-2010	
21	Barometer S&Dlmini	1	CM	UNPAR	1,496,250	JY	Jun-2010	
22	Cradle (for USB)	1	CM	UNPAR	66,150	JY	Jun-2010	
23	Absorption meter	1	CM	UNPAR	583,485	JY	Nov-2010	
24	Reactor	1	CM	UNPAR	164,015	JY	Nov-2010	
25	Reagent Chloride	1	CM	UNPAR	12,075	JY	Mar-2011	
26	Reagent Total nitrogen	1	CM	UNPAR	22,050	JY	Mar-2011	
27	Reagent Ammonia	1	CM	UNPAR	18,375	JY	Mar-2011	
28	Reagent Nitrous acid	1	CM	UNPAR	8,400	JY	Mar-2011	
29	Reagent Nitric acid	1	CM	UNPAR	8,400	JY	Mar-2011	
30	Reagent Total phosphorous	1	CM	UNPAR	13,650	JY	Mar-2011	
31	Reagent Phosphoric acid	1	CM	UNPAR	6,825	JY	Mar-2011	
32	Reagent COD-Mn	1	CM	UNPAR	10,500	JY	Nov-2010	
33	Reagent Ammonia	1	CM	UNPAR	4,200	JY	Nov-2010	
34	Reagent Phosphoric acid	1	CM	UNPAR	4,725	JY	Nov-2010	
35	Reagent Chloride	1	CM	UNPAR	6,300	JY	Mar-2011	
36	Tipping-bucket rain gauge (0.5mm)	1	CM	UNPAR	848,400	JY	Mar-2011	
37	Rainfall monitoring data logger	1	CM	UNPAR	145,596	JY	Jun-2010	
38	Soil water sensor, theta probe (cable 15m)	1	CM	UNPAR	538,816	JY	Jun-2010	
39	Soil water logger	1	CM	UNPAR	826,184	JY	Jun-2010	

40	DL/N70 water gauge with logger	1	CM	UNPAR	6,401,220	JY	Jun-2010	
41	Interface cable	1	CM	UNPAR	70,560	JY	Jun-2010	
42	Software	1	CM	UNPAR	25,200	JY	Jun-2010	
43	Lithem battery	1	CM	UNPAR	107,100	JY	Jun-2010	
44	A set of GPS equipment	1	CM	UNPAR	2,588,250	JY	Jun-2010	
45	Stainless steel pipe 304TP-A	1	CM	UNPAR	16,695	JY	Jul-2010	
46	Stainless steel pipe 304TP-A	1	CM	UNPAR	420	JY	Jul-2010	
47	Stainless steel pipe 304TP-A	1	CM	UNPAR	840	JY	Jul-2010	
48	Stainless steel pipe 304TP-A	1	CM	UNPAR	735	JY	Jul-2010	
49	Stainless steel ring cutting board 304	1	CM	UNPAR	25,410	JY	Jul-2010	
50	Stainless steel ring cutting board 304	1	CM	UNPAR	37,800	JY	Jul-2010	
51	Stainless steel cutting board 304	1	CM	UNPAR	2,436	JY	Jul-2010	
52	Stainless steel ring cutting board 304	1	CM	UNPAR	12,180	JY	Jul-2010	
53	Stainless steel cutting board 305	1	CM	UNPAR	3,675	JY	Jul-2010	
54	Stainless steel cutting board 305	1	CM	UNPAR	5,880	JY	Jul-2010	
55	Stainless steel round bar 304	1	CM	UNPAR	1,008	JY	Jul-2010	
56	Stainless steel wire net 304 100 mesh	1	CM	UNPAR	2,730	JY	Jul-2010	
57	Stainless steel FB	1	CM	UNPAR	1,512	JY	Jul-2010	
58	Stainless steel board	1	CM	UNPAR	4,305	JY	Jul-2010	
59	Straight union	1	CM	UNPAR	3,528	JY	Jul-2010	
60	Straight barbed union	1	CM	UNPAR	3,822	JY	Jul-2010	
61	Ball valve 1/2	1	CM	UNPAR	3,969	JY	Jul-2010	
62	Trunnion ball valve	1	CM	UNPAR	15,204	JY	Jul-2010	
63	SUS304BA tube	1	CM	UNPAR	8,400	JY	Jul-2010	
64	SUS304BA tube	1	CM	UNPAR	4,410	JY	Jul-2010	
65	Parameter sheet	1	CM	UNPAR	6,300	JY	Jul-2010	
66	K thermo couple	1	CM	UNPAR	18,900	JY	Jul-2010	
67	Digital temperature indicator	1	CM	UNPAR	9,660	JY	Jul-2010	
68	Parameter sheet	1	CM	UNPAR	2,100	JY	Jul-2010	
69	Weather bucket High-grade type	1	CM	UNPAR	682,500	JY	Jun-2010	
70	Tripod for installation	1	CM	UNPAR	21,000	JY	Jun-2010	
71	ZYAURA Carbon dioxide meter SM-4106	1	CM	UNPAR	22,800	JY	Jul-2010	
72	Rainfall monitoring data logger	1	CM	UNPAR	98,700	JY	Sept-2010	
73	Weather bucket High-grade type	1	CM	UNPAR	682,500	JY	Jun-2010	
74	Tripod for installation	1	CM	UNPAR	21,000	JY	Jun-2010	
75	NO & NO2. Sampler for simultaneous measurement	1	CM	UNPAR	95,760	JY	Sept-2010	
76	NO2 impregnated paper filter (Short term)	1	CM	UNPAR	2,730	JY	Sept-2010	
77	NOx impregnated paper filter (Short term)	1	CM	UNPAR	3,675	JY	Sept-2010	
78	SO2 impregnated paper filter (Short term) K2CO3	1	CM	UNPAR	2,730	JY	Sept-2010	
79	pF meter, 20 cm	1	CM	UNPAR	97,650	JY	Sept-2010	
80	Communication module	1	CM	UNPAR	420,000	JY	Sept-2010	

81	USB-serial conversion cable	1	CM	UNPAR	9,450	JY	Sept-2010	
82	Rubber boat	1	CM	UNPAR	53,760	JY	Nov-2010	
83	Battery	1	CM	UNPAR	8,820	JY	Nov-2010	
84	Carbonization furnace Inner kiln	1	CM	UNPAR	220,500	JY	Feb-2011	
85	Portable catch basin for iron kiln	1	CM	UNPAR	21,000	JY	Feb-2011	
86	Custom-made thermocouple 8φ×1300L	1	CM	UNPAR	56,700	JY	Feb-2011	
87	Digital caliper CD67-S20PS	1	CM	UNPAR	23,908	JY	Mar-2011	
88	Micrometer Quantum microphone MDE-25PJ	1	CM	UNPAR	17,955	JY	Mar-2011	
89	Number tape A-D (Pink, orange, yellow, white, each 4 sets)	1	CM	UNPAR	25,200	JY	Mar-2011	
90	Sign tape 0.1MM*30MM*100M (pink, orange)	1	CM	UNPAR	20,475	JY	Mar-2011	
91	Sign tape 0.1MM*15MM*100M (pink, orange)	1	CM	UNPAR	14,955	JY	Mar-2011	
92	"Swing-catch-kun"	1	CM	UNPAR	11,340	JY	Mar-2011	
93	ML-2 Mini rod	1	CM	UNPAR	7,560	JY	Mar-2011	
94	"LS-25 Level Tracon" surveying compass	1	CM	UNPAR	84,525	JY	Mar-2011	
95	Tripod for "LS-25 Level Tracon" surveying compass No. 33	1	CM	UNPAR	11,970	JY	Mar-2011	
96	61-0474 A&D Electronic balance FX-1200I	1	CM	UNPAR	55,755	JY	Mar-2011	
97	Soil test strainer (stainless steel)	7	CM	UNPAR	41,160	JY	Mar-2011	
98	Stainless steel sample cylinder, 6 pak, Without stamp	1	CM	UNPAR	53,700	JY	Mar-2011	
99	SK inverse scale test measuring stick, AT-15 15M	1	CM	UNPAR	78,529	JY	Mar-2011	
100	SK inverse scale test measuring stick, AT-6 6M	1	CM	UNPAR	26,932	JY	Mar-2011	
101	Balance	1	PM	UNPAR	62,790	JY	Mar-2010	
102	Chlorophyll meter	1	PM	UNPAR	133,140	JY	Mar-2010	
103	Peat sampler	1	PM	UNPAR	299,250	JY	Jun-2010	
104	U12 thermocouple logger	1	PM	UNPAR	191,520	JY	Jun-2010	
105	T-type thermocouple	1	PM	UNPAR	38,304	JY	Jun-2010	
106	Digital thermometer	1	PM	UNPAR	22,050	JY	Jun-2010	
107	Thermo recorder (humidity/temperature)	1	PM	UNPAR	337,932	JY	Jun-2010	
108	End mill with three blades	6	PM	UNPAR	70,455	JY	Jul-2010	
109	Toshiba Chip	3	PM	UNPAR	23,016	JY	Jul-2010	
110	Iketa Chip	1	PM	UNPAR	5,670	JY	Jul-2010	
111	Liquid CO2 cartridge (12g) (25 sets)	1	PM	UNPAR	25,200	JY	Jun-2010	
112	pF meter (for farm) 20 cm	1	PM	UNPAR	97,650	JY	Sept-2010	
113	Pendant logger with attachment	1	PM	UNPAR	309,750	JY	Sept-2010	
114	Number tape	1	PM	UNPAR	99,960	JY	Feb,Mar,Apr,Jul-2011	
115	Completely waterproof "PDA Archer Field PC w/BT" surveying computer	1	PM	UNPAR	534,912	JY	Jul-2011	
116	Thermohygrometer for U12	1	PM	UNPAR	167,580	JY	Feb-2011	
117	Thermocouple probe for U12	1	PM	UNPAR	31,920	JY	Feb-2011	
118	DIGIMATIC caliper	1	PM	UNPAR	29,568	JY	Mar-2011	
119	Kingston SD card 2 GB SD/2 GB	1	PM	UNPAR	720	JY	Mar-2011	
120	Panasonic Lithium battery, 2 pack CR2032/2P	1	PM	UNPAR	2,780	JY	Mar-2011	
121	HAM24001 Indicating Drierite 10/20 mesh	1	PM	UNPAR	39,690	JY	Mar-2011	

