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プロジェクト
中間レビュー調査報告書

平成 27 年 8 月
（2015年）

独立行政法人国際協力機構
農村開発部

農 村
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15-053

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序　　文

独立行政法人国際協力機構は、2011 年 11 月 23 日ナミビア共和国と締結した討議議事録（R/D）に基づき、2012 年 2 月より技術協力の枠組みによる「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（SATREPS）」を 5 年間の計画で実施しています。

このたび、プロジェクトが協力期間の中間地点にいたったことから、プロジェクトの進捗や実績を確認のうえで目標及び成果達成に向けた貢献・阻害要因を分析すること、評価 5 項目（妥当性、有効性、効率性、インパクト及び持続性）の観点から日本・ナミビア共和国側双方で総合的にプロジェクトを評価すること、及び今後の対策について提言を行うことを目的として、2014 年 8 月 23 日から 9 月 14 日まで中間レビュー調査団を現地に派遣しました。

現地ではナミビア共和国側の団員と合同評価調査団を形成し、評価結果を合同評価報告書に取りまとめ、ナミビア共和国側の政府関係者と今後の方向性について協議し、ミニッツ（M/M）に署名を取り交わしました。本報告書は、その結果を取りまとめたものであり、今後のプロジェクトの実施にあたり広く活用されることを願うものです。

終わりに本調査にご協力とご支援を頂いた内外の関係者の皆様に対し、心から感謝の意を表します。

平成 27 年 8 月

独立行政法人国際協力機構

農村開発部長　**北中　真人**

目　　次

プロジェクト位置図

ナミビア国地図

プロジェクト対象地域：ナミビア国北中部地域

※　行政区分では、北中部（4 州：Ohangwena, Oshana, Omusati, Oshikoto)、北東部（2 州：Kavango, Caprivi)、北西部（1 州：Kunene）であるが、季節湿地が形成される地域は行政区分と一致するわけではないため、「北中部地域」とした。

写　　真

実証農家へのインタビュー

実証圃場（乾期のため稲・ヒエともに収穫されている）

実証圃場に設置された転倒マス式雨量計

実証試験で収穫されたコメ

カウンターパートインタビュー

キャンパス内の温室内に設置された育苗ハウス

キャンパス内に設置されたプロジェクト概要説明パネル

キャンパス内に設置された傾斜実験圃場（左写真のように湛水条件と畑条件を段階的に再現できる）

キャンパス内に設置された稲-ヒエ混作実験プロット（写真は稲とヒエの混作実験）

JICA より供与された刈取り機

供与機材等を保管するための建屋（刈取り機、脱穀機や精米器等を保管している）

中間レビュー中に実施されたプロジェクト成果を発表する国際シンポジウム

略　語　表

略　語	正式名称	日本語
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	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
JCC	Joint Coordination 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	独立行政法人　科学技術振興機構
MAWF	Ministry of Agriculture, Water and Forestry	農業・水・森林省
MC	Management Committee	マネジメント・コミッティ
M/M	Minutes of Meeting	協議議事録
MODIS	Moderate Resolution Imaging Spectroradiometer	中分解能撮像分光放射計
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 Operations	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
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

評価調査結果要約表

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（評価時点）：約 3 億 143 万円
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、龍谷大学、総合地球環境学研究所、滋賀県立大学
		他の関連協力：なし

１－１　協力の背景と概要

ナミビア共和国（以下、「ナミビア」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。1 人当たり国民総所得（Gross National Income : 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（Ministry of Agriculture, Water and Forestry：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、食料不足、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。また、この地域の近年の年間降水量の変動が大きく、2008 年にはナミビア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。過去 10 年では、当該地域の年間降雨量は、200 mm～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。近年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

[1] Pearl-millet。ナミビア内で栽培されている主要穀物であり、耐乾性が高いという特性をもつ。

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料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。そして、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」（以下、「本プロジェクト」と記す）が開始された。

１－２　協力内容

（1）上位目標

1.「洪水-干ばつ対応農法」が、ナミビア北中部地域において普及し、現地農家の食料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、ナミビア北東部地域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得る「洪水-干ばつ対応農法」が開発される。

（3）アウトプット

1)【作物学領域】 洪水-干ばつに対応し、かつ節水型である稲-ヒエ混作栽培モデルが提案される。

2)【開発学領域】 「稲-ヒエ混作農法」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取りまとめられる。

（4）投入（評価時点）

1）日本側

専門家派遣：長期専門家延べ 2 名及び短期専門家延べ 12 名

研修員受入：国別研修延べ 28 名、長期研修（博士課程）2 名、短期研修延べ 11 名

機材供与：総額約 5,700 万円

ローカルコスト負担：約 5,600 万円

2）ナミビア側

カウンターパート（Counterpart：C/P）配置：17 名（中間レビュー時）

ローカルコスト負担：約 740 万円

土地・施設提供：作物試験圃場、専門家執務室、温室、ラボ、倉庫等

２．評価調査団の概要			
調査者	担当分野	氏　名	所　属
	団　長/総　括	武市　二郎	JICA 農村開発部計画調整課　課長
	協力企画	大岩　拓也	JICA 農村開発部農業・農村開発第二グループ第四チーム
	科学技術評価（オブザーバー）	国分　牧衛	JST 研究主幹（東北大学大学院農学研究科　教授）
	科学技術評価（オブザーバー）	梅村　佳美	JST 国際科学技術協力部地球規模課題協力グループ
	評価分析	道順　勲	中央開発株式会社海外事業部
調査期間	2014 年 8 月 23 日～2014 年 9 月 14 日		評価種類：中間レビュー調査

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、かつ節水型である稲-ヒエ混作栽培モデルが提案される。

実　績：洪水-干ばつに対応し、かつ節水型である農法の技術開発に関する研究活動は、着実に進捗しており、また、各種の論文発表・学会/シンポジウム発表が行われている。今後、稲-トウジンビエ、稲-ソルガム、稲-カウピーの組み合わせによる複数の混作農法が開発されることが期待される。

成果 2：【開発学領域】　「稲-ヒエ混作農法」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　績：農民の態度や意識の変化を理解する手法の開発並びに農民に対する社会経済的インパクトを計測する手法の開発がおおむね計画どおりに進捗し、学会/シンポジウムで各種の発表が行われている。

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。

実　績：混作栽培可能面積を推定するための各種データが収集され、面積を推定する手法が開発された。さらに、各種の論文作成、学会/シンポジウムでの発表が行われた。小湿地の貯水量変動を分析する手法が開発された。

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取りまとめられる。

実　績：作物学領域、開発学領域、水文学領域の研究活動が進捗し、研究結果はナミビア側 C/P、日本人専門家、普及員、農家等と共有されている。これら 3 領域の研究成果の統合は、今後、行われる予定である。

プロジェクト目標：半乾燥地の水資源を持続的に保全し得る「洪水-干ばつ対応農法」が開発される。
実　績：各種の研究活動が順調に進展しており、研究成果も着実にプロジェクト目標達成に向けて集積されつつある。なお、プロジェクト目標達成のために、「洪水-干ばつ対応農法」に関するガイドラインの概要を準備することが重要である。ガイドラインの概要案が作成された後に、プロジェクト目標の達成が可能かどうか判断できるようになると考える。これまでに重要かつ独特な研究成果を産出しつつあることを考慮すると、プロジェクト目標を十分満足できる水準で達成することが期待される。

３－２　評価結果の要約

(1) 妥当性：以下の観点から判断して、本プロジェクトの妥当性は高い。
1) ナミビアの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
2) ナミビアの国家政策との整合性
3) わが国の対ナミビア国援助方針との整合性
4) プロジェクトアプローチの適切さ
5) わが国がもつ技術的優位性

(2) 有効性：各種研究活動が順調に進捗し、プロジェクト目標の達成に向けて、研究成果が着実に積み上げられている。プロジェクト終了時までにプロジェクト目標がおおむね達成できると期待されているものの、現時点では、プロジェクト目標が達成するかどうか正確に述べることは難しい。3 つの領域（作物学、開発学、水文学）の研究結果がうまく統合されたときに、本プロジェクトの有効性が高いと評価することが可能となる。

(3) 効率性：以下の観点から判断して、本プロジェクトの効率性は、おおむね高いと判断する。
1) 日本側の投入の適切さ、2) ナミビア側投入の適切さ、3) プロジェクトマネジメント

(4) インパクト：上位目標が将来達成するかどうかを現時点で予想することは困難である。将来発現すると予想されるプラスのインパクトが見られる。
1) 上位目標
〔1.「洪水-干ばつ対応農法」が、ナミビア北中部地域において普及し、現地農家の食料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、ナミビア北東部地域の多雨地帯や近隣諸国でも検討される。〕達成の見通し。
中間レビュー時点では、上位目標が将来、どの水準で達成可能かを判断するには時期尚早である。
2) その他のインパクト
①稲作に関心をもつ農家の増加
②普及員の能力強化

(5) 持続性

1) 政策面

ナミビア政府は、食料安全保障、収入増加、農作物の多様化を重視しており、本プロジェクトの政策面での持続性は確保されるものと思われる。

2) 組織面

農業天然資源学部（Faculty of Agriculture and Natural Resources : FANR）は、ナミビア大学（University of Namibia : UNAM）にある 8 学部の 1 つであり、能力を有する教授や講師がいる。FANR は複数のキャンパスをもち、その 1 つがナミビア北中部に所在するオゴンゴ校であり、ここで主なプロジェクト活動が実施されている。FANR は、ナミビアにおいて、コミュニティ農業及び商業的農業に対し、教育・研究・普及を通じて、持続的農業及び天然資源の開発・管理を促進するという明確な使命を有している。本プロジェクトは、半乾燥地の水環境を持続的に保全可能な「洪水-干ばつ対応農法」の開発を行うことを目的としており、この目的は、UNAM の使命と整合性がある。さらに UNAM は、このような種類の研究活動を実施するに必要な組織体制も有する。

3) 技術面

UNAM の講師や技術者が継続的に勤務する可能性は高いと期待され、プロジェクトの残り期間においては、更にナミビア側 C/P の研究にかかわる知識やスキルが強化され、プロジェクト終了後においても強化された能力は、研究活動や教育活動に活用されるものと思われる。約 20 名の普及員が、各種の研修を受講するとともに、農家に対する稲作技術及び混作農法の普及活動に参画している。「洪水-干ばつ対応農法」が開発された後（主としてプロジェクト終了後）には、普及員の更なる能力強化と開発された農法を農家に普及するための展示圃場などを使った実証活動が必要になるであろう。

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) MAWF の普及員がプロジェクト活動に参加し、特に、農家への稲の苗供給や生産状況のモニタリングを含む稲-トウジンビエ混作農法技術の普及において重要な役割を担っている。このような MAWF との協働は、農家圃場レベルの活動を円滑に進めるうえで必要でありかつ有効である。

2) 多くの農家が、稲-トウジンビエ混作農法を農家圃場に導入してみようという意思を有していること。

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

1) ナミビア側 C/P の一部にプロジェクト活動に積極的に参加しない者がいること。このような状況は、計画した活動を円滑に実施するうえで、また、チームワークを構築するうえで障害となっている。

2) ナミビア側 C/P のなかには、収集したデータや研究成果を使って、論文を作成するのかどうか不明確なため、プロジェクト活動を実施するモチベーションを強くもてない者がいる。

３－５　結　論

合同中間レビューチームは、おおむねプロジェクト活動が良好かつ着実に進捗していることを確認した。また、プロジェクト活動の結果として、稲-トウジンビエ混作農法、農家の態度や認識の変化を理解する手法、農家への社会経済的インパクト計測手法、水収支・水資源分析に関する科学的知見・情報がおおむね計画どおり産出されつつあることも確認された。

３－６　提　言

３－６－１　プロジェクトチームに向けた提言

(1) プロジェクチーム全体として目標達成のため、課題を共有しながら研究することについて

1) より具体的な年間活動計画の作成と JCC における協議及び承認について

2) チーム内での連携強化について

(2) プロジェクト目標及び成果具現化に向けた議論を進めることについて

1) ガイドラインの内容等の具体化について

2) 計画的な論文作成について

(3) PDM の改訂について

３－６－２　ナミビア関係機関に対する提言

(1) プロジェクトに対する UNAM 側予算措置について

(2) MAWF との協力関係の継続について

３－７　教訓

（中間レビュー時点では、特になし）

Summary of Mid-term Review

<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： About US$ 3,074,000 dollars</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, Ryukoku University, Research Institute for Humanity and Nature, and University of Shiga Prefecture</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. The research project aims to develop "Flood- and drought-adaptive cropping system" which can preserve water resources and cope with the yearly fluctuation of flood and drought. "Flood- and drought-adaptive cropping 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.

2. Project Overview

(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-pearl millet 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-pearl millet 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 : Japanese Expert: 2 long-term experts and 12 short-term experts in total, Trainees received in Japan: 28 persons for the country-specific trainings, 2 persons for Doctor course as long-term training, and 11 persons for short-term training, Provision of equipment: around US$567,000 dollars, Local cost expenditure: around US$560,000 dollars

Namibian side : Counterpart 17 persons (at the mid-term review), Local Cost: around US$73,765 dollar, Provision of land and facilities: office spaces, laboratories, green house, and crop experiment fields etc.

II. Evaluation Team

Members of Evaluation Team	1) Leader: Mr. Jiro TAKEICHI, Director, Planning and Coordination Division, Rural Development Department, JICA 2) Cooperation Planning: Mr. Takuya OIWA, Associate Expert, Agricultural and Rural Development Group 2, Rural Development Dept., JICA 3) Science and Technology Evaluation (As observer): Dr. Makie KOKUBUN, Program Officer, JST/ Professor, Tohoku University 4) Science and Technology Evaluation (As observer): Dr. Yoshimi UMEMURA, Assistant Program Officer, JST 5) Evaluation Analysis: Mr. Isao DOJUN, Consultant, Chuo Kaihatsu Corporation
Period of Evaluation	From August 23, 2014 to September 14, 2014 **Type of Evaluation:** Mid-term

III. Results of Evaluation

1. Project Performance

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

Achievement: Research activities for developing techniques to deal with flooding and drought conditions as well as water saving are progressing steadily and various publications and presentations at academic conferences/symposiums have been made. It is expected that several mixed cropping systems are developed; combination of rice and millet, rice and sorghum, rice and cowpea.

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-pearl millet mixed cropping system are established.

Achievement: Development of methods to understand the change of attitudes and perception by farmers, and socio-economic impacts on farmers are progressing mostly as planed and various presentations at academic conferences/symposiums have been made.

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.

Achievement: Various kinds of data have been collected and a method for estimating the possible area of mixed-cropping field is developed and various publications and presentations at academic conferences/symposiums have been made. A method for analyzing flood (surface) water volume fluctuation of small wetland is developed.

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

Achievement: Research activities in the respective areas of Crop science, Development Studies and Hydrology are progressing and research results have been shared with Namibian counterparts, Japanese experts, extension officers, and farmers etc. Integration of research results of three areas are carried out hereafter.

Project Purpose: "Flood- and drought-adaptive cropping systems" are developed which can sustainably preserve the water environment of semi-arid region.
Achievement: Various research activities have been progressing well and the research results have been steadily accumulated toward achieving the Project Purpose. It is important to prepare draft outlines of guideline for "Flood- and drought-adaptive cropping systems". After that, it will become possible to prospect achievability of the Project Purpose. Considering the facts that important and unique research outcomes have been produced, it is expected that the Project Purpose will be achieved at very satisfactory level.

2. Summary of Evaluation Results

(1) Relevance

The relevance of the Project is considered to be high from the viewpoints of 1) conformity with needs for increasing crop production in seasonal wetlands in north-central Namibia, 2) relevance to the national policies of Namibia, 3) conformity to the assistance policy of Japan to Namibia, 4) appropriateness of the approaches taken by the Project, and 5) comparative advantage of technical cooperation by Japan.

(2) Effectiveness

Various research activities have been progressing well and the research results have been steadily accumulated toward achieving the Project Purpose. The Project Purpose is expected to produce an effective way forward mostly at the end of the Project, however, it is difficult to prospect precisely yet.

When research results of three areas (Crop Science, Development Studies, and Hydrology) are integrated well, the overall effectiveness of the Project can be considered to be high.

(3) Efficiency

The efficiency of the Project is considered to be moderately high from the viewpoints of 1) appropriateness of inputs provided by Japan, 2) inputs provided by Namibian side, and 3) project management.

(4) Impact

1) Prospect of achieving the 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.

At the point of the Mid-term Review, it is premature to describe the possible level of achievement of the Overall Goal in future.

2) Other Potential Impacts Observed

a) Increase of farmers who have interest in rice cultivation

According to extension officers and farmers concerned with the Project, number of farmers who have interest in rice cultivation is increasing. When number of farmers who cultivate rice and they acquire rice cultivation techniques step by step, it is expected that dissemination of research results (rice and pearl millet mixed cropping systems) to such farmers becomes easy, because they have technical basis to grow rice.

b) Acquired knowledge by extension officers

Following the training for extension officers in Japan, it is expected that the knowledge gained will be transferred to farmers thereby leading to improved techniques in cultivation of rice and also mixed cropping systems.

(5) Sustainability

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

1) Policy aspect

Food security and income increases, and diversification of agricultural crops are considered as important issues by the Government of Namibia. Therefore, policy sustainability of the Project will be secured.

2) Institutional and Organizational Aspects

The Faculty of Agriculture and Natural Resources (FANR) is part of the eight faculties of UNAM and has capable professors and lecturers. One of the campuses of FANR is the Ogongo Campus in north-central Namibia where the main project activities are being carried out. FANR has a clear mission to promote sustainable agricultural and natural resource development and management in Namibia, through teaching, research and extension services to communal and commercial farming communities. The Project aims at developing a "Flood- and drought-adaptive cropping systems" which can sustainably preserve the water environment of semi-arid region, therefore, objective of the Project is consistent with the mission of UNAM and UNAM has organizational setup for carrying out this kind of research activities.

3) Technical aspect

Continuity of lecturers and technologists of UNAM is expected to be retained , therefore, Namibian counterparts will strengthen research knowledge and skills further in the remaining project period and enhanced capacity of them will be utilized for research and teaching activities after the completion of the Project. Around 20 extension officers are involved in the project activities for disseminating rice cultivation techniques and mixed cropping system to farmers while receiving various trainings. When "Flood- and drought-adaptive cropping systems" is developed, further capacity building to extension officers and demonstration activities for disseminating developed cropping systems to farmers will be necessary after the completion of the Project.

3. Factors that promoted realization of effects

(1) Factors concerning to the implementation process

None

(2) Factors concerning to the implementation process

1) Extension officers of MAWF are involved in the project activities and taking important roles especially for providing rice and mixed cropping techniques including distribution of rice seedlings to farmers and monitoring results of productions. This collaboration is necessary and effective for carrying out farmers' field level activities smoothly.
2) Willingness of local farmers to participate in rice and pearl millet mixed cropping in their fields.

4. Factors that impeded realization of effects

(1) Factors concerning to planning

None

(2) Factors concerning to the implementation process

1) There are some Namibian counterparts who do not actively participate in all project activities. This situation has brought negative effect for implementing planned activities and creating team work.
2) There are some Namibian counterparts who are not very motivated to carry out project activities due to uncertainness about paper writing using collected research data.

5. Conclusion

The Joint Mid-term Review Team has confirmed that the project activities have shown a good and steadily progress in general. As the results of the project activities, scientific knowledge and information on rice and pearl millet mixed cropping systems, methods to understand the change of attitudes and perception by farmers, and socio-economic impacts on farmers and water budget/water source analysis have been produced as originally planned mostly. The summary of evaluation based on five evaluation criteria is described in the table below.

Criteria	Evaluation
Relevance	High
Effectiveness	Expected to be high
Efficiency	Moderately high
Impact	--- (Premature to assess)
Sustainability	Likely to be moderately high

6. Recommendations

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

(1) Mutually share challenges with all members of the Project Teams to achieve the Project overall objectives.
1) Establishment of the more concrete annual activity plan, Discussion and Approval by JCC
2) Enhance the linkage among Research Team Members

(2) Advancement of discussion to embody the Project Purpose and Outputs
1) The embodied Guideline
2) Implementation of intentional publication

(3) PDM Revision

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

(1) Budget allocation to the project by UNAM

(2) Collaboration with MAWF

7. Lessons Learned (No specific lessons learned at the mid-term review)

第１章　中間レビュー調査の概要

１－１　中間レビューの背景

ナミビア共和国（以下、「ナミビア」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。1 人当たり国民総所得（Gross National Income：GNI）は 4,270 米ドル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、農業・水・森林省（Ministry of Agriculture, Water and Forestry：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、食料不足、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。

ナミビア北中部は、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が大きく、2008 年にはナミビア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。過去 10 年では、当該地域の年間降雨量は、200 mm～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。近年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料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。そして、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」（以下、「本プロジェクト」と記す）が開始された。

プロジェクトが 2014 年 9 月に協力期間の中間地点を迎えることから、中間レビュー調査を実施した。

１－２　中間レビューの目的

本中間レビュー調査では、ナミビア側と JICA が合同でプロジェクト目標や成果の達成状況を検証し、評価を行う。また、評価結果に基づきプロジェクト後半の活動計画を検討し、改善策の

[1] Pearl-millet。ナミビア内で栽培されている主要穀物であり、耐乾性が高いという特性をもつ。

提言や教訓の抽出を取りまとめる。同結果を中間レビュー報告書として取りまとめたうえで、内容を合意することを目的とする。

１－３　中間レビュー評価団

（1）独立行政法人国際協力機構（JICA）団員

担当分野	氏　名	所　属
団長/総括	武市　二郎	JICA　農村開発部　計画調整課　課長
評価分析	道順　勲	中央開発株式会社　海外事業部
協力企画	大岩　拓也	JICA　農村開発部　農業・農村開発第二グループ第四チーム

（2）独立行政法人科学技術振興機構（JST）団員

担当分野	氏　名	所　属
科学技術/評価	国分　牧衛	東北大学大学院農学研究科　教授 （地球規模課題国際科学技術協力　研究主幹）
科学技術/評価	梅村　佳美	JST 国際科学技術協力部地球規模課題協力グループ

（3）ナミビア側

氏　名	所　属
Prof. Edosa Omoregie	Director, University of Namibia（UNAM）, Sam Nujoma Marine & Coastal Resources Research Center
Dr. N. Indongo	Director, University of Namibia（UNAM）, Multidisciplinary Research Center

１－４　中間レビュー評価団日程

現地調査は 2014 年 8 月 23 日から 9 月 14 日までの期間で実施された。調査日程の概要は、以下のとおりである。

日　付		活動内容		
		JICA（コンサルタント）	JICA（団長・協力企画）	JST
8/23	土	日本発		
8/24	日	ウィントフック着		
8/25	月	JICA ナミビア支所　打合せ C/P インタビュー		
8/26	火	移動（ウィントフック-オシャカティ）		
8/27	水	日本人専門家（業務調整）インタビュー 学部長表敬訪問		
8/28	木	C/P インタビュー		
8/29	金	農業・水・森林省普及員インタビュー C/P インタビュー		

日　付		活動内容		
		JICA（コンサルタント）	JICA（団長・協力企画）	JST
8/30	土	書類作成	日本発	
8/31	日	書類作成	ウィントフック着	
9/1	月	書類作成 ナミビア大学オゴンゴ校農業天然資源学部長表敬訪問 C/P インタビュー	移動（ウィントフック-オシャカティ）	
9/2	火	実証農家圃場視察（Oshiteyatemo 村） 実証農家圃場視察（Onamundindi 村）		
9/3	水	実証農家圃場視察（Afoti 村）		日本発
9/4	木	C/P インタビュー取りまとめ 団内協議		移動（ウィントフック-オシャカティ）
9/5	金	ナミビア大学オゴンゴ校農業天然資源学部長表敬訪問 C/P インタビュー（各研究班のサブリーダー）		
9/6	土	日本人専門家インタビュー ナミビア大学オゴンゴ校内実験圃場及び施設の視察		
9/7	日	移動（オシャカティ-ウィントフック） 団内協議		
9/8	月	国際シンポジウム聴講（“Agricultural Use of Seasonal Wetlands in Southern African Countries”, SATREPS Rice-Mahangu Project）		
9/9	火	国際シンポジウム聴講 合同調整委員会（JCC）		ウィントフック発
9/10	水	合同評価メンバー意見集約		日本発
9/11	木	中間レビュー結果報告（プロジェクト関係者向け） 協議議事録（M/M）署名		
9/12	金	中間レビュー結果報告（JICA ナミビア支所）		
9/13	土	ウィントフック発		
9/14	日	日本着		

１－５　対象プロジェクト概要

（1）上位目標

1.「洪水-干ばつ対応農法」が、ナミビア北中部地域において普及し、現地農家の食料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、ナミビア北東部地域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得る「洪水-干ばつ対応農法」が開発される。

(3) 成果

成果 1.【作物学領域】　洪水-干ばつに対応し、かつ節水型である稲-ヒエ混作栽培モデルが提案される。

成果 2.【開発学領域】　「稲-ヒエ混作農法」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。

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。

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取りまとめられる。

(4) 活動

1) 成果 1 を達成するための活動

1.1　稲-ヒエ混作農法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) 成果 2 を達成するための活動

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) 成果 3 を達成するための活動

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、季節湿地全域の表流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）成果 4 を達成するための活動

4.1　小湿地を有する篤農家圃場において、稲-ヒエ混作農法の実証栽培試験を実施する。

4.2　稲-ヒエ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得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稲-ヒエ混作農法を検討する。

