ナミビア共和国
（科学技術）半乾燥地の水環境保全を目指した洪水-干ばつ対応農法の提案
終了時評価報告書

平成 28 年９月
（2016年）

独立行政法人国際協力機構
農村開発部

農 村
ＪＲ
16-061

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序　　文

独立行政法人国際協力機構は、ケニア共和国と締結した討議議事録（R/D）に基づき、2012 年 2 月より技術協力「半乾燥地の水環境保全を目指した洪水–干ばつ対応農法の提案」を約 5 年間の計画で実施しています。

当機構は、プロジェクト開始から約 4 年半が経過した 2016 年 8～9 月に、当機構農村開発部 大島 歩を団長とする終了時評価調査団を現地に派遣し、ナミビア共和国側のカウンターパートと合同でこれまでの活動実績並びにその結果について終了時評価を行いました。

本報告書は、同調査団によるナミビア政府関係者との協議及び終了時評価調査結果等を取りまとめたものであり、本プロジェクト並びに関連する国際協力の推進に活用されることを願うものです。

最後に、本調査にご協力いただいた内外の関係者各位に対し、心からの感謝の意を表します。

平成 28 年 9 月

独立行政法人国際協力機構
農村開発部長　三次　啓都

目　　次

序　文
目　次
プロジェクトサイト位置図
写　真
略語表
終了時評価調査結果要約表

第１章　終了時評価調査の概要……1
　１－１　終了時評価調査の背景……1
　１－２　終了時評価調査の目的……1
　１－３　終了時評価団 ……1
　１－４　終了時評価日程 ……2
　１－５　主要面談者 ……2
　１－６　終了時評価の方法……3

第２章　プロジェクト概要 ……5
　２－１　プロジェクトの背景……5
　２－２　プロジェクトの概要……5

第３章　プロジェクトの実績と実施プロセス……8
　３－１　投入実績 ……8
　　３－１－１　日本側投入……8
　　３－１－２　ナミビア側投入……8
　３－２　プロジェクト活動の進捗状況……9
　３－３　成果（アウトプット）の達成状況 …… 16
　　３－３－１　成果 1 …… 16
　　３－３－２　成果 2 …… 18
　　３－３－３　成果 3 …… 21
　　３－３－４　成果 4 …… 23
　３－４　プロジェクト目標の達成見込み…… 24
　３－５　実施プロセス …… 27
　　３－５－１　促進要因 …… 27
　　３－５－２　阻害要因 …… 27

第４章　評価結果 …… 28
　４－１　妥当性 …… 28
　４－２　有効性 …… 29
　４－３　効率性 …… 30
　　４－３－１　日本側の投入の適切さについて …… 30

４－３－２　ナミビア側投入の適切さについて …… 30
４－３－３　プロジェクトマネジメント …… 31
４－４　インパクト …… 31
４－４－１　上位目標の達成見込み（将来） …… 31
４－４－２　その他のインパクト …… 31
４－５　持続性 …… 32
４－６　結　論 …… 34

第５章　提言と教訓 …… 35
５－１　提　言 …… 35
５－１－１　プロジェクトチームがプロジェクトの残り期間に行うべき事項に係る提言 … 35
５－１－２　ナミビア側関係機関に対する提言 …… 35
５－２　教　訓 …… 36

付属資料
１．ミニッツ及び合同終了時評価報告書（英文） …… 39
２．調査日程 …… 110
３．PDM Version 3（仮和文） …… 111
４．PDM 改定案 Version 4（仮和文） …… 113

プロジェクトサイト位置図

プロジェクト対象の北中部の 4 州：Omusati 州、Sshana 州、Oshikoto 州、Ohangwena 州

現地写真

ミニッツ署名後の関係者記念撮影

合同評価報告書（英文）署名

合同調整委員会会議後半、
終了時評価結果の質疑応答風景

ワークショップ参加者記念撮影

ナミビア大学オゴンゴ校内の施肥試験圃場

イネとトウジンビエ混作（接触混植）試験圃場

供与機材（農業機械）

供与機材（籾摺り精米機）

コメとトウジンビエの粉を半々に混ぜた食品

実践農家の小湿地で混作（イネとソルガム）
干ばつのため、イネの収穫はなかったが、
ソルガムの収穫があった。

実証農家圃場の視察

実証農家の圃場内に設置された気象観測装置

実践農家（Afoti 村）の小湿地
（乾期で水がない）

農家の敷地内の倉庫や住居など

農業・水・森林省の普及所

左記普及所に置いてあるトラクター
（賃貸サービス用）

略　語　表

AMSR	Advanced Microwave Scanning Radiometer	高性能マイクロ波放射計
AMSR-E	Advanced Microwave Scanning Radiometer for EOS	改良型高性能マイクロ波放射計
C/P	Counterpart	カウンターパート
FANR	Faculty of Agriculture and Natural Resources	ナミビア大学農業天然資源学部
GDP	Gross Domestic Product	国内総生産
GIS	Geographic Information System	地理情報システム
GNI	Gross National Income	国民総所得
GPS	Global Positioning System	地理情報システム
JCC	Joint Coordinating Committee	合同調整委員会
JICA	Japan International Cooperation Agency	独立行政法人国際協力機構
JOCV	Japan Overseas Cooperation Volunteers	青年海外協力隊
JST	Japan Science and Technology Agency	国立研究開発法人科学技術振興機構
IITA	International Institute of Tropical Agriculture	国際熱帯農業研究所
IRRI	International Rice Research Institute	国際稲研究所
MAWF	Ministry of Agriculture, Water and Forestry	農業・水・森林省
MODIS	Moderate Resolution Imaging Spectroradiometer	中分解能撮像分光放射計
M/M	Minutes of Meeting	協議議事録（ミニッツ）
NERICA	New Rice for Africa	ネリカ
NAD	Namibian Dollars	ナミビア・ドル
PDM	Project Design Matrix	プロジェクト・デザイン・マトリックス
PO	Plan of Operation	活動計画
R/D	Record of Discussions	討議議事録
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
UAV	Unmanned Aerial Vehicle	無人航空機（通称：ドローン）
UNAM	University of Namibia	ナミビア大学
UNDP	United Nations Development Programme	国連開発計画
WDI	World Development Indicator	世界開発指標

【通貨交換レート】

1 US ドル＝13.9NAD（2016 年 8 月時点）

1 US ドル＝102 円（2016 年 8 月時点）

終了時評価調査結果要約表（和文）

１．案件の概要		
国名：ナミビア共和国		案件名：半乾燥地の水環境保全を目指した洪水–干ばつ対応農法の提案
分野：農業一般		援助形態：技術協力プロジェクト–科学技術協力
所轄部署：農村開発部		協力金額：4.2 億円（2016 年 9 月時点）
協力期間	2012 年 2 月 28 日～2017 年 2 月 27 日（5 年間）	先方関係機関： （１）責任機関：ナミビア国教育省国家科学技術局 （２）実施機関：ナミビア大学農業天然資源学部
		日本側協力機関：近畿大学、名古屋大学、東北大学、龍谷大学、滋賀県立大学など
		他の関連協力：無し

１－１　協力の背景と概要

ナミビア共和国（以下、「ナミビア国」と記す）は、南部アフリカに位置し、国土面積は約 82 万 km^2、人口は約 220 万人である。一人当たり GNI は 4,270 米ドル（2010 年、世銀）と中進国に位置づけられ、産業の中心はウラン、ダイヤモンド等の鉱業及び農林水産業であるが、農業については輸出向け牧畜が中心である。一方で、国内で消費されている穀物の自給率は小麦 33%、メイズ 44%、トウジンビエ[1]・ソルガム 95%〔2007／2008 年、ナミビア農業・水・森林省（MAWF)〕と低く、穀物全体としては約半数を輸入に依存している。

ナミビア国は、ジニ係数が 0.74（2007 年）と世界で最も高い国の 1 つとされ、国内における経済格差が大きい。特に、国内人口の約 60%が居住する北部 7 州では、食糧不足、教育・保健への限られたアクセス、電気の未整備などから、国内全体の貧困率が 28%であるのに対し、北中部・北東部においては、平均約 46.8%と特に貧困率が高い地域である（2006 年世帯調査、ナミビア中央統計局)。

ナミビア国北中部は、年間平均降水量 400 mm の半乾燥地であるが、雨期になると隣国のアンゴラ高原から氾濫水が流れ込むため、広大な季節性湿地帯（以下、「季節湿地」と記す）が形成される。この地域の近年の年間降水量の変動は大きく、2008 年にはナミビア国北部の河川氾濫による洪水、翌 2009 年にはオカバンゴ川、クワンド川、ザンベジ川の水位が過去最高を記録する大洪水が発生し、2010 年には再びザンベジ川を中心に洪水が起こっている。この地域の降水量の年次変動をみると、200～1,000 mm の範囲で変動しており、アンゴラからの氾濫水が早期に一挙に押し寄せる年と、氾濫が極度に遅れ規模が小さい年が繰り返し発生しており、その結果、大洪水と干ばつという極端な水環境が同一地域で発生している。この地域は乾燥地作物であるトウジンビエの主要生産地であり、住民の大多数はナミビア国の伝統的な主食であるトウジンビエの栽培と牧畜を生業とし、現金収入の手段をほとんどもたない自給自足農民であるとされている。2011 年頃までの大規模洪水の頻発により、トウジンビエの生産量が低下してきていることから、これまで栽培が行われてこなかった洪水耐性の一番高い穀物であるコメへの期待が高まっている。

このような背景から、ナミビア国北中部地域の自然環境に起因する不安定な水環境を保全しつつ、季節湿地が形成される地域に居住する自給自足的農家の食糧安全保障と経済的自立を実現するため、現地に適した農法の開発に資する研究が必要とされている。そのような状況下、ナミビア政府の要請を受けて、2012 年 2 月から 5 年間の予定で科学技術協力プロジェクトであ

[1] Pearl-millet。ナミビア国における主要穀物であり、耐乾性が高いという特性をもつ。一方、湛水耐性は低い。

る「半乾燥地の水環境保全を目指した洪水–干ばつ対応農法の提案」が開始された。

１－２　協力内容

本プロジェクトは、半乾燥地であるナミビア国北部の季節湿地に注目し、あるがままの不安定な水環境を保全しながらも、洪水や干ばつ年でも常に一定以上の穀物生産が維持されるような「洪水–干ばつ対応農法」を開発するとともに、その導入過程の社会・自然環境インパクトを定量することにより、自給自足農民の生活向上に資する農法の導入と半乾燥地の水環境保全とを持続的に両立させることを目指すものである。

（１）上位目標

１.「洪水–干ばつ対応農法」が、ナミビア国北中部において普及し、現地農家の食糧確保と現金収入の獲得に寄与する。

２.「洪水–干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。

（２）プロジェクト目標

半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」が開発される。

（３）成果（アウトプット）

１.【作物学領域】洪水–干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。

２.【開発学領域】「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。

３.【水文学領域】湿地の水収支・水源解析により、水環境を改変しない混作栽培可能面積が推定される。

４.【総合領域】フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。

（４）投入（評価時点）

日本側：総投入額 4.2 億円

①専門家派遣：長期専門家延べ 2 名及び短期派遣研究者延べ 20 名、②研修員受入れ：国別研修延べ 28 名、長期研修（博士課程及び修士課程）計 3 名、短期研修延べ 16 名、③機材供与：総額約 0.97 億円、④ローカルコスト負担：約 0.79 億円

ナミビア側：①カウンターパート（C/P）配置：12 名（終了時評価時）、②ローカルコスト負担：約 760 万円、③土地・施設提供：作物試験圃場、日本人研究者・専門家執務室、温室、ラボ、倉庫等

２．評価調査団の概要

日本側評価者	団長／総括	大島　歩	独立行政法人国際協力機構（JICA）農村開発部農業・農村開発第二グループ課長
	協力企画	浅岡真紀子	JICA 農村開発部農業・農村開発第二グループ第三チーム　主任調査役
	科学技術計画・評価	國分　牧衛	国立研究開発法人科学技術振興機構（JST）国際科学技術部（SATREPS グループ）研究主幹 （東北大学名誉教授）

	科学技術計画・評価	小平　憲祐　JST 国際科学技術部（SATREPS グループ）調査員
	評価分析	道順　勲　　中央開発株式会社
ナミビア側評価者	リーダー	Prof. Edosa OMOREGIE, Professor, Department of Fisheries and Aquatic Science, Sam Nujoma Campus, University of Namibia（UNAM）
	メンバー	Prof. Nelago INDONGO, Director, Multidisciplinary Research Center（MRC）, University of Namibia（UNAM）
調査期間	2016 年 8 月 13 日～9 月 3 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

成果１：【作物学領域】洪水–干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。

達成度：おおむね達成された。

実　績：洪水–干ばつ条件に対応し、かつ節水型である栽培技術の開発に係る研究活動がプロジェクト期間中、着実に進捗してきた。研究成果の分析結果は、各種国際誌あるいは国内誌への論文投稿という形で取りまとめられている。分析結果はまた、日本やナミビア国で開催された多くの学会／セミナー等で発表された。プロジェクトチームは、6 つの栽培技術で構成されるイネを基幹とする混作栽培農法を提案している。それら技術の中でも、特に接触混植については、農家圃場レベルでの実証はまだできていないものの、試験レベルにおいて収量の比較優位性が科学的に実証されたことは特筆すべき成果である。

成果２：【開発学領域】「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。

達成度：おおむね達成された。

実　績：実証農家[2]や実践農家[3]の社会経済状況や営農状況を分析・理解するために、7 つの異なる手法、すなわち、①ファームスケッチ、②携帯型 GPS 調査、③無人航空機（UAV：通称ドローン）を用いた空中写真撮影、④アンケート調査、⑤村落モノグラフ作成、⑥景観分析、⑦ワークショップが適用された。上記手法のうち、①、④、⑤といった手法は、農家の主観的認識を理解するための手法であり、②と③といった手法は、農家の営農実践に係る情報をより客観的・正確に把握するためのものである。これら 2 つのタイプの手法を組み合わせることが、農家の認識や実態を把握するために有効であると確認された。研究活動の結果、論文が国際的学術誌あるいは国内の学術誌に投稿され、今後もさらに投稿される見通しである。また、研究活動の成果は、ナミビア国あるいは日本で開催された多くの学会／セミナーで発表された。

成果３：【水文学領域】湿地の水収支・水源解析により、水環境を改変しない混作栽培可能面積が推定される。

達成度：達成された。

実　績：各種データを分析した結果、水環境を改変しない混作栽培可能面積は、Cuvelai 季節湿

[2] 実証試験を実施する農家：農家所有小湿地を借りて、プロジェクト活動として実証試験や水位計測等を実施。

[3] イネを基幹とする混作栽培あるいは稲作を自主的導入する意志を示した農家。

地システム内の土地面積の 3～7%であろうとの推計が出た。水文学領域の各種研究活動の結果は、各種の論文にまとめられ、国際的学術誌あるいは国内の学術誌に投稿された。研究成果はまた、日本あるいはナミビア国で開催された各種の学会／セミナーで発表された。

成果４：【総合領域】フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。
達成度：中程度
実　績：作物学領域、開発学領域、水文学領域の研究活動の成果は、ナミビア側 C/P、日本人研究者、普及員、農家等の間で共有されてきた。2015／16 作期にイネを基幹とする混作栽培を実践した 111 戸の実践農家のうち、32 戸の農家の湿地でコメの収穫ができた。トウジンビエとソルガムについては、それぞれ 30 戸、27 戸の農家で収穫があった。国家緊急事態宣言が出るような厳しい干ばつ年であったにもかかわらず、約 4 分の 1 の農家で何らかの収穫があった。イネを基幹とする混作栽培農法についての経済的インパクトに係る詳細分析は 2015 年に開始されたところであり、その結果を用いた論文は 2017 年 3 月までに学術誌に投稿される見込みである。成果 4 の達成度は中程度。

プロジェクト目標：半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」が開発される。
達成度：おおむね達成された。
実　績：作物学領域、開発学領域、水文学領域、統合領域で、各種の研究活動が順調に進展し、各種の論文作成と学会発表が行われてきた。研究成果を用いて、農家及び普及員向けの各種リーフレットが作成されてきた。「洪水–干ばつ対応混作農法」に関するガイドライン（案）が作成され、これらガイドラインは、2016 年中に最終化される。農家に向けて普及されることになるイネを基幹とする混作栽培技術については、特に接触混植が試験レベルにおいて収量性において比較優位があると科学的に実証された。しかしながら、プロジェクト開始後の 4 年間干ばつあるいは干ばつ傾向であったため、プロジェクト終了までに農家レベルでイネを基幹とする混作栽培農法を実証することは困難な見込みである。

３－２　評価結果の要約
（１）妥当性：高い。
１）ナミビア国北中部の季節湿地における作物生産増加のニーズとの整合性が高い
２）ナミビア国の国家政策（経済分野の優先事項が農業分野、コメ生産振興）との整合性が高い
３）我が国の対ナミビア国援助方針（農村部の貧困削減・生活水準改善への貢献）との整合性が高い
４）プロジェクトアプローチの適切さ（作物学、開発学、水文学の観点を踏まえた総合アプローチ）
５）我が国がもつ技術的優位性（稲作研究、社会経済分析、水文解析技術の蓄積）

（２）有効性：おおむね高い。
半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」の開発に関しては、試験的には確立された。一方、厳しい干ばつが生じたため、プロジェクトチームは十分なデータを得ることができず、イネを基幹とする混作栽培農法の農家圃場での実証には至らな

かった。

ただし、経済調査結果によると、厳しい干ばつ条件下でも 111 戸のうち 32 戸の農家がコメを収穫することができたことは、提案している混作栽培農法の有効性を部分的に示すものである。なお、各アウトプット（作物学領域、開発学領域、水文学領域及び左記を統合した総合領域の各領域）に基づき、プロジェクト目標である「洪水–干ばつ対応農法」が開発されるというロジックの流れは適切であった。

（３）効率性：中程度。

日本側の投入について、人数、専門性、研究能力の観点において適切であった。他方、一部機材（乾燥機、インキュベーターや籾摺り精米機）について、諸般の事情（機材輸送の遅延や干ばつ等）はあるものの、活用が十分でないものも見受けられた。また、プロジェクト活動の円滑な実施そのものには影響を与えなかったものの、人事異動や留学等の理由により、本邦研修や技術移転を受けた C/P の交替があった（本邦研修参加者のうち、6 人の C/P が交替）。

（４）インパクト：

上位目標の一部について、具体的には、農家の食糧安全保障の貢献についてはある程度達成できる見込みがある。また、複数の正のインパクトが観察され、負のインパクトは確認されなかった。本プロジェクトのインパクトの達成見込みは、おおむね高いと判断する。

１）上位目標

「１.「洪水–干ばつ対応農法」が、ナミビア国北中部において普及し、現地農家の食糧確保と現金収入の獲得に寄与する。及び２.「洪水–干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。」は、達成の見通し。

ナミビア大学（UNAM）と農業・水・森林省（MAWF）は、次期予算年度（2017 年 4 月～2018 年 3 月）の予算獲得に向けた努力を行った。農家向けワークショップがナミビア国北部の 5 州で 12 回実施し、フィールド・デーを 5 回実施する計画である。したがって、イネを基幹とする混作栽培農法に関するフィールド・デーやワークショップがプロジェクト終了後もナミビア国の北中部と北東部で定期的に実施される見込みである。より多くの農家が混作栽培技術を導入・適用するようになれば、農家の食糧安全保障に貢献することが期待される。

「洪水–干ばつ対応農法」について、近隣国と一緒に地域研究会合を実施することについては、プロジェクト終了後の数年以内に実施されるかどうか判断することが困難である。さらに、イネを基幹とする混作栽培農法が短期間に隣国に導入されるかどうか現時点で判断することは難しい。

２）その他のインパクト

① 稲作及びイネを基幹とする混作栽培に対する農家の強い関心
② コミュニティ所有の季節湿地の共同利用
③ UNAM による新しいコメ製品の研究に係る提案
④ UNAM オゴンゴ校の教員の研究活動実施に向けたモチベーション向上

（５）持続性

おおむね高いと判断する。

１）政策面

ナミビア政府の政策「Vision 2030」では、農業生産の持続的増加、食糧安全保障、収入増加が重視されている。また、2015 年ナミビア農業政策には、農業の開発・多様化、農

業研究振興と適正技術の適用、災害への準備・農業生産資源の持続的利用促進が示されている。したがって、本プロジェクトの成果が、UNAM、MAWF、州政府の支援によってより広い地域に普及されていることが期待される。

2）制度・財務面

プロジェクト終了後、イネを基幹とする混作栽培農法を普及し、またプロジェクトで実施してきた研究活動の一部を継続するために、UNAM と MAWF が協働して 2017 年 4 月から 2018 年 3 月までの予算提案書を作成し、UNAM オゴンゴ校は UNAM 財務部に、また MAWF は財務省に各々提出済みである。予算提案書で計画されている普及対象地域は、ナミビア国の北中部地域と Kavango 州である。予算計上に係る状況の進展具合から判断すると、本プロジェクトの財務面及び制度面の持続性（プロジェクトの成果を有効に活用し、普及すること）は、比較的高いと判断することが可能である。なお、供与機材類については、現時点では深刻な故障は発生していないものの、今後より多くの UNAM 職員が維持管理に係る知識・技能を身に付けるため研修を受けることが望ましい。

3）技術面

ナミビア側 C/P は、主に UNAM 農業天然資源学部オゴンゴ校の教師や技術者である。日本人研究者との共同研究実施、短期あるいは長期の本邦研修、学術誌へ投稿するための論文作成、学会／セミナーのための発表原稿作成を通じて、ナミビア側 C/P の研究能力が強化された。本プロジェクトにおいて強化された C/P の知識や技能は、UNAM における学術活動に活用される見通しである。したがって、技術面の持続性は確保されるものと期待される。

3－3　効果発現に貢献した要因

（1）計画内容に関すること

特になし

（2）実施プロセスに関すること

① ナミビア側研究者及び日本側研究者の熱意が有用な研究成果を生み出した。
② 博士課程での学びと平行しつつ研究活動を実施したことにより、プロジェクト活動を効果的に実施するうえでの促進要因となった。
③ 研究者間のコミュニケーション改善により、計画的な学術論文の作成に貢献した。

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

特になし

（2）実施プロセスに関すること

厳しい干ばつが期待するような研究成果（特に新たな作物であるイネの導入効果測定）を得るうえでの制約要因となった。

3－5　結　論

本プロジェクトは、ナミビア国の政策並びに北中部の季節湿地における作物生産増加ニーズに即した取り組みであった。プロジェクト目標はおおむね達成見込みであり、4 年継続した干ばつ傾向が負の影響を与えたものの、本プロジェクトにおいて良好な研究成果が生み出され、同農法が試験的に確立されたことを確認した。イネを基幹とする混作栽培あるいはコメ栽培を経験した大半の農家は、季節湿地で作物栽培することに高い関心をもち、また干ばつの影響で良

い収穫が得られなかったにもかかわらず、作物栽培を継続する意欲も高いといったインパクト発現も確認されている。さらに、UNAM と MAWF が継続的に研究・普及活動予算を一定程度計上していることや本プロジェクトにより UNAM 側の能力強化が図られたことから、供与した機材の有効利用や維持管理については引き続き留意が必要なものの、持続性もおおむね高いと見込まれる。以上の結果から、本プロジェクトは予定通り 2017 年 2 月に完了することが妥当と判断する。

３－６　提　言

３－６－１　プロジェクトチームに向けた提言

（１）プロジェクトチームによる「洪水–干ばつ対応農法」ガイドライン（案）のレビューと改定

（２）プロジェクト終了後に UNAM 及び MAWF が継続する研究・普及活動の検討

（３）JICA 供与機材の物品管理台帳の見直し・改定及び今後の維持管理経費の試算

（４）PDM の改定（上位目標２の指標：近隣諸国との国際研究会合開催から、近隣諸国との研究成果情報の共有に変更）

３－６－２　ナミビア国関係機関に対する提言

（１）プロジェクト終了後の UNAM の研究及び普及活動に係る詳細計画の作成

（２）イネを基幹とする混作栽培方法普及に向けた、UNAM と MAWF／地方政府との連携強化・役割明確化

（３）供与機材の運用計画作成及び技術者向け研修を含めた継続的な維持管理予算の確保

３－７　教　訓

（１）プロジェクト期間中、小雨の年がつづき、小湿地における作物栽培に大きなダメージを与えたものの、本プロジェクトでは 5 年間のプロジェクト期間において目指す成果のレベルについて関係者間での摺り合わせが十分ではなかったと思われる。将来、類似のプロジェクトを実施する際にはこのような外的要因を考慮しつつ、JICA と JST がより密接で素早い判断のもと、対応策を探すことが望まれる。

（２）日本側・ナミビア側がリーダーを中心に緊密に連絡を取りつつ、定期会合を日本・ナミビア国双方にて開催し、各領域の活動に係る年間計画と研究成果を関係者全員に共有するなど、複数の研究機関との国際的協働プロジェクトをマネジメントする有効な方法を、ナミビア側パートナーが身に付けた。その得られたノウハウが将来の各種研究プロジェクト実施において活用されることが期待される。

Summary of Terminal Evaluation Results

<table>
<tr><td colspan="3">I. Outline of the Project</td></tr>
<tr><td colspan="2">Country： Republic of Namibia</td><td>Project title： Flood- and drought-adaptive cropping systems to conserve water environments in semi-arid regions</td></tr>
<tr><td colspan="2">Issue/Sector： Agriculture</td><td>Cooperation scheme： Technical Cooperation Projects (SATREPS)</td></tr>
<tr><td colspan="2">Division in charge： Rural Development Department</td><td>Total cost： 420,545 Thousand Yen (September 2016)</td></tr>
<tr><td rowspan="2">Period of Cooperation</td><td rowspan="2">From February 28, 2012 to February 27, 2017
(5 years)</td><td>Partner Country's Implementing Organization：
(1) Responsible organization: Directorate of National Research, Science, Technology and Innovation, Ministry of Education
(2) Implementing organization: Faculty of Agriculture and Natural Resources, University of Namibia</td></tr>
<tr><td>Supporting Organization in Japan： Kinki University, Nagoya University, Tohoku University, Ryukoku University, and University of Shiga Prefecture etc.</td></tr>
</table>

1. Background of the Project

Harmonization between development and environment conservation is one of the universal issues in the 21st century. Especially for the semi-arid areas in Africa, there is risk for the rapidly disordered development without any consideration for the environment. On the other hand, periodic serious drought and deluge caused by heavy rains frequently affect semi-arid areas of Sub-Sahara Africa in recent years. Millions of people suffered and experienced shortage of food by the heavy rains from 2006 to 2007, for example. It is the new challenges for the change of global environment that to cope with such contradistinctive water conditions.

Namibia is located in the Southern Africa with the area of 824,000 km^2. The population is about 2,147,000 with its Gross National Income (GNI) per capita of 4,270 USD (World Development Indicator (WDI)), World Bank, 2011). With its rich mineral resources, the economic growth marked 4.5% a year on average from 1990 to 2008 (WDI, 2011). Although Namibia is categorized as Upper Middle Income country, the nation is one of the least equitable countries as shown by a Gini coefficient of 0.74 (UNDP, 2007).

A quarter of the nation lives in north central Namibia, where most of people are subsistence farmers cropping pearl millet and farming livestock. The annual precipitation in the area is about 400 mm, but flood water from the Angolan plateau creates vast seasonal wetland utmost of about 800,000 ha during rainy season. The amount of flood water has been widely changing in the last ten years, which causes serious deluge or drought to the area. Currently, the water resource of the seasonal wetland is not utilized for cropping but mainly for grazing. The reasons for the limited used of the water resource are: the national sanctuary for the wild animals, unstable flood intensity, etc. However, there is risk for the destruction of this vulnerable water environment if irrelevant large-scale development plan would have targeted to the area.

Therefore, the Government of Namibia has requested the technical cooperation project under the framework of science and technology cooperation program. To respond to the request, a project titled " Flood- and drought-adaptive cropping systems to conserve water environments in semi-arid regions" (the Project) is being implemented from February 2012 to February 2017 (5 years).

2. Project Overview

This Project aims to develop "Flood- and drought-adaptive cropping system" which can sustainably preserve water resources and cope with the yearly fluctuation of flood and drought. This system is going to be developed through trials in the field of crop science, development studies, hydrology and integrated study of Agricultural and Social Science. The project is also expected to contribute to adaption to climate changes.

(1) Overall Goal

1. "Flood- and drought-adaptive cropping systems" are disseminated in north-central Namibia to contribute to the food security and cash income of local farmers.
2. "Flood- and drought-adaptive cropping systems" are considered in the northeastern area of Namibia of high rainfall as well as in neighboring countries.

(2) Project Purpose

"Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of semi-arid region.

(3) Outputs

1) [Crop Science] The rice-based mixed cropping system, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.
2) [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers through introduction of the rice-based mixed cropping system are established.
3) [Hydrology] The possible area of mixed-cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.
4) [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.

(4) Inputs

Japanese side : Total cost: 420,545 Thousand Yen.
Japanese Expert: 2 long-term experts and 20 short-term experts in total, Trainees received in Japan: 28 persons for the country-specific trainings, 3 persons for doctor and master course, and 16 persons for short-term training, Provision of equipment: approx. US$967,000, Local cost expenditure: approx. US$787,000.

Namibian side : Counterpart 12 persons (at the terminal evaluation), Local Cost: around US$73,765 dollar, Provision of land and facilities: crop experiment fields, office spaces for Japanese researchers and expert, green house, laboratories, and store house etc.

II. Evaluation Team

Members of Japanese Evaluation Team	1) Leader: Ms. Ayumu OHSHIMA , Director, Agricultural and Rural Development Group 2, Rural Development Department, JICA 2) Cooperation Planning: Ms. Makiko ASAOKA, Deputy Director, Agricultural and Rural Development Group 2, Rural Development Department, JICA 3) Science and Technology Evaluation: Dr. Makie KOKUBUN, Research Supervisor, Japan Science and Technology Agency (JST)/ Professor Emeritus, Tohoku University 4) Science and Technology Evaluation: Dr. Kensuke KODAIRA, Associate Research Supervisor, JST 5) Evaluation Analysis: Mr. Isao DOJUN, Consultant, Chuo Kaihatsu Corporation
Members of Namibian Evaluation Team	1) Leader: Prof. Edosa OMOREGIE, Professor, Department of Fisheries and Aquatic Science, Sam Nujoma Campus, University of Namibia (UNAM) 2) Member: Prof. Nelago INDONGO, Director, Multidisciplinary Research Center (MRC), University of Namibia (UNAM)

Period of Evaluation	From August 13, 2016 to September 3, 2016	**Type of Evaluation:** Terminal

III. Results of Evaluation

1. Project Performance

Output 1: [Crop Science] The rice-based mixed cropping system, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.

Degree of achievement: **moderately high**

Achievement: Research activities to develop techniques to deal with flooding and drought conditions as well as water-saving progressed steadily throughout the Project term. The results of the analysis on the research activities have been summarized in various papers and submitted to domestic and/or international journals. The results of analysis have also been presented at many academic conferences/seminars in Japan and Namibia. The project team is proposing the rice-based mixed cropping systems consisting of six cultivation techniques. Mixed seedling technique in particular has been scientifically verified to have comparative advantage on yield on experimental basis, although it is yet to be verified at farmers' field level.

Output 2: [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers through introduction of the rice-based mixed cropping system are established.

Degree of achievement: **moderately high**

Achievement: There were seven different methods, namely, 1) farm sketch, 2) hand-held GPS survey, 3) taking aerial photos by UAV, 4) questionnaire survey, 5) summarizing village monograph, 6) landscape analysis, and 7) workshops that were applied to analyze and understand the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration or voluntary trials. There are methods to understand the subjective perception of the farmers such as 1), 4), and 5) and more objective ways

to clarify the situation with precise data and information on farming practices such as 2) and 3). Appropriate combination of both methods was found to be effective to grasp farmers' perception and reality. As a result of the research activities, papers were submitted to domestic and/or international journals and additional papers will be submitted. The results of the research activities were presented at many academic conferences/seminars in Japan and Namibia.

Output 3: [Hydrology] The possible area of mixed-cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.
Degree of achievement: **high**
Achievement: Various kinds of data analyzed revealed that the possible area for introducing mixed-cropping, that would not modify the water environment of the seasonal wetlands, could be from 3 to 7% of the land in the Cuvelai System Seasonal Wetlands. The results of the analysis of the research activities have been summarized as various papers and submitted to domestic and/or international journals. The results of analysis were also presented at academic conferences/seminars in Japan and Namibia.

Output 4: [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.
Degree of achievement: **moderate**
Achievement: The results of the research activities in the respective areas of Crop science, Development Studies and Hydrology have been shared among the Namibian counterparts, Japanese researchers, extension officers, and farmers etc. Among 111 volunteer farmers who carried out rice-based mixed cropping in 2015/16 cropping season, 32 farmers were able to get rice harvest at their wetlands. Pearl millet and sorghum were harvested by 30 and 27 farmers respectively. Broadly speaking, one-quarter of volunteer farmers obtained some amount of harvest even during the severe drought year with the national emergency declaration. A paper based on the detailed analysis of the economic impact of rice-based mix cropping systems will be submitted to peer-reviewed journal by the March 2017.

Project Purpose: "Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of semi-arid region.
Degree of achievement: **moderately high**
Achievement: Various research activities have progressed well in the areas of crop sciences, development studies, hydrology, and integrated study on agricultural and social sciences, as well as various papers have been written and presentations for conferences/seminars have been made. Various leaflets for farmers/extension officers were developed using the research results. The draft guidelines for a "Flood- and drought-adaptive cropping systems" have been produced and these guidelines will be finalized within 2016. Regarding the rice-based mixed cropping techniques which are to be disseminated to the farmers, mixed seedling in particular has been scientifically verified to have comparative advantage on yield on experimental basis. At farmers' field level, however, adaptability of rice-based mixed cropping techniques is difficult to be verified by the project completion due to drought or semi-drought since the Project has started.

2. Summary of Evaluation Results

(1) Relevance: high.

The relevance of the Project is considered to be high from the following viewpoints.

1) conformity with needs for increasing crop production in seasonal wetlands in north-central Namibia is high.
2) relevance to the national policies of Namibia which shows agriculture as the priority issues of the economic sector and the strong promotion of rice production.
3) conformity to the assistance policy of Japan to Namibia, which states the contribution to the improvement of the present living standard and the reduction of poverty in the rural area, is high.
4) holistic approach based on the areas of Crop Science, Development Studies and Hydrology taken by the Project was appropriate.
5) comparative advantage of technical cooperation by Japan which has long history in rice research, socio-economic analysis and hydrological analysis.

(2) Effectiveness: moderately high.

The degree of development of the "Flood- and drought-adaptive cropping systems" which can sustainably preserve the water environment of the semi-arid region is experimentally established. On the other hand, the project team could not collect sufficient data due to severe drought for verifying the rice-based mixed cropping systems at the farmer's fields. According to the economic survey, however, 32 farmers out of 111 farmers have adopted and harvested rice even in severe drought condition, which partly supports the effectiveness of the

proposed mixed cropping systems. Also, the logical flow from each of the four outputs, such as Crop Science, Development Study, Hydrology and Integrated Study of Agricultural and Social Science to the project purpose as to develop the "Flood- and drought-adaptive cropping systems" was appropriate.

(3) Efficiency: moderate.

The efficiency of the Project is considered to be moderate from the following viewpoints.

1) dispatch of Japanese researchers was mostly appropriate in terms of number of persons, expertize and research capacity, etc.
2) most of the agricultural machinery, measuring and laboratory equipment and materials provided have been well utilized, however, some such as dry oven, incubator and rice milling machines were observed to be not in full use because of the delay in arrival or due to low production of rice caused by severe drought.
3) though there have not been observed any negative effect to the smooth implementation of the project activities, several counterparts including six personnels who have participated the training in Japan turnovered mainly due to study leave.

(4) Impact: likely to be moderately high.

Part of the Overall Goal is likely to be achieved, especially in regard with the food security of the farmers. There were several positive impacts observed and negative impact was not observed.

1) Prospect of achieving the Overall Goal

The overall goals are set as follows:

1. "Flood- and drought-adaptive cropping systems" are disseminated in north-central Namibia to contribute to the food security and cash income of local farmers.
2. "Flood- and drought-adaptive cropping systems" are considered in the northeastern area of Namibia of high rainfall as well as in neighboring countries.

UNAM and MAWF have made efforts to obtain budget for the next financial year (from April 2017 to March 2018). Workshops for farmers will be held at 12 locations in five regions and field days will be held five times. Therefore, it is expected that field days and workshops on the rice-based mixed cropping techniques will be held periodically after the completion of the Project in north-central and north-east of Namibia. When more local farmers introduce/adopt these techniques, it is expected to contribute to food security of local farmers. As for implementation of regional research conference together with neighboring countries on "Flood- and drought-adaptive cropping systems", it is difficult to prospect whether such conference can be held within a few years after the completion of the Project. Also, the Terminal Evaluation Team cannot assess at this moment that the rice-based mixed cropping systems to be introduced in neighboring countries in a short period of time.

2) Other Positive Impacts Observed

a) Farmers' strong interests on rice cultivation and rice-based mixed cropping were observed.
b) Joint use of community's seasonal wetland was observed.
c) UNAM have made a proposal for research on new rice product.
d) Lecturers at UNAM Ogongo Campus have increased motivation for carrying out research activities.

(5) Sustainability: likely to be moderately high.

1) Policy aspect

Sustainable increase of agriculture production and productivity, food security, and income increase are regarded important in "Vision 2030", which is the national development strategy of the Government of Namibia. In addition, one of the overall goals of the Namibia Agriculture Policy for 2015 cleary shows 1) to develop and diversify agricultural production, 2) to promote agricultural research and adaptation of appropriate technology, and 3) to promote the sustainable utilization of resources for agricultural production to contribute and support disaster preparedness. Therefore, it is expected that the outcomes of the Project will be disseminated to wider areas with support by UNAM, MAWF, and regional governments.

2) Institutional and Financial Aspects

A joint budgetary proposal by UNAM and MAWF for the next financial year (from April 2017 to March 2018) was prepared and submitted for disseminating rice-based cropping systems and continuing a part of research activities which were conducted under the Project. Target areas for dissemination proposed by the plan are the north-central Namibia and Kavango region. Financial and institutional sustainability (on effective utilization and dissemination of the outcomes of the Project) can be considered relatively high, considering the progress the budget allocation.

3) Technical aspect

The Namibian counterparts are mainly lecturers and technicians of the Ogongo campus of the Faculty of Agriculture and Natural Resources of UNAM. Research skills of the Namibian counterparts have been strengthened through project activities such as joint research activities with Japanese researchers, short-term and long-term trainings in Japan, preparation of papers for submitting academic journals and proceedings for academic conferences/seminars. Their knowledge and skills enhanced under the Project will be utilized for academic activities at UNAM. Technical sustainability is expected to be secured.

As for the effective use and maintenance of the provided machinery and equipment, most of them are still new and severemalfunction or problem has not occurred. However, it is preferable that more staff members of UNAM need to be trained to acquire knowledge and skills on operation and maintenance of tractors, hand power tillers, milling machines, UAVs etc.

3. Factors that promoted realization of effects

(1) F actors concerning to the implementation process

None

(2) Factors concerning to the implementation process

1) Enthusiasm of Namibian and Japanese researchers brought useful research outcomes.
2) Research activities parallel to learning at doctoral level promoted the effective implementation of the project activities.
3) Improved communication with the project team has contributed to prepare publications (academic papers) in more collaborative and organized manner.

4. Factors that impeded realization of effects

(1) Factors concerning to planning

None

(2) Factors concerning to the implementation process

1) Severe drought became a limiting factore in obtaining expected research results.

5. Conclusion

This Project is in line with the policies and strategies of the Government of Namibia and is based on the needs for increasing the agricultural productivity in seasonal wetlands in north-central Namibia. The Project purpose is likely to be achieved and despite the four-year consecutive trend of low rainfall has given negative effect, the Terminal Evaluation Team has confirmed that the Project produced good research results and the guidelines for “Flood- and drought- adaptive cropping systems” is established on experimental basis. Positive impacts are observed such as most of the farmers, who experienced rice-based mixed cropping and rice cropping, keep higher interest on cropping at seasonal small wetlands and they have willingness to continue it. Furthermore, since UNAM and MAWF have allocated budget for continuous research and dissemination activities at at certain amount and that capacity of UNAM counterparts has been improved, sustainability of the project is likely to be high (however, effective utilization and operation and maintenance of the provided machinery and equipment are necessary). According to the above results, it is concluded that the Project will be completed in February 2017 as scheduled.

6. Recommendations

6-1. Recommended Actions to be taken by the Project Teams (Namibian counterparts and Japanese researchers) in the Remaining Cooperation Period (up to February 2017)

(1) Reviewing and refining the Guidelines to suit the target users by the Project Teams

(2) Discussion on the research and dissemination activities by UNAM and MAWF to be continued after the completion of the Project

(3) Reviewing and revising the Inventory list of JICA provided machineries and equipment, and estimating the cost of operation and maintenance of these machineries and equipment

(4) Amendment of the PDM (revising the “Objectively Verifiable Indicator 2” from “holding reginal research conference with neighbouring countries” to “sharing information with neighboring countries”)

6-2. Recommended Actions to be taken by the Namibian Authorities Concerned

(1) Preparation of a detailed implementation plan for UNAM's research activities and dissemination activities

(2) Enhanced partnership and clear demarcation of roles and responsibilities between UNAM and MAWF/regional governments for further dissemination of the rice-based mixed cropping systems.

(3) Drawing a utilization plan of machineries and equipment provided by the Project and continuously securement of budgetary allocation for maintenance of machineries and equipment including refresher training for technitians.

7. Lessons Learned

(1) Though low rainfall during the project period significantly affected crop cultivation at the farmers' small wetlands, discussions between the stakeholders about the achievement level of the outputs during the five year project period were not enough. For the future projects, when serious external factors hinder the project implementation, it is desirable that JICA and JST have closer and prompt communication with the Project to seek for alternative measures to address the situation.

(2) Periodical meetings both in Namibia and in Japan were conducted with the team leader's close communication in preparation and yearly plans and research results in each study area were shared at these meetings. These information sharings have contributed to the Namibian partners to obtaine how to manage effectively in the international collaborative project with several research institutes. In the future research projects, these know-hows are expected to be utilized for some other projects/programs.