122	HAM14001 Drierite 10	1	PM	UNPAR	23,620	JY	Mar-2011	
123	"Arcview SU" software basic educational license	1	PM	UNPAR	59,031	JY	Jul-2011	
124	"Arcview SU" software educational extensions	1	PM	UNPAR	88,578	JY	Jul-2011	
125	Stress wave speed measuring instrument	1	PM	UNPAR	688,800	JY	Jul-2011	
126	GARMIN GPS English version	1	PM	UNPAR	57,750	JY	Jul-2011	
127	Gramin City Navigator Southeeastern	1	PM	UNPAR	27,300	JY	Jul-2011	
128	Laptop computer	1	PM	UNPAR	82,950	JY	Jul-2011	
129	AT type inverse scale test measuring stick	1	PM	UNPAR	89,628	JY	Jul-2011	
130	VERTEX IV Original package	1	PM	UNPAR	191,625	JY	Apr-2011	
131	SXBlue II GPSKit	1	PM	UNPAR	659,064	JY	Apr-2011	
132	"ArcPad ver.10" software basic educational license	1	PM	UNPAR	29,526	JY	Jul-2011	
133	"ArcPad ver.10" software educational extensions	1	PM	UNPAR	23,625	JY	Jul-2011	
134	KOKUYO Field notebook for survey SE-Y11	1	PM	UNPAR	30,000	JY	Mar-2011	
135	Field-data transmission equipment	1	PM	UNPAR	367,500	JY	May-2011	
136	LaVie Light	2	Mgt	UNPAR	126,000	JY	Jun-2010	

FF Total	0	JY
CA Total	1,247,770	JY
CM Total	24,596,204	JY
PM Total	4,942,854	JY
Management	126,000	JY
Total	30,912,828	JY

A.8 List of Input (Equipment Procured in Indonesia, 2009-2013)

Equipment procured in Indonesia by the Project as of 30 Oct 2013

No.	Item	Brand/Maker	Model	Qty.	Activity	Allocation	Total Cost		Delivery	Remarks
JFY 2009										
1	Carbon Active Furnish	KOBIKA LIPI	custom made	1	CM	UNPAR	25,000,000	IDR	31-Mar-10	Local Costs
2	Microscope	PT. Multi Indosaintifik	Motic Microscope DM-143-FBGG-B9	1	CM	UNPAR	42,238,000	IDR	30-Mar-10	Local Costs
3	Microscope	PT. Multi Indosaintifik	Motic Microscope DM-B1-223ASC-B	1	CM	UNPAR	28,360,000	IDR	30-Mar-10	Local Costs
4	Small Computor	ASUS	Eee PC 1201T	1	CM	UNPAR	4,994,000	IDR	30-Mar-10	Local Costs
5	Software	Microsoft	Windows7	1	CM	UNPAR	1,250,000	IDR	30-Mar-10	Local Costs
6	Software	Microsoft	Office 2007	1	CM	UNPAR	3,313,000	IDR	30-Mar-10	Local Costs
7	Software	Norton	Antivirus	1	CM	UNPAR	500,000	IDR	30-Mar-10	Local Costs
JFY 2010										
1	Notebook PC	HP COMPAQ	Probook 4520s	3	FF	LAPAN(2), UNPAR(1)	4,125	USD	28-Mar-11	
2	Inkjet Printer	CANON	PIXUS MG8170	3	FF	LAPAN(2), UNPAR(1)	1,395	USD	28-Mar-11	
3	Desktop PC (Work station)	Dell	Alineware Aurora ALX Premium Package	1	FF"	LAPAN	4,075	USD	28-Mar-11	
4	Desktop PC (Work Station)	Dell	Alineware Aurora ALX Premium Package	2	FF	LAPAN(1), UNPAR(1)	7,360	USD	28-Mar-11	
5	External HD	LaCie	2big Network · 4TB	7	FF	LAPAN(6), UNPAR(1)	4,200	USD	28-Mar-11	
6	Server	HP	Proliant ML350 G6	1	FF	LAPAN	7,500	USD	28-Mar-11	
7	UPS	APC	Smart UPS SC 1500VA-SUA1500i	4	FF	LAPAN(3), UNPAR(1)	2,360	USD	28-Mar-11	
8	Network Installation			2	FF"	LAPAN(1), UNPAR(1)	980	USD	28-Mar-11	
9	Network Installation			1	FF	LAPAN	525	USD	28-Mar-11	
10	sensor network for meteorological observation			1	FF	*(total)*		USD		
11	Sensor Board	Crossbow	SN21140	20	FF	UNPAR	74,680,000	IDR	26-Mar-11	
12	Interface Board	Crossbow	BU2110	1	FF	UNPAR	3,458,000	IDR	26-Mar-11	
13	Gateways & Network Interface	Crossbow	MIB520	1	FF"	UNPAR	1,125,300	IDR	26-Mar-11	
14	Startgate NetBridge	Crossbow	NB100	1	FF	UNPAR	10,378,500	IDR	26-Mar-11	
15	Waterproof & Dustproof Case Body	TAKACHI	BCAS081108	20	FF	UNPAR	1,540,000	IDR	26-Mar-11	
16	Plastic Base for Waterproof & Dustproof Case	TAKACHI	BMP0811P	20	FF	UNPAR	208,000	IDR	26-Mar-11	
17	Vento Filter for Waterproof & Dustproof Case	TAKACHI	PMF-12S	20	FF	UNPAR	1,392,000	IDR	26-Mar-11	
18	External Sleeve Antenna	Crossbow	W1030		FF	UNPAR	10,375,200	IDR	26-Mar-11	
19	Freezer	Sanyo	SCR1497	1	CA	UNPAR	5,500,000	IDR	27-May-10	Local Costs
20	TOC analyzer	SHIMADZU	TOC-Vcph	1	CA	RCB-LIPI	42,750	USD	28-Mar-11	
21	Motorcycle	Kawasaki	KLX150S	2	CM	UNPAR	48,000,000	IDR	10-Dec-10	

22	Water purifier deionizer	DUBUQUE	D7031	1	CM	UNPAR	49,850,000	IDR	03-Mar-11	Local Costs
23	Accessories for water purifier	NALGENE	DSO 205-4045	1	CM	UNPAR	23,000,000	IDR	03-Mar-11	Local Costs
24	CO Gas Analyzer	Riken	EAGLE RI-557	1	CM	UNPAR	47,520,000	IDR	26-Mar-11	
25	CO2 Gas Analyzer	Riken	EAGLE RI-557	1	CM	UNPAR	47,520,000	IDR	26-Mar-11	
26	Projector	EPSON	EB-1915	1	CM	UNPAR	2,375	USD	28-Mar-11	
27	Portable Infrared HC analyzer	Riken	RI-415	1	CM	UNPAR	31,680,000	IDR	26-Mar-11	
28	HDTV Flat Panel (LCD)	SONY	KDL-55NX810 BRAVIA	1	CM	UNPAR	46,090,000	IDR	26-Mar-11	
29	Ion−Chromatograph	Metrohm	883 Basic IC Plus (1 for Anion, 1 for Cation determination)	1	CM	UNPAR	1,176,209,000	IDR	26-Mar-11	
30	Peat sampler	Geotek LIPI	custom made	1	CM	UNPAR	6,000,000	IDR	29-Mar-11	Local Costs
31	Automobile	Toyota	Kijang Innova G	1	Manage ment	UNPAR	251,000,000	IDR	10-Dec-10	
32	Photocopy machine	Kyocera	Color Multifunction Copier TA250Ci	1	Manage ment	BSN	45,000,000	IDR	03-Sep-10	
33	Digital SLR Camera	Canon	EOS 500D	1	Manage ment	BSN	8,450,000	IDR	30-Jul-10	Local Costs
34	Notebook PC	HP COMPAQ	Pavilion DV2-1206AV	1	Manage ment	UNPAR	7,000,000	IDR	24-Sep-10	Local Costs
35	Notebook PC	Toshiba	SATELLITE L635-1038X	2	Manage ment	BSN	19,680,000	IDR	20-Oct-10	Local Costs

JFY2011

1	Motorcycle Wagon	Jialing	JH200	1	CM	UNPAR	26,500,000	IDR	24-Aug-11	Local Costs
2	Plasma TV	LG	RS232C IN	1	PM	UNPAR	12,000,000	IDR	24-Jun-11	Local Costs

A.9 List of Input (Local Costs)

(Unit: Indonesia Rp)

(JFY)	2009	2010	2011	2012	2013(up to Q2)	Total
Total	298,400,000	1,567,400,000	2,162,105,000	2,663,542,000	1,395,015,600	8,086,462,600
Miscellaneous	224,000,000	972,700,000	1,171,420,000	1,382,710,000	499,562,000	4,250,392,000
Air Fare	25,200,000	239,600,000	261,600,000	317,000,000	272,109,400	1,115,509,400
Travel Allowance	23,200,000	154,000,000	241,685,000	280,932,000	254,944,200	954,761,200
Fees and honorarium (non-staff)	23,000,000	150,900,000	418,400,000	205,900,000	177,900,000	976,100,000
Contract with Local Based Consultant	0	0	0	0	0	0
Contract with Local Based NGO	0	0	0	0	0	0
Commission Contract (others)	0	0	0	360,000,000	0	360,000,000
Refreshments	3,000,000	50,200,000	69,000,000	117,000,000	190,500,000	429,700,000