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）投入（評価時点）

1）日本側

JICA 専門家派遣：延べ 2 名（長期）、12 名（短期）

本邦研修受入：延べ 28 名（国別研修）、2 名（長期研修）、11 名（短期研修）

機材供与：総額約 5,700 万円、ローカルコスト負担：約 5,600 万円

2）ナミビア側

カウンターパート（Counterpart : C/P）配置 : 17 名〔ナミビア大学（University of Namibia : UNAM）、中間レビュー時〕

ローカルコスト負担：約 740 万円　光熱費等

土地・施設提供：作物試験圃場、専門家執務室、温室、研究室、倉庫等

（6）プロジェクト期間

2012 年 2 月 28 日～2017 年 2 月 27 日（5 年間）

（7）研究代表機関

1）日本側：近畿大学、名古屋大学、龍谷大学

2）ナミビア側：ナミビア大学（UNAM）

１－６　中間レビュー評価方法

（1）評価手法

本中間レビュー調査は、「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、PDM や 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、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、半期報告書、年次実施報告書、日本人専門家作成の中間レビュー向け資料など）を参考にしつつ、また、2011 年 11 月 10 日に策定された PDM（Version.1）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） ・対ナミビア共和国 国別援助方針（2012 年 2 月）（外務省） ・国別データブック（外務省） ・詳細計画策定調査報告書（JICA、2011 年 12 月） ・年次実施報告書（H23, H24, H25） ・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（長期専門家及び日本側研究者） ・ナミビア側 C/P〔ナミビア大学農業天然資源学部（Faculty of Agriculture and Natural Resources : FANR）の教員等〕 ・MAWF の普及員 ・実証農家
③質問票	プロジェクトの実績、成果の発現状況、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

第２章　プロジェクトの実績と実施プロセス

２－１　投入実績

２－１－１　日本側投入

(1) 日本人専門家派遣

2 名の長期専門家（業務調整/研修）と作物学、開発学、水文学に関する分野の 12 名の研究者（短期専門家）が派遣された。詳細は、付属資料.1 の Annex 4 を参照のこと。

(2) カウンターパートの本邦研修

稲-トウジンビエ混作農法の農民参加型普及技術に関する国別研修が、2012 年と 2013 年に日本で実施された。この国別研修には、合計 9 名の UNAM 研究者と 19 名の MAWF 普及員が参加した。このほか現在、長期研究として 2 名の UNAM 研究者が近畿大学の博士課程に留学している。さらに、主に近畿大学で実施された短期研究プログラムには、11 名の UNAM 研究者が参加した。本邦研修に関する詳細情報については、付属資料.1 の Annex 5 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、車両、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[2]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 56 万 7,000 米ドルである。資機材の詳細リストについては、付属資料.1 の Annex 6 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、2014 年 7 月時点で約 590 万ナミビア・ドル（Namibian Dollars : NAD）（約 56 万米ドル）である。この活動経費に含まれるものは、交通費、会議費、その他一般経費である。詳細については、付属資料.1 の Annex 7 を参照のこと。

２－１－２　ナミビア側投入

(1) プロジェクト活動に参加した C/P

中間レビュー時点で、17 名の 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・マネジャー、アシスタント・プロジェクト・マネジャーを含む。全 17 名は、UNAM の研究者である。C/P の詳細リストについては、付属資料.1 の Annex 8 を参照のこと。

(2) ナミビア側負担経費

ナミビア側は、表－1 に示すように、ナミビア側研究者の交通費、供与機材の内陸輸送費を負担した。総支出額は、2014 年 12 月までの予定分を含めて、78 万 1,869.15 NAD

[2] 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）。

（約 73,765 米ドル）である。

表－１　ナミビア側負担経費

項目/期間	2012 年 4 月～ 2012 年 12 月	2013 年 1 月～ 2013 年 12 月	2014 年 1 月～ 2014 年 12 月	合計 （単位：NAD）
交通費（ナミビア国内及び国外） Walvis 港から UNAM オゴンゴ校までの機材輸送費	341,949.15	239,920.00	200,000	781,869.15

（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、事務スペース、研究室・実験室、温室、作物栽培試験圃場、倉庫を提供している。詳細については、付属資料.1 の Annex 9 を参照のこと。

２－２　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、中間レビュー調査団が報告書やプロジェクトチームメンバーから得た情報に基づき作成したものを表－２に示す。

表－２　活動の進捗状況と主な成果

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	稲-ヒエ混作農法の確立に必要な耕種法を検討する。	日本国内の滋賀県立大学の湿地と畑地の水環境をもつ傾斜実験圃場（20m×20m）で、各種栽培試験（栽植密度等）が実施されている。 UNAM オゴンゴ校では、傾斜実験圃場（160m×80m）が造成され、稲・トウジンビエ混作栽培試験（生産性、水分生理、播種時期、耐湿性等）が実施されている。また同校では、栽培技術、肥培管理、洪水-干ばつ対応に関する試験も実施された。さらに 9 カ所の実証農家圃場における混作モデル栽培試験が実施されている。	計画どおり	今後も計画どおり各種栽培試験が実施される。造成圃場における検討が継続実施される。さらに、ポット試験結果については、2015 年 3 月までに取りまとめが行われる。
1-2	節水栽培技術を安定同位体法等により検討する。	混作における節水技術の検討として、近畿大学の簡易ライシメータ[3]埋設圃場において地下水制御技法の検討が行われ、作物水分生理実験と水源解析実験が完了した。稲とトウジンビエの近接栽培により、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という結果がみられた。稲・トウジンビエ混作農法のための水利用効率の測定技術の検討については、基礎的な検討が完了し、今後、圃場試験が繰り返し実施される予定である（圃場試験の結果は、プロジェクト 5 年目、すなわち最終年度に取りまとめられる予定)。なお、ポット試験からは、稲は表層水に、一方、トウジンビエは深層水への依存を高めるという、いわば水利用に対する住み分けが存在することが明らかになった。	計画どおり	干ばつ-湛水条件下の混作における水分応答に関する試験結果については、2015 年 3 月までに結果が取りまとめられる。その他の試験の結果については、プロジェクト終了時までに取りまとめられる予定（2017 年 2 月)。
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	近畿大学と滋賀県立大学では、混作作物のストレス環境応答（塩、乾燥、貧栄養等）に関する基礎的実験（ポット試験及び圃場試験により）が実施された。このうち、乾燥、塩、湛水ストレス耐性	計画どおり	以下の活動に関する結果は、2016 年 3 月までに取りまとめられる予定。

[3] 金属やコンクリート製の大きな容器に土壌などを充填して実験棟や圃場などに設置し、さまざまな環境シュミレーションにおけるさまざまな計測を行う実験装置。

	沃度の維持対策を検討する。	に対する稲の種・品種間比較研究（アジアイネ、アフリカイネ、種間交雑系統ネリカの総計 37 品種）についてのポット試験が完了した。また、トウジンビエの耐湿性を強化する栽培技術について基礎的な知見が得られた。 季節湿地の土壌肥沃度を評価するための土壌サンプリングが、ナミビアの季節河川に沿って実施された（約 50 地点のサンプルが採集された）。さらに、土壌肥沃度維持対策として、混作作物の有機物由来窒素への依存度の検討が行われた。また、ナミビア大学オゴンゴキャンパスに配属された青年海外協力隊隊員と連携して、土壌肥沃度対策の検討が進められている。現地で利用可能なマメ科作物として耐乾性が強いカウピーを稲-トウジンビエ混作栽培へ組み込むための基礎的な検討が 2014 年から開始された。		塩類集積、乾燥、貧栄養に関するポット試験を通じた稲・トウジンビエ混作での環境ストレスに関する知見を集積する。 稲・トウジンビエ混作条件下における有機物由来の窒素利用効率を検討する。 なお、ポット試験による基礎的検討の中間結果の取りまとめは、2015 年 3 月までに取りまとめられる。 以下の活動の結果は、プロジェクト終了時までに取りまとめられる。 1) 地力維持のための牛糞投入量を求める。 2) 圃場試験結果の取りまとめを完了する。
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）	本プロジェクトの実証農家（4 戸）及び実践農家（フィールド・デー参加農家）を対象とする聞き取り調査（参加意思の確認を含む）が実施された。その後、ベースライン調査の対象村選定、調査手法検討、プレテスト（予備調査）が実施された後に、2013 年 2 月 4 日から 16 日にかけてベースライン調査が実施された（4 選挙区 370 農家に対するインタビュー調査）。なお、実証農家・実践農家の存在する村以外も対象に実施された。実証農家の存在する村 3	若干の遅れがある	UNAM 研究者の調査手法に対する理解を深めつつ、追加調査を継続的に実施する予定。 最終年度にはベースライン調査結果との比較調査を実施する予定。

		カ所は確実にデータが収集できるよう調査計画が修正され、2014年末までに追加調査が実施される予定になっている。2013 年に収集したデータについては、単純集計は終了している。また、1 つの村に関する村落モノグラフの作成は、2014 年 9 月末になる見込みである。		
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。	活動目的に関する情報並びに、作物学及び水文学領域の活動で得られた知見が、各種のワークショップ、コミュニティ集会、フィールド・デー等を通じて実証試験参加農家（デモンストレーション農家）に対して説明され、共有されている。	計画どおり	イネの苗配付時にデモンストレーション農家に対して、プロジェクト活動から得られた知見の提供や共有が行われる。
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。	在来農法や新しい混作技術に対する農家の理解と実践、及びその変化を把握するためのモニタリングが継続実施されている。また、農家自身が本プロジェクトにおける研究内容をどう理解しているか説明できるようにするため、各種ツール〔PRA（参加型農村調査の各種手法、たとえば、ファームスケッチ手法[4]、フォーカスグループインタビュー[5]、GPS 技術、空中写真撮影[6]）の各種手法を組み合わせ〕の開発が進められている（農家の主観的理解と実際のフィールド・データを組み合わせつつ)。このほか、GPS を用いて収集した農家の位置情報データについては、GIS データとして整理されている。	計画どおり	モニタリング活動を継続実施する。

[4] 本プロジェクトでは、農家に、自分の所有地の利用状況を図化してもらい、実際の土地利用状況を計測し、農家が土地利用状況をどのように認識しているかを把握している。
[5] 定性調査による資料収集方法の1つで、ある目的に対する情報を収集するために集められた対象のグループに、面接形式でインタビューを行うもの。
[6] 本プロジェクトでは、プロペラ付きで遠隔操作ができる機械にカメラを付けて、空中に浮遊させ、地上の写真を撮影している。

2-4	農家圃場の立地を景観生態学的観点から分類する。	2013 年 1 月から 2 月にかけて、Onamundindi 村の 10 農家を対象に、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、湿地や自然環境に対する農家の認識と小湿地を分類する指標が抽出された。その後、研究を展開する調査地選定（Onamundindi 村、Afoti 村、Oshiteyatemo 村の 3 カ村で計 18 の季節湿地を抽出）と対象農家選定が行われ、景観構成要素に関する定量調査（水位変動、降雨、地形、植生、土壌）と農家による湿地の認識・分類基準に関する情報収集が実施された。現在も追加調査を実施中である。収集したデータに基づき、基礎的検討が行われ、中間取りまとめ結果が、2014 年 9 月に開催されたシンポジウムで発表された。今後、追加調査の結果も踏まえて、混作に対する地域の景観生態学的な評価が行われる予定である。	計画どおり	収集されたデータの取りまとめが進められ、また、継続的に調査が実施される。
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。	2012 年 9 月に、フォーカスグループディスカッションを通じて農家経済状況や労働分配実態についての予備的把握が行われた。また、ベースライン調査のなかでも、作物の消費や流通に関する農家の認識調査が実施された。Omagalanga 村（約 20 農家）を対象に、季節カレンダーとランキング手法による調査が実施され、作物の消費や流通に関する農家の認識が把握された。さらに、2014 年 4 月から 5 月にかけて、農家の在来農法に関する認識と実践状況を把握するための追加調査が実施された。2014 年 5 月から 6 月にかけては、種子を配付した農家を対象に、混作の実施状況調査が実施された。 「新たな作付体系に対する農家の採択・拒否の判断基準や湿地に対する農家の意識変化に関する調査」及び「農家の理解や認識の変化を調査・分析する手法の開発」については、PRA ツールを用いた調査が実施され、調査・分析手法の開発が進められている。	計画どおり	UNAM 研究者と日本側研究者が協力して、プロジェクト終了時までに、農家の理解度・意識の変化を計測する手法を開発する。

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、季節湿地全域の表流水貯留量変動を推定する。	日本国内では、現地の地形図、各種衛星画像、並びに現地観測データなどを用いて、季節湿地全域の表流水貯留量変動を推定する作業が実施された。そして、マイクロ波画像データを用いて NDPI（正規化偏波指数）の算出、可視・近赤外画像データから算出した NDWI（正規化水指数）とのマッチアップ（対応付け）が行われ、水域の時系列マップが作成された。	計画どおり	1) 地形図や航空写真データから小湿地の面積を同定する。 2) 現地測量を実施し、小湿地の地表水量推定手法を確立する。
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。	季節湿地帯の降水量を面的に把握するために、ナミビア大学オゴンゴキャンパスを中心とする東西180km、南北60kmのエリア内に、計 25 台の転倒マス式雨量計が設置された（2012 年 11 月下旬までに）。その後、データを継続的に取得している。また、ナミビア大学オゴンゴキャンパス内の傾斜実験圃場内に、3 基のボーエン比測定システムが設置され（2012 年 9 月）、データの継続的な取得と、トウジンビエと稲の混作状況が異なる場所での蒸発散量の季節変化の解析が行われた。さらに、傾斜実験圃場に隣接する自然湿地圃場に、ボーエン比計測システム 1 基が追加設置され（2013 年 9 月）、稲作が季節湿地（オンドベ： Ondombe）の水収支に及ぼす影響の定量評価が行われた。	計画どおり	1) 降水量の時空間マップを作成する。 2) 実験圃場における蒸発散量の時系列データを作成する。 3) 地下浸透量を見積もる。
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。	2012/2013 年の雨期に、季節湿地帯の北部と中部において、地表水、地下水、降水の採取と、採取した水の水安定同位体組成の分析が行われた。 また、季節湿地帯の北部、中部、南部からそれぞれ 3 カ所の実証農家が選定され（計 9 カ所）、農家が保有する小湿地の中央部に地下水観測井が設置され、2013 年雨期から、地下水位の計測が開始された。現在、日本側及びナミビア側研究者が共同で、人工衛星データを解析し、ナミビア側研究者は、土地被覆分類（GIS 解析）を進めている。	計画どおり	1) 水安定同位体分析により小湿地の水源を同定する。 2) 水位変動の時系列データを作成する。

		今後、小湿地の水源が同定される予定であり、また、小湿地の水面面積の時系列（季節）変化が明らかになる見込みである。		
4-1	小湿地を有する篤農家圃場において、稲-ヒエ混作農法の実証栽培試験を実施する。	既に述べたように、2013 年雨期に実証農家となる 9 農家が選定され、農家圃場において、実証モデル試験が実施されている。これらの農家圃場内の小湿地において、作物班が混作モデル試験、開発班が農家の行動様式調査、水文班が水環境調査をそれぞれ実施中である。	計画どおり	1）計画した活動を継続する。 2）プロジェクト終了時までに最適な混作農法を提案する。
4-2	稲-ヒエ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。	農家の自由意思に基づき、稲栽培を実践する農家数（2013/14 作期）は、30 年来の大干ばつ（2012/13 作期）と干ばつ（2013/14 作期）の影響を受け、70～80 数戸にとどまっている。	計画どおり	最終年度まで、農家の自主性に任せた稲作導入を奨励する。
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得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稲-ヒエ混作農法を検討する。	ナミビアにおける JCC 会議並びに日本国内で年 1 回行われている会議における情報共有を通じて、アウトプット 2 とアウトプット 3 の成果のアウトプット 1 へのフィードバックは、計画どおりに進捗している。	プロジェクト活動の進捗に応じてフィードバックされている。	情報のフィードバックが定期的に行われ、本格的なフィードバックは、プロジェクトの 5 年目に実施される予定。

<table>
<tr>
<td>4-4</td>
<td>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。</td>
<td>下表に示すように、農民参加型ワークショップが 8 回実施された。ワークショップ参加者は、実証農家、実践農家、UNAM 研究者、日本人研究者等である。なお、これまでにフィールド・デーが 3 回実施され、そのうち、2 回は、農民向けであった（残り 1 回は、小中校生向け）。
<table>
<tr><th></th><th>年月日</th><th>名　称</th><th>場　所</th><th>参加人数（農家数）</th><th>概　要</th></tr>
<tr><td>1</td><td>2012 年 9 月 5 日</td><td>開発班ワークショップ（第 1 回）</td><td>Ohaingu 村</td><td>13 名（9 農家）</td><td>ファームスケッチ法により、新農法に対する農家の認識を把握した。</td></tr>
<tr><td>2</td><td>2012 年 9 月 6 日</td><td>開発班ワークショップ（第 2 回）</td><td>Onamundindi 村</td><td>27 名（20 農家）</td><td>ファームスケッチ法により、新農法に対する農家の認識を把握した。</td></tr>
<tr><td>3</td><td>2012 年 12 月 12 日</td><td>開発班ワークショップ（第 3 回）</td><td>Onamundindi 村</td><td>18 名（9 農家）</td><td>ベースライン調査に向けた調査手法の確認と調査内容に関する農家との打合せを行った。</td></tr>
</table>
</td>
<td>計画どおり</td>
<td>定期的に農民参加型ワークショップを開催する。</td>
</tr>
</table>

4	2013年 3月5日	開発班ワークショップ（第4回）	ナミビア大学オゴンゴ校	30名 （22農家）	ファームスケッチ法により、新農法に対する農家の認識を把握した。
5	2013年 3月9日	開発班ワークショップ（第5回）	ナミビア大学オゴンゴ校	31名 （22農家）	ファームスケッチ法により、新農法に対する農家の認識を把握した。
6	2013年 3月14日	開発班ワークショップ（第6回）	Omagalanga村	17名 （8農家）	季節カレンダー、ランキング手法により、新農法に対する農家の認識を把握した。
7	2013年 12月17日	開発班ワークショップ（第7回）	Omagalanga村	24名 （23農家）	農家に向けて混作の意義や方法を説明。
8	2013年 12月18日	開発班ワークショップ（第8回）	Afoti村	41名 （40農家）	農家に向けて混作の意義や方法を説明。

２－３　成果（アウトプット）の達成状況

２－３－１　成果 1：【作物学領域】　洪水-干ばつに対応し、かつ節水型である稲-ヒエ混作栽培モデルが提案される。

洪水-干ばつに対応し、かつ節水型である農法の技術開発に関する研究活動は、着実に進捗しており、また、各種の論文発表・学会/シンポジウム発表が行われている。今後、稲-トウジンビエ、稲-ソルガム、稲-カウピーの組み合わせによる複数の混作農法が開発されることが期待される。

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（X 回）

1 つの論文が国際誌に掲載され、もう 1 つの論文が日本国内の学会誌に掲載予定である（計 2 件）。この他に、2 つの論文と 26 件の学会/シンポジウムでの発表がある。論文や学会発表についての詳細情報は、付属資料.1 の Annex 10 を参照のこと。

指標 1-2：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

水利用効率の高い節水栽培技術については、稲とトウジンビエの接触混植方法が候補の 1 つとなる可能性がある。この農法を用いると、トウジンビエ栽培における湛水被害を緩和できる可能性がある。技術開発される農法の候補として、下記のものがある。

・稲とトウジンビエの接触混植方法
・水位変動帯における混作
・畝の上部と畝間における混作
・降雨後の移植（雨期後期における稲の移植、例えば、3 月に移植）
・トウジンビエの湛水耐性系統の選抜

以上のとおり、プロジェクト終了時までに計 5 種類の栽培技術が開発されることが期待される。

２－３－２　成果 2：【開発学領域】　「稲-ヒエ混作農法」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。

農民の態度や意識の変化を理解する手法の開発並びに農民に対する社会経済的インパクトを計測する手法の開発がおおむね計画どおりに進捗し、学会/シンポジウムで各種の発表が行われている。

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

プロジェクト活動に参加している農家が居住する村において、ベースライン調査と定性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・情報の整理が行われ、関連する論文の作成が進められている。モニタリング調査が継続的に実施され、更に論文作成が進められる予定である。

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（X 回）

UNAM 研究者 1 名が、2014 年 9 月 8 日～9 日にかけて実施された国際シンポジウムにおいて、稲-トウジンビエ混作農法の適用に向けての農民の意識、特にコメの圃場レベルでの適用についての発表が行われた。

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（X 回）

プロジェクト開始から現在まで、混作農法の景観生態学的評価方法に関する発表が 2 件行われた。このほか、開発学領域のチームメンバーが行った国際シンポジウムあるいは国内シンポジウムでの発表が 10 件ある。これら発表に関する詳細情報については、付属資料.1 の Annex 11 を参照のこと。

２－３－３　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。

混作栽培可能面積を推定するための各種データが収集され、面積を推定する手法が開発された。さらに、各種の論文作成、学会/シンポジウムでの発表が行われた。小湿地の貯水量変動を分析する手法が開発された。

指標 3-1：表流水貯留量変動、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）
2）29 カ所の雨量計設置地点の雨量
3）UNAM オゴンゴ校内の傾斜圃場の蒸発散量データ
4）地下水位モニタリング機器を得られたデータから計算した浸透量データ（実証農家の圃場、計 9 地点）

（なお、土壌の特性調査は今後実施予定）

上記のデータのモニタリング及び収集、そしてデータ分析については、継続的に実施される。

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（X 回）

プロジェクト開始から現在まで、国際誌に 2 つの論文が掲載された。国際シンポジウムあるいは国内シンポジウムでの発表が 8 件ある。これら発表に関する詳細情報については、付属資料．1 の Annex 12 を参照のこと。

２－３－４　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取りまとめられる。

作物学領域、開発学領域、水文学領域の研究活動が進捗し、研究結果はナミビア側 C/P、日本人専門家、普及員、農家等と共有されている。今後、3 領域の研究成果の統合が行われる予定である。

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取りまとめ

フィールド・デーやワークショップ開催の際に普及員や農家に対して混作農法についての説明が行われている。ハンドアウト（配付資料）としては、2013 年 3 月に実施された農家向けフィールド・デーにおいて、リーフレットが配付された。リーフレットの主な内容は、稲作における種子選別から移植までの手順と収穫から収穫後処理（脱穀、選別、乾燥、精米、保管）までの手順である。2014 年 3 月に実施された農家向けフィールド・デーでは、前年作成のリーフ

レットに若干の改善を施した改訂版の技術リーフレットが配付された（リーフレットの名称は、“Rice Cultivation, Harvesting & Post-harvest Techniques”〔英文版とローカル言語版（Oshiwambo）がある〕。このリーフレットのコピーを付属資料．1 の Annex 14 として添付した。混作栽培モデルについての研究が進められている最中であり、混作栽培モデルに関する資料作成は、今後になる予定であり、2015 年の 3 月に予定されている次回のフィールド・デーでは、混作農法についてのリーフレットが配付される見込みである）。

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

表－３に示すように、これまでに 3 回のフィールド・デーが開催され、プロジェクトの目的や成果の説明が実施された。農家や農業副大臣、市長等幅広い層からの参加があり、延べ 1,000 人以上が参加した（うち、2 回は、農家向けで、1 回は、小・中・高校生向けの稲栽培方法に関する説明）。

表－３　フィールド・デーの開催

年月日	場　所	参加人数	概　要
2013 年 3 月 12 日	ナミビア大学 オゴンゴ校	462 名	プロジェクトの目的などを説明した後、新しい農法を検討している実験圃場が農家に公開され、議論も行われた。また、日本から輸送した農業機械を用いたデモストレーションが実施された。
2014 年 3 月 12 日	ナミビア大学 オゴンゴ校	529 名	農家向けのプロジェクト成果、混作方法の説明。
2014 年 4 月 29 日	ナミビア大学 オゴンゴ校	143 名	現地の小・中・高校生を対象に、稲の収穫実習、稲の栽培方法に関する講義が実施された。
計		1,134 名	

２－４　プロジェクト目標の達成見込み

【半乾燥地の水資源を持続的に保全し得る「洪水-干ばつ対応農法」が開発される。】

各種の研究活動が順調に進展しており、研究成果も着実にプロジェクト目標達成に向けて集積されつつある。なお、プロジェクト目標達成においては、「洪水-干ばつ対応農法」に関するガイドラインの概要を準備することが重要である。ガイドラインの概要案が作成された後に、プロジェクト目標が達成可能かどうか判断することが可能となると考える。重要かつ独特な研究成果を産出しつつあることを考慮すると、プロジェクト目標を十分満足できる水準で達成することが期待される。

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。

3 つの領域（作物学、開発学、水文学）における各種研究活動が進められており、これら 3 領域の研究成果を統合した水資源を持続的に保全し得る「洪水-干ばつ対応農法」のモデルが、プロジェクト 5 年目（最終年）に開発されることが期待される。ガイドラインの関連では、これまでのところ、「稲作、収穫、収穫後処理に関する技術」のマニュアル（案）が英語及びローカル言語（Oshiwambo）で作成されている（2014 年 3 月改訂版）。

洪水-干ばつ対応農法ガイドラインの概要（目的、利用対象者、内容等）については、まだナミビア側 C/P と日本人専門家間での議論が開始されていない。

２－５　実施プロセス

２－５－１　促進要因

(1) MAWF の普及員はプロジェクト活動に参加し、特に、農家への稲の苗供給や生産状況のモニタリングを含む稲-トウジンビエ混作農法技術の普及において重要な役割を担っている。このような MAWF との協働は、農家圃場レベルの活動を円滑に進めるうえで必要でありかつ有効である。

(2) 多くの農家が、稲-トウジンビエ混作農法を農家圃場に導入してみようという意思を有していること。

２－５－２　阻害要因

(1) ナミビア側 C/P の一部にプロジェクト活動に積極的に参加しない者がいること。このような状況は、計画した活動を実施するうえで、また、チームワークを構築するうえで障害となる可能性がある。