第１章　終了時評価調査の概要

１－１　終了時評価調査の背景

ナミビア共和国（以下、「ナミビア国」と記す）における「半乾燥地の水環境保全を目指した洪水–干ばつ対応農法の提案」プロジェクトは、2012 年 2 月から 5 年間の予定で開始され、プロジェクトの残り期間が約 6 カ月となったことから、本終了時評価を実施することになった。

１－２　終了時評価調査の目的

本終了時評価調査は、最新版のプロジェクト・デザイン・マトリックス（Project Design Matrix：PDM）に基づき現在までの活動実績、成果とプロジェクト目標の達成度を確認し、さらに評価 5 項目の観点からプロジェクトの評価を行うとともに、プロジェクト終了前後の活動に関する提言と類似案件のための教訓を得ることを目的とする。なお、現地調査においては国立研究開発法人科学技術振興機構（Japan Science and Technology Agency：JST）からも評価メンバーが参加し、収集済みの情報等とナミビア側及び日本側研究者ヒアリング、プロジェクト成果発表に係るワークショップ参加を通じて研究の進捗状況や成果を確認し、科学技術的視点からの評価を行うとともに、国際共同研究運営の改善のための提言を行う。JICA は科学技術の専門的観点からの助言を JST から得る。

１－３　終了時評価団

本終了時評価は、日本側評価団とナミビア側関係者との合同評価として実施された。両国側の評価メンバーを以下に示す。

（１）日本側評価団

No.	担当	氏名	組織・職位
1	団長／総括	大島　歩	JICA 農村開発部　農業・農村開発第二グループ　第三チーム課長
2	協力企画	浅岡　真紀子	JICA 農村開発部　農業・農村開発第二グループ　第三チーム主任調査役
3	科学技術計画・評価	国分　牧衛	JST 国際科学技術部（SATREPS グループ）研究主幹
4	科学技術計画・評価	小平　憲祐	JST 国際科学技術部（SATREPS グループ）調査員
5	評価分析	道順　勲	中央開発株式会社　海外事業部

（２）ナミビア側評価団

No.	担当	氏名	組織・職位
1	団長	Prof. Edosa OMOREGIE	Professor, Department of Fisheries and Aquatic Science, Sam Nujoma Campus, UNAM
2	メンバー	Prof. Nelago INDONGO	Director, Multidisciplinary Research Center（MRC）, UNAM

１－４　終了時評価日程

2016 年 8 月 13 日から 9 月 3 日まで。

詳細日程は付属資料 2 を参照のこと。

１－５　主要面談者

（１）ナミビア大学（University of Namibia：UNAM）

Prof. Osmund Mwandemele	Pro-Vice Chancellor：Academic Affairs（Project Director）
Prof. Kenneth Matengu	Pro-Vice Chancellor：Research Innovation and Development
Dr. Simon Angombe	Faculty Dean, Faculty of Agriculture and Natural Resources（FANR）
Prof. Edosa OMOREGIE	Professor, Department of Fisheries and Aquatic Science, University of Namibia, Sam Nujoma Campus（FANR）（Joint Evaluation Team Member）
Prof. Nelago INDONGO	Director, Multidisciplinary Research Center（MRC）（Joint Evaluation Team Member）
Dr. Christopher Mberema	Assistant Pro-Vice Chancellor, Ogongo Campus
Mr. Mathew Nghihangwa	Campus Manager, Ogongo Campus
Mr. Martin Samuel	Farm Manager, Ogongo Campus
Mr. Benisiu Thomas	Lecturer, Deputy Director Academic Affairs and Research, Ogongo Campus（C/P of Development Studies Team）
Prof. Fisseha Itanna	Lecturer, Head of Department of Crop Science, Ogongo Campus（C/P of Crop Science Team）
Mr. Simon K. Awala	Lecturer, Department of Crop Science, Ogongo Campus（C/P & Project Manager）
Mr. Leonard Nuugulu	Lecturer, Department of Crop Science, Ogongo Campus（C/P & Assistant Project Manager）
Dr. Jack Kambatuku	Lecturer, Department of Integrated Environmental Sciences, Ogongo Campus（C/P of Hydrology Team）
Mrs. Ottilie T Shivolo	Lecturer, Department of Crop Science, Ogongo Campus （C/P of Development Studies Team）
Mr. Teofilus Lwiinga	Field supervisor, Department of Crop Science, Ogongo Campus（C/P of Crop Science Team）

（２）農業・水・森林省（Ministry of Agriculture, Water and Forestry：MAWF）

Dr. B. Malima	Deputy Director of Plant Production, Directorate of Research and Development
Mr. Martin Embundile	Chief Agricultural Scientific Officer, Omusati Region（Outapi）
Ms. Magdalena Sheetekela	Chief Agricultural Scientific Officer, Omusati Region（Outapi）
Ms. Wilhelmina Amashili	Senior Agricultural Extension Technician（AET）, Oshana Region
Ms. NAWA Ottilie	AET, Oshikuku, Omusati Region

Ms. Shapenga Kaunapawa　　AET, Okalongo, Omusati Region

（３）高等教育研修変革省（Ministry of Higher Education, Training and Innovation）

Dr. Alfred van Kent　　Permanent Secretary

（４）日本人専門家

飯島　盛雄	近畿大学農学部教授
檜山　哲哉	名古屋大学地球水循環研究センター教授
藤岡悠一郎	東北大学学際科学フロンティア研究所助教授
増田　忠義	近畿大学農学部准教授
秋山　真莉	業務調整／研修専門家

（５）在ナミビア共和国日本国大使館

坂本　秀之	特命全権大使
濱田　真一	参事官
横谷　薫	一等書記官

（６）JICA ナミビア支所

中村　俊介	支所長

１－６　終了時評価の方法

（１）評価手法

本終了時評価調査は、「新 JICA 事業評価ガイドライン第 1 版（2010 年）」に沿って、日本側及びナミビア側メンバーで構成される合同評価チームを結成し、プロジェクト関連資料のレビュー、プロジェクト関係者へのヒアリング、プロジェクト対象地区の視察と農民からのヒアリングを実施し、さらにプロジェクト成果に関するワークショップに参加し、PDM や活動計画（Plan of Operation：PO）に基づき、合同評価を行ったものである。評価においては、プロジェクトの実施プロセス、プロジェクト活動の進捗状況、プロジェクトの実績・成果の把握と分析を行い、また 5 項目評価（妥当性、有効性、効率性、インパクト、持続性）の観点からの評価も行った。現地においては、評価結果を英文報告書に取りまとめ、評価結果概要を、合同調整委員会（Joint Coordinating Committee：JCC）会議の際にプロジェクト関係者に説明した。

（２）評価項目

本プロジェクトに関する各種資料（詳細計画策定調査報告書、中間レビュー調査報告書、半期報告書、年次実施報告書、日本人専門家作成の終了時評価向け資料など）を参考にしつつ、また 2016 年 3 月 10 日に改定された PDM（Version. 3）に基づき、プロジェクトの成果、5 項目評価、実施プロセスに関する評価設問と収集必要なデータ等を設定した。

（３）データ収集方法

情報・データ収集は以下の方法により実施した。

情報・データ収集方法	目的	主な情報源
①文献調査	プロジェクトに関連する政策、プロジェクトの実績に関連する資料	・ナミビア政府の長期ビジョン（Vision 2030） ・第 4 次国家開発計画 2012/13-2016/17（Namibia's Fourth National Development Plan） ・2015 年ナミビア農業政策 ・対ナミビア共和国 国別援助方針（2012 年 12 月）（外務省） ・国別データブック（2015 年 4 月）（外務省） ・詳細計画策定調査報告書（JICA、2011 年 12 月） ・中間レビュー調査報告書 ・年次実施報告書（H23, H24, H25, H26） ・専門家作成のプロジェクトの投入・活動・実績に関する資料
②インタビュー	プロジェクトの実績・進捗状況及び実施プロセスに関するヒアリング・確認	・日本人専門家（日本側研究者及び業務調整専門家） ・ナミビア側カウンターパート（C/P）（主として UNAM 農業天然資源学部の教員・技術者等） ・MAWF の普及員・幹部職員 ・実証農家／実践農家／一般農家
③質問票	プロジェクト実績、成果発現状況、効率性、インパクト、持続性等に関する事項の把握	・ナミビア側 C/P

（４）評価実施上の制約要因

研究活動を通じて収集された詳細データをプロジェクトチームから入手することが困難で、具体的な成果がみえにくいこと。

中間レビュー調査報告書で指摘されているように、本プロジェクトでは、プロジェクトチームメンバー間の合意事項として、論文を投稿するまで研究活動にかかわる詳細データは公開しない方針である。その影響で、例えば、実証農家や実践農家で実施されている混作栽培にかかわるデータ（栽培面積や収量データなど）を入手することができなかった。また、ベースライン調査や村落モノグラフ作成が進められたが、具体的で詳細なデータの入手が困難であった。これらのことが影響して、どのような成果が具体的に上がっているのか、あるいは、どのような理由でデータが不足し、科学的に実証できる分析まで至っていないのかなど、日本人研究者やナミビア側カウンターパート（Counterpart : C/P）から詳細に説明を受けるまで理解は難しいという面があった。

また、通常の評価日程では、日本人研究者及び C/P からプロジェクトの進捗と成果についての説明を受け、その後に活動現場を視察し、さらに関係者にインタビューするというプロセスを踏み評価レポートを作成するが、本プロジェクトでは成果発表会が JCC 会議の前日に設定されているため、成果の達成状況の理解において不十分な面を残しながら評価を進めざるを得なかった。

第２章　プロジェクト概要

２－１　プロジェクトの背景

ナミビア国は南部アフリカに位置し、その国土面積は約 82 万 km²、人口は約 220 万人である。一人当たり GNI は 4,270 米ドル（2010 年、世銀）と中進国に位置づけられ、産業の中心はウラン、ダイヤモンド等の鉱業及び農林水産業である。農業については輸出向け牧畜が中心である一方で、国内で消費されている穀物の自給率は小麦 33%、メイズ 44%、ヒエ・ソルガム 95%（2007／2008 年、MAWF）と低く、穀物全体としては約半分の量を輸入に依存している。

ナミビア国は、ジニ係数が 0.74（2007 年）と世界で最も高い国の 1 つとされ、国内における経済格差が大きい。特に国内人口の約 60%が居住する北部 7 州は、食糧不足、教育・保健への限られたアクセス、電気の未整備などから、国内全体の貧困率が 28%であるのに対し、北中部・北東部においては、平均約 46.8%と特に貧困率が高い地域である（2006 年世帯調査、ナミビア国中央統計局）。

ナミビア国北中部は年間平均降水量 400mm の半乾燥地であるが、雨期になると隣国のアンゴラ高原から氾濫水が流れ込むため、広大な季節性湿地帯（以下、「季節湿地」と記す）が形成される。この地域では近年、降水量の変動が大きく、2008 年にはナミビア国北部の河川氾濫による洪水、翌 2009 年にはオカバンゴ川、クワンド川、ザンベジ川の水位が過去最高を記録する大洪水が発生し、2010 年には再びザンベジ川を中心に洪水が起こっている。この地域の降水量の年次変動をみると、200～1,000mm 程度で変動しており、アンゴラからの氾濫水が早期に一挙に押し寄せる年、氾濫が極度に遅れ洪水規模が小さい年が繰り返し発生しており、その結果、大洪水と干ばつという極端な水環境が同一地域で発生している。

ナミビア国北中部地域は、乾燥地作物であるトウジンビエの主要生産地であり、この地域の住民の大多数は、ナミビアの伝統的な主食であるトウジンビエの栽培と牧畜を生業とし、現金収入の手段をほとんどもたない自給自足農民である。2011 年頃までの大規模洪水の頻発により、トウジンビエの生産量が低下してきていることから、これまで栽培が行われてこなかった洪水耐性の一番高い穀物であるコメへの期待が高まっている。

このような状況下、ナミビア国北中部地域の自然環境に起因する不安定な水環境を保全しつつ、季節湿地が形成される地域に居住する自給自足農民の食糧安全保障と経済的自立を実現するため、現地に適した農法の開発に資する研究が必要とされたことから、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）が要請され 2012 年から本事業が実施されてきた。

２－２　プロジェクトの概要

プロジェクト期間中、PDM の改定が行われているが、終了時評価においては PDM Version 3 に基づき評価を行った。PDM Version 3 の概要を以下に記載する。

（１）上位目標

１．「洪水–干ばつ対応農法」が、ナミビア国北中部において普及し、現地農家の食糧確保と

現金収入の獲得に寄与する。
2．「洪水–干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。

（2）プロジェクト目標

半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」が開発される。

（3）成果

1．【作物学領域】洪水–干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。
2．【開発学領域】「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。
3．【水文学領域】湿地の水収支・水源解析により、水環境を改変しない混作栽培可能面積が推定される。
4．【総合領域】フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。

（4）活動

1.1 イネを基幹とする混作栽培の確立に必要な耕種法を検討する。
1.2 節水栽培技術を安定同位体法等により検討する。
1.3 洪水–干ばつ等の環境ストレスに対する対応策や土壌肥沃度の維持対策を検討する。
2.1 実証と実践試験に参加する農家の社会経済状況や営農形態を調査する。（ベースライン調査）
2.2 実証試験参加農家に対し、活動目的に関して事前了解を得るとともに、作物学・水文学領域の活動で得られた知見をワークショップ等を通じ共有する。
2.3 実証試験参加農家の研究内容・目的共有の理解の変化に関する評価を実施し、展開における留意点を整理する。
2.4 農家圃場の立地を景観生態学的観点から分類する。
2.5 新たな作付体系を農民が選択あるいは拒否する判断基準や生産された作物の利用方法、湿地に対する農家の意識変化を明らかにし（農家経済、労働分配調査)、社会経済面の持続性を検討する。
3.1 現地の地形図、各種衛星画像、並びに現地観測データなどから、季節湿地全域の地表水貯留量変動を推定する。
3.2 現地観測データ（降水量、蒸発散量、地下浸透量）を基礎として、季節湿地の水収支を時系列的に解析する。
3.3 実証試験と実践試験を実施する農家圃場内の小湿地の水源を解析する。
4.1 小湿地を有する篤農家圃場において、イネを基幹とする混作栽培の実証栽培試験を実施する。
4.2 イネを基幹とする混作栽培を希望する農家において、実践栽培試験を実施する。
4.3 開発学・水文学領域の検討結果を作物学領域に毎年フィードバックすることにより、半乾燥地の水資源を持続的に保全しうるような節水型であり、かつ、洪水と干ばつにも対

応可能なイネを基幹とする混作栽培を検討する。

4.4　現地でのフィールド・デーの開催などを通じて、ナミビア大研究者・技術員などが、新しく提案される農法に係る農民参加型研究・普及を実施する。

（５）実施機関

１）責任機関：教育省国家科学技術局

２）実施機関：ナミビア大学農業天然資源学部（Faculty of Agriculture and Natural Resources：FANR）

（６）受益者

FANR 研究者及びナミビア国北中部地域の農民。

（７）対象地域

FANR オゴンゴ校及びナミビア国北中部の季節湿地。

（８）プロジェクト期間

5 年間（2012 年 2 月 28 日～2017 年 2 月 27 日）

詳細については、付属資料 3 の PDM Version 3（仮和訳版）を参照のこと。

第３章　プロジェクトの実績と実施プロセス

３－１　投入実績

３－１－１　日本側投入

（１）日本人専門家派遣

延べ 2 名の業務調整／研修担当専門家と 20 名の日本人研究者（短期専門家として）がナミビア国に派遣された。担当専門分野は、作物学、開発学、水文学である。日本人専門家に関する派遣実績詳細は、付属資料 1 の英文評価レポートの Annex 3 を参照のこと。

（２）C/P の本邦研修

イネを含む混作農法に係る農民参加型普及技術に関する国別本邦研修が、2012 年と 2013 年に計 2 回実施された。これら国別研修には合計で UNAM の 9 名の研究者と MAWF の 19 名の農業普及技術者（普及員）らが参加した。UNAM の研究者 1 名が、近畿大学の博士課程を完了した。現在、もう 1 名の UNAM 研究者が近畿大学の博士課程で学び、また MAWF の職員 1 名が同大学の修士課程で学んでいる。さらに、UNAM の研究者 16 名（延べ人数）が短期研究プログラムに参加した（主に近畿大学で研修が実施された）。本邦研修に関する詳細実績については、英文評価レポートの Annex 4 を参照のこと。

（３）機材・資材類の供与

日本側から、研究活動用並びにプロジェクト事務所用の機材及び資材類が供与されている。主な機材には、車輌、コピー機、コンピュータ、プリンター、トラクター、耕耘機、脱穀機、精米機、灌漑用ポンプ、ボーエン比[4] 測定システム、雨量計測システム、測量機器、土壌サンプリング器などがある。資機材の価格総額は約 967,000 米ドルである。供与資機材の詳細リストについては、英文評価レポートの Annex 5 を参照のこと。

（４）日本側負担現地活動経費

プロジェクト活動実施のために日本側が負担した現地活動経費は、2016 年 6 月末時点で約 1,090 万ナミビア・ドル（Namibian Dollars : NAD）（約 787,000 米ドル）である。この活動経費に含まれるものは、日本人専門家のナミビア国内交通費、プロジェクト雇用技術者や労働者の給料、会議費、その他一般活動経費である。詳細については、英文評価レポートの Annex 6 を参照のこと。

３－１－２　ナミビア側投入

（１）プロジェクト活動に参加した C/P

終了時評価時点で、12 人の C/P がプロジェクト活動に参加している。この人数には、プロジェクト・ダイレクター、プロジェクト・マネージャー、アシスタント・プロジェクト・マネージャーを含む。12 名全員が UNAM 所属の職員（研究者や技術者）である。プロジェクト開始当初から終了時評価時点までの C/P 配置に係る詳細情報については、

[4] 潜熱フラックスに対する顕熱フラックスの比。蒸発散量を間接的な物理量から推定するための手法（熱収支法）。

英文評価レポートの Annex 7 を参照のこと。

（2）ナミビア側負担経費

ナミビア側は表３－１、３－２に示すように、主にナミビア側研究者の交通費や施設経費を負担した。予算計上額合計は、1,896,000 NAD（2017 年 3 月まで）であり、また実際の支出総額は 1,052,812 NAD（2016 年 6 月末まで）である（米ドル換算額は、それぞれは 136,400 米ドル及び 75,700 米ドルとなる）。

表３－１　ナミビア側がプロジェクト経費として確保した予算額

（単位：NAD）

項目	2012 年 4 月-2013 年 3 月	2013 年 4 月-2014 年 3 月	2014 年 4 月-2015 年 3 月	2015 年 4 月-2016 年 3 月	2016 年 4 月-2017 年 3 月	合計
確保された予算額	500,000	250,000	200,000	500,000	446,000	1,896,000

表３－２　ナミビア側が実際に支出した経費

（単位：NAD）

項目	2012 年 4 月-2013 年 3 月	2013 年 4 月-2014 年 3 月	2014 年 4 月-2015 年 3 月	2015 年 4 月-2016 年 3 月	2016 年 4 月-2016 年 6 月	合計
トラクターやディスクハロー	522,674	222,102	210,235	85,751	12,050	1,052,812
運営及び交通費						
オゴンゴ校の施設利用経費						

（3）UNAM による事務スペース、土地、施設の提供

UNAM は、プロジェクト活動に必要な日本人専門家用事務スペース、ラボラトリー、温室、作物栽培試験圃、種子保管庫、コメ袋詰め室、物品倉庫を提供している。詳細については、英文評価レポートの Annex 8 を参照のこと。

３－２　プロジェクト活動の進捗状況

プロジェクト活動は、プロジェクト開始以降、PDM や PO に沿って実施されてきた。活動項目ごとの活動の進捗状況及び主な成果並びにプロジェクト残り期間の活動について、終了時評価調査団が各種進捗報告書やプロジェクトチームメンバー（日本人専門家及びナミビア側 C/P）から得た情報に基づき作成したものを表３－３に示す。

表３－３　活動の進捗状況と主な成果（プロジェクトより提出された報告書類に基づく）

活動項目		進捗と主な成果	進捗度	プロジェクト残り期間の活動
1-1	イネを基幹とする混作栽培の確立に必要な耕種法を検討する。	適切な栽培方法を検討するため各種の栽培試験が、UNAM オゴンゴ校、近畿大学、滋賀県立大学、実証圃場設置農家で実施されてきた。実施された主な栽培試験は次の点である。 １）UNAM オゴンゴ校内の大型傾斜実験圃場及び小型の水田圃場では、混作栽培条件下における収量、生産性及び水分生理の評価。 ２）近畿大学では、土耕及び水耕条件下における混作作物の、土壌ストレス応答、生存試験、水源調査、収量性に関する各種基礎研究。 ３）滋賀県立大学では、各種栽培試験として、混作における成長と生産性、コメとトウジンビエを用いた混作と単作における水利用効率に係る試験。 ４）実証農家 12 戸の圃場を用いて混作に係るモデル試験栽培が行われ、また、111 戸の実践農家圃場の一部で収量調査が実施された。	ほぼ完了	2016 年 9 月に日本作物学会の講演会で複数の発表が行われる予定。
1-2	節水栽培技術を安定同位体法等により検討する。	節水栽培技術を検討するため、近畿大学では、ライシメーター設置圃場において地下水制御技法の試験が実施された。安定同位体法を用いた検討結果として、イネとトウジンビエの苗を同じ地点で栽培（接触栽培）することで、混作作物の地下水依存率が高まるとともに、水利用効率が向上することがみられた。洪水ストレスを与えた状態で同様の栽培試験が、UNAM オゴンゴ校の大型傾斜圃場で実施され、安定同位体法を用いて、混作栽培における水源調査（降雨、湿地の水、地下水）と深層水と深層水利用効率が計算された。これら試験結果が完了後に順次、複数の論文が作成される予定である。また、オゴンゴ校における試験結果からアジアイネ、アフリカイネ、ネリカの水分生理と水利用効率に係る基礎的な知見が得られた。	ほぼ完了	2016 年 10 月の日本熱帯農業学会の講演会で 1 つの発表が行われる予定。
1-3	洪水−干ばつ等の環境ストレスに対する対応策や土壌肥沃度の維持対策を検討する。	近畿大学と滋賀県立大学で、混作における環境ストレス（塩類、乾燥、貧栄養など）に係る基礎試験（ポット試験及び圃場試験）が実施された。アジアイネ、アフリカイネ、ネリカの総計 37 品種を用いた、乾燥耐性、塩耐性、炭水ストレス耐性に係る品種間比較研究がポット試験で完了した。また、乾燥ストレス、湛水ストレス、塩ストレスの各条件下で、コメとその他の穀類との接触混作の試験（ポット試験）が実施され、その結果、接触混作が乾燥適応穀類の洪水ストレス耐性を強化するポテンシャルを有することが判明した。 貧栄養条件下における有機物由来窒素への混作作物の依存度に係る試験が実施された。その後、在来マメ科作物のカウピー（ササゲ）をイネ・トウジンビエ混作体系へ組み込むため、カウピーの湛水ストレス耐性及び塩ストレス耐性に係る基礎試験が実施された。土壌肥沃度維持のための検討として、ナミビア国の季節河川流域における土壌サンプル調査が実施され、その調査結果にかかわる論文が投稿された。牛糞の投入試験が実施され、その成果は日本で 9 月に開催される学会で発表される予定である。	ほぼ完了	今後、3 つの論文が提出予定で、複数の学会の講演会で発表が予定されている（2016 年 9 月の日本作物学会の講演会と同 9 月の日本土壌肥料学会の年次大会）。

<table>
<tr>
<td>2-1</td>
<td>実証と実践試験に参加する農家の社会経済状況や営農形態を調査する。（ベースライン調査）</td>
<td>2012 年 12 月 12 日に、ある一村の 9 農家を対象としたベースライン調査のプレテスト（予備調査）が実施された。その後、2013 年 2 月 4 日から 2 月 16 日にかけてベースライン調査が実施され、386 農家に対するインタビュー調査が実施された。比較的情報整理ができた一村（Onamundindi（オナムンディンディ）の 38 戸）を対象とする村落モノグラフが作成され、季節湿地における社会経済の経時的変化を解析する基礎資料とすることになった。その際、村の社会構造などに関する情報が不十分であったので、2015 年に村長を対象とする追加のインタビューが実施され、得られた情報が村落モノグラフに加えられた。その村落モノグラフの骨子をまとめた論文が最近、学会誌に投稿された。また、調査結果を基に村落モノグラフを冊子として UNAM 側で出版する予定である。これらの活動の結果、政府による統計では把握しきれていない農村の多様な実態が明らかになった。具体的には以下の点である。
１）農村家庭間の違い・格差
✧リソースあるいは農業用ツール（鍬、鋤、トラクターなど）の所有状況
✧老齢年金、障害者年金、子供手当の受給の有無による所得格差
✧種子調達：ほとんどの農家は種子を購入しない。ただし、改良品種については、政府の販売する種子やローカル市場で販売されている種子を購入する。また、前作期で種子を収穫できなかった場合、種子を購入する。
２）小作農家は非常に少ない。ほとんどの農家が所有地を持つ。所有地面積の格差は大きくなく、平均的な土地所有面積は、2～3ha である。
３）約 80%の農家が所有地内に小湿地を有する。</td>
<td>ほぼ完了</td>
<td>UNAM によるビレッジモノグラフ文書の最終化と印刷。この文書は、UNAM の基礎資料になるとともに、MAWF と共有される予定。</td>
</tr>
<tr>
<td>2-2</td>
<td>実証試験参加農家に対し、活動目的に関して事前了解を得るとともに、作物学・水文学領域の活動で得られた知見をワークショップ等を通じ共有する。</td>
<td>2012 年から 2013 年にかけて 3 村で実証試験を実施する農家が選定された（計 9 農家）。農家の敷地内に実証農家圃場が設置され、また水位計や雨量計も設置された。実証農家は、他の村落で 2014／15 年に 2 戸増加し、2015／16 年に 1 戸増加した。農家選定の際、農家を個別に訪問して活動目的についての説明が実施され、さらに実証農家が位置する村及び周辺の村において複数のワークショップが開催された。その際、プロジェクトの概要や混作栽培技術についての説明が行われ、また混作栽培に係る農家の認識に関する情報収集が行われた。また実証農家圃場では、混作試験栽培と水文データの収集・モニタリングが実施された。実証試験参加農家等に対する作物学・水文学領域に活動で得られた知見等を共有するためのワークショップが複数の村において開催された。その実績を下表に示す。

＜農家とのワークショップ＞
<table>
<tr><th>No.</th><th>年月日</th><th>対象村落名</th><th>参加者数
(括弧内は、農家数)</th><th>ワークショップの主な内容</th></tr>
<tr><td>1</td><td>2012 年 9 月 5 日</td><td>Ohaingu</td><td>11</td><td rowspan="3">伝統的な農業と新しい混作栽培に関する農家の認識を知るための、ファームスケッチ手法を用いたフォーカス</td></tr>
<tr><td>2</td><td>2012 年 9 月 6 日</td><td>Onamundindi</td><td>23</td></tr>
<tr><td>3</td><td>2012 年 12 月 12 日</td><td></td><td>17</td></tr>
</table>
</td>
<td>完了</td>
<td>---</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>4</td><td>2013 年 3 月 5 日</td><td></td><td>27</td><td rowspan="3">グループディスカッション。</td></tr>
<tr><td>5</td><td>2013 年 3 月 9 日</td><td></td><td>27</td></tr>
<tr><td>6</td><td>2013 年 3 月 14 日</td><td>Omagalanga</td><td>16</td></tr>
<tr><td>7</td><td>2013 年 12 月 17 日</td><td>Omagalanga</td><td>23</td><td rowspan="7">（1）伝統的な農業と新しい混作栽培に関する農家の認識を知るための、ファームスケッチ手法を用いたフォーカスグループディスカッション。
（2）実証農家としての参加意思の確認（候補農家に対する対面調査）</td></tr>
<tr><td>8</td><td>2013 年 12 月 18 日</td><td>Afoti</td><td>41</td></tr>
<tr><td>9</td><td>2014 年 12 月 4 日</td><td>Ombafi</td><td>20</td></tr>
<tr><td>10</td><td>2014 年 12 月 15 日</td><td>Afoti</td><td>17</td></tr>
<tr><td>11</td><td>2014 年 12 月 16 日</td><td>Onamundindi</td><td>15</td></tr>
<tr><td>12</td><td>2014 年 12 月 18 日</td><td>Oshiteyatemo</td><td>13</td></tr>
<tr><td>13</td><td>2014 年 12 月 19 日</td><td>Omagalanga</td><td>8</td></tr>
<tr><td>14</td><td>2015 年 7 月 16 日</td><td>---</td><td>---</td><td>学校の生徒に対するワークショップ</td></tr>
<tr><td>15</td><td>2015 年 8 月 19 日</td><td>Omagalanga</td><td>28</td><td rowspan="4">（1）プロジェクト概要と混作栽培方法についての説明。
（2）農家の土地管理と農法の認識に関する追加調査。</td></tr>
<tr><td>16</td><td>2015 年 11 月 13 日</td><td>Omagalanga</td><td>23</td></tr>
<tr><td>17</td><td>2015 年 11 月 14 日</td><td>Osikuku</td><td>23</td></tr>
<tr><td>18</td><td>2015 年 12 月 22 日</td><td>Afoti</td><td>27</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>2-3</td><td>実証試験参加農家の研究内容・目的共有の理解の変化に関する評価を実施し、展開における留意点を整理する。</td><td>実証農家や実践農家に対して研究内容や目的を説明した後、実証農家及び実践農家を訪問し、農業実践に関する観察が行われた。また、ファームスケッチや個別インタビューを繰り返すことによって、双方向（農家とプロジェクトメンバー間）の学びが実施されるとともに、活動の展開に関する情報整理が行われた。混作についての農家の理解内容が、プロジェクト側の意図するものと乖離がある可能性が判明したため、混作農法について繰り返し農家にフィードバックを行うとともに、稲作実践農家視察をアレンジし、一部実証農家自身の言葉による説明を記録して、研究者と農家のコミュニケーションの改善方法の可能性が検討された。この過程で、農家が大学から得た情報をもとにどのように新しい栽培技術を採択するか（または拒否するか）の指標を農家自身が発言できる環境づくりを目指し、研究者と農家の対話型・参加型研究手法の試行を続けた。それらの活動結果の一部が、学会の講演会で発表された。</td><td>ほぼ完了</td><td>---</td></tr>
<tr><td>2-4</td><td>農家圃場の立地を景観生態学的観点から分類する。</td><td>2013 年初めに、Onamundindi 村の 10 農家の圃場で、季節湿地の生態環境に関する予備的な聞き取り調査が実施され、湿地環境や周辺の自然環境に対する農家の認識について把握され、農家が小湿地を分類する際に鍵となる指標が抽出された。農家圃場の立地を景観生態学的観点から分類するため、植生や土壌、水環境、地形などの景観構成要素の定量的な解析が実施された。同時に、農家の生態環境に対する認識や環境を区分する指標を抽出するためインタビュー及びワークショップが実施された。景観生態学的観点からの農家圃場における混作栽培方法の評価が進められている。</td><td>ほぼ完了</td><td>国際科学雑誌向けに 2 つの論文に向け準備中。</td></tr>
</table>

2-5	新たな作付体系を農民が選択あるいは拒否する判断基準や生産された作物の利用方法、湿地に対する農家の意識変化を明らかにし（農家経済、労働分配調査）、社会経済面の持続性を検討する。	新たな栽培体系を農家が選択あるいは拒否する判断基準、生産された作物の利用方法、湿地に対する農家の意識変化についての調査が、複数の調査手法を用いて実施された。用いられた手法は、①インタビュー、②ワークショップ、③スタディツアー、④ファームスケッチ、⑤携帯型 GPS、⑥無人航空機（UAV：通称「ドローン」）による空中撮影、⑦季節カレンダー、⑧ランキング法などである。これらの調査から、農家の混作に対する意識やその変化についての抽出が行われ、これらの結果については学会において報告済みである。また、2016 年 8 月時点で論文作成が進行中である。 農家経済及び労働分配については、2013 年 2 月のベースライン調査によって関連情報が収集された。その後、2016 年 5 月から 8 月にかけて、選定された農家（Onamundindi 村と Oshiteyatemo 村の実践農家と一般農家）を対象に、追加のインタビュー調査と情報収集調査が実施された。混作栽培が農家家計や労働分配に与える影響評価が現在進展中であり、2016 年 9 月には最終の評価結果が出る見通しである。小湿地における混作栽培の費用便益分析の予備的結果によると、混作栽培によってある程度の収益が得られる可能性がある。	ほぼ完了	2016 年 11 月に開催される国際開発学会の大会で、科学的成果の 1 つが発表される予定。 2 つの論文が国際学会誌に投稿される予定。
3-1	現地の地形図、各種衛星画像、並びに現地観測データなどから、季節湿地全域の地表水貯留量変動を推定する。	UAV を用いた連続写真空撮と SfM-MVS 技術とを組み合わせた写真測量が小湿地を分解可能なスケールで実施された。具体的には、プロジェクト対象地域の以下に示す範囲の中の 16 区域が調査対象となった。 １）北部地域の 6 区域（17°27′00”S - 17°30′00”S, 15°21′00”E - 15°24′00”E） ２）中部地域の 6 区域（17°43′00”S - 17°46′00”S, 15°13′00”E - 15°16′00”E ３）南部地域の 4 区域（17°58′00”S - 18°01′00”S, 15°19′00”E - 15°22′00”E） 地表水貯留量の変動の時系列データが計算され、その後、2002 年から 2015 年までの 13 年間における 16 区域の地表水貯留量が、高解像度の衛生リモートセンシングデータを用いて計算された。その分析結果、上記 3 地域において推定された地表水貯水量は降水量の影響を受けて年々大きく変動しており、地域差も大きいことがわかった。	ほぼ完了	---
3-2	現地観測データ（降水量、蒸発散量、地下浸透量）を基礎として、季節湿地の水収支を時系列的に解析する。	UNAM オゴンゴ校を中心とする東西 180km、南北 60km のエリア内に 30 カ所に転倒マス式雨量計が設置され、降雨量データが継続的に収集された（オゴンゴ校内の雨量計を合わせると計 31 カ所）。その結果、4 年にわたる雨期の広域雨量マップを描くことができた。一方、ボーエン比測定システムがオゴンゴ校内の大型傾斜実験圃場内に 3 基、実験圃場に隣接する自然湿地圃場内に 1 基設置され、蒸発散量推計に必要な気象データが継続的に収集された。異なる地表状態（異なる作物と異なる地表面の状況）における蒸発散量の 4 年間の時系列データが得られた。この得られたデータとリモートセンシングデータを用いて、広域における蒸発散量が推計された。さらに、実証農家の小湿地の深層部分から土壌サンプルを採取し、土壌透水試験が実施された。その結果、地表水で湛水した状況にある小湿地における飽和透水係数が得られた。	ほぼ完了	米国で 2016 年 12 月に開催予定の AGU（アメリカ地球物理学連合）秋大会において 1 つの発表が行われる予定。

<table>
<tr><td>3-3</td><td>実証試験と実践試験を実施する農家圃場内の小湿地の水源を解析する。</td><td>オゴンゴ校内で降雨サンプルが採取され、それらの安定同位体組成が分析された結果、この地域の地表水と浅層地下水は、この地域の降水を起源とすることがわかった。また大気水収支解析と照らし合わせた結果、この地域の降水－蒸発散のリサイクル率（雨期平均）は、約 80%であり、雨期後半ほどリサイクル率が高い（地表面から蒸発散した水が再び降水となり、地表にもたらされる）ことが明らかとなった。また、実証農家の小湿地中央部に観測井が設けられ、水位の時系列データが取得された。データの分析結果、雨期の前半よりも後半のほうが小湿地の水位の低下速度は緩やかであることがわかった。</td><td>ほぼ完了</td><td>---</td></tr>
<tr><td>4-1</td><td>小湿地を有する篤農家圃場において、イネを基幹とする混作栽培の実証栽培試験を実施する。</td><td>栽培シーズン（作期）別の実証農家数は、下表に示すとおりである。

＜実証農家数＞
<table><tr><td colspan="2"></td><td>2012/13</td><td>2013/14</td><td>2014/15</td><td>2015/16</td></tr><tr><td colspan="2">実証農家数</td><td>9</td><td>9</td><td>11</td><td>12</td></tr><tr><td rowspan="5">村落ごとの農家数</td><td>Onamundindi 村</td><td>3</td><td>3</td><td>3</td><td>3</td></tr><tr><td>Afoti 村</td><td>3</td><td>3</td><td>3</td><td>3</td></tr><tr><td>Oshiteyatemo 村</td><td>3</td><td>3</td><td>3</td><td>3</td></tr><tr><td>Epayaliwa 村</td><td>---</td><td>---</td><td>2</td><td>2</td></tr><tr><td>Onandjandja 村</td><td>---</td><td>---</td><td>---</td><td>1</td></tr></table>
2012／13 作期は、厳しい干ばつが発生した年であり、いくつかの実証農家の圃場の小湿地でイネを移植することが困難であった。小湿地にたまる降水の貯留期間が長い農家の湿地でイネとトウジンビエの混作と降雨後（3 月）の移植の 2 種類の試験が実施された。同様の試験が、実証農家の小湿地において、2013／14、2014／15、2015／16 の各作期に実施された。</td><td>ほぼ完了</td><td>2016 年 11 月に開催される国際開発学会の大会で、科学的成果の 1 つが発表される予定。</td></tr>
<tr><td>4-2</td><td>イネを基幹とする混作栽培を希望する農家において、実践栽培試験を実施する。</td><td>イネを基幹とする混作栽培あるいは稲作を自主的導入する意思を示した農家にイネを苗あるいは種子が配布された。本プロジェクトでは、この種類の農家を「実践農家」と分類している。下表に作期ごとの実践農家数を示す。

＜実践農家数＞
<table><tr><td></td><td>2012/13</td><td>2013/14</td><td>2014/15</td><td>2015/16</td></tr><tr><td>実践農家数</td><td>72</td><td>88</td><td>76</td><td>128</td></tr></table>
2015／16 作期に、Onamundindi 村及び Oshiteyatemo 村の実践農家各 20 戸からデータを収集し、社会経済インパクト評価が実施された。また、それぞれの村で湿地での作物栽培を行っていない一般農家を 20 戸選定し、データを収集した。2015／16 作期のイネを基幹とする混作栽培の圃場実証作業が完了し、収集データの分析が進められている。</td><td>ほぼ完了</td><td>2016 年 11 月に開催される国際開発学会の大会で、科学的成果の 1 つが発表される予定。</td></tr>
</table>

		2015／16 作期には、111 戸の実践農家でイネを基幹とする混作栽培が実施され、そのうち 32 農家でコメの収穫があった。また、トウジンビエとソルガムの収穫があったのは 30 戸と 27 戸であった。大まかにいって、実践農家の約 4 分の 1 が何らかの収穫を得た。		
4-3	開発学・水文学領域の検討結果を作物学領域に毎年フィードバックすることにより、半乾燥地の水資源を持続的に保全しうるような節水型であり、かつ、洪水と干ばつにも対応可能なイネを基幹とする混作栽培を検討する。	JCC 会議の際や日本での年次会合の際に、研究成果が開発学チーム及び水文学チームから作物学チームに対しフィードバックされた。また、イネを基幹とする混作栽培の提案に関する議論が、2016 年 8 月 29 日に開催された本プロジェクトのワークショップで行われた。	ほぼ完了	---
4-4	現地でのフィールド・デーの開催などを通じて、UNAM 研究者・技術員などが、新しく提案される農法に係る農民参加型研究・普及を実施する。	2013 年 3 月から 2016 年 6 月までに、計 10 回のフィールド・デーが開催され、イネを基幹とする混作栽培方法、イネの栽培スケジュール、プロジェクト概要、トラクター・ハイアリング・スキーム、耕耘機の運転デモンストレーションなどについての説明が実施された。第 1 回目（2013 年 3 月）の参加者数は 462 人で、第 2 回目（2014 年 3 月）の参加者数は、529 人であった。農家が参加するだけでなく、MAWF 次官、政治家、市長、伝統的権威者なども参加した。また、第 3 回目（2014 年 4 月）のフィールド・デーでは、中等学校の生徒と教師が参加した。第 5 回目（2016 年 3 月）のフィールド・デーには、オムサティ州の州知事が参加した。また、同州知事の要望を受け、2016 年 6 月にはコメ収穫祭がオゴンゴ校で開催され、州知事、UNAM 副学長、郡政府議員など、150 名以上が参加した。 フィールド・デーのほかに、農家参加型ワークショップが 18 回開催された。開催場所は、オゴンゴ校、Ohaingu 村、Onamundindi 村、Omagalanga 村、Afoti 村、Osikuku 村、Oshiteyatemo 村である。参加した農家数は延べ 358 人である。 このほか、MAWF の普及員や、UNAM スタッフ、農家等を対象とする各種のセミナーやワークショップも開催された。 フィールド・デー、ワークショップ、セミナー等の開催情報詳細については、英文評価レポートの Annex 9 を参照のこと。	ほぼ完了	最終回のフィールドデー（あるいはワークショップ）が 2016 年 12 月に村落で開催される予定。

３－３　成果（アウトプット）の達成状況

３－３－１　成果 1:【作物学領域】　洪水–干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。

洪水–干ばつ条件に対応し、かつ節水型である栽培技術の開発に係る研究活動がプロジェクト期間中、着実に進捗してきた。研究成果の分析結果は、各種国際誌あるいは国内誌への論文投稿といった形で取りまとめられている（4 つの論文が出版済み、1 つの論文が印刷中、2 つの論文が提出済み、さらに 5 つの論文を投稿予定)。分析結果はまた日本やナミビア国で開催された多くの学会／セミナー等で発表された（既に 26 件の発表が行われ、さらに 8 件の発表が行われる予定)。プロジェクトチームは、6 つの栽培技術で構成されるイネを基幹とする混作栽培農法を提案している。それら技術のなかでも特に接触混植については農家圃場レベルでの実証はまだできていないものの、試験レベルで収量の比較優位性が科学的に実証されたことは特筆すべき成果である。これらの成果から、成果 1 の達成度はおおむね高いと判断する。

指標 1-1：作物学、熱帯農学等の関連分野の学会や国際セミナーでの発表・報告回数（27 回）

作物学、熱帯農学等の関連分野の学会や国際セミナーでの発表回数は、2016 年 8 月までに 26 回を数える。さらに、2016 年末までに 8 件の発表が予定されている。発表回数総計は 34 回となる。学会発表に係る詳細情報については、英文評価レポートの Annex 10 を参照のこと。

指標 1-2：関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 6 件以上

査読付きの作物科学分野の学術誌への論文投稿数は、2016 年 8 月時点で 7 件である（4 件が出版済みで、1 件が印刷中、2 件が投稿済み)。さらに、5 件の論文が 2017 年 3 月までに投稿される見通しとなっている。その場合、論文投稿数の合計は 12 件となる。これら論文の詳細情報を表３－４に示す。

表３－４　発表済み論文と投稿予定の論文

	発表済み/印刷中/受付済み	執筆者名、論文名、出版物名、出版年など	国際誌あるいは国内誌
A：ナミビア人研究者及び日本人研究者の共同執筆			
1	発表済み	Suzuki, T., T. Ohta, Y. Izumi, L. Kanyomeka, O. Mwandemele, J-I. Sakagami, K. Yamane, and M. Iijima, Role of canopy coverage in water use efficiency of lowland rice in early growth period in semi-arid region. Plant Production Science, 2013, 16（1), 12-23.	国際誌
2	発表済み	Awala, S.K., K. Yamane, Y. Izumi, Y. Fujioka, Y. Watanabe, K.C. Wada, Y. Kawato, O. Mwandemele, and M. Iijima, Field evaluation of mixed-seedlings with rice to alleviate flood stress for semi-arid cereals. European Journal of Agronomy, 2016, 80, 105-112.	国際誌

3	発表済み	Iijima, M., S.K. Awala, Y. Watanabe, Y. Kawato, Y. Fujioka, K. Yamane, and K.C. Wada, Mixed cropping has the potential to enhance flood tolerance of drought-adapted grain crops. Journal of Plant Physiology, 2016, 192, 21–25.	国際誌
4	投稿済み	Nanhapo et al., Mix cropping with ice plant alleviates the damage and the growth of cowpea under consecutive NaCl treatment and after the recovery from high concentration of NaCl.	国際誌
5	投稿済み	Watanabe, Y., F. Itanna, Y. Fujioka, A. Petrus, and M. Iijima, Characteristics of soils under seasonally flooded wetlands（oshanas）in north-central Namibia. Journal of Arid Environments.（6. Jun. submitted）	国際誌
6	投稿予定	（This paper will be submitted in October 2016） Watanabe et al., Soil fertility status of seasonally closed wetland ecosystem（Ondombe）in Northern Namibia.	国際誌
7	投稿予定	（This paper will be submitted in November 2016） Iijima et al., Oxygen transfer between mix-cropped rice and pearl millet in water culture.	国際誌
8	投稿予定	（This paper will be submitted in January 2017） Watanabe et al., Inspect the amount of cow manure and chemical fertilizer dosage for rice, pearl millet and cowpea in north-central Namibia.	国際誌
9	投稿予定	（This paper will be submitted in March 2017） Iijima et al., Effects of soil moisture conditions on the water relation and water source of intercropped rice and pearl millet.	国際誌
10	投稿予定	（This paper will be submitted in March 2017） Izumi et al., Examination of Water Use Efficiency in Mix-cropped Rice and Pearl millet.	国際誌
B：日本人研究者による執筆			
11	発表済み	Okazaki, Y., K. Yamane, Y. Izumi, and M. Iijima, Drought, salinity and flooding tolerance of Oryza sativa, Oryza glaberrima and their interspecific cultivars. Journal of Crop Research, 2014, 59, 23-30.	国内誌
12	印刷中	Izumi, Y., Y. Okazaki, K. Yamane, and M. Iijima, Evaluation of the Resistance to "Multiple Environmental Stress" of Oryza sativa, O. glaberrima and their Interspecific Progenies. - Effect of Drought and Re-watering on the Growth and Physiological Parameters of Rice Cultivars. - Journal of Crop Research, 61, 23-30.	国内誌