A.10 List of Counterparts

Activities	Japanese Side	Indonesian Side						
		BSN	LAPAN	LIPI	FORDA	UNPAR	BPPT	Other Organizations
Output1: FF	HONMA Thoshihisa		Orbita Roswintiarti Agus Hidayat			Aswin Usup	Muhhamad Evri	
1-1. Improve fire hotspot algorithms	NAKAU Koji KAKU Kazuya TOKUNO Masami HONMA Toshihisa TANABE Seiji KIMURA Keiji NAGANO Yoshihito ONO Atsushi TAKIGUCHI Tutoshi		Bambang Trisakti Kustiyo Fajar Yulianto Budhi Kustiandi M. Priatna Rossi Hamzah			Cakrabirawa Santosa Yulianto	Muhhamad Evri	
1-2. Estimate carbon emission by biomass burning among different ecotypes.	TAKEUCHI Wataru KIMURA Keiji		Yenni Vetrita					
1-3. Establish a system to transfer in-situ fire information to each region.	NAKAU Koji HONMA Toshihisa HEONSHIK Shin		Orbita Roswintiarti			Aswin Usup	Muhhamad Evri	
1-4. Construct a prediction model of wild fire occurrence.	KIMURA Keiji NAKAU Koji HONMA Toshihisa		Orbita Roswintiarti				Muhhamad Evri	
1-5. Construct a model of water regime.	TAKEUCHI Wataru FUKUDA Masami KUSHIDA Keiji WATANABE Manabu		Parwati Sofan					
1-6. Make a map of land cover and land use change.	KIMURA Keiji HENDRIK SEGAH		Kustiyo Bambang Trisakti			Yusuf Aguswan		
1-7. Establish a spectral library (plant / soil) in investigation areas	TANI Hiroshi HENDRIK SEGAH		Ratih Dewanti					
Output2: CA	HIRANO Takashi			Joeni.S.R		Suwido.H. Limin		
2-1. Estimate carbon balance in various tropicalpeatland	Tower Observation HIRANO Takashi			Joeni.S.R		Suwido.H. Limin		

Activities	Japanese Side	Indonesian Side						
		BSN	LAPAN	LIPI	FORDA	UNPAR	BPPT	Other Organizations
ecosystems	Atmosphere Observation INOUE Gen KAWASAKI Masahiro					Aswin Usup		
2-2. Estimate amount of carbon in biomass and peat.	SWEDA Tatsuhiko TSUZUKI Hayato SHIMAMURA Tetsuya					Suwido.H. Limin		
2-3. Assess peat decomposition and organic carbon loss.	HATANO Ryusuke INUBUSHI Kazuyuki KURAMOCHI Kanta					Suwido H. Limin Untung Darung Kitso Kusin Fengky F.Adji		Supiandi Sabiham (Bogor Agricultural University) Abdul Hadi (Lambung Mangkurat University)
2-4. Assessment of carbon efflux through groundwater flow.	YAMADA Hiroyuki			Joeni.S.R		Suwido.H. Limin		
2-5. Develop carbon balance assessment model	HIRANO Takashi							
Output3: GM	TAKAHASHI Hidenori					Suwido.H. Limin		
3-1. Examine the outflow of groundwater from peat layer 3-2. Based on the above 3.1 and after the verification, propose a method to restore the hydrological conditions	***Watershed management*** Yoshiyuki Ishii Sawahiko shimada Masayuki Takada Hideaki Nagare Koji Fukami Koichi Yamamoto Ken Koizumi Yukihisa Shigenaga Tadaoki Itakura Makoto Nakatsugawa Yasuharu Watanabe Hikaru Sugimoto Mitsuhiko Kamiya Takashi Inoue Misao Okada Noriyoshi Ochi					Suwido.H. Limin Adij Jaya Aswin Usup Untung Darung Kitso Kusin		

Activities	Japanese Side	Indonesian Side						
		BSN	LAPAN	LIPI	FORDA	UNPAR	BPPT	Other Organizations
	Hirochika Hayashi Yukio Komai Kazuo Taki							
3-3. Develop plan for peat fire control 3-4. Develop manual for peat fire control	***Fire management*** Hiroshi Hayasaka Izumi Noguchi Nobumasa Sekisita					Aswin Usup Adij Jaya Nina Yulianti		Alpon Sepriando (BNKG)
3-5. Quantify the carbon stock amount of above-ground vegetation 3-6. Measure parameters on vegetation growth 3-7. Explicate the process of vegetative restoration after disturbance	***Terrestrial ecology*** Takashi Kohyama Akira Haraguchi Tatsuyuki Seino Kazuo Yabe Satomi Shiodera			Joeni.S.R				
3-8. Examine the characteristics of soil organic matter and its impact on the environment 3-9. Examine the relations between water level and water qualities 3-10. Examine the discharge and decomposition process of organic matter in soil 3-11. Examine the changes of aquatic community caused by fire	***Aqua-sphere ecology*** Shunichu Tanaka Masaaki Kurasaki Hideaki Kuramitsu Toshiyuki Hosokawa Takeshi Saito					Sulmin Gumiri Ardianor Imar Rosana Elvince		
3-12. Develop technologies to restore forest	***Reforestation*** Takeshi Tange Hideyuki Saito Yutaka Tamai Seiichi Tokura Hiroshi Maruyama Masato Ogawa Yasumitsu Uraki Masao Koizumi Kei Sawada Takuro Hirai Masato Shibuya				Maman Turjaman	Penyang Prawira Yuda		Gaman Sampang (Junior High School, Palangka Raya)
Output4: PM	OSAKI Mitsuru							
4-1. Establish a proto-type for database system to	OSAKI Mitsuru HIROSE Kazuyo							

Activities	Japanese Side	Indonesian Side						
		BSN	LAPAN	LIPI	FORDA	UNPAR	BPPT	Other Organizations
integrate the research/survey results.	Hendrik Segah Yan Gao							
4-2. Operate the database management of the research/survey results	OSAKI Mitsuru HIROSE Kazuyo							
4-3. Support the institutional arrangement of carbon management	OSAKI Mitsuru HIROSE Kazuyo KOBAYASHI Noriyuki KOBAYASHI Hiroshi					Aswin Usup Ici Piter Kulu		
4-4. Establish a carbon balance model	OSAKI Mitsuru HIROSE Kazuyo TAKAHASHI Yukihiro FUKUHARA Tetsuya Hendrik Segah Yan Gao					Hyper DOC mapping: Sulmin Gumiri, Linda Wulandari		DGPS: Hasanuddin Z. Abidin (ITB)
4-5. Assess the effect of carbon control based on carbon management system	OSAKI Mitsuru HIROSE Kazuyo SEKINE Hozuma							
4-6. Introduce an economic analysis model	TACHIBANA Towa TAKEUCHI Kenji OHMURA Makiko							Starling Resources
4-7. Propose methodology on deforestation for International Standardization	OSAKI Mitsuru HIROSE Kazuyo KOBAYASHI Hiroshi	BSN						
4-8. Organize workshop/symposium/seminar towards establishing international network and information/knowledge dissemination to the public	OSAKI Mitsuru HIROSE Kazuyo MOMOTA Eriko KOBAYASHI Hiroshi					Aswin Usup Ici Piter Kulu		Farhan Helmy, Doddy Sukadri (DNPI)
4-9. Recommend project proposals to government authorities	OSAKI Mitsuru HIROSE Kazuyo HONMA Toshihisa HIRANO Takashi TAKAHASHI Hidenori KOBAYASHI Hiroshi	BSN	LAPAN	LIPI	FORDA	UNPAR	BPPT	

Annex 11 Progress of Project Activities

Activities 活動項目	Outputs as of Oct. 2013 2013年10月時点までの成果	Achievement Rate 進捗度(%)	Activity plan to termination 活動完結に向けての今後の主な取組み事項
Project Purpose: Peat-forest management method to reduce carbon emission is developed. Indicators: 1) Carbon management method which can contribute to carbon reduction of 1/3 to 1/5 amount compared to current level in peatland is proposed. 2) Peat-forest management method is utilized in policy decision in developing international rules and bilateral off-set mechanism. 3) Results of researches are published (Number and quality of research papers is good enough)	1) Through this project, CO2 emission from peatland and ground water level in the target area (70km2) were identified for three land condition (undrained forest, drained forest and burnt forest) and It was revealed that suitable water level control together with 1) fire control, 2) peatland restoration, and 3) reforestation will contribute to the reduction of carbon emission (ref: Output 3). By combining these approach considering the the ground condition, landuse and the location (fire prone area: near roads, canals and farmlands), ground water control, forest restoration, natural succession will be applied. 2) [International Level] Through the achievement of the project, the project result is presented and reflected in IPCC, SABSTA38, ISO and so on. [Bilateral Level] There have been several feasibility studies utilizing the project achievement for Joint Crediting Mechanism (JCM) between Japan and Indonesia. [National Level] It is expected that Indonesian National Standard on deforestation is assumed to be discussed and drafted. [Provincial Level] The regional commissions for REDD+ appreciated the input from the project and evaluated that . Further 3) 56 original articles (6 in Japanese journals, 50 in international journals), 29 books or proceedings (9 in Japanese publication, 20 in international publication), and 48 invited speech and 186 conference presentation and many other outputs were produced through the project.	85%	
Output 1: Fire Detection and Fire Prediction System are established. 成果1：火災検知および火災予測システムが構築される Indicators 1) In the event of a fire with more than 1 km2 coverage, 3 target communities can obtain fire information within 16 hours, and moreover they can obtain information on fire spread prediction within 8hours.	Fire detection and fire prediction system was established and tried. 1) In the event of a fire with more than 1 km2 coverage, 4 target communities (Tarunajaya, Tumbang Nusa, Pilang and Djabiren) can obtain fire information at an average of 13-16 hours (Average satellite detection time is 6-8 hours because of twice detection a day, hotspot data analysis time is 4 hours, fire information data production time is 1 hour and SMS data transmission time is 2-3 hours). Fire spread prediction time for 2km area from the target villages is about 4	80%	・Estimate traffic congestion time of SMS of real traffic in Indonesia. ・Estimate the omission error and the commission error in peat-forest fire detection by satellite. ・Examine the movement