(2) ナミビア側 C/P のなかには、収集したデータや研究成果を使って、論文を作成するのかどうか不明確であるため、プロジェクト活動を実施するモチベーションを強くもてない者がいる。

第３章　レビュー結果

３－１　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) ナミビアの北中部地域に季節湿地における作物生産増加のニーズとの整合性

ナミビアの農業部門は、GDP の 8.8%（2010 年推定）を占め、北部における自給的農業生産と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・食料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頻繁に起こる一方で、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。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し、食料確保に貢献することは、ナミビア北中部地域の農家の基本的なニーズに応えるものである。

(2) ナミビアの国家政策との整合性

ナミビア政府の政策の 1 つである“Vision 2030”では、長期展望の 1 つとして「世帯レベル・国家レベルでの食料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 年～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、グリーン・スキーム政策の拡大実施や耐干性作物の開発が重点戦略に含まれている。なお、グリーン・スキーム政策の実施戦略には、農地と水資源の効率的利用の促進と農作物の多様化が含まれている。したがって、これら政府政策の重点事項と本プロジェクトの目的との整合性は高い。

(3) わが国の対ナミビア援助方針との整合性

わが国の対ナミビア援助方針には、2 つの重点分野があり、その 1 つが「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、気候変動対応型の農業開発プログラムのなかに位置づけられている。したがって、本プロジェクトは、日本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得る「洪水-干ばつ対応農法」の開発をめざしている。具体的には、

1）洪水-干ばつに対応し、かつ節水型である稲-ヒエ混作栽培モデルの提案
2）稲-ヒエ混作農法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の確立
3）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の推定
4）これら研究の統合によるプロジェクトが提案する農法の提案

をめざしている。

このプロジェクトアプローチは、対象地域の自然環境、水資源、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ると考える。

(5) わが国がもつ技術的優位性

わが国には、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、水文解析等においても技術を有する。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として、ナミビアからの研修員受入やナミビアへの専門家派遣の実績がある。このように、日本は、稲作導入等の分野において技術的優位性があるとともに、日本側研究者が、ナミビアの半乾燥地農業に関する知見を有していることから、本共同研究を通じてナミビアの研究者等へ技術移転・能力強化を図る意義は非常に大きいといえる。

３－２　有効性

既に述べたように、各種研究活動が順調に進捗し、プロジェクト目標の達成に向けて、研究成果が着実に積み上げられている。プロジェクト終了時までにプロジェクト目標がおおむね達成できると期待されているものの、現時点では、プロジェクト目標が達成するかどうか正確に述べることは難しい。3 つの領域（作物学、開発学、水文学）の研究結果がうまく統合されたときに、本プロジェクトの有効性が高いと評価することが可能となる。

３－３　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、おおむね高いと判断する。

３－３－１　日本側の投入の適切さについて

近畿大学、名古屋大学、龍谷大学、滋賀県立大学等の日本人専門家（研究者）がナミビアを短期間（多くの場合、10～20 日間）、定期的に訪問し、また、業務調整専門家が長期専門家として滞在している。日本人専門家の派遣は、その人数、専門分野、研究能力等においておおむね適切である。ただし、ナミビア側 C/P が通常業務で多忙な時期に、日本人専門家がナミビアを訪問するケースがあるとの指摘があった。

日本側は、研究活動のために各種の資機材を供与し、それら資機材は、プロジェクト活動のために有効に利用されている。なお、農家圃場における作物栽培面積や作物収量をモニタリングするためには、さらに面積測定機器や重量計が必要であるとの意見がみられた。

本邦研修については、多くの場合、ナミビア側研究者や MAWF 普及員の能力強化に有効であったといえる。特に研修に参加した普及員は、稲作技術について学べただけでなく、農家と

の効果的コミュニケーション手法に学べたことが役立っていると述べている。一方、ナミビア側 C/P からは、本邦研修には実践的研修が十分には含まれてなかったとの指摘があった。

３－３－２　ナミビア側投入の適切さについて

投入の項で述べたように、現時点で 15 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・マネジャーを含めると 17 名）。これまでに、1 名の C/P（作物学領域）が海外留学のために C/P から外れ、また、もう 1 名が近々、海外留学する。プロジェクト開始当初の C/P の人数が 9 名であったことと比較すると、C/P 数は増加している。領域ごとの C/P 数は、作物学チームが 7 名、開発学チームが 6 名、水文学チームが 2 名である。人数的には、C/P 数は適切であろうと思われるが、開発学チームの C/P のなかには、プロジェクト活動への参加度が低い者がいる。

UNAM は、研究活動のために、作物栽培圃場、温室、研究室・実験室、倉庫、事務スペース等を提供しており、これら施設は、研究活動のために有効に利用されている。

UNAM による資金面での貢献としては、プロジェクト活動に必要な経費の支出に努力しているものの、本プロジェクトに対する予算支出は減少傾向にある。そのため、ナミビア側 C/P がフィールド調査に出かける際に必要な経費である日当や交通費が十分には出ないという状況を招いている。このような予算的制約があることが、フィールド調査を効果的に実施するうえでの障害となっている。

３－３－３　プロジェクトマネジメント

既に述べたように、プロジェクト活動の効果的実施を確保するために、合同調整委員会（Joint Coordination Committee：JCC）やマネジメント・コミッティ（Management Committee：MC）が定期的に実施されている。JCC は、プロジェクト活動の進捗をレビューし、次期の活動計画を承認し、プロジェクト実施上の課題について議論する、という機能を適切に果たしていると思われる。JCC には、UNAM、MAWF、教育省、JICA 及び日本人専門家が合わせて 20～30 名出席している。MC では、特定のプロジェクト活動に関する課題についての議論や詳細な活動内容を決めることなどが行われている。本プロジェクトの活動を円滑に実施するうえで、MC はよく機能していると思われる。

３－４　インパクト

上位目標が将来達成するかどうかを現時点で予想することは困難である。将来発現し得るプラスのインパクトとし、以下のものが挙げられる。

３－４－１　上位目標の達成見込み（将来）

【1.「洪水-干ばつ対応農法」が、ナミビア北中部地域において普及し、現地農家の食料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、ナミビア北東部地域の多雨地帯や近隣諸国でも検討される。】

中間レビュー時点では、上位目標が将来、どの水準で達成可能かを判断するには時期尚早である。

指標 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

既に述べたように、フィールド・デーにおいて、プロジェクトの目的や成果の説明が行われた。これまでに 3 回フィールド・デーが実施され、農家や農業副大臣、市長等幅広い層からの参加があり、延べ 1,000 人以上が参加した。プロジェクト終了後、本プロジェクトで開発しようとしている「洪水-干ばつ対応農法」をナミビア北中部地域の農家に広く普及するために、フィールド・デーを定期的に開催するためには、以下の点が重要である。

1）UNAM 研究者と MAWF 普及員との連携継続

2）「洪水-干ばつ対応農法」に関する普及員向け研修事業の実施

3）フィールド・デーやデモ圃場といった普及活動のために必要な予算の確保

指標 1-2：「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

本プロジェクトの活動の一環として、2014 年 9 月 8 日～9 日にナミビアの首都 Windhoek で開催された国際シンポジウム「アフリカ南部諸国の季節湿地の農業利用（Agricultural Use of Seasonal Wetlands in Southern African Countries）」において、近隣諸国（ザンビアやボツワナ）から 2 名の発表者が参加した。本プロジェクトのチームメンバーは、これら近隣国からの参加者との関係を築いたことは、将来、類似の地域研究会合を開催する第一歩といえる。このような人間的関係を活用し、また、地域会議を開催するための資金源をさがすことを通じて、将来、類似の研究学会/シンポジウムが定期的に開催されることが期待される。

３－４－２　その他、発現可能性があるインパクト

（1）稲作に関心をもつ農家の増加

本プロジェクトにかかわっている普及員や農家の話によると、稲作に関心をもつ農家数が増えている。稲作を行う農家が増加し、農家が稲作技術を徐々に習得すれば、稲作の基礎技術を身につけているので、研究成果（稲-トウジンビエ混作農法）を普及することが容易になる。

（2）普及員の能力強化

普及員の本邦研修に続いて、普及員が習得した稲作技術並びに混作農法の技術を農家に移転することが期待される。

３－５　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

既に述べたように、ナミビア政府は、食料安全保障、収入増加、農作物の多様化を重視しており、本プロジェクトの政策面での持続性は確保されるものと思われる。

（2）組織面

FANR は、UNAM にある 8 学部の 1 つであり、能力を有する教授や講師がいる。FANR は複数のキャンパスをもつが、その 1 つがナミビア北中部に所在するオゴンゴ校であり、ここで主なプロジェクト活動が実施されている。FANR は、ナミビアにおいて、コミュニティ農業及び商業的農業に対し、教育・研究・普及を通じて、持続的農業及び天然資源の開発・管理を促進するという明確な使命を有している。本プロジェクトは、半乾燥地の水環境を持続的に保全可能な「洪水-干ばつ対応農法」の開発を行うことを目的としており、この目的は、UNAM の使命と整合性がある。さらに UNAM は、このような種類の研究活動を実施するに必要な組織体制も有する。

（3）技術面

UNAM の FANR 内の 3 つの学科の講師や技術者がナミビア側 C/P となっている。さらに、MAWF の普及員や研究者も本プロジェクトの活動に協力している。表－4 に 3 学科の教員数と本プロジェクトの C/P 数を示す。

表－4　3 学科の教員数と本プロジェクトの C/P 数

学　科	教員数	技術者数	本プロジェクトの C/P の人数（現在）
作物学	教授：　2 名 上級講師：1 名 講師：　13 名	テクニシャン：1 名	講師：　5 名 圃場監督：　1 名 Institutional Worker：1 名
農業経済及び普及	教授：　1 名 講師：　11 名	なし	講師：　6 名
総合的環境学	上級講師：1 名 講師：　8 名	テクニシャン：1 名	講師：　2 名
計	教授：　3 名 上級講師：2 名 講師：　32 名	テクニシャン：2 名	講師：　13 名 圃場監督：　1 名 Institutional Worker：1 名

UNAM の講師や技術者が継続的に勤務する可能性は高いと期待され、プロジェクトの残り期間においては、更にナミビア側 C/P の研究にかかわる知識やスキルが強化され、プロジェクト終了後においても強化された能力は、研究活動や教育活動に活用されるものと思われる。約 20 名の普及員が、各種の研修を受講するとともに、農家に対する稲作技術及び混作農法の普及活動に参画している。「洪水-干ばつ対応農法」が開発された後（主としてプロジェクト終了後）には、普及員の更なる能力強化と開発された農法を農家に普及するための展示圃場活動が必要になるであろう。

３－６　結論

合同中間レビューチームは、おおむねプロジェクト活動が良好かつ着実に進捗していることを確認した。また、プロジェクト活動の結果として、稲-トウジンビエ混作農法、農家の態度や認識

の変化を理解する手法、農家への社会経済的インパクト計測手法、水収支・水資源分析に関する科学的知見・情報がおおむね計画どおり産出されつつあることも確認された。5 項目評価の要約は、表－５に示すとおりである。

表－５　5 項目評価の要約

項　目	評　価
妥当性	高い。
有効性	高くなると期待される。
効率性	おおむね高い。
インパクト	---（評価するには時期尚早）
持続性	おおむね高くなる見込み。

第４章　提言

４－１　プロジェクトに対する提言

(1) プロジェクトチーム全体として目標達成のため、課題を共有しながら研究する

本プロジェクトは、3 つの学問領域、すなわち作物学領域、開発学領域及び水文学領域からなる。それぞれの学問領域について各研究チームがプロジェクト活動・共同研究を実施していることから、各チーム並びに 3 つのチーム全体がプロジェクト目標を再確認し、達成に向けて協調しながら活動を実施していくことが重要である。そのために以下の点を実施することを提案する。

1) より具体的な年間活動計画の作成と JCC における協議及び承認

約半期に 1 度開催される JCC において、活動細目ごとの進捗状況の確認や年間活動計画・研究計画が協議、承認されている。更にプロジェクト関係者での理解を深めるために、PO 表を活用したより具体的な年間活動表（主担当者やタイムスケジュール明記）を作成し、JCC で協議、承認される必要がある。そのうえで、次回の JCC において実際の活動実績及び進捗と年間活動計画を比較した資料を用いて報告する。この過程でプロジェクトチーム全体として計画された活動がどこまで実施され、残りのプロジェクト期間にどのような活動を実施すべきであるのかを確認する必要がある。

2) チーム内での連携強化

各チームは複数の日本側研究者とナミビア側 C/P から構成されており、お互いが離れて活動を行う場合も多く、プロジェクトにおいて E メールを中心とした日常のコミュニケーションが特に重要である。例えば、タイムリーで円滑なコミュニケーションを確保するために、チーム内で CC 等の形で情報をシェアする担当者を設定するような仕組みが望まれる。

また、研究チーム内での更なる連携強化を図るために、研究とは自発的参加によるものであるという概念を再確認する必要がある。

(2) プロジェクト目標及び成果具現化に向けた議論を進める

プロジェクト開始から約 2 年半が経過し、2 度の大干ばつにもかかわらず着実な進捗を見せている。現在の進捗を踏まえ、残りの期間でプロジェクト目標及び成果を具現化するために、各チームがこれを相互に理解する必要がある。そのために具体的に以下の点を実施することを提案する。

1) ガイドラインの具現化

プロジェクト目標の指標として“Guideline for‘Flood- and drought- adaptive cropping systems’is compiled”が設定されている。残り約 2 年半の活動目的を明確にするためにも、早急にプロジェクトチーム内で議論を行い、ガイドラインの概要（目的、対象者、構成、執筆担当者等）及び作成スケジュール等に関する案を作成し、JCC で協議しつつ、プロジェクト終了まで内容の充実を図るべきである。

2) 計画的な論文作成

本プロジェクトはナミビアの持続的農業技術の開発をめざした国際共同研究であると

同時に研究人材の能力開発も目的としている。限られたプロジェクト期間のなかで、論文作成は研究成果の発表という点にとどまらず、ナミビア側 C/P の研究能力強化という点においても期待されている。ナミビア C/P のプロジェクトへの積極的な参加を促すためにも、日本側研究者とナミビア C/P で論文の内容、執筆担当者（共著者を含む）及び作成スケジュールについて双方で協議し、計画案を作成するべきである。また、論文作成に際しては、能力強化の観点から、双方の研究者が協働で作成にあたり、相互に必要な支援を行うことが重要である。

４－２　ナミビア側に対する提言

（1）プロジェクトに対する UNAM 側予算措置

UNAM 側の本プロジェクト活動経費に対する予算確保努力について歓迎する。しかしながら、プロジェクト活動に対する予算額はプロジェクト開始から年々減少している。本プロジェクトではキャンパス外におけるフィールド調査も重要な活動であるが、ナミビア C/P への旅費・手当等の支給が十分ではない現状において学外の調査の一部が実施できないなど、活動に遅れを生じるケースがある。UNAM 側においては、今後のプロジェクト活動を円滑に実施するためより一層の適切な予算措置がとられることを期待している。

（2）MAWF との協力関係の継続

本プロジェクトでめざしている農法を普及するためには MAWF との連携が重要となってくる。現在、プロジェクトのなかで稲作技術の研修、普及を中心に MAWF と良好な連携、協力がなされている。これまで構築してきた協働体制を引き続き維持しつつ、必要に応じて普及のための連携強化が望まれる。

付　属　資　料

１．ミニッツ及び合同中間レビュー報告書（英文）

２．主要面談者リスト

３．PDM Version 1（和文）

４．PDM Version 2 改定案（和文版）

MINUTES OF MEETING
ON
THE MID-TERM REVIEW
ON
JAPANESE TECHNICAL COOPERATION (SATREPS)
ON
THE PROJECT FOR FLOOD- AND DROUGHT-ADAPTIVE CROPPING SYSTEM 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 Mid-term Review Team from August 25 to September 11, 2014 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 Mid-term Review Report (hereinafter referred to as "the Report") attached and presented it to the Meeting that persons concerned with the Project participate in and which is held on September 11, 2014.

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

Windhoek, September 11, 2014

Mr. Jiro TAKEICHI
Leader of the Japanese Mid-Term Review Team
Japan International Cooperation Agency (JICA)
Japan

Mr. Alfred Adriann van Kent
Deputy Permanent Secretary,
Ministry of Education
Republic of Namibia

For witness

Dr.Morio Iijima
Professor,
Faculty of Agriculture,
Kinki University

For witness

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

Attachment

Main points of discussions based on the Report at the Meeting are as follows.

I. Acceptance of the Report

After the intensive discussion, persons participated in the Meeting accepted the Report and agreed to take necessary actions to each recommendation. Recommendations in the Report are following;

Recommended Actions to be taken by the Project Teams (Namibian counterparts and Japanese experts) in the Remaining Cooperation Period

(1) Mutually share challenges with all members of the Project Teams to achieve the Project overall objectives.

The Project has three (3) Research Themes which are Crop Science, Development Studies and Hydrology. Each Research Team (comprising of Namibian and Japanese counterparts) is involved in the project activities and collaborative researches. It is important not only to recognize the Project Purpose but also to collaboratively implement all project activities to the goal within each Research Theme as well as the whole of the Project Teams.

The Joint Review Team is therefore making the following recommendations to address the observed challenges in the first two and half years of the Project:

1) Establishment of the more concrete annual activity plan, Discussion and Approval by JCC

Confirmation of annual activity/research plan and the progress of planned activities to be discussed in JCC half-yearly meeting. In order to further understand among the project team members, it is necessary to be established the concrete annual activity plan/sheet which will include name of person in charge and timeline with amended PO grid, discussed and approved it by JCC. Through this process, the project team members is expected to understand the achievement degree of not only annual activities but also the whole plan and recognized what the Project will be supposed to do in the rest of the project period.

2) Enhance the linkage among Research Team Members

There are Japanese researchers (Experts) and Namibian Counterparts in each Research Team and in some case, Research Team members are physically separated so that the communication in daily basis is the key factor for the Project. Each Research Team should nominate a person who is to monitor timely and smooth mutual communication as Cc within the Research Team.

In order to strengthen the tight linkage among members in each Research Team, all project team members should voluntarily participate in planned research activities. Participant in the research should be chosen from researchers who have strong commitment to the Project.

(2) Advancement of discussion to embody the Project Purpose and Outputs

Approximately two and a half years have passed since the project commenced. Although the Project has undergone two (2) severe droughts for the past cropping season, steady activities and progress have been made. With taking the progress into consideration and to embody the Project Purpose and Outputs in the

remaining of the project period, there are needs to develop mutual understanding in each Research Team and the whole of the project team members.

Thus, the Project Team is recommended to refer to the suggested requirements as follows:

1) The embodied Guideline
[Guideline for "Flood- and drought- adaptive cropping systems" is compiled] has been established as the indicator of the Project Purpose. In order to further define the purpose of each activity in the rest of the project period, it is necessary to discuss the contents of the guideline (purpose, target, contents and persons in charge of writing etc.) and time schedule for producing the guideline.

2) Implementation of intentional publication
The aim of the Project is expected not only international joint research for development of sustainable agricultural techniques in Namibia but also capacity development of researchers and technicians in both Japan and Namibia. The project period is limited in 5 years, but the publication is regarded as the important aspects for the presentation of the project outcomes as well as improvement of research ability for Namibian counterparts. In order to initiate further engagement with Namibian counterparts, it is essential to prepare a plan and schedule for publications. Also it is important to include all contributors to peer-reviewed publications. In addition, to enhance capacity development, there are needs to write peer-reviewed publications collaboratively and execute mutual assistance among both sides.

(3) PDM Revision
Several quantitative indicators of PDM version 1 (for example, presentations at academic conference/seminar) have not been decided with specific target numbers. It is necessary to decide target numbers through discussions among the project team members and to approve revised PDM at the next JCC meeting. The Joint Review Team propose to add number of publications submitted to peer-reviewed journals as new indicator for Output 1, 2 and 3. Proposed modification of PDM is attached as Annex 15.

Recommended Actions to be taken by the Namibian Authorities Concerned
(1) Budget allocation to the project by UNAM
We appreciate all the efforts done by UNAM to allocate necessary budget to the Project. However, the amount of secured budget for the project activities has been decreasing yearly basis. Especially insufficient payment of lunch allowance to Namibian counterparts due to budget shortage leads to delays and cancellation of crucial activities such as field investigation. To implement these activities smoother in latter part of the project period, we recommend that UNAM should commit itself to provide adequate funds towards local field activities such as per diem and transportation for data collection and field works agreed in the Record of Discussions.

(2) Collaboration with MAWF
The collaboration between UNAM and MAWF is crucial to extend the cropping system that will be developed by the Project. The Project has established positive relationship with MAWF mainly in training and extension of rice cultivation techniques. We expect that the Project keeps good relation with MAWF

and deepens partnership with them as the progress of the Project for effective extension of the cropping system for benefit of Namibia.

Attachment 1: List of persons participated in the Meeting
Attachment 2: Joint Mid-term Review Report

Attachment1: List of persons participated in the Meeting

No	Name	Position
1	Prof. Osmund D. Mwandemele	Pro-Vice Chancellor, Academic Affairs and Research, UNAM
2	Mr. Alfred A van Kent	Deputy Permanent Secretary, Ministry of Education
3	Dr. Joseph T. Njunge	Deputy Dean, Ogongo Campus, UNAM
4	Mr. Petrus A. Ausiku	Lecturer, Department of Crop Science, UNAM
5	Mr. Simon Awala	Lecturer, Department of Crop Science, UNAM
6	Ms. Martha M. Hangula	Lecturer, Head of Department of Agricultural Economics and Extension, UNAM
7	Dr. Jack Kambatuku	Lecturer, Department of Integrated Environmental Sciences, UNAM
8	Prof. Edosa Omoregie	Director, Sam Nujoma Marine and Costal Resources Research Centre, UNAM
9	Dr. Nelago INDONGO	Director of the Multidisciplinary Research Center (MRC), UNAM
10	Prof. Morio Iijima	Project Leader (Crop Science), Kinki University, Japan
11	Ms. Tomoko Hasegawa	Project Coordinator, UNAM Ogongo
12	Ms. Mari Akiyama	Project Coordinator, UNAM Ogongo
13	Mr. Jiro Takeichi	Leader, The Mid-Term Evaluation Team
14	Mr. Isao Dojun	Evaluation Analysis, The Mid-Term Evaluation Team
15	Mr. Takuya Oiwa	Cooperation and Planning, The Mid-Term Evaluation Team

Attachment 2

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

Windhoek September 11, 2014

JOINT MID-TERM REVIEW TEAM

Mr. Jiro TAKEICHI
Leader
Japanese Mid-term Review Team
Japan International Cooperation Agency

Prof. Edosa OMOREGIE
Leader
Namibian Mid-term Review Team
University of Namibia

Table of Contents

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
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
JST	Japan Science and Technology Agency
MAWF	Ministry of Agriculture, Water and Forestry
MODIS	Moderate Resolution Imaging Spectroradiometer
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
UNAM	The University of Namibia
UNDP	United Nations Development Programme
WDI	World Development Indicator

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 in 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 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 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 a 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 nation 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: the national sanctuary for wild life, unstable flood intensity, etc. However, this vulnerable water environment is at risk of destruction if irrelevant large-scale development plans targeted for the area are all implemented as is.

Therefore, the Government of Namibia has requested a technical cooperation project under the framework of the Science and Technology Research Partnership for Sustainable Development (SATREPS) to the Government of Japan. 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. 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 Mid-term Review

The Namibia and Japanese sides respectively signed the Record of Discussions 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") started for a five year duration since February 2012. Since the Project has now reached to around half the project period, a mid-term review has been conducted jointly by the Namibia and Japanese governments.

1-3 Objectives of the Mid-Term Review

(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 Mid-term Review Report and make necessary recommendations on project activities in the remaining period of the Project to both the Namibia and Japanese sides,

(4) To participate in a meeting in order to present and discuss the results of the Mid-term Review on the Project with the Namibia authorities concerned and sign the Minutes of Meeting.

1-4 Members of the Joint Mid-term Review Team

1-4-1 Japanese Mid-term Review Team

No.	Assignment	Name	Position and Organization
1	Leader	Mr. Jiro TAKEICHI	Director, Planning and Coordination Division, Rural Development Department, Japan International Cooperation Agency (JICA)
2	Cooperation Planning	Mr. Takuya OIWA	Associate Expert, Agricultural and Rural Development Group 2, Rural Development Dept., JICA
3	Science and Technology Evaluation (As observer)	Dr. Makie KOKUBUN	Program Officer, Japan Science and Technology Agency (JST) / Professor, Tohoku University
4	Science and Technology Evaluation (As observer)	Dr. Yoshimi UMEMURA	Assistant Program Officer, JST
5	Evaluation and Analysis	Mr. Isao DOJUN	Consultant, Chuo Kaihatsu Corporation

1-4-2 Namibia Mid-term Review Team

No.	Assignment	Name	Present Occupation
1	Leader	Prof. Edosa OMOREGIE	Director, Sam Nujoma Marine and Coastal Resources Research Centre, the University of Namibia (UNAM)
2	Member	Dr. Nelago INDONGO	Director of the Multidisciplinary Research Center (MRC), UNAM

1-5 Schedule of the Mid-term Review

The Joint Mid-term Review was conducted from August 25 to September 12, 2014. The detailed schedule of the mid-term review is shown in Annex 1.

1-6. Methodology of the Mid-term Review

1-6-1 Evaluation Method

The Project was evaluated jointly by the Namibian and Japanese Mid-term Review teams (the Joint Mid-term Review), based on materials showing the framework of the Project such as PDM, 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,

Japanese experts, and farmers who participated in the project activities. This mid-term review 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 Record of Discussions (R/D) signed on November 23, 2011. The project summary described in PDM version 1 is as described below. (For additional details, see Annex 2).

