Generation of a Agricultural technologies to mitigate climate change imposed risks to food security in smallholder farming communities in Western Pacific Countries

Final Narrative Project Report
June 2016

In Partnership with Ministry of Agriculture and Livestock of Solomon Islands, The Department of Agriculture and RuralDevelopment of the Ministry of Agriculture, Quarantine, Forestry and Fisheries of Vanuatu, and The University of Natural Resources and Applied Life Sciences, Vienna, Austria

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FINAL NARRATIVE REPORT

1. Description

1.1. Name of beneficiary of grant contract: **National Agricultural Research Institute (NARI) of Papua New Guinea (**PG-2009-ENG-1809852755)

1.2. Name and title of the Contact person: Dr Birte Komolong

1.3. Name of partners in the Action:

1.3.1. University of Natural Resources and Applied Life Sciences, Vienna (BOKU) (EuropeAid ID number[1]: AT-2007-DPL-2711241106)

1.3.2. Ministry of Agriculture and Livestock (MAL) (EuropeAid ID number: (*derogation sought*)

1.3.3. Department of Agriculture and Rural Development (DARD) Vanuatu (EuropeAid ID number: VU-2009-FSD-1509831023.

1.4. Title of the Action: Generation and adaptation of improved agricultural technologies to mitigate climate change-imposed risks to food production within vulnerable smallholder farming communities in Western Pacific countries

1.5. Contract number: **DCI/FOOD/2010/257-394**

1.6. Start date and end date of the reporting period: 15 February 2011 to 14 February 2016.

1.7. Target country(ies) or region(s):

1.7.1. Papua New Guinea (Five communities at Kopafo (Bena Bena) in Eastern Highlands Province, Alkena & Kiripia (Tambul) in Western Highlands Province, Derin in Madang Province, Murukanam in Madang Province and Hisiu & Yule island in Central Province).

1.7.2. Solomon Islands (three communities at Aruligo in Guadalcanal Province, Buma in Malaita Province, and Hunda & Kena in Western Province).

1.7.3. Vanuatu (three communities at Siviri in Shefa Province, Middle Bush in Tanna Province and Esema (Malafau) in Shefa Province).

1.8. Final beneficiaries &/or target groups[2] (if different) (including numbers of women and men):

Smallholder farmers in stress vulnerable 5 locations in Papua New Guinea (500 households), 3 in Solomon Islands (300 households) and 3 in Vanuatu (300 households). Final beneficiaries are estimated at 2.4 million smallholder crop-livestock mixed farmers in the three countries.

1.9. Country (ies) in which the activities take place (if different from 1.7): Same as in 1.7 above.

2. Assessment of implementation of Action activities

2.1 Executive summary of the Action

The Action 'Generation and adaptation of improved agricultural technologies to mitigate climate change-imposed risks to food production within vulnerable smallholder farming communities in Western Pacific countries' was a five year partnership between organisations of three Western Pacific Countries and the BOKU in Austria as the main partners. This collaboration was the first of its kind for all partners. In particular it was a first collaboration where the three Western Pacific Countries

[1] See footnote 2.

[2] "Target groups" are the groups/entities who will be directly positively affected by the project at the Project Purpose level, and "final beneficiaries" are those who will benefit from the project in the long term at the level of the society or sector at large.

worked together under its own management to implement an agricultural research for development project of this scale.

The specific objective of this Action aimed at increasing the capacity for food production in 11 pilot communities in the three countries (five sites in PNG, three sites in Solomon Islands, three sites in Vanuatu) where precipitation deficits and/or excesses and soil salinity problems are becoming significant threats to agricultural production and productivity. The project team used a participatory action research approach for implementation of project activities wherever possible and appropriate. Needs assessment surveys in all pilot sites laid the foundation for identifying the major constraints and opportunities in crop and livestock production as well as issues relating to soil and water management in the context of emerging climate change imposed risks to food production. A portfolio of site specific options for addressing the specific constraints and opportunities in each of the sites were presented back to the communities and the project team then facilitated a decision-making process in which the representative members of the communities would decide what their priorities were for the implementation of capacity building activities that would enhance food production in those sites. The approach itself was a novelty for the communities that the project team worked with as they were used to and expecting the project team to direct them and tell them what to do.

There were three major strategies used in the Action to enhance food production and household food security. Technologies, strategies and practices introduced into the communities would address a) food availability with better yielding crop varieties, varieties that produce yields under soil moisture deficit or excess conditions, crop varieties with different maturity times that helped to shorten periods of food shortage due to dry season, new crop species that can be stored for longer time such as rice and African Yam or livestock species (e.g. goats and ducks), better livestock feeding systems and management practices, improved soil water and fertility management; b) food access with interventions that helped farmers increase their cash incomes from sale of surplus crops and livestock in local markets and c) food utilization by introducing simple processing methods for staple crops such as cassava, sweetpotato and yam into flour or other products.