2) Fire detection accuracy can reach the level of more than 80%. 3) Rate between predicted fire spread coverage and real fire coverage can reach the level of more than 50%.	hours applying simplified fire-extension model in accordance with the needs of villages. This current radius (2km) of fire alert target area is adjustable in accordance with demand. 2) All record of 10 hotspot data (July 2009) and 2 current firing hotspot data (September 2012) detected by the improved algorithm were confirmed to be burnt or burning area by UAV photographs (100%). Considering both omission and commission errors, hotspot detection accuracy is assumed to be able to achieve 80% level though further monitoring is required for statistic accuracy. 3) By using the simplified fire-extension model, 1km square hotspot is approximated by either an inscribed circle with the radius 1/2 km or a circumscribed circle with the radius $\sqrt{2}/2$ km. Considering the interval of satellite image acquisition, predicted fire spread coverage error becomes within 50% if the velocity of hotspot center is less than 2m/min (if it is faster than that, it is detected as different fire, not the extension of the same fire by this algorithm).		velocity function of hotspot center which is determined wind velocity, soil moisture and vegetation.
1-1. Improve fire hotspot algorithms 火災ホットスポット検出アルゴリズムを改良する。	1)MODIS (1 km2 mesh) fire hot spot detection system was transferred to the server purchased and set up in LAPAN. Data has been accumulated every day since 20 May 2011. 2) MTSAT hot spot detection system was installed in the server in LAPAN. The comparison of data between MODIS and MTSAT was conducted and from viewpoint of data resolution, MODIS data were selected to detect hotspots by the satellite. 3) To verify the hot spot data obtained by satellites, aerial photography was taken by the electrically-powered unmanned aerial vehicle (UAV) equipped with optical camera and infrared camera. During the project, two UAV design were developed and tried. The improved UAV which can fly about 1 hour took the forest fire detected by the satellite for the first time in September 6, 2012. 4) Improve the precision of algorism proposed by the project by comparing it with other, 5 existing algorisms. 5) To verify the hot spot data obtained by satellites, aerial photography was taken by the electrically-powered unmanned aerial vehicle (UAV) equipped with optical camera and infrared camera. 6) Article on the UAV test flight for data verification on the peatland and forest was carried by a local newspaper (Kalteng Pos) 7) In order to validate the satellite detection accuracy of hotspots data, the hotspots map detected in July, 2009 was utilized because there were no fires occurred in study site during dry seasons in 2010-2011. All 10 hotspots in the 2009 map were confirmed to be burnt area by	90%	・Organize workshop to cultivate a better understanding of the proposed algorism, and develop a manual to operate and utilize the system.

	UAV aerial photography in 2011 and 2012. In addition, two hotspots detected by satellite in 3rd September, 2012 were also confirmed to be real on-going fires by UAV aerial photography taken in 6th September, 2012. In a word, the improved hotspot detection algorithm could find the fire at 100% accuracy though the sample cases are limited. In addition, by UAV observation, it was confirmed that 15~20 % areas were burning inside the hotspots (1 km x 1 km). 8) As above, it is concluded that hotspots are detected by the algorithm with the very high precision.		
1-2. Estimate carbon emission by biomass burning among different ecotypes 異なる生態系の中で燃焼するバイオマスの炭素排出量を推定する。	1) The amount of carbon emission from biomass-burning was estimated based on the satellite data with a mode established by FRP method and NDVI method, and the results was compared with those from NASA's existing database (GFED) 2) The amount of carbon emission originated from biomass in Kalimantan, from 2002 to 2010, was estimated. FRP: 2.5~24.2 TgC/yr NDVI: 0.05~1.2 TgC/yr GFED: 1.3~241.3 TgC/yr 3) Compare the satellite data of the vegetation change and degradation of land use due to peat-forest fires with the aerial photography by UAV.	80%	・Estimate the amount of carbon emission from biomass by the observation on the ground of vegetation change due to forest fire, and the result is to be compared with that from this model. ・Examine the validity and limitation of this proposed model, and discuss the points of improvement.
1-3. Transfer in-situ fire information to each region 現場の火災情報の伝達手法を構築する。	1) The software for the short message system (SMS) was selected and four pilot villages (Tarunajaya, Tumbang Nusa, Pilang and Djabiren) were selected for the installation of fire communication system. 2) Procure the SMS system including both hardware and software in Indonesia and installed in Pekayon office, LAPAN. The fire information transmission system based on SMS was established, and introduced to the pilot villages. 3) The system that integrates forest fire information (data of fire detection, latitude and longitude, distance from village center, fire dangerous index and the direction of spread of fire) was developed. 4) Taking aerial photography by UAV was conducted above Tarunajaya and Tumbang Nusa, and the possibility of translating the geographical information including its latitude and longitude into the local language was considered, for example, the distance and the direction to occurred hotspots inside the distance 2 km from the center of villages, the fire dangerous index determined by the soil moisture, and types of peat fires are considered to be useful information. 5) The recipients of the fire communication system (SMS) are set to be village heads and leaders of fire fighting teams 6) The first trial to send SMS was successfully conducted in September 26 2013 and peat-forest fire information were delivered to	90%	・Discuss and coordinate about fire communication with local government authorities for its realization.

	stakeholders for using the information for suppression of real ground surface fires.		
1-4. Construct prediction model of wild fire occurrence 森林・泥炭火災発生予測モデルを構築する。	1) A climate prediction model, MM5, was installed in the server in Hokkaido University, and data inputs as well as parameter setting which reflect the weather condition in Indonesia was examined, and a wind atlas was developed with 5km resolution. 2) A simulation model on forest fire spread, taking into consideration the vegetation data, was developed and its validity was examined. 3) Experiments of temperature increase by artificial fire were conducted, in which the temperature was measured by wireless sensor network (WSN) at 500m away in distance and the applicability of WSN to fire prediction was confirmed. 4) The new technical specification of the 500 wireless sensors that cover the area of 10km×10km was elaborated. 5) The time sequence of 1km2 hotspot data was examined and the fire occurrence process in time was clarified. 6) The simplified fire-extension model was developed based on time-series hotspot data and the fire extension area was estimated as the movement distance of the hotspot center.	70%	・Examine and establish the velocity of the movement of hotspot center determined by wind velocity and soil moisture, and verify the precision of the simplified fire-extension model through the time-series hotspot data analysis and on-site inspection. ・Examine the spatial arrangement of WSN that can detect the fire in the large area (10km×10km), and implement the arrangement. ・Prepare the manual for the operation and utilization of the simulation system, and conduct workshops to cultivate the understanding of the system.
1-5. Construct model of water regime 水変動モデル・土壌水分量評価モデルを構築する。	1) A model was established to estimate the spatial distribution of soil moisture based on satellite data, and the validity of the model was verified by comparing the measurement data of ground water level with the model. 2) By integrating the data from fixed point observation into the satellite data, the spatial distribution of soil moisture was presented with high precision for the first time in the world. 3) The validity of the established water fluctuation/soil moisture estimation model was examined though the accumulation of data and fixed point measurement. 4) The developed system was transferred to the server in LAPAN and has accumulated the data from 2006 to the present. 5) The level of the peat fire index (PFI) was defined by the correlation of the ground water level with the number of fire occurrence and the fire dangerous index based on PFI was developed.	90%	・if necessary, workshops to cultivate a better understanding of the model, develop a manual to operate and utilize the system.
1-6. Make map of land cover/land use change 土地被覆図・土地利用変化図を作成する。	1) To understand the degradation of the forest from 2005 to 2010, maps of land cover and land use change were developed based on the LANDSAT satellite data.	90%	・ Review the possibility of making accumulated data open for researchers.