(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

Output 1: [Crop Science] The rice-pearl millet mixed cropping system, 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-pearl millet mixed cropping system 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-pearl millet mixed cropping system.

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

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

2.1 Survey the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration 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 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).

3.1 Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography map, satellite image and measurement of hydrological conditions.

3.2 Analyze the water budget of 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 at their small wetlands, on the rice-pearl millet mixed cropping system.

4.2 Conduct field trials at farmers who participate in trials on the rice-pearl millet mixed cropping system voluntarily.

4.3 Examine the rice-pearl millet 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 by the Namibian researchers/technicians on the cropping system 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

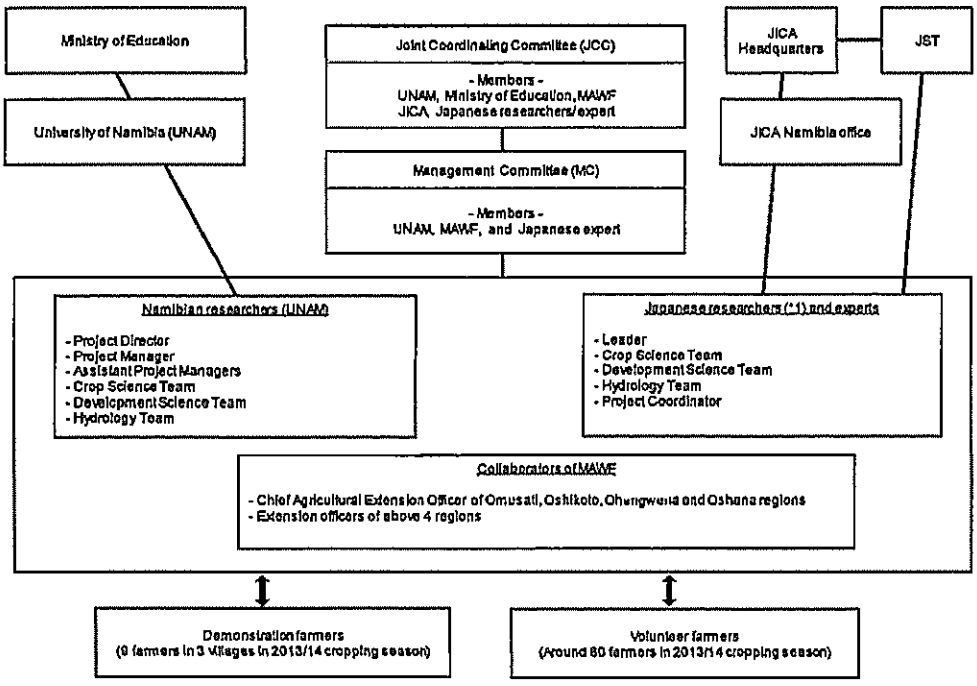
The duration of the Project is 5 years (February 28, 2012 to February 27, 2017)

(8) Counterpart Organizations

The counterpart organizations are Directorate of National Research, Science, Technology and Innovation, Ministry of Education, and the Faculty of Agrieulture and Natural Resources, UNAM.

2-2 Implementation Structure of the Project

The project activities have been conducted mainly by researchers of UNAM and Japanese experts with collaboration by officials and extension officers of MAWF. Pro-Vice Chancellor of Academic Affairs and Research of UNAM is involved in the Project as Project Director and Deputy Dean of Ogongo Campus of UNAM is involved as Project Manager. The following figure shows the conceptual project implementation structure.



(*1): Researchers of Kinki University, Nagoya University, Ryukoku University, University of Shiga Prefecture, and the Research Institute for Humanity and Nature

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

Title of meeting	Frequency of meeting	Main function	Members
JCC (Joint Coordinating Committee)	Twice a year (held 4 times)	· 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 depend in Namibia the necessity, and · To discuss any other issues(s) pertinent to the smooth implementation of the Project.	Project Director, Project Manager, Namibian counterparts and persons concerned of UNAM, representative of the Ministry of Education, Deputy Director of the Division of Agricultural Training (MAWF), Deputy Director of Plant Production Research (MAWF), Chief Agricultural Extension Officer of Omusati Region (MAWF), Agricultural Extension Officer of Caprivi Region (MAWF), Japanese experts, Representative of JICA office
MC (Management Committee)	Periodically (held 7 times)	· 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 give feedback to project team	Project Manager, Campus Manager, Farm administrator, Namibian counterparts of Crop Science, Development Studies and Hydrology teams, Field Supervisor, Chief Agricultural Extension Officer of Omusati Region (MAWF), Chief Researcher (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 expert (project coordinator/ training) and 12 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 dispatch of Japanese experts is shown in Annex 4.

(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 Ministry of Agriculture, Water & Forestry (MAWF) participated in these trainings. Two researchers of UNAM are studying at post-graduate course level of the Kinki University. Eleven researchers of UNAM participated in short-term research programs mainly at Kinki University. The detailed information on trainings in Japan is shown in Annex 5.

(3) Provision of Equipment and Materials

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 materials is US$567,000 dollars. The detailed list of equipment and materials is shown in Annex 6.

(4) Local Operational Cost Borne by Japanese Side

Local cost borne by the Japanese side for the implementation of the Project is around 5.9 million NAD (Namibian dollars; around US$560,000 dollars) as of July 2014. This includes the expenses for travel expenses, meeting cost and other general expenditures for project activities. The detailed breakdown of expenditures is shown in Annex 7.

3-1-2 Namibian Side

(1) Namibian Counterparts Involved in Project Activities

At the time of the mid-term review, a total of seventeen (17) counterparts including the Project Director, Project Manager, and Assistant Project Managers are involved in project activities. All 17 counterparts are researchers of UNAM. The detailed list of counterparts is provided in Annex 8.

(2) Project Operation Cost Borne by the Namibia Side

UNAM has borne operational expenses for travel allowances for Namibian researchers and inland transportation cost for equipment as shown in the following table. The total amount of expenses disbursed is cost 781,869.15 NAD as of December 2013 (equivalent to US$73,765 dollar approximately).

Description	Apr. 2012 - Dec. 2012	Jan. 2013 - Dec. 2013	Jan. 2014 – Dec. 2014	Total (Unit: NAD)
Travel Allowance (within/outside Namibia)	341,949.15	239,920.00	200,000	781,869.15
Transport cost for equipment from Walvis Bay to Ogongo				

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

UNAM is providing various facilities for the Project activities such as office spaces, laboratories, green house, crop experiment field and store rooms. The detailed information is shown in Annex 9.

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 mid-term review based on information provided by the project team members (Japanese experts and Namibian counterparts).

Table: Progress and Main Achievements of the Planned Activities

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 system.	Various cultivation experiments (planting density and others) on rice and pearl millet mixed cropping system have been carried out at the sloped experimental field (20 m x 20 meter), which has both wetland and upland environments at the University of Shiga Prefecture, Japan. At the Ogongo Campus of UNAM, experiments on rice and pearl millet mixed cropping systems such as productivity, moisture physiology, sowing period, and moisture resistance, etc., have been conducted on the sloped experimental field (160 m x 80 meter). At the same campus, experiments on cultivation techniques, fertilization, adaptability against flood and drought, etc., have been conducted. In addition, cultivation experiments for establishing model mixed cropping systems have been carried out at the 9 demonstration farms (farmer's fields).	As planned	Various cultivation experiments will be carried out continuously as planned. Examination of a methodology to assess deep water use efficiency will be carried out continuously at the field. Results of pot experiments will be compiled by March 2015.
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, Kinki University. Crop water physiological experiments and water source analysis experiments have been completed. As results of the experiments on rice and pearl millet mixed cropping (planting at same plot), the findings are that groundwater dependency rate becomes higher and water use efficiency is improved, Basic examinations for developing measuring techniques on water use efficiency for rice and pearl millet mixed cropping system were completed and field experiments are to continue. (Results of field experiments will be summarized in the 5th year of the Project (final year). As a result of pot experiments, it was learned that for rice planted fields water dependency becomes dominant in the upper part of soil, while for non-planted rice fields, water dependency becomes dominant in the lower part of soil.	As planned	The results of water relation on mixed plants under drought and waterlogging conditions will be compiled by March 2015. The results of other experiments will be compiled by the end of the project period (Feb. 2017).
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 Asian rice; African rice and New Rice for Africa (NERICA) were carried out. Basic findings on pearl millet cultivation techniques showed that moisture tolerance becomes high. Soil samples were collected from seasonal river sides in Namibia for examining soil fertility of seasonal wetlands (around 50 samples were collected). Examination on the degree of dependence on nitrogen derived from organic matter was carried out to understand the measures for sustaining soil fertility. Investigation on measures for sustaining soil fertility is underway in collaboration with Japanese volunteers (JICA) who were dispatched to the Ogongo Campus UNAM. Since 2014, basic experiments for incorporating cowpea in rice and pearl millet mixed cropping system has been started (cowpea is a leguminous and drought tolerant crop, and locally available).	As planned	Results of the following activities will be compiled by March 2016. 1) Accumulation of findings on environmental stress responses of the rice-pearl millet mixed cropping through pot experiments on salt accumulation, drought and low nutrition. 2) Examine nitrogen use efficiency derived from organic matter for rice-pearl millet mixed cropping. Results of mid-term review on basic examination of pot experiments will be compiled by March 2015. Results of the following activities will be compiled by the end of the Project. 1) Inspect the amount of cow manure to sustain the soil fertility. 2) Complete the terminal review on field experiments.

Activities		Progress and Main Achievements	Progress	Planned Activities in the Remaining Period
2-1	Survey the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration or voluntary trials (baseline survey).	Interview surveys on field demonstration farmers (4 farmers) and volunteer farmers (who participated in the field days) (including confirmation of intention to conduct mixed cropping) were carried out. After selection of target villages for the baseline survey, discussions on survey methods, implementation of pre-test of the baseline survey, a baseline survey was carried out from February 4 to February 16, 2013 (370 farmers in 4 constituencies). The baseline survey was conducted at the village level where not only the field demonstration and the trial farmers exist but also at the villages where such farmers do not exist. The baseline survey plan was modified to enable the collection of necessary data on the villages where field demonstration farmers exist. An additional survey will be conducted by the end of 2014. Compilation (simple tabulation) of the collected data, which was obtained in 2013, was completed. Preparation of village monographs will be completed by the end of September 2014.	Delay to some extent	Supplementary survey will be carried out continuously for strengthening UNAM's researcher's understanding on survey methods. Comparative survey to the baseline survey will be conducted in final year of the Project.
2-2	Secure informed consent by demonstration farmers prior to project activities and share findings from output 1 and 3 through workshops.	Information on the objectives and the findings from the areas of Crop Science and Hydrology have been explained and shared with the demonstration farmers at the occasions of various workshops, community meetings and field surveys.	As planned	Findings from the project activities are provided and shared with demonstrations farmers at the delivery of rice seedlings.
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.	Monitoring activities have been continuously conducted to grasps the conventional farming methods, understanding about the new mixed cropping techniques its practice by farmers, and changes on farmer's understandings and their practices. In addition, development of various tools (by combining various tools of PRA (Participatory Rural Appraisal) such as farm sketch method, focus group interview, GPS technology, and aerial photographs, etc.), so that the farmers themselves can speak with their understanding of research contents, is underway (by combining farmer's subjective understandings and actual field data). Location information of the 9 demonstration farmers collected using GPS are being processed as GIS data.	As planned	Monitoring activities will be carried out continuously.
2-4	Classify the environment of farmers' fields from the viewpoint of landscape ecology.	A preliminary interview survey on ecological environment of wetlands was conducted on 10 farmlands in the Onamundindi village from January to February 2013 and then, criteria to classify farmer's recognition of wetlands and the natural environment were decided. Criteria to classify small wetlands were also decided. Selections of places for research (18 seasonal wetlands in 3 villages, i.e. Onamundindi, Afoti village, and Oshiteyatemo villages were selected) and target farmers were instructed. A quantitative survey on parameters of landscape (change of water level, precipitation, geographical features, vegetation, and soil) and information collection about farmer's recognition on wetlands and criteria for classification were carried out. Supplementary surveys have been conducted continuously. Basic analysis has been done using collected data. Interim summary on the results of basic analysis was presented at the Symposium held in September 2014 (Windhoek). Evaluation on the mixed cropping systems from the viewpoints of land ecology will be carried out by considering the results of supplementary surveys.	As planned	The obtained data will be compiled and survey is carried out continuously.
2-5	Examine the sustainability of the mixed cropping system from the socio-economic viewpoint by finding out farmers' decision making criteria to	A preliminary survey on household economy and labour distribution was conducted through focus group discussions in September 2012. Surveys on farmer's recognition on crop consumption and marketing were conducted in the framework of the baseline survey. A survey using seasonal calendar and ranking method was conducted at the Omagalanga village (around 20 farmers) and the farmer's recognition of crop consumption and marketing were grasped. In addition, supplemental surveys on the framer's recognition of conventional farming and the situation of trial of mixed cropping were conducted from	As planned	Method for measuring farmer's understanding and change of perception (focusing several trial farmers) will be developed by the end of the Project jointly by researchers of UNAM and Japanese

Activities		Progress and Main Achievements	Progress	Planned Activities in the Remaining Period
	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).	April to May 2014. Surveys on the situation of mixed cropping were conducted on the farmers who received seeds from May to June 2014. Regarding "survey on farmer's decision making criteria to adopt or reject new cropping systems and survey on farmer's change of perception on wetlands" and the "development of method that can survey and analyze change of farmer's understanding and recognition", and surveys using various techniques including PRA tools as core approach, were conducted. Development of survey and analyzing methods is progressing.		researchers. In fifth year of the Project, survey will be carried out by utilizing developed method if possible.
3-1	Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography map, satellite image and measurement of hydrological conditions.	Activities for estimating the change of surface water storage volume in the whole of the seasonal wetlands areas have been carried out in Japan using topographic maps, various satellite images, and hydrological data collected in the Project target area. Then, time-series maps of water areas were produced by matching up the Normalized Difference Polarization Index (NDPI) (which is calculated using microwave image data) and Normalized Difference Water Index (NDWI) (which is calculated using visible and near-infrared image data).	As planned	1) Area of small wetlands will be estimated using data of topographic maps and aerial photographs. 2) Develop estimation method of surface water storage volume in small wetlands by carrying out field topographic surveys.
3-2	Analyze the water budget of seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation)	Twenty-five 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 in order to monitor the rainfall pattern of the entire seasonal wetland area (by late November 2012). Subsequently, rainfall data has been collected continuously. The Bowen ratio measurement systems (3 units) were installed at the sloped experiment field at the Ogongo Campus of UNAM in September 2012 and data has been collected continuously. Seasonal change of evapotranspiration where rice and pearl millet mixed cropping has a different situation was also analyzed. In September 2013, one more Bowen ratio measurement system was installed at a field which has a natural wetland future near the sloped experiment field. The quantitative evaluation on effects of rice and pearl millet mixed cropping system against water balance of seasonal wetland (Ondombe) was also carried out.	As planned	1) Develop spatio-temporal map on rainfall 2) Create time-series data of evapotranspiration at the experimental fields 3) Estimate subsurface percolation volume
3-3	Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields.	Samples of surface water, groundwater and rain water were collected at the north and central parts of the seasonal wetland areas in the 2012/2013 rainy season and stable isotope composition of the collected water samples were analyzed. Three demonstration farmers were selected from each sector (north, central and south) of seasonal wetlands area (9 farmers in total) and groundwater observation wells were installed at the central part of small-area wetlands that the demonstration farmers owned. Monitoring of groundwater level was started in the 2012/2013 rainy season. Analysis of satellite data is being carried out jointly by the Japanese and Namibian researchers in charge and the Namibian researchers are carrying out land-cover classification (GIS analysis). It is expected that the water source of small-area wetlands will be identified after the analysis using stable isotope technique.	As planned	1) Identify water source for small wetlands using stable isotope technique. 2) Create time-series data on water level fluctuation
4-1	Conduct field demonstration with committed and hardworking farmers at their small wetlands, on the	As mentioned above, 9 demonstration farmers were selected before the 2012/2013 rainy season and demonstrative model experiments have been carried out at the farmer's fields. (At the small-area wetlands of the demonstration farmer's fields, mixed cropping model experiments (by the Crop Science Team), the farmer's behavior survey (by the Development Studies Team), and water environmental surveys (by the Hydrology Team) have been conducted.)	As planned	1) Continue planned activities 2) Propose optimum mixed cropping systems by the end of the Project.

<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>rice-pearl millet mixed cropping system.</td><td></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 system voluntarily.</td><td>The number of trial farmers who showed willingness to practice rice cultivation remains in the range between 70 and 80 due to the worst drought in 30 years (in 2012/2013 cropping season) and drought in 2013/2014 cropping season.</td><td>As planned</td><td>Promote introduction of rice cultivation with farmer's initiative by the last year of the project.</td></tr>
<tr><td>4-3</td><td>Examine the rice-pearl millet 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.</td><td>Feedback from Output 2 and 3 to Output 1 is progressing as planned through sharing information at the occasions of JCC meetings in Namibia and meetings which were held twice a year in Japan.</td><td>Feedback is carried out in accordance with progress of project activities.</td><td>Feedback of information will be continued regularly and activity 4-3 will be carried out in fifth year of the Project in full-scale.</td></tr>
<tr><td>4-4</td><td>Carry out participatory research and extension by the Namibian researchers/ technicians on the cropping system through opportunities such as field days.</td><td>Farmer participatory workshops have been conducted 8 times as shown in the following table. Participants to workshops were demonstration farmers, trial farmers, researchers of UNAM and Japanese researchers, etc. The field day was held 3 times, of which, workshops for farmers was held twice.
<table>
<tr><th></th><th>Date</th><th>Title</th><th>Venue</th><th>Participants (farmers)</th><th>Contents</th></tr>
<tr><td>1</td><td>Sep. 5, 2012</td><td>First Workshop by the Development Studies Team</td><td>Ohaingu village</td><td>13 persons (9 farmers)</td><td>Survey on recognition of the farmers on the new farming method (using the farm sketch method)</td></tr>
<tr><td>2</td><td>Sep. 6, 2012</td><td>Second Workshop by the Development Studies Team</td><td>Onamundindi village</td><td>27 persons (20 farmers)</td><td>Ditto</td></tr>
<tr><td>3</td><td>Dec. 12, 2012</td><td>Third Workshop by the Development Studies Team</td><td>Omagalanga village</td><td>18 persons (9 farmers)</td><td>Confirmation about survey method for baseline survey and discussion with farmers about survey contents</td></tr>
<tr><td>4</td><td>Mar. 5, 2013</td><td>Fourth Workshop by the Development</td><td>Ogongo UNAM</td><td>30 persons (22 farmers)</td><td>Survey on recognition of the farmers on the new farming method (using</td></tr>
</table></td><td>As planned</td><td>Farmer participatory workshop will be carried out periodically.</td></tr>
</table>

Activities		Progress and Main Achievements					Progress	Planned Activities in the Remaining Period
				Studies Team			the farm sketch method)		
		5	Mar. 9, 2013	Fifth Workshop by the Development Studies Team	Ogongo UNAM	31 persons (22 farmers)	Ditto		
		6	Mar. 14, 2013	Sixth Workshop by the Development Studies Team	Omagalanga village	17 persons (8 farmers)	Survey on recognition of the farmers on the new farming method (using seasonal calendar and ranking method)		
		7	Dec. 17, 2013	Seventh Workshop by the Development Studies Team	Omagalanga village	24 persons (23 farmers)	Explanation to farmers on the significance and method of mixed cropping		
		8	Dec. 18, 2013	Eighth Workshop by the Development Studies Team	Afoti village	41 persons (40 farmers)	Ditto		

3-3 Achievement of Outputs

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

Research activities for developing techniques to deal with flooding and drought conditions as well as water saving are progressing steadily and various publications and presentations at academic conferences/symposiums have been made. It is expected that several mixed cropping systems are developed; combination of rice and millet, rice and sorghum, rice and cowpea.

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

A paper was published in an international journal and other paper will be published soon in a journal in Japan (2 papers in total). There are 2 more publications and 26 presentations at conferences/symposiums. Detailed information on papers and presentations is shown in Annex 10.

Indicator 1-2): 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.

Planting together "close mixed planting" method of rice and pearl millet is a candidate for water-saving cultivation technique with high water-use efficiency. This cropping method has potential to mitigate flood damage to millet. Currently, additional experiment on this cropping method is being carried out. In addition, the following techniques are also candidate techniques to be developed.

- Mixed cropping in the water fluctuation zone
- Ridge and furrow mixed cropping
- Sequential planting after rain (rice transplanting in late rainy season, for example in March)
- Selection of flood tolerant lines of millet

Five (5) cultivation techniques will be developed by the end of the Project.

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-pearl millet mixed cropping system are established.

Development of methods to understand the change of attitudes and perception by farmers, and socio-economic impacts on farmers are progressing mostly as planed and various presentations at academic conferences/symposiums have been made.

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

A baseline survey and qualitative surveys were carried out at the villages where farmers, who participate in the project activities, live. The collected data and information through these surveys are summarizing and papers are also in preparation. Monitoring surveys will be carried out continuously and more papers will be

made.

Indicator 2-2): Number of presentation on study methods of understanding perception and the socio-economic impacts by researchers of UNAM (X times).

A researcher of UNAM made presentation at International Symposium (8-9 September, 2014) about farmers' perception towards adoption of rice and pearl millet cropping system, especially about adoption of rice at farm level.

Indicator 2-3): Number of report at academic conferences/seminar on the evaluation method for landscape ecology of the cropping system (X times).

From the start of the project up to now, 2 presentations on the evaluation method for landscape ecology of the cropping system were made. There are 10 other presentations (related with researches of the Development Studies area) that were made members of the Development Studies team at international and/or domestic symposiums. Detailed information of the presentations is shown in Annex 11.

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 have been collected and a method for estimating the possible area of mixed-cropping field is developed and various publications and presentations at academic conferences/symposiums have been made. A method for analyzing flood (surface) water volume fluctuation of small wetland is developed.

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

The following kinds of data have been acquired
1) Satellite image data (AMRS-E/ AMSR2, MODIS, and Landsat)
2) Precipitation data of 29 rain gauges
3) Evapotranspiration data at the sloped field in the Ogongo Campus UNAM
4) Percolation data using data of groundwater level monitoring tools (at the fields of 9 demonstration farmers) (Soil property will be surveyed)
Monitoring and collection of above data, and data analysis are being carried out continuously.

Indicator 3-2): Number of presentations at academic conference/seminar in related areas such as the potential cultivation area which does not affect the water environment (X times).

Since the start of the Project up to now, 2 papers was published in the international journal. 8 presentations at international and/or domestic symposiums were made. Detailed information on papers and presentations is shown in Annex 12.

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

Research activities in the respective areas of Crop science, Development Studies and Hydrology are progressing and research results have been shared with Namibian counterparts, Japanese experts, extension officers, and farmers etc. Integration of research results of three areas are carried out hereafter.

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

Method of mixed cropping systems has been explained to extension officers and farmers at the field days and workshops. As for hand-out, leaflet was distributed at the farmer field day that was held in March 2013. Main contents of the leaflet are techniques from seed selection to transplanting, and from rice harvest to post harvest (threshing, selection, drying, milling and storage). There are English and Oshiwambo versions. At the farmer field day in March 2014, a leaflet on "Rice Cultivation, Harvesting & Post-harvest Techniques", which was modified from the previous version, was distributed. This leaflet is attached as Annex 13. Development of rice and pearl millet mix cropping system is progress, therefore, based on the results obtained, preparation of hand-out on mixed cropping system will be started. The hand-out on the mixed cropping system will be distributed at the field day which will be held in next March (in 2015).

Indicator 4-2): Execution of field days by researchers and technicians of UNAM on the mixed cropping system.

As shown in the following table, the objectives of the Project and outcomes of the Project were explained at the field days (3 times). Farmers, Head of Local Governments and Deputy-Minister of MAWF, etc. participated in the field days and participants were more than 1,000 persons in total. (2 field days were carried out for farmers and one of the filed days was held for students of primary and secondary schools.)

Date	Venue	Participants	Contents
March 12, 2013	UNAM'S Ogongo Campus	462	Explanation of the purpose of the Project and the experimental fields in the Ogongo Campus and discussion on the Project. Demonstration by agricultural machinery which were procured from Japan.
March 12, 2014	UNAM'S Ogongo Campus	529	Explanation of results of the Project and method of mixed cropping.
April 29, 2014	UNAM'S Ogongo Campus	143	Practice on rice harvest and explanation on rice cultivation method to students of primary and secondary schools.
Total		1,134	

3-4 Prospects for Achieving the Project Purpose

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

Various research activities have been progressing well and the research results have been steadily accumulated toward achieving the Project Purpose.

It is important to prepare draft outlines of guideline for "Flood- and drought-adaptive cropping systems". After that, it will become possible to prospect achievability of the Project Purpose. Considering the facts

that important and unique research outcomes have been produced, it is expected that the Project Purpose will be achieved at very satisfactory level.

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

Various research activities have been progressing in the areas of "Crop Sciences", "Development Studies", and "Hydrology". It is expected to develop a farming model of mixed cropping system that can conserve the water environment in the fifth year of the Project by integrating research results of three areas. So far, a draft manual on "rice cultivation, harvesting and post-harvest techniques (revised version in March 2014)" has been developed in English and Oshiwambo.

Outlines of the guideline for "Flood- and drought-adaptive cropping systems" (purpose, target users, contents etc.) are not discussed yet among Namibian counterparts and Japanese experts.