指標 1-3：水利用効率の高い節水栽培技術、並びに洪水–干ばつ等の環境ストレスにおいて生産性の高い農法のリスト

作物学チームは、表３－５の 6 種類の洪水–干ばつ対応栽培技術を提案している。これらの栽培技術はプロジェクト成果に係るワークショップ（2016 年 8 月 29 日）で説明され、また現在作成中の「洪水–干ばつ対応混作栽培農法ガイドライン」の中でもそれらの概略が説明されている。

表３－５　提案されている洪水-干ばつ対応栽培技術

	栽培技術名	技術の概要
1	水変動領域における混作栽培	農地の傾斜部分を利用し、低位部にはイネを栽培し、高位部にはトウジンビエを植える。この栽培技術を用いることで、イネとトウジンビエの両方の生存が可能となる。
2	畝とその溝における混作	畝の上部にトウジンビエを播種し、畝の溝部分にイネを植える。この技術を用いることで、トウジンビエもイネも良好に生育する。
3	接触混植	イネもトウジンビエも同じ地点（穴）に植える。この技術を用いることで、水利用効率が強化され、洪水、干ばつ、塩のストレスが軽減される。
4	降雨後の播種	雨期後期である 3 月の降雨後にイネを移植するにより厳しい干ばつを克服することについての試行が進捗中。
5	品種選抜	国際熱帯農業研究所（IITA）から調達したトウジンビエ及びカウピーなどの畑作物の洪水耐性品種の選抜。IRRI から調達した早生の陸稲品種の選抜試験が、オゴンゴ校で進行中。
6	土壌肥沃度維持	小湿地の水変動領域におけるカウピー導入と小湿地への牛糞の投入。

３－３－２　成果 2 :【開発学領域】　「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。

実証農家や実践農家の社会経済状況、営農状況を分析・理解するために、7 つの異なる手法、すなわち、①ファームスケッチ、②携帯型 GPS 調査、③無人航空機（Unmanned Aerial Vehicle : UAV）を用いた空中写真撮影、④アンケート調査、⑤村落モノグラフ作成、⑥景観分析、⑦ワークショップが適用された。上記手法のうち、①、④、⑤といった手法は、農家の主観的認識を理解するための手法であり、②と③といった手法は、農家の営農実践に係る情報をより客観的・正確に把握するためのものである。これら 2 つのタイプの手法を組み合わせることが、農家の認識や実態を把握するために有効であると確認された。

研究活動の結果 3 件の論文が投稿され、今後、5 件の論文が投稿される見通しである。また、研究活動の成果はナミビア国あるいは日本国で開催された多くの学会／セミナーで発表された（既に 19 回の発表が行われ、さらに 2 回の発表が予定されている）。これらの成果から、成果 2 の達成度はおおむね高いと判断する。

指標 2-1：実証栽培試験参加農家の研究内容・目的の理解の変化の記録

実証農家がいる村落で、ベースライン調査や質的調査が実施された。これらの調査を通じて収集されたデータや情報は整理中であり、論文の作成も進行中である。農家を対象とする追加調査も実施され、またファームスケッチ、アンケート調査、ワークショップ、携帯型 GPS 調査、無人航空機による空中写真撮影、景観分析などの手法を用いて、混作に対する農家の認識や農家における混作実践状況についても把握された。調査結果に基づく論文作成が進行中である。

7 つの手法の利用目的と利点を表３－６に示す。

表３－６　適用した手法の利用目的と利点

	手法名	利用目的	長所と弱点
1	ファームスケッチ	・農家の認識を理解するため。ファームスケッチは、研究者と農家間の対話のためのツールである。	1）長所 - 研究者が農家の認識を理解できる。 - 図を描くことで、農家と研究者間で価値ある情報を交換することができる。 2）弱点 - 情報の大きさを記録できない。
2	携帯型 GPS 調査	・研究者が携帯型 GPS レシーバーを持って歩いた場所の図を描く。 ・農家の実践状況を研究者が把握することができる。	1）長所 - GPS 図は、地理情報に係る視覚的イメージを提供する。農家との情報共有を補助する。 - 区画の面積を容易に計算できる。 2）弱点 - 小さな区画の面積を測定するのは困難。 - 記録対象が研究者の認識によって限定される。
3	無人航空機を用いた空中写真撮影	・農家圃場の空中写真によって混作栽培形態を理解することが可能となる。	1）長所 - GPS 調査では把握することが困難な、詳細栽培体系をみることが可能。 - DEM（電子標高モデル：Digital Elevation Model）を作ることで微少な地理情報を得ることが可能。 2）弱点 - 無人航空機の操作が困難。 - 分析するためには、特殊な技能が必要。
4	アンケート調査	・世帯の経済社会状況を理解する。	1）長所 - 各世帯の状況についての量的データを得ることが可能。 2）弱点 - 質的データを得ることが困難。 - 質問の範囲内あるいは農家の期待にそって回答する傾向がある。
5	村落モノグラフの要約	・世帯の経済社会状況を理解する。	1）長所 - 村落モノグラフは、ある村落の社会経済状況について将来の変化を知るための基礎的情報となる。 - 研究者は、質的・量的情報の多面的視点で村落の情報を理解することができる。
6	景観分析	・自然環境を理解する。これには人間による認識や利用を含む。	- 景観は、ある土地の見ることができるすべての性質を包含するもので、土地形態の物理的要素、生活要素、人的要素、土地利用を含む。
7	ワークショップ	・双方向のコミュニケーションを通じて農家と研究者間で情報を共有する。	- ファシリテーション技能がワークショップを成功させるうえで重要である。

開発学チームは、本プロジェクトの 4 つの側面の社会的インパクトを把握した。具体的には、①農家中心の普及手法の開発（稲作導入）、②イネを基幹とする混作栽培に対する農家の認識の変化、③季節湿地利用に係る農家の認識変化（農家は伝統的に「湿地は作物栽培に適していない」とみなしていたが、本プロジェクトを通じて湿地であっても作物（コメ、トウジンビエ、ソルガムなど）の栽培・収穫が可能であると認識し始めた）、④コミュニティ共有湿地の共同利用。イネを基幹とする混作栽培農法の持続性について、開発学チームは次の 4 つの要因に左

右されると指摘している。それらは、①イネを基幹とする混作栽培を行うインセンティブ、②混作栽培農法適用における農家が自発性に同農法を実践できること、③リソース（湿地、コメ種子、耕起用機械）の利用可能性、④イネを基幹とする栽培技術の普及方法のシステム化。

指標 2-2：ナミビア大学研究者による手法の成果発表回数（9 回）

プロジェクト活動実施の結果、開発学チームは農家の態度や認識変化を理解し、イネを基幹とする混作農法の導入を通じた農家への社会経済的インパクトを理解するため、ファームスケッチ等の 7 種類の手法を確立した。

現状の認識を理解する研究手法と社会経済インパクトについての発表が、2016 年 8 月まで、学会やセミナーで計 14 回行われた。2016 年中にさらに 3 つの発表が予定されている。したがって、発表総数は 17 回となる。なお、発表についての詳細情報は、英文評価レポートの Annex 10 を参照のこと。

指標 2-3：混作の景観生態学的評価の方法に関する学会や国際セミナーでの成果報告回数（7 回）

混作農法に関する景観生態学的評価手法に関する発表は、2016 年 8 月までに 7 回を数える。さらに 2016 年末までに 1 件の発表が予定されている。発表回数総計は 8 回となる。学会発表に係る詳細情報については、英文評価レポートの Annex 10 を参照のこと。

指標 2-4：関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 5 件以上

開発学関連で査読付き学術誌への論文投稿数は、2016 年 8 月時点で 3 件であり、さらに年末まで 5 件の論文が投稿される予定である。その場合、論文数の合計は 8 件となる。論文の詳細情報は表３－７に示すとおりである。

表３－７　発表済み論文と投稿予定の論文

	発表済み/印刷中/受付済み	執筆者名、論文名、出版物名、出版年など	国際誌あるいは国内誌
A：ナミビア人研究者及び日本人研究者の共同執筆			
1	受付済み	Nishikawa, Y., O. Shivolo, M. Hangula, B. Thomas, M. Hangula, T. Maharero, and Y. Fujioka, Village Monograph of an Agro-pastoral Society in North-central Namibia. Ryukoku Journal of Economics, accepted.	国内誌
2	投稿済み	（This paper was submitted） Kaida, K., Nishikawa, Y., Thomas, B., Shivolo, O., and Hango, V., What encouraged households to adopt rice as a new crop? Development in Practice.	国際誌
3	投稿予定	（This paper will be submitted in September 2016） Thomas et al., Understanding the variations of cropping patterns focused on the gaps between farmer’s perceptions and practices in north-central Namibia.	国際誌

4	投稿予定	（This paper will be submitted in September 2016） Njunge et al., Variation in composition of plant species growing in small ponds（oondombe）of the Cuvelai Basin seasonal wetlands in north-central Namibia.	国際誌
5	投稿予定	（This paper will be submitted in September 2016） Fujioka et al., Evaluation of mixed-cropping patterns using aerial photos taken by UAV.	国際誌
6	投稿予定	（This paper will be submitted in September 2016） Thomas et al., Application of multiple survey techniques for improving scientist's understanding and farmer's consent.	国際誌
7	投稿予定	（This paper will be submitted in September 2016） Fujioka et al., Diversity of seasonal small wetlands（oondombes）landscape and its recognitions by local people in north-central Namibia.	国際誌
B：日本人研究者による執筆			
8	受付済み	甲斐田きよみ・西川芳昭. 稲作試行が女性農民の行う世帯内意思決定に与え得る影響―ナミビア北部オヴァンボ人の事例. 農村生活研究, 第 59 巻第 2 号	国内誌

３－３－３　成果 3：【水文学領域】　湿地の水収支・水源解析により、水環境を改変しない混作栽培可能面積が推定される。

各種データを分析した結果、水環境を改変しない混作栽培可能面積は、Cuvelai 季節湿地システム内の土地面積の 3～7%であろうとの推計が出た。水文学領域の各種研究活動の結果は、各種の論文にまとめられ、国際的学術誌あるいは国内の学術誌に投稿された（4 件の論文が発表され、さらに 5 件の論文を投稿予定）。研究成果はまた日本あるいはナミビア国で開催された各種の学会／セミナーで発表された（16 回の発表が行われ、さらに 1 回の発表が予定されている）。このような状況から、成果 3 の達成度は高いと判断する。

指標 3-1：地表水貯留量変動、水収支、小湿地の水源等のデータ取得

以下の種類のデータが収集された。

① 衛星画像データ（AMRS-E/AMSR2、MODIS、ランドサット ETM＋）
② 31 カ所の雨量計設置地点の雨量データ（4 年間分）（雨量計設置地点は、農家圃場、普及事務所、オゴンゴ校）（収集されたデータを用いて、広域雨量分布図が作成された）
③ UNAM オゴンゴ校内の傾斜試験圃場と隣接地の自然湿地における蒸発散量データ（4 年間分）（地表及び異なる植生状況における時系列の蒸発散量データが収集された）
④ 無人航空機による写真撮影手法と SfM-MVS を用いた地表貯留量の変化に関するデータ
⑤ 9 戸の実証農家の小湿地における地表水の水位と地下水位のデータ（モニタリングが 3 年以上実施された）

収集されたデータを分析した結果、プロジェクトチームは以下の点を確認した。

① 最近 4 年間（2011／12～2015／16）の降雨量は、比較的少なかった。一方、2008／09 年及び 2010／11 年の雨期の降雨量は比較的多かった。
② 蒸発散量は地表状態に大きく影響を受けることがわかった。コメ栽培による水の損失は、

自然の湿地状態における水損失よりも小さかった。（すなわち、湿地にコメを栽培しても蒸発散による水損失は増加しない）

③ 小湿地の浅層地下水は、小湿地の地表水からもたらされた水である可能性が高い（降雨が主たる起源である）。

④ 水環境を改変しない混作栽培可能面積（最大面積）は、Cuvelai 季節湿地システム内の土地面積の 3～7%であろうと推計された。

指標 3-2:水環境を改変しない混作栽培可能面積についての関連分野の学会や国際セミナーでの発表・報告回数（10 回）

2016 年 8 月までに、水文と作物栽培に関連する発表が学会やセミナーにおいて合計 16 回実施された。もう 1 件の発表が 2016 年末までに予定されている。発表回数の合計は 17 回となる見込みである。なお、発表についての詳細情報は、英文評価レポートの Annex 10 を参照のこと。

指標 3-3：関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 6 件以上

水文学関連で査読付き学術誌への論文投稿数は 2016 年 8 月時点で 4 件であり、さらに年末まで 5 件の論文が投稿される予定である。その場合、論文数の合計は 9 件となる。論文の詳細情報は表３－８に示すとおりである。

表３－８　発表済み論文と投稿予定の論文

	発表済み/印刷中/受付済み	執筆者名、論文名、出版物名、出版年など	国際誌あるいは国内誌
A：ナミビア人研究者及び日本人研究者の共同執筆			
1	発表済み	Suzuki, T., T. Ohta, T. Hiyama, Y. Izumi, O. Mwandemele, and M. Iijima. Effects of the introduction of rice on evapotranspiration in seasonal wetlands. Hydrological Processes, 2014, 28, 4780-4794.	国際誌
2	発表済み	Hiyama, T., T. Suzuki, M. Hanamura, H. Mizuochi, J.R. Kambatuku, J.N. Niipele, Y. Fujioka, T. Ohta, and M. Iijima, Evaluation of surface water dynamics for water-food security in seasonal wetlands, north-central Namibia. IAHS Publication, 2014, 364, 380-385.	国際誌
3	投稿予定	（This paper will be submitted in September 2016） Hiyama et al., Analyzing origin of rain- and subsurface-water for water-food security in seasonal wetlands of north-central Namibia.	国際誌
4	投稿予定	（This paper will be submitted in September 2016） Mizuochi et al., High-resolution spatiotemporal monitoring of micro-scale seasonal wetlands in north-central Namibia with a new multiple data fusion of satellite images.	国際誌
5	投稿予定	（This paper will be submitted in December 2016） Kotani et al., Evaluation of surface conductance under water controlled crop experiment in north-central of Namibia.	国際誌
6	投稿予定	（This paper will be submitted in December 2016） Mizuochi et al., Estimating evapotranspiration from seasonal wetlands in north-central Namibia based on satellite data fusion and VI-Ts method.	国際誌

7	投稿予定	（This paper will be submitted in February 2017） Kambatuku et al., Coupling of the Frequency and Duration of Intraseasonal Dry Spells at Finer Spatial Scale to Synoptic Circulation Patterns and Implications for Rice Cultivation in the Cuvelai.	国際誌
B：日本人研究者による執筆			
8	発表済み	Mizuochi, H., T. Hiyama, T. Ohta, and K. Nasahara, Evaluation of the surface water distribution in north-central Namibia based on MODIS and AMSR series. Remote Sensing, 2014, 6, 7660-7682.	国際誌
9	発表済み	水落裕樹・檜山哲哉・金森大成・太田岳史・藤岡悠一郎・飯嶋盛雄・奈佐原顕郎．長期衛星観測データと UAV 地形測量を組み合わせた半乾燥地の季節湿地における貯水量モニタリング．日本リモートセンシング学会誌，2016，36（2），81-92	国内誌

３－３－４　成果 4：【総合領域】　フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。

作物学領域、開発学領域、水文学領域の研究活動の成果は、ナミビア側 C/P、日本人研究者、普及員、農家等の間で共有されてきた。2015／16 作期にイネを基幹とする混作栽培を実践した 111 戸の実践農家のうち、32 戸の農家の湿地でコメを収穫できた。トウジンビエとソルガムについては、それぞれ 30 戸、27 戸の農家で収穫があった。すなわち、国家緊急事態宣言が出るような厳しい干ばつ年であったにもかかわらず、対象とした農家の約 4 分の 1 に何らかの収穫があったといえる。なお、イネを基幹とする混作栽培農法についての経済的インパクトに係る詳細分析は 2015 年に開始されたところであり、その結果取りまとめは現在対応中であり、詳細分析結果を用いた論文が 2017 年 3 月までに学術誌に投稿される見込みである。このような状況から、成果 4 の達成度は中程度と判断する。

指標 4-1：フィールド・デーにおける農家向け、研究者向けの混作栽培モデルに関する毎年ごとの配布資料とりまとめ

イネを基幹とする混作栽培方法は、フィールド・デーやデモンストレーション／ワークショップを通じて普及員や農家に説明されてきた。各種のリーフレット類が普及員や農家に配布されてきた。リーフレット類のリストと主な内容を表３－９に示す。

表３－９　作成されたリーフレット類と主な内容

No.	言語の種類	作成年	主な内容
1	英語	2013	稲作技術（種子選別から移植まで）
2	英語	2013	イネの収穫と収穫後処理技術：イネ収穫から保管まで
3	英語	2014	稲作、収穫、収穫後技術
4	英語	2014	イネ苗床、移植、混植、肥料に関するスライド
5	英語	2013	イネとトウジンビエの混作栽培：スライド 10 枚
6	英語	2015	湿地における混作栽培
7	英語	2016	ナミビア国の新しいポリッジ「Oluthima」

8	英語	2016	コメの調理方法
9	英語	2014	湿地における圃場準備
10	英語	2014	厳しい干ばつをどう乗り越えるか？
11	オシワンボ	2013	稲作技術（種子選別から移植まで）
12	オシワンボ	2013	イネの収穫と収穫後処理技術：イネ収穫から保管まで
13	オシワンボ	2014	稲作、収穫、収穫後技術
14	オシワンボ	2015	湿地における混作栽培

指標 4-2：ナミビア大学研究者及び研究協力者による混作農法に関するフィールド・デーの実施

2013 年 3 月から 2016 年 6 月にかけて 10 回のフィールド・デーが開催された。フィールド・デーの内容は、イネを基幹とする混作栽培、コメ栽培スケジュール、プロジェクトの概要、トラクター・ハイアリング・パイロットサービス活動、耕耘機の模擬運転などである。フィールド・デーには、農家の参加のほか、MAWF の副大臣、UNAM 副学長、州政府の知事、地方政府の政治家、伝統的権威者、村のヘッドマンなども参加した。また、なかには中等学校の生徒と先生が参加したケースもあった。フィールド・デー参加者総数は約 1,950 人にのぼる。最後のフィールド・デー（あるいはワークショップ）の開催が、2016 年 12 月に予定されている。

上述したように、総合領域に関連する論文が査読付き学術誌に投稿される予定である。論文の詳細情報を表３－10 に示す。

表３－10　投稿予定の論文

	発表済み/印刷中/受付済み	執筆者名、論文名、出版物名、出版年など	国際誌あるいは国内誌
1	投稿予定	（This paper will be submitted in March 2017） Masuda et al., Integrated Assessment of Mixed Cropping System in Seasonal Wetland in the Northern Namibia.	国際誌

３－４　プロジェクト目標の達成見込み

プロジェクト目標：半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」が開発される。

作物学領域、開発学領域、水文学領域、統合領域で、各種の研究活動が順調に進展し、各種の論文作成と学会発表が行われてきた。また、研究成果を用いて農家及び普及員向けの各種リーフレットが作成されてきた。以下に述べるように、「洪水–干ばつ対応混作農法」に関するガイドライン（案）が作成され、これらガイドラインは、2016 年中に最終化される。農家に向けて普及されることになるイネを基幹とする混作栽培技術については、接触混植が試験レベルにおいて収量性において比較優位があると科学的に実証された。しかしながら、プロジェクト開始後の 4 年間干ばつあるいは干ばつ傾向であったため、プロジェクト終了までに農家レベルでイネを基幹とす

る混作栽培農法を実証することは困難な見込みである。

以上より総合的に判断して、プロジェクト目標の達成度は、2016 年中にはおおむね高い水準に達する見込みである。

指標：洪水–干ばつ対応農法ガイドライン（指針）が作成される。

ナミビア側及び日本側研究者が協力して 2 種類の洪水–干ばつ対応農法ガイドラインを作成中である。英文版のドラフトについては、これまでの研究成果を 4 つの領域ごと（①作物学、②開発学、③水文学、④統合領域）に説明しているものである。想定しているガイドライン利用者は、UNAM の研究者、MAWF の職員・普及員、農家である。別の種類のガイドライン（案）は、ローカル言語（オシワンボ語）で作成されている。このオシワンボ語のガイドラインの内容は作物学領域に絞っており、想定している利用者は農家である。これらガイドラインに関する情報は、2016 年 8 月 29 日に開催された本プロジェクトのワークショップ（プロジェクト成果発表）と翌日の第 9 回 JCC 会議で説明され、ガイドラインに対する意見・コメントを受けた。関係者の意見やコメントを反映しつつ、ガイドライン（案）の最終化が図られる予定である。最終化後、2016 年 12 月には、既に作成されたリーフレットと合わせて関係者に配布される予定である。印刷部数や配布先については、プロジェクトチームメンバー間で今後議論される予定である。参考として、ガイドライン（案）の内容を下表に示す。

（1）ガイドライン（案）の内容（英文版）

・プロジェクトの背景と目的 ・季節湿地へのコメ導入努力 ・季節河川における洪水の変動 ・農地内の小湿地をどう利用するか ・要約 【総合領域】 ・新しい食品「オルシマ（Oluthima）」 ・実践農家の実践事例 ・実証農家の実践事例 ・実践上の課題 ・生徒のためのフィールド・デー ・将来における近隣国との協力 【作物学領域】 ・提案する栽培技術のリスト ・提案する栽培技術	【水文領域】 ・要約 ・目標 ・手法 ・降雨の年変動 ・降雨の空間的分布 ・蒸発散量の一時的傾向 ・小湿地の地表水の起源 ・地表水の衛星リモートセンシング ・日地表水図の作成 ・小湿地の詳細地形測量 ・地表水量の空間一時的変化と降雨応答 ・コメ栽培のポテンシャルを持つ地域の分布 【開発学領域】 ・要約 ・序文

1）水変動領域における混作栽培 2）畝とその溝における混作 3）接触混植 4）降雨後の播種 5）品種選抜 6）土壌肥沃度維持 ・脆弱な水環境を保全するための作物学、開発学、水文学の共同作業。	・目標 ・調査方法 1）ファームスケッチ 2）携帯型 GPS 調査 3）無人航空機による空中写真撮影 4）アンケート調査 5）村落モノグラフ要約 6）景観分析 7）ワークショップ

（2）ローカル言語版のガイドライン（案）の内容

・提案する栽培技術のリスト ・提案する栽培技術 1）水変動領域における混作栽培 2）畝とその溝における混作 3）接触混植 4）降雨後の播種 5）品種選抜 6）土壌肥沃度維持 ・脆弱な水環境を保全するための作物学、開発学、水文学の共同作業。

なお、下図に示すように、プロジェクト開始後の 4 年間（2012／13～2015／16 作期まで）干ばつあるいは干ばつ傾向の年が続いた。そのため開発された混作栽培農法を洪水条件下で確認する機会はなかったといえる。

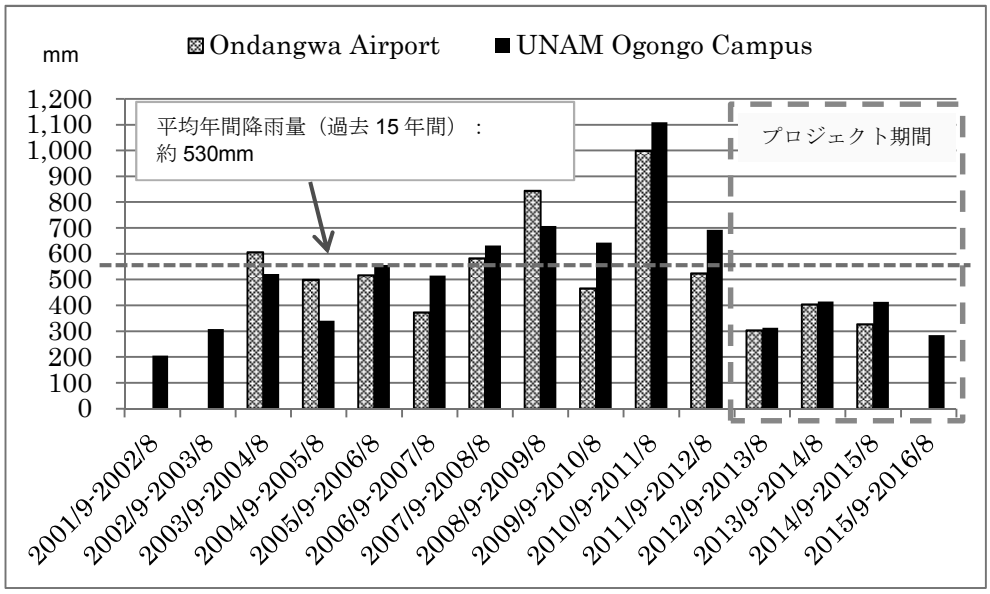

図　オゴンゴ校と Ondangwa 空港における年間降雨量の推移（2001／2 年から 2015／16 年まで）

３－５　実施プロセス

３－５－１　促進要因

（１）ナミビア側研究者及び日本側研究者の熱意

研究活動実施におけるナミビア側研究者及び日本側研究者の熱意が、有用な研究成果を生み出した。

（２）博士課程で学びと平行しつつ研究活動を実施

ナミビア側 C/P のなかには、日本の大学の博士課程で学びながら本プロジェクトの研究活動を実施した。このことは本プロジェクトの活動を効果的に実施するうえでの促進要因となった。

（３）コミュニケーション改善と計画的な学術論文の作成

中間レビュー時の提言を受けて、ナミビア側 C/P と日本人研究者間のコミュニケーションが改善し、また論文作成がより協働した形で計画的に進められた。

３－５－２　阻害要因

厳しい干ばつが、期待するような研究成果を得るうえでの制約要因となった。

第４章　評価結果

４－１　妥当性

以下に述べる事項から判断して、本プロジェクトの妥当性は高い。

（１）ナミビア国北中部の季節湿地における作物生産増加のニーズとの整合性

ナミビア国の農業部門は、GDP の 3.2%（Annual National Accounts 2015）を占め、北部における自給的農業生産と中南部における商業的牧場経営に大きく分けられる。ナミビア国は、穀物の 50%以上を輸入に依存し、また約 48%の農村部世帯は自給的農業に依存している。MAWF の 2008 年穀物生産・食糧状況レポートによると、穀物生産（トウジンビエ、ソルガム、メイズ）は、オムサティ州・オハングェナ州・オシャナ州・オシコト州の北中部 4 州で国内生産全体の 54%が生産されている。季節湿地が形成されるナミビア国北部の半乾燥地では、近年降水量の変動が大きく、河川氾濫による洪水が散発的に起こる一方で、干ばつも生じる地域である。そのため、この地域の伝統的作物であるトウジンビエの年間生産量は不安定で大きな増減がある。この地域の農家は、不安定な気候（洪水–干ばつ状況）に対応する作物栽培を実践したいとの意向をもっている。

本プロジェクトは、洪水年でも干ばつ年であっても一定以上の穀物生産が維持されるような水資源保全型の新しい農法を開発することを目的にしている。したがって、本プロジェクトはナミビア国北中部地域の農家のニーズにそったものである。

（２）ナミビア国の国家政策との整合性

ナミビア国政府の政策の 1 つである「Vision 2030」では、長期展望の 1 つとして「世帯レベル・国家レベルでの食糧確保と収入増加に貢献すると同時に、土地生産力の維持・向上も図っていくこと」が示されている。また、戦略の 1 つとして「より適応性があり、答えがある農法を適用すること、例えば、作物の単一栽培から混作、作物ローテーション、アグロフォレストリーなどによる換金作物生産への転換」が掲げられている。ナミビア政府の「2012／13～2016／17 年国家開発 4 カ年計画」における経済分野の優先事項の 1 つが農業であり、計画期間内の農業分野の年成長率目標を 4%に設定している。2015 年ナミビア農業政策の目的には、次の 3 点が示されている。①農業生産の開発・多様化、②農業研究振興と適正技術の適用、③災害への準備に貢献・支援する農業生産のための資源の持続的利用促進。ナミビア政府は、Kalimbeza 国家コメプロジェクト（ナミビア国の北東部に位置する）を通じてコメ生産振興を強力に図っている。したがって、本プロジェクトの目的とナミビア政府のこれら政策の重点事項との整合性は高い。

（３）我が国の対ナミビア国援助方針との整合性

我が国の対ナミビア国援助方針の一つは、「地方農村部における貧困削減・生活水準改善への貢献」である。北部地方の貧困層が抱える貧困・低所得を改善するためにナミビア政府が取り組んでいる「農業振興」の効果・効率的な実施に向けて、関連する人材の育成を支援する方針がある。本プロジェクトは、気候変動に対応する栽培方法を開発することを目的と

しており、そのような農法は、農村住民の食糧安全保障や生計向上に貢献するものである。したがって、本プロジェクトは、我が国の援助方針と整合性があるといえる。

（４）プロジェクトアプローチの適切さ

本プロジェクトでは、作物学領域、開発学領域、水文学領域の研究成果を総合して、半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」の開発を目指している。具体的に期待される成果は、次の点である。

１）洪水–干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培農法の提案。

２）イネを基幹とする混作農法導入における農民の認識変化と社会経済的インパクトを理解する方法の確立。

３）水収支・水源解析に基づく混作栽培可能面積の推定。

このプロジェクトアプローチは、対象地域の自然環境、利用可能な水資源、農家のニーズ、農業生産の現状を踏まえたものであり、適切なアプローチであったと考える。

（５）我が国がもつ技術的優位性

我が国には、稲作の長い歴史・経験をもち、日本国内だけでなく、アジア諸国やアフリカ諸国でも稲作研究の蓄積がある。また、節水型栽培技術、社会経済分析、水文解析等の技術開発において長い歴史を有する。さらに、名古屋大学や近畿大学は、2000 年代初めからナミビア国半乾燥地への稲作導入に関する活動実績[5] があり、また、ナミビア国からの研修生受入れやナミビア国への専門家派遣の実績もある。このように、日本国は、稲作導入等の分野において技術的優位性がある。さらに、日本側研究者と UNAM との間には非常に良い関係が築かれている。したがって、ナミビア側研究者への技術移転を含む共同研究活動を実施することで、意義ある良い成果を発現させることが可能であると思われる。

４－２　有効性

３－４節のプロジェクト目標の達成見込みで述べたように、作物学、開発学、水文学、総合の各領域で各種研究活動が良好に進展している。また、研究結果を用いて各種の論文が作成され、学会／セミナーでの発表も行われている。また、普及員・農家向けのリーフレット類も作成された。

半乾燥地の水資源を持続的に保全しうる「洪水–干ばつ対応農法」の開発に関しては、試験的には確立された。一方、厳しい干ばつが生じたためプロジェクトチームは十分なデータを得ることができず、イネを基幹とする混作栽培農法の農家圃場での実証には至らなかった。ただし、経済調査結果によると、厳しい干ばつ条件下でも 32 戸の農家がコメを収穫することができており、そのことは提案している混作栽培農法の有効性を部分的に示すものである。なお、各アウトプット（作物学領域、開発学領域、水文学領域及び左記を統合した総合領域の各領域）に基づき、プ

[5] ナミビア国における稲作導入に関して、名古屋大学の研究者が中心となって、技術協力プロジェクト「ナミビア大学農学部強化支援計画」（2001-2003）、技術協力個別案件（研修）及びフォローアップ事業「稲作導入理論」（2004-2010）、科学技術研究費補助金による「ナミビア国半乾燥地域におけるトウジンビエ栽培体系下での氾濫水利用型粗放稲作の導入」（2004-2007）および「季節湿地の水環境と人間活動に調和した粗放稲作の導入」（2008-2012）が実施されている。

ロジェクト目標である「洪水–干ばつ対応農法」が開発されるというロジックの流れは適切であった。以上より、本プロジェクトの有効性は、おおむね高いと判断する。

４－３　効率性

以下に述べる点から判断して、本プロジェクトの効率性は、中程度と判断する。

４－３－１　日本側の投入の適切さについて

いろいろな大学及び研究機関の日本人研究者がナミビア国を定期的に訪問（多くの場合、10～20 日間）する一方、1 名の業務調整専門家が長期に滞在した。日本人研究者の派遣については、その人数、専門性、研究能力等においておおむね適切であった。

研究活動のため、各種の車両、農業機械、測定機器、ラボ機器、資材（消耗品やスペアパーツを含む）が供与された。供与機材の大半は良好に活用された。しかしながら、乾燥機とインキュベータについては機材到着が遅れたためまだ利用されていない。また、籾摺り精米機が 2 台あるが、干ばつの影響で予想された量のコメの収穫がなかったためフルには活用されていない（1 台は、片方が故障した際の補完機能も想定されている)。2 台の無人航空機（通称ドローン）がフルに活用されているが、操作しているのは主として日本人研究者であり、今後ナミビア側で利用するためには、ナミビア側 C/P が操作方法を学ぶ必要がある。

本邦研修については、多くの場合、UNAM のナミビア側 C/P の研究能力とファシリテーション技能の強化に有効であった。なお、普及員が稲作技術に自信をもつためには、本邦研修がより実践指向でより長期の研修であったほうがよかったとの意見があった。ナミビア側 C/P 3 名が長期研修（博士課程と修士課程）に参加し、2 名については博士資格、もう 1 名については修士資格を得ることが期待されている。

４－３－２　ナミビア側投入の適切さについて

「３－１－２」で述べたように、終了時評価時点で 12 名の UNAM の C/P がプロジェクト活動に参加している（プロジェクト・ダイレクター、プロジェクト・マネージャー、アシスタント・プロジェクト・マネージャーを含む)。作物学チームについては延べ 11 人の C/P が参加し、現在 9 名が残っている。開発学チームについては延べ 8 名の C/P が参加し、現在 2 名が残っている。水文学チームについては延べ 2 名の C/P が参加し、現在 1 名が残っている。C/P の交替の主な理由は海外留学である。

UNAM はプロジェクト活動のために各種の施設の提供を行った。具体的には、日本人研究者／業務調整専門家用の執務室、ラボ、温室、作物試験圃場、種子室、コメ袋詰め室、保管庫である。これら施設はプロジェクト活動のために有効に利用されている。

UNAM のプロジェクトに対する資金面の貢献として、プロジェクト活動に必要な経費の支出に努力している。プロジェクト活動向けに計上された経費は、既に表３－１と表３－２に示したとおりである〔「３－１－２」の（２)〕。

４－３－３　プロジェクトマネジメント

既に述べたように、プロジェクトに係る会議が 2 種類ある。1 つは JCC 会議で、もう 1 つはマネジメント会議である。これまでに JCC 会議は 8 回開催され（年 2 回の頻度で、UNAM 本校あるいは Ongwediva 校で実施）、マネジメント会議は 16 回開催された（オゴンゴ校で 4 半期ごと）。ナミビア側 C/P によると、これら会議はよく組織され、プロジェクト活動の進捗状況のレビュー、次期の活動計画の承認、プロジェクト実施に伴う主要な問題点の議論において建設的であったと評価している。

４－４　インパクト

上位目標の一部、具体的には農家の食糧安全保障の貢献については一定程度達成できる見込みがある。また、複数の正のインパクトが観察され、負のインパクトは確認されなかった。本プロジェクトのインパクトの達成見込みは、おおむね高いと判断する。

４－４－１　上位目標の達成見込み（将来）

１.「洪水–干ばつ対応農法」がナミビア国北中部において普及し、現地農家の食糧確保と現金収入の獲得に寄与する。

２.「洪水–干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。

UNAM と MAWF は、ナミビア国北中部及び Kavango 地域（ナミビア国北東部）に「洪水–干ばつ対応農法」を普及するため、また「洪水–干ばつ対応農法」の研究活動を継続するため、次期予算年度（2017 年 4 月～2018 年 3 月）の予算獲得に向けた努力を行った。UNAM 作成の予算提案によると、農家向けワークショップが 5 州で 12 回実施し、フィールド・デーを 5 回実施する計画である。したがって、イネを基幹とする混作栽培農法に関するフィールド・デーやワークショップがプロジェクト終了後もナミビア国の北中部と北東部で定期的に実施される見込みである。より多くの農家が混作栽培技術を導入・適用するようになれば、農家の食糧安全保障に貢献することが期待される。

「洪水–干ばつ対応農法」について、近隣国と一緒に地域研究会合を実施することについては、2014 年 9 月に「南部アフリカ諸国における季節湿地の農業利用」と題する国際シンポジウム（本プロジェクトが主催したシンポジウム）が開催され、ザンビアとボツワナから計 2 名の参加があった。他方、終了時評価チームとしては、プロジェクト終了後の数年以内に同様のシンポジウムが実施されるかどうか判断することが困難である。また、終了時評価チームにとって、イネを基幹とする混作栽培農法が短期間に隣国に導入されるかどうか判断することも難しい。

４－４－２　その他のインパクト

（１）稲作及びイネを基幹とする混作栽培に対する農家の強い関心

実証農家や実践農家からの聞き取り結果によると、近年の継続する小雨のためコメやその他の作物の収穫がよくなかったにもかかわらず、農家は小湿地を利用したイネを基幹とする混作栽培を継続する強い意欲を示している。このことは、2015 年 6 月に開催されたコ

メの収穫祭に 200 名もの人（農家だけでなく、政府職員や生徒が含まれるが）が参加していることからもうかがえる。農家の高い関心が継続し、イネを基幹とする混作栽培農法が農家レベルで広がっていくことが期待される。

（2）コミュニティ所有の季節湿地の共同利用

2 カ村において、コミュニティ所有湿地が農家によって共同利用されたとの報告がある。このような共同利用は、自分の所有地内に利用可能な小湿地をもたない農家にとって、イネを基幹とする混作栽培を実践可能となる良い方法である。

（3）新しいコメ製品の研究に係る提案

本プロジェクトにおいて、砕米を利用してコメの粉にし、トウジンビエの粉と混合された（米粉が 50%で、トウジンビエの粉が 50%）新しい製品が作られた。本プロジェクトの副産物である。この混合粉を利用してポリッジを作ることができる。混合ポリッジの味はトウジンビエ 100%のポリッジより良いといわれている。UNAM は、コメを用いた新しい製品を作る研究のための提案書を準備している。

（4）UNAM オゴンゴ校の教員の研究活動実施に向けたモチベーション向上

ナミビア側 C/P によると、教員が教育のみに従事するだけでなく、これまでよりも研究プロジェクトに参画しようとする意欲が高まっているとのこと。

４－５　持続性

本プロジェクトの持続性については、以下に述べる点に基づき、おおむね高くなると見込まれる。

（1）政策面

４－１　「妥当性」で述べたように、ナミビア政府の政策や戦略では農業生産の持続的増加、食糧安全保障、収入増加が重視されている。UNAM、MAWF、州政府、農家では、稲作導入やイネを基幹とする混作栽培農法に対する関心が高まっている。したがって、本プロジェクトの成果が UNAM、MAWF、州政府の支援によってより広い地域に普及されていることが期待される。このように本プロジェクトの政策面での持続性は確保される見通しである。

（2）制度・財務面

プロジェクト終了後、イネを基幹とする混作栽培農法を普及し、また、プロジェクトで実施してきた研究活動の一部を継続するため、UNAM と MAWF が協働して 2017 年 4 月から 2018 年 3 月までの予算提案書を作成し、UNAM オゴンゴ校は 500,000NAD を UNAM 財務部に、また MAWF は 281,000NAD を財務省に提出した。予算提案書で計画されている普及対象地域は、ナミビア国の北中部地域（本プロジェクトの対象地域）と Kavango 州（ナミビア国北東部）である。提案書に記載されている活動内容には、UNAM 予算と MAWF 予算でカバーされるものがあり、具体的には以下のとおりである。

【A：UNAM オゴンゴ校における基礎研究のための予算でカバーされる項目、申請金額は500,000NAD】

① 臨時労働者雇用経費（圃場準備、灌漑、収穫、脱穀など）
② 消耗品費（ディーゼル燃料、肥料、収穫及び袋詰め材料）
③ コメ関連イベント開催経費（収穫祭、大会、会議）
④ 出版経費（ポスター印刷、冊子、ドキュメンタリー・フィルム）
⑤ その他経費（農村までの交通費、機械の維持管理費）

【B：MAWF がコミュニティサービスとしてカバーする項目、申請金額は 281,000NAD】

① コメ農家向けの研修ワークショップ開催経費（北中部地域と Kavango 州が対象）
② 種子・苗の供給経費（北中部地域が対象）
③ コメ農家フィールド・デー開催経費（北中部地域と Kavango 州が対象）
④ 農家圃場に設置した気象観測機器の維持費とデータ収集経費（北中部地域が対象）
⑤ ドキュメンタリー・フィルムに関連する経費（北中部地域と Kavango 州が対象）

作物栽培に関する情報や技術を提供することにおいて、UNAM と MAWF の間には強固な協働関係が築かれており、上記の予算面でのアレンジはイネを基幹とする混作栽培農法の普及と農法の更なる改良を促進するものである。ただし、提案している予算額が十分であるかどうか、確認することが望ましい。

予算計上に係る状況の進展具合から判断すると、本プロジェクトの財務面及び制度面の持続性（プロジェクトの成果を有効に活用し、普及すること）は、比較的高いと判断することが可能である。なお、上記予算には、JICA が供与した機材の維持管理費が含まれていないので、このための経費も確保する必要がある。

（3）技術面

ナミビア側 C/P は、主に FANR オゴンゴ校の教師や技術者である。さらに、MAWF の普及員や幹部職員がプロジェクト活動に協力した。日本人研究者との共同研究実施、短期あるいは長期の本邦研修、学術誌へ投稿するための論文作成、学会／セミナーのための発表原稿作成を通じて、ナミビア側 C/P の研究能力が強化された。一般的に、UNAM の教師や技術者は継続的に大学に勤務し、本プロジェクトにおいて強化された C/P の知識や技能は、UNAM における学術活動に活用される見通しである。したがって、技術面の持続性は確保されるものと期待される。

供与した機材類の有効利用や維持管理については、大半の機械類がまだ新しく、深刻な故障は発生していない。UNAM の 2 名の職員が本邦において農業機械の維持管理に係る研修を受講したものの、より多くの UNAM 職員がトラクター、耕耘機、籾摺り精米機、無人航空機などの維持管理に係る知識・技能を身に付けるため研修を受けることが望ましい。

４－６　結　論

4 年継続した小雨傾向が、農家圃場レベルにおける「イネを基幹とする混作栽培農法」の確立に負の影響を与えたものの、終了時評価チームは本プロジェクトにおいて良好な研究成果が生み出されていることを確認した。具体的には、「洪水–干ばつ対応農法」ガイドライン（現在、作成中）、学術雑誌向けの論文、学会／セミナーでの発表などである。作物学チームは、「洪水–干ばつ対応農法」の一部を構成する 6 種類の栽培技術を提案している。開発学チームは、農家の姿勢・認識の変化及び農家に対する社会経済インパクトを理解するために用いる 7 種類の手法を確立した。水文学チームは、季節湿地の水環境を変えることなく、イネを基幹とする混作栽培農法の導入可能な面積（最大面積）を推計した。

イネを基幹とする混作栽培あるいはコメ栽培を経験した大半の農家は、季節湿地で作物栽培することに高い関心をもち、また栽培を継続する意欲も高い。

評価 5 項目に基づく評価結果の要約を下表に示す。

項目	評価
妥当性	高い。
有効性	おおむね高い。
効率性	中程度。
インパクト	おおむね高くなる見込み。
持続性	おおむね高くなる見込み。

以上の評価結果に基づき、本プロジェクトは予定通り 2017 年 2 月に完了することが妥当である。

第５章　提言及び教訓

５－１　提　言

５－１－１　プロジェクトチーム（ナミビア側 C/P と日本人研究者）がプロジェクトの残り期間（2017 年 2 月まで）に行うべき事項に係る提言

（１）「洪水–干ばつ対応農法」ガイドライン（案）のレビューと改定

2 種類の「洪水–干ばつ対応農法」ガイドライン（案）が提案され、2016 年 12 月に配布する予定になっている。最終化のプロセスにおいて、それぞれのガイドラインの利用者の意見を反映しつつ、利用者にとってわかりやすい内容に仕上げることが望まれる。

（２）プロジェクト終了後に継続する活動の検討

本プロジェクト終了後に UNAM 側が継続的に実施していく研究・普及活動の内容・範囲について、UNAM 側の研究面の優先事項や人員体制を考慮したうえで十分検討することが求められる。検討した活動内容を基に、必要な予算と実施体制を用意する必要がある。

（３）JICA 供与機材の適切な管理

JICA 供与機材の物品管理台帳の見直しと改定を行ったうえで、UNAM 側に供与機材が適切に引き渡しされる必要がある。また、UNAM が必要な予算を確保するための基礎データとなるよう、本プロジェクトにおける機材類の維持管理費支出実績に基づき、供与機材の今後の維持管理経費（燃料・スペアパーツ代等を含む）を試算する必要がある。

（４）PDM の改定

終了時評価調査団は、上位目標の指標 2 及びその入手手段を改定することを提案する。その理由としては、プロジェクト終了後に、UNAM の自助努力により現実的に対応可能な活動内容に変更することが適切であると考えるためである（上位目標に関する「４－４－１」項参照のこと）。改定点（案）を表４－１に示した。また、英文の PDM 改定（案）（Version 4）は、英文評価レポートの Annex 11 参照のこと。PDM Version 4 案（仮和文）は、付属資料 4 を参照のこと。

表４－１　PDM ver.3 から PDM ver.4（案）への改訂点

項目	PDM ver.3	PDM ver.4（案）
上位目標の指標 2-1)	2-1)「洪水–干ばつ対応農法」に関する国際研究会合の近隣諸国との間での定期的な開催の合意と実施	2-1)「洪水–干ばつ対応農法」の研究成果に係る情報の共有が近隣諸国と定期的に行われる。
上位目標の指標入手手段	国際研究会合での記述	共有情報や同等物（通信情報等）

５－１－２　ナミビア側関係機関に対する提言

（１）プロジェクト終了後の UNAM の研究及び普及活動に係る詳細計画の作成

提言「５－１－１」の（２）の検討結果を踏まえ、UNAM 側がプロジェクト終了後における研究活動及び普及活動に係る詳細計画を作成することが望まれる。

（２）UNAM と MAWF／地方政府との連携強化

本プロジェクトでは、イネを基幹とする混作栽培の農家への普及を試験的に行った。今後、さらにこの栽培方法を普及するには、UNAM と MAWF・州政府との更なる連携強化及び各機関が担う役割の明確化が必要不可欠である。既に本プロジェクトを通して UNAM と MAWF との間には強固な関係の構築ができているが、今後さらにイネを基幹とする混作栽培を奨励するためには、その関係の維持・強化が望まれる。

（３）供与機材の継続的な維持管理

UNAM は、本プロジェクトの供与機材の運用計画を作成する必要がある。また、UNAM は技術者向け研修を含め、供与機材の維持管理に必要な予算を確保する必要がある。

５－２　教　訓

（１）プロジェクト期間中、小雨の年がつづき、小湿地における作物栽培に大きなダメージを与えたものの、本プロジェクトでは 5 年間のプロジェクト期間において目指す成果のレベルについて関係者間での摺り合わせが十分ではなかったと思われる。将来、類似のプロジェクトを実施する際には、このような外的要因を考慮しつつ、JICA と JST がより密接で素早い判断のもと、対応策を探すことが望まれる。

（２）日本側・ナミビア側がリーダーを中心に緊密に連絡を取りつつ、定期会合を日本・ナミビア国双方で開催し、各領域の活動に係る年間計画と研究成果を関係者全員に共有するなど、複数の研究機関との国際的協働プロジェクトをマネジメントする有効な方法を、ナミビア側 C/P が身に付けた。その得られたノウハウが将来の各種研究プロジェクト実施において活用されることが期待される。

付　属　資　料

１．ミニッツ及び合同終了時評価報告書（英文）

２．調査日程

３．PDM Version 3（仮和文）

４．PDM改定案 Version 4（仮和文）

MINUTES OF MEETING
ON
THE TERMINAL EVALUATION
ON
JAPANESE TECHNICAL COOPERATION (SATREPS)
ON
THE PROJECT FOR FLOOD-AND DROUGHT-ADAPTIVE CROPPING SYSTEMS TO CONSERVE WATER ENVIRONMENTS IN SEMI-ARID REGIONS IN THE REPUBLIC OF NAMIBIA

Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Faculty of Agriculture and Natural Resources, University of Namibia organized the Terminal Evaluation Team (hereinafter referred to as "the Team") from August 15 to September 1, 2016 in order to review the progress and achievements of the Technical Cooperation on the Project for Flood-and Drought-Adaptive Cropping Systems to Conserve Water Environments in Semi-Arid Regions (hereinafter referred to as "the Project ").