	2) The time-series data of Normalized Difference Vegetation Index (NDVI) on typical areas was accumulated with the interval of 16 days, and the time of forest degradation by peatland/forest fire or plantation as well as the cause of forest degradation was examined. 3) Based on the time-series data from revised NDVI (EVI), the change over the years of forest conservation, forest degradation and the reforestation was examined with precision. 4) Data on land cover and land use change (change in month and in year) of the target area have been accumulated in the server that was purchased by the project and set up in LAPAN. 5) The aerial photography by UAV was conducted to confirm and understand the current situation of land cover/use change.		
1-7. Establish spectral library (plant / soil) in investigation area 調査地域において植物と土壌水分のスペクトラルライブラリーを構築する。	1) 51 kinds of plants and soil and water spectrum were measured at around 70 observation points independent of its environment. The range of observation wavelength: 350～2500mm, the interval of data measurement: 0.1 second/spectrum. 2) As to satellite data analysis, data with high precision has become available, and it has become possible to investigate the precision of estimating carbon emission from biomass due to peatland/forest fire. Some data analysis utilizing spectrum data have been initiated. 3) Spectral library (plant/soil) in investigation area was developed, and started to be used them as text data for supervised satellite data classification.	90%	Enter the location information of accumulated data to date to GIS; examine and establish a system that can indicate the information on vegetation and soil moisture on a map. By the end of the project, 75 plant species will be analyzed and recorded in the spectral library.
1-8. Validate established system 構築したシステムの評価を行う。	1) The several fire processes such as satellite hotspot detection, hotspot data analysis, fire information production and delivery, and UAV verification is integrated. 2) The practical operation of fire detection and prediction based on the integrated systems and SMS is carried out. 3) The usefulness of the information system for suppression of real fires by fire fighters is confirmed. After suppression of fires, leaders of fire fighting teams reported to participants at meeting about the suppression activities based on fire information delivered through SMS, in which suppression starting and ending time, the type of fire, the fire burned area size and personal impression etc. are reported. In addition, leader of UAV monitoring team explained the UAV flight performance and current moving images of real fires taken by UAV. Stakeholders satisfied the reports from leaders and Q&A, and were interviewed by the local TV station TVRP. 4) The fire historical data and the land covered/use change data were	90%	Estimate the CO2 emission due to fires based on the time-series hotspot data.

	stored as database in LAPAN server to evaluate the CO2 emission due to fires.		
Outputs2: Carbon Assessment System is established 成果２：炭素量評価システムが構築される。 Indicator Carbon balance assessment model within the error of less than 20% for central Kalimantan province is developed.	Data collection from field observation is sufficiently completed and the continuous monitoring has been conducted. Tropical peat ecosystems, including a relatively intact peat swamp forest with little drainage (UF), a drained swamp forest (DF) and a drained burnt swamp forest (DB), functioned as net carbon sources. Mean annual NEE (± a standard deviation) for four years from July 2004 to July 2008 was 174±203, 328±204 and 499±72 gC m^{-2} y^{-1}, respectively, for the UF, DF and DB sites. The carbon emissions increased according to disturbance degrees. It was found that the carbon balance of each ecosystem was chiefly controlled by groundwater level (GWL). The net ecosystem CO_2 exchange (NEE) showed a linear relationship with GWL on an annual basis. The relationships suggest that annual CO_2 emissions increase by 79–238 gC m^{-2} every 0.1 m of GWL lowering probably because of the enhancement of oxidative peat decomposition. As for ecosystem modeling, a research group, lead by National Institute for Environmental Studies (NIES), is developing a process-based model, which simulates carbon cycles in tropical peat ecosystems in detail, using observation data of CO_2 flux and environmental variables related to meteorology and hydrology for parameterization and verification. In any case, because we have no reference at present, it is quite difficult to evaluate uncertainties in model estimates on a large scale, such as whole Central Kalimantan. Thus, it is planned to assess uncertainties by comparing estimates from three different approaches: 1) aerial laser survey, 2) empirical equations between net CO_2 balance and groundwater level and 3) the terrestrial ecosystem model. The annual CO_2 balance using the empirical equations was estimated within 20% (12~18%) difference from observations on a small scale. After the ecosystem model is completed by March 2014, difference will be quantitatively estimated using several method developed in the above mentioned researches namely 1) aerial laser survey and 2) empirical equations between net CO_2 balance and groundwater level. By the end of the project period, the ecosystem model is expected to achieve the output 2.	90%	1) Model development 2) Data analysis for verification
2-1. Estimate carbon balance	1) Significant relationships were shown between CO2 balance and groundwater level by 10-year monitoring of CO2 flux. The	100%	Completed.

in various tropical peatland ecosystems タワー観測、大気観測を通じた広域スケールの炭素収支評価を行う。		relationships can be used to assess regional CO2 balance in combination with the model developed for groundwater estimation using satellite data. 2) Based on the monitoring data in three tropical peat forests with different levels of disturbance (undrained, drained, drained & fire), the following was disclosed 1 the amount of carbon emission from tropical peat ecosystem is, drained & fire > drained > undrained. 2 Carbon emission increases in a dry year which is affected by El Nino. 3 Undrained forest, which is not affected by large-scale canals, is still a source of carbon emission. 4 At the sites of forest fire, the amount of carbon emission decreases along with the restoration of vegetation.		
	Atmospheric observation	1) Atmospheric CO_2 concentration profiles were successfully measured using ground-based optical sensors, FES-C "Nafas Bumi", both at upstream and downstream sites of peat fires in Central Kalimantan. Using the field data and an airstream model, CO_2 emissions from the fires can be estimated. 2) In addition, a practical method to assess CO_2 emissions through oxidative peat decomposition was developed using only atmospheric CO_2 concentration (the carbon emission caused by peat fire, based on the actual measurement conduced in 2011.	80%	Verification of the method by inter-comparison with other methods
2-2. Estimate amount of carbon in biomass and peat 航空機レーザー計測によるバイオマス炭素量の評価を行う。		CO_2 uptake by biomass growth (1.62 tC ha^{-1} y^{-1}) and CO_2 release by peat degradation (fires and oxidative decomposition) (10.3-42.2 gC ha^{-1} y^{-1}) were assessed separately using two data sets of aerial laser survey in 2007 and 2011.	90%	Reduction in uncertainties to accurately estimate CO_2 emissions from peat subsidence
2-3. Assess peat decomposition and organic carbon loss 泥炭土壌からの温室効果気体の放出量の評価を行う。		1) Using field data, the relationship of soil emissions of greenhouse gases (CO_2, CH_4 and N_2O) with chemical and physical properties of peat soil was obtained. Followings are major findings: - A positive correlation was acknowledged between the C/N ratio of micro-organisms and carbon emission. - It was acknowledged that the increase of precipitation promotes CO_2 and N_2O emission. - It was acknowledged that the decrease of soil organic matter promotes the N_2O emission. 2) In addition, the greenhouse gas emissions through peat fires were experimentally quantified, and the method to estimate total carbon emissions from peat fires using only CO_2 emission data was developed.	90%	Further analysis of field data to improve the method

2-4. alidate ecosystem carbon balance using different approaches 地下水流動にともなう溶存有機炭素流動の評価を行う	The DOC (dissolved organic carbon) flux was compared between a relatively intact peat swamp forest (UF), a drained peat swamp forest (DF) and a drained burnt swamp forest (DB). Groundwater DOC concentration, groundwater level, precipitation and evapotranspiration were observed in each site from January 2011 to December 2012. The DOC flux was calculated by multiplying the DOC concentration by groundwater loss estimated by a tank model in each site. The groundwater depth was significantly lower in DF than in other sites. The seasonal variation of the DOC concentration was small at each site. The concentration in UF, DF and DB ranged from 29.3 to 57.5, from 59.3 to 83.1, and from 21.1 to 38.5 mg L-1, respectively, and that of DF was significantly higher than other sites. The rank of the concentration coincided with the rank of groundwater level, suggesting that the DOC production was increased with increasing groundwater level. The lowest DOC concentration was observed in the DB, where the last fire occurred in 2009. The tank model successfully simulated groundwater level at each site. Mean annual groundwater loss for two years in UF, DF and DB was 497, 1046 and 736 mm m^{-2} y^{-1}, respectively. Then, the mean annual DOC flux for two years in UF, DF and DB was 20.1, 76.3 and 23.5 g C m^{-2} y^{-1}, respectively. Although the fluxes in DB and UF were similar level, the flux in DF was significantly greater than in other sites. This was because both conditions of higher DOC concentration and of higher groundwater loss were satisfied. We therefore concluded that the DOC leaching was promoted by drainage and that the leaching was lowered by fire because of low DOC concentration.	100%	Completed.
2-5. Develop carbon balance assessment model 炭素バランスの評価モデルを開発する	A new sub-model of a terrestrial ecosystem model (VISIT) is going to be developed by March 2014 using observation data collected by the project for parameterization. The sub-model illustrates carbon cycles in tropical peatland ecosystems. By incorporating the sub-model into VISIT, peatland carbon cycles in future can be simulated under climate change and human disturbances. The model performance will be evaluated in comparison with field observations by the end of the project period.	70%	Completion of the sub-model and simulation of carbon balance of tropical peatland ecosystems
Output3: Carbon Management System is established. 成果 3：炭素管理システムが構築される。 Indicators	1) In 70km2 target area, MODFLOW simulation model was developed and distributions of groundwater level before canal construction and after the dam construction are clearly shown. The suitable water level was compiled	80%	Appling the real time measurement and data transfer system, SESAME, to the water

1) In 70km2 target area, model of suitable water level is developed. 2) Vegetation restoration plan is developed based on model of suitable water level. 3) Amount and quality of groundwater becomes clear, and then firefighting strategy including infrastructure plan is developed.	to be shown in the distribution map (50m mesh) 2) It was revealed that suitable water level control together with 1) fire control, 2) peatland restoration, and 3) reforestation will contribute to the reduction of carbon emission as follows. i) Suitable water level control without fire control: reduced to be 76% Suitable water level control with fire contol: reduced to be 38% ii) NEE: by restoring peatland from drained burnt swamp forest (DB) to intact peat swamp forest with little drainage (UF), Case A (GWL:from -0.2m to -0.1m: reduced to be 16% Case B: GWL -0.1m: reduced to be 19% Case C: GWL: -0.2m: reduced to be 60% iii) Reforestation *Shorea balangeran* planataion in DB, GWL -0.1m will contribute to reduction to be 89% (in 5 years) In addition, current plant community and vegetation in different water level in peatland were investigated and data for 31 major species are collected. For the three vegetation types (mix-dipterocarpus forest, heath forest, and peatland forest), natural restoration and succession model is under development for comparison. From the findings as above, it is considered that the forest restoration by *Shorea balangeran* can be prioritized in the fire prone area near roads, canals and farmlands, while natural succession can be applied more in remote area where daily management is difficult and is not fire prone. 3) The amount of groundwater underneath of the peat layer was measured with pumping up test. The amount of groundwater is enough to use firefighting. On the other hand, it was proved that groundwater is not suitable for drinking without improved treatment system due to high humic acid content in groundwater in the peatland. The compact firefighting system was proposed and under trial in the target local firefighting teams. Supply route of used fire hoses from Japanese companies was initiated. The system will be proposed to BNPB (National Agency Disaster Management).		management system in a watershed. Appling the real time measurement and data transfer system, SESAME, to peat fire management To propose the compact firefighting system to BNPB (National Agency Disaster Management).
3-1. 3-1. Examine the outflow of groundwater from peat layer 泥炭層中の地下水の流出現況を把握する。	1) By utilizing MODFLOW simulation model, the outflow of groundwater from peat layer was made clear. In order to elaborate the model, following data was collected.	100%	Completed.