3-5 Implementation Process

Factors contributing to and impeding the effective implementation of the project activities are as follow.

(1) Factor contributing to

1) Extension officers of MAWF are involved in the project activities and taking important roles especially for providing rice and mixed cropping techniques including distribution of rice seedlings to farmers and monitoring results of productions. This collaboration is necessary and effective for carrying out farmers' field level activities smoothly.

2) Willingness of local farmers to participate in rice and pearl millet mixed cropping in their fields.

(2) Factors impeding

1) There are some Namibian counterparts who do not actively participate in all project activities. This situation has brought negative effect for implementing planned activities and creating team work.

2) There are some Namibian counterparts who are not very motivated to carry out project activities due to uncertainness about paper writing using collected research data.

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 occupies 8.8% of GDP (estimation in 2010) and it is roughly divided into the subsistence agricultural production in the northern area and the commercial livestock production in the southern area. 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 4 regions (Omusati, Ohangwena, Oshana, and Oshikoto) of Namibia, all of which are located in the northern sector of the country. The northern Namibia, where seasonal wetlands are

formed, is located in the semi-arid zone. Annual rainfall of this area fluctuates widely in recent years and river floods and droughts occur very frequently. Therefore, annual production of pearl millet, which is the traditional crop in this area, is unstable and the degree of fluctuation is large.

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 northern area of Namibia.

(2) Relevance to the national policies of Namibia

One of the visions of "Vision 2030" is to contribute towards food security and an increase income at the household and national levels and also sustain and improve land productivity. One of the strategies of "Vision 2030" 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 agro forestry". One of the priority issues of the economic sector of Namibia's Fourth National Development Plan 2012/13 to 2016/17 is the agricultural sector and the target of the annual growth rate in the agricultural sector during the period of the plan is 4%. Extended implementation of the "Green Scheme" and development of drought-resistant crops are regarded as important in this plan. As an implementation strategy of the Green Scheme Policy, promotion of efficient utilization of agricultural land and water resources and also diversification of agricultural crops are considered important. Therefore, the objective of the project is 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 important issues of the assistance policy of the Government of Japan to Namibia is contributing to poverty reduction and the livelihood improvement of peoples in rural areas. The Government of Japan has the intension to support human resource development that is necessary for effective and efficient agricultural development which the Government of Namibia is tackling for improving the problems of poverty and low income of those living in poverty in the northern area of Namibia. This project is one scheme within the climate change-responsive agricultural development program of the Japanese Government. Therefore, this project is consistent with the assistance policy of Japan.

(4) Appropriateness of the approaches taken by the Project

The main objective of the Project is to develop "flood- and drought-adaptive cropping systems thereby conserving water environments in semi-arid regions" by integrating research results of crop science, development studies and hydrology areas. In particular, the main goals are:

1) to propose a rice and pearl millet mixed cropping system that is adaptable to flooding and drought as well as water-saving,
2) to establish methods to understand the change of farmer's attitudes and perception on the rice and pearl millet mixed cropping system and socio-economic impacts on farmers,
3) to estimate possible area for mixed-cropping based on the water budget/water source analysis, and
4) to propose a cropping system by integrating research results of the Project.

The Project approach is consistently considering the conditions of nature, water resources, and agricultural production in the North-central Namibia and it can be thus said that the Project approach is appropriate.

(5) Comparative advantage of technical cooperation by Japan

Japan has long history and significant experiences on rice cultivation. Japan has accumulated research

results not only in Japan but also in Africa. Japan has also techniques on water-saving cultivation, socio-economic analysis, and hydrological analysis. The Nagoya University and the Kinki University have experiences in introducing rice cultivation in semi-arid regions in Namibia from the early 2000s. These universities received Namibian trainees to Japan and dispatched experts to Namibia. Thus, Japan has technical advantages in introducing rice cultivation and the Japanese researchers concerned from the above universities have knowledge on agriculture in semi-arid regions in Namibia. Therefore, it is very significant to conduct technical transfer and capacity building to Namibian researchers through the joint research of the Project.

4-2 Effectiveness

As mentioned, various research activities have been progressing well and the research results have been steadily accumulated toward achieving the Project Purpose. The Project Purpose is expected to produce an effective way forward mostly at the end of the Project, however, it is difficult to prospect precisely yet.

When research results of three areas (Crop Science, Development Studies, and Hydrology) are integrated well, the overall effectiveness of the Project can be considered to be high.

4-3 Efficiency

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

4-3-1 Inputs by the Japan Side

The experts (researchers) of the Kinki, Nagoya, Ryukoku, and Shiga Prefecture universities etc. have visited Namibia periodically in short-term (10 to 20 days in most cases) and a project coordinator has stayed in Namibia as long-term expert. It seems that the dispatch of Japanese experts is appropriate in terms of number of persons, expertize, and research capacity, etc. It is however important to point out that there are cases that Japanese experts visit Namibia when Namibian counterparts are very busy with the regular activities.

Various equipment and materials for research activities have been provided by the Japanese Government and it seems that the equipment has been utilized effectively for the project activities. However, there are opinion that additional measuring tools and weighing scales are necessary to monitor planted areas at farmer's fields and crop yields.

As for the trainings in Japan, in most cases, trainings were effective in terms of strengthening research ability of the Namibian counterparts and the extension officers. Especially extension officers expressed usefulness of the training because they have learned not only rice cultivation techniques but also effective communication methods with farmers. On the other hand, some Namibian counterparts pointed out that the contents of the training do not include sufficient practical training.

4-3-2 Inputs by the Namibian Side

As mentioned in article on Input, a total of 17 Namibian counterparts of UNAM including Project Director, Project Manager, and Assistant Project Managers are involved in project activities. A person was released from member of crop science team for study abroad. One more person is going to study abroad. At the beginning, number of Namibian counterparts was 9, so number of Namibian counterparts has increased.

Numbers of members by team are 7 at Crop Science Team, 6 at Development Studies Team, and 2 at Hydrology Team. It seem number of Namibian counterparts is adequate. However, there are some Namibian counterparts in the Development Studies Team whose degree of involvement in the project activities is low.

UNAM is facilitating various facilities and buildings for research activities, such as crop field, green house, laboratory, store rooms and office spaces. It seems these facilities are effectively used for research activities.

In terms of financial contribution to the Project, UNAM has made effort to allocate expenses necessary for the project activities. However, there is tendency that the annual budget for the projeet is being reduced yearly and there is limited budget for expenses necessary to carry out field surveys such as per diem and local transportation expenses for Namibian counterparts. This financial limitation has resulted certain negative effect in carrying out field surveys effectively.

4-3-3 Project Management

As mentioned, in order to assure effective implementation of project activities, JCC and MC meetings were held regularly or periodically. It seems that JCC meeting is functioning adequately for reviewing progress of the project activities, approving work plan for next period, and discussing major issues arising from the project implementation. Around 20 to 30 persons from UNAM, MAWF, Ministry of Education, JICA and Japanese experts participated in JCC meetings.

MC meeting deals with issues related with specific project activities and makes detailed plan of activities. It seems that MC meeting is functioning very well for ensuring smooth implementation of the project activities.

4-4 Impact

It is difficult to prospect achievability of the Overall Goal at present. A potential impact is observed.

4-4-1 Prospect of Achieving the Overall Goal

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.

At the point of the Mid-term Review, it is premature to describe the possible level of achievement of the Overall Goal in future.

Indicator 1-1): Field day held regularly on the cropping systems.

As mentioned already, the objectives of the Project and outcomes of the Project were explained at the field days. Farmers, Head of Local Governments and Deputy-Minister of MAWF, etc. participated in the field days and number of participants is more than 1,000 in total. In order to disseminate "flood- and drought-adaptive cropping systems", which will be developed by the end of the Project, to farmers in the north-central Namibia widely, the following issues are important.

1) Continuation of collaboration between UNAM and extension officers of MAWF,
2) Implementation of activities for training of extension officers on "flood- and drought-adaptive cropping systems", and
3) Allocation of necessary budget for extension activities like field days and demonstration farms.

Indicator 2-1): Regional research conference agreed and held together with the neighboring countries on the 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" (8 Sep. to 9 Sep. 2014). The project team members created relationship with the persons from neighboring countries at the symposium, and this is an entry point to hold similar regional research conference. It is expected that similar research conferences/symposiums are held periodically in future utilizing the relationship built at the symposium and seeking financial source for holding regional conferences.

4-4-2 Other Potential Impacts Observed

(1) Increase of farmers who have interest in rice cultivation

According to extension officers and farmers concerned with the Project, number of farmers who have interest in rice cultivation is increasing. When number of farmers who cultivate rice and they acquire rice cultivation techniques step by step, it is expected that dissemination of research results (rice and pearl millet mixed cropping systems) to such farmers becomes easy, because they have technical basis to grow rice.

(2) Acquired knowledge by extension officers

Following the training for extension officers in Japan, it is expected that the knowledge gained will be transferred to farmers thereby leading to improved techniques in cultivation of rice and also mixed cropping systems.

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 this report, food security and income increases, and diversification of agricultural crops are considered as important issues by the Government of Namibia. Therefore, policy sustainability of the Project will be secured.

(2) Institutional and Organizational Aspects

The Faculty of Agriculture and Natural Resources (FANR) is part of the eight faculties of UNAM and has capable professors and lecturers. One of the campuses of FANR is the Ogongo Campus in north-central Namibia where the main project activities are carrying out. FANR has a clear mission to promote sustainable agricultural and natural resource development and management in Namibia, through teaching, research and extension services to communal and commercial farming communities. The Project aims at developing a "Flood- and drought-adaptive cropping systems" which can sustainably preserve the water environment of semi-arid region, therefore, objective of the Project is consistent with the mission of UNAM and UNAM has organizational setup for carrying out this kind of research activities.

(3) Technical Aspect

The Namibian counterparts are lecturers and technicians of the three departments of the Faculty of Agriculture and Natural Resources of UNAM. In addition, extension officers and researchers of MAWF are collaborating in the project activities. The following table shows number of teaching staff of three departments and number of the Namibian counterparts.

Department	Teaching staff	Technician	Namibia counterparts for the Project (at present)
Crop Science	2 professors 1 senior lecturer 13 lecturers	1 technician	5 lecturers 1 field supervisor 1 institutional worker
Agricultural Economics and Extension	1 professor 11 lecturers	---	6 lecturers
Integrated Environmental Science	1 senior lecturer 8 lecturers	1 technicians	2 lecturers
Total	3 professors 2 senior lecturers 32 lecturers	2 technicians	13 lecturers 1 field supervisor 1 institutional worker

Continuity of lecturers and technologists of UNAM is expected to be retained , therefore, Namibian counterparts will strengthen research knowledge and skills further in the remaining project period and enhanced capacity of them will be utilized for research and teaching activities after the completion of the Project. Around 20 extension officers are involved in the project activities for disseminating rice cultivation techniques and mixed cropping system to farmers while receiving various trainings. When "Flood- and drought-adaptive cropping systems" is developed, further capacity building to extension officers and demonstration activities for disseminating developed cropping systems to farmers will be necessary after the completion of the Project.

4-6 Conclusions

The Joint Mid-term Review Team has confirmed that the project activities have shown a good and steadily progress in general. As the results of the project activities, scientific knowledge and information on rice and pearl millet mixed cropping systems, methods to understand the change of attitudes and perception by farmers, and socio - economic impacts on farmers, and water budget/water source analysis have been produced as originally planned mostly. The summary of evaluation based on five evaluation criteria is described in the table below.

Criteria	Evaluation
Relevance	High
Effectiveness	Expected to be high
Efficiency	Moderately high
Impact	--- (Premature to assess)
Sustainability	Likely to be moderately high

5. Recommendations

5-1. Recommended Actions to be taken by the Project Teams (Namibian counterparts and Japanese experts) in the Remaining Cooperation Period

(1) Mutually share challenges with all members of the Project Teams to achieve the Project overall objectives.
The Project has three (3) Research Themes which are Crop Science, Development Studies and Hydrology. Each Research Team (comprising of Namibian and Japanese counterparts) is involved in the project activities and collaborative researches. It is important not only to recognize the Project Purpose but also to collaboratively implement all project activities to the goal within each Research Theme as well as the whole of the Project Teams.

The Joint Review Team is therefore making the following recommendations to address the observed challenges in the first two and half years of the Project:

1) Establishment of the more concrete annual activity plan, Discussion and Approval by JCC
Confirmation of annual activity/research plan and the progress of planned activities to be discussed in JCC half-yearly meeting. In order to further understand among the project team members, it is necessary to be established the concrete annual activity plan/sheet which will include name of person in charge and timeline with amended PO grid, discussed and approved it by JCC. Through this process, the project team members is expected to understand the achievement degree of not only annual activities but also the whole plan and recognized what the Project will be supposed to do in the rest of the project period.

2) Enhance the linkage among Research Team Members
There are Japanese researchers (Experts) and Namibian Counterparts in each Research Team and in some case, Research Team members are physically separated so that the communication in daily basis is the key factor for the Project. Each Research Team should nominate a person who is to monitor timely and smooth mutual communication as Cc within the Research Team.

In order to strengthen the tight linkage among members in each Research Team, all project team members should voluntarily participate in planned research activities. Participant in the research should be chosen from researchers who have strong commitment to the Project.

(2) Advancement of discussion to embody the Project Purpose and Outputs
Approximately two and a half years have passed since the project commenced. Although the Project has undergone two (2) severe droughts for the past cropping season, steady activities and progress have been made. With taking the progress into consideration and to embody the Project Purpose and Outputs in the remaining of the project period, there are needs to develop mutual understanding in each Research Team and the whole of the project team members.

Thus, the Project Team is recommended to refer to the suggested requirements as follows:

1) The embodied Guideline
[Guideline for "Flood- and drought- adaptive cropping systems" is compiled] has been established as the indicator of the Project Purpose. In order to further define the purpose of each activity in the rest of the project period, it is necessary to discuss the contents of the guideline (purpose, target, contents and persons in charge of writing etc.) and time schedule for producing the guideline.

2) Implementation of intentional publication

The aim of the Project is expected not only international joint research for development of sustainable agricultural techniques in Namibia but also capacity development of researchers and technicians in both Japan and Namibia. The project period is limited in 5 years, but the publication is regarded as the important aspects for the presentation of the project outcomes as well as improvement of research ability for Namibian counterparts. In order to initiate further engagement with Namibian counterparts, it is essential to prepare a plan and schedule for publications. Also it is important to include all contributors to peer-reviewed publications. In addition, to enhance capacity development, there are needs to write peer-reviewed publications collaboratively and execute mutual assistance among both sides.

(3) PDM Revision

Several quantitative indicators of PDM version 1 (for example, presentations at academic conference/seminar) have not been decided with specific target numbers. It is necessary to decide target numbers through discussions among the project team members and to approve revised PDM at the next JCC meeting. The Joint Review Team proposes to add number of publications submitted to peer-reviewed journals as new indicator for Output 1, 2 and 3. Proposed modification of PDM is attached as Annex 15.

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

(1) Budget allocation to the project by UNAM

We appreciate all the efforts done by UNAM to allocate necessary budget to the Project. However, the amount of secured budget for the project activities has been decreasing yearly basis. Especially insufficient payment of lunch allowance to Namibian counterparts due to budget shortage leads to delays and cancellation of crucial activities such as field investigation. To implement these activities smoother in latter part of the project period, we recommend that UNAM should commit itself to provide adequate funds towards local field activities such as per diem and transportation for data collection and field works agreed in the Record of Discussions.

(2) Collaboration with MAWF

The collaboration between UNAM and MAWF is crucial to extend the cropping system that will be developed by the Project. The Project has established positive relationship with MAWF mainly in training and extension of rice cultivation techniques. We expect that the Project keeps good relation with MAWF and deepens partnership with them as the progress of the Project for effective extension of the cropping system for benefit of Namibia.

Annex 1 Schedule of the Mid-term Review

	Date		Activity				Place of stay
			Prof. Omoregie & Dr. Indongo (UNAM)	Mr. Takeichi & Mr. Oiwa (JICA)	Mr. Dojun (Consultant)	Dr. Kokubun & Dr. Umemura (JST)	
1	23-Aug	Sat			Depart from Japan		---
2	24- Aug	Sun			Arrival in Windhoek		Windhoek
3	25- Aug	Mon			9:00 Meeting at JICA Namibia office 16:00 Interview to a Namibian counterpart of UNAM (Mr. Angula, Neudamn campus)		Windhoek
4	26- Aug	Tue			Move from Windhoek to North (Oshakati city) (public holiday: Heroes' Day)		(Oshakati)
5	27- Aug	Wed			9:00 Interview to a Japanese expert (project coordinator) 12:15 Courtesy call to Deputy Dean Dr. Joseph Njunge		(Oshakati)
6	28- Aug	Thu			9:00-16:00 Interview to Namibian counterparts of UNAM (Dr. Njunge, Mr. Ausiku, Ms. Shivolo, Mr. Hangula, and Mr. Thomas)		(Oshakati)
7	29- Aug	Fri			9:00-11:00 & 14:00 – 16:00 Interview to extension officers concerned of the Outapi extension office of MAWF 13:00 Interview to a counterpart of UNAM (Mr. Shomagwe)		(Oshakati)
8	30- Aug	Sat		Depart from Japan	Preparation of draft review report		(Oshakati)
9	31- Aug	Sun		Arrival in Windhoek	Preparation of draft review report		Windhoek/ Oshakati
10	1-Sep	Mon		Move to North (SW101, 08:05am arrive Ondangwa)	Preparation of draft review report		(Oshakati)
				11:00 Curtesy call to Deputy Dean of Ogongo Campus UNAM (Dr. Joseph Njunge) 12:00 Interview to a Namibian counterpart of UNAM (Ms. Niipele)			(Oshakati)
11	2- Sep	Tue		- Site survey to demonstration farmers			(Oshakati)
12	3- Sep	Wed		- Site survey to demonstration farmers		Depart from Japan	(Oshakati)
13	4- Sep	Thu		- Compile the result of Interviews - Internal meeting		Arrival in Windhoek Move to North (Ondangwa)	(Oshakati)
14	5- Sep	Fri	Move to North 09:00 Courtesy call to Deputy Dean of Ogongo Campus UNAM (Dr. Joseph Njunge) 10:30 Interview to Namibian counterpart of UNAM (Mr. Awala and Mr. Lwiinga) 11:25 Interview to Namibian counterpart of UNAM (Ms. Hangula) 13:35 Interview to Namibian counterpart of UNAM (Dr. Njunge) 13:55 Interview to Namibian counterpart of UNAM (Dr. Kambatuku)				(Oshakati)
15	6- Sep	Sat	09:20 Interview to Japanese researcher (Prof. Nishikawa) 10:30 Observation of the experimental fields in Ogongo Campus 13:00 Interview to Japanese researcher (Prof. Hiyama) 14:00 Interview to Japanese researcher (Prof. Iijima)				(Oshakati)
16	7- Sep	Sun	Move to Windhoek (Flight 08:35am SW102, arrive Windhoek 09:40) - Internal meeting of Japanese review team - Debriefing draft review report by the Japanese Team to Japanese researchers				Windhoek

	Date		Activity				Place of stay
			Prof. Omoregie & Dr. Indongo (UNAM)	Mr. Takeichi & Mr. Oiwa (JICA)	Mr. Dojun (Consultant)	Dr. Kokubun & Dr. Umemura (JST)	
17	8- Sep	Mon	9:00-16:00 International Symposium 2014, "Agricultural Use of Seasonal Wetlands in Southern African Countries", SATREPS Rice-Mahangu Project				Windhoek
18	9- Sep	Tue	9:00-13:00 Symposium (second day) 14:00-16:00 Joint Coordinating Committee (JCC) meeting			Departure from Windhoek	Windhoek
19	10- Sep	Wed	9:00-15:00 Joint review meeting by the Joint Review Team (discussion of the Joint Mid-term Review Report)			Arrival in Japan	Windhoek
20	11- Sep	Thu	9:00-10:00 Meeting with persons concerned of the Project for explaining results of the mid-term review 10:00 Signing of Minutes of Meeting (M/M)				Windhoek
21	12- Sep	Fri		Report to JICA Namibia office by the Japanese Team			Windhoek
22	13- Sep	Sat		Departure from Windhoek by the Japanese Team			---
23	14- Sep	Sun		Arrival in Japan			---

Annex 2 Project Design Matrix (PDM) Version 1

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) Ver. 1 (10 Nov 2011)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
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.	1-1) Field day held regularly on the cropping systems. 2-1) Regional research conference agreed and held together with the 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 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-pearl millet 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 presentations at academic conference/seminar in related areas such as crop science and tropical agriculture (X times). 1-2) 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 • 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-pearl millet 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 on study methods of understanding perception and the socio-economic impacts by researchers of UNAM (X times). 2-3) Number of report at academic conferences/seminar on the evaluation method for landscape ecology of the cropping system (X times).	• Interview/questionnaire • Progress report • Report on research results • Proceedings of conference/seminar	
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 on the change of flood (surface) water, the water budget and the dependence on flood (surface) water of small wetlands. 3-2) Number of presentations at academic conference/seminar in related areas such as the potential cultivation area which does not affect the water environment (X times).	• Report on research results • Proceedings of conference/seminar	
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) Execution of field days 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-pearl millet mixed cropping system. 1.2 Examine water-saving cultivation techniques by methods including stable isotope technique. 1.3 Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain the soil fertility. 2.1 Survey the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration 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 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). 3.1 Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography map, satellite image and measurement of hydrological conditions. 3.2 Analyze the water budget of 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 at their small wetlands, on the rice-pearl millet mixed cropping system. 4.2 Conduct field trials at farmers who participate in trials on the rice-pearl millet mixed cropping system voluntarily. 4.3 Examine the rice-pearl millet 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 by the 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 mixed cropping of rice and pearl millet.

Annex 3 Plan of Operation (PO) Version 1 (R/D)

Ver 1 (6 Nov 2011)

		Responsible Personnel		Schedule
		Namibia	Japan	2012 / 2013 / 2014 / 2015 / 2016 (1 4 7 10 / -3 -6 -9 -12; Rain)
Output 1 【Crop Science】 The rice-pearl millet mixed cropping system, which is adaptable to the yearly fluctuation of flood and drought as well as water-saving, is proposed.				
1.1	Examine appropriate cultivation methods to establish the rice-pearl millet mixed cropping system.	UNAM	KU, USP	
1.1.1	Construct the sloped experimental fields with both wetland and upland environments and conduct various cultivation experiments such as planting density and cultivar trials.	UNAM	KU, USP	
1.1.2	Examine a methodology to assess the deep water use efficiency at field and pot experiments.	UNAM	KU	
1.1.3	Compile a mid-term review on basic examination of pot experiments.	UNAM	KU	
1.2	Examine water-saving cultivation techniques by methods including stable isotope technique	UNAM	KU, USP	
1.2.1	Examine water relation of mixed plants under drought- and waterlogging- conditions by pot experiments.		KU	
1.2.2	Analyze water sources (rain water, wetland water, underground water) of mixed plants and calculate the dependence on deep water and deep water use efficiency by the stable isotope techniques.	UNAM	KU, USP	
1.2.3	Examine the measurement technique of water use efficiency for the rice-pearl millet mixed cropping system.	UNAM	KU	
1.2.4	Complete the terminal review on field experiments.	UNAM	KU	
1.3	Examine measures to deal with environmental stress such as flood and drought as well as measures to sustain the soil fertility.	UNAM	KU, USP	
1.3.1	Accumulate findings on environmental stress responses of the rice-pearl millet mixed cropping through pot experiments on salt accumulation, drought and low nutrition.	UNAM	KU, USP	
1.3.2	Examine nitrogen use efficiency derived from organic matter for rice-pearl millet mixed cropping.		KU	
1.3.3	Compile a mid-term review on basic examination of pot experiments.	UNAM	KU	
1.3.4	Inspect the amount of cow manure to sustain the soil fertility.	UNAM	KU	
1.3.5	Complete the terminal review on field experiments.	UNAM	KU	
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-pearl millet mixed cropping system are established.				
2.1	Survey the socio-economic conditions and farm operation of farmers who participate in conducting field demonstration or voluntary trials (baseline survey).	UNAM	NU, KU	
2.1.1	Comprehend the socio-economic conditions and farm operation of the demonstration/trial farmers.	UNAM	NU, KU	
2.1.2	Compile a mid-term review on the findings.	UNAM	NU, KU	
2.1.3	Comprehend the socio-economic conditions and farm operations of farmers that additionally participate in the field demonstration/trial.	UNAM	NU, KU	
2.1.4	Compile the terminal review on the findings.	UNAM	NU	
2.2	Secure informed consent by demonstration farmers prior to project activities and share findings from output 1 and 3 through workshops.	UNAM	NU, KU	
2.2.1	Organize workshops for farmers.	UNAM	NU, KU	
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.	UNAM	NU, KU	
2.4	Classify the environment of farmers' fields from the viewpoint of landscape ecology.	UNAM	NU, KU	
2.4.1	Conduct an interview survey for criteria of classification on landscape ecology.	UNAM	NU, KU	
2.4.2	Compile a mid-term review on basic findings.	UNAM	NU, KU	