After the intensive study and analysis of the progress and achievements of the Project, the Team prepared a Joint Terminal Evaluation Report (hereinafter referred to as "the Report") attached and presented it to the Joint Coordinating Committee meeting that persons concerned with the Project participate in and which was held on August 31, 2016.

At the meeting, persons concerned with the Project discussed the major issued of the Project stated in the Report and agreed on the matters attached hereto.

Windhoek, September 1, 2016

Ms. Ayumu OHSHIMA
Leader,
Japanese Terminal Evaluation Team,
Japan International Cooperation Agency (JICA)

Dr. Alfred van KENT
Permanent Secretary,
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For witness

Dr. Morio IIJIMA
Professor,
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Kindai University

For witness

Dr. Osmund D. MWANDEMELE
Pro-Vice Chancellor,
Academic Affairs and Research,
University of Namibia

Attachment: Joint Terminal Evaluation Report

THE JOINT TERMINAL EVALUATION REPORT ON JAPANESE TECHNICAL COOPERATION (SATREPS) ON THE PROJECT FOR FLOOD- AND DROUGHT-ADAPTIVE CROPPING SYSTEMS TO CONSERVE WATER ENVIRONMENTS IN SEMI-ARID REGIONS IN THE REPUBLIC OF NAMIBIA

Windhoek, September 1, 2016

JOINT TERMINAL EVALUATION TEAM

Ms. Ayumu OHSHIMA	Prof. Edosa OMOREGIE
Leader	Leader
Japanese Terminal Evaluation Team	Namibian Terminal Evaluation Team
Japan International Cooperation Agency	University of Namibia

Table of Contents

1. Introduction
1-1 Background of the Project
1-2 Background of the Terminal Evaluation
1-3 Objectives of the Terminal Evaluation
1-4 Members of the Joint Terminal Evaluation Team
1-5 Schedule of the Terminal Evaluation
1-6 Methodology of the Terminal Evaluation

2. Outline of the Project
2-1 Summary of the Project
2-2 Implementation Structure of the Project

3. Achievement and Implementation Process of the Project
3-1 Inputs
3-2 Progress and Main Achievements of the Planned Activities
3-3 Achievement of Outputs
3-4 Prospects for Achieving the Project Purpose
3-5 Implementation Process

4. Results of Evaluation
4-1 Relevance
4-2 Effectiveness
4-3 Efficiency
4-4 Impact
4-5 Sustainability
4-6 Conclusions

5. Recommendations and Lessons Learned
5-1 Recommendations
5-2 Lessons Learned

Annexes
Annex 1: Schedule of the Terminal Evaluation
Annex 2: Project Design Matrix (PDM) Version 3
Annex 3: Dispatch of Japanese Researchers/Experts
Annex 4: Counterpart Personnel Trained in Japan
Annex 5: Equipment Procured by Japanese Side
Annex 6: Local Operational Expenses Covered by Japanese Side
Annex 7: List of Counterpart Personnel Involved in the Project Activities
Annex 8: Provision of Office Spaces, Land and Facilities by UNAM
Annex 9: Field Days, Participatory Workshops and Demonstrations Implemented
Annex 10: Presentations at Academic Conferences/Seminars
Annex 11: PDM Version 4

Acronym and Abbreviation

AMSR	Advanced Microwave Scanning Radiometer
AMSR-E	Advanced Microwave Scanning Radiometer for EOS
FANR	Faculty of Agriculture and Natural Resources
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
GPS	Global Positioning System
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
JST	Japan Science and Technology Agency
IITA	International Institute of Tropical Agriculture
IRRI	International Rice Research Institute
MAWF	Ministry of Agriculture, Water and Forestry
MODIS	Moderate Resolution Imaging Spectroradiometer
NERICA	New Rice for Africa
NAD	Namibian Dollars
PDM	Project Design Matrix
PO	Plan of Operation
R/D	Record of Discussions
SATREPS	Science and Technology Research Partnership for Sustainable Development
SfM-MVS	Structure from Motion, Multi View Stereo
UAV	Unmanned Aerial Vehicle
UNAM	The University of Namibia
UNDP	United Nations Development Programme
WDI	World Development Indicator

Currency Conversion Rate

1 US dollar = 13.9 Namibian Dollar (NAD) (as of August 2016)

1. Introduction

1-1 Background of the Project

Harmonization between development and environment conservation is one of the universal issues in the 21st century. Especially for the semi-arid areas of Africa, there is a certain amount of risk for rapidly disordered development that does not entail any consideration for the environment. On the other hand, periodic serious drought and deluge caused by heavy rains frequently affects semi-arid areas of Sub-Sahara Africa in recent years. Millions of people suffered and experienced shortage of food by the heavy rains from 2006 to 2007, for example. It is these new challenges due in some part to the change of the global environment that it is imperative to cope now with such contradistinctive water conditions.

Namibia is located in Southern Africa, an area of 824,000 km^2. The population is about 2,147,000 with its Gross National Income (GNI) per capita of US$4,270 (World Development Indicator (WDI), (World Bank, 2011). With its rich mineral resources, the economic growth marked 4.5% a year on average from 1990 to 2008 (WDI, 2011). Although Namibia is categorized as an Upper Middle Income country, the nation is one of the least equitable countries as proved out by its Gini coefficient of 0.74 (UNDP, 2007).

A quarter of the population lives in north central Namibia, where most of the inhabitants are subsistence farmers cropping pearl millet and livestock farming. The annual precipitation in the area is about 400 mm, but flood water from the Angolan plateau creates vast seasonal wetlands, utmost to about 800,000 ha during the rainy season. The amount of flood water has been widely changing in the last ten years, which causes serious deluge or drought to the area. Currently, the water resource of the seasonal wetland is not utilized for cropping but mainly for grazing. The reasons for the limited use of the existing water resources are: large spans of land are set aside as a national sanctuary for wild life, unstable flood intensity, etc. However, this vulnerable water environment is at risk of degradation if irrelevant large-scale development plans targeted for the area are all implemented as is.

Therefore, the Government of Namibia has requested the Government of Japan to undertake a technical cooperation project under the framework of the Science and Technology Research Partnership for Sustainable Development (SATREPS). This research project aims to develop "Flood- and drought-adaptive cropping systems" which can preserve water resources and cope with the yearly fluctuation of flood and drought. To develop "flood- and drought-adaptive cropping systems" through trials in the field of crop science, development studies, hydrology and the integrated study of Agricultural and Social Science is the goal. The project is also expected to contain measures that will adapt to climate changes.

1-2 Background of the Terminal Evaluation

The Namibia and Japanese sides respectively signed the Record of Discussions (R/D) on November 23, 2011. Based on the R/D, the Project for Flood- and Drought-Adaptive Cropping Systems to Conserve Water Environments in Semi-Arid Regions (herein after referred to as "the Project") commenced as five-year project in February 2012. Since the Project has now reached to around six months prior to the termination of the project period, a terminal evaluation has been conducted jointly by the Namibia and Japanese governments.

1-3 Objectives of the Terminal Evaluation

(1) To review the inputs to the Project, the progress and achievements of project activities based on the Project Design Matrix (PDM) and the Plan of Operation (PO), and also to exchange opinions with the Namibia authorities concerned by visiting the project sites,

(2) To review the Project from the viewpoints of the five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact and Sustainability),

(3) To formulate the Joint Terminal Evaluation Report and make necessary recommendations on project activities in the remaining period of the Project and after the completion of the Project period to both the Namibia and Japanese sides, and

(4) To participate in a Joint Coordinating Committee meeting to present and discuss the results of the Terminal Evaluation on the Project with the Namibia authorities concerned and sign the Minutes of Meeting.

1-4 Members of the Joint Terminal Evaluation Team

1-4-1 Japanese Terminal Evaluation Team

No.	Assignment	Name	Position and Organization
1	Leader	Ms. Ayumu OHSHIMA	Director, Agricultural and Rural Development Group 2, Rural Development Department, Japan International Cooperation Agency (JICA)
2	Cooperation Planning	Ms. Makiko ASAOKA	Deputy Director, Agricultural and Rural Development Group 2, Rural Development Department, JICA
3	Science and Technology Evaluation	Dr. Makie KOKUBUN	Research Supervisor, Japan Science and Technology Agency (JST)/ Professor Emeritus, Tohoku University
4	Science and Technology Evaluation	Dr. Kensuke KODAIRA	Associate Research Supervisor, JST
5	Evaluation and Analysis	Mr. Isao DOJUN	Consultant, Chuo Kaihatsu Corporation

1-4-2 Namibia Terminal Evaluation Team

No.	Assignment	Name	Present Occupation
1	Leader	Prof. Edosa OMOREGIE	Professor, Department of Fisheries and Aquatic Science, Sam Nujoma Campus, the University of Namibia (UNAM)
2	Member	Prof. Nelago INDONGO	Director, Multidisciplinary Research Center (MRC), University of Namibia (UNAM)

1-5 Schedule of the Terminal Evaluation

The Joint Terminal Evaluation was conducted from August 15 to September 1, 2016. The detailed schedule of the terminal evaluation is provided as Annex 1.

1-6. Methodology of the Terminal Evaluation

1-6-1 Evaluation Method

The Project was evaluated jointly by the Namibian and Japanese Terminal Evaluation teams (the Joint

Terminal Evaluation Team), based on materials showing the framework of the Project such as PDM version 3, PO and the R/D. The evaluation work consists of the analysis of project reports, field surveys, and interviews with various persons concerned with the University of Namibia, the Ministry of Agriculture, Water and Forestry (MAWF), Japanese experts, and farmers who participated in the project activities. This Terminal Evaluation was conducted through examination of all the relevant information obtained by applying the following "Five Evaluation Criteria".

1-6-2 Evaluation Criteria (Five Evaluation Criteria)

(1) Relevance

"Relevance" refers to the validity of the Project Purpose and the Overall Goal in connection with the development policy of the Namibian authorities concerned as well as the needs of beneficiaries and assistance policies of the Government of Japan.

(2) Effectiveness

"Effectiveness" refers to the extent to which the expected benefits of the Project have been achieved as planned. It also examines whether these benefits have been brought about as a result of the Project.

(3) Efficiency

"Efficiency" is analyzed with emphasis on the relationship between Outputs and Inputs in terms of timing, quality, and quantity.

(4) Impact

"Impact" refers to direct and indirect, positive and negative impacts caused by the implementation of the Project, including the extent to which the overall goal has been attained.

(5) Sustainability

"Sustainability" refers to the extent to which the Project can be further developed by the Namibian authorities concerned and the extent to which the benefits generated by the Project can be sustained under national policies, technology, systems and the financial state of the nation.

2. Outline of the Project

2-1 Summary of the Project

The framework of the Project (PDM version 1) was decided by the R/D signed on November 23, 2011. Corresponding to the recommendation of the mid-term review of the Project (September 2014), the PDM was revised as PDM version 2 and approved on March 11, 2015 at the 6th JCC meeting. At the 8th JCC meeting (March 2016), the wording used in the PDM and PO was changed from "pearl millet" to "rice based mixed cropping" and the PDM was revised as PDM version 3. The Project summary described in PDM version 3 is as described below. (For additional details, see Annex 2).

(1) Overall Goal

1. "Flood- and drought-adaptive cropping systems" are disseminated in the north-central Namibia to contribute to the food security and cash income of local farmers.
2. "Flood- and drought-adaptive cropping systems" are considered for the northeastern areas of Namibia

where high rainfall occurs as well as in neighboring countries.

(2) Project Purpose

"Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of the semi-arid region.

(3) Outputs

Output 1: [Crop Science] The rice-based mixed cropping systems, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.

Output 2: [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers through introduction of the rice-based mixed cropping systems are established.

Output 3: [Hydrology] The possible area of mixed cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.

Output 4: [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.

(4) Activities

1.1 Examine appropriate cultivation methods to establish the rice-based mixed cropping systems.

1.2 Examine water-saving cultivation techniques by methods including the stable isotope technique.

1.3 Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain soil fertility.

2.1 Survey the socio-economic conditions and farm operations of farmers who participate in conducting field demonstrations or voluntary trials (baseline survey).

2.2 Secure informed consent by demonstration farmers prior to project activities and share findings from Output 1 and 3 through workshops.

2.3 Describe the changes of understanding by demonstration farmers on the contents and purposes of project activities and delineate the points to consider in the process of expansion of the mixed cropping systems.

2.4 Classify the environment of farmers' fields from the viewpoint of landscape ecology.

2.5 Examine the sustainability of the mixed cropping systems from the socio-economic viewpoint by understanding the farmers' decision making criteria to adopt or reject a new cropping system, ways to use the agricultural produce, and the change of perception on wetlands (farm household economy, labour distribution survey).

3.1 Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography maps, satellite images and measurements of meteorological and hydrological conditions.

3.2 Analyze the water budget of the seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation)

3.3 Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields.

4.1 Conduct field demonstration with committed and hardworking farmers on their small wetlands, on the rice-based mixed cropping systems.
4.2 Conduct field trials with farmers who participate in trials on the rice-based mixed cropping systems voluntarily.
4.3 Examine the rice-based mixed cropping systems, which can preserve the water resources in semi-arid region and cope with the yearly fluctuation of flood and drought, by incorporating the feedback from Output 2 and 3 to Output 1.
4.4 Carry out participatory research and extension activities by Namibian researchers/technicians on the cropping systems through opportunities such as field days.

(5) Project Site

The project sites are the Faculty of Agriculture & Natural Resources, Ogongo Campus, the University of Namibia (UNAM) and seasonal wetlands in north-central Namibia.

(6) Target Group (beneficiaries)

The target groups are researchers of the Faculty of Agriculture & Natural Resources, UNAM, and farmers in north-central Namibia.

(7) Project Duration

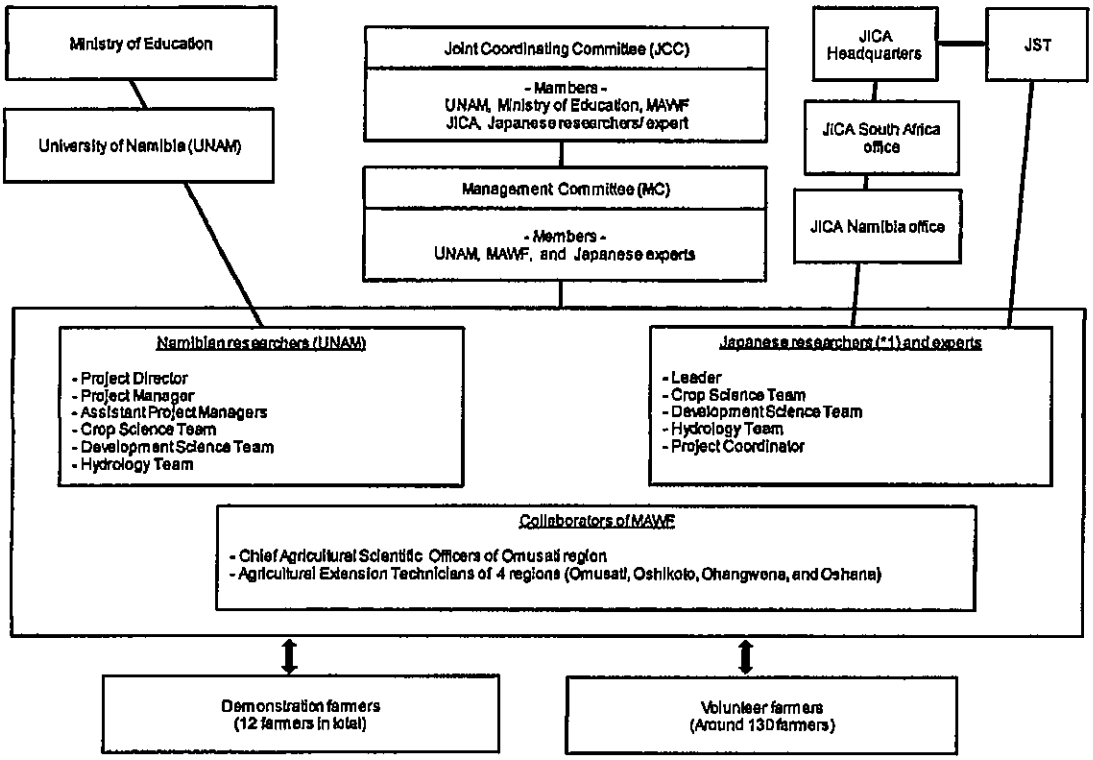
The duration of the Project is 5 years (February 28, 2012 to February 27, 2017)

(8) Counterpart Organizations

The Namibian Implementing Agency is the University of Namibia.

2-2 Implementation Structure of the Project

The project activities have been conducted mainly by researchers of UNAM and Japanese experts in collaboration with officials and agricultural extension technicians of MAWF. Pro-Vice Chancellor of Academic Affairs of UNAM is involved in the Project as Project Director and a lecturer of Department of Crop Science of the UNAM Ogongo Campus is involved as Project Manager. The following figure shows the conceptual project implementation structure.



(*1): Researchers of Kindai, Nagoya, Tohoku, Shiga Prefecture, Ryukoku universities and others.

Figure 1: Implementation Structure of the Project

In order for assuring effective implementation/management of project activities, the following two kinds of meetings were set up and held regularly or periodically.

Table 1: Core Meeting Held Including Function and Attendees

Title of Meeting	Frequency of Meeting	Main Function	Members
JCC (Joint Coordinating Committee)	Twice a year (held 8 times as of end of August 2016)	• To approve the annual work plan of the Project, • To review the overall progress and achievements of the Project, • To examine major issues arising from or in connection with the Project, • To work out the modification of activities dependent and of necessity in Namibia the necessity, and • To discuss any other issues(s) pertinent to the smooth implementation of the Project.	Project Director, Project Manager, Assistant Project Manager, Namibian counterparts and persons concerned of UNAM, Representative of the Ministry of Education, Representatives of MAWF, Japanese experts, Representative of JICA office
MC (Management Committee)	Periodically (held 16 times as of May 2016)	• To create awareness to all stakeholders and implementing partners about the project activities and objectives, • To give advice and assist the Project on solving issues arising from the Project's day-to-day activities, • To propose particular issues for discussing at the JCC, and • To raise Project issues which have not been resolved at the Management Committee to the JCC and provide feedback to project team	Project Manager, Assistant Project Manager, Campus Manager, Farm Manager, and Farm Administrator of the UNAM Ogongo campus, Sub-leaders of Crop Science, Development, and Hydrology teams, Chief Agricultural Scientific Officers of Omusati Region (MAWF), and Japanese project coordinator etc.

3. Achievement and Implementation Process of the Project

3-1 Inputs

3-1-1 Japan Side

(1) Dispatch of Japanese Experts

Two long-term experts (project coordinator/ training) and 20 researchers (as short-term experts) have been dispatched to Namibia with expertise in the following areas: crop science, development studies, and hydrology. The detailed information on the dispatch of Japanese experts is provided as Annex 3.

(2) Counterpart personnel trained in Japan

Country-specific training on farmer's participatory extension techniques for mixed cropping of rice and pearl millet was carried out twice in Japan (in 2012 and 2013). Nine researchers of UNAM and 19 agricultural extension technicians of MAWF participated in these trainings. A researcher of UNAM completed the graduate school (doctoral course) of Kinki University, Japan (the title of this university changed to Kindai University since April 2016). A researcher of UNAM is studying at the graduate school (doctoral course) of Kindai University and a staff of MAWF is studying the graduate school (master course) of Kindai University. Sixteen researchers of UNAM participated in short-term research programs mainly at Kindai University. The detailed information on trainings in Japan is provided as Annex 4.

(3) Provision of Equipment and Machinery

Equipment and materials for research activities and the Project office has been provided by the Japanese side. Equipment includes vehicles, copy machine, computers, printers, tractors, power tillers, rice threshers, rice millers, irrigation pumps, Bowen ration measuring systems, rainfall measurement systems, surveying instruments, and soil sampling tools, etc. Total value of equipment and machinery is around US$967,000. The detailed information on the procured equipment and machinery is provided as Annex 5.

(4) Local Operational Cost Borne by the Japanese Side

Local cost borne by the Japanese side for the implementation of the Project is around 10.9 million NAD (Namibian dollars; approx. US$787,000) as of June 2016. This sum includes the expenses for travel, meeting cost and other general expenditures for project activities. The detailed breakdown of expenditures is provided as Annex 6.

3-1-2 Namibian Side

(1) Namibian Counterparts Involved in Project Activities

At the time of the terminal evaluation, a total of 11 counterparts including the Project Director, Project Manager, and Assistant Project Managers are involved in various project activities. All 11 counterparts are researchers of UNAM. The detailed list of counterparts is provided as Annex 7.

(2) Project Operation Cost Borne by the Namibia Side

UNAM has secured budget and disbursed expenses mainly for operational cost such as travel allowances for Namibian researchers and utilities as shown in the following tables. The total amount of budget secured will be 1,896,000 NAD (by the end of March 2017) and the total amount of expenses disbursed was 1,052,812 NAD (as of June 2016) (approx. US$136,400 and US$75,700 respectively).

Table 2: Secured Budget for Project Operation by the Namibia Side

(Unit: NAD)

Description	Apr. 2012-Mar. 2013	Apr. 2013-Mar. 2014	Apr. 2014-Mar. 2015	Apr. 2015-Mar. 2016	Apr. 2016-Mar. 2017	Total
Amount of secured budget	500,000	250,000	200,000	500,000	446,000	1,896,000

Table 3: Actual Expenditure Borne by the Namibia Side

(Unit: NAD)

Description	Apr. 2012-Mar. 2013	Apr. 2013-Mar. 2014	Apr. 2014-Mar. 2015	Apr. 2015-Mar. 2016	Apr. 2016-Jun. 2016	Total
Tractor & Disc Harrow	522,674	222,102	210,235	85,751	12,050	1,052,812
Operations, Travelling Allowance						
Utility covered under campus						

(3) Provision of office space, land and facilities by UNAM

UNAM has provided various facilities for activities of the Project such as office space for Japanese researchers/expert, laboratories, a green house, crop experiment fields, seed room, rice packing room and store rooms. The detailed information is presented as Annex 8.

3-2 Progress and Main Achievements of the Planned Activities

Project activities have been carried out in accordance with the PDM and PO since the beginning of the Project. Project activities undertaken and their main achievements are presented in the table below. This table shows the planned activities in the remaining project period at the time of the terminal evaluation based on information provided by the Project team members (Japanese experts and Namibian counterparts).

Table 4: Progress and Main Achievements of the Planned Activities based on the reports submitted by the Project

Activities		Progress and Main Achievements	Progress	Planned Activities in the Remaining Period
1-1	Examine appropriate cultivation methods to establish the rice-pearl millet mixed cropping systems.	Various cultivation experiments for examining appropriate cultivation methods have been carried out at the fields in the UNAM Ogongo Campus, Kindai University, University of Shiga Prefecture, and the demonstration farmers. Main experiments conducted are as follows. 1) Evaluation of yield & productivity, and moisture physiology under the mixed cropping condition (at the sloped experimental field and small-scale paddy fields in the UNAM Ogongo campus) 2) Various experiments such as response to soil stress, survival test, water resources survey, and productivity of mixed crop under hydroponic and soil conditions (at Kindai university) 3) Various cultivation experiments such as growth & productivity of mixed cropping, water use efficiency of mixed cropping & single cropping using rice and pearl millet, and rice variety selection which is suitable for rice-pearl millet mixed cropping (at University of Shiga Prefecture) 4) Cultivation experiments on model mixed cropping at the fields of 12 demonstration farmers and yield surveys at the fields of a part of the volunteer farmers (111 farmers)	Nearly completed	Several presentations will be made at the conference of the Crop Science Society of Japan in September 2016.
1-2	Examine water-saving cultivation techniques by methods including stable isotope technique.	To examine water-saving cultivation techniques, examinations of groundwater control techniques have been carried out at the Lysimeter installed field in Kindai University. Then, as results of examination using the stable isotope technique, it was found that groundwater dependency rate becomes higher and water use efficiency is improved by planting seedlings of rice and pearl millet in same hole. Experiments of this planting method under the flood stressed condition were also carried out at the sloped experimental field in the UNAM Ogongo campus, and analysis of water sources (rain water, wetland water, underground water) of mixed plants and calculation of the dependence on deep water and deep water use efficiency were carried out by using the stable isotope techniques. Several papers will be made after the completion of analysis. In addition, basic knowledge on water physiology and water use efficiency of Oryza sativa, Oryza glaberrima, and NERICA was obtained as results of the experiments at the UNAM Ogongo campus.	Nearly completed	A presentation will be made at the conference of the Japanese Society for Tropical Agriculture in October 2016.
1-3	Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain the soil fertility.	Basic experiments (using pot and field) on environmental stress (salinity, drought, and poor soil fertility etc.) on mixed cropping have been conducted at Kinki University and at the University of Shiga Prefecture. Pot rice varietal comparative research experiments on drought, salinity, waterlogging stress tolerances were completed using 37 varieties of Oryza sativa; Oryza glaberrima and NERICA were carried out. Experiments (using pot) of mixed seedlings of rice and other grain crops under conditions with stress of drought, flood, or salinity were carried out. As results of the experiments, it was found that mixed seedlings have the potential to enhance flood tolerance of drought-adapted grain crops. Experiments on dependency of mixed crops to nitrogen of organic matters were carried out under the nutrient-poor soil condition. Then, basic experiments on flood and salinity stressed conditions using cowpea were carried out in order to incorporate cowpea in rice-pearl millet mixed cropping systems. Soil samples were collected from seasonal river sides in Namibia for examining soil fertility of seasonal wetlands and then, a paper was published using the results of analysis. As for the results of experiments of application of cow manure, a presentation will be made at the conference which is held in September in Japan.	Nearly completed	Three papers will be prepared and presentations will be made at the conferences in Japan (conference of the Crop Science Society of Japan, in September 2016 and conference of the Japanese Society of Soil Science and Plant Nutrition, in September 2016)
2-1	Survey the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration or	Pre-test for the baseline survey was carried out in a village (nine farmers) on December 12, 2012. After that, a baseline survey was carried out from February 4 to 16, 2013 (interview survey to 386 farmers). Collection and organizing information/data of a village can be done comparatively well, then, a village monograph (Onamudindi village) was prepared. This village monograph became basic information to be used for analysis of time-series changes of socio-economic of seasonal wetlands. Information on social structure of the village and others was not	Nearly completed	Finalization and printing the document on the village monograph by UNAM. This document will be basic information for UNAM and

<table>
<tr><th colspan="2">Activities</th><th>Progress and Main Achievements</th><th>Progress</th><th>Planned Activities in the Remaining Period</th></tr>
<tr><td></td><td>voluntary trials (baseline survey).</td><td>enough in the village monograph, additional interview survey was conducted to the village headman, thereafter, the obtained data was incorporated in the village monograph. A paper on the village monograph was submitted to an academic journal. In addition, a document on the village monograph will be published by UNAM. As results of various surveys, diversified situations in local villages, which were not grasped in the official statistics of the Government, are revealed. The followings are revealed situations.
1) Main difference or disparity among rural household
✧ Possession of resource or agricultural tools such as hoe, plow, and tractor, etc.
✧ Income difference depending on old-age pension, disability pension, and child allowance.
✧ Purchase of seeds: farmers don't buy seeds mostly. In case of improved varieties, farmers purchase seeds from the government or local markets. If farmers were not able to harvest crop previous season, they purchase seeds.
2) Peasant farmers are very few. Most of farmer households have own land. Difference of area of landholding is small, and average land holding is 2 to 3 ha.
3) Approx. 80% of farmers have own wetland.</td><td></td><td>this document will be shared with MAWF.</td></tr>
<tr><td>2-2</td><td>Secure informed consent by demonstration farmers prior to project activities and share findings from output 1 and 3 through workshops.</td><td>Nine demonstration farmers, where demonstration experiments are carried out, were selected in three villages (nine farmers in total) from 2012 to 2013. The demonstration fields, water level monitoring equipment, and rain gauges were installed in the fields the demonstration farmers. Number of the demonstration farmers were increased in 2014/15 and 2015/16 in other villages (two farmers in 2014/15 and a farmer in 215/16). At the selection of the demonstration farmers, the project team members visited the demonstration farmers individually and explained the purpose of the demonstration activities. In addition, workshops with farmers in the demoostration farmers' villages and also its surrounding villages were carried out for explaining/discussing the outlines of the Project and new mixed cropping systems, and for obtaining farmers' perception on the new mixed cropping systems. At the fields of the demonstration farmers, experiments on rice-based mixed cropping and collection of hydrological data have been carried out.
Table 5: Workshops with Farmers
<table>
<tr><th>No.</th><th>Date</th><th>Target Village</th><th>Number of participants (farmers)</th><th>Main contents of workshop</th></tr>
<tr><td>1</td><td>Sep. 5, 2012</td><td>Ohaingu</td><td>11</td><td rowspan="6">Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.</td></tr>
<tr><td>2</td><td>Sep. 6, 2012</td><td rowspan="5">Onamundindi</td><td>23</td></tr>
<tr><td>3</td><td>Dec. 12, 2012</td><td>17</td></tr>
<tr><td>4</td><td>Mar. 5, 2013</td><td>27</td></tr>
<tr><td>5</td><td>Mar. 9, 2013</td><td>27</td></tr>
<tr><td>6</td><td>Mar. 14, 2013</td><td>Omagalanga</td><td>16</td></tr>
<tr><td>7</td><td>Dec. 17, 2013</td><td>Omagalanga</td><td>23</td><td rowspan="7">(1) Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.
(2) Confirmation of will of participation as demonstration farmer (face-to-face survey to candidate farmers).</td></tr>
<tr><td>8</td><td>Dec. 18, 2013</td><td>Afoti</td><td>41</td></tr>
<tr><td>9</td><td>Dec. 4, 2014</td><td>Ombafi</td><td>20</td></tr>
<tr><td>10</td><td>Dec. 15, 2014</td><td>Afoti</td><td>17</td></tr>
<tr><td>11</td><td>Dec. 16, 2014</td><td>Onamundindi</td><td>15</td></tr>
<tr><td>12</td><td>Dec. 18, 2014</td><td>Oshiteyatemo</td><td>13</td></tr>
<tr><td>13</td><td>Dec. 19, 2014</td><td>Omagalanga</td><td>8</td></tr>
<tr><td>14</td><td>Jul. 16, 2015</td><td>---</td><td>---</td><td>Workshop for School Students</td></tr>
<tr><td>15</td><td>Aug. 19, 2015</td><td>Omagalanga</td><td>28</td><td>(1) Explanation of the outline of the Project and</td></tr>
</table></td><td>Completed</td><td>---</td></tr>
</table>

Activities		Progress and Main Achievements	Progress	Planned Activities in the Remaining Period
		16 Nov. 13, 2015 Omagalanga 23 17 Nov. 14, 2015 Osikuku 23 18 Dec. 22, 2015 Afoti 27 mixed cropping method. (2) Additional survey was done on farmer's land management and recognition on farming method.		
2-3	Describe the changes of understanding by demonstration farmers on the contents and purposes of project activities and delineate the points to consider in the process of expansion of the mixed cropping systems.	After explaining the research objectives and contents to the demonstration farmers and the volunteer farmers, the project team members visited to them and observed how they are practicing agriculture. Two-day learning (between the farmers and the project team members) was carried out and information/data on the progress of activities was organized by repeating individual interviews and the farm sketch method. It was found that there are differences between the farmer's understanding on the contents of mixed cropping and intention of the project team members on the contents of mixed cropping. Then, the project team members explained repeatedly about the mixed cropping systems, arranged farm visit to the farmers who are practicing rice cultivation, recording the contents of verbal explanation by the volunteer farmers. The project team members examined method to improve communication between researchers and farmers. Then, the project team members continued trials of interactive and participatory research methods between researchers and farmers in order to make environment that farmer can make comments whether they adopt new cropping techniques or reject its after obtaining information from UNAM. A part of the results of these trial activities was presented at the academic conferences.	Nearly completed	---
2-4	Classify the environment of farmers' fields from the viewpoint of landscape ecology.	Preliminary interview surveys on ecological environments of season wetlands were carried out at the fields of 10 farmers in Onamundindi village at the beginning of 2013. Key indicators for classifying small wetland from the viewpoints of farmers were extracted through understanding farmers' perception on wetland environment and natural environment around wetland. In order to classify the environment of farmers' fields from the viewpoint of landscape ecology, qualitative analysis on the components of landscape, such as vegetation, soil, water, and topography, etc. has been carried out. At the same time, interviews and workshops with farmers were carried out in order to extract indicators which classify environment and farmers' perceptions on ecological environment. Evaluation on the mixed cropping systems in farmers' fields from the viewpoint of landscape ecology is in progress.	Nearly completed	Two papers will be prepared for submitting to international scientific journals.
2-5	Examine the sustainability of the mixed cropping systems from the socio-economic viewpoint by finding out farmers' decision making criteria to adopt or reject a new cropping system, ways to use the agricultural produce, and the change of perception on wetlands (farm household economy, labour distribution survey).	Surveys on the farmers' decision making criteria as to adopt or reject a new mixed cropping system, usage of harvested crops, and farmers' perception change on the use of wetland have been carried out using several survey methods. Utilized survey methods are interview, workshop, study tour, farm sketch, hand-held GPS, aerial photos by UAV, and seasonal calendar, ranking method, etc. Farmers' recognition on the mixed cropping and their perception change were extracted through analysis of the results of surveys, and the result of analysis was presented at the conference. Preparation of a paper related with this issue was in progress in August 2018. As for farm household economy and labour distribution, related information was collected by baseline survey which was carried out in February 2013. Additional interview survey and data collection was carried out from May to August 2016 at the selected farmers (volunteer farmers and other general farmers in two villages (Onamundindi and Oshiteyatemo villages)). Evaluation of mixed cropping on the farm household economy and labor distribution is in progress. Evaluation will be finalized in September 2016. According to the preliminary result of analysis on cost and benefit of mixed cropping at small-wetlands, there is potential to have certain gains from mixed cropping.	Nearly Completed	A part of the scientific results is presented at the conference of the Japan Society for International Development, in November 2016 in Japan. Two papers will be submitted to international scientific journals.
3-1	Estimate the change of flood (surface) water of seasonal wetland based on	Topographical surveys combining techniques of continuous aerial photography using Unmanned Aerial Vehicle (UAV) and SfM-MVS (Structure from Motion, Multi View Stereo) were carried out with the scale that can identify small-wetland. The surveyed areas were 16 sites within the following area in the Project targeted area. 1) Six sites in northern area (17°27'00"S - 17°30'00"S, 15°21'00"E - 15°24'00"E)	Nearly Completed	---

<table>
<tr><th colspan="2">Activities</th><th>Progress and Main Achievements</th><th>Progress</th><th>Planned Activities in the Remaining Period</th></tr>
<tr><td></td><td>regionally-obtained data such as topography map, satellite image and measurement of hydrological conditions.</td><td>2) Six sites in central area (17°43'00"S - 17°46'00"S, 15°13'00"E - 15°16'00"E
3) Four sites in southern area (17°58'00"S - 18°01'00"S, 15°19'00"E - 15°22'00"E)

Time-series data on change of surface water storage volume was estimated. After that, the changes of surface water storage volume at 16 sites from 2013 to 2015 (three years) were estimated by using satellite remote sensing high resolution data. As a result of analysis, the estimated surface water storage volumes in the above three areas fluctuate largely from year by year under the influence of rainfall. It was also found that the surface water storage volumes are different largely by areas.</td><td></td><td></td></tr>
<tr><td>3-2</td><td>Analyze the water budget of seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation)</td><td>Thirty units of tipping bucket rain gauges were installed in the range east and west 180km, north and south of 60km, centered at the Ogongo Campus of UNAM, and collected rainfall data continuously (There are 31 sites of rain gauges in total, including the rain gauge in the UNAM Ogongo campus). As a result, a wide area rainfall map in 4 year rainy seasons was made. The Bowen ratio measurement systems (three units) were installed at the sloped experimental field and a system was installed at a natural wetland field nearby the sloped field at the UNAM Ogongo campus. Meteorological data necessary for estimating evapotranspiration was continuously collected. Four-year time-series evapotranspiration data at the different situations of surface (different cropping and soil surface) was collected. Using collected data and using remote sensing data, amount of evapotranspiration in wide area was estimated. In addition, samples of soil from deep part of small wetlands of the demonstration farmers were taken and soil permeability tests were carried out. As a result, a coefficient on saturated hydraulic conductivity at small wetlands under flooded condition with surface water was estimated.</td><td>Nearly Completed</td><td>A presentation will be made at the AGU Fall meeting in December 2016 in USA.</td></tr>
<tr><td>3-3</td><td>Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields.</td><td>Samples of rainwater were taken at the UNAM Ogongo campus and the stable isotope composition of those samples was analyzed. As results of analysis, it was understood that main origin of surface water and shallow groundwater in this area is rainfall. As results of atmospheric water balance analysis, it was also found that recycle rate of rainfall-evapotranspiration in the area is about 80% (average in rainy season), and recycle rate is higher at the later period of rainy season (water from evapotranspiration becomes rainfall again). Water level gauges were installed in the center of the small wetlands off the demonstration farmers and time-series data of water level was collected. As results of analysis, it was found that lowering of water level in small wetland is slow in the second half of the rainy season compared with lowering speed in the first half of the rainy season.</td><td>Nearly Completed</td><td>---</td></tr>
<tr><td>4-1</td><td>Conduct field demonstration with committed and hardworking farmers at their small wetlands, on the rice-pearl millet mixed cropping systems.</td><td>Number of the demonstration farmers by cropping season is shown in the table below.