	- Monitoring of groundwater level at 51 points (6: confined ground water, 32: surface ground water, and 13: canal surface water) - Monitoring of river water of Kahayan River and Sebangau River at 18 points at 1 hour interval (11: river water level and 7: rainfall) - Survey of ground/water level at all monitoring points by static GPS within the error of +/- 5mm. Following activities were conducted to supplement the information needed for improving the model. 2) New findings were obtained about the correlation between groundwater level of peat, groundwater level of basement soil, water level of Taruna Canal and water level of Kahayan and Sebangau river. 3) Pumping test: Pumping tests of groundwater level of peat bed revealed that there is a layer with a high permeability in the basement soil. 4) Soil moisture: the relation between the movement of soil moisture in the surface layer with different vegetation cover, hydric environment, and peat/forest fire was made clear 5) The relation between the dissolved carbon density in peat layer and the electrical conductivity was made clear. 6) It was made clear that the Peat Fire Index calculated from precipitation was proved useful in estimating the danger and damage of peat forest. 7) The water level was predicted with Nearest-Neighbor method by analyzing the long term records of river water level of River Kahayan. 8) The automatic water-gauge and rain gauge that were set to record every 1 hour, in addition to the water level of Kahayan, Rungan and Sebangau river as well as rainfall over the past 30 years. 9) The telemetric data logger system, SESAME-II was developed and applied to measure water level of Kahayan and Sebangau rivers, and groundwater levels in peatland. 10) The physical property of peat layer such as permeability was made clear by observing the surface shape around the canal.		
3-2. Based on the above 3.1 and after the verification, propose a method to restore the hydrological conditions 上記 3-1.の活動結果を踏まえ、モデル検証を行い水文環境修復手法を提案する。	Structure of weir in canal was designed using many data of physical, hydrological properties of peat and basic material. Based on the developed MODFLOW model, the plan for efficient canal blocking was simulated for the target area. It was estimated that the construction of seven weirs in the canal would contribute to the rise of ground water level from -2 m to -1 m near the canal. The groundwater rise	100%	Completed.

	by weir construction is simulated to be extended up to 600 m far from the canal.		
3-3. Develop plan for peat fire control 泥炭火災特性を把握する。	Seasonal and regional pattern of peat/forest fire occurrence were made clear using MODIS and rainfall data in Indonesia. 1) The preparation to understand the movement of pollutant accompanying peat fire was completed. 2) The fireproof belt by ditch was proved useful in the real fire case of 2009 3) Compact fire fighting system was introduced and its capacity was verified. 4) The water supply capacity of fire-fighting pond and of the underground water layer was verified, and they were proved very useful for first-aid fire fighting around roads, and fire fighting activity in peadland.	100%	Completed.
3-4. Develop manual for peat fire control 泥炭火災の制御方法を提案する。	Compact firefighting system composed of a portable pump (5.5Hp, suction 8m, following volume 500 L/min, weight 26 kg) used for watering and digging), a water tank (750L), hoses, and a specially designed vehicle (motor bike with attachment of cart to carry all of the equipment) for peat fire was proposed. Supply route of used hoses from Sapporo City to Palangkaraya was established. As pilot activities, 6 sets of the system were provided for (UNPAR, Taruna, Tumbang, Nusa, Henda, Pilang and Team Imanuel Palangka Raya)	90%	Manual for capacity development and institutionalization of local people for fighting fire is
3-5. Quantify the carbon stock amount of above-ground vegetation 植生地上部の炭素貯留量を定量化する。	1) 3 permanent observation areas (Bawan (2), Sebangau (11), Hampangen (3), in total 16 plots) were set up and vegetation monitoring was initiated including the every tree measurement. The composition of species of tree and mass/carbon amount were measured and applied to estimate the future aspect of forest. In addition, 394 species of flora were identified in the area. 2) The carbon stock amount and above-ground biomass amount was quantified in the tropical heath forest (Bawan) and peatforest (Bawan, Sebangau and Hampangen). 3) The allometry of tree species in heath forest and peat forest was examined and its difference was made clear.	100%	Completed.
3-6. Measure parameters on vegetation growth 植物生育パラメーターの計測を行う。	The seasonal change or leafing stage, defoliation stage and mass amount of the forest was made clarified using litter trap.	90%	Utilizing the collected data, further analysis is required.

3-7. Explicate the process of vegetative restoration after disturbance 攪乱後の植生回復過程を解明する。	It was clarified that the vegetation types of grassland after the disturbance by fire are determined by groundwater level and soil type. Rooting process of tree seedlings after forest/peat fire was studied.	90%	Succession from grassland to tree vegetation shall be identified through further monitoring. It will be the target of the next stage.
3-8. Examine the characteristics of soil organic matter and itsimpact on the environment 土壌有機物の特性とその環境影響を把握する。	Residuals of peat heated above 300 °C was confirmed to have genotoxicity. And some polysaccharides were found as causative agent of genotoxicity. The dissolved organic matter in canal water was condensed and refined, and it was found that the most part of dissolved organic matter was humic acid and fulvic acid from corrosion. The characteristics of ecotoxicity and biotoxicity of humic acid in the river and canal water were identified, while both toxicities of fulvic acid were not observed. The toxicity mechanism was clarified that humic acid induced upregulation of eNOS using human umbilical vein endothelial cell system. Furthermore this is the first study to report that humic acid induces upregulation of heat shock protein (Hsp)90a, Hsp90b, eNOS phosphorylation at Ser1177, and eNOS phosphorylation at Thr495.	100%	Completed.
3-9. Examine the relations between water level and water qualities 水位と水質の関係を把握する。	The water quality of canal was examined, and a survey to detect its fluctuation in time and space was conducted. The characteristics of physicochemical property in fresh water of peatland in dry season, and its relation with plankton were surveyed. About the general quality of river water and the general pollution of heavy metal, those of developed countries and developing countries were compared. Polymeric fatty acid was found in deeper layer peat. But the effect of Polymeric fatty acid on water quality is not clear.	80%	Further monitoring and data collection, and analysis are required to examine the relationship between the water level and water quality.
3-10.Examine the discharge and decomposition process of organic matter in soil 土壌有機物の溶出と分解プロセスを解明する。	The impact of fire on the movement of organic matter in peat was studied and it was found that organic matter in peat is changed into water solved materials with heating by fire and flows out by rain after the fire. The amount of DOC flown after firing is 4 times as much as that before firing.	100%	Completed.
3-11.Examine the changes of aquatic community caused by fire 火災由来の水圏環境の変化を把握する。	As above in 3-11, it was suggested that the amount of water solve material increases after fire (4 times of DOC concentration flown out from peat soil).	100%	Completed.
3-12.Develop technologies to restore forest 森林修復のための技術を開発する。	1) The most suitable indigenous tree species for reforestation in the burned and wasted peatland in Central Kalimantan, *Shorea balangeran*,	95%	The manual for plantation of *S. balangeran* will be prepared.

	was selected from many tree species and tested in various environmental conditions. It was found that *Shorea balangeran* is a promising tree species in terms of reforestation for the environment and reforestation for the industry from following reasons. ・The seeds can be collected every year. ・The storage of seeds and its germination are easy to handle (It can be stored for about two months in flowing water of 15℃ ・The rate of producing seedlings from germination is high (about 100%) (About 50% of shading is required for about a month during rooting.) ・Inoculating of *Scleroderma columnare* and *Azospirillum sp.* JW13 has positive effect on the growth of *S. balangeran* (1.4 times better in 7 months) ・It was indicated that *S. balangeran* has pest resistance. ・The rooting rate after planting is high (about 90%) (Planting of the species is non-territorial and the preparation of the land is not necessary) ・Resistance to environmental stress (strong light, submersion, drying) is high and its growth is fast. (it grows to 4.7m of height in average and 8.8m of height at maximum in 9 years) ・Its effects as a sink of carbon dioxide is as follows. (the amount of above-ground = 2.14 MgDW ha^{-1}, the amount of net primary production of above-ground = 4.4 MgDW ha^{-1}) ・It was proved that 8-year planted *S. balangeran* could survive the wildfire at the survival rate of 66% (24% survived and 32% regenerated from coppice) ・Low preference of goat (survival rate: 97%) of *S. balangeran* compared with other species (*Dyera lowii* 63% and *Alstonia scholaris* 77%) was . ・Even at its juvenile stage (ex. 6-10 years old), it has good characteristics as timber. 2) Leaflet for forest restoration focusing on plantation technology of *S. balangeran* was prepared and distributed to public. 3) Various findings were collected though experiments, such as on planting of fruit tree and rubber tree following "Satoyama" Initiative, pasturage of goat and its affinity with planting. 4) Trial on the production of activated charcoal and wood vinegar was conducted successfully. These could be used for water purification, soil		