		Responsible Personnel		Schedule
		Namibia	Japan	2012 / 2013 / 2014 / 2015 / 2016 (1 4 7 10 / -3 -6 -9 -12; Rain)
2.4.3	Evaluate the mixed cropping system in farmers' fields from the viewpoint of landscape ecology.	UNAM	NU, KU	
2.5	Examine the sustainability of the mixed cropping system 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, labor distribution survey).	UNAM	NU, KU	
2.5.1	Evaluate the farm household economy and labor distribution.	UNAM	NU, KU	
2.5.2	Survey the ways to allocate the agricultural produce to different purposes.	UNAM	NU, KU	
2.5.3	Survey the farmers' decision making criteria as to adopt or reject a new cropping system (setting the criteria and its preliminary assessment)	UNAM	NU	
2.5.4	Evaluate the impacts on the demonstration/trial farmers.	UNAM	NU	
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.				
3.1	Estimate the change of flood (surface) water of seasonal wetland based on regionally-obtained data such as topography map, satellite image and measurement of hydrological conditions.		RIHN, NU	
3.2	Analyze the water budget of seasonal wetland based on hydrological data (precipitation, evapotranspiration, subsurface percolation)	UNAM	RIHN, NU	
3.2.1	Collect precipitation data using rainfall gauges set up across the overall seasonal wetlands.	UNAM	RIHN, NU	
3.2.2	Estimate evapotranspiration by the Bowen ratio measurement system set up in the campus of UNAM.	UNAM	RIHN, NU	
3.2.3	Estimate subsurface percolation by soil infiltration tests in the local fields.	UNAM	RIHN, NU	
3.3	Analyze the dependence on flood (surface) water of small wetlands that are formed in the farmers' demonstration/trial fields.	UNAM	RIHN, NU	
3.3.1	Estimate dependence of wetland water on flood water and/or groundwater by the stable isotope technique.	UNAM	RIHN, NU	
3.3.2	Estimate water age in small wetlands by the analysis of hydrological tracers.	UNAM	RIHN, NU	
Output 4 【Integrated Study of Agricultural and Social Science】 The cropping systems proposed by the project are integrated through field activities.				
4.1	Conduct field demonstration with committed and hardworking farmers at their small wetlands, on the rice-pearl millet mixed cropping system.	UNAM	KU, NU, USP	
4.1.1	Demonstrate cultivation techniques at about three farmers' fields.	UNAM	KU, NU, USP	
4.1.2	Propose some farming models and expand them at farmers' demonstration fields.	UNAM	KU, NU, USP	
4.2	Conduct field trials at farmers who participate in trials on the rice-pearl millet mixed cropping system voluntarily.	UNAM	KU, NU, USP	
4.2.1	Try cultivation techniques dependent on farmers' voluntary ideas by providing rice seedlings to farmers.	UNAM	KU, NU, USP	
4.3	Examine the rice-pearl millet 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.	UNAM	KU, USP	
4.3.1	Propose the farming model of mixed cropping system that can conserve the water environment.	UNAM	KU, NU, USP	
4.4	Carry out participatory research and extension by the Namibian researchers/technicians on the cropping system through opportunities such as field days.	UNAM	KU, NU, USP	
4.4.1	Organize workshop by researchers who attend the technical training courses.	UNAM	KU, NU, USP	

UNAM: University of Namibia, KU: Kinki University, NU: Nagoya University, USP: University of Shiga Prefecture, RIHN: Research Institute for Humanity and Nature

Annex 4 Dispatch of Japanese Researchers/Experts

No	Name	Field in charge	Position	Organization	Period of Dispatch			2012			2013				2014			
					From	To	Days	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
1	Prof. Morio Iijima	Leader, Crop Science and Integrated Study of Agricultural and Social Science	Professor, Faculty of Agriculture	Kinki University	26/04/2012	07/05/2012	12											
					27/08/2012	14/09/2012	19											
					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											
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											
3	Prof. Yoshiaki Nishikawa	Sub-leader, Development	Professor, Faculty of Economics	Ryukoku 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											
					30/08/2014	12/09/2014	14											
4	Prof. Tetsuya Hiyama	Sub-leader, Hydrology	Professor, Hydrospheric Atmospheric Research Center	Nagoya University	02/09/2012	14/09/2012	13											
					07/03/2013	16/03/2013	10											
					25/08/2013	10/09/2013	17											
					27/08/2014	11/09/2014	16											
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											
6	Dr. Toru Sakai	Hydrology	Project Senior Researcher	The Research Institute for Humanity and Nature	07/03/2013	16/03/2013	10											

No	Name	Field in charge	Position	Organization	Period of Dispatch			2012			2013				2014			
					From	To	Days	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
7	Dr. Koji Yamane	Crop Science	Lecturer, Faculty of Agriculture	Kinki University	25/04/2013	06/05/2013	12											
8	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											
9	Prof. Takeshi Ohta	Sub-leader, Development Studies	Professor, Graduate School of Bioagricultural	Nagoya University	01/09/2013	14/09/2013	14											
10	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											
11	Mr. Hisanori Tanaka	Hydrology	Technitian	CLIMATEC, Inc.	01/09/2013	10/09/2013	10											
12	Ms. Tomoko Hasegawa	Project Coordinator/ Training	Long-term Expert	JICA	30/03/2012	30/09/2014	915											
13	Ms. Mari Akiyama	Project Coordinator/ Training	Long-term Expert	JICA	23/08/2014	27/02/2017	920											

Annex 5 Counterpart Personnel Trained in Japan

No.	Name	Position	Department	Institution	Field/Name of the Course	Contents	Implementing Institution	Training period		
								From	To	Days
1	HANGULA Martha Mweneni	Lecturer	Economics	UNAM	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	2012/7/8	2012/7/28	21
2	ANGULA Martin Ndinomupya	Lecturer	Economics	UNAM						
3	THOMAS Benisiu	Lecturer	Economics	UNAM						
4	SHIVOLO Ottilie Taiilombwele	Lecturer	Crop Science	UNAM						
5	LWIINGA Teofilus Taleni	Field Supervisor	Crop Science	UNAM						
6	EMBUDILE Martin	CAEO	DEES, Omusati	MAWF						
7	SHEEHAMA Patricia Ashipala	AET	DEES, Oshana	MAWF						
8	SHEEHAMA Pombili	AET	DEES, Omusati	MAWF						
9	IIPUMBU Festus	AET	DEES, Omusati	MAWF						
10	PAULUS William Ngumbe Haishonga	AET	DEES	MAWF						
11	SHEEHAMA Paulina Munyambali	AET	DEES	MAWF						
12	AMWAALWA Anna Aia	AET	DEES, Oshana	MAWF						
13	UUSIKU Aina	AET	DEES, Omusati	MAWF						
14	Simon Awala	Lecturer	Crop Science	UNAM	Long-term research program	Graduate school (doctoral course)	Kinki University	2013/4/15	2016/3/31	1,082
15	Frans Titus	Technician	Machinery	UNAM	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	2013/6/30	2013/7/20	21
16	Brendan Matomola	Technician	Agronomy	UNAM						
17	Thulla Maharero	Lecturer	Economics	UNAM						
18	Moris Eiseb	Lecturer	Economics	UNAM						
19	Patrick Kompeli	Chief ART	DRT	MAWF						
20	Athon Wanga	Senior ART	DRT, Kavango	MAWF						
21	Ujama Abiud Mbunguha	ART	Plant Production Research	MAWF						
22	Kaunapawa Shapenga	AET	DEES, Omusati	MAWF						
23	Otilie Nawa	AET	DEES, Omusati	MAWF						
24	Wilhelmina Amashili	Senior AET	DEES, Omusati	MAWF						
25	Agnes Akwenye	Senior AET	DEES, Omusati	MAWF						
26	Nikolaus Endjala	AET	DEES, Ohangwena	MAWF						
27	Elikias Iyambo	Senior AET	DEES	MAWF						
28	Taimi Ndinelago Nambambi	AET	DEES, Oshana	MAWF						
29	George Haufiku	AET	DEES, Oshikoto	MAWF						

No.	Name	Position	Department	Institution	Field/Name of the Course	Contents	Implementing Institution	Training period		
								From	To	Days
30	Dr. Jack Kambatuku	Lecturer	Environment	UNAM	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	Kinki University	2013/7/1	2013/7/14	14
31	Ms. Johanna Ngula Niipele	Lecturer	Environment	UNAM						
32	Prof. F Mausse	Dean		UNAM	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	Kinki University	2013/7/8	2013/7/14	7
33	Dr. Joseph Njunge	Deputy Dean	Ogongo Campus	UNAM						
34	Dr. C Gwanama	Head of Department	Crop Science	UNAM						
35	Mr. Benisus Thomas	Lecturer	Economics	UNAM						
36	Mr. Pamwenafye Nanhapo	Lecture	Crop Science	UNAM	Long-term Research Program	Graduate school (doctoral course)	Kinki University	2014/3/28	2017/3/31	1,100
37	Mr. Athon Maliata Wanga	Senior ART	DRT, Kavango	MAWF	Short-term Research Program	Research training for flood-drought adaptive cropping system	Kinki University	2014/7/3	2014/11/28	149
38	Dr. Joseph Njunge	Deputy Dean	Ogongo Campus	UNAM	Short-term Research Program	Landscape analysis of seasonal wetlands	Kinki University	2014/7/10	2014/7/18	9
39	Mr. Teofilus Taleni Lwiinga	Field Supervisor		UNAM	Short-term Research Program	Basic training for flood-drought adaptive cropping system	Kinki University	2014/7/3	2014/8/14	43
40	Ms. Anna Shomagwe	Institution Worker		UNAM			Kinki University			
41	Mr. Benisus Thomas	Lecturer	Ogongo Campus	UNAM	Short-term Research Program	Farmers' perception to flood-drought adaptive cropping system	Ryukoku University/ Kinki University	2014/7/6	2014/7/26	21

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

Annex 6 Equipment Procured by Japanese Side

(1) Equipment procured from Indonesia

ID	Delivery Date	Description of goods		Model	Qty		Price (Yen)	Delivery Date	Stored place	Purpose of Use	Current Condition
1	09/08/2012	Power Tiller	Yanmar Diesel power Tiller	YZC-DL	3	unit	1,172,793	09/08/2012	Magazine under roof	Tillage	One Power Tiller out of order. One kept as backup.
2			Yanmar Diesel power Tiller	BROMO-DX	3	unit	967,608		Magazine under roof		
3			Spare parts of Power Tiller	---	30	pcs	166,900		Magazine room		
1	27/11/2012	Rice Thresher	Yanmar Rice Thresher w/ Engine	DB1000	3	unit	646,297	27/11/2012	Magazine under roof	Threshing	One kept as backup
2			Spare Parts for DB1000 w/ Engine	---	177	pcs			Magazine room		
3		Reaper	Yanmar Reaper	YAP120	3	unit	1,510,578		Magazine under roof	Harvesting	Kept as backup
4			Spare Parts for YAP120	---	174	pcs			Magazine room		
5		Rice Miller	Yanmar Rice Milling Equipment w/ Engine	YHPC800	2	unit	3,728,482		Magazine under roof	Milling	One kept as backup
6			Spare Parts for YHPC800 w/ Engine	---	54	pcs			Magazine room		
					Sub Total		8,192,658	Yen			
1 US$= 102 Yen				Conversion to US$			80,320.18	US$			

(2) Equipment procured from Japan

Delivery Date	10/08/2012

C/No.	ITEM	Description of goods	Quantity	Qty	Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
1	1-1	Bowen Ratio Measurement System	1 set	1	259,000	259,000	Data Logger (for Bowen_1)	Installed in the sloped filed	Bowen ratio measurement at inclined experimental field	Running
	1-2			1	119,000	119,000	Channel Multiplexer			
	1-3			1	40,000	40,000	Relay Driver			
	1-4			3	50,000	150,000	Surge Terminal array			
	1-5			1	20,000	20,000	Charge Controller			
	1-6			1	1,000	1,000	Molded Case Circuit Breaker			
	1-7			16	10	160	Fuse			
	1-8			8	100	800	Fuse Box			
	1-9			1	73,000	73,000	Measurement Box			
	1-10	Spare Parts for Bowen Ratio Measurement System		1	500	500	Cover sheet		(Spare Parts)	(Spare Parts)
	1-11			1	200	200	Elastic			
	1-12			2	100	200	Screwdriver			
	1-13			1	1,000	1,000	Communication Cable			
2	2-1	Bowen Ratio Measurement System		1	250,000	250,000	Net Radiation Meter	Installed in the sloped filed	Bowen ratio measurement at inclined experimental field	Running
	2-2			2	111,000	222,000	Hygro-thermometer			
	2-3			2	100,000	200,000	Sun Shield Shelter			
	2-4			3	32,000	96,000	TDR soil moisture sensor			
	2-5			3	18,000	54,000	Soil Thermometer			
	2-6			3	18,000	54,000	Water Thermometer			
	2-7			1	70,000	70,000	Soil Heat Flux meter			
3	3-1			1	90,000	90,000	Tipping Gauge	Installed Bowen 3		
	3-2			1	40,000	40,000	Attachment for Rain Gauge			
	3-3			1	158,000	158,000	Albedo Meter			
	3-4			1	60,000	60,000	3cup anemometer			
	3-5			1	100,000	100,000	Water gauge			
4	4-1			1	20,000	20,000	Power Box	Installed in the sloped filed		
	4-2			3	20,000	60,000	Battery			
	4-3			5	100	500	Clamp			
	4-4			1	20,000	20,000	Attachment Parts			
	4-5			1	1,000	1,000	Ground Rod			
5	5	Bowen Ratio Measurement System		2	120,000	240,000	Solar Cell Panel	Installed in the sloped filed	Ditto	
	6-1			1	259,000	259,000	Data Logger (for Bowen_1)			
	6-2			1	119,000	119,000	Channel Multiplexer			
	6-3			1	40,000	40,000	Relay Driver			

C/No.	ITEM	Description of goods	Quantity	Qty	Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
6	6-4	Bowen Ratio Measurement System	1 set	3	50,000	150,000	Surge Terminal array	Installed in the sloped filed	Ditto	
	6-5			1	20,000	20,000	Charge Controller			
	6-6			1	1,000	1,000	Molded Case Circuit Breaker			
	6-7			16	10	160	Fuse			
	6-8			8	100	800	Fuse Box			
	6-9			1	73,000	73,000	Measurement Box			
	6-10	Spare Parts for Bowen Ratio Measurement System		1	500	500	Cover sheet		(Spare Parts)	(Spare Parts)
	6-11			1	200	200	Elastic			
	6-12			2	100	200	Screwdriver			
	6-13			1	1,000	1,000	Communication Cable			
7	7-1	Bowen Ratio Measurement System		1	250,000	250,000	Net Radiation Meter	Installed in the sloped filed	Bowen ratio measurement at inclined experimental field	Running
	7-2			2	111,000	222,000	Hygro-thermometer			
	7-3			2	100,000	200,000	Sun Shield Shelter			
	7-4			3	32,000	96,000	TDR soil moisture sensor			
	7-5			3	18,000	54,000	Soil Thermometer			
	7-6			3	18,000	54,000	Water Thermometer			
	7-7			1	70,000	70,000	Soil Heat Flux meter			
8	8-1			1	90,000	90,000	Tipping Gauge	Installed Bowen 3		
	8-2			1	40,000	40,000	Attachment for Rain Gauge			
	8-3			1	158,000	158,000	Albedo Meter			
	8-4			1	60,000	60,000	3cup anemometer			
	8-5			1	100,000	100,000	Water gauge			
9	9-1			1	20,000	20,000	Power Box	Installed in the sloped filed		
	9-2			3	20,000	60,000	Battery			
	9-3			5	100	500	Clamp			
	9-4			1	20,000	20,000	Attachment Parts			
	9-5			1	1,000	1,000	Ground Rod			
10	10	Bowen Ratio Measurement System		2	120,000	240,000	Solar Cell Panel	Installed in the sloped filed	Ditto	
11	11-1	Bowen Ratio Measurement System		2	111,000	222,000	Hygro-thermometer	Installed in the sloped filed	Ditto	
	11-2			2	100,000	200,000	Sun Shield Shelter			
	11-3			2	20,000	40,000	Attachment Parts			
12	12-1	Spare Parts for Bowen Ratio Measurement System		1	27,533	27,533	Tools Set with BOX	New Laboratory	Ditto	
	12-2			12	856	10,270	Iron Pole	Installed in the sloped filed		
	12-3			1	55,825	55,825	Wire and Wire Parts for pole			
	12-4			10	2,346	23,460	Parallel attachment			
	12-5			5	1,087	5,435	U-Bolt			

C/No.	ITEM	Description of goods	Quantity	Qty	Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
13	13	Water Level Gauge	1 set	25	51,000	1,275,000	Water Level Gauge	Stolen after installation	Water level measuring at wet land	Running
14～38	14～38	Rainfall Measurement System	1 set	25	86,500	2,162,500	Tipping Bucket Rain Gauge	Installed in 25 farmers' filed	Rainfall Measurement	Running
39	39			25	14,000	350,000	Data Logger			
40	40			25	500	12,500	Accessories: Box, Bolt set, Band			
41	41	Rainfall Measurement System	1 set	1	20,000	20,000	Polyethylene Bottle for Tritium Analysis	New Laboratory	Rainfall Measurement	Running
42	42			1	70,000	70,000	Glass Bottle Set for CFCs Analysis			
43	43			1	220,000	220,000	Peristaltic Tubing Pump for CFCs Analysis			
44	44-1	Weather Station	1 set	1	76,000	76,000	HOBO Weather Station Logger	Installed in Afoti Village	Weather observation	Running
	44-2			1	36,000	36,000	Solar Radiation Sensor			
	44-3			1	29,000	29,000	Temperature/RH Sensor			
	44-4			1	38,000	38,000	Photosynthetically Active Radiation Sensor			
	44-5			1	12,000	12,000	Solar Radiation Shield			
	44-6	Spare Parts for Weather Station		1	17,000	17,000	HOBOware Pro Software	Office		(Spare Parts)
	44-7			1	8,000	8,000	USB Interface Cable			
					Sub Total	9,711,243	Yen			
					Conversion to US$	95,208.26	US$			

1 US$= 102 Yen

(3) Equipment procured from Japan

Delivery Date	25/01/2013

C/No.	ITEM	Description	Quantity		Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
1	1-1	Centrifuge	1 set	1	613,000	613,000	Centrifuge 5810 (230V 50-60Hz) (5810 000.017)	Crop Labo	Centrifuge	In use
	1-2			1			Roter key			
	1-3			1			Power cable			
	1-4			1			Operation manual			
2	2-1	Accessories for Centrifuge	1 set	1	274,000	274,000	Roter A-4-62, incl. 4 x 250 ml rectangular buckets (5810 709. 008)	Crop Labo		(Spare parts)
	2-2			2	24,700	49,400	adapter 7-18 ml (5810 756. 006)			
	2-3			2	24,700	49,400	adapter 50-75 ml (5810 760. 003)			
	2-4			2	24,700	49,400	adapter 80-120 ml (5810 761.000)			
3	3	Super Freezer	1 set	1	472,237	472,237	Super Freezer LAB06	Laboratory	Keep samples	In use
4	4	Refrigerator	1 set	1	660,502	660,502	Refrigerator URD-180 RE3	Laboratory	Keep seeds and samples	In use
5~40	5~40	Bird Net	1 box	36	22,050	793,800	Bird Net	If not in use stored in Laboratory or Magazine room	Prevent bird damages to crop at fields	For experiment
41~50	41~50	Paper Bag	1000 sheets/unit	10	15,000	150,000	Paper Bag	If not in use stored in Laboratory or Magazine room	Sampling	For experiment
51	51	Color Mesh Bag	1000 sheets	1000	48	48,000	Color Mesh Bag	If not in use stored in Laboratory or Magazine room	Sampling	For experiment
					Sub Total	3,159,739	Yen			
1 US$= 102 Yen					Conversion to US$	30,977.83	US$			

(4) Equipment procured from Japan

Delivery Date	25/01/2013

C/No.	ITEM	Description	Qty	Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
1	1-1	Accessory for measurement equipment	5	14,400	72,000	Core catcher soil sampling parts	Magazine room	Accessory for PC liner soil sampler	In use
	1-2	Accessory for measurement equipment	4	18,900	75,600	Extension lod for soil sampler			
	1-3	Accessory for measurement equipment	2	2,000	4,000	Polyvinyl chloride (PVC) Pipe			
2	2	General-purpose balance	1	46,400	71,390	FX1200I-JA S/N 15413705	Crop Labo	Weight measuring	In use
				24,990		FXI-09-JA Built-in rechargeable battery			
3	3	General-purpose balance	1	46,400	71,390	FX1200I-JA S/N 15413704	Laboratory	Weight measuring	In use
				24,990		FXI-09-JA Built-in rechargeable battery			
4	4	General-purpose balance	1	46,400	71,390	FX1200I-JA S/N 15413585	Laboratory	Weight measuring	In use
				24,990		FXI-09-JA Built-in rechargeable battery			
5	5	Analytical balance	1	116,500	141,490	HR250AZ-JA S/N T1100706	Crop Labo	Weight measuring	In use
				24,990		HRA-09-JA Built-in rechargeable battery			
6	6	Analytical balance	1	116,500	141,490	HR250AZ-JA S/N T1100699	Laboratory	Weight measuring	In use
				24,990		HRA-09-JA Built-in rechargeable battery			
7	7	Analytical balance	1	116,500	141,490	HR250AZ-JA S/N T1100571	Laboratory	Weight measuring	In use
				24,990		HRA-09-JA Built-in rechargeable battery			
8	8-1	Bowen Ratio Measurement System	1	259,000	259,000	Data Logger (for Bowen_1)	Installed	Bowen ratio measurement	Running
	8-2		1	119,000	119,000	Channel Multiplexer			
	8-3		1	40,000	40,000	Relay Driver			
	8-4		3	50,000	150,000	Surge Terminal array			
	8-5		1	20,000	20,000	Charge Controller			
	8-6		1	1,000	1,000	Molded Case Circuit Breaker			
	8-7		16	10	160	Fuse			
	8-8		8	100	800	Fuse Box			
	8-9		1	73,000	73,000	Measurement Box			
	8-10		1	500	500	Cover sheet			
	8-11		1	200	200	Elastic			
	8-12		2	100	200	Screwdriver			
	8-13		1	1,000	1,000	Communication Cable			
	9-1		1	250,000	250,000	Net Radiation Meter			

C/No.	ITEM	Description	Qty	Unit price (Yen)	Amount (Yen)	Content	Stored place	Purpose of Use	Current Condition
9	9-2	Bowen Ratio Measurement (Heat balance sensor)	2	111,000	222,000	Hygro-thermometer	Installed	Bowen ratio measurement	Running
	9-3		2	100,000	200,000	Sun Shield Shelter			
	9-4		3	32,000	96,000	TDR soil moisture sensor			
	9-5		3	18,000	54,000	Soil Thermometer			
	9-6		3	18,000	54,000	Water Thermometer			
	9-7		1	70,000	70,000	Soil Heat Flux meter			
10	10-1	Bowen Ratio Measurement (Air quality measuring instrument)	1	90,000	90,000	Tipping Gauge	Installed	Bowen ratio measurement	Running
	10-2		1	40,000	40,000	Attachment for Rain Gauge			
	10-3		1	158,000	158,000	Albedo Meter			
	10-4		1	60,000	60,000	3cup anemometer			
	10-5		1	100,000	100,000	Water gauge			
11	11-1	Accessories of Bowen Ratio Measurement	1	20,000	20,000	Power Box	Installed	Bowen ratio measurement	Running
	11-2		3	20,000	60,000	Valve Regulated Lead-Acid Battery			
	11-3		5	100	500	Clamp			
	11-4		1	20,000	20,000	Attachment Parts			
	11-5		1	1,000	1,000	Ground Rod			
12	12	Accessories of Bowen Ratio Measurement	2	120,000	240,000	Solar Cell Panel	Installed	Bowen ratio measurement	Running
13	13	Soil Sample Remover	1	10,950	10,950	Soil Sample Remover	Laboratory	Soil sampling	In use
14	14	Sieve	1	4,914	4,914	Sieve	Laboratory	Sieve of soil	In use
15～20	15～20	Plug tray	6	16,800	100,800	Cell Tray (100sheets/unit)	If not in use stored in Magazine room	Crop cultivation	In use
				Sub Total	3,307,264	Yen			
1 US$= 102 Yen			Conversion to US$		32,424.16	US$			

(5) Equipment procured from Japan

Delivery Date	25/01/2013

C/No.	ITEM	Description	Content	Qty	Unit price (Yen)	Amount (Yen)	Stored Place	Purpose of Use	Condition
1	1	Tractor	Tractor (EG231, VXUKS6ME)	1	2,334,000	2,334,000	Magazine under shade	Tillage	In use
2	2	Deep cultivator	Deep cultivator (GS155T,RTD)	1	545,000	545,000	Magazine under shade	Tillage	In use
3	3	Multi Rotary	Multi Rotary (R31220MK)	1	477,000	477,000	Magazine under shade	Tillage	In use
4	4-1	Sun visor	Sun visor (ST33C,TNTH)	1	53,000	53,000	Attached to the tractor	Attachment to tractor	In use
	4-2	3P Toplink	3P Toplink (3P—CT340)	1	16,000	32,000		Attachment to tractor	
	4-3	3P Toplink	3P Toplink (3P—CT340A)	1	16,000	32,000		Attachment to tractor	
5	5-1	Ridger	Ridger (VT7TA, UNTH)	1	25,000	25,000	Magazine room	Tillage	In use
	5-2	Attachment for ridger	Attachment (UTK8RA,UNTA)	1	10,000	10,000	Attached to the tractor	Tillage	In use
	5-3	Rear wheel	Rear wheel (cage wheel set) (593113)	1	24,000	24,000		Attachment to tractor	
	5-4	Front Weight	Front Weight (ITS100-01001)	1	6,000	24,000		Attachment to tractor	
	5-5	Front Weight	Front Weight (ITS100-01002)	1	6,000	24,000			
	5-6	Front Weight	Front Weight (ITS100-01003)	1	6,000	24,000			
	5-7	Front Weight	Front Weight (ITS100-01004)	1	6,000	24,000			
	5-8	Spare parts for tractor	Gasket (Cylinder head)	1	8,400	8,400	Magazine room	Spare parts for tractor	(Spare parts)
	5-9		V belt	1	2,250	2,250			
	5-10		Solenoid	1	9,900	9,900			
	5-11		Bulb COM	3	18,300	54,900			
	5-12		Hose	2	525	1,050			
	5-13		Nozzle sheet	3	195	585			
	5-14		Filter (Lubricating oil)	2	1,050	2,100			
	5-15		Element (oil water separation)	2	1,005	2,010			
	5-16		Filter (fuel)	2	1,440	2,880			
	5-17		Element (outer)	2	5,250	10,500			
	5-18		Element (safety)	3	4,500	13,500			
	5-19		Seal	1	1,800	1,800			
	5-20		Fuse 5A	5	180	900			
	5-21		Fuse 10A	2	180	360			
	5-22		Fuse 15A	2	180	360			
	5-23		Fuse 20A	2	180	360			
	5-24		slow-blow fuse 80A	1	300	300			
	5-25		slow-blow fuse 60A	1	945	945			