Table 6: Number of Demonstration Farmers
<table>
<tr><th colspan="2"></th><th>2012/13</th><th>2013/14</th><th>2014/15</th><th>2015/16</th></tr>
<tr><td colspan="2">Number of Demonstration Farmers</td><td>9</td><td>9</td><td>11</td><td>12</td></tr>
<tr><td rowspan="5">Number of farmers by village</td><td>Onamundindi village</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Afoti village</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Oshiteyatemo village</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Epayaliwa village</td><td>---</td><td>---</td><td>2</td><td>2</td></tr>
<tr><td>Onandjandja village</td><td>---</td><td>---</td><td>---</td><td>1</td></tr>
</table>
2012/13 Cropping season was severe drought year and it was difficult to transplant rice seedlings in small wetlands at several demonstration farmers' fields. Two kinds of experiments; i.e. rice and pearl millet mixed cropping and sequential planting after rain (in March) were carried out at the farmer's wetland where rainwater can hold longer period. Experiments on mixed cropping were continued at the wetlands of the demonstration farmers in 2013/14,</td><td>Nearly completed</td><td>A part of the scientific results will be presented at the conference of the Japan Society for International Development in November 2016 in Japan.</td></tr>
</table>

<table>
<tr><th colspan="2">Activities</th><th>Progress and Main Achievements</th><th>Progress</th><th>Planned Activities in the Remaining Period</th></tr>
<tr><td></td><td></td><td>2014/15, and 2015/16 cropping seasons.</td><td></td><td></td></tr>
<tr><td>4-2</td><td>Conduct field trials at farmers who participate in trials on the rice-pearl millet mixed cropping systems voluntarily.</td><td>Rice seedlings or seeds were distributed to farmers who showed willingness to introduce rice-based cropping systems or rice cultivation voluntarily. This kind of farmers is categorized as volunteer farmers under the Project. The following table shows number of volunteer farmers by cropping season.

Table 7: Number of Volunteer farmer
<table><tr><td></td><td>2012/13</td><td>2013/14</td><td>2014/15</td><td>2015/16</td></tr><tr><td>Number of Volunteer farmer</td><td>72</td><td>88</td><td>76</td><td>128</td></tr></table>
Socio-economic impact evaluation has been carried out in 2015/16 cropping season by collecting data from 20 volunteer farmers in Onamundindi and Oshiteyatemo villages. Cropping data was collected from 20 farmers who don't cultivate rice at their wetlands. Field trials on rice-based mixed cropping for the 2015/2016 season were completed and analysis of the collected data is underway.

111 volunteer farmers carried out rice-based mixed cropping at their wetlands in 2015/16 cropping season and 32 farmers were able to get rice harvest. Pearl millet and sorghum were harvested by 30 and 27 farmers respectively at their wetlands. Broadly speaking, one-quarter of volunteer farmers obtained some amount of harvest.</td><td>Nearly completed</td><td>A part of the scientific results will be presented at the conference of the Japan Society for International Development in November 2016 in Japan.</td></tr>
<tr><td>4-3</td><td>Examine the rice-pearl millet mixed cropping systems, which can preserve the water resources in semi-arid region and cope with the yearly fluctuation of flood and drought, by incorporating the feedback from output 2 and 3 to output 1.</td><td>Feedback of research results from the Development Studies Team and the Hydrology Team toward the Crop Science Team has been carried out every year at the JCC meetings and the annual meetings in Japan. Discussion on the proposed rice-based cropping systems was held at the Workshop on the Project Achievement (August 29, 2016).</td><td>Completed</td><td>---</td></tr>
<tr><td>4-4</td><td>Carry out participatory research and extension by the Namibian researchers/ technicians on the cropping systems through opportunities such as field days.</td><td>Field day was carried out 10 times from March 2013 to June 2016 for explaining rice-based mixed cropping systems, rice cropping cycle, outlines of the Project, tractor hiring pilot activities, and demonstration of operation of power tiller, etc. Number of participants to the first (March 2013) and second (March 2014) field days was 462 and 529 respectively. Not only local farmers but also vice-minister of MAWF, politicians, mayor, and traditional headman, etc. participated. Students and teachers of secondary schools participated in the third field day (April 2014). The governor of Omusati region participated in the fifth field day (March 2016). Responding to his request at the field day, a rice harvest festival was held at the UNAM Ogongo campus in June 2016. Over 150 persons including the governor of Omusati region, the Pro-Vice Chancellor of UNAM, and councilors of local government attended.
In addition to the field days, farmer participatory workshop has been held 18 times in total at the UNAM Ogongo campus, and Ohaingu, Onamundindi, Omagalanga, Afoti, Osikuku, and Oshiteyatemo Villages. 358 farmers participated in total.
Several kinds of demonstrations and seminars have also been held for agricultural extension technicians of MAWF, UNAM staff and farmers etc. Detailed information on these field days, workshops and demonstrations/seminars is provided as Annex 9.</td><td>Almost completed</td><td>The final field day (or workshop) will be held in a local village in December 2016.</td></tr>
</table>

3-3 Achievement of Outputs

3-3-1 Output 1: [Crop Science] The rice-based mixed cropping systems, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.

Research activities to develop techniques to deal with flooding and drought conditions as well as water-saving progressed steadily throughout the Project term. The results of the analysis on the research activities have been summarized in various papers and submitted to domestic and/or international journals (four papers published, one paper in press, two papers submitted, and five others will be additionally submitted). The results of analysis have also been presented at many academic conferences/seminars in Japan and Namibia (26 presentations were made and 8 presentations will be additionally made). The project team is proposing the rice-based mixed cropping systems consisting of six cultivation techniques. Mixed seedling technique in particular has been scientifically verified to have comparative advantage on yield on experimental basis, although it is yet to be verified at farmers' field level. Considering these outputs, the degree of achievement of the objective of Output 1 is moderately high.

Indicator 1-1):	Number of presentations at academic conferences/seminars in related areas such as crop science and tropical agriculture (27 times).

Presentations at academic conferences/seminars in crop science and tropical agriculture related area amounted to 26 by August 2016. Eight additional presentations are to be made by the end of 2016. The total number of presentations will be 34. Detailed information on the presentations is provided as Annex 10.

Indicator 1-2):	Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6.

Number of the publications (papers) related with the crop science area submitted to peer-reviewed journals is seven (four papers published, one paper in press and two papers submitted) by August 2016. Additional five papers will be submitted by March 2017. In that case, total number of submitted papers will be 12. Detailed information on these papers is shown in the table below.

Table 8: Papers Published and to be Submitted

	Published/ in Press/ Accepted	Author Name, Name of Paper, Name of Publication, Year Published etc.	International or Domestic Journal
A: Joint paper by Namibian and Japanese Researchers			
1	Published	Suzuki, T., T. Ohta, Y. Izumi, L. Kanyomeka, O. Mwandemele, J-I. Sakagami, K. Yamane, and M. Iijima, Role of canopy coverage in water use efficiency of lowland rice in early growth period in semi-arid region. Plant Production Science, 2013, 16 (1), 12-23.	International
2	Published	Awala, S.K., K. Yamane, Y. Izumi, Y. Fujioka, Y. Watanabe, K.C. Wada, Y. Kawato, O. Mwandemele, and M. Iijima, Field evaluation of mixed-seedlings with rice to alleviate flood stress for semi-arid cereals. European Journal of Agronomy, 2016, 80, 105-112.	International
3	Published	Iijima, M., S.K. Awala, Y. Watanabe, Y. Kawato, Y. Fujioka, K. Yamane, and K.C. Wada, Mixed cropping has the potential to enhance flood tolerance of drought-adapted grain crops. Journal of Plant Physiology, 2016, 192, 21–25.	International
4	Submitted	Nanhapo et al., Mix cropping with ice plant alleviates the damage and the growth of cowpea under consecutive NaCl treatment and after the recovery from high concentration of NaCl.	International
5	Submitted	Watanabe, Y., F. Itanna, Y. Fujioka, A. Petrus, and M. Iijima, Characteristics of soils under seasonally flooded wetlands (oshanas) in north-central Namibia. Journal of Arid Environments. (6. Jun. submitted)	International
6	To be submitted	(This paper will be submitted in October 2016) Watanabe et al., Soil fertility status of seasonally closed wetland ecosystem (Ondombe)	International

		in Northern Namibia.	
7	To be submitted	(This paper will be submitted in November 2016) Iijima et al., Oxygen transfer between mix-cropped rice and pearl millet in water culture.	International
8	To be submitted	(This paper will be submitted in January 2017) Watanabe et al., Inspect the amount of cow manure and chemical fertilizer dosage for rice, pearl millet and cowpea in north-central Namibia.	International
9	To be submitted	(This paper will be submitted in March 2017) Iijima et al., Effects of soil moisture conditions on the water relation and water source of intercropped rice and pearl millet.	International
10	To be submitted	(This paper will be submitted in March 2017) Izumi et al., Examination of Water Use Efficiency in Mix-cropped Rice and Pearl millet.	International
B: Paper by Japanese Researchers			
11	Published	Okazaki, Y., K. Yamane, Y. Izumi, and M. Iijima, Drought, salinity and flooding tolerance of Oryza sativa, Oryza glaberrima and their interspecific cultivars. Journal of Crop Research, 2014, 59, 23-30.	Domestic
12	In press	Izumi, Y., Y. Okazaki, K. Yamane, and M. Iijima, Evaluation of the Resistance to "Multiple Environmental Stress" of Oryza sativa, O. glaberrima and their Interspecific Progenies. - Effect of Drought and Re-watering on the Growth and Physiological Parameters of Rice Cultivars. - Journal of Crop Research, 61, 23-30.	Domestic

Indicator 1-3):	List of water-saving cultivation techniques with high water-use efficiency and of cropping systems with high productivity under environmental stress such as flood and drought.

Based on their extensive study and preliminary work, the Crop Science Team proposed the following six cultivation techniques adapted to flood and drought conditions. Name and outline of each cultivation technique are as indicated in the following table. These cultivation techniques were explained during the workshop on the project achievement (held on August 29, 2016) and were explained briefly in the Guideline for "Flood- and drought- adaptive cropping systems" (this guideline is under finalization).

Table 9: Proposed Cultivation Techniques Adapted to Flood and Drought Conditions

	Name of Cultivation Techniques	Outline of Techniques
1)	Mixed cropping in the water fluctuation zone	Planting rice in the lower part of slopes and pearl millet in the upper part of slopes by utilizing the slope of the farm field. By using this cultivation technique, both rice and pearl millet can survive.
2)	Ridge and furrow mixed cropping	Planting pearl millet on ridges and rice between ridges (furrow). By using this technique, both rice and pearl millet can grow well.
3)	Mixed seedling	Rice and pearl millet are seeded in the same hole. This technique enhances water use efficiency and mitigates flood, drought and salt stress.
4)	Sequential planting after rain	There is a trial in progress to overcome severe drought; i.e. transplanting on March after delayed rain.
5)	Cultivar selection	Selection of flood tolerant cultivars of upland crops such as pearl millet and cowpea from IITA. Short duration upland rice cultivars from IRRI are now being tested in the field of UNAM.
6)	Sustaining soil fertility	Introduction of cowpea in the water fluctuation zone of small wetland and cow manure application on the small wetland.

3-3-2 Output 2: [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio-economic impacts on farmers through introduction of the rice-based mixed cropping systems are established.

There were seven different methods, namely, 1) farm sketch, 2) hand-held GPS survey, 3) taking aerial photos by UAV, 4) questionnaire survey, 5) summarizing village monograph, 6) landscape analysis, and 7) workshops that were applied to analyze and understand the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration or voluntary trials. There are methods to understand the subjective perception of the farmers such as 1), 4), and 5) and more objective ways to clarify the situation with precise data and information on farming practices such as 2) and 3). Appropriate combination of both methods was found to be effective to grasp farmers' perception and reality.

As a result of the research activities, three papers were submitted and five will be submitted. The results of the research activities were presented at many academic conferences/seminars in Japan and Namibia (19 presentations were made and two additional presentations will be made). Considering these outputs, it is assessed that the degree of achievement of the objective of Output 2 is moderately high.

Indicator 2-1): Records of changes in understanding by demonstration farmers on the contents and purpose of the mixed cropping systems.

A baseline survey and qualitative surveys were carried out at the villages of participating farmers. The collected data and information through these surveys are being summarized and papers are also in preparation. Additional surveys with segments of farmers have been continuously carried out and farmers' perception on mixed cropping and situation of their practices of mixed cropping were identified using the combination of various metbods such as farm sketches, questionnaire surveys, workshops, hand-held GPS surveys, aerial photos using UAV (Unmanned Aerial Vehicle), and landscape analysis, etc. Preparation of papers with regards to these activities is underway using the results of surveys.

Purpose of use and advantage of the seven methods are described in the table below.

Table 10: Purpose of Use and Advantage of the Applied Methods

	Method	Purpose of Use	Advantage and Disadvantage
(1)	Farm sketch	- To understand farmer's perceptions Farm sketch is a tool for interactions between researchers and farmers.	1) Advantage - Researchers can understand the farmers' perceptions. - By drawing pictures, valuable information can be exchanged between farmers and researchers. 2) Disadvantage - Size information can not be recorded.
(2)	Hand-held GPS Survey	- To draw a map where a researcher walks around with hand-held GPS receiver - A farmer's practice can be captured by researcher	1) Advantage -A GPS map provides the visual image of geographical information. It helps o share the information with farmers. - The area size of the plot can easily be calculated. 2) Disadvantage - Small plots are difficult to measure - The target of record is limited by a researcher's perception.
(3)	Taking Aerial Photos by UAV	- To understand the mixed cropping patterns by aerial photos of farmers' fields.	1) Advantage - Detailed cropping patterns can be seen, which is not possible with a GPS survey. - The micro-topographic information can be obtained by making DEM (Digital Elevation Model). 2) Disadvantage - Difficult to manipulate the UAV. - Needs special techniques to conduct analysis

(4)	Questionnaire Survey	- To understand the socio-economic situation of the households.	1) Advantage - It is possible to obtain quantitative data of each household's situation. 2) Disadvantage - It is difficult to obtain qualitative data. - Farmers tend to answer within the framework of the questionnaire and their expectations.
(5)	To Summarize Village Monograph	- To understand the socio-economic situation of the households.	1) Advantage - Village monograph is the basic information required to understand future changes in socio-economic conditions in a village. 2) Disadvantage - Researcher can understand the village situation in multiple views with qualitative and quantitative information.
(6)	Landscape Analysis	- To understand the natural environments including human perceptions and utilization	- Landscape comprises all visible features of an area of land including the physical elements of landforms, living elements, human elements as well as land uses.
(7)	Workshop	- To share information between farmers and researchers by two-way communication channel	- Facilitation skill is important for the success of a workshop

The Development Studies Team identified four aspects of social impacts of the Project, i.e. 1) development of the farmer-based extension methods of rice, 2) changes of farmers' perceptions toward the rice-based cropping systems, 3) changes in farmers' perceptions about the use of seasonal wetlands (traditionally farmers regarded wetlands not suitable for cropping, however, through the Project they have recognized that crops (rice, pearl millet or sorghum, etc.) can be cultivated and harvested in wetlands), and 4) cooperative use of seasonal wetlands. As for sustainability of techniques of the rice-based mixed cropping, the Development Studies Team pointed out that it depends on four factors, namely: 1) incentives for the rice-based mixed cropping, 2) local farmers' independence of the activities, 3) accessibility of resources such as available wetlands, rice seeds and plowing machinery, and 4) systematization of extension of rice-based cropping techniques.

Indicator 2-2):	Number of presentations and reports on study methods of understanding perception and the socio-economic impacts (9 times).

As a result of the activities carried out, the Development Studies Team established the following seven methods (farm sketch method and others) for understanding the changing attitudes and perception of farmers and the socio-economic impact on farmers through the introduction of rice-based mixed cropping systems.

Presentations on study methods to understand the perception of the existing conditions and the socio-economic impacts at academic conferences/seminars amounted to 14 by August 2016. Three additional presentations are to be made by the end of this year. Total number of presentations will then be 17. Detailed information on the presentations is presented as Annex 10.

Indicator 2-3):	Number of presentations at academic conferences/seminars on the evaluation method for landscape ecology of the cropping systems (7 times).

Presentations on the evaluation method for landscape ecology of the cropping systems at academic conferences/seminars amounted to seven by August 2016. One additional presentation is to be made by the end of this year. Total number of presentations will be eight. Detailed information on the presentations is

presented as Annex 10.

Indicator 2-4):	Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 5.

Number of the papers related with the development studies area submitted to peer-reviewed journals is three by August 2016. It is planned that five additional papers will be submitted within this year. In that case, total number of submitted papers will be eight. Detailed information on the papers is shown in the table below.

Table 11: Papers Submitted and to be Submitted

	Published/ in Press/ Accepted	Author Name, Name of Paper, Name of Publication, Year Published etc.	International or Domestic Journal
A: Joint paper by Namibian and Japanese Researchers			
1	Accepted	Nishikawa, Y., O. Shivolo, M. Hangula, B. Thomas, M. Hangula, T. Maharero, and Y. Fujioka, Village Monograph of an Agro-pastoral Society in North-central Namibia. Ryukoku Journal of Economics, accepted.	Domestic
2	Submitted	(This paper was submitted) Kaida, K., Nishikawa, Y., Thomas, B., Shivolo, O., and Hango, V., What encouraged households to adopt rice as a new crop? Development in Practice.	International
3	To be submitted	(This paper will be submitted in September 2016) Thomas et al., Understanding the variations of cropping patterns focused on the gaps between farmer's perceptions and practices in north-central Namibia.	International
4	To be submitted	(This paper will be submitted in September 2016) Njunge et al., Variation in composition of plant species growing in small ponds (oondombe) of the Cuvelai Basin seasonal wetlands in north-central Namibia.	International
5	To be submitted	(This paper will be submitted in September 2016) Fujioka et al., Evaluation of mixed-cropping patterns using aerial photos taken by UAV.	International
6	To be submitted	(This paper will be submitted in September 2016) Thomas et al., Application of multiple survey techniques for improving scientist's understanding and farmer's consent.	International
7	To be submitted	(This paper will be submitted in September 2016) Fujioka et al., Diversity of seasonal small wetlands (oondombes) landscape and its recognitions by local people in north-central Namibia.	International
B: Paper by Japanese Researchers			
8	Accepted	Kaida, K. and Nishikawa. Effect of rice cultivation trial on women farmer's participation in intra-household decision making: The case of Ovambo people in Northern Namibia. Rural Life Society of Japan. Journal 59-2, 2016	Domestic

3-3-3 Output 3: [Hydrology] The possible area of mixed cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.

Various kinds of data analyzed revealed that the possible area for introducing mixed-cropping, that would not modify the water environment of the seasonal wetlands, could be from 3 to 7% of the land in the Cuvelai System Seasonal Wetlands. The results of the analysis of the research activities have been summarized as various papers and submitted to domestic and/or international journals (four papers published and five papers to be submitted). The results of analysis were also presented at academic conferences/seminars in Japan and Namibia (16 presentations were made and one presentation to be made). Considering these outputs, it is assessed that achievement of Output 3 is high.

Indicator 3-1):	Acquisition of data (scientific) on the change of flood (surface) water, the water budget and the dependence on flood (surface) water of small wetlands.

The following data has been collected.

1) Satellite image data (AMSR-E/ AMSR2, MODIS, and Landsat ETM+)
2) Rainfall data (four years) at 31 locations using rain gauges (at farmers' fields, extension offices and the UNAM Ogongo campus) (Using the collected data, a wide area rainfall distribution map was created.)
3) Data of evapotranspiration (four years) at the sloped experimental field within the UNAM Ogongo campus and natural wetland nearby the campus (time-series data of evapotranspiration from surface at different cropping conditions were collected).
4) Data on the change of surface water volume by the photographic survey method using UAV (Unmanned Aerial Vehicle) and SfM-MVS (Structure from Motion, Multi View Stereo)
5) Data on the surface and ground water levels in the small wetlands of the 9 demonstration farmers (monitoring was carried out over a 3-years period).

As results of analysis of the collected data, the following findings were obtained by the project team.

1) Amounts of rainfall of the recent four years (2012-2016) were relatively lower. On the contrary, 2008/09 and 2010/11 rainy seasons had higher amounts of rainfall.
2) It was understood that evapotranspiration varied very largely depending on the surface conditions. The water loss owing to rice cropping could be lower than that of natural small wetland conditions.
3) Shallow groundwater of small wetlands is very likely to be recharged from surface water in small wetlands (source of that is mainly local rainfall).
4) Possible area (maximum area) for introducing mixed-cropping that does not modify water environment of seasonal wetlands could be from 3 to 7% of the land area in the Cuvelai System Seasonal Wetlands.

Indicator 3-2):	Number of presentation at academic conferences/seminars in related areas such as the potential cultivation area which does not affect the water environment (10 times).

Presentations in related hydrology and crop cultivation at academic conferences/seminars amounted 16 by August 2016. One more presentation will be made by the end of this year. Total number of presentations will then be 17. Detailed information on the presentations is presented as Annex 10.

Indicator 3-3):	Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6.

The number of the papers related with the hydrology area published to peer-reviewed journals is four by August 2016. It is planned to submit five additional papers by the end of the Project. Total number of papers will then be nine. Detailed information on papers is shown in the table below.

Table 12: Papers Published and to be Submitted

	Published/ in Press/ Accepted	Author Name, Name of Paper, Name of Publication, Year Published etc.	International or Domestic Journal
A: Joint paper by Namibian and Japanese Researchers			
1	Published	Suzuki, T., T. Ohta, T. Hiyama, Y. Izumi, O. Mwandemele, and M. Iijima. Effects of the introduction of rice on evapotranspiration in seasonal wetlands. Hydrological	International

		Processes, 2014, 28, 4780-4794.	
2	Published	Hiyama, T., T. Suzuki, M. Hanamura, H. Mizuochi, J.R. Kambatuku, J.N. Niipele, Y. Fujioka, T. Ohta, and M. Iijima, Evaluation of surface water dynamics for water-food security in seasonal wetlands, north-central Namibia. IAHS Publication, 2014, 364, 380-385.	International
3	To be submitted	(This paper will be submitted in September 2016) Hiyama et al., Analyzing origin of rain- and subsurface-water for water-food security in seasonal wetlands of north-central Namibia.	International
4	To be submitted	(This paper will be submitted in September 2016) Mizuochi et al., High-resolution spatiotemporal monitoring of micro-scale seasonal wetlands in north-central Namibia with a new multiple data fusion of satellite images.	International
5	To be submitted	(This paper will be submitted in December 2016) Kotani et al., Evaluation of surface conductance under water controlled crop experiment in north-central of Namibia.	International
6	To be submitted	(This paper will be submitted in December 2016) Mizuochi et al., Estimating evapotranspiration from seasonal wetlands in north-central Namibia based on satellite data fusion and VI-Ts method.	International
7	To be submitted	(This paper will be submitted in February 2017) Kambatuku et al., Coupling of the Frequency and Duration of Intraseasonal Dry Spells at Finer Spatial Scale to Synoptic Circulation Patterns and Implications for Rice Cultivation in the Cuvelai.	International
B: Paper by Japanese Researchers			
8	Published	Mizuochi, H., T. Hiyama, T. Ohta, and K. Nasahara, Evaluation of the surface water distribution in north-central Namibia based on MODIS and AMSR series. Remote Sensing, 2014, 6, 7660-7682.	International
9	Published	Mizuochi, H., T. Hiyama, T. Kanamori, T. Ohta, Y. Fujioka, M. Iijima, and K. Nasahara, Water Storage Monitoring of Seasonal Wetlands in a Semi-Arid Environment by the Integrated Use of Long-Term Satellite Images and UAV Topography Measurement. Journal of the Remote Sensing Society of Japan 36(2), 81-92, 2016-04.	Domestic

3-3-4 Output 4: [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.

The results of the research activities in the respective areas of Crop science, Development Studies and Hydrology have been shared among the Namibian counterparts, Japanese researchers, extension officers, and farmers etc. Among 111 volunteer farmers who carried out rice-based mixed cropping in 2015/16 cropping season, 32 farmers were able to get rice harvest at their wetlands. Pearl millet and sorghum were harvested by 30 and 27 farmers respectively. Broadly speaking, one-quarter of volunteer farmers obtained some amount of harvest even during the severe drought year with the national emergency declaration.
Detailed analysis of the economic impact of rice-based mix cropping systems has just started in 2015 and the results are still in the process of finalization. The results are to be submitted to peer-reviewed journal by the March 2017.
The degree of achievement of Output 4 is moderate.

Indicator 4-1): Annual completion of hand-out on the mixed cropping systems for researchers and farmers at the field day

Method of rice-based mixed cropping systems has been explained to agricultural extension technicians and farmers during the field days and at demonstrations/seminars. Various leaflets were produced and distributed to agricultural extension technicians and farmers. List of leaflets and their main contents are shown in the following table.

Table 13: List of Leaflets and Their Main Contents

No.	Language	Year produced	Main contents
1)	English	2013	Rice Cultivation Technique (from selection of rice seeds to transplanting)
2)	English	2013	Rice harvesting & Post-Harvest Techniques: from rice harvesting to storage
3)	English	2014	Rice Cultivation, Harvesting & Post-Harvest Techniques
4)	English	2014	Slide on rice nursery, transplanting, harvest, mixed cropping and manure.
5)	English	2013	Rice and Pearl Millet Mixed Cropping: 10 slides.
6)	English	2015	Mixed Cropping in Wetlands
7)	English	2016	New Namibian Porridge "Oluthima"
8)	English	2016	Rice Cooking Method
9)	English	2014	Land preparation at wetlands
10)	English	2014	How to overcome severe drought?
11)	Oshiwambo	2013	Rice harvesting & Post-Harvest Techniques: from rice harvesting to storage
12)	Oshiwambo	2013	Rice Cultivation Technique (from selection of rice seeds to transplanting)
13)	Oshiwambo	2014	Rice Cultivation, Harvesting & Post-Harvest Techniques
14)	Oshiwambo	2015	Mixed Cropping in Wetlands

Indicator 4-2): Executions of field day by researchers and technicians of UNAM on the mixed cropping systems.

Field day was carried out 10 times from March 2013 to June 2016 for explaining rice-based mixed cropping systems, rice cropping cycle, outlines of the Project, tractor hiring pilot activities, and demonstration of operation of power tiller, etc. Participants of the field days were farmers, the Deputy-Minister of MAWF, the Vice Chancellor and the Pro-Vice Chancellors of UNAM, the governors of the regional governments, politicians of local government, high officials, the Chief of Uukwambi Traditional Authority, the senior headmen and the headmen of the local villages, etc. There were also the cases that students and teachers of secondary schools participated. Over 1,950 persons participated in the program in total. Final field day (or workshop) will be carried out in December this year (2016).

As mentioned above, the following paper related to the integrated study of agricultural and socio science area will be submitted to peer-reviewed journal by the end of the Project. Detailed information on the paper is shown on the table below.

Table 14: Paper to be Published

	Published/ in Press/ Accepted	Author Name, Name of Paper, Name of Publication, Year Published etc.	International or Domestic Journal
1	To be submitted	(This paper will be submitted in March 2017) Masuda et al., Integrated Assessment of Mixed Cropping System in Seasonal Wetland in the Northern Namibia.	International

3-4 Prospects for Achieving the Project Purpose

"Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of the semi-arid region.

Various research activities have progressed well in the areas of crop sciences, development studies, hydrology, and integrated study on agricultural and social sciences, as well as various papers have been

written and presentations for conferences/seminars have been made. Various leaflets for farmers/extension officers were developed using the research results. As mentioned below, draft guidelines for a "Flood- and drought-adaptive cropping systems" have been produced and these guidelines will be finalized within this year. Regarding the rice-based mixed cropping techniques which are to be disseminated to the farmers, mixed seedling in particular has been scientifically verified to have comparative advantage on yield on experimental basis. At farmers' field level, however, adaptability of rice-based mixed cropping techniques is yet to be verified mostly due to severe drought. Therefore, the Project Purpose will be achieved to a moderately high within this year.

Indicator: Guideline for "Flood- and drought-adaptive cropping systems" is compiled.

Namibian and Japanese researchers have jointly been producing two types of "Guidelines for "Flood- and drought- adaptive cropping systems". A draft guideline is now available in English, covering the results of research activities of the four research areas i.e. 1) crop science, 2) development studies, 3) hydrology, and 4) integrated study of agricultural and social science. Assumed users of the guideline are researchers of UNAM, officers and agricultural extension technicians of MAWF, and farmers. The other draft guideline in the local language (Oshiwambo) is available. This guideline focuses on crop science area because the target users of the guidelines are farmers. Information of the draft guidelines was shared with stakeholders at the Workshop on the Project achievement (August 29, 2016) and the 9th JCC Meeting (August 30, 2016) to obtain comments and suggestions on the guidelines. The draft guidelines are finalized considering the comments and suggestions of the stakeholders. After finalization, the guidelines together with the developed leaflets will be printed and shared with stakeholders in December 2016. The number of copies of the guidelines and their distribution will be discussed among project team members (Namibian and Japanese researchers). As a reference, the tables of contents are shown in the boxes below.

a) The contents of the draft guideline (in English).

• Background and purpose of the project • Rice introduction effort to a seasonal wetland • Fluctuation of flood water in a seasonal river • How to utilize the small-scale seasonal wetland within the farm • Summary [Integrated Study of Agricultural and Social Science] • The new food "Oluthima" • Examples of volunteer farmers' practices • Examples of demonstration farmers' practices • Practical problems • Field days for school children • Future collaboration with neighboring countries [Crop Science] • List of the proposed cultivation techniques • Proposed cultivation techniques 1) Mixed cropping in the water fluctuation zone 2) Ridge and furrow mixed cropping 3) Mixed seedling 4) Sequential planting after rains 5) Cultivar selection 6) Sustaining soil fertility • Joint work of Crop Science, Hydrology, and Development studies to preserve fragile water environments	[Hydrology] • Summary • Goal • Methods • Inter-annual variation of rainfall • Spatial distributions of rainfall • Temporal Trends in Evapotranspiration • Origin of surface water of small wetlands • Satellite remote sensing of surface water • Developing a daily surface water map • Detailed topographic survey of small wetlands • Spatio-temporal changes in surface water storage and the response to precipitation • Distribution of the areas potentially suitable for rice cultivation [Development Studies] • Summary • Introduction • Goal • Survey methods 1) Farm sketch 2) Hand-held GPS survey 3) Taking Aerial photos by UAV 4) Questionnaire survey 5) Summary of a village monograph 6) Landscape Analysis 7) Workshop

b) The contents of the draft guideline in the local language.

- List of the proposed cultivation techniques
- Proposed cultivation techniques
  1) Mixed cropping in the water fluctuation zone
  2) Ridge and furrow mixed cropping
  3) Mixed seedling
  4) Sequential planting after rains
  5) Cultivar selection
  6) Sustaining soil fertility
- Joint work of Crop Science, Hydrology, and Development studies to preserve fragile water environments

Drought or semi-drought years continued during the Project period (4 years from 2012/13 to 2015/16 cropping seasons), therefore, there was no opportunity to confirm adaptability of the developed cropping systems under the flood situation.

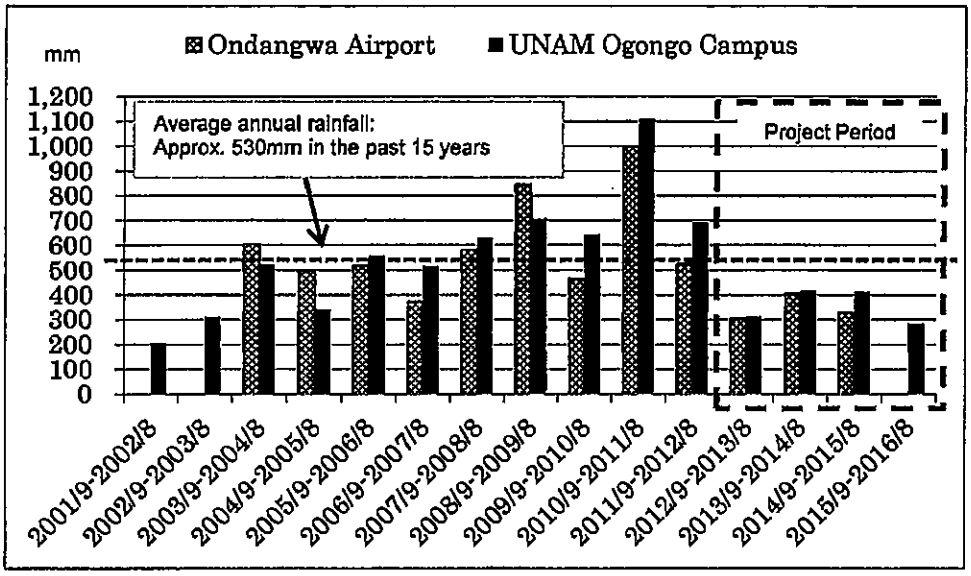


Figure 2: Annual Rainfall at the UNAM Ogongo Campus and Ondangwa Airport

3-5 Implementation Process

Promoting and obstructing factors that influenced the effective implementation of the Project activities are as follow.

(1) Promoting Factors

1) Enthusiasm of Namibian and Japanese researchers

Enthusiasm of Namibian and Japanese researchers for implementing research activities brought useful research outcomes.

2) Research activities parallel to learning at doctoral level

Namibian counterparts learned at the doctoral level in Japan by carrying out research activities of the Project. This is a promoting factor for effective implementation of the Project activities.

3) Improved communication and organized preparation of publications (academic papers)

Responding to the recommendations at the mid-term review, communication between Namibian counterparts and Japanese researchers has improved, and publications have been made with more collaborative and organized manner.

(2) Obstructing Factors

1) Severe drought

Low rainfall in the recent rainy seasons became a limiting factor in obtaining expected research results.

4. Results of Evaluation

4-1 Relevance

The relevance of the Project is considered to be high based on the facts described below.

(1) Conformity with needs for increasing crop production in seasonal wetlands in north-central Namibia

The agricultural sector of Namibia contributes 3.2% of GDP (Annual National Accounts 2015) and it is roughly divided into the subsistence agricultural production in the northern area and the commercial livestock production in the central and southern areas. Namibia depends on imports for more than 50% of the country's grain consumptions and around 48% of rural households are dependent on subsistence agriculture. According to the report on grain production and the situation of food in 2008 of MAWF, 54% of domestic grains (millet, sorghum, and maize) were produced in four regions (Omusati, Ohangwena, Oshana, and Oshikoto) of Namibia, all of which are located in the northern sector of the country. Northern Namibia, where seasonal wetlands are located, is within the semi-arid zone. Annual rainfall in this area has fluctuated widely in recent years: floods and droughts occur very sporadically. Therefore, annual production of pearl millet, which is the traditional crop in this area, is unstable and the degree of fluctuation is large. Farmers in this area are willing to practice crop cultivation which is adapted to unstable climate (drought and flood situations).

This Project is aiming to develop a new cropping system, with water resource conservation techniques, that enables a certain degree of stable crop production even in flood or drought years. Therefore, this project is consistent with the needs of farmers in the north-central area of Namibia.

(2) Relevance to the national policies of Namibia

"Vision 2030" aims to contribute toward food security and to increase income at the household and national levels, while sustaining and improving land productivity. One of its strategies is "adopting more adaptive and responsive agricultural methods, e.g. replacing a monoculture of food and cash crops with viable intercropping systems, crop rotation or agroforestry". One of the priority issues of the economic sector of the present Namibia's Fourth National Development Plan (2012/13 to 2016/17) is agriculture and the target of the annual growth rate in the sector during the period of this plan is 4% per year. One of the overall goals of the Namibia Agriculture Policy for 2015 is to create a conducive environment to increase and sustain agriculture production and its productivity. The following specific objectives are included in the Namibia Agriculture Policy for 2015: 1) to develop and diversify agricultural production, 2) to promote agricultural research and adaptation of appropriate technology, and 3) to promote the sustainable utilization of resources for agricultural production to contribute and support disaster preparedness. The Government of Namibia is strongly promoting rice production at the Kalimbeza National Rice Project (located in north-east Namibia). Therefore, the objectives of this Project are relevant to the important issues of these policies of the Government of Namibia.

(3) Conformity to the assistance policy of Japan to Namibia

One of the priority areas of Japan's Country Assistance Policy to Namibia is the contribution to the

improvement of the present living standard and the reduction of poverty in the rural area. The Government of Japan has the intention to support human resource development that is necessary for effective and efficient agricultural development which the Government of Namibia is tackling for alleviating poverty and low income of those living in north-central Namibia. The Project aims to develop cropping systems adaptable to climate change and such systems will contribute to food security and livelihood improvement of rural residents. Therefore, this Project is consistent with the assistance policy of Japan.

(4) Appropriateness of the approaches taken by the Project

The main purpose of the Project is to develop "flood- and drought-adaptive cropping systems which can sustainably preserve the water environment of the semi-arid region" by integrating research results of crop science, development studies and hydrology areas. In particular, the main expected results of the Project are:

1) to propose rice-based mixed cropping systems that are adaptable to flooding and drought as well as water-saving,
2) to establish methods to understand the change of farmers' attitudes and perception on the rice-based mixed cropping systems and socio-economic impacts on farmers, and
3) to estimate possible areas for mixed-cropping based on water budget/water source analysis.

The Project approach was relevant to the conditions of the natural environment, available water resources, the needs of farmers, and agricultural production in the north-central Namibia.

(5) Comparative advantage of technical cooperation by Japan

Japan has a long history and significant experiences with rice cultivation. Japan has accumulated research results not only within its borders and in Asia, but also in Africa as well. Japan also has long history in developing techniques on water-saving cultivation, socio-economic analysis, and hydrological analysis. Nagoya and Kindai Universities of Japan have experiences in introducing rice cultivation in semi-arid regions in Namibia from the early 2000s. These universities had received Namibian trainees to Japan and also had dispatched researchers to Namibia. Thus, Japan has the technical advantage in introducing rice cultivation in the existing cropping system. It can also be underlined, that there is an excellent working relationship between UNAM and Japanese universities. Therefore, it is very likely to say that a significant positive result will be produced by carrying out joint research activities including technical skills transfer to Namibian researchers.

4-2 Effectiveness

As mentioned in "3-4 Prospects for Achieving the Project Purpose", various research activities have progressed well in the areas of the crop sciences, development studies, hydrology, and integrated study on agricultural and social sciences. Various papers were written, presentations were made at conferences/seminars, and leaflets for farmers/extension officers were developed using the research results. The degree of development of the "Flood- and drought-adaptive cropping systems" which can sustainably preserve the water environment of the semi-arid region is experimentally established. On the other hand, the project team could not collect sufficient data due to severe drought for verifying the rice-based mixed cropping systems at the farmer's fields. According to the economic survey, however, 32 farmers have adopted and harvested rice even in severe drought condition, which partly supports the effectiveness of the proposed mixed cropping systems. Therefore, the overall effectiveness of the Project is considered to be moderately high.

4-3 Efficiency

The efficiency of the Project is considered to be moderate based on the facts described below.

4-3-1 Inputs by the Japanese Side

Japanese researchers from various universities and research institutes have visited Namibia periodically for a short-term (10 to 20 days in most cases) while a project coordinator was assigned on a long-term basis. The dispatch of Japanese researchers is mostly appropriate in terms of number of persons, expertize, and research capacity, etc.

Various vehicles, agricultural machinery, measuring and laboratory equipment and materials (including consumables and spare parts) for research activities have been provided. Most of them have been well utilized. However, because of delay in arrival, a dry oven and an incubator have not yet been in use. Also, there were two rice milling machines that were observed to be not in full use, due to low production of rice caused by severe drought. Two UAVs were in full use, but mainly by Japanese experts and trainings of counterparts on proper operation is necessary for future utilization and maintenance.

As for the trainings in Japan, in most cases, trainings were effective in terms of strengthening research ability and facilitation skills of the Namibian counterparts of UNAM. Regarding the agricultural extension technicians of MAWF, their rice cultivation techniques were strengthened. There are opinions that practice-oriented longer training in Japan on rice cultivation techniques is effective for agricultural extension technicians in order to acquire self-confidence on the rice cultivation techniques. Three Namibian counterparts have participated in long-term trainings at doctoral and master levels. Two counterparts are expected to obtain PhD degree and one to obtain master degree next year.

4-3-2 Inputs by the Namibian Side

As mentioned in an article on Inputs, the total number of 12 Namibian counterparts of UNAM including Project Director, Project Manager, and Assistant Project Managers are involved in project activities.
As for the crop science team, 11 staff members of UNAM participated in the Project in total and currently nine remain. As for the development studies team, eight staff members of UNAM participated in total and currently two remain. As for the hydrology team, two staff members of UNAM participated in total and currently one remains. The major reason for participation turnover was due to study leave.

UNAM has provided various facilities for the Project activities such as office spaces for Japanese researchers/coordinator, laboratories, green house, crop experiment fields, seed room, rice packing room and store rooms. It seems that these facilities are effectively used for project activities.

In terms of financial contribution by UNAM for the Project, UNAM has made efforts to allocate budget and disbursed necessary amount of expenses for the project activities as shown in the Table 2 and 3 (see item 3-1-2 (2)).

4-3-3 Project Management

As mentioned earlier, there are two kinds of meeting for the Project, such as JCC meeting and Management Committee meeting. These meetings were held regularly. The JCC meeting was held eight times (twice a year at the UNAM main campus or Ongwediva Campus), and the Management Committee meeting was held 16 times (once a quarter at the UNAM Ogongo Campus). According to opinions of the Namibian counterparts, these meetings were well organized and productive for reviewing progress of the project

activities, approving work plan for next period, and discussing major issues arising from the project implementation.

4-4 Impact

It is prospected that a part of the Overall Goal, such as contribution to food security of local farmers, can be attained at certain degree. Several impacts of the Project are observed. The impact of the Project is likely to be moderately high.

4-4-1 Prospect of Achieving the Overall Goal

Overall Goal: **1. "Flood- and drought-adaptive cropping systems" are disseminated in the north-central Namibia to contribute to the food security and cash income of local farmers.**

2. "Flood- and drought-adaptive cropping systems" are considered for the northeastern areas of Namibia where high rainfall occurs as well as in neighboring countries.

UNAM and MAWF have made efforts to obtain budget for the next financial year (from April 2017 to March 2018) for disseminating "Flood- and drought-adaptive cropping systems" to the north-central Namibia and Kavango region (located north-east Namibia) and for continuing research activities on "Flood- and drought-adaptive cropping systems". According to the budget proposal by UNAM, workshops for farmers will be held at 12 locations in five regions and field days will be held five times. Therefore, it is expected that field days and workshops on the rice-based mixed cropping techniques will be held periodically after the completion of the Project in north-central and north-east of Namibia. When more local farmers introduce/adopt these techniques, it is expected to contribute to food security of local farmers.

As for implementation of regional research conference together with neighboring countries on "Flood- and drought-adaptive cropping systems", two presenters from neighboring countries (Zambia and Botswana) participated in the international symposium on "Agricultural Use of Seasonal Wetlands in Southern African Countries" in September 2014 (a symposium organized by the Project). However, the Terminal Evaluation Team cannot assess at this moment whether such conference can be held within a few years after the completion of the Project. Also, the Terminal Evaluation Team cannot assess at this moment that the rice-based mixed cropping systems to be introduced in neighboring countries in a short period of time.

4-4-2 Impacts Observed

(1) Farmers' strong interests on rice cultivation and rice-based mixed cropping

According to the results of hearing from demonstration farmers and volunteer farmers, they have strong intension to continue rice-based mixed cropping using seasonal small wetlands of their fields, even though their harvests of rice and other crops were not good due to consecutive low rainfall of recent years. Around 200 persons (not only farmers but also governmental officials and school students) participated in the rice harvest festival which was carried out in June 2016 under the Project. It is expected that farmers' interests will continue and the rice-based mixed cropping techniques at farmer level will be expanded.