	improvement media, and media for cultivating mushrooms.		
Output4: Integrated Peat Management System is developed. 成果４：統合的な炭素管理を行うための基盤が整備される。 1) Research data and information is utilized. 2) Rate of errors for established carbon balance model is less than 20%. 3) Carbon management system design which can contribute to reduction of 1/3 to 1/5 of total carbon emission is developed. 4) Integrated Peat Management System is introduced in policy formulation and institutional arrangement process (ex. IPCC, ISO, REDD+ activity).	1) 56 original articles are published including "Effects of disturbances on the carbon balance of tropical peat swamp forests" published in Global Change Biology (Impact Factor is high, 6.91 in 2012) and others. Also, outputs were presented in many international and local (both in Indonesia and in Japan) conference and seminars. Some published original articles have already acknowledged the project. The Web GIS was installed to the server in Hokkaido University and the prototype database was established, into which various data has been integrated such as satellite images and thematic maps produced and obtained in the Project. 2) The rate of errors less than 20% will be achieved by completing the output 2 by the end of the project. In addition, various measures such as hyperspectoral remote sensing and subsidence monitoring are considered and compared in order to propose the integrated MRV system fulfilling both the easiness and cost efficiency. 3) Carbon management method which can contribute to the reduction of total carbon emission into 1/3 to 1/5 is going to be developed by the end of the Project mainly based on the results from output 3 Followings Carbon loss by fire was estimated by using the relationship between carbon loss and lowest groundwater level in the MRP area. Carbon loss by fire in the area from canal to 1 km far from canal will be decreased to 76 % with seven weirs construction in the canal. Firefighting activity near the canal is very important. If the firefighting extinguishes 50% of fire events, carbon loss will be decreased to 38%. Carbon loss by NEE(Net Ecosystem Exchange) is estimated by using annual mean groundwater level. Rising of groundwater level from -2 m to -1 m brings decreasing of carbon loss to 20% and less than it. 4) BSN initiated the discussion on the international standard for deforestation in ISO/TC (technical committee) 207 – Environmental Management in Cairo, Egypt in June, 2009. After this, Indonesian Government continued approaching the international society to establish standard for deforestation. The effort on the national standard for Indonesia was initiated. Seminars and international workshops were organized to form an international researchers' network, and series of roundtable on MRV were held jointly with DNPI.	85%	Database transfer plan will be prepared. Packaging and moderating the achievements from all outputs will be elaborated.

4-1. Establish a proto-type for database system to integrate the research/survey results 研究・調査結果を統合するプロトタイプデータベースを構築する。	Proto-type database (Web GIS) was developed and installed at Hokkaido University. Thematic data and various research/survey results have been compiled on Web GIS taking into account of data availability and accessibility. The discussion was initiated so that the Web GIS system would be installed into the system in I-CTC (Indonesian Climate Technology Center) under BPPT.	80%	The organization to have this database (Web GIS) installed should be decided through the discussion. The capacity development plan (infrastructure and human resource) will be developed by the project.
4-2. Operate the database management of the research/survey results プロトタイプデータベースにより研究・調査結果を一元的に管理する。	Following data were integrated into the proto-type database. 1) GIS integration of data Satellite image ・ Landsat (ETM:2000/07/16, ETM:2005/10/02, TM:2004/06/17, TM:2006/06/07) ・ ASTER (2003/02/15, 2011/5/8, 2011/6/13, 2011/08/16, 2012/08/18, and 2012/09/03) ・ SPOT (2004/05/19) ・ PALSAR(2007/07/09, 2008/07/22, 2009/07/14, 2010/07/17) Thematic map and data ・ Digital Elevation Model(DEM) : SRTM-DEM(90m grid)、ASTER－GDEM(30m grid) ・ River・road data・Administrative boundary data : shape file developed by Ministry of Forestry ・ CM-1.1 Watershed Management Group/ Water level monitoring points (48 points) ・ CM-2.1 Terrestrial Ecosystem Group/Permanent points (15 points) ・ CM-2.2 Aquatic Ecosystem Group/water sample collection points (12 points) ・ Land subsidence monitoring point (3 reference points, 4 variation points) ・ Geological map published by Ministry of energy and mineral resource: 1/250,000 geological map including Palangka Raya area (6 maps) ・ Peatland study report developed by Ministry of energy and mineral resource:1/50,000 ・ Map for estimation of peatland depth, Janicke et al.(2008)	90%	The information from KOMDA REDD+ in Central Kalimantan Province, the result of landuse analysis will be added. To consider the necessity of other layers such as landuse plan.

	・ Mega rice project boundary(shape file) ・ HyMap simultaneous water sample collection points (13 points) ・ Wetlands International (WI) petland map (2004) layer thickness distribution map(Central Kalimantan Province) (less than 1m、1-2m、2-4m、4-8m、8-12m) ・ Peatland boring information/1615 points ・ Moratorium Map by Ministry of Forestry (from Version-0 in May 2011)		
4-3. Support the institutional arrangement of carbon management 炭素管理を行う実施体制整備を支援する。	1) Working group consisted by national experts in Indonesia was organized, and REDD COE Kalteng which can be utilized for draft activity plan on REDD+ implementation in Central Kalimantan Province was developed and submitted to KOMDA REDD+, implementing agency of REDD+ in the Province in August, 2011. This draft plan is directly related to institutional arrangement for REDD+ implementation in Central Kalimantan Province. On May 2012, KOMDA REDD+ prepared a document "STRADA" which is focusing on policy guideline of REDD+ for Central Kalimantan and a RAD-GRK document was prepared to make a provincial plan of GHGs emissions reduction in Central Kalimantan coordinated by BAPPENAS in December 2012. REDD+ COE Kalteng and output from SATREPS such as emission factor of peat will be used in the revision documents according to the Kalteng offices. 2) Indonesian researchers (DNPI) was invited and I-VER that is Indonesian version of J-VER was introduced through promotion activities like workshop. ("MRV Technical Roundtable": eight times (July 2010 – March 2011), about 800 participants in total. 3) Kalimantan University Network was established to strengthen carbon management on peatland.	90%	Further support will be conducted.
4-4. Establish a carbon balance model 放出炭素量測定シュミレーションモデルを構築する。	1) Based on the wide variety of field works and long-term observations since 1997, Japanese and Indonesian scientists concluded that eight elements should be monitored to assess carbon balance in peatland. This is the first proposal of comprehensive monitoring system for peatland carbon balance management. [Eight key elements] (1) CO2 Flux and concentration, (2) Hotspots detection, (3) Forest degradation and species mapping, (4) Deforestation, forest biomass	80%	Further analysis will be conducted.

	change, (5) Water level and soil moisture, (6) Peat dome detection and peat thickness, (7) Peat subsidence and (8) Water soluble organic carbon. 2) Basic data collection for carbon balance assessment model is work in progress and some of the results have been published in the scientific journals shown also in Output 2. 3) To further strengthen model function, several measurements methodologies were introduced such as (a) precise GPS survey and (b) laser distance meter for peat subsidence evaluation, (c) hyperspectral observation for (c-1) peat forest biomass estimation, (c-2) ground water table estimation, (c-3) Dissolved Organic Carbon (DOC), (d) peat depth estimation. 4) As for the precise GPS survey (a), monitoring system was set up and first observation was conducted in November, 2010 (3 reference points and 4 variation points). Consequently second observation was made in July, 2011 and first precise ground surface displacement (around 3.4cm) by peat subsidence was identified. Third observation was conducted in March, 2012 and 2.0cm of subsidence was confirmed. 5) Laser distance meter method was introduced in October 2012 for the peat subsidence evaluation with ground water table (GWT) fructuations. As a result, peat subsidence is strongly correrated with GWT fructuatins (subsidence is about 4.5% of GWT fructuations). It reveals that annual subsidence rate derived from conventional leveling pole method or others are difficult to evaluateCO2 emission and laser distance meter is most reliable measurement method with more than 50 times precision than conventional methodologies. 6) To develop method on peat forest biomass estimation with degradation monitoring, assessment of ground water table and Dissolved Organic Carbon (DOC) in river, hyperspectral observation was made by aircraft (HyMAP) in July, 2011, in cooperation with researchers related to output 3 and ERSDAC(J-Systems)/MRI. Peat forest biomass estimation method which is applicable up to 300t/ha was developed. Strong correlation between DOC and intensity of CDOM absorption at 420 nm has been observed by laboratory analysis. Moreover CDOM intensity at 420nm is highly correlated with		

	HyMAP band ratio at 470nm and 500nm. Then DOC can be estimated by HyMAP data. Thus information of LCTF onboard microsatellite or HISUI hyperspectral which will be launched in 2016 will provide DOC mapping data and it contributes to high precision carbon balance modeling in peatland. 7) In Tropical Peat Swamp Forest, type of forest stand and its phenology are corresponded to Peat Depth, in terms of seasonal groundwater level fluctuations. This fluctuations produce spatial trends of plant activity in each season. To detect these variations, Supervised classification were conducted using multi-temporal satellite scenes with Peat Depth Database as training data. As a result, peat depth map with 1.64m of RMSE was produced. This is first result in the world to estimate peat depth using only satellite data and existing drill data.		
4-5. Assess the effect of carbon control based on carbon management system 炭素排出抑制統合モデルを開発する。	1) Multispectral observation for carbon management using Airborne Multicolor Imager onboard an UAV developed by BPPT was conducted in Pangandaran, West Java, on 31 Oct 2012. The preliminary result demonstrates that multispectral remote-sensing by microsatellites is technically feasible and economically suitable for carbon management. 2) As a result, proto-type of comprehensive carbon management system using ground observation network, airborne, satellite including microsatellite was established.	80%	Further analysis will be conducted.
4-6. Introduce an economic analysis model 経済分析モデルを導入する。	The project contributed to identify the figures necessary for the economic analysis. Some feasibility study including economic analysis was conducted utilizing the outputs from the project. However, the model itself was not introduced yet.	80%	No further plan.
4-7. Propose methodology on deforestation for International Standardization 国際基準に沿った森林減少抑制の手法を提案する。	The project supported BSN to prepare a draft of standard for deforestation and BSN presented it in ISO/TC (technical committee) 207 – Environmental Management in Cairo, Egypt in June, 2009.	100%	Completed. Further support will be continued.
4-8. Organize workshop/symposium/seminar towards establishing international network and information/knowledge dissemination to the public 国際的ネットワーク構築に向けたセミナー・シンポジウムを開催する。	1) The project organized workshop/seminar/symposium based on results of the Project to build networks with international researchers. ・ 1st International Workshop 2009 on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" (5-6 March, 2009) ・ 2nd International Workshop 2010 on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" (28-29 September,	100%	Completed. Further several seminars are planned for standardization and others.