C/No.	ITEM	Description	Content	Qty	Unit price (Yen)	Amount (Yen)	Stored Place	Purpose of Use	Condition
	5-26		Start switch	1	3,900	3,900			
	5-27		Pin (lift york)	4	525	2,100			
	5-28		Seal QLF578016.5	2	3,900	7,800			
	5-29		Seal QLNY527514.5	2	6,600	13,200			
	5-30		Clutch disk 225	1	20,100	20,100			
	5-31		Filter	2	3,750	7,500			
	5-32		Ball socket lock pin CMP	4	255	1,020			
	5-33		Snap pin JASO 16	10	75	750			
	5-34		Check chain CMP	2	12,300	24,600			
	5-35	Attached to rotary	Holder (cover side)	2	1,425	2,850	Attached to the rotary	Spare parts for rotary	(Spare parts)
	5-36		spacer	2	840	1,680			
	5-37		seal cap BP35210	1	750	750			
	5-38		oil seal QLNY40721516	1	3,150	3,150			
	5-39		oil seal QLFY508014.5	1	4,200	4,200			
	5-40		oil seal SC45x62x09	1	435	435			
	5-41		Finger KIT (32 pin)	2	20,700	41,400			
	5-42		Pin 19*80	4	1,290	5,160			
	5-43		Lock pinCMP	4	255	1,020			
6	6-1	Bed for crop cultivation	The product made from a Stainless steel (1mm in thickness)	18	130,700	2,352,600	Installed in the greenhouse	Equipment for hydroponics	In use
	6-2		The product made from a Stainless steel (1mm in thickness)	6	92,600	555,600			
	6-3		Water level control set consists of C-type Bulb Socket, Lock Nut, Washer, Packing (small size), Packing (large size)	24	1,055	25,320			
7	7-1	Fixed point camera (Garden Watch Cam)	Garden Watch Cam	10	19,490	194,900	Installed in the farmers house, manuals are in the office	Automatic camera for fixed point observation	Running
	7-2		Manual	10	100	1,000			
	7-3		CD	10	500	5,000			
	7-4		USB	10	1,000	10,000			
	7-5		Rod	40	1,000	40,000			
	7-6		Joint	10	500	5,000			
	7-7		Adapter	10	500	5,000			
8	8-1	Surveying instrument	Aluminum Stuff mini M-33FZ	2	1,500	3,000	Crop Labo	Topographical survey	In use
	8-2	Surveying instrument	Aluminum Cross ACR-110	2	6,300	12,600	Crop Labo	Topographical survey	In use

C/No.	ITEM	Description	Content	Qty	Unit price (Yen)	Amount (Yen)	Stored Place	Purpose of Use	Condition
	8-3	Surveying instrument	Pole for super reflection 100 SRT-0100PS	1	18,000	18,000	Crop Labo	Topographical survey	In use
	8-4		Level	1	940	940	Crop Labo	Topographical survey	In use
9	9-1	Surveying instrument	Stake AK-250	500	96	48,000	Installed in the farmers house, rest in Crop Labo	Topographical survey	In use
	9-2		Level M-30	3	8,000	24,000	Crop Labo	Topographical survey	In use
	9-3	Hand level	Hand level	2	9,623	19,246	Crop Labo	Topographical survey	In use
	9-4		Hand level (equipped telephoto and angle)	2	15,103	30,206	Crop Labo	Topographical survey	In use
10	10-1	Rain gauge	Tipping bucket rain gauge RT-5E	1	95,000	95,000	Farmers house	Rainfall measuring	Running
	10-2		Datalogger UA-003-64	1	20,000	20,000			
	10-3	Water level gauge	Water level gauge U20-001-01	5	54,000	270,000	Farmers house	Water level measuring	Running
11	11-1	Hexacopter	Hexacopter H601G	1	236,190	236,190	Office	Taking aerial photograph	In use
	11-2		Camera mount	1	35,000	35,000			
	11-3		Attachment (propeller)	1	2,000	2,000			
12	12-1	Hexacopter (accessories)	Transmitter	1	70,000	70,000	Office		In use
	12-2		Camera COOLPIX P330	1	36,000	36,000			
	12-3		Controller	1	45,000	45,000			
13	13-1	Spatula	spatula 180mm	1	936	936	Labo, Crop Labo	Distribute Reagent	In use
	13-2	Spatula	spatula 150mm	1	1,134	1,134			
	13-3	Spatula	spatula 240mm	5	293	1,465			
	13-4	Filter	Filter	3	8,610	25,830	Labo, Crop Labo	Filtering	In use
	13-5	Adaptor for air pump	Five-lot tap	5	2,958	14,790	Labo	Accessory for air pump	In use
	13-6	Adaptor for air pump	Three-lot tap	30	374	11,220	Labo	Accessory for air pump	In use
	13-7	Balance dish	Balance dish	1000		6,800	Labo	Cultivation of crop seedlings	In use
14	14-1	Accessory for EC meter	EC electrode	1	28,350	28,350	Labo	Electrical conductivity measurement of soil	(Spare parts)
	14-2	Accessory for pH meter	pH electrode	1	27,405	27,405	Labo	Measuring soil pH	(Spare parts)
	14-3	Plastic bag	Plastic bag A8	5	576	2,880	Labo, Crop Labo	Keeping samples	Keeping samples
	14-4	Plastic bag	Plastic bag D8	5	794	3,970			
	14-5	Plastic bag	Plastic bag H8	5	1,115	5,575			
	14-6	Plastic bag	Plastic bag J8	5	1,796	8,980			
15	15-1	Soil survey handbook	Soil survey handbook	3	2,436	7,308	Office, Crop Labo	Reference for soil sampling	In use
	15-2	Soil sampling accessories	Soil sampling accessories	5	10,950	54,750	Crop Labo	Soil sampling	In use
	15-3	Soil sampling accessories	Soil sampling accessories	5	10,950	54,750	Crop Labo	Soil sampling	In use
	15-4	Clinometer	Clinometer	3	10,000	30,000	Crop Labo	Topographic survey	In use

C/No.	ITEM	Description	Content	Qty	Unit price (Yen)	Amount (Yen)	Stored Place	Purpose of Use	Condition
	15-5	Soil color chart	Soil color chart	2	20,948	41,896	Office, Crop Labo	Determine color of soil	In use
16	16	Sieve 2mm	Sieve 2mm	5	4,914	24,570	Crop Labo	Sieve soils	In use
17	17-1	Fixed angle rotor	Fixed angle rotor			70,000	Labo	Spare part for centrifugal	In use
	17-2	Syringe	Syringe	3	2,621	7,863	Labo, Crop Labo	Spare part for centrifugal	In use
18	18	Petri desh	Petri desh	1		35,265	Labo	Germination for crop	In use
19	19	Petri desh	Petri desh	1					
20	20-1	Pipette tip	Pipette tip 10mL	2	5,712	11,424	Labo	Tip for pipette	In use
	20-2	Pipette tip	Pipette tip 5mL	1	4,872	4,872			
	20-3	Pipette tip	Pipette tip 1mL	1	2,100	2,100			
21	21	Centrifuge tube	Centrifuge tube	1		13,200	Labo	For centrifugal	In use
22~51	22~51	Plastic pot	Plastic pot 1/2000a, 6/unit	30	13,167	395,010	Magazine and stare room	Pot for crop cultivation	In use
52~55	52~55	Plastic pot	Plastic pot 1/10000a, 60/unit	4	35,910	143,640	Magazine and stare room	Pot for crop cultivation	In use
56~62	56~62	Cell Tray	Cell Tray 72cells, 100/unit	7	11,500	80,500	Laboratory, Magazine	Pot for crop cultivation	In use
63	63	Cell Tray	Cell Tray 25cells	10	267	2,670			In use
64	64	Cell Tray	Cell Tray 25cells	10	267	2,670			In use
65	65	Cell Tray	Cell Tray 25cells	10	267	2,670			In use
66	66	Cat guard	Cat guard	20	100	2,000	Laboratory, Magazine	Cultivate seedlings for experiment	In use
67	67	Cat guard	Cat guard	20	100	2,000			
68	68-1	Cat guard	Cat guard	10	100	1,000			
	68-2	Root shading sheet	Root shading sheet	5	4,872	24,360			
69	69	Styrene board	Floter	5	2,400	2,400		For crop cultivation	In use
70	70-1	Sample Chamber for PSYPRO	C-52-SF Sample Chamber for PSYPRO	8	111,300	890,400	Laboratory	Measure water potential in plant	In use
	70-2		Caple holder (7 x 1.25mm)	8	5,250	42,000			
	70-3		Caple holder (7 x 2.5mm)	8	5,250	42,000			
	70-4		Caple holder (7 x 4.5mm)	8	5,250	42,000			
	70-5		Allen key	8	5,250	42,000			
71	71-1	PSYPRO	Water Potential System	1	698,250	698,250	Laboratory		In use
	71-2		Manuals (English)	1					
	71-3		Battery Charger	1					
					Sub Total	10,955,220	Yen		
					Conversion to US$	107,404.12	US$		

1 US$= 102 Yen

(6) Equipment procured from Japan

Delivery Date	August 2014

C/No.	ITEM	Description	Quantity	Unit price (Yen)	Amount (Yen)	Content	Stored Place	Purpose of Use	Condition
1	1	Tractor	1	1,297,500	1,297,500	Tractor (EG231, VU)	Ogogon Campus	Tillage	Just arrived
		Rotary	1	192,500	192,500	Rotary (RB16SME)		Tillage	
2	2	Sun visor (for tractor)	1	53,000	53,000	Sun visor (ST33C,TNTH)		Attachment to tractor	
3	3	Front weight	2	6,000	12,000	Front weight (ITS100-01001)		Tillage	
4	4	Disc rotor	1	450,000	450,000	Disc rotor (Model: DS427T, RTA)		Tillage	
5	5	Disc rotor	1	450,000	450,000	Disc rotor (Model: DS428T, RTA)		Tillage	
6	6	Water level gauge	12	54,000	648,000	Water level gauge U20-001-01		Measuring water level	
7	7	Accessories for PC Liner	200	2,750	550,000	DIK-161B-A1 Sample liner tube φ50mm x 1m		Sampling of soil core	
8	8-1		1	261,800	261,800	DIK-161D-D1 soil sampling pipe φ63mm x 100cm			
	8-2		10	15,400	154,000	DIK-121D-Q1 Joint Sleeve φ45 x 200mm (Round screw type)			
9	9		10	23,100	231,000	DIK-121D-H1 Joint shaft φ35 x 1000mm (Round screw type)			
10	10-1	Suction filter	2	32562	65,124	Suction filter K-P (with manual pump)		Filtration of water samples	
	10-2		2	25138	50,276	Filter holder for Vacuum filtration KGS-47			
	10-3		7	11,998	83,986	Membrane filter A020A047A (0.2um - φ47mm)			
11	11-1	Suction filter	2	3489	6,978	Suction bottle 500mL			
	11-2		1	6060	6,060	Rubber tube for aspirator φ6 x 12mm x 20m			
	11-3		4	11184	44,736	Oil mist trap OMT-050A			
	11-4		2	2295	4,590	GLD/GCD Vacuum pump hose intake pipe φ8 x M20			
	11-5		5	482	2,410	Standard filter paper No.1 90φ			
	11-6		5	595	2,975	Standard filter paper No.2 90φ			
12	12	Suction filter	2	68850	137,700	Oil-sealed rotary vacuum pump G-5DA			
13	13	Printer toner	3	6,961	20,883	Brother tonner cartridge TN-27J		Printer toner	
14	14	Printer toner	3	6,961	20,883	Brother tonner cartridge TN-28J			
15	15	Printer toner	3	6,961	20,883	Brother tonner cartridge TN-29J			
16	16-1	Printer toner	1	6,961	6,961	Brother tonner cartridge TN-30J			
	16-2		10	5,980	59,800	Epson Inc cartridge, set of 6 colors, IC6CL50			
				Sub Total	4,834,045	Yen			
1 US$= 102 Yen			Conversion to US$		47,392.60	US$			

(7) Equipment procured in Namibia

	Date of procurement	Name of equipment	Maker and model	Quantity	Price (NAD)	Stored Place	Place of use	Condition
1	2012/5/10	Copy machine	Canon IR2030i	1	73,000.00	Project Office	Project site	In use
2	2012/5/29	Desktop Computer	HP 6200 with Monitor LE1711	1	7,225.87	Project Office	Project site	In use
3	2012/5/29	Desktop Computer	HP 6200 with Monitor LE1711	1	7,225.87	Crop Lab	Project site	In use
4	2012/5/29	Desktop Computer	HP 6200 with Monitor LE1711	1	7,225.87	Crop Lab	Project site	In use
5	2012/5/29	Desktop Computer	HP Probook 4530s	1	5,998.89	Project Office	Project site	In use
6	2012/5/29	Desktop Computer	HP Probook 4530s	1	5,998.89	Project Office	Project site	In use
7	2012/7/2	UPS	Proline 3000VA Online UPS	1	9,500.00	Project Office	Project site	In use
8	2012/7/13	Trailer (1)	Rims&Tyres 2.5ton breaked axles	1	44,000.00	Parking	Project site	In use
9	2013/12/11	Irrigation pump	Water Pomp Fitted with Double Cylinder	1	108,962.50	Magazine	Project site	In use
10	2012/12/14	Trailer (2)	Rims&Tyres 2.5ton breaked axles	1	44,000.00	Parking	Project site	In use
11	2013/1/2	Generator	Honda EP2500CX	1	4,502.35	Crop Lab	Project site	In use
12	2013/2/13	Desktop Computer	Proline POH61M,Samusung27	1	13,561.37	Ms Niipelle's office	Project site	In use
13	2013/2/28	Projector	LG BX275	1	5,978.85	Project Office	Project site	In use
14	2013/3/28	Vehicle	Toyota Hilux	1	450,497.52	Parking	Project site	In use
15	2012/3/27	Vehicle	Toyota Land Cruiser	1	477,034.30	Parking	Project site	In use
16	2012/3/27	Vehicle	Toyota Hilux	1	431,109.56	Parking	Project site	In use
17	2013/12/9	Shelves for warehouse	---	1	8,000.00	warehouse	Project site	In use
18	2013/12/16	Shelves for warehouse	---	1	7,028.68	warehouse	Project site	In use
19	2014/1/23	Irrigation pump	Water Pomp Fitted with Double Cylinder	1	84,582.50	Field	Project site	In use
20	2014/3/10	Irrigation pump	Water Pump 2 GX160 HONDA WABC-9239062	1	3,310.83	Crop Lab	Project site	In use
21	2014/3/10	Irrigation pump	Trash Pump 4"HONDA GX390 WAYJ-1000594	1	21,739.13	Field	Project site	In use
22	2014/3/27	House for irrigation pump	---	1	17,200.00	Field	Project site	In use
				Sub Total	1,837,682.98	NAD		

1 USD = 10.6124 NA

Conversion to US$	173,163.75	US$
Grand total in US dollar	566,890.89	US$

Annex 7 Local Operational Expenses Covered by Japanese Side

Unit: NAD

Description		JFY2012	JFY2013	JFY2014 Apr.-Jun.	Total
Airfare	(Project coodinator and C/Ps who visited Japan)	37,961.00	114,574.00	0.00	152,535.00
Travel Allowance	(Project coodinator and C/Ps who visited Japan)	57,802.95	43,559.30	810.00	102,172.25
Remuneration	(Technitians, workers and drivers)	627,891.90	932,471.97	222,682.04	1,783,045.91
Meeting Cost	(Management Committee meetings, field days, and workshops)	60,534.70	90,939.40	9,019.70	160,493.80
General Operating Cost		2,003,673.72	1,395,398.27	347,678.04	3,746,750.03
Total		2,787,864.27	2,576,942.94	580,189.78	5,944,996.99
(Amount converted to US dollar)		262,699	242,824	54,671	560,193

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

1 USD = 10.6124 NAD

Annex 8 List of Counterpart Personnel Involved in the Project Activities

No.	Name	Position/Area of Specialty	Institution	Name of Japanese Expert in charge	In charge of Output				Assigned Period						Training in Japan
					1	2	3	4	From	To	2012	2013	2014	2015	
1	Prof. Osmund D. Mwandemele	Pro-Vice Chancellor, Academic Affairs and Research	UNAM (Windhoek)	Prof. Iijima	Project Director X				2012/4/1	present					
2	Dr. Joseph T. Njunge	Deputy Dean, Ogongo Campus	UNAM (Ogongo)	Prof. Iijima/ Ms. Hasegawa	Project Manager X				2013/3/13	present					In 2013 and 2014
3	Mr. Simon Awala	Lecturer, Department of Crop Science	UNAM (Ogongo)	Prof. Iijima/ Ms. Hasegawa	Asst. Project Manager X				2012/4/1	study leave (from 2013/4/15)					2013/4/15 - 2016/3/31 (doctoral course)
4	Mr. Pamwenafye Nanhapo	Lecturer, Department of Crop Science	UNAM (Neudamm)	Prof. Iijima	X				2012/4/1	study leave (from 2014/3/28)					2014/3/28 - 2017/3/31 (doctoral course)
5	Mr. Petrus A. Ausiku	Lecturer, Department of Crop Science	UNAM (Ogongo)	Prof. Iijima/ Ms. Hasegawa	Asst. Project Manager X				2012/4/1	present					
6	Ms. Martha M. Hangula	Lecturer, Head of Department of Agricultural Economics and Extension	UNAM (Ogongo)	Prof. Nishikawa		X			2012/4/1	present					In 2012
7	Mr. Martin N. Angula	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)	Prof. Nishikawa		X			2012/4/1	present					In 2012
8	Mr. Benisiu Thomas	Lecturer, Department of Agricultural Economics and Extension	UNAM (Ogongo)	Prof. Nishikawa		X			2012/4/1	present					In 2012, 2013 and 2014
9	Ms. Erikka R. Sheehama	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)	Prof. Nishikawa		X			2012/4/1	present					
10	Mr. Thula Maharero	Lecturer, Department of Agricultural Economics and Extension	UNAM (Ogongo)	Prof. Nishikawa		X			2013/3/13	present					In 2013
11	Mr. Morritz Eiseb	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)	Prof. Nishikawa		X			2013/3/13	present					In 2013
12	Ms. Cecilie Jona	Lecturer, Department of Agricultural Economics and Extension	UNAM (Neudamm)	Prof. Nishikawa		X			2012/4/1	study leave (from Sep 2012)		(South Africa)			
13	Ms. Ottilie T. Shivolo	Lecturer, Department of Crop Science	UNAM (Ogongo)	Prof. Nishikawa/ Prof. Iijima	X	X			2012/9/4 (2014/3/13)	present					In 2012
14	Dr. Jack Kambatuku	Lecturer, Department of Integrated Environmental Sciences	UNAM (Ogongo)	Prof. Hiyama			X		2012/9/4	present					In 2013
15	Ms. Johanna N. Niipele	Lecturer, Department of Integrated Environmental Sciences	UNAM (Ogongo)	Prof. Hiyama			X		2012/9/4	present (study leave from ep. 2014)					In 2013
16	Mr. H. Kaholongo	Lecturer, Department of Crop Science	UNAM (Ogongo)	Dr. Fujioka	X				2014/3/13	present					
17	Mr. Teofilus Lwiinga	Field Supervisor, Department of Crop Science	UNAM (Ogongo)	Prof. Iijima/ Dr. Fujioka	X				2014/3/13	present					In 2012 and 2014
18	Ms. Anna Shomagwe	Institution Worker, Department of Crop Science	UNAM (Ogongo)	Prof. Iijima/ Dr. Fujioka	X				2014/3/13	present					In 2014
	Collaboration Partners														
1)	Mr. Martin Embundile	Chief Agricultural Extension Officer, Omusati Region	MAWF		X	X			2013/4/23	present					
2)	Mr. Athon Wanga	Senior Agricultural Research Technician, Directorate of Research and Training, Bagani	MAWF		X	X			2013/4/23	present					In 2013 and 2014

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

Annex 9 Provision of Office Spaces, Land and Facilities by UNAM

NO	ROOM	PLACE	USED BY
1	Laboratory (1)	Crop Science Bldg in Ogongo campus	
2	Laboratory (2)	Administration Bldg in Ogongo campus	
3	Office (1)	Administration Bldg in Ogongo campus	Japanese Experts and JOCV
4	Office (2)	Administration Bldg in Ogongo campus	Project Coordinator
5	Green House	in Ogongo campus	
6	Store Room	Magazine in Ogongo campus	
7	Store Space	Magazine in Ogongo campus	
8	Crop field	Campus field in Ogongo campus	
9	Seed Room	Crop Science Bldg in Ogongo campus	

Annex 10 Number of presentations at academic conference/seminar in related areas such as crop science and tropical agriculture (related with Indicator 1-1)

(1) Papers submitted (2 papers)

1) Suzuki, T. Ohta, T. Izumi, Y. Kanyomeka, L. Mwandemele, O. Sakagami, J-I. Yamane, K. Iijima, M. 2013. Role of canopy coverage in water use efficiency of lowland rice in early growth period in semi-arid region. Plant Prod. Sci. 16 (1): 12-23. (An international journal)

2) Okazaki, Y. Yamane, K. Izumi, Y. and Iijima, M. 2014. Drought, salinity and flooding tolerance of *Oryza sativa*, *Oryza glaberrima* and their interspecific cultivars. Journal of Crop Research. (In press) (A journal in Japan)

(2) Other publications (2 other publications)

1) Iijima, M., 2013. Flood- and drought-adaptive cropping systems to conserve water environments in semi-arid regions. Monthly magazine "Global Net" July 2012. 2-3. Global Environmental Forum.

2) Iijima, M. 2014. Frequent floods and droughts in semi-arid regions and Examination of flood- and drought-adaptive cropping systems (this title is tentative translation from Japanese title), Journal of Crop Research. (In press)

(3) Presentations at international and/or domestic conferences/ symposiums (26 presentations)

A: International Symposiums

1) Iijima, M., Simon, A. and Mwandemele, O. Introduction of subsistence rice cropping system harmonized with the water environment and human activities in seasonal wetlands in Northern Namibia. Proceedings of SATREPS Rice-Mahangu Project, International Symposium on Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. 4-12. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.

2) Dr. Morio Iijima (Professor), Faculty of Agriculture, Kinki University. Experimental trials for flood- and drought- adaptive mixed cropping system in seasonal wetlands. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

3) Mr. Simon K. Awala (PhD student), Faculty of Agriculture, Kinki University. 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, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

4) Dr. Yasuhiro Izumi (Associate Professor), School of Environmental Science, The University of Shiga Prefecture. Rice, pearl millet, and sorghum intercropping trials at sloped FOEAS field in Shiga, Japan. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

B: Domestic Symposiums

1) Iijima, M., 2013. Flood- and drought-adaptive cropping systems to conserve water environments in semi-arid regions. TICAD Presymposium "Activities of Japanese universities, companies and research institutions in Africa and the way for future", at JICA Yokohama, Japan. 26 May, 2013.

2) Iijima, M., Rice cultivation using natural water collecting devices "Rice and Pearl Millet Intercropping" (this title is tentative translation from Japanese title) at citizen open lecture at Nagoya University, Aichi, Japan. 13 July, 2013.

3) Okazaki, Y. Cisse Amara, Izumi, Y. Sakagami J. Yamane, K. Iijima, M., Stress tolerance evaluation on drought, salinity and Turbidity of intervarietal hybrid lines of Asian, African and NERICA rices (this title is tentative translation from Japanese title). The 175 regular meeting of the Kinki Crop and Breeding Research Branch of the Crop Science Society of Japan. At the Kinki University. Nara, Japan. 12 July, 2013.

4) Iijima, M. 2014. Frequent floods and droughts in semi-arid regions and Examination of flood- and drought-adaptive cropping systems (this title is tentative translation from Japanese title), Open symposium "Global Climate Change and Agriculture in the Future). Kinki Crop and Breeding Research Branch of the Crop Science Society of Japan. At Osaka Prefecture University, Osaka, Japan. 14 December, 2013.

5) Chie Araki, Koji Yamane, 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 the Crop Science Society of Japan. March 29-30, 2014, Chiba University, Chiba, Japan.

6) Iijima, M. Situation of development of Flood- and drought-adaptive cropping systems and its challenges in Namibia (this title is tentative translation from Japanese title). Symposium on "Climate and social fluctuation and agriculture in Namibia". Kyoto University, July 5, 2014.

7) Fujioka, Y. Iijima, M. Climate disasters in agro-pastoral communities and their way to cope it (this title is tentative translation from Japanese title). Symposium on "Climate and social fluctuation and agriculture in Namibia". Kyoto University, July 5, 2014.

C: Poster Presentations

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 the Crop Science Society of Japan. March 29-30, 2014, Chiba University, Chiba, Japan.