(2) Joint use of community's seasonal wetland

It was reported that community's seasonal wetlands were shared by farmers in two communities. This kind of shared use enables practicing rice-based mixed cropping by farmers who do not have own usable wetland.

(3) Proposal for research on new rice product

Rice flour was made using broken rice and was mixed with pearl millet flour (50% of rice flour and 50% of pearl millet flour) under the Project. This is a new product and by-product of the Project. Using this, porridge can be made and the taste is said to be better than porridge made from only pearl millet. UNAM is preparing a proposal for conducting researches for producing some other new rice products.

(4) Increased motivation of lecturers of the UNAM Ogongo Campus for carrying out research activities.

According to Namibian counterparts, lecturers became more motivated to get involved in research project aside from only teaching.

4-5 Sustainability

Sustainability of the Project is likely to be moderately high based on the facts described below.

(1) Policy Aspect

As mentioned earlier in the item on relevance, sustainable increase of agriculture production and productivity, food security, and income increase are regarded important in the strategies and policies of the Government of Namibia. There are growing interests at UNAM, MAWF, regional governments and local farmers on the introduction of rice cultivation and the rice-based mixed cropping techniques. Therefore, it is expected that the outcomes of the Project will be disseminated to wider areas with support by UNAM, MAWF, and regional governments. Hence policy sustainability of the Project will be secured.

(2) Institutional and Financial Aspects

A joint budgetary proposal by UNAM and MAWF for the next financial year (from April 2017 to March 2018) was prepared and submitted to UNAM Department of Finance from UNAM Ogongo Campus for its contribution of NAD 500,000 and also to Ministry of Finance from MAWF for its contribution of NAD 281,000 respectively, for disseminating rice-based cropping systems and continuing a part of research activities which were conducted under the Project. Target areas for dissemination proposed by the plan are the north-central Namibia and Kavango region (north-east Namibia), which is beyond the current target area of the Project. The activities covered by the budget of UNAM and MAWF will be the following items.

A: Items to be covered by the budget for the basic research at the Ogongo Campus by UNAM from April 2017 to March 2018 (NAD 500,000)

1) Casual labour (land preparation, irrigation, harvesting and threshing)
2) Consumables (diesel, fertilizers, harvesting & packaging materials)
3) Rice events (harvest festival, conferences and meetings)
4) Publications (printing of posters, brochures, and documentary film)
5) Others (on-farm transport and maintenance of machinery)

B: Items to be covered by the budget for community services by MAWF from April 2017 to March 2018 (NAD 281,000)

1) Training workshops for rice farmers (North-central and Kavango)
2) Seed and seedling distribution (North-central)
3) Rice farmers' field day (North-central and Kavango)
4) On-farm weather station maintenance and data collection (North-central)
5) Contribution to documentary film (North-central and Kavango)

There is solid collaborative relationship between UNAM and MAWF in providing information and techniques on crop cultivation, and, it is expected that the financial arrangements will promote further dissemination of the rice-based cropping systems and further improvement of the systems. It is better to confirm whether the amount of budget to be prepared is sufficient.
Thus, financial and institutional sustainability (on effective utilization and dissemination of the outcomes of the Project) can be considered relatively high, considering the progress the budget allocation. Cost of operation and maintenance for machineries provided by JICA, however, is not included in the above budget plan, and it should be secured..

(3) Technical Aspect

The Namibian counterparts are mainly lecturers and technicians of the Ogongo campus of the Faculty of Agriculture and Natural Resources. In addition, agricultural extension technicians and officers of MAWF have collaborated for project activities. Research skills of the Namibian counterparts have been strengthened through project activities such as joint research activities with Japanese researchers, short-term and long-term trainings in Japan, preparation of papers for submitting academic journals and proceedings for academic conferences/seminars. Lecturers and technicians work at UNAM continuously in general, therefore, their knowledge and skills enhanced under the Project will be utilized for academic activities at UNAM. Technical sustainability is expected to be secured.

As for effective use and maintenance of the provided machinery and equipment, most of machinery is still new and severe malfunction or problem has not occurred. Two staff members of UNAM received training on maintenance of agricultural machinery in Japan. However, it is preferable that more staff of UNAM need to be trained to acquire knowledge and skills on operation and maintenance of tractors, hand power tillers, milling machines, UAVs etc.

4-6 Conclusions

The Terminal Evaluation Team has confirmed that the Project produced good research results such as the guidelines for "Flood- and drought- adaptive cropping systems" (under finalization), papers for academic journals, presentations to academic conferences/seminars, despite the four-year consecutive trend of low rainfall affected negatively for rice-based mixed cropping cultivation at the farmers' fields.

Crop Science Team proposed 6 cultivation techniques as part of "Flood- and drought- adaptive cropping systems". Development Studies Team established 7 kinds of method to understand the change of attitudes & perception by farmers, and socio-economic impacts on farmers. Hydrology Team estimated the possible area (maximum area) for introducing rice-based mixed cropping that does not modify water environment of seasonal wetlands.

Most of the farmers, who experienced rice-based mixed cropping and rice cropping, keep higher interest on cropping at seasonal small wetlands and they have willingness to continue it.

The summary of evaluation based on five evaluation criteria is described in the table below.

Criteria	Evaluation
Relevance	High
Effectiveness	Moderately high
Efficiency	Moderate
Impact	Likely to be moderately high

Sustainability	Likely to be moderately high

In accordance with the results of the comprehensive evaluation, it is concluded that the Project will be completed in February 2017 as scheduled.

5. Recommendations and Lessons Learned

5-1 Recommendations

5-1-1 Recommended Actions to be taken by the Project Teams (Namibian counterparts and Japanese researchers) in the Remaining Cooperation Period (up to February 2017)

(1) Reviewing and refining the Guidelines to suit the target users

Two versions of the Guidelines for "Flood- and drought- adaptive cropping systems" were proposed, and they are to be published by December 2016. In that process, however, it is advisable to refine the contents to be user-friendly, reflecting the comments from each user's points of view.

(2) Discussion on the activities to be continued after the completion of the Project

The scope of the research activities as well as dissemination activities, which UNAM counterparts are to carry out after the completion of the Project, should be well discussed considering UNAM's research priorities and human resources. Based on that scope, necessary budget and implementing structure should be arranged.

(3) Proper management of JICA provided machineries and equipment

The project team is expected to review and revise the Inventory list of JICA provided machineries and equipment, and properly have them registered in the custody of UNAM. Also, cost of operation and maintenance of these machineries and equipment, including purchase of spare parts should be estimated based on the experience of the Project, so that UNAM can have the basis for securing budget.

(4) Ammendment of the PDM

The Terminal Evaluation Team recommends to revise the "Objectively Verifiable Indicator 2" and its "Means of Verification" of the Overall Goal 2 so that it would be realistically achievable by the own efforts of UNAM after the project completion (see item 4-4-1). See Appendix 11 for the proposed PDM version 4.

5-1-2 Recommended Actions to be taken by the Namibian Authorities Concerned

(1) Preparation of a detailed implementation plan for UNAM's research activities and dissemination activities

It is expected that UNAM prepare a detailed plan of implementation for UNAM's research activities and dissemination activities for communities as well, based on the discussions to be made (responding to the recommendation (2) mentioned above (in the item 5-1-1).

(2) Enhanced partnership between UNAM and MAWF/regional governments

The Project has succeeded in disseminating the rice-based mixed cropping systems to farmers on a trial basis. Considering further dissemination in the future, solid partnership and clear demarcation of roles and responsibilities among partnership between UNAM and MAWF/regional governments is crucial. There has been solid partnership between UNAM and MAWF and this should be maintained to promote the rice-based mixed cropping systems.

(3) Continuous maintenance of machineries and equipment

UNAM should draw up a utilization plan of machineries and equipment provided by the Project.
UNAM should also secure budgetary allocation for maintenance of machinery procured under the Project including refresher training for technicians.

5-2 Lessons Learned

(1) Low rainfall during the project period significantly affected crop cultivation at the farmers' small wetlands. For the future projects, when serious external factors hinder the project implementation, it is desirable that JICA and JST have closer and prompt communication with the Project to seek for alternative measures to address the situation.

(2) Effective ways to manage the international collaborative project with several research institutes were obtained by the Namibian partners. In the future projects, these know-hows are expected to be utilized for some other projects/programs.

Annex 1 Schedule of the Terminal Evaluation

	Date		Namibian Evaluatin Team	Japanese Evaluation Team			
			Prof. Omoregie & Prof. Indongo (UNAM)	Ms. Ohshima (JICA)	Ms. Asaoka (JICA)	Mr. Dojun (Consultant)	Dr. Kokubun & Dr. Kodaira (JST)
1	13 Aug	Sat				Depart from Japan	
2	14 Aug	Sun				Arrival in Windhoek	
3	15 Aug	Mon	Meeting with JICA consultant			- Courtesy call to UNAM Main campus (two Pro-Vice Chancellors, a JCC member, and a of Namibian Evaluation Team) - Explanation of evaluation method to a member of Namibian Evaluation Team - Meeting at JICA Namibia office	
4	16 Aug	Tue				Move from Windhoek to North - Meeting with JICA coordinator - Courtesy call to UNAM Ogongo campus (Assistant Pro-Vice Chancellor, Campus Manager, Farm Manager, and Deputy Director Academic Affairs and Research) - Interview to C/Ps of UNAM (three Namibian counterparts)	
5	17 Aug	Wed			Leave Japan	Field visit and interview to three volunteer farmers (Afoti Village)	
6	18 Aug	Thu			Arrival in Windhoek Arrive in North	Observation of experimental fields and others in the UNAM Ogongo campus Interview to demonstration farmers (Oshiteyatemo village)	
7	19 Aug	Fri			- Interview to extension officers (five officers of MAWF)		
8	20 Aug	Sat			Preparation of draft evaluation report		
9	21 Aug	Sun		Leave Japan	Preparation of draft evaluation report		Leave Japan
10	22 Aug	Mon		Arrival in Windhoek	- Interview to C/Ps of UNAM (six Namibian counterparts)		Arrival in Windhoek
11	23 Aug	Tue	Arrive in North	Arrive in North			Arrive in North
			- Field visit to Onamundindi village (interview to a demonstration farmer, a volunteer farmer, and a control farmer)				
12	24 Aug	Wed	- Field visit to Oshiteyatemo village (interview to a demonstration farmer, a volunteer farmer, and a control farmer)				
13	25 Aug	Thu	- Observation of the facilities using for project activities at the UNAM Ogongo campus (experimental fields, laboratory, agricultural machinery, green house and store rooms) - Interview to a Japanese researcher - Internal meeting of the Japanese Evaluation Team				
14	26 Aug	Fri	(Heroes day: public holiday) Internal Meeting for Summarizing Joint Evaluation Report				
15	27 Aug	Sat	- Meeting for discussing contents of the Terminal Evaluation Report with Japanese researchers - Meeting for discussing contents of the Terminal Evaluation Report with the Namibian Evaluation member and Namibian counterparts				
16	28 Aug	Sun	- Meeting of the Joint Terminal Evaluation Team (Namibian and Japanese sides)				
17	29 Aug	Mon	- Participation to the Symposium of the Project at UNAM Engineering Campus				
18	30 Aug	Tue	- JCC meeting (UNAM Engineering Campus) and Discussion of contents of the Terminal Evaluation Report				Leave North
19	31 Aug	Wed	- Move to Windhoek				Leave Windhoek
20	1 Sep	Thu	- (11:00 Report the results of the terminal evaluation to the Embassy of Japan) - 14:30 Signing on M/M (UNAM Main Campus)				Arrive in Japan
21	2 Sep	Fri		Leave Windhoek			
22	3 Sep	Sat		Arrive in Japan			

Annex 2 Project Design Matrix (PDM) Version 3

Project Title: Flood- and Drought-Adaptive Cropping Systems to Conserve Water Environments in Semi-arid Regions
Project Site: Faculty of Agriculture & Natural Resources, Ogongo Campus, The University of Namibia (UNAM) and seasonal wetlands in north-central Namibia
Target Group: Researchers of Faculty of Agriculture & Natural Resources, UNAM, and farmers in north-central Namibia
Project Duration: February 2012 - February 2017 (5 years)

Proposed Ver. 3 (March 10, 2016)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal 1. "Flood- and drought-adaptive cropping systems" are disseminated in the north-central Namibia to contribute to the food security and cash income of local farmers. 2. "Flood- and drought-adaptive cropping systems" are considered for the northeastern areas of Namibia where high rainfall occurs as well as in neighboring countries.	1-1) Field day held regularly on the cropping systems. 2-1) Regional research conference agreed and held together with neighbouring countries on the cropping systems.	• University of Namibia, Ministry of Agriculture, or media reports • Reference in regional research conference	
Project Purpose "Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of the semi-arid region.	Guideline for "Flood- and drought-adaptive cropping systems" is compiled.	• Guideline for "Flood- and drought-adaptive cropping systems"	• Extension works sustained and expanded. • Understanding and cooperation of neighbouring countries obtained.
Output 1: [Crop Science] The rice-based mixed cropping system, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.	1-1) Number of presentation at academic conferences/seminars in related areas such as crop science and tropical agriculture (27 times). 1-2) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6. 1-3) List of water-saving cultivation techniques with high water-use efficiency and of cropping systems with high productivity under environmental stress such as flood and drought.	• Proceedings of conference/seminar • Progress report • Journal publication • Report on research results	• Government policies on seasonal wetlands remain unchanged. (Large-scale physical planning or commercial farming not introduced in the seasonal wetlands.)
2: [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers through introduction of the rice-based mixed cropping system are established.	2-1) Records of changes in understanding by demonstration farmers on the contents and purpose of the mixed cropping system. 2-2) Number of presentation and report on study methods of understanding perception and the socio-economic impacts (9 times). 2-3) Number of presentation at academic conferences/seminars on the evaluation method for landscape ecology of the cropping system (7 times). 2-4) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 5.	• Interview/questionnaire • Progress report • Report on research results • Proceedings of conference/seminar • Journal publication	
3: [Hydrology] The possible area of mixed-cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.	3-1) Acquisition of data (scientific) on the change of flood (surface) water, the water budget and the dependence on flood (surface) water of small wetlands. 3-2) Number of presentation at academic conferences/seminars in related areas such as the potential cultivation area which does not affect the water environment (10 times). 3-3) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6.	• Report on research results • Proceedings of conference/seminar • Journal publication	

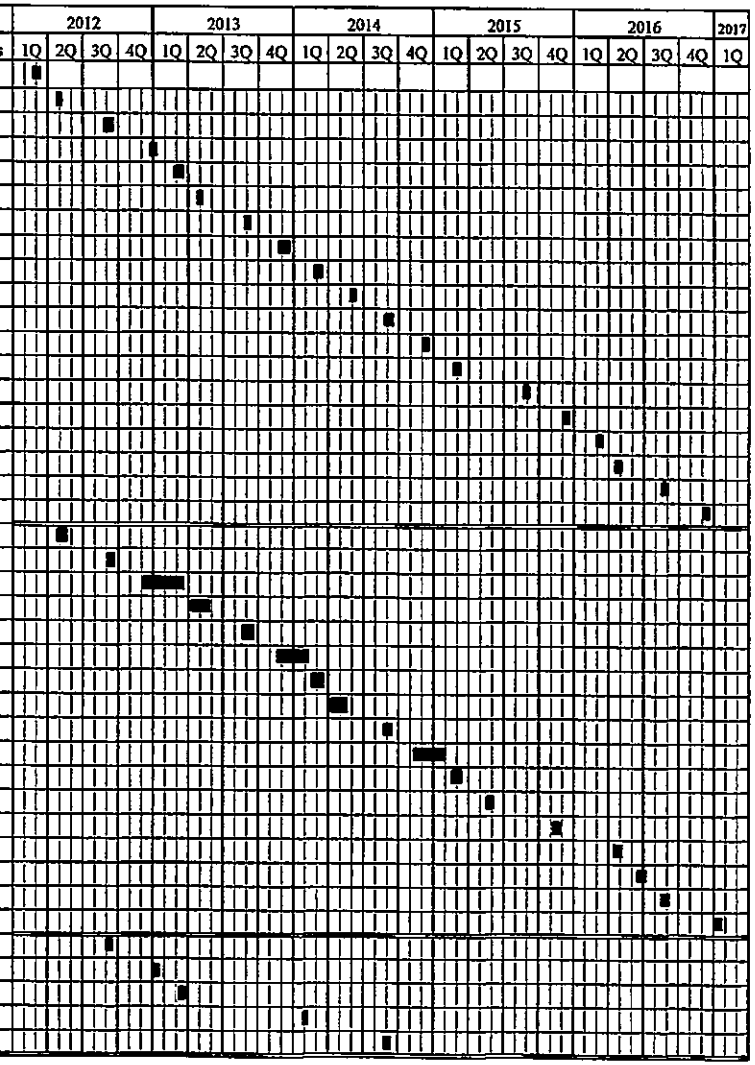
Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
4: [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.	4-1) Annual completion of hand-out on the mixed cropping system for researchers and farmers at the field day 4-2) Executions of field day by researchers and technicians of UNAM on the mixed cropping system.	· Progress report · Report on research results	

Narrative Summary	Inputs	Important Assumptions
Activity 1.1 Examine appropriate cultivation methods to establish the rice-based mixed cropping system. 1.2 Examine water-saving cultivation techniques by methods including the stable isotope technique. 1.3 Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain soil fertility. 2.1 Survey the socio-economic conditions and farm operations of farmers who participate in conducting field demonstrations or voluntary trials (baseline survey). 2.2 Secure informed consent by demonstration farmers prior to project activities and share findings from Output 1 and 3 through workshops. 2.3 Describe the changes of understanding by demonstration farmers on the contents and purposes of project activities and delineate the points to consider in the process of expansion of the mixed cropping system. 2.4 Classify the environment of farmers' fields from the viewpoint of landscape ecology. 2.5 Examine the sustainability of the mixed cropping system from the socio-economic viewpoint by understanding the farmers' decision making criteria to adopt or reject a new cropping system, ways to use the agricultural produce, and the change of perception on wetlands (farm household economy, labour distribution survey). 3.1 Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography maps, satellite images and measurements of meteorological and hydrological conditions. 3.2 Analyze the water budget of the seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation) 3.3 Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields. 4.1 Conduct field demonstration with committed and hardworking farmers on their small wetlands, on the rice-based mixed cropping system. 4.2 Conduct field trials with farmers who participate in trials on the rice-based mixed cropping system voluntarily. 4.3 Examine the rice-based mixed cropping system, which can preserve the water resources in semi-arid region and cope with the yearly fluctuation of flood and drought, by incorporating the feedback from Output 2 and 3 to Output 1. 4.4 Carry out participatory research and extension activities by Namibian researchers/technicians on the cropping system through opportunities such as field days.	**Namibia Side** 1) Assignment of Counterparts · Project Director · Project Manager · other necessary personnel 2) Provision of Facilities · Office space, working place, internet and other facilities (Ogongo Campus in the University of Namibia) · Experimental field and basic materials 3) Local Costs · Expenses for Namibian researchers' activities (e.g. domestic travel costs) · Operating expenses for the day-to-day activities and management of the project (such as utilities and communication costs) **Japan Side** 1) Dispatch of Experts · Long-term expert (Project Coordinator) · Short-term experts (Agronomy, Development Sociology, Hydrology, Crop Physiology, Geography) 2) Training · Counterpart trainings in Japan for several researchers 3) Provision of Equipment and Materials · Vehicle (4WD) · Agricultural machinery and equipment · Analytical instrument for crop physiology · Meteorological instrument · Training equipment (personal computers, projector, peripheral equipment) · Office machinery (copier, scanner) · Other necessary equipment 4) Local Costs · Share of training costs	· The implementation arrangement of the project sustained. · Weather conditions are as usual without extreme drought or flood. **Pre-conditions** · Conditions are satisfied to initiate the project as agreed in the Minutes of Meeting

"Flood- and drought-adaptive cropping system": The farming system which secures food crop production by the subsistent farmers in both flood and drought years by rice-based mixed cropping.

Annex 3 Dispatch of Japanese Researchers/Experts

No	Name	Field in charge	Position	Organization	Period of Dispatch From	To	Days
1	Prof. Morio Iijima	Leader, Crop Science and Integrated Study of Agricultural and Social Science	Professor, Faculty of Agriculture	Kinki University	27/02/2012	17/03/2012	20
					26/04/2012	07/05/2012	12
					23/08/2012	14/09/2012	23
					26/12/2012	10/01/2013	16
					25/02/2013	17/03/2013	21
					25/04/2013	04/05/2013	10
					25/08/2013	07/09/2013	14
					23/11/2013	01/12/2013	9
					24/02/2014	17/03/2014	22
					24/04/2014	03/05/2014	10
					27/08/2014	14/09/2014	19
					06/12/2014	14/12/2014	9
					25/02/2015	14/03/2015	18
					23/08/2015	01/09/2015	10
					06/12/2015	13/12/2015	8
				Kindai University	02/03/2016	12/03/2016	11
					28/04/2016	09/05/2016	12
					22/08/2016	03/09/2016	13
				(planned)	04/12/2016	12/12/2016	9
2	Dr. Yuichiro Fujioka	Development Studies	PostDoc, Faculty of Agriculture	Kinki University	23/04/2012	16/05/2012	24
					02/09/2012	22/09/2012	21
					02/12/2012	16/03/2013	105
					09/04/2013	22/05/2013	44
					17/08/2013	14/09/2013	29
					18/11/2013	09/02/2014	84
					18/02/2014	17/03/2014	28
					14/04/2014	18/05/2014	35
					30/08/2014	14/09/2014	16
					23/11/2014	04/02/2015	74
					23/02/2015	18/03/2015	24
		Sub-leader, Development Studies	Assistant Professor, Frontier Research Institute for Interdisciplinary Sciences	Tohoku University	27/05/2015	07/06/2015	12
					17/11/2015	26/11/2015	10
					24/04/2016	04/05/2016	11
					29/06/2016	07/07/2016	9
					23/08/2016	03/09/2016	12
				(planned)	17/01/2017	28/01/2017	12
3	Prof. Yoshiaki Nishikawa	Sub-leader, Development Studies	Professor, Graduate School of International Development	Nagoya University	02/09/2012	10/09/2012	9
					01/01/2013	08/01/2013	8
					08/03/2013	18/03/2013	11
					29/01/2014	08/02/2014	11
			Professor, Faculty of Economics	Ryukoku University	30/08/2014	12/09/2014	14



No	Name	Field in charge	Position	Organization	Period of Dispatch From	To	Days	2012 1Q	2Q	3Q	4Q	2013 1Q	2Q	3Q	4Q	2014 1Q	2Q	3Q	4Q	2015 1Q	2Q	3Q	4Q	2016 1Q	2Q	3Q	4Q	2017 1Q
4	Prof. Tetsuya Hiyama	Sub-leader, Hydrology	Associate Professor	The Research Institute for Humanity and Nature	02/09/2012	14/09/2012	13																					
					07/03/2013	16/03/2013	10																					
					25/08/2013	10/09/2013	17																					
			Professor, Hydrospheric Atmospheric Research Center	Nagoya University	27/08/2014	11/09/2014	16																					
					23/08/2015	05/09/2015	14																					
					25/08/2016	03/09/2016	10																					
5	Prof. Yasuhiro Izumi	Crop Science	Associate Professor, School of Environmental Sciences	University of Shiga Prefecture	03/03/2013	31/03/2013	29																					
					25/04/2013	06/05/2013	12																					
					02/03/2014	26/03/2014	25																					
					30/08/2014	12/09/2014	14																					
					05/03/2015	24/03/2015	20																					
			Professor, School of Environmental Sciences		03/03/2016	24/03/2016	22																					
					28/04/2016	08/05/2016	11																					
				(planned)	26/11/2016	04/12/2016	9																					
6	Dr. Koji Yamane	Crop Science	Lecturer, Faculty of Agriculture	Kinki University	25/04/2013	06/05/2013	12																					
7	Dr. Yoshinori Watanabe	Crop Science	PostDoc, Faculty of Agriculture	Kinki University	25/04/2013	12/05/2013	18																					
					02/03/2014	17/03/2014	16																					
					21/08/2015	08/09/2015	19																					
					20/11/2015	15/06/2016	209																					
				(planned)	17/11/2016	17/12/2016	31																					
				(planned)	04/01/2017	02/02/2017	30																					
8	Prof. Koichi Shoji	Crop Science	Associate Professor, Faculty of Agriculture	Kobe University	23/08/2015	01/09/2015	10																					
					03/03/2016	14/03/2016	12																					
					26/08/2016	19/09/2016	25																					
9	Dr. Satoru Muranaka	Crop Science	Researcher	JIRCAS	06/12/2015	14/12/2015	9																					
10	Dr. Yoshihiro Hirooka	Crop Science	Assistant Professor, Faculty of Agriculture	Kindai University	28/04/2016	08/05/2016	11																					
					22/08/2016	03/09/2016	13																					
				(planned)	28/11/2016	12/12/2016	15																					
11	Prof. Takeshi Ohta	Sub-leader, Development Studies	Professor, Graduate School of Bioagricultural Sciences	Nagoya University	01/09/2013	14/09/2013	14																					
12	Prof. Koichi Usami	Development Studies	Professor, Graduate School of International Development	Nagoya University	19/08/2013	31/08/2013	13																					
					24/07/2014	02/08/2014	10																					
13	Dr. Kiyomi Kaida	Development Studies	Visiting researcher	Ryukoku University	01/03/2015	15/03/2015	15																					
					02/07/2015	22/07/2015	21																					
			Doctor researcher		07/08/2015	29/08/2015	23																					
					06/11/2015	21/11/2015	16																					
					03/02/2016	22/02/2016	20																					
14	Prof. Tadayoshi Masuda	Development Studies	Associate Professor, Faculty of Agriculture	Kinki University	23/08/2015	01/09/2015	10																					
					26/02/2016	14/03/2016	18																					
				Kindai University	28/04/2016	11/05/2016	14																					
					19/08/2016	03/09/2016	16																					

No	Name	Field in charge	Position	Organization	Period of Dispatch			2012				2013				2014				2015				2016				2017
					From	To	Days	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q
15	Dr. Gen Shoji	Development Studies	Visiting researcher	Miyagi University of Education	24/04/2016	04/05/2016	11																					
16	Mr. Hiroyuki Inai	Development Studies	Research assistant	Kindai University	28/04/2016	27/05/2016	30																					
					05/06/2016	05/07/2016	31																					
					07/08/2016	13/09/2016	38																					
17	Dr. Toru Sakai	Hydrology	Senior Researcher	The Research Institute for Humanity and Nature	07/03/2013	16/03/2013	10																					
18	Mr. Hisanori Tanaka	Hydrology	Technician	CLIMATEC, Inc.	01/09/2013	10/09/2013	10																					
19	Dr. Hironari Kanamori	Hydrology	Researcher, Hydrospheric Atmospheric Research Center	Nagoya University	23/08/2015	05/09/2015	14																					
					22/11/2015	14/12/2015	23																					
					25/08/2016	03/09/2016	10																					
				(planned)	03/01/2017	14/01/2017	12																					
20	Dr. Ayumi Kotani	Hydrology	Associate Professor, Faculty of Agriculture	Nagoya University	25/08/2016	03/09/2016	10																					
21	Ms. Tomoko Hasegawa	Project Coordinator/ Training	Long-term Expert	JICA	30/03/2012	30/09/2014	915																					
22	Ms. Mari Akiyama	Project Coordinator/ Training	Long-term Expert	JICA	23/08/2014	27/02/2017	920																					

Annex 4 Counterpart Personnel Trained in Japan

No.	Name	Position	Department	Institution	Current Position	Field/Name of the Course	Contents	Implementing Institution	Training period		
									From	To	Days
1	Hangula Martha Mweneni	Lecturer	Economics	UNAM	Same	Farmers participatory extension technique course for mixed cropping of rice and pearl millet	Japanese researchers concerned to the Project explained the theoretical background of the three research fields (crop science, development studies and hydrology) and research techniques to be used, and also the experiment sites at Kinki University, Nagoya University, University of Shiga Prefecture and the Research Institute for Humanity and Nature. Instructions on social science methods such as workshop implementing method at farmer's field and method to extract the recognition of the farmers for new cropping method.	Nagoya University, Kinki University, Shiga Prifectural University, and RIHN (The Research Institute for Humanity and Nature)	2012/7/9	2012/7/27	19
2	Angula Martin Ndinomupya	Lecturer	Economics	UNAM	Same						
3	Thomas Benisiu	Lecturer	Economics	UNAM	Same						
4	Shivolo Ottilie Taiilombwele	Lecturer	Crop Science	UNAM	Same						
5	Lwiinga Teofilus Taleni	Field Supervisor	Crop Science	UNAM	Same						
6	Embudile Martin	CAEO	DEES, Omusati	MAWF	Same						
7	Sheehama Patricia Ashipala	AET	DEES, Oshana	MAWF	Same						
8	Sheehama Pombili	AET	DEES, Omusati	MAWF	Same						
9	Iipumbu Festus	AET	DEES, Omusati	MAWF	Same						
10	Paulus William Ngumbe Haishonga	AET	DEES	MAWF	Same						
11	Sheehama Paulina Munyambali	AET	DEES	MAWF	Same						
12	Amwaalwa Anna Aia	AET	DEES, Oshana	MAWF	Same						
13	Uusiku Aina	AET	DEES, Omusati	MAWF	Same						
14	Simon Awala	Lecturer	Crop Science	UNAM	Same	Discussion	Discussion	Kinki University	2013/2/20	2013/2/25	6
15	Simon Awala	Lecturer	Crop Science	UNAM	Same	Long-term research program	Graduate school (doctoral course)	Kinki University	2013/4/15	2016/3/31	1,082
16	Frans Titus	Technician	Machinery	UNAM	Same	Farmers participatory extension technique course for mixed cropping of rice and pearl millet	Japanese researchers concerned to the Project explained the theoretical background of the three research fields and also the experiment sites at Kinki University, Nagoya University, University of Shiga Prefecture and the Research Institute for Humanity and Nature. The trainees participated in "the International Symposium 2013 Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa" at Nagoya University.	Nagoya University, Kinki University, Shiga Prifectural University, and RIHN (The Research Institute for Humanity and Nature)	2013/6/30	2013/7/20	21
17	Brendan Matomola	Technician	Agronomy	UNAM	Same						
18	Thulla Maharero	Lecturer	Economics	UNAM	Same						
19	Moris Eiseb	Lecturer	Economics	UNAM	Same						
20	Patrick Kompeli	Chief ART	DRT	MAWF							
21	Athon Wanga	Senior ART	DRT, Kavango	MAWF	Same						
22	Ujama Abiud Mbunguha	ART	Plant Production Research	MAWF	Same						
23	Kaunapawa Shapenga	AET	DEES, Omusati	MAWF	Same						
24	Otilie Nawa	AET	DEES, Omusati	MAWF	Same						
25	Wilhelmina Amashili	Senior AET	DEES, Omusati	MAWF	Same						
26	Agnes Akwenye	Senior AET	DEES, Omusati	MAWF	Same						
27	Nikolaus Endjala	AET	DEES, Ohangwena	MAWF	Same						
28	Elikias Iyambo	Senior AET	DEES	MAWF	Same						
29	Taimi Ndinelago Nambambi	AET	DEES, Oshana	MAWF	Same						
30	George Haufiku	AET	DEES, Oshikoto	MAWF	Same						
31	Jack Kambatuku	Lecturer	Environment	UNAM	Same	Short-term Research Program	To obtain necessary skills to analyze and examine the data collected from a variety of hydro-meteorological Instruments or satellites images	ditto	2013/6/30	2013/7/15	16
32	Johanna Ngula Niipele	Lecturer	Environment	UNAM	Same						

Annex 4 Counterpart Personnel Trained in Japan

No.	Name	Position	Department	Institution	Current Position	Field/Name of the Course	Contents	Implementing Institution	Training period		
									From	To	Days
33	Francisco Mausse	Dean	Animal Science	UNAM	Same	Short-term Research Program	To understand the progress of the Project-related research activities implemented in Japan and to share basic knowledge about the research conducted by crop science, development studies and hydrology team	ditto	2013/7/7	2013/7/15	9
34	Joseph Njunge	Deputy Dean	Ogongo Campus	UNAM	Same						
35	Cousins Gwanama	Head of Department	Crop Science	UNAM	Lecturer						
36	Benisus Thomas	Lecturer	Economics	UNAM	Same						
37	Osmund D. Mwandemele	Lecturer	Crop Science	UNAM	Same			Nagoya University	2013/7/9	2013/7/15	7
38	Angula Martin	Lecturer	Economics	UNAM	Same	Short-term Research Program	Trainig for development study	Kinki University/ Ryukoku University	2014/1/23	2014/2/15	24
39	Pamwenafye Nanhapo	Lecturer	Economics	UNAM	Same	Discussion	Discussion	Kinki University	2014/2/19	2014/2/25	7
40	Pamwenafye Nanhapo	Lecture	Crop Science	UNAM	Same	Long-term Research Program	Graduate school (doctoral course)	Kinki University	2014/3/28	2017/3/31	1,100
41	Athon Maliata Wanga	Senior ART	DRT, Kavango	MAWF	Same	Short-term Research Program	Research training for flood-drought adaptive cropping system	Kinki University	2014/7/2	2014/11/28	150
42	Joseph Njunge	Deputy Dean	Ogongo Campus	UNAM	Same	Short-term Research Program	Landscape analysis of seasonal wetlands	Kinki University	2014/7/9	2014/7/18	10
43	Teofilus Taleni Lwiinga	Field Supervisor	Crop Field Section	UNAM	Same	Short-term Research Program	Basic training for flood-drought adaptive cropping system	Kinki University	2014/7/2	2014/8/16	46
44	Anna Shomagwe	Institution Worker	Crop Field Section	UNAM	Same			Kinki University			
45	Benisus Thomas	Lecturer	Ogongo Campus	UNAM	Same	Short-term Research Program	Farmers' perception to flood-drought adaptive cropping system	Ryukoku University/ Kinki University	2014/7/4	2014/8/27	55
46	Athon Maliata Wanga	Senior ART	DRT	MAWF	Same	Long-term Research Program	Graduate school	Kinki Universiy	2015/3/29	2017/3/31	734
47	Danno F. Itanna	Head of Department of crop science	Crop Science	UNAM	Same	Short-term Research Program	Basic training for Flood-drought adaptive cropping system	Kinki Universiy/Shiga prif. Univ/Tohoku Univ.	2015/7/1	2015/7/10	10
48	Kabolongo K. Isak	Lecture	Crop Science	UNAM	Same	Short-term Research Program			2015/7/1	2015/7/10	10
49	Jack Kambatuku	Lecture	Environment	UNAM	Same	Short-term Research Program	Examine the data collected from a variety of Hydro-meteorological Instruments or satellites images	Nagoya University/ Tshukuba University	2015/7/7	2015/7/21	15
50	Shivolo Ottilie Taiilombwele	Lecture	Crop Science	UNAM	Same	Short-term Research Program	Incentive development and communication for new technology introduction (Including post-harvest)	Ryukoku University/ Nagoya University/ Tohoku University	2015/10/26	2015/11/7	13

DRT: Directorate of Research and Training
DEES: Directorate of Agricultural Extension & Engineering Services
AET: Agricultural Extension Technician
CAEO: Chief Agricultural Extension Officer
ART: Agricultural Research Technician
MAWF: Ministry of Agriculture, Water and Forestry

Annex 5 Provision of Equipment and Machinery (unit price is more than 27,250NAD or 200,000 Yens)

(1) Project vehicles

No.	Purpose of Use	Arrival Date	Name of Machinery	Product No.	Maker	Unit	Unit Price (NAD)	Amount (NAD)	Installation Place	Procurement Place	Current Condition
1	Use for project activities	27/03/2012	Hilux	N145197	TOYOTA	1	431,109.56	431,109.56	Ogongo Campus	Namibia Office	In use
2	Use for project activities	27/03/2012	Land cruiser	N145196	TOYOTA	1	477,034.30	477,034.30	Ogongo Campus	Namibia Office	In use
3	Use for project activities	28/03/2013	Hilux	N155372	TOYOTA	1	450,497.52	450,497.52	Ogongo Campus	Namibia Office	In use
							Total (1)	1,358,641.38	NAD		

(2) Project Equipment

No.	Purpose of Use	Arrival Date	Name of Machinery	Maker	Unit	Unit Price (NAD)	Amount (NAD)	Installation Place	Procurement Place	Current Condition
4	Use in office	10/05/2012	Copier IR2030i	Cannon	1	73,000.00	73,000.00	Ogongo Campus	Namibia Office	In use
5	Use for project activities	13/07/2012	Trailer 2.5ton	Zebra	2	44,000.00	88,000.00	Ogongo Campus	Namibia Office	In use
6	Use for project activities	11/12/2013	Water Pump	Kuku Agri	1	108,962.50	108,962.50	Ogongo Campus	Namibia Office	In use
7	Use for project activities	23/01/2014	Water Pump	Kuku Agri	1	84,582.50	84,582.50	Ogongo Campus	Namibia Office	In use
8	Use in office	08/05/2015	Copier MX-2614	Sharp	1	50,000.00	50,000.00	Ogongo Campus	Namibia Office	In use
9	Use for project activities	23/07/2015	Greenhouse	N/A	1	234,608.04	234,608.04	Ogongo Campus	Namibia Office	In use
10	Use for project activities	22/12/2015	Air conditioner 48000BTUDC	Gree	1	48,987.70	48,987.70	Ogongo Campus	Namibia Office	In use

(3) Agricultural Machinery (year 2012)

No.	Purpose of Use	Arrival Date	Name of Machinery	Product No.	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
11	Tillage	09/08/2012	Power Tiller	YZC-DL	Yanmer	3	310,000	930,000	Under the roof of Milling Machine	Indonesia	in use
12	Tillage	09/08/2012		BROMO-DX	Yanmer	3	272,000	816,000	Under the roof of Milling Machine	Indonesia	in use
13	Tillage	27/11/2012	Reaper	YAP120	Yanmer	1	310,000	310,000	Under the roof of Milling Machine	Indonesia	Usable (Consumables)
14	Tillage	27/11/2012		YAP120	Yanmer	1	310,000	310,000	Under the roof of Milling Machine	Indonesia	Usable (Consumables)
15	Tillage	27/11/2012		YAP120	Yanmer	1	310,000	310,000	Magazine under roo	Indonesia	Usable (Consumables)
16	Harvest	27/11/2012	Rice Milling	YHPC800	Yanmer	1	1,700,000	1,700,000	Under the roof of Milling Machine	Indonesia	Waiting for fabrication
17	Harvest	27/11/2012		YHPC800	Yanmer	1	1,700,000	1,700,000	Under the roof of Milling Machine	Indonesia	in use

(4) Equipment for climate monitoring

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
18	Climate monitoring	10/08/2012	Bowen Ratio Measurement System	Data Logger (for Bowen_1)	Climatec	1	259,000	259,000	Installed in the sloped filed	Japan	in use
				Channel Multiplexer	Climatec	1	119,000	119,000		Japan	in use
				Relay Driver	Climatec	1	40,000	40,000		Japan	in use
				Surge Terminal array	Climatec	3	50,000	150,000		Japan	in use
				Charge Controller	Climatec	1	20,000	20,000		Japan	in use
				Molded Case Circuit Breaker	Climatec	1	1,000	1,000		Japan	in use
				Fuse	Climatec	16	10	160		Japan	in use
				Fuse Box	Climatec	8	100	800		Japan	in use
				Measurement Box	Climatec	1	73,000	73,000		Japan	in use
19	Climate monitoring	10/08/2012	Bowen Ratio Measurement System	Net Radiation Meter	Climatec	1	250,000	250,000	Installed in the sloped filed	Japan	in use
				Hydro-thermometer	Climatec	2	111,000	222,000		Japan	in use
				Sun Shield Shelter	Climatec	2	100,000	200,000		Japan	in use
				TDR soil moisture sensor	Climatec	3	32,000	96,000		Japan	in use
				Soil Thermometer	Climatec	3	18,000	54,000		Japan	in use
				Water Thermometer	Climatec	3	18,000	54,000		Japan	in use
				Soil Heat Flux meter	Climatec	1	70,000	70,000		Japan	in use
				Tipping Gauge	Climatec	1	90,000	90,000	Installed Bowen 3	Japan	in use
				Attachment for Rain Gauge	Climatec	1	40,000	40,000		Japan	in use
				Albedo Meter	Climatec	1	158,000	158,000		Japan	in use
				3cup anemometer	Climatec	1	60,000	60,000		Japan	in use
				Water gauge	Climatec	1	100,000	100,000		Japan	in use
				Power Box	Climatec	1	20,000	20,000	Installed in the sloped filed	Japan	in use
				Battery	Climatec	3	20,000	60,000		Japan	in use
				Clamp	Climatec	5	100	500		Japan	in use
				Attachment Parts	Climatec	1	20,000	20,000		Japan	in use
				Ground Rod	Climatec	1	1,000	1,000		Japan	in use
20	Climate monitoring	10/08/2012	Bowen Ratio Measurement System	Data Logger (for Bowen_1)	Climatec	1	259,000	259,000	Installed in the sloped filed	Japan	in use
				Channel Multiplexer	Climatec	1	119,000	119,000		Japan	in use
				Relay Driver	Climatec	1	40,000	40,000		Japan	in use
				Surge Terminal array	Climatec	3	50,000	150,000		Japan	in use
				Charge Controller	Climatec	1	20,000	20,000		Japan	in use
				Molded Case Circuit Breaker	Climatec	1	1,000	1,000		Japan	in use
				Fuse	Climatec	16	10	160		Japan	in use
				Fuse Box	Climatec	8	100	800		Japan	in use
				Measurement Box	Climatec	1	73,000	73,000		Japan	in use
21	Climate monitoring	10/08/2012		Net Radiation Meter	Climatec	1	250,000	250,000		Japan	in use
				Hydro-thermometer	Climatec	2	111,000	222,000		Japan	in use

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
			Bowen Ratio Measurement System	Sun Shield Shelter	Climatec	2	100,000	200,000	Installed in the sloped filed	Japan	in use
				TDR soil moisture sensor	Climatec	3	32,000	96,000		Japan	in use
				Soil Thermometer	Climatec	3	18,000	54,000		Japan	in use
				Water Thermometer	Climatec	3	18,000	54,000		Japan	in use
				Soil Heat Flux meter	Climatec	1	70,000	70,000		Japan	in use
				Tipping Gauge	Climatec	1	90,000	90,000	Installed Bowen 3	Japan	in use
				Attachment for Rain Gauge	Climatec	1	40,000	40,000		Japan	in use
				Albedo Meter	Climatec	1	158,000	158,000		Japan	in use
				3cup anemometer	Climatec	1	60,000	60,000		Japan	in use
				Water gauge	Climatec	1	100,000	100,000		Japan	in use
				Power Box	Climatec	1	20,000	20,000	Installed in the sloped filed	Japan	in use
				Battery	Climatec	3	20,000	60,000		Japan	in use
				Clamp	Climatec	5	100	500		Japan	in use
				Attachment Parts	Climatec	1	20,000	20,000		Japan	in use
				Ground Rod	Climatec	1	1,000	1,000		Japan	in use
22	Climate monitoring	10/08/2012	Bowen Ratio Measurement System	Hydro-thermometer	Climatec	2	111,000	222,000	Installed in the sloped filed	Japan	in use
				Sun Shield Shelter	Climatec	2	100,000	200,000		Japan	in use
				Attachment Parts	Climatec	2	20,000	40,000		Japan	in use
23	Climate monitoring	10/08/2012	Rainfall Measurement System	Polyethylene Bottle for Tritium Analysis	Hydrotec	1	20,000	20,000	New Laboratory	Japan	in use
				Glass Bottle Set for CFCs Analysis	Hydrotec	1	70,000	70,000		Japan	in use
				Peristaltic Tubing Pump for CFCs Analysis	Hydrotec	1	220,000	220,000		Japan	in use