	2010) ・ 3rd International Workshop 2011 on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" (22-24 September, 2011) ・ International Symposium 2012 on "Wild Fire and Carbon Management in Peat-Forest in Indonesia" (13-14 September, 2012) ・ 4th International Workshop 2013 on Wild Fire and Carbon Management in Peat-Forest in Indonesia (24-26 September, 2013) ・ Sustainability Week 2010-2013 in Hokkaido University. ・ Hyper Mapping Seminar (4 July, 2011) ・ Kick-off meeting, Trans Kalimantan University Network (18 January, 2012) ・ Study tour for students (03-09 March, 2012) ・ 2nd Workshop on Trans Kalimantan University Network (19 April, 2012) ・ The 2nd Meeting of Indonesia-Japan collaboration on Micro Satellite (28 June, 2012) ・ The 2nd Workshop on Development of "Integrated MRV System" (01 August, 2012) ・ The 3rd Workshop on Development of "Integrated MRV System" (11 September, 2012) ・ The 3rd Workshop on Kalimantan University Consortium (29 September, 2012) ・ Workshop on "Natural resources and future remote sending in Indonesia" (17 December, 2012) ・ Workshop on Water Level Controlling Towards Sustainable Practice of Oil Palm Plantation (06 February, 2013) ・ 2nd Workshop on Green House Gas Integrated Estimating and Monitoring System for Sustainable Peatland Management in Indonesia (29 April, 2013) ・ Meeting on Green House Gas Integrated Estimating and Monitoring System for Sustainable Peatland Management in Indonesia (14 June, 2013) ・ Workshop on "Biochar Promotion in Wetland of Indonesia"		

	(12-13 July, 2013) ・ The workshop on "Integrated on MRV standard in Peatland" (15 July, 2013) ・ Meeting on "Evaluation and Management of Carbon-Water-Biodiversity System in Kalimantan, Indonesia" (15 July, 2013) ・ The 2nd Meeting on "Evaluation and Management of Carbon-Water-Biodiversity System in Kalimantan, Indonesia" (26 August, /2013) 2) The project organized meetings on MRV and proposed system on MRV in collaboration with DNPI which played most active roles in Indonesia in REDD+. ・ MRV Technical Roundtable(first meeting: July 2010～ eighth meeting: March 2011) ・ Asian Forum Carbon Update 2011（14-18 March, 2011） ・ Asian Forum Carbon Update 2012（15-17 February, 2012） 3) Together with Indonesian authorities concerned, the Project proposed "Sapporo Initiative" at 2nd International Workshop 2010 (September 2010) on Wild Fire and Carbon Management in Peat-Forest in Indonesia. 4) The project published newsletter and pamphlet, and developed homepage.		
4-9. Recommend project proposals to government authorities プロジェクトの提言を政府関係機関に伝える。	1) The project presented project results at COP15, COP16, COP17 and COP18. 2) The project participated in IPCC guideline editing work. 3) The project provided information and data for bilateral off-set mechanism. (MOFA, METI, MOE, FA, private companies) 4) The project made policy recommendation to DNPI, UKP4, KOMDA-REDD+. 5) Peat definition was summarized for giving a scientific recommendation to Indonesian government and it was used for several meetings and workshops organized by DNPI and ICCC. After that, it was published as "Policy Memo of Peat Definition" aiming to define Indonesian standard of peat based on the scientific aspect in 2012.	90%	To prepare materials for packaging and moderating the findings of the project

収集資料一覧

No	Title	Note
1	Vision and Missions of UNPAR	Copy / 1 page excerpt only 現地収集
2	A Guide of Kahui Reforestation	パンフレット 現地収集
3	平成 24 年度　二国間オフセット・クレジット制度の実現可能性調査 「泥炭の再湿潤化による分解抑制と稲作増産に基づく籾殻発電」（インドネシア共和国）	清水建設
4	インドネシア 泥炭管理 NAMA 実現可能性調査プレゼン資料	清水建設
5	REDD プラスへの取り組み動向 Country Report インドネシア 平成 24 年度 独立行政法人 森林総合研究所 REDD 研究開発センター	http://www.ffpri.affrc.go.jp/redd-rdc/ja/redd/_trends/02_country_report_indonesia.pdf (2014 年 2 月アクセス)
6	RAD-GRK	Kalbar/ Kalteng IJ-REDD より
7	RAN-GRK	IJ-REDD より
8	発表資料一式 International Workshop on Peatland Management Future Aspects of Management in Tropical and Cool Temperate Peatlands Harmonious and Sustainable Relationship with Nature	Thursday, 10th October, 2013 10:00-17:00 Centennial Hall, Hokkaido University,Sapporo, Japan
9	発表資料一式 The 4th Int. Workshop on Wild Fire and Carbon Management in Peat-Forest in Indonesia	24-26 Sept. 2013 in Palangkaraya, Indonesia,

注：8 および 9 はすべてが公開資料ではない

以下、プロジェクト原著論文

No	Title	Note
1	Kaku, K., Kushida, K., Honma, T., and Fukuda, M. (2009). An Evaluation Method for Hotspot Detection Algorithms using Web-GIS. “Asian Journal of GEOINFORMATICS, 9(4), 19-27”（国際）.	
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3	Kaku, K, and Tokuno, M. Developing Hotspots Monitoring Web-GIS using MTSAT Infrared Data. “Asian Journal of GEOINFORMATICS”, 10(1), 2010, 27-36.（国際）	
4	Kaku, K., Fukami, K., Honma, T. & Fukuda, M. Sentinel Asia –the Overview and Prospect. Asian Journal of GEOINFORMATICS, 10(2), 2010, pp. 35–41.（国際）	
5	Segah, H., H. Tani and T. Hirano (2010), Detection of fire impact and vegetation recovery over tropical peat swamp forest by satellite data and ground-based NDVI instrument, International Journal of Remote Sensing, 31(20), pp.5297-5314.（国際）	
6	Cha J.Y.,I.G.P. Wirawan, Y. Tamai, S.Y. Lee, K.W. Chun, K.W., S.Y. Lee, S. Ohga,: A Food Factory Strictly Managed by Fungus-growing Termites. Journal of Faculty of Agriculture, Kyushu University, 55(1), 11-14 (2010)（国際）	
7	Rizki M., Y. Tamai, T. Yajima, M. Terazawa: Scrutiny on physical properties of sawdust from tropical commercial wood species: Effects of different mills and sawdust's particle size. Journal of Forestry Research, 7(1), 20-32 (2010)（国際）	
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9	Khatun R, Ohta T, Kotani A, Asanuma J, Gamo M, Han S, Hirano T, Nakai Y, Saigusa N, Takagi K, Wang H, Yoshifuji N, Spatial variations in evapotranspiration over East Asian forest sites. I. Evapotranspiration and decoupling coefficient. Hydrological Research Letters, 5, 83-87, 2011（国際）	
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11	Erianto Indra Putra and Hiroshi Hayasaka. The effect of the precipitation pattern of the dry season on peat fire occurrence in the Mega Rice Project area, Central Kalimantan, Indonesia. TROPICS, vol. 19 / 20. 2011.（国際）	
12	山本裕基, 竹内憲司「気候変動緩和策としての REDD+の役割」『国民経済雑誌』 第 203 巻第 4 号, 77-101, 2011 年 (国内)	
13	Turjaman M., E. Santoso, A. Susanto, S. Gaman, S.H. Limin, Y. Tamai, M. Osaki, K. Tawaraya: Ectomycorrhizal fungi promote growth of Shorea balangeran in degraded peat swamp forests. Wetlands Ecology and Management, 19(4), 331-339 (2011), （国際）	
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17	Sundari S, Hirano T, Yamada H, Kusin K and Limin S, Effect of groundwater level on soil respiration in tropical peat swamp forest. Journal of Agricultural Meteorology, 68, 121-134, 2012（国際）	
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20	Shuli Niu, Yiqi Luo, Shenfeng Fei, Wenping Yuan, David Schimel, Brian Amiro, Christof Ammann, M. Altaf Arain, Almut Arneth, Marc Aubinet,	

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21	Kaku, K. and Held, A. A space-based disaster management support in the Asia-Pacific region. International Journal of Disaster Risk Reduction. Elsevier, 2013. （国際）	
22	Gatot,E.S., Yamamoto,K., Imai,T., Ishii,Y., Fukami,H., Sekine,M.: The effect of ENSO on rainfall characteristics in the tropical peatland areas of Central Kalimantan, Indonesia. Hydrological Sciences Journal, 58(3), 539-548, 2013. DOI:10.1080/02626667.2013.772298 （国際）	
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