2) Yoshinori Watanabe, Simon K. Awala, Pamwenafye I. Nanhapo, Osmund D. Mwandemele, Koji Yamane, Morio Iijima. Nutrient Competition between Pearl Millet and Cowpea under Limited nutrient supply: Nitrogen Use Efficiency Derived from Organic Manure. The 237th Meeting of the Crop Science Society of Japan. March 29-30, 2014, Chiba University, Chiba, Japan.

3) Simon Awala, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamane, Osmund Mwandemele, 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 the Crop Science Society of Japan. September 10-11, 2013, Kagoshima University, Japan.

4) Chie Araki, Yoshinori Watanabe, Koji Yamane, Morio Iijima. Effects of soil moisture conditions on the water relation and water source of intercropped rice and pearl millet. The 235th Meeting of the Crop Science Society of Japan. Meiji University. March 28-29, 2013.

5) Chie Araki, Koji Yamane, Morio Iijima. Effects of soil water stress on the growth of cereal species under mixed cropping. The 234th Meeting of the Crop Science Society of Japan. Tohoku University. September 10-11, 2012.

6) Yuki Okazaki, Koji Yamane, Morio Iijima. Effects of salt stress on the growth of cereal species under mixed cropping. The 234th Meeting of the Crop Science Society of Japan. Tohoku University. September 10-11, 2012.

7) Suzuki, T. Ohta, T. Hiyama, T. Osmund Mwandemele. Iijima, M. Effect of rice introduction to evapotranspiration in north Namibia. (this title is tentative translation from Japanese title). Japan Society of Hydrology and Water Resources. Proceedings of research results presentation in 2012, 162-162. Hiroshima University. September 26-28, 2012.

8) Simon K. Awala, Yasuhiro Izumi, Yuichiro Fujioka, Pamwenafye. Nanhapo, Osmund D. Mwandemele, Morio Iijima. Rice Production Trials in Farmers Fields in North-central Namibia. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

9) Simon K. Awala, Petrus A. Ausiku, Yasuhiro Izumi, Yuichiro Fujioka, Koji Yamane, Yoshinori Watanabe, Osmund D. Mwandemele, Morio Iijima. Soil Fertility of Seasonal Wetlands in Northern Namibia. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

10) Yoshinori Watanabe, Chie Araki, Simon K. Awala, Koji Yamane, Morio Iijima. Water Source and Water Use Efficiency of Intercropped Rice and Pearl Millet. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

11) Yoshinori Watanabe, Simon K. Awala, Pamwenafye Nanhapo, Osmund D. Mwandemele, Koji Yamane, Morio Iijima1. Nutrient Competition between Pearl Millet and Cowpea under Excess Moisture Condition: Nitrogen Use Efficiency Derived from Organic Manure. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

12) Yuki Okazaki, Koji Yamane, Morio Iijima, Yasuhiro Izumi. Drought and Flooding Resistance of *Oryza sativa, Oryza glaberrima* and their Interspecific Progenies. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

13) Yuki Okazaki, Koji Yamane, Morio Iijima, Yasuhiro Izumi. Mix-cropping with Tolerant Plant Species Can Relieve Rice Growth from Salinity Stress. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

14) Seitaro Watanabe, Masaya Masumoto, Simon K. Awala, Josef Njunge, Osmund D. Mwandemele, Morio Iijima. Research Activities on Rice and Pearl Millet Mixed Cropping System under a Seasonal Wetland at Ogongo Campus in North-central Namibia: Joint Activities of Japan Overseas Cooperation Volunteers (JOCV) and Namibia SATREPS Project. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

15) 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, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

Annex 11 Presentations at academic conferences/seminar on the evaluation method for landscape ecology of the cropping system and others (related with Indicator 2-3)

1. Presentations on the evaluation method for landscape ecology of the cropping system (2 presentations)

1) Fujioka, Y., Nishikawa, Y., and Iijima, M. Environment of seasonal wetlands and its recognition by local people in northern Namibia: Landscape analysis toward the participatory rural development. The Study Meeting of the Association of Japanese Geographers, Spring 2014, March 27-28, 2014, Kokushikan University, Tokyo, Japan.

2) Fujioka, Y., Nishikawa, Y., and Iijima, M. Environment of seasonal wetlands and its recognition by local people in northern Namibia. Conference of Japan Association for African Studies, No.51, May 24-25, 2014, Kyoto University, Kyoto, Japan.

2. Other presentations (10 presentations)

A: International Symposiums

1) Thomas, B. Nishikawa, Y. Hangula, M., Kaida, K. and Fujioka, Y. Rural crop farmers' livelihood diversification and coping strategies in changing environment of north central Namibia. Proceedings of SATREPS Rice-Mahangu Project, International Symposium on Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. 37-46. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.

2) Dr. Yoshiaki Nishikawa (Professor), Faculty of Economics, Ryukoku University. Trials to integrate farmers' consent to the process of introduction of new cropping system and participatory research: Tentative discussions from Experiences of Inter-Cropping Research in Northern Namibia. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

3) Mrs. Martha Hangula (Lecturer), Department of Agricultural Economics & Extension, FANR, UNAM. Evaluation of socioeconomic situation of rice farmers in Omusati Region. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

4) Mr. Benisiu Thomas (Lecturer), Department of Agricultural Economics & Extension, FANR, UNAM. Farmers' perceptions towards adoption of rice and pearl millet cropping system in north-central Namibia: A case of Onamundindi village. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

5) Dr. Yuichiro Fujioka (Postdoctoral Research Fellow), Faculty of Agriculture, Kinki University. Diversity of seasonal wetlands (ondombes) landscape and its recognition by local people in north-central Namibia. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

B: Domestic Symposiums

1) Fujioka, Y., Nishikawa, Y., and Iijima, M. Coping behavior for food security by agro-pastoralists in semi-arid Namibia under heavy rain and flood disaster (this title is tentative translation from Japanese title).

The Study Meeting of the Association of Japanese Geographers, Autumn 2012, October 6-8, 2012, Kobe University, Hyogo, Japan.

2) Fujioka, Y., Nishikawa, Y., and Iijima, M. Study on actual situation of conventional agriculture towards participatory rural development and examination of feedback method (this title is tentative translation from Japanese title). The Study Meeting of the Association of Japanese Geographers, Spring 2013, March 28-29, 2013, RISSHO University, Saitama, Japan.

3) Yoshiaki Nishikawa, Martha Hangula, Ottilie Shivolo, Benisiu Thomas, Kiyomi Kaida, Yuichiro Fujioka & Morio Iijima. Improvement of Informed Consent by Farmers for Technology Adoption (1) - Application of Farm Sketch in Northern Namibia -. Conference of the Japanese Society for Tropical Agriculture, No.113, March 30-31, 2013, Ibaraki University, Ibaraki, Japan.

4) Nishikawa, Y. Farmers learn and learn from farmers, "Rice cultivation in Northern Namibia". (This title is tentative translation from Japanese title). Public lecture at Nagoya University, Aichi, Japan. 13 July, 2013.

C: Poster presentations

1) 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, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

Annex 12 Presentations at academic conference/seminar in related areas such as the potential cultivation area which does not affect the water environment (related with Indicator 3-2)

(1) Papers submitted (2papers)

1) Suzuki, T., T. Ohta, T. Hiyama, Y. Izumi, O. Mwandemele, and M. Iijima. 2013. Effects of the introduction of rice on evapotranspiration in seasonal wetlands. Hydrological Processes, doi:10.1002/hyp.9970.

2) Hiyama, T., T. Suzuki, M. Hanamura, H. Mizuochi, J.R. Kambatuku, J.N. Niipele, Y. Fujioka, T. Ohta, and M. Iijima 2014. Evaluation of surface water dynamics for water-food security in seasonal wetlands, north-central Namibia. IAHS Publication, No.364, 380-385.

(2) Presentations at international and/or domestic conferences/ symposiums (8 presentations)

A: International Symposiums

1) Hiyama, T., T. Suzuki, M. Hanamura, H. Mizuochi, J.R. Kambatuki, 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-EGU International Symposium on Integrated Water Resources Management, Bologna Italy, June 2014.

2) Kambatuku, J. R., Hiyama, T., Hanamura, M., Suzuki, T., Fujioka, Y., Ohta, T. and Iijima, M. Regional precipitation patterns and their implication for drought-adapted mixed cropping systems in the cuvelai drainage basin, north-central Namibia. Proceedings of SATREPS Rice-Mahangu Project, International Symposium on Agricultural Use of Seasonal Wetland Formed in Semiarid Region of Africa. 47-54. Noyori Conference Hall in Nagoya University, Nagoya, Japan. 13 July, 2013.

3) Dr. Tetsuya Hiyama (Professor), Nagoya University. Analysing water budget of seasonal wetlands based on hydrologi-cal observation data. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

B: Domestic Symposiums

1) Hiyama T. Water of seasonal wetlands in Northern Namibia "Where water comes from and where water disappears to". (This title is tentative translation from Japanese title). Public lecture at Nagoya University, Aichi, Japan. 13 July, 2013.

C: Poster presentations

1) Hamamura, M. Ohta, T. Kotani, A. Suzuki, T. Hiyama, T. Jack Kambatuku, Iijima, M. Analysis of evapotranspiration characteristics in northern area of Namibia towards introduction of rice and pearl millet mixed cropping. (This title is tentative translation from Japanese title.) Research results presentation of Japan Society of Hydrology and Water Resources in 2013. Kobe, Japan. September 25-27, 2013.

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, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

3) Tetsuya Hiyama, Yuichiro Fujioka, Yoshinori Watanabe, Jack Kambatuku, Johanna Niipele, Takanori Nakano, Morio Iijima. Estimating Origins of Surface- and Subsurface-water in Small Wetlands of Cuvelai System Seasonal Wetlands (CSSWs), North-central Namibia. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

4) Hiroki Mizuochi, Kenlo Nishida Nasahara, Tetsuya Hiyama, Johanna Niipele, Yuichiro Fujioka, Morio Iijima. Evaluation of Water Storage at Small-scale Wetlands in North-central Namibia Based on Topographical Model with Satellite Remote Sensing. International Symposium, September 2014. "Agricultural Use of Seasonal Wetlands in southern Africa". 8-9 September 2014.

Annex 13 List of Trainings for Extension Officers of MAWF

No.	Training period	Title of training	Objective	Target	Total participants	Participants by region (MAWF)					Others (farmers, UNAM and JICA)
						Omusati	Oshikoto	Ohangwena	Oshana	Kavango	
1	May 8, 2013	Rice Harvesting and Soil Sample Collection Demonstrations	To assist field staff engaged in survey and sampling of soil fertility		44	18	3	2	4	---	17
2	November 12 to 14, 2013 (3 days)	Training on Mixed Cropping of Rice and Pearl Millet Cultivation	To obtain necessary skills to implement mixed cropping of rice and pearl millet cultivation.	Extension officials around Ogongo area, especially who participated in training course in Japan	16	9	1	1	2	3	—
3	July 31 to August 1, 2014 (2 days)	Evaluation workshop for mix-cropping of rice and peal millet cultivation	To evaluate progress and issues of mixed cropping of rice and pearl millet cultivation.	Extension officials, who participated in Rice-Mahangu training course last year	14	9	2	1	2	---	---
				Total	74	36	6	4	8	3	17

RICE MAHANGU PROJECT

University of Namibia

RICE CULTIVATION, HARVESTING & POST-HARVEST TECHNIQUES

(English)

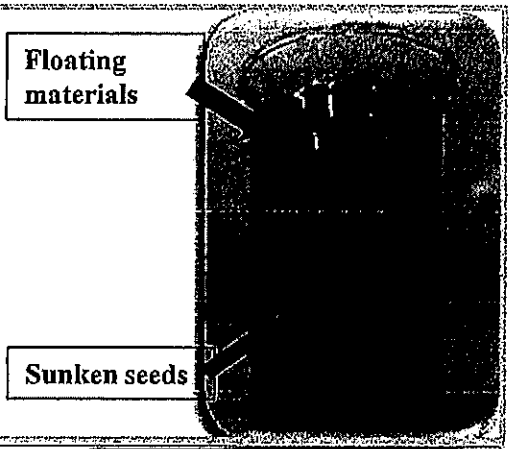
Mar 2013

Ogongo Campus, Department of Crop Science
Private Bag 5520, Oshakati, Faculty of Agriculture and Natural Resources

In Namibia, it has been observed that the productivity of common upland-adapted major crops such as pearl millet, sorghum, cowpea and cucurbits has been recently decreasing due to the effects of flooding. Rice, as a semi-aquatic crop, can grow well under these flooding conditions hence it is essential to urge local farmers to integrate rice cultivation in the local agricultural system in order to insure food security. However, for rice production to be successful, the farmers need to be equipped with appropriate production technologies, including cultivation techniques.

A. Seed selection by water

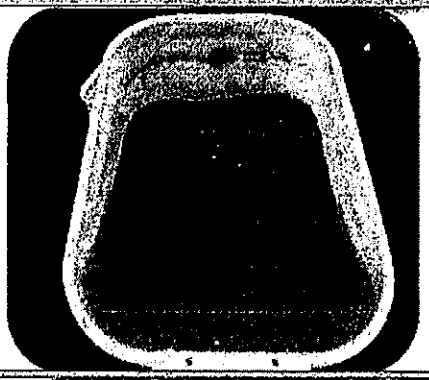
1. Put rice seed in a bucket or basin.
2. Fill the container with water and stir gently.
3. Wait for all the seeds to settle down.
4. Discard all floating materials.
5. Retain the sunken seeds.
6. Wash them thoroughly with clean water and sun-dry them.
7. The seed can then be stored for future use.



B. Nursery and seedling preparation

i) Pre-germination

1. Soak the seeds for 3-6 days.
2. Change the water 2-3 times a day.
3. Shoots will start to emerge from the seed coat.
4. The seeds are then ready for planting in a nursery.



ii) Nursery planting

1. Carefully broadcast the pre-germinated seeds over a damp nursery plot.
2. Cover them lightly with a layer of soil.
3. Label all plots very well for future identification.
4. Keep watering until seedlings emerge from the soil.

iii) Nursery management

1. Water the growing seedlings two times a day.
2. Always keep sufficient moisture in the soil medium.
3. The seedlings can be transplanted to the field after 20 to 30 days of nursery growth.

C. Land preparation

i) Site selection

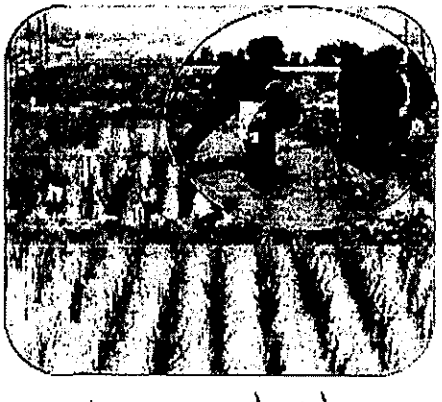
Select a site that can retain water for more than two months, depending on cultivar growth duration (a wetland or *oshana*).

ii) Ploughing

1. Plough the rice field in the same way as ploughing for common crops.
2. Ploughing should be done earlier with the first rainfall before the site is flooded.

iii) Paddling and leveling of the field

1. When it rains, the ploughed site becomes muddy.
2. Break soil clods and level the field by paddling.
3. The field is now ready for transplanting operation.



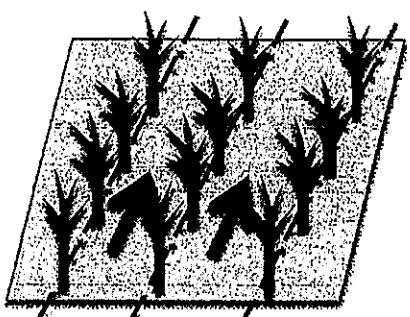
iv)Planting methods; Broad casting & Transplanting

Broad casting: Sowing seeds directly into field (not submerged)

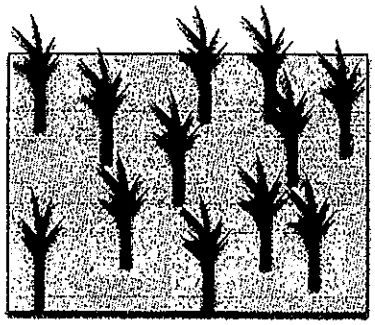
Transplanting :

1. When transplanting, consider the following:
   *Seedlings to be transplanted must be well-watered.
   *Do not damage the roots when separating the seedlings.
2. There are two methods of transplanting:
   Line Planting, Random Planting
3. Transplant one seedling per hill by gently holding the stem and pushing the roots into soil/mud.

Broad Casting



Line Transplanting

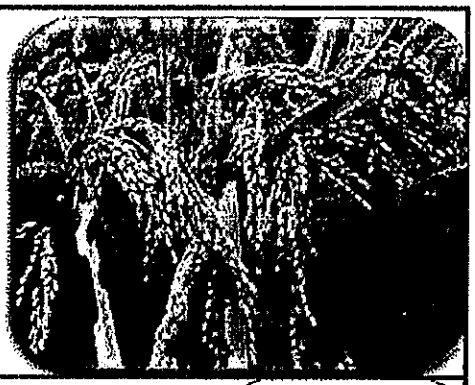


Random Transplanting

HARVESTING & POST-HARVEST TECHNIQUES

Like production management techniques, harvesting and post-harvest procedures for rice require great attention for high final grain output.

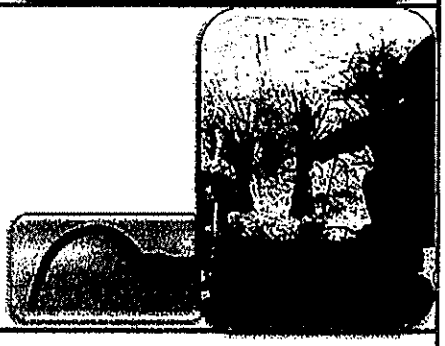
A. Harvesting of rice



i. Harvest after 5 weeks of heading:

1. When grains change colour from green to tan.
2. When the grains become hard as they get dry.
3. When grain shattering is observed.
4. When plant changes colour from green to tan.

i. How to harvest



1. Use a sickle to cut rice stalks 10 cm above the ground.
2. Paddy bunches may be stacked in the plot.
3. This allows further drying of the grains before threshing.

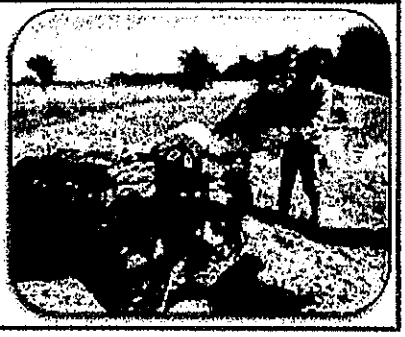
B. Threshing

Threshing of rice can be done in two ways, manually or mechanically.

i) Manual threshing

1. Prepare the threshing ground.
2. Cover the floor with a plastic sheet if necessary and lay a wooden pole.
3. Beat the panicles against the pole.

ii) Mechanical threshing



1. Take a bunch of harvested paddy rice.
2. Hold harvested plants firmly and place the panicles in the thresher.
3. The thresher will separate the grains from the panicles.
4. Ensure that all the grains are removed before discarding the stalks.

C. Winnowing

1. Put a reasonable amount of paddy rice in a basket.
2. Always stand facing across the wind direction.
3. Lift the basket high and calmly pour the grains out.
4. The wind will separate the chaffs from the grains by blowing the chaffs away.

D. Grain drying

1. Sun drying: spread the grains on a drying surface, e.g. plastic sheets or concrete floor and dry them for few days.
2. In-store drying: use storage bags or bins with aeration components, to dry the grains further in the storage.

E. Milling of rice

Milling can be done manually or mechanically.

i) Hand pounding

1. Prepare a mortar and pestle.
2. Clean the milling place.
3. Put paddy rice in a mortar.
4. Gently pound with a pestle to induce force on grains thereby removing the husk and bran layers.

ii) Mechanical milling

1. By this methods, milling and grain cleaning are done at the same time.
2. The milling machine also discharges husks.

F. Storage of milled grains

1. Store the milled grains in clean containers such as glass jars, bins or bags.
2. Close the containers tightly.
3. Keep the containers in a cool place.
4. The milled rice can be stored for a longer period, without losing flavor and nutrients.

Annex 15 Propose Revision of PDM as Version 2

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. 2 (September 11, 2014)

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-pearl millet 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 (X times). 1-2) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least X. 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-pearl millet 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 on study methods of understanding perception and the socio-economic impacts by researchers of UNAM (X times). 2-3) Number of report at academic conferences/seminars on the evaluation method for landscape ecology of the cropping system (X times). 2-4) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least X.	• 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 dependenca 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 (X times). 3-3) Number of publication (paper) submitted to peer-reviewed journals (domestic and/or international) in related area is at least X.	• 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-pearl millet 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-pearl millet mixed cropping system. 4.2 Conduct field trials with farmers who participate in trials on the rice-pearl millet mixed cropping system voluntarily. 4.3 Examine the rice-pearl millet 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 mixed cropping of rice and pearl millet.

2．主要面談者リスト

附属資料-2　主要面談者リスト

(1)　ナミビア国教育省

Mr. Alfred Adriaan Van Kent	Deputy Permanent Secretary, Ministry of Education

(2)　ナミビア大学（UNAM）

Dr. Osmund D. Mwandemele	Pro-Vice Chancellor, Academic Affairs and Research
Dr. Joseph T. Njunge	Deputy Dean, Ogongo Campus, Faculty of Agriculture and Natural Resources (FANR)
Mr. Simon Awala	Lecturer, Department of Crop Science, FANR
Mr. Petrus A. Ausiku	Lecturer, Department of Crop Science, FANR
Ms. Martha M. Hangula	Lecturer, Head of Department of Agricultural Economics and Extension, FANR
Mr. Martin N. Angula	Lecturer, Department of Agricultural Economics and Extension, FANR
Mr. Benisiu Thomas	Lecturer, Department of Agricultural Economics and Extension, FANR
Ms. Ottilie T. Shivolo	Lecturer, Department of Crop Science, FANR
Dr. Jack Kambatuku	Lecturer, Department of Integrated Environmental Sciences, FANR
Ms. Johanna N. Niipele	Lecturer, Department of Integrated Environmental Sciences, FANR
Mr. Teofilus Lwiinga	Field Supervisor, Department of Crop Science, FANR

(3)　農業・水・森林省（MAWF）

Mr. Martin Embundile	Chief Agricultural Extension Officer, Omusati Region
Ms. Agnes Akwenye	Senior Agricultural Extension Technician (AET), Directorate of Agricultural Extension & Engineering Services (DEES) in Outapi, Omusait Region
Ms. Kaunapawa Shapenga	AET, DEES in Ocalongo, Omusait Region
Ms. UUSIKU Aina	AET, DEES in Outapi, Omusait Region
Ms. Wilhelmina Amashili	Senior AET, DEES, Omusait Region

(4)　日本人専門家（研究者）

飯嶋　盛雄	近畿大学農学部　教授
西川　芳昭	龍谷大学経済学部　教授
檜山　哲哉	名古屋大学地球水循環研究センター　教授
泉　泰弘	滋賀県立大学環境科学部　准教授
長谷川　朋子	長期専門家（業務調整/研修）
秋山　真莉	長期専門家（業務調整/研修）

(5)　在南アフリカ共和国日本国大使館

麻妻　信一	公使
山田　朋秀	一等書記官

(6)　JICA ナミビア支所

中村　俊介	支所長
吉田　清史	企画調査員（ボランティア）

(7)　JICA 南アフリカ共和国事務所

大平　崇之	所員

附属資料-3 PDM Version 1 (和文版)

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
ターゲットグループ: ナミビア大学農業天然資源学部(オゴンゴ・キャンパス)教員(約 10 名)、及びナミビア国北中部地域の農民(約 50 世帯)
プロジェクト期間: 2012 年 2 月～2017 年 2 月 (5 年間) Ver. 1 (2011 年 11 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、ナミビア国北中部地域において普及し、現地農家の食料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、ナミビア国北東部地域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得る「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、かつ節水型である稲-ヒエ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(X 回) 1-2) 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 ・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】「稲-ヒエ混作農法」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(X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(X回)	・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	
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) 表流水貯留量変動、水収支、小湿地の水源等のデータ取得 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(X 回)	・研究成果報告 ・学会・セミナー要旨	
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取りまとめられる。	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取りまとめ 4-2) ナミビア大学研究者及び研究協力者による混作農法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 稲-ヒエ混作農法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、季節湿地全域の表流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、稲-ヒエ混作農法の実証栽培試験を実施する。 4.2 稲-ヒエ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得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稲-ヒエ混作農法を検討する。 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 ・車両 (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」:稲とトウジンビエを混作することにより、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。

附属資料-4 PDM Version 2 改定案(和文版) （注: 数値が入っていない部分に数値目標を入れる必要がある）

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
ターゲットグループ: ナミビア大学農業天然資源学部（オゴンゴ・キャンパス）教員（約 10 名）、及びナミビア国北中部地域の農民（約 50 世帯）
プロジェクト期間: 2012 年 2 月～2017 年 2 月 （5 年間） Ver. 2 (2014 年 9 月 11 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、ナミビア北中部地域において普及し、現地農家の食料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、ナミビア北東部地域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得る「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、かつ節水型である稲-トウジンビエ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（X 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 X 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】「稲-トウジンビエ混作農法」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（X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（X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 X 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) 表流水貯留量変動、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（X 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 X 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取りまとめられる。	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取りまとめ 4-2) ナミビア大学研究者及び研究協力者による混作農法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 稲-トウジンビエ混作農法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、季節湿地全域の表流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、稲-トウジンビエ混作農法の実証栽培試験を実施する。 4.2 稲-トウジンビエ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得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稲-トウジンビエ混作農法を検討する。 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 ・車両 (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」:稲とトウジンビエを混作することにより、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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