(5) Equipment for Crop Science

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
24	Crop science	12/12/2012	Portable Photosynthesis System (Analyzer with Broad Head)	ADC Lcpro-SD main unit	ADC	1	4,265,000	4,265,000	Crop lab	Japan	in use
				Leaf chamber	ADC	1	20,000	20,000		Japan	in use
				LED light source	ADC	1	20,000	20,000		Japan	in use
				Telescopic Pole	ADC	1	2,000	2,000		Japan	in use
				Attachment of Telescopic pole	ADC	1	500	500		Japan	in use
				Tube	ADC	1	100	100		Japan	in use
				String	ADC	1	500	500		Japan	in use
				AC power cable	ADC	1	500	500		Japan	in use
				cable	ADC	1	500	500		Japan	in use
				Attachment for cable (PLC-011)	ADC	1	200	200		Japan	in use
				Bottle	ADC	2	200	400		Japan	in use
				Reagent Case	ADC	1	1,000	1,000		Japan	in use
				Attachment (LC1-020/B)	ADC	3	20	60		Japan	in use
				Cable (LC1-056)	ADC	1	500	500		Japan	in use
				Cable (LCM-059)	ADC	1	500	500		Japan	in use
25	Crop science	12/12/2012	Plant Moisture Tensiometer PC-40 type	DIK-7003 Plant Moisture Tensiometer PC-40Type	Daiki	1	675,675	675,675	Crop lab	Japan	in use
26	Field experiment	12/12/2012	Dew Point Microvoltmeter	HR-33T Dew Point Microvoltmeter	Wescor	1	546,000	546,000	New lab	Japan	in use
				Manuals (English&Japanease)	Wescor	1				Japan	in use
				Sample Discs 5000pcs	Wescor	1				Japan	in use
27	Crop science	12/12/2012	Porometer	AP4 Porometer (Included Sensor Head, Plate, Case)	Delta-T Devices	2	998,900	1,997,800	Crop lab	Japan	in use
				RS232 cable, Software & Manuals CD and battery charger.	Delta-T Devices	2	1,000	2,000		Japan	in use
				Manual Japanese	Delta-T Devices	2	100	200		Japan	in use
28	Field experiment	12/12/2012	Profile Probe	PR2/6 Profile Probe 100cm	Delta-T Devices	2	224,500	449,000	Crop lab	Japan	in use
				Comprises 6 x integral soil moisture sensors.	Delta-T Devices	2	20,000	40,000		Japan	in use
				Supplied with user manual, protective tube, spare centring springs and O-rings.	Delta-T Devices	2	500	1,000		Japan	in use
29	Field experiment	12/12/2012	Profile Probe (40cm) with Access Tube	PR2/4 Profile Probe 40cm	Delta-T Devices	2	190,650	383,100	Crop lab	Japan	in use
				Comprises 4 x integral soil moisture sensors.	Delta-T Devices	2	20,000	40,000		Japan	in use
				Supplied with user manual, protective tube, spare centring springs and O-rings.	Delta-T Devices	2	100	200		Japan	in use
				ATS1 Access Tube short	Delta-T Devices	120	6,600	792,000	Magazine	Japan	in use
				PR2 access tube bungs (red)	Delta-T Devices	120	100	12,000		Japan	in use
				PR2 access tube collars (black)	Delta-T Devices	120	100	12,000		Japan	in use

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
30	Field experiment	12/12/2012	Automatic Area Meter	Automatic Area Meter AAM-9	Hayashi Denko	1	1,246,700	1,246,700	Crop lab	Japan	in use
				Cable (4m)	Hayashi Denko	1	1,000	1,000		Japan	in use
				Adapter (RS-232C)	Hayashi Denko	1	500	500		Japan	in use
				Cable	Hayashi Denko	1	500	500		Japan	in use
				Sheet	Hayashi Denko	1	200	200		Japan	in use
				Plug	Hayashi Denko	1	200	200		Japan	in use
				Adapter (large)	Hayashi Denko	1	500	500		Japan	in use
				Adapter (small)	Hayashi Denko	1	500	500		Japan	in use
				Plate	Hayashi Denko	1	200	200		Japan	in use
				CD	Hayashi Denko	1	500	500		Japan	in use
				Manual	Hayashi Denko	1	100	100		Japan	in use
31	Field experiment	12/12/2012	Laser Area Meter	CI-203	CID	1	891,100	891,100	Crop lab	Japan	in use
				USB cable	CID	1	500	500		Japan	in use
				Power cable	CID	1	500	500		Japan	in use
				String	CID	1	200	200		Japan	in use
				Closs	CID	1	200	200		Japan	in use
32	Office instrument	12/12/2012	ENVI (software for computer)	ENVI Runtime Windows	esri	1	472,500	472,500	Ms Niipele's Office	Japan	in use
33	Field experiment	12/12/2012	Laser Measuring Instrument	Turu Pulse 360	LASER TECHNOLOGY	2	192,340	384,680	Office (1 to be repaired)	Japan	in use
				Manual	LASER TECHNOLOGY	2	100	200		Japan	in use
				Closs	LASER TECHNOLOGY	2	100	200		Japan	in use
				Case	LASER TECHNOLOGY	2	1,000	2,000		Japan	in use
				String	LASER TECHNOLOGY	2	500	1,000		Japan	in use
				Reflector SRT-0100	LASER TECHNOLOGY	8	11,000	88,000		Japan	in use
				Installation attachment	LASER TECHNOLOGY	8	340	2,720		Japan	in use
34	Field experiment	12/12/2012	PC Liner Sampler	Striking adoptor	Daiki	1	41,400	41,400	Magazine	Japan	Usable (Consumables)
				Extension rod 100cm φ35mm	Daiki	4	18,900	75,600		Japan	Usable (Consumables)
				Connection	Daiki	4	12,600	50,400		Japan	Usable (Consumables)
				Engine	Daiki	1	723,860	723,860		Japan	Usable (Consumables)
				Hose + handbraker	Daiki	1	10,000	10,000		Japan	Usable (Consumables)
				Rod puller	Daiki	1	10,000	10,000		Japan	Usable (Consumables)
				2-man rod puller	Daiki	1	567,600	567,600		Japan	Usable (Consumables)
				Stand for rod puller	Daiki	1	20,000	20,000		Japan	Usable (Consumables)
				Sample tube φ63mm X 100cm	Daiki	2	214,200	428,400		Japan	Usable (Consumables)
				PVC Sample Liner Tube (10 tubes)	Daiki	5	22,500	112,500		Japan	Usable (Consumables)
				PVC Sample Liner Tube (10 tubes)	Daiki	5	22,500	112,500		Japan	Usable (Consumables)
35	Climate monitoring	12/12/2012		Data Logger	Climatec	1	259,000	259,000		Japan	in use
				Channel Multiplexer	Climatec	1	119,000	119,000		Japan	in use
				Relay Driver	Climatec	1	40,000	40,000		Japan	in use
				Surge Terminal array	Climatec	3	16,667	50,001		Japan	in use
				Charge Controller	Climatec	1	20,000	20,000		Japan	in use

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
			Bowen Ratio Measuring System (Heat balance sensor)	Molded Case Circuit Breaker	Climatec	1	1,000	1,000	Installed on the sloped field	Japan	in use
				Fuse	Climatec	16	1	16		Japan	in use
				Fuse Box	Climatec	8	13	104		Japan	in use
				Measurement Box	Climatec	1	73,000	73,000		Japan	in use
				Cover sheet	Climatec	1	500	500		Japan	in use
				Elastic	Climatec	1	200	200		Japan	in use
				Screwdriver	Climatec	2	50	100		Japan	in use
				Communication Cable	Climatec	1	1,000	1,000		Japan	in use
36	Climate monitoring	12/12/2012	Bowen Ratio Measuring System (Atmosphere Environment Measurement Meter)	Net Radiation Meter	Climatec	1	250,000	250,000	Installed on the sloped field	Japan	in use
				Hydro-thermometer	Climatec	2	55,500	111,000		Japan	in use
				Sun Shield Shelter	Climatec	2	50,000	100,000		Japan	in use
				Soil Heat Flux meter	Climatec	1	70,000	70,000		Japan	in use
				Albedo Meter	Climatec	1	158,000	158,000		Japan	in use

(6) Equipment for Lab and Field

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
37	Lab Experiment	25/01/2013	Adapter of centrifuge	Roter A-4-62, incl. 4 x 250 ml rectangular buckets (5810 709. 008)	Eppendorf	1	274,000	274,000	Crop Lab	Japan	in use
				adapter 7-18 ml (5810 756. 006)	Eppendorf	2	24,700	49,400		Japan	in use
				adapter 50-75 ml (5810 760. 003)	Eppendorf	2	24,700	49,400		Japan	in use
				adapter 80-120 ml (5810 761.000)	Eppendorf	2	24,700	49,400		Japan	in use
38	Lab Experiment	25/01/2013	Super Freezer	Super Freezer LAB06	Fukushima	1	472,237	472,237	New lab	Japan	in use
39	Lab Experiment	25/01/2013	Refrigerator	Refrigerator URD-180RE3	Fukushima	1	660,502	660,502	New lab	Japan	in use

(7) Field Equipment (year 2013)

No.	Purpose of Use	Arrival Date	Name of Machinery	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation on Place	Procurement Place	Current Condition
40	Tillage	25/01/2013	Tractor (EG231, VXUKS6ME)	YAMMAR	1	2,334,000	2,334,000	Magazine under shade	Japan	in use
41	Tillage	25/01/2013	Deep cultivator (GS155T,RTD)	YAMMAR	1	545,000	545,000	Magazine under shade	Japan	in use
42	Tillage	25/01/2013	Multi Rotary (R31220MK)	YAMMAR	1	477,000	477,000	Magazine under shade	Japan	in use
43	Field experiment	25/01/2013	Hexacopter H601G	Medx	1	236,190	236,190	Office	Japan	in use
44	Field experiment	25/01/2013	Water Potential System	Wescor	1	698,250	698,250	New Lab	Japan	in use
45	Field experiment	25/01/2013	Manuals (English)	Wescor	1				Japan	in use
46	Field experiment	25/01/2013	Battery Charger	Wescor	1				Japan	in use

(8) Equipment for Lab and Climate Monitoring (year 2013)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
47	Climate monitoring	25/01/2013	Bowen Measurement System	Data Logger (for Bowen_1)	Climatec	1	259,000	259,000		Japan	in use
		25/01/2013		Channel Multiplexer	Climatec	1	119,000	119,000		Japan	in use
		25/01/2013		Relay Driver	Climatec	1	40,000	40,000		Japan	in use
		25/01/2013		Surge Terminal array	Climatec	3	50,000	150,000		Japan	in use
		25/01/2013		Charge Controller	Climatec	1	20,000	20,000		Japan	in use
		25/01/2013		Molded Case Circuit Breaker	Climatec	1	1,000	1,000		Japan	in use

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
		25/01/2013		Fuse	Climatec	16	10	160	Installed in slope field	Japan	in use
		25/01/2013		Fuse Box	Climatec	8	100	800		Japan	in use
		25/01/2013		Measurement Box	Climatec	1	73,000	73,000		Japan	in use
		25/01/2013		Cover sheet	Climatec	1	500	500		Japan	in use
		25/01/2013		Elastic	Climatec	1	200	200		Japan	in use
		25/01/2013		Screwdriver	Climatec	2	100	200		Japan	in use
		25/01/2013		Communication Cable	Climatec	1	1,000	1,000		Japan	in use
48	Climate monitoring	25/01/2013	Bowen Ratio Measuring System (Heat balance sensor)	Net Radiation Meter	Climatec	1	250,000	250,000	Installed in slope field	Japan	in use
		25/01/2013		Hydro-thermometer	Climatec	2	111,000	222,000		Japan	in use
		25/01/2013		Sun Shield Shelter	Climatec	2	100,000	200,000		Japan	in use
		25/01/2013		TDR soil moisture sensor	Climatec	3	32,000	96,000		Japan	in use
		25/01/2013		Soil Thermometer	Climatec	3	18,000	54,000		Japan	in use
		25/01/2013		Water Thermometer	Climatec	3	18,000	54,000		Japan	in use
		25/01/2013		Soil Heat Flux meter	Climatec	1	70,000	70,000		Japan	in use
49	Climate monitoring	25/01/2013	Bowen Ratio Measuring System (Atmosphere Environment Measurement Meter)	Tipping Gauge	Climatec	1	90,000	90,000	Installed in slope field	Japan	in use
		25/01/2013		Attachment for Rain Gauge	Climatec	1	40,000	40,000		Japan	in use
		25/01/2013		Albedo Meter	Climatec	1	158,000	158,000		Japan	in use
		25/01/2013		3cup anemometer	Climatec	1	60,000	60,000		Japan	in use
		25/01/2013		Water gauge	Climatec	1	100,000	100,000		Japan	in use

(9) Filed and Lab Equipment (year 2014)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
50	Tillage	23/08/2014	Tractor	Tractor (EG231, VU)	Yanmar	1	1,297,500	1,297,500	Magazine	Japan	in use
51	Tillage	23/08/2014	Disc Rotary	Disc Rotary (DS427T, RTA)	Yanmar	2	450,000	900,000		Japan	in use
52	Field experiment	23/08/2014	PC Liner equipment	DIK-161B-A1 Sample Liner tube φ 50mmX1m	Daiki	200	2,750	550,000		Japan	Usable (backup)
				DIK-161D-D1 Core Sampler φ63mm x 100cm	Daiki	1	261,800	261,800		Japan	Usable (backup)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
				DIK-1210-Q1 Coupling Sleeve φ 45x200mm (RD32 Type)	Daiki	10	15,400	154,000		Japan	Usable (backup)
				DIK-1210-H1 Extension Rod φ35x 1000mm (RD32 Type)	Daiki	10	23,100	231,000		Japan	Usable (backup)

(10) Provision of Equipment

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
53	Tillage	24/11/2014	YANMAR DIESEL POWER TILLER MODEL: YZC-DL	BODY, ENGINE	Yanmer	1	395,000	395,000	Under the roof of Milling Machine	Indonesia	In use
				BODY, ENGINE	Yanmer	1	395,000	395,000	Magazine	Indonesia	In use
				BODY, ENGINE	Yanmer	1	395,000	395,000	Magazine	Indonesia	In use
54	Tillage	24/11/2014	YANMAR DIESEL POWER TILLER MODEL: BROMO-DX	BODY, ENGINE, CAGE WHEEL 800	Yanmer	1	326,000	326,000	Under the roof of Milling Machine	Indonesia	In use
				BODY, ENGINE, CAGE WHEEL 801	Yanmer	1	326,000	326,000	Magazine	Indonesia	In use
				BODY, ENGINE, CAGE WHEEL 802	Yanmer	1	326,000	326,000	Magazine	Indonesia	In use

(11) Field Equipment (2014)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
55	Field experiment	04/12/2014	Solar Radiation Measuring instrument	Solar Radiation Measuring instrument	EKO	1	176,904	176,904	Crop Lab	Japan	in use
				Sensor	EKO	1	93,366	93,366		Japan	in use
56	Field experiment	04/12/2014	Hexacopter	Hexacopter H601G	Medx	1	235,190	235,190	Office	Japan	in use
				Camera mount	Medx	1	35,000	35,000	Office	Japan	in use
				Transmitter	Medx	1	12,000	12,000	Office	Japan	in use
				Shatter	Medx	1	15,000	15,000	Office	Japan	in use
				Camera Licoh	Medx	2	84,000	168,000	Office	Japan	in use
				Controller	Medx	1	45,000	45,000	Office	Japan	in use
				propeller shaft	Medx	4	1,000	4,000	Office	Japan	in use
				shock absorb lubber	Medx	1	100	100	Office	Japan	in use
				Battery checker	Medx	1	900	900	Office	Japan	in use

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
				band	Medx	1	200	200	Office	Japan	in use
				Adapter	Medx	4	100	400	Office	Japan	in use
				Socket Set Screw Wrench	Medx	1	200	200	Office	Japan	in use
				Wrench	Medx	1	200	200	Office	Japan	in use
				Vercro	Medx	4	250	1,000	Office	Japan	in use
				Arm	Medx	2	500	1,000	Office	Japan	in use
				Cat guard	Medx	20	100	2,000	Office	Japan	in use
57	Field experiment	04/12/2014	Dissolved Oxygen mater	Dissolved Oxygen mater	WTW	3	209,530	628,590	New lab	Japan	in use

(12) Field Equipment (year 2015)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Stored Place	Procurement Place	Condition
58	Field experiment		PC Liner Soil Sampler	Engine	Daiki	1	815,400	815,400	Magazine	Japan	Usable (backup)
				Oil Pressure hose	Daiki	2	6,000	12,000		Japan	Usable (backup)
				Hand break	Daiki	1	34,000	34,000		Japan	Usable (backup)
				Adaptor	Daiki	1	45,540	45,540		Japan	Usable (backup)

(13) Lab and Field Equipment (year 2016)

No.	Purpose of Use	Arrival Date	Name of Machinery	Description	Product No.	Maker	Qty	Unit Price (JPY)	Amount (JPY)	Installation Place	Procurement Place	Current Condition
59	Lab experiment	03/02/2016	O2 monitor	O2 monitor (2ch)	012980	Pyro Science	1	689,472	689,472	New Lab	Japan	in use
				O2 sensor (2m)	OXROB3	Pyro Science	5	73,440	367,200		Japan	in use
				O2 sensor (2m)	TROXROB3	Pyro Science	2	73,440	146,880		Japan	in use
				Temperature sensor (2m)	TSUB21	Pyro Science	1	43,718	43,718		Japan	in use
60	Lab experiment	03/02/2016	Soil permeability meter	Soil permeability meter		Daiki	2	342,144	684,288		Japan	Usable (backup)
						Daiki					Japan	Usable (backup)
61	Lab experiment	03/02/2016	Dessolve O2 meter	Dessolve O2 meter Multi3410		WTW	3	229,824	689,472		Japan	in use
62	Field experiment	03/02/2016	Dissolve O2 meter	Dessolve O2 meter Multi3410		WTW	3	229,824	689,472		Japan	in use
63	Lab experiment	03/02/2016	Drt oven		DX602	Yamato kagaku	1	256,392	256,392	New Lab	Japan	in use
64	Lab experiment	03/02/2016	Incubator		IC602	Yamato kagaku	1	266,328	266,328		Japan	in use
65	Climate monitoring	03/02/2016	Weather station	Micro Station		ONSET	2	251,100	502,200		Japan	Usable (backup)

Annex 6 Local Operational Expenses Covered by Japanese Side

Unit: NAD

Description		JFY2012	JFY2013	JFY2014	JFY2015	JFY2016 April-June	Total
Airfare	(Inland transportation of Japanese researchers and project coordinator, transportation of C/Ps who visited Japan)	37,961.00	114,574.00	35,733.00	16,366.00	-	204,634.00
Travel Allowance	(per diem and expenses for accommodation)	57,802.95	43,559.30	26,580.00	8,761.00	-	136,703.25
Remuneration	(Technicians, workers and drivers)	627,891.90	932,471.97	882,333.03	1,002,346.85	202,426.76	3,647,470.51
Meeting Cost	(JCC, management committee meetings, field days, and workshops)	60,534.70	90,939.40	52,889.35	11,630.10	186.70	216,180.25
General Operating Cost	(Consumables, materials, fuels, insurance for vehicles, etc.)	2,003,673.72	1,395,398.27	1,694,964.71	1,295,187.00	353,031.86	6,742,255.56
Total		2,787,864.27	2,576,942.94	2,692,500.09	2,334,290.95	555,645.32	10,947,243.57
(Amount converted to US dollar)		200,566	185,392	193,705	167,935	39,974	787,571

JFY: Japanese Fiscal Year (from April to March of next year)

1 USD = 13.9 NAD

Annex 7 List of Counterpart Personnel Involved in the Project Activities

Remark: 1: Crop Science, 2: Development Studies, 3: Hydrology, 4: Integrated Study of Agricultural and Social Science

No.	Name	Position at the terminal evaluation/Area of Specialty and Role for the Project	Institution	In charge of Output				Assigned Period		2012	2013	2014	2015	2016	2017	Training in Japan
				1	2	3	4	From	To							
1	Prof. Osmund D. Mwandemele	Pro-Vice Chancellor, Academic Affairs Project Director (Windhoek Main Campus)	UNAM (Windhoek)					2012/4/1	present							In 2013
2	Dr. Joseph T. Njunge	Senior Lecturer, Department of Integrated Environment Science Former Project Manager	UNAM (Ogongo)	X				2013/3/13	2016/4/20							In 2013 and 2014
3	Mr. Simon Awala	Lecturer, Department of Crop Science Project Manager	UNAM (Ogongo)	X			X	2012/4/1	present							2013/4/15 - 2016/3/31 (doctoral course in Japan)
4	Mr. Pamwenafye Nanhapo	Lecturer, Department of Crop Science	UNAM (Neudamm)	X				2012/4/1	study leave (from 2014/3/28)							2014/3/28 - 2017/3/31 (doctoral course in Japan)
5	Mr. Petrus A. Ausiku	Lecturer, Department of Crop Science Former Assistant Project Manager	UNAM (Ogongo)	X				2012/4/1	study leave (from Sep. 2014)							
6	Ms. Martha M. Hangula	Lecturer, Coordinator of Department of Agricultural Economics and Extension Former Sub-Leader of Development Team	UNAM (Ogongo)		X			2012/4/1	2016/3/10							In 2012
7	Mr. Martin N. Angula	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)		X			2012/4/1	2016/5/6 (study leave)					(South Africa)		In 2012 and 2014
8	Mr. Benisiu Thomas	Deputy Director of Academic Affairs and Research, Ogongo Campus	UNAM (Ogongo)		X			2012/4/1	present							In 2012, 2013 and 2014
9	Ms. Erikka R. Sheehama	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)		X			2012/4/1	2016/3/10							
10	Mr. Thula Maharero	Lecturer, Department of Agricultural Economics and Extension	UNAM (Ogongo)		X			2013/3/13	2016/3/10							In 2013
11	Mr. Moritz Eiseb	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)		X			2013/3/13	2016/3/10							In 2013
12	Ms. Cecilie Jona	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)		X			2012/4/1	study leave (from Sep 2012)		(South Africa)					
13	Ms. Otilie T. Shivolo	Lecturer, Department of Crop Science Sub-Leader of Development Team	UNAM (Ogongo)	X	X			2012/9/4 (2014/3/13)	present							In 2012 and 2015
14	Dr. Jack Kambatuku	Head, Department of Integrated Environmental Sciences Sub-Leader of Hydrology Team	UNAM (Ogongo)			X		2012/9/4	present							In 2013 and 2015
15	Ms. Johanna N. Niipele	Lecturer, Department of Integrated Environmental Sciences	UNAM (Ogongo)			X		2012/9/4	present (study leave from Sep. 2014)					(China)		In 2013
16	Mr. Teofilus Lwiinga	Field Supervisor, Department of Crop Science	UNAM (Ogongo)	X				2014/3/13	present							In 2012 and 2014
17	Ms. Anna Shomagwe	Institution Worker, Department of Crop Science	UNAM (Ogongo)	X				2014/3/13	present							In 2014
18	Mr. Isak K. Kaholongo	Lecturer, Department of Integrated Environmental Sciences	UNAM (Ogongo)	X				2014/3/13	present							In 2015
19	Prof. Fisseha Itanna	Lecturer, Head of Department of Crop Science Sub-Leader of Crop Science Team	UNAM (Ogongo)	X				2015/3/1	present							
20	Mr. Leonard Nunguhu	Lecturer, Department of Crop Science Assistant Project Manager	UNAM (Ogongo)	X				2015/6/1	present							
21	Mr. Shou Ruben	Technologist, Department of Crop Science	UNAM (Ogongo)	X				2015/10/1	present							
22	Mr. Brendan Matomola	Farm Supervisor, Agronomy and Horticulture	UNAM (Neudamm)	X					present							In 2013
	Collaboration Partners															
1)	Mr. Martin Embundile	Chief Agriculture Scientific Officer, Omusati Region Office, Ministry of Agriculture, Water and Forestry (MAWF)	MAWF					2013/4/23	present							
2)	Mr. Athon Wanga	Senior Agricultural Research Technician, Directorate of Research and Training, Begani (Rundu)	MAWF					2013/4/23	present							In 2013, 2014 and from March 2015 to March 2017 (graduate school)
3)	Ms. Magdalena H. Sheetekela	Chief Agriculture Scientific Officer, Omusati Region Office	MAWF					2013/4/23	present							

Annex 8 Provision of Office Spaces, Land and Facilities by UNAM

NO	ROOM	PLACE	PREPARED BY	USED BY
1	Laboratory (1)	Crop Science Bldg	UNAM	Project Experts, Staff and JOCV
2	Laboratory (2)	Administration Bldg	UNAM	Project Experts and Coordinator
3	Office (1)	Administration Bldg	UNAM	Japanese Experts and JOCV
4	Office (2)	Administration Bldg	UNAM	Project Coordinator
5	Green House	Next to Crop Science Bldg	UNAM	Project Experts and Staff
6	Store Room	Magazine	UNAM	Project Experts, Staff and JOCV
7	Store Space	Magazine	UNAM	Project Experts, Staff and JOCV
8	Crop field	Campus field	UNAM	Project Experts, Staff and JOCV
9	Seed Room	Crop Science Bldg	UNAM	Project Experts and Staff
10	Rice Packing Room	Magazine	UNAM	Project Experts and Staff
11	Old Store Room	Near Old Police Station	UNAM	Project Experts and Staff

Annex 9 Field Days, Participatory Workshops and Demonstrations Implemented

(1) Field days implemented

No.	Date	Venue	Number of participants (total)	Target participants	Main contents
1	Mar. 12, 2013	UNAM'S Ogongo Campus	462	Farmers	1) Explanation of the purpose of the Project and the experimental fields in the Ogongo Campus, and discussion on the Project. 2) Demonstration by agricultural machinery which were procured from Japan.
2	Mar. 12, 2014	UNAM'S Ogongo Campus	529	Farmers	"Rice farming information day": Explanation of results of the Project and method of mixed cropping.
3	Apr. 29, 2014	UNAM'S Ogongo Campus	158	Students of grade 10-12	Practice of rice harvesting and milling, and explanation on rice cultivation method
4	March 13, 2014	Onamudindi village	113	Farmers	Demonstration of rice harvesting and explanation of method of mixed cropping
5	Dec. 11, 2014	Onamudindi village	73	Farmers	Explanation on the summary of the Project and tractor hiring scheme, and demonstration of power tiller
6	Mar. 10, 2015	Oshiteyatemo village	140	Farmers	Explanation on the project activities and their results at the farm land of farmer, and discussion with participants
7	Nov. 23, 2015	Onamudindi village	52	Farmers	Explanation on the project activities and tractor hiring scheme, and demonstration of power tiller
8	Nov. 25, 2015	Oshiteyatemo village	70	Farmers	Explanation on the project activities and tractor hiring scheme, and demonstration of power tiller
9	Mar. 9, 2016	Onamudindi village	157	Farmers	Explanation on the project activities and method of mixed cropping, and demonstration of power tiller
10	Jun. 10, 2016	UNAM Ogongo Campus	202	Farmers, University Staff and Goverment	Harvest Festival
Total			1,956		

(2) Workshops implemented

No.	Date	Venue	Number of participants in total (number of farmers)	Target participants	Main contents
1	Sep. 5, 2012	Ohaingu Village	13 (11)	Farmers	Workshop for farmers No.1. Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.
2	Sep. 6, 2012	Onamundindi Village	27 (23)	Farmers	Workshop for farmers No.2. Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.
3	Dec. 12, 2012	Onamundindi Village	18 (17)	Farmers	Workshop for farmers No.3
4	Mar. 5, 2013	UNAM Ogongo Campus	30 (27)	Farmers of Onamundindi Village	Workshop for farmers No.4. Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.
5	Mar. 9, 2013	UNAM Ogongo Campus	31 (27)	Farmers of Onamundindi Village	Workshop for farmers No.5. Focus group discussion using farm sketch method for knowing farmer's recognition on traditional agriculture and new mixed cropping.
6	Mar. 14, 2013	Omagalanga Village	17 (16)	Farmers	Workshop for farmers No.6.
7	Dec. 17, 2013	Omagalanga Village	24 (23)	Farmers	Workshop for farmers No.7. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.
8	Dec. 18, 2013	Afoti Village	41 (40)	Farmers	Workshop for farmers No.8. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.
9	Dec. 4, 2014	UNAM Ogongo Campus	25 (20)	Farmers of Ombafi Village	Workshop for farmers No.9
10	Dec. 15, 2014	Afoti Village	18 (17)	Farmers	Workshop for farmers No.10. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.
11	Dec. 16, 2014	Onamundindi Village	16 (15)	Farmers	Workshop for farmers No.11. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.

No.	Date	Venue	Number of participants in total (number of farmers)	Target participants	Main contents
12	Dec. 18, 2014	Oshiteyatemo Village	14 (13)	Farmers	Workshop for farmers No.12. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.
13	Dec. 19, 2014	Omagalanga Village	9 (8)	Farmers	Workshop for farmers No.13. Focus group discussion for knowing farmer's recognition and confirmation of participation as demonstration farmer.
14	Jul. 16, 2015	UNAM Ogongo Campus	65 (0)	School Students (grade 10-12)	Workshop for farmers No.14
15	Aug. 19, 2015	Omagalanga Village	36 (28)	Farmers	Workshop for farmers No.15. Explanation of the outline of the Project and mixed cropping method. In addition, additional survey was done on farmer's land management and recognition on farming method.
16	Nov. 13, 2015	Omagalanga Village	31 (23)	Farmers	Workshop for farmers No.16. Explanation of the outline of the Project and mixed cropping method. In addition, additional survey was done on farmer's land management and recognition on farming method.
17	Nov. 14, 2015	Osikuku Village	23 (23)	Farmers	Workshop for farmers No.17. Explanation of the outline of the Project and mixed cropping method. In addition, additional survey was done on farmer's land management and recognition on farming method.
18	Dec. 22, 2015	Afoti Village	27 (27)	Farmers	Workshop for farmers No.18. Explanation of the outline of the Project and mixed cropping method. In addition, additional survey was done on farmer's land management and recognition on farming method.
Total			465 (358)		

(3) Other demonstrations and seminar etc.

No.	Date	Venue	Number of participants (total)	Target participants	Main contents
1	May. 8, 2013	UNAM Ogongo Campus	44	Agricultural Extension Technicians	Rice harvesting and soil sample collection demonstrations
2	Aug. 23-31, 2013	Ongwediva Trade Fair Centre	(—)	General Public	Exhibition (explanation of the Project and products) at Ongwediva Trade Fair
3	Nov. 11-13, 2013	UNAM Ogongo Campus	36	Agricultural Extension Technicians	Training on mixed cropping of rice and pearl millet cultivation
4	Mar. 10-11, 2014	UNAM Ogongo Campus	4	Lecturers of Development Study Team	SPSS Data Analysis Workshop for Development Study team
5	Mar. 13, 2014	Onamundindin Village	113	Farmers and others	Rice Harvesting Demonstration in Onamundindin Village
6	Jul. 31-Aug. 1, 2014	UNAM Ogongo Campus	(—)	Agricultural Extension Technicians	Evaluation workshop on mixed cropping of rice and pearl millet cultivation
7	Aug. 23-31, 2014	Ongwediva Trade Fair Centre	(—)	General Public	Exhibition (explanation of the Project and products) at Ongwediva Trade Fair
8	Sep. 8-9, 2014	UNAM (Windhoek)	94	Scientist, General Public	International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa.
9	Aug. 21-29, 2015	Ongwediva Trade Fair Centre	(—)	General Public	Exhibition (explanation of the Project and products) at Ongwediva Trade Fair
10	Sep. 24, 2015	UNAM Ogongo Campus	21	Agricultural Extension Technicians	Information sharing session
11	Nov. 17, 2015	UNAM Ogongo Campus	38	Omagalanga Famers	Study tour
12	Feb. 10, 2016	Oshiteyatemo Village	28	Omagalanga Famers	Study tour (Meme Rauna's field)
Total			378		

Annex 10 Presentations at Academic Conferences/Seminars

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
	[Crop Science Team]				
A: Presentation Jointly Made by Namibian and Japanese Researchers					
1-1	Performed	1.3.1	Gwanama, C., P. Ausiku, and O. D.Mwandemele, Selecting cultivars for rice-sorghum-millet mixed cropping systems to mitigate alternate flooding and drought in Namibia. Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.	International (in Japan)	Invited lecture
1-2	Performed	1.1.1	Simon K. Awala, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamane, Osmund D. Mwandemele, and Morio Iijima. Growth of Mix-cropped Pearl millet, Sorghum and Rice in the Model Sloped Field with both Wetland and Upland Environments in Semiarid north-central Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Oral presentation
1-3	Performed	1.1.2	Seitaro Watanabe, Masaya Masumoto, Simon K. Awala, Josef Njunge, Osmund D. Mwandemele, and Morio Iijima. Research activities on rice and pearl millet mixed cropping system un-der a seasonal wetland at Ogongo Campus in north-central Namibia: Joint activities of Japan Overseas Cooperation Volunteers (JOCV) and Namibia SATREPS Project. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-4	Performed	1.1.1	Simon Awala, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamana, Osmund Mwandemele, and Morio Iijima. Growth of mixed-cropped pearl millet, sorghum and rice under imposed flooding stress of a model sloped field in north-central Namibia. The 236th Meeting of Crop Science Society of Japan. Kagoshima University, 10-11 Sep. 2013.	Domestic (in Japan)	Poster presentation
1-5	Performed	1.3.4	Yoshinori Watanabe, Simon K. Awala, Pamwenafye I. Nanhapo, Osmund D. Mwandemele, Koji Yamane, and Morio Iijima, Nutrient Competition between Pearl Millet and Cowpea under Limited nutrient supply: Nitrogen Use Efficiency Derived from Organic Manure. The 237th Meeting of Crop Science Society of Japan. Chiba University, 29-30 March 2014.	Domestic (in Japan)	Poster presentation
1-6	Performed	1.1.2 and 1.2.1	Yoshinori Watanabe, Chie Araki, Simon Awala, Koji Yamane, and Morio Iijima. Water Source and Water Use Efficiency of Intercropped Rice and Pearl millet. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-7	Performed	1.3.2 and 1.3.4	Yoshinori Watanabe, Simon Awala, Pamwenafye Nanhapo, Osmund D. Mwandemele, Koji Yamane, and Morio Iijima, Nutrient Competition between Pearl millet and Cowpea under excess Moisture Condition: Nitrogen Use Efficiency Derived from Organic Manure. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-8	Performed	1.3.4	Simon K. Awala, Petrus A. Ausiku, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamane, Yoshinori Watanabe, Osmund D. Mwandemele, and Morio Iijima, Soil Fertility of Seasonal Wetlands in Northern Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-9	Performed	1.3.4	Yoshinori Watanabe, Yuichiro Fujioka, Petrus Ausiku, and Morio Iijima, Evaluation of soil fertility in seasonal ricers in north-central Namibia. Tokyo Conference of the Japanese Society of Soil Science and Plant Nutrition in 2014, Koganei Campus, Tokyo University of Agriculture and Technology, 10 Sep. 2014.	Domestic (in Japan)	Oral presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
1-10	Performed	1.3.1	Simon Awala1, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamana, Osmund Mwandemele, and Morio Iijima, Survival of Mix-cropped Pearl Millet and Sorghum with Rice under Flash Flood Stresses in the Experimental Paddy Field in Semiarid North-Central Namibia. The 240th Meeting of Crop Science Society of Japan. Nagano Campus of Shinshu University, 6 Sep. 2015.	Domestic (in Japan)	Poster presentation
1-11	Performed	1.3.1	Simon Awala, Yasuhiro Izumi, Yuichiro Fujioka, Yoshinori Watanabe, Koji Yamane, Kaede Wada, Yoshimasa Kawato, Osmund Mwandemele, and Morio Iijima, Field Evaluation of Mixed cropping of millet species with rice in temperate Japan and semiarid Namibia: The survival rates and yields of millets under flash flood stress. The 241st Meeting of Crop Science Society of Japan. Mito Campus of Ibaraki University, 28-29 March 2016.	Domestic (in Japan)	Poster presentation
1-12	Planned	1.1.3	Yoshimasa Kawato, Maliata A. Wanga, Nodoka Shinohara, Pamwenafye I. Nanhapo, Yoshinori Watanabe, Kaede Wada, Koji Yamane, and Morio Iijima, Evaluation of Oxygen transfer through roots of mixed cropped rice-pearl millet. The 242nd Meeting of Crop Science Society of Japan. Faculty of Agriculture, Ryukoku University, 10-11 Sep. 2016.	Domestic (in Japan)	Oral presentation
1-13	Planned	1.1.3	Maliata A. Wanga, Nodoka Shinohara, Yoshimasa Kawato, Koji Yamane, and Morio Iijima. Cultivar Difference of Rice on the Flooding Stress Mitigation by Mixed Cropping. The 242nd Meeting of Crop Science Society of Japan. Faculty of Agriculture, Ryukoku University, 10-11 Sep. 2016.	Domestic (in Japan)	Poster presentation
1-14	Planned	1.1.3	Shinji Okaichi, Yasuhiro Izumi, Simon AWALA, Koji Yamane, and Morio Iijima, Effect of mixed cropping on crop growth and water physiology under water stressed condition. The 242nd Meeting of Crop Science Society of Japan. Faculty of Agriculture, Ryukoku University, 10-11 Sep. 2016.	Domestic (in Japan)	Poster presentation
1-15	Planned	1.3.1	Pamwenafye I. Nanhapo, Koji Yamane, and Morio Iijima, Mix Cropping with Ice Plant Alleviates the Damage by NaCl and Promotes the Recovery of Cowpea. The 242nd Meeting of Crop Science Society of Japan. Faculty of Agriculture, Ryukoku University, 10-11 Sep. 2016.	Domestic (in Japan)	Oral presentation
1-16	Planned	1.3.4	Yoshinori Watanabe, Fisseha Itanna Danno, Yasuhiro Izumi, Yuichiro Fujioka, Simon K. Awala, and Morio Iijima, Effect of application of farmyards manure and chemical fertilizer to rice cultivation in north-central Namibia. Conference of the Japanese Society of Soil Science and Plant Nutrition in Saga in 2016, Honjo Campus of Saga University, 20-22 Sep. 2016.	Domestic (in Japan)	Oral presentation
1-17	Planned	1.2.2	Yoshinori Watanabe, Fisseha Itanna, Yasuhiro Izumi, Simon K. Awala, and Morio Iijima, Mixed-seedlings of rice and pearl millet in Namibia; Effects of moisture stress on crop water resources and crop s physiology. The 120th meeting of Japanese Society for Tropical Agriculture, Kagoshima University, 8-9 Oct. 2016	Domestic (in Japan)	Oral presentation
B: Presentation Made by Japanese Researchers					
1-18	Performed	1.3.1	Yuki Okazaki, Koji Yamane, Morio Iijima, Effects of salt stress on the growth of cereal species under mixed cropping. The 234th Meeting of Crop Science Society of Japan. Tohoku University, 10-11 Sep. 2012.	Domestic (in Japan)	Poster presentation
1-19	Performed	1.2.1 and 1.2.3	Chie Araki, Koji Yamane, Morio Iijima, Effects of soil water stress on the growth of cereal species under mixed cropping. The 234th Meeting of Crop Science Society of Japan. Tohoku University, 10-11 Sep. 2012.	Domestic (in Japan)	Poster presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
1-20	Performed	1.2.1	Chie Araki, Yoshinori Watanabe, Koji Yamane and Morio Iijima, Effects of soil moisture conditions on the water relation and water source of intercropped rice and pearl millet. The 235th Meeting of Crop Science Society of Japan. Meiji University, 28-29 March 2013.	Domestic (in Japan)	Poster presentation
1-21	Performed	1.1.3	Koji Yamane, Yuki Okazaki, Cisse Amara, Yasuhiro Izumi, Junichi Sakagami, and Morio Iijima, Drought, Salinity and Flooding Tolerance of Oryza sativa, Oryza glaberrima and their Interspecific Cultivars. The 175th regular meeting of the Society of Crop Science and Breeding in Kinki, Japan, Faculty of Biology-Oriented Science and Technology, 13 Jul. 2013.	Domestic (in Japan)	Oral presentation
1-22	Performed	1.2.1	Shinji Okaichi, Chie Araki, Koji Yamane, Yoshinori Watanabe, Morio Iijima, Water Use of Intercropped Rice and Pearl Millet: Simultaneous Evaluation of Dependence of Surface and Deep Water Use examined by the pot experiment. The 237th Meeting of Crop Science Society of Japan. Chiba University, 29-30 March 2014.	Domestic (in Japan)	Poster presentation
1-23	Performed	1.2.1	Chie Araki, Koji Yamane, Yoshinori Watanabe, and Morio Iijima, Water Use of Intercropped Rice and Pearl Millet: Dependence of Deep Water and Water Use Efficiency examined by the Lysimeter method. The 237th Meeting of Crop Science Society of Japan. Chiba University, 29-30 March 2014.	Domestic (in Japan)	Oral presentation
1-24	Performed	1.1.2 and 1.1.3	Yasunobu Okada, Yoshinori Watanabe, Koji Yamane, and Morio Iijima. Observation of Root Grafting in Maize Root. The 238 Meeting of Crop Science Society of Japan. Ehime University, 9-10 Sep. 2014.	Domestic (in Japan)	Poster presentation
1-25	Performed	1.1.3 and 1.3.1	Yuki Okazaki, Koji Yamane, Morio Iijima, and Yasuhiro Izumi, Mix-cropping with Tolerant Plant Species Can Relieve Rice Growth from Salinity Stress. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-26	Performed	1.1.3 and 1.3.1	Yuki Okazaki, Koji Yamane, Morio Iijima, and Yasuhiro Izumi, Drought and Flooding Resistance of Oryza sativa, Oryza glaberrima and their Interspecific Progenies. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
1-27	Performed	1.1.3	Yasuhiro Izumi, Yuki Okazaki, Koji Yamane, and Morio Iijima, Tolerance evaluation on multiple stresses of Oryza sativa, Oryza glaberrima and their Interspecific Cultivars: Effects of drought stress and rewatering on rice growth and physiological activity. The 179th regular meeting of the Society of Crop Science and Breeding in Kinki, Japan, Archaeological Institute of Kashihara, Nara prefecture, 30 May 2015.	Domestic (in Japan)	Oral presentation
1-28	Performed	1.3.4	Yoshinori Watanabe, Yuichiro Fujioka, and Morio Iijima, Evaluation of soil fertility in north-central Namibia: Environment of small seasonal wetlands. Kyoto conference in 2015 of the Japanese Society of Soil Science and Plant Nutrition, Yoshida Campus, Kyoto University, 10 Sep. 2015.	Domestic (in Japan)	Oral presentation
1-29	Performed	1.3.1	Yoshimasa Kawato, Yoshinori Watanabe, Yuichiro Fujioka, Koji Yamane, Morio Iijima, Oxygen consumption characteristics of the mix-cropped rice and pearl millet: Time course changes of the dissolved O2 concentration in an open water system. The 240th Meeting of Crop Science Society of Japan. Nagano Campus of Shinshu University, 6 Sep. 2015.	Domestic (in Japan)	Poster presentation
1-30	Performed	1.1.2	Shinji Okaichi, Koji Yamane, Yasuhiro Izumi, Morio Iijima. Examination of Water Use Efficiency in Mix-cropped Rice and Pearl millet. The 241st Meeting of Crop Science Society of Japan. Mito Campus of Ibaraki University, 28-29 March 2016.	Domestic (in Japan)	Poster presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
1-31	Performed	1.3.1	Yoshimasa Kawato, Yoshinori Watanabe, Koji Yamane, Yasuhiro Izumi, Morio Iijima, Drought stress mitigation by mixed cropping: Water supply from pearl millet to mix-cropped rice. The 241st Meeting of Crop Science Society of Japan. Mito Campus of Ibaraki University, 28-29 March 2016.	Domestic (in Japan)	Oral presentation
1-32	Performed	1.1.3	Kazuma Mori, Yasuhiro Izumi, Koji Yamane, and Morio Iijima, Selection of rice cultivars suitable for rice-pearl millet mixed cropping: Evaluation of drought tolerance and crop yield of upland NERICA varieties under mixed cropping with pearl millet. The 181st regular meeting of the Society of Crop Science and Breeding in Kinki, Japan, University of Shiga Prefecture, 28 May 2016	Domestic (in Japan)	Oral presentation
1-33	Planned	1.1.3	Miki Mariyama, Koji Yamane, and Morio Iijima, Waterlogging stress reduction effect on root system of soybean and maize by treatment of root cap removal and root apex cutting. The 242nd Meeting of Crop Science Society of Japan. Faculty of Agriculture, Ryukoku University, 10-11 Sep. 2016.	Domestic (in Japan)	Oral presentation
1-34	Planned	1.3.4	Yoshinori Watanabe et al., Soil fertility maintenance measures: Evaluation of soil fertility in seasonal wetlands in Namibia and investigation of effect of fertilization on wetland and upland. The 27th Annual Conference of the Japan Society for International Development, special thematic session "Evaluation of introduction of mixed cropping system in seasonal wetlands in semi-arid northern Namibia", East Hiroshima Campus of Hiroshima University, 26-27 Nov. 2016.	Domestic (in Japan)	Oral presentation
[Development Studies Team]					
A: Presentation Jointly Made by Namibian and Japanese Researchers					
2-1	Performed	2.2.1	Yoshiaki Nishikawa, Martha Hangula, Ottilie Shivolo, Benisiu Thomas, Kiyomi Kaida, Yuichiro Fujioka and Morio Iijima, Improvement of Informed Consent by Farmers for Technology Adoption (1) - Application of Farm Sketch in Northern Namibia –. The 113 conference of the Japanese Society for Tropical Agriculture, Ibaraki University, 30-31 March 2013.	Domestic (in Japan)	Oral presentation
2-2	Performed	2.4 (landscape related)	Joseph T. Njunge, Natural vegetation and potential agroforestry use of the seasonal wetlands in north, central Namibia. Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. Noyori Conference Hall in Nagoya University, Nagoya, 13 July, 2013.	International (in Japan)	Invited lecture
2-3	Performed	2.2 and 2.5.3	Thomas, B. Y.Nishikawa, M. Hangula, K. Kaida, and Y. Fujioka, Rural crop farmers' livelihood diversification and coping strategies in changing environment of north central Namibia. Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.	International (in Japan)	Invited lecture
2-4	Performed	2.1.1 and 2.5.2	Martha Hangula, Thula Maharero, Morio Eiseb, and K.Usami, Evaluation of Socioeconomic Situation of Rice Farmers in Omusati Region. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Oral presentation
2-5	Performed	2.1.3	Yoshiaki Nishikawa, Yuichiro Fujioka, Martha Hangula, Benisiu Thomas, and Morio Iijima, Trials to Integrate Farmers' Consent to the Process of Introduction of New Cropping System and Participatory Research: Tentative Discussions from Experiences of Mixed-Cropping Research in Northern Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Invited lecture
2-6	Performed	2.4.3 and 2.5.3	Benisiu Thomas, Ottilie Shivolo, Yuichiro Fujioka, Yoshiaki Nishikawa, Mizuki Iida, Erica Sheehama, Thula Maharero. Farmers' Perceptions Towards Adoption of Rice and Pearl Millet Cropping System in North-Central Namibia: A Case of Onamundindi Village. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Oral presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
2-7	Performed	2.5.3 (landscape related)	Mizuki Iida, Yoshiaki Nishikawa, Yuichiro Fujioka, Kiyomi Kaida, Toru Seki, Benisiu Thomas, Ottilie Shivolo, Martha Hangula. Comparison among GPS, Interview and Farm Sketch as a Possible Research Methodology to Reveal Farmers' Perception and to Obtain Farmers' Consent; Case of Northern Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
2-8	Performed	2.4.1, 2.4.2, 2.4.3 (landscape related)	Yuichiro Fujioka, Joseph Njunge, Johanna Niipele, Hiroki Mizuochi, Yoshinori Watanabe, Tetsuya Hiyama, Yoshiaki Nishikawa, and Morio Iijima. Diversity of seasonal small wetlands (ondombes) landscape and its recognitions by local people in north-central Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Oral presentation
2-9	Performed	2.4.3 (landscape related)	Joseph Njunge, Isak Kaholongo and Yuichiro Fujioka. Variation in Composition of Plant Species Growing in Small Ponds (endombe) of the Cuvelai Basin Seasonal Wetlands in north-central Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Oral presentation
2-10	Performed	2.5.3	Kiyomi Kaida, Yoshiaki Nishikawa, Ottillie Shivolo, Benisiu Thomas, and Yuichiro Fujioka, Farmer's Adaptation Strategy to Foreign Farming Methods: A Case of Pearl millet-Rice Mixed Cropping System in Northern Namibia. The 119th conference of the Japanese Society of Tropical Agriculture and Development, Faculty of Agriculture of Meiji University, 23 March 2016.	Domestic (in Japan)	Oral presentation
2-11	Performed	2.2 and 2.4.3	Yuichiro Fujioka, Yoshiaki Nishikawa, Tetsuya Hiyama, Hiroyuki Mizuochi, Awala Simon, Mwandemele Osmund, and Morio Iijima, Collaboration between Local Farmers and Scientists towards Introduction of Flood- and Drought-adoptive Cropping Systems. The conference of the Japan Geoscience Union in 2016, Makuhari Messe, 22 May 2016.	Domestic (in Japan)	Poster presentation
2-12	Performed	2	Yuichiro Fujioka, Meteorological disaster and agriculture in Northern Namibia. Workshop of overseas academic investigation Forum, Tokyo University of Foreign Studies, 9 Jul. 2016.	Domestic (in Japan)	Invited lecture
2-13	Planned	2.3 and 2.5	Yuichiro Fujioka et al., Perception of farmers on introduction of Flood- and drought-adaptive cropping system and its practice -Cases of SATREPS project in north-central Namibia. The 27th Annual Conference of the Japan Society for International Development, special thematic session "Evaluation of introduction of mixed cropping system in seasonal wetlands in semi-arid northern Namibia", East Hiroshima Campus of Hiroshima University, 26-27 Nov. 2016.	Domestic (in Japan)	Oral presentation
2-14	Planned	2.5.1, 2.5.4 and Integrated Study	Masuda et al., Analysis on agricultural economics in north-central Namibia, the 27th Annual Conference of the Japan Society for International Development, special thematic session "Evaluation of introduction of mixed cropping system in seasonal wetlands in semi-arid northern Namibia", East Hiroshima Campus of Hiroshima University, 26-27 Nov. 2016.	Domestic (in Japan)	Oral presentation
B: Presentation Made by Japanese Researchers					
2-15	Performed	2.5.1 and 2.5.2	Yuichiro Fujioka, Yoshiaki Nishikawa, and Morio Iijima, Coping behavior for food security by agro-pastoralists in semi-arid Namibia under heavy rain and flood disaster. The autumn conference of the Association of Japanese Geographers, Kobe University, 6-7 Oct. 2012.	Domestic (in Japan)	Oral presentation
2-16	Performed	2.2 and 2.3	Yuichiro Fujioka, Yoshiaki Nishikawa, and Morio Iijima, Examination of methods for grasping actual situation of conventional agriculture and its feedback toward the participatory rural development. The spring conference of the Association of Japanese Geographers, Rissho University, 28-29 March 2013.	Domestic (in Japan)	Oral presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
2-17	Performed	2	Yoshiaki Nishikawa, Farmers learn and learn from farmers, rice production in northern Namibia. Citizen open lecture "Rice production in desert country?" Nagoya University, 13 Jul. 2013.	Domestic (in Japan)	Invited lecture
2-18	Performed	2.4.3 (landscape related)	Yuichiro Fujioka, Yoshiaki Nishikawa, and Morio Iijima, Natural environment of seasonal wetlands in north-central Namibia and its recognitions by local people- landscape analysis toward the participatory rural development. The spring conference of the Association of Japanese Geographers, Kokushikan University, 27-28 March 2014.	Domestic (in Japan)	Oral presentation
2-19	Performed	2.4.1 (landscape related)	Yuichiro Fujioka, Yoshiaki Nishikawa, and Morio Iijima, Environmental diversity in seasonal wetlands in north-central Namibia and perceptions of people on its environmental. The 51st conference of the of Japan Association For African Studies, Kyoto University, 24-25 May 2014.	Domestic (in Japan)	Oral presentation
2-20	Performed	2.5.3	Mizuki iida, Yoshiaki Nishikawa, Yuichiro Fujioka, Kiyomi Kaida, Toru Seki, Benisiu Thomas, Ottilie Shivolo, and Martha Hangula, Application of Multiple Research Methodologies for Improving Researchers Understanding and Farmers' Consent : A Case of Introduction of New Inter-Cropping in Northern Namibia. The 117th conference of Japanese Society of Tropical Agriculture and Development, Tsukuba University, Tsukuba, 14-15 March 2015.	Domestic (in Japan)	Oral presentation
2-21	Performed	2.4.3 and 2.5.3	Yuichiro Fujioka, Yoshiaki Nishikawa, Hiroyuki Mizuochi, and Morio Iijima, Diversity of Cropping Pattern in Rural Area of Northern Namibia: Development a geographical method to understand subjective activities local farmers. The spring conference 2015 of the Association of Japanese Geographers, Nihon University, 28-30 March 2015.	Domestic (in Japan)	Oral presentation
2-22	Performed	2.4.3 and 2.5.3 (landscape related)	Yuichiro Fujioka, Yoshiaki Nishikawa, Hiroyuki Mizuochi, and Morio Iijima, Examination of geographical approach toward understanding of cropping pattern - Cases of rural villages in Northern Namibia. The 52 conference of the Japan Society for International Development, Inuyama International Tourist Center Freude, 25 May 2015.	Domestic (in Japan)	Oral presentation
2-23	Performed	2.5.3	Kiyomi Kaida and Yoshiaki Nishikawa, Roles of farmer's women in their household in the villages in Northern Namibia from the viewpoints of gender. The 63rd conference of the Rural Life Society of Japan, 10-11 Oct. 2015.	Domestic (in Japan)	Oral presentation
2-24	Performed	2.5.3	Kiyomi Kaida and Yoshiaki Nishikawa, Decision making system in farmer's household for introducing new crop - A case of Ovambo people in Northern Namibia. The 26th Annual Conference of the Japan Society for International Development, Niigata University, 28-29 Nov. 2015.	Domestic (in Japan)	Oral presentation
2-25	Planned	2.4.3 (landscape related)	Yuichiro Fujioka, Hiroyuki Mizuochi, Yoshinori Watanabe, and Morio Iijima, Classification of small seasonal wetlands in north-central Namibia by soil-hydrological environment. The autumn conference of the Association of Japanese Geographers, Tohoku University, 30 Sep. - 1 Oct. 2016.	Domestic (in Japan)	Poster presentation
[Development Studies Team]					

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
A: Presentation Jointly Made by Namibian and Japanese Researchers					
3-1	Performed	3.2.2	Tetsuji Suzuki, Takeshi Ohta, Tetsuya Hiyama, Osmund Mwandemele, and Morio Iijima, Effects of rice cropping on evapotranspiration in the norther Namibia. The conference of the Japan Society of Hydrology and Water Resources in 2012, Hiroshima University, 26-28 Sep. 2012.	Domestic (in Japan)	Poster presentation
3-2	Performed	3.2.1	Jack R. Kambatuku, Tstsuya Hiyama, Miho Hanamura, Tetsuji Suzuki, Yuichiro Fujioka, Takeshi Ohta, and Morio Iijima, Regional precipitation patterns and their implication for drought-adapted mixed cropping systems in the cuvelai drainage basin, north-central Namibia. Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.	Domestic (in Japan)	Invited lecture
3-3	Performed	3.2.2	Miho Hanamura, Takeshi Ohta, Ayumi Kotani, Tetsuji Suzuki, Tetsuya Hiyama, Jack Kambatuku, and Morio Iijima, Analysis of characteristics of evapotranspiration in northern Namibia for introducing the mixed cropping of rice and pearl millet. The conference of the Japan Society of Hydrology and Water Resources in 2013, 25-27 Sep. 2013.	Domestic (in Japan)	Poster presentation
3-4	Performed	3.1, 3.2, 3.3	Tetsuya Hiyama, Tetsuji Suzuki, Miho Hanamura, Hiroki Mizuochi, Jack R. Kambatuku, Johanna N. Niipele, Yuichiro Fujioka, Takeshi Ohta, and Morio Iijima, Evaluation of surface water dynamics for water-food security in seasonal wetlands, north-central Namibia. IAHS-EGU International Symposium on Integrated Water Resources Management, Bologna Italy, June 2014.	International (in Italy)	Oral presentation
3-5	Performed	3.1	Hiroki Mizuochi, Kenlo Nishida Nasahara, Tetsuya Hiyama, Johanna Niipele, Yuichiro Fujioka, and Morio Iijima. Evaluation of water storage at small-scale wetlands in north-central Namibia based on topographical model with satellite remote sensing. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
3-6	Performed	3.1, 3.2, 3.3	Tetsuya Hiyama, Jack Kambatuku, Johanna Niipele, Hiroki Mizuochi, Miho Hanamura, Takeshi Ohta, Morio Iijima, Osmund Mwandemele. Analyzing Water Budget of Seasonal Wetlands based on Hydrological Observation Data. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Invited lecture
3-7	Performed	3.3.1	Tetsuya Hiyama, Yuichiro Fujioka, Yoshinori Watanabe, Jack Kambatuku, Johanna Niipele, Takanori Nakano, and Morio Iijima, Estimating Origins of Surface- and Subsurface-water in Small Wetlands of Cuvelai System Seasonal Wetlands (CSSWs), north-central Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
3-8	Performed	3.2.2	Miho Hanamura, Takeshi Ohta, Ayumi Kotani, Tetsuya Hiyama, Jack Kambatuku, and Morio Iijima, Analysis of characteristics of evapotranspiration in northern Namibia for introducing the mixed cropping of rice and pearl millet. The conference of the Japan Society of Hydrology and Water Resources in 2014, 25-28 Sep. 2014.	Domestic (in Japan)	Poster presentation
3-9	Performed	3.2.2	Miho Hanamura, Takeshi Ohta, Ayumi Kotani, Jack Kambatuku, Tetsuya Hiyama, Morio Iijima, Controlling Factors on Evapotranspiration of Rice-Mahangu Mixed-cropping Field. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation
3-10	Performed	3.1	Hiroki Mizuochi, Kenlo Nasahara, Tetsuya Hiyama, Yuichiro Fujioka, Johanna Niipele, Morio Iijima. Surface Water Monitoring of Seasonal Wetlands based on Regionally-obtained Data from Micro-topography and Satellite Remote Sensing. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
3-11	Performed	3.3.1	Tetsuya Hiyama, Jack R. Kambatuku, Kazuyoshi Asai, Yuichiro Fujioka, and Morio Iijima, Composition of stable isotopes in precipitation over the area of seasonal wetlands in north-central Namibia. The Conference of the Japanese Association of Hydrological Sciences in 2015, 9-11 Oct. 2015.	Domestic (in Japan)	Poster presentation
3-12	Performed	3.3.1	Tetsuya Hiyama, Hiroyuki Mizuochi, Hironari Kanamori, Yuichiro Fujioka, Jack R. Kambatuku, Ayumi Kotani, Takeshi Ohta, and Morio Iijima, Analyzing surface water budgets for water-food security in seasonal wetlands of north-central Namibia, 2015 AGU Fall Meeting, San Francisco, 13-18 December 2015	International (in USA)	Poster presentation
3-13	Performed	3.3.1	Tetsuya Hiyama, Jack R. Kambatuku, Hiroki Mizuochi, Hironari Kanamori, Yuichiro Fujioka, and Morio Iijima, Analyzing origin of surface water for water-food security in seasonal wetlands of north-central Namibia, The 5th symposium on isotope environmental studies, Research Institute for Humanity and Nature, 25 Dec. 2015.	Domestic (in Japan)	Poster presentation
3-14	Performed	3.3.1 and 3.3.2	Tetsuya Hiyama, Hironari Kanamori, JacK Kambatuku, Kazuyoshi Asai, Morio Iijima. Analyzing origin of rainwater and shallow groundwater in seasonal wetlands of north-central Namibia, Japan Geoscience Union Meeting 2016, May 25th, Makuhari Messe.	Domestic (in Japan)	Oral presentation
3-15	Planned	3.2.1	Hironari Kanamori, Tetsuya Hiyama, Jack R. Kambatuku, Hiroki Mizuochi, Hatsuki Fujinami and Morio Iijima, Characteristics of precipitation associated with land surface conditions in north-central Namibia. AGU Fall meeting. San Francisco, USA. 12-16 Dec 2016.	International (in USA)	Poster presentation
B: Presentation Made by Japanese Researchers					
3-16	Performed	3.1, 3.2, 3.3	Tetsuya Hiyama, Water of seasonal wetlands in Northern Namibia "Where water comes from and where water disappears to". Public open lecture on "Rice production in arid country?" at Nagoya University, Aichi, Japan, 13 Jul. 2013.	Domestic (in Japan)	Invited lecture
3-17	Performed	3.2.1 and 3.2.2	Hiroyuki Mizuochi, Tetsuya Hiyama, Kenlo Nasahara, Estimating evapotranspiration from seasonal wetlands in north-central Namibia based on satellite data fusion and VI-Ts method. The conference in 2016 of the Japan Geoscience Union, 25 May 2016.	Domestic (in Japan)	Oral presentation
[Integrated Study of Agricultural and Social Science]					
A: Presentation Jointly Made by Namibian and Japanese Researchers					
4-1	Performed	4.3.1	Morio Iijima, Simon Awala, and Osmund D. Mwandemele. Introduction of subsistence rice cropping system harmonized with the water environment and human activities in seasonal wetlands in Northern Namibia. International Symposium on Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. Noyori Conference Hall in Nagoya University, Nagoya, 13 July 2013.	International (in Japan)	Invited lecture
4-2	Performed	4.1.2	Simon K. Awala, Yasuhiro Izumi, Yuichiro Fujioka, Pamwenafye I. Nanhapo, Osmund D. Mwandemele, and Morio Iijima, Rice Production Trials in Farmers Fields in north-central Namibia. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Poster presentation

No.	Performed/ Planned	PO#	Presenters, Title of Presentation, Name of Society, Venue of Presentation, Date etc.	Domestic or International	Invited lecture/ Oral presentation/ Poster presentation
4-3	Performed	4.3.1	Morio Iijima, Simon Awala, Yuichiro Fujioka, and Osmund Mwandemele, Experimental Trials for Flood- and Drought- Adaptive Mixed Cropping System in Seasonal Wetland. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Invited lecture
4-4	Performed	4.3.1	Akihiko Utsunomiya, Simon Awala, Osmund D. Mwandemele, and Josef Njunge. How to Mechanize Resource Limited Subsistent Farmers in Seasonal Wetlands: toward rice introduction strategy to overcome labor competition. International Symposium on Agricultural Use of Seasonal Wetlands in Southern Africa. University of Namibia, School of Medicine, Auditorium, Windhoek, 8-9 Sep 2014.	International (in Namibia)	Invited lecture
4-5	Planned	4.	Morio Iijima et al., Introduction of rice-based mixed cropping in semi-arid region of Namibia. The 27th Annual Conference of the Japan Society for International Development, special thematic session "Evaluation of introduction of mixed cropping system in seasonal wetlands in semi-arid northern Namibia", East Hiroshima Campus of Hiroshima University, 26-27 Nov. 2016.	Domestic (in Japan)	Oral presentation
B: Presentation Made by Japanese Researchers					
4-6	Performed	4.3.1	Morio Iijima, Proposal of flood- and drought-adaptive cropping systems to conserve water environments in semi-arid regions, a cooperation of agricultural technology for livelihood improvement and environmental conservation. Pre-Symposium for TIC AD "Activities of Japanese universities, companies, and research institutes in African countries and way forward." JICA Yokohama center, 26 May 2013.	Domestic (in Japan)	Invited lecture
4-7	Performed	4.3.1	Morio Iijima, Rice cultivation using natural water colleting mechanism - Rice and pearl millet mixed cropping? Citizen open lecture "Rice production in desert country?" Nagoya University, 13 Jul. 2013.	Domestic (in Japan)	Invited lecture
4-8	Performed	4.3.1	Morio Iijima, Frequent occurrence of flood and drought in semi-arid region and investigation of its adaptive farming methods. Open Symposium "Global environmental change and the future of agriculture" by the Society of Crop Science and Breeding in Kinki, Osaka Prefecture University, 14 Dec. 2013.	Domestic (in Japan)	Invited lecture
4-9	Performed	4.3.1	Koichi Shoji and Morio Iijima, Investigation of tillage method for upland crops at seasonal wetlands in Namibia - trial production of both sides inverted Japanese type plow using two-wheel tractor. The 75the conference of the Japanese Society of Agricultural Machinery and Food Engineers, Tokimesse, 27-30 May 2016.	Domestic (in Japan)	Oral presentation
4-10	Performed	4.3.1	Morio Iijima, Yoshiaki Nishikawa, and Tetsuya Hiyama, Development of Flood- and Drought-Adaptive Cropping Systems in Namibia. The 241 conference of the Crop Science Society of Japan, Mito Campus of Ibaraki University, 28-29 March 2016.	Domestic (in Japan)	Invited lecture

Annex 11 Project Design Matrix (PDM) Version 4 (proposed)

Project Title: Flood- and Drought-Adaptive Cropping Systems to Conserve Water Environments in Semi-arid Regions
Project Site: Faculty of Agriculture & Natural Resources, Ogongo Campus, The University of Namibia (UNAM) and seasonal wetlands in north-central Namibia
Target Group: Researchers of Faculty of Agriculture & Natural Resources, UNAM, and farmers in north-central Namibia
Project Duration: February 2012 - February 2017 (5 years)

Proposed Ver. 4 (August 30, 2016)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal 1. "Flood- and drought-adaptive cropping systems" are disseminated in the north-central Namibia to contribute to the food security and cash income of local farmers. 2. "Flood- and drought-adaptive cropping systems" are considered for the northeastern areas of Namibia where high rainfall occurs as well as in neighboring countries.	1-1) Field day held regularly on the cropping systems. 2-1) Information on research results of cropping systems is shared periodically with neighboring countries.	• University of Namibia, Ministry of Agriculture, or media reports • Shared information, correspondences	
Project Purpose "Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of the semi-arid region.	Guideline for "Flood- and drought-adaptive cropping systems" is compiled.	• Guideline for "Flood- and drought-adaptive cropping systems"	• Extension works sustained and expanded. • Understanding and cooperation of neighbouring countries obtained.
Output 1: [Crop Science] The rice-based mixed cropping systems, which is adaptable to the yearly fluctuation of flooding and drought as well as water-saving, is proposed.	1-1) Number of presentation at academic conferences/seminars in related areas such as crop science and tropical agriculture (27 times). 1-2) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6. 1-3) List of water-saving cultivation techniques with high water-use efficiency and of cropping systems with high productivity under environmental stress such as flood and drought.	• Proceedings of conference/seminar • Progress report • Journal publication • Report on research results	• Government policies on seasonal wetlands remain unchanged. (Large-scale physical planning or commercial farming not introduced in the seasonal wetlands.)
2: [Development Studies] The methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers through introduction of the rice-based mixed cropping systems are established.	2-1) Records of changes in understanding by demonstration farmers on the contents and purpose of the mixed cropping systems. 2-2) Number of presentation and report on study methods of understanding perception and the socio-economic impacts (9 times). 2-3) Number of presentation at academic conferences/seminars on the evaluation method for landscape ecology of the cropping systems (7 times). 2-4) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 5.	• Interview/questionnaire • Progress report • Report on research results • Proceedings of conference/seminar • Journal publication	
3: [Hydrology] The possible area of mixed-cropping field that does not modify the water environment of seasonal wetlands is estimated based on the water budget/water source analysis.	3-1) Acquisition of data (scientific) on the change of flood (surface) water, the water budget and the dependence on flood (surface) water of small wetlands. 3-2) Number of presentation at academic conferences/seminars in related areas such as the potential cultivation area which does not affect the water environment (10 times). 3-3) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least 6.	• Report on research results • Proceedings of conference/seminar • Journal publication	

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
4: [Integrated Study of Agricultural and Social Science] The cropping systems proposed by the project are integrated through field activities.	4-1) Annual completion of hand-out on the mixed cropping systems for researchers and farmers at the field day 4-2) Implementation of field days by researchers and technicians of UNAM on the mixed cropping systems.	· Progress report · Report on research results	

Narrative Summary	Inputs	Important Assumptions
Activity 1.1 Examine appropriate cultivation methods to establish the rice-based mixed cropping systems. 1.2 Examine water-saving cultivation techniques by methods including the stable isotope technique. 1.3 Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain soil fertility. 2.1 Survey the socio-economic conditions and farm operations of farmers who participate in conducting field demonstrations or voluntary trials (baseline survey). 2.2 Secure informed consent by demonstration farmers prior to project activities and share findings from Output 1 and 3 through workshops. 2.3 Describe the changes of understanding by demonstration farmers on the contents and purposes of project activities and delineate the points to consider in the process of expansion of the mixed cropping systems. 2.4 Classify the environment of farmers' fields from the viewpoint of landscape ecology. 2.5 Examine the sustainability of the mixed cropping systems from the socio-economic viewpoint by understanding the farmers' decision making criteria to adopt or reject a new cropping systems, ways to use the agricultural produce, and the change of perception on wetlands (farm household economy, labour distribution survey). 3.1 Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography maps, satellite images and measurements of meteorological and hydrological conditions. 3.2 Analyze the water budget of the seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation) 3.3 Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields. 4.1 Conduct field demonstration with committed and hardworking farmers on their small wetlands, on the rice-based mixed cropping systems. 4.2 Conduct field trials with farmers who participate in trials on the rice-based mixed cropping systems voluntarily. 4.3 Examine the rice-based mixed cropping systems, which can preserve the water resources in semi-arid region and cope with the yearly fluctuation of flood and drought, by incorporating the feedback from Output 2 and 3 to Output 1. 4.4 Carry out participatory research and extension activities by Namibian researchers/technicians on the cropping systems through opportunities such as field days.	**Namibia Side** 1) Assignment of Counterparts · Project Director · Project Manager · other necessary personnel 2) Provision of Facilities · Office space, working place, internet and other facilities (Ogongo Campus in the University of Namibia) · Experimental field and basic materials 3) Local Costs · Expenses for Namibian researchers' activities (e.g. domestic travel costs) · Operating expenses for the day-to-day activities and management of the project (such as utilities and communication costs) **Japan Side** 1) Dispatch of Experts · Long-term expert (Project Coordinator) · Short-term experts (Agronomy, Development Sociology, Hydrology, Crop Physiology, Geography) 2) Training · Counterpart trainings in Japan for several researchers 3) Provision of Equipment and Materials · Vehicle (4WD) · Agricultural machinery and equipment · Analytical instrument for crop physiology · Meteorological instrument · Training equipment (personal computers, projector, peripheral equipment) · Office machinery (copier, scanner) · Other necessary equipment 4) Local Costs · Share of training costs	· The implementation arrangement of the project sustained. · Weather conditions are as usual without extreme drought or flood. **Pre-conditions** · Conditions are satisfied to initiate the project as agreed in the Minutes of Meeting

"Flood- and drought-adaptive cropping systems": The farming systems which secures food crop production by the subsistent farmers in both flood and drought years by rice-based mixed cropping.

	月日		ナミビア側評価団	日本側評価団			
			Prof. Omoregie & Prof. Indongo (UNAM)	大島　歩 (JICA)	浅岡　真紀子 (JICA)	道順　勲 (評価分析担当コンサルタント)	国分牧衛 & 小平憲祐 (JST)
1	8月13日	土				日本発	
2	8月14日	日				Windhoek 到着	
3	8月15日	月	JICA 評価分析担当とのミーティング			- UNAM メイン・キャンパス表敬 (副学長2名、農業天然資源学部長、ナミビア側評価メンバーのうちの1名) - ナミビア側評価メンバーに対する評価方法の説明 - JICA ナミビア支所打ち合わせ	
4	8月16日	火				Windhoek から北部へ移動 - JICA 業務調整員と打ち合わせ - UNAM オゴンゴ校幹部表敬（副学長補佐、キャンパス・マネージャー、圃場マネージャー、学術・研究副部長） - UNAM のカウンターパートへのインタビュー（3名）	
5	8月17日	水			日本発	実践農家インタビュー（3名、Afoti 村）	
6	8月18日	木			Windhoek→北部到着	- オゴンゴ校の試験圃場等の施設視察 - 実証農家インタビュー（Oshiteyatemo 村）	
7	8月19日	金			- MAWF の普及員及び地域事務所の幹部職員へのインタビュー		
8	8月20日	土			評価レポート案の検討		
9	8月21日	日		日本発	評価レポート案の検討		日本発
10	8月22日	月		Windhoek 到着	- UNAM のカウンターパートインタビュー（6名）		Windhoek 到着
11	8月23日	火	北部到着	北部到着			北部到着
			- 関係農家訪問・インタビュー（Onamundindi 村：実証農家1名、実践農家1名、コントロール農家1名）				
12	8月24日	水	-関係農家訪問・インタビュー（Oshiteyatemo 村：実証農家1名、実践農家1名、コントロール農家1名）				
13	8月25日	木	-オゴンゴ校でプロジェクト活動に用いられた施設の視察（試験圃場、ラボ、農業機械、温室、倉庫など） - 日本人研究者へのインタビュー				
14	8月26日	金	(ナミビア国の祭日)　合同評価レポート作成のための団内打ち合わせ				
15	8月27日	土	- 日本人研究者との打ち合わせ（合同評価レポートの内容について） - ナミビア側評価メンバー及びナミビア側カウンターパートとの打ち合わせ（合同評価レポートの内容について）				
16	8月28日	日	- 合同評価団による評価レポート検討				
17	8月29日	月	- プロジェクト主催のシンポジウム参加（NAM Engineering Campus）				
18	8月30日	火	- JCC 会議 (UNAM Engineering Campus)、終了時評価レポートの内容説明と質疑応答				Windhoek へ移動
19	8月31日	水	- Windhoek へ移動				Windhoek 発
20	9月1日	木	- 日本大使館への報告 - ミニッツ署名 (UNAM メイン・キャンパス)				日本着
21	9月2日	金		Windhoek 発			
22	9月3日	土		日本着			

プロジェクト名：　半乾燥地の水環境保全を目指した洪水-干ばつ対応農法の提案
プロジェクトサイト：　ナミビア大学農業天然資源学部オゴンゴ・キャンパス及びナミビア国北中部の季節湿地
ターゲットグループ：　ナミビア大学農業天然資源学部研究者及びナミビア国北中部地域の農民
プロジェクト期間：　2012 年 2 月～2017 年 2 月（5 年間）　Ver. 3 (2016 年 3 月 10 日)

プロジェクト要約	指標	指標入手手段	外部条件
上位目標 1.「洪水-干ばつ対応農法」が、ナミビア国北中部において普及し、現地農家の食糧確保と現金収入の獲得に寄与する。 2.「洪水-干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。	1-1)「洪水-干ばつ対応農法」に関するフィールド・デーの定期的な開催 2-1)「洪水-干ばつ対応農法」に関する国際研究会合の近隣諸国との間での定期的な開催の合意と実施	・ナミビア大学、農業省やメディアでの報告・報道 ・国際研究会合での記述	
プロジェクト目標 半乾燥地の水資源を持続的に保全しうる「洪水-干ばつ対応農法」が開発される。	洪水-干ばつ対応農法ガイドライン（指針）が作成される。	・洪水-干ばつ対応農法ガイドライン（指針）	・普及のための活動が維持・拡大される。 ・近隣諸国の理解と協力が得られる。
成　果 1:【作物学領域】 洪水-干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。	1-1) 作物学、熱帯農学等の関連分野の学会や国際セミナーでの発表・報告回数（27 回） 1-2) 関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 6 件以上 1-3) 水利用効率の高い節水栽培技術、並びに洪水-干ばつ等の環境ストレスにおいて生産性の高い農法のリスト	・学会・セミナー要旨 ・プログレスレポート ・学術誌 ・研究成果報告	・ナミビア政府の季節湿地に関する政策に大きな変化がない（季節湿地に対して大規模開発や商業的農業の導入が行われない）。
2:【開発学領域】「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。	2-1) 実証栽培試験参加農家の研究内容・目的の理解の変化の記録 2-2) ナミビア大学研究者による手法の成果発表回数（9 回） 2-3) 混作の景観生態学的評価の方法に関する学会や国際セミナーでの成果報告回数（7 回） 2-4) 関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 5 件以上	・インタビュー・アンケート調査 ・プログレスレポート ・研究成果報告 ・学会・セミナー要旨 ・学術誌	
3:【水文学領域】 湿地の水収支・水源解析により、水環境を改変しない混作栽培可能面積が推定される。	3-1) 地表水貯留量変動、水収支、小湿地の水源等の（科学的）データ取得 3-2) 水環境を改変しない混作栽培可能面積についての関連分野の学会や国際セミナーでの発表・報告回数（10 回） 3-3) 関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 6 件以上	・研究成果報告 ・学会・セミナー要旨 ・学術誌	
4:【総合領域】 フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。	4-1) フィールド・デーにおける農家向け、研究者向けの混作栽培モデルに関する毎年ごとの配布資料とりまとめ 4-2) ナミビア大学研究者及び研究協力者による混作栽培に関するフィールド・デーの実施	・プログレスレポート ・研究成果報告	

プロジェクト要約	投入	外部条件
活　動 1.1 イネを基幹とする混作栽培の確立に必要な耕種法を検討する。 1.2 節水栽培技術を安定同位体法等により検討する。 1.3 洪水-干ばつ等の環境ストレスに対する対応策や土壌肥沃度の維持対策を検討する。 2.1 実証と実践試験に参加する農家の社会経済状況や営農形態を調査する。(ベースライン調査) 2.2 実証試験参加農家に対し、活動目的に関して事前了解を得るとともに、作物学・水文学領域の活動で得られた知見をワークショップ等を通じ共有する。 2.3 実証試験参加農家の研究内容・目的共有の理解の変化に関する評価を実施し、展開における留意点を整理する。 2.4 農家圃場の立地を景観生態学的観点から分類する。 2.5 新たな作付体系を農民が選択あるいは拒否する判断基準や生産された作物の利用方法、湿地に対する農家の意識変化を明らかにし(農家経済、労働分配調査)、社会経済面の持続性を検討する。 3.1 現地の地形図、各種衛星画像、並びに現地観測データなどから、季節湿地全域の地表水貯留量変動を推定する。 3.2 現地観測データ(降水量、蒸発散量、地下浸透量)を基礎として、季節湿地の水収支を時系列的に解析する。 3.3 実証試験と実践試験を実施する農家圃場内の小湿地の水源を解析する。 4.1 小湿地を有する篤農家圃場において、イネを基幹とする混作栽培の実証栽培試験を実施する。 4.2 イネを基幹とする混作栽培を希望する農家において、実践栽培試験を実施する。 4.3 開発学・水文学領域の検討結果を作物学領域に毎年フィードバックすることにより、半乾燥地の水資源を持続的に保全しうるような節水型であり、かつ、洪水と干ばつにも対応可能なイネを基幹とする混作栽培を検討する。 4.4 現地でのフィールド・デーの開催などを通じて、ナミビア大研究者・技術員などが、新しく提案される農法に係る農民参加型研究・普及を実施する。	ナミビア側 1) カウンターパートの配置 ・ プロジェクト・ダイレクター ・ プロジェクト・マネージャー ・ その他必要なカウンターパート 2) 施設等 ・ 専門家執務スペースと執務環境 (ナミビア大学オゴンゴ・キャンパス) ・ 試験栽培圃場と基礎的材料 3) 管理費 ・ プロジェクトに関係するナミビア側研究者経費(国内旅費等) ・ 光熱費・通信費等のプロジェクト運営費用 日本側 1) 専門家 ・ 長期専門家(業務調整員) ・ 短期専門家(作物学、開発学、水文学、作物生理学、地理学) 2) カウンターパート研修 ・ 本邦への研修員受入れ若干名 3) 資機材供与 ・ 車輌 (4WD) ・ 農業機械 ・ 作物生理分析機器 ・ 気象観測機器 ・ 研修機材(パソコン、プロジェクター等) ・ 事務機器(コピー機、スキャナー等) ・ その他に必要な機材 4) 活動費 ・ 研修費用の一部	・ ナミビア側・日本側のプロジェクト研究参加者が離職しない。 ・ 極度の洪水や干ばつといった異常気象が発生しない。 **前提条件** ・ ミニッツに記された案件実施にあたっての条件が満たされる。

「洪水-干ばつ対応農法」:イネを基幹とする混作栽培により、洪水年でも干ばつ年であっても、自給自足農民が食用作物生産を確保する農法。

プロジェクト名：　半乾燥地の水環境保全を目指した洪水-干ばつ対応農法の提案
プロジェクトサイト：　ナミビア大学農業天然資源学部オゴンゴ・キャンパス及びナミビア国北中部の季節湿地
ターゲットグループ：　ナミビア大学農業天然資源学部研究者及びナミビア国北中部地域の農民
プロジェクト期間：　2012 年 2 月～2017 年 2 月（5 年間）　　改訂案 Ver.4 (2016 年 8 月 30 日)

プロジェクト要約	指標	指標入手手段	外部条件
上位目標 1.「洪水-干ばつ対応農法」が、ナミビア国北中部において普及し、現地農家の食糧確保と現金収入の獲得に寄与する。 2.「洪水-干ばつ対応農法」が、ナミビア国北東部の多雨地帯や近隣諸国でも検討される。	1-1)「洪水-干ばつ対応農法」に関するフィールド・デーの定期的な開催 2-1)「洪水-干ばつ対応農法」の研究成果に係る情報の共有が近隣諸国と定期的に行われる。	・ナミビア大学、農業省やメディアでの報告・報道 ・共有情報や同等物（通信情報等）	
プロジェクト目標 半乾燥地の水資源を持続的に保全しうる「洪水-干ばつ対応農法」が開発される。	洪水-干ばつ対応農法ガイドライン（指針）が作成される。	・洪水-干ばつ対応農法ガイドライン（指針）	・普及のための活動が維持・拡大される。 ・近隣諸国の理解と協力が得られる。
成　果 1:【作物学領域】 洪水-干ばつに対応し、かつ節水型であるイネを基幹とする混作栽培モデルが提案される。	1-1) 作物学、熱帯農学等の関連分野の学会や国際セミナーでの発表・報告回数（27 回） 1-2) 関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 6 件以上 1-3) 水利用効率の高い節水栽培技術、並びに洪水-干ばつ等の環境ストレスにおいて生産性の高い農法のリスト	・学会・セミナー要旨 ・プログレスレポート ・学術誌 ・研究成果報告	・ナミビア政府の季節湿地に関する政策に大きな変化がない（季節湿地に対して大規模開発や商業的農業の導入が行われない）。
2:【開発学領域】「イネを基幹とする混作栽培」導入による農民の意識変化・社会経済的インパクト計測方法が確立される。	2-1) 実証栽培試験参加農家の研究内容・目的の理解の変化の記録 2-2) ナミビア大学研究者による手法の成果発表回数（9 回） 2-3) 混作の景観生態学的評価の方法に関する学会や国際セミナーでの成果報告回数（7 回） 2-4) 関連分野の査読付き学術誌（国内誌もしくは国際誌）への論文投稿数が 5 件以上	・インタビュー・アンケート調査 ・プログレスレポート ・研究成果報告 ・学会・セミナー要旨 ・学術誌	
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4:【総合領域】 フィールド・アクティビティを通じて、プロジェクトが提案する農法がとりまとめられる。	4-1) フィールド・デーにおける農家向け、研究者向けの混作栽培モデルに関する毎年ごとの配布資料とりまとめ 4-2) ナミビア大学研究者及び研究協力者による混作栽培に関するフィールド・デーの実施	・プログレスレポート ・研究成果報告	

プロジェクト要約	投入	外部条件
活　動 1.1 イネを基幹とする混作栽培の確立に必要な耕種法を検討する。 1.2 節水栽培技術を安定同位体法等により検討する。 1.3 洪水-干ばつ等の環境ストレスに対する対応策や土壌肥沃度の維持対策を検討する。 2.1 実証と実践試験に参加する農家の社会経済状況や営農形態を調査する。(ベースライン調査) 2.2 実証試験参加農家に対し、活動目的に関して事前了解を得るとともに、作物学・水文学領域の活動で得られた知見をワークショップ等を通じ共有する。 2.3 実証試験参加農家の研究内容・目的共有の理解の変化に関する評価を実施し、展開における留意点を整理する。 2.4 農家圃場の立地を景観生態学的観点から分類する。 2.5 新たな作付体系を農民が選択あるいは拒否する判断基準や生産された作物の利用方法、湿地に対する農家の意識変化を明らかにし(農家経済、労働分配調査)、社会経済面の持続性を検討する。 3.1 現地の地形図、各種衛星画像、並びに現地観測データなどから、季節湿地全域の地表水貯留量変動を推定する。 3.2 現地観測データ(降水量、蒸発散量、地下浸透量)を基礎として、季節湿地の水収支を時系列的に解析する。 3.3 実証試験と実践試験を実施する農家圃場内の小湿地の水源を解析する。 4.1 小湿地を有する篤農家圃場において、イネを基幹とする混作栽培の実証栽培試験を実施する。 4.2 イネを基幹とする混作栽培を希望する農家において、実践栽培試験を実施する。 4.3 開発学・水文学領域の検討結果を作物学領域に毎年フィードバックすることにより、半乾燥地の水資源を持続的に保全しうるような節水型であり、かつ、洪水と干ばつにも対応可能なイネを基幹とする混作栽培を検討する。 4.4 現地でのフィールド・デーの開催などを通じて、ナミビア大研究者・技術員などが、新しく提案される農法に係る農民参加型研究・普及を実施する。	ナミビア側 1) カウンターパートの配置 ・ プロジェクト・ダイレクター ・ プロジェクト・マネージャー ・ その他必要なカウンターパート 2) 施設等 ・ 専門家執務スペースと執務環境 (ナミビア大学オゴンゴ・キャンパス) ・ 試験栽培圃場と基礎的材料 3) 管理費 ・ プロジェクトに関係するナミビア側研究者経費(国内旅費等) ・ 光熱費・通信費等のプロジェクト運営費用 日本側 1) 専門家 ・ 長期専門家(業務調整員) ・ 短期専門家(作物学、開発学、水文学、作物生理学、地理学) 2) カウンターパート研修 ・ 本邦への研修員受入れ若干名 3) 資機材供与 ・ 車輌 (4WD) ・ 農業機械 ・ 作物生理分析機器 ・ 気象観測機器 ・ 研修機材(パソコン、プロジェクター等) ・ 事務機器(コピー機、スキャナー等) ・ その他に必要な機材 4) 活動費 ・ 研修費用の一部	・ ナミビア側・日本側のプロジェクト研究参加者が離職しない。 ・ 極度の洪水や干ばつといった異常気象が発生しない。 **前提条件** ・ ミニッツに記された案件実施にあたっての条件が満たされる。

「洪水-干ばつ対応農法」:イネを基幹とする混作栽培により、洪水年でも干ばつ年であっても、自給自足農民が食用作物生産を確保する農法。


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