The target set in the Action was to reach 500 households in PNG and 300 households each in Solomon Islands and Vanuatu, respectively. Capacity was build in the pilot communities through different learning activities including training workshops, demonstrations, testing and assessment of introduced technologies and practices by model farmers and participatory assessments and feed-back sessions with model farmers and others who participated in the activity. Targets were not reached in all sites and countries. The project was able to reach close to 600 households in PNG, 238 households in Solomon Islands and 225 in Vanuatu where members of this household participated in at least one of the learning activities conducted. At the planning stage of the project, target numbers were not based on actual population figures for each of the pilot sites as the selection of pilot communities was one of the project activities. Many communities in the three countries consist of dispersed hamlets and dwellings and total size of the population was in a number of pilot sites below 100 households in the first place.

Secondary spread of the technologies, skills and knowledge to other neighbouring communities in the three countries was limited by the end of the Action in February 2016. While there are plans by local institutions to build on the project outcomes and make the technologies, practices, skills and knowledge available to other communities as part of their own programme, model farmers within the communities are also now experts in their own right. Much innovation is also happening within communities where such new knowledge and skills are passed to other community members through observations, informal information exchange and community based initiatives.

Summary of achievements:

- Capacity of members in 11 communities in three countries to produce, process, market food or food products has been increased by addressing their skills, knowledge, aspirations and attitudes towards food production:
    - Communities have now access to improved crop varieties that produce higher yields and better quality (cassava, yam, taro, sweetpotato) for home consumption and sale of surplus

- Communities have introduced new crops into their system that enable them to sell to markets to generate cash (vegetables, potato)
- Communities have introduced new livestock species into their system for home consumption or sale (goats, ducks, fish)
- Communities have improved skills to produce their staple crops (improved practices), grow new crops, look after their livestock better (chicken, pigs) and look after new livestock species
- Communities have improved skills to process their local staple crops (sweetpotato and cassava) into livestock feed and food products that can be stored and help to save cost in feeding of livestock
- Communities have been exposed to new ideas and approaches that can initiate changes in attitudes and aspirations

- New Research outputs:
  - Promising drought and excess tolerant sweetpotato accessions identified
  - Improved knowledge on sweetpotato virus prevalence and epidemiology in PNG
  - Best performing NERICA rice variety/ies (1) for cultivation under upland rain-fed condition and (2) under lowland irrigated condition in Laloki (PNG) identified.
  - Improved knowledge on soil moisture retention characteristics and available water capacity of soils to recommend suitable crops, soil and water management practices under present climate and future extreme environmental conditions
  - Improved knowledge on maturity times and groupings of sweetpotato accessions.

Overall, implementation of the Action by the main partner organisations progressed well, although there were initial delays with the mobilization phase of setting up project offices, assembling the project team members, personnel changes and the selection or development of novel or adapted methods and tools for needs assessment and reporting back workshops. Some external factors also had negative impacts on project implementation. Civil unrest in the Aiyura Valley, road and bridge damages from severe weather events preventing travel to project sites in the PNG Highlands, impacts of Cyclone Pam in Vanuatu on pilot communities and the strong El Nino event with a prolonged and severe drought affecting all three countries, all caused some form of delay for project implementation. Despite that the project and pilot site implementation plans were mostly fully implemented. In fact, the El Nino in PNG also came at an opportune time as community could well appreciate the utility of some of the technologies introduced in helping them to better cope with such natural disasters.

Towards the end of the Action, final assessments were conducted in all the pilot sites. Representative were asked to provide their feed-back on the activities implemented in their communities, what they thought was useful in the context of mitigation of, and adaptation to climate change imposed risks and what did not meet their expectations. Those that had been involved with the practical application of the introduced technologies and practices gave their comments. While some interventions were not considered an improvement over their e.g. local crop varieties or practice, in each of the community there was at least one or more technologies that were rated as highly useful meeting the needs of the community for increased food production and income generation. Community leaders expressed on behalf of their community the gratefulness towards the project and EU as the donor for being chosen to be part of the project. This was re-emphasized by the representative of the communities attending the Closing workshop in PNG in February 2016 who gave their testimony on the positive outcomes of the project.

Throughout the project there was a very good professional relationship between the main partners. Partners were generally responsive to each other's needs. There was a good appreciation of the capacities available in each of the partner organisations and organisations made those capacities generally available to support project implementation. Institutional capacity building achievements can be summarized as follows.

- Improved capacity in NARI and partner organisations
  - Skills and knowledge improved for scientists: 4 NARI cadet scientists trained under this project in areas of agronomy, plant protection, socio-economics, water and soil water management), MAL and DARD staff gained skills in project management, on-farm

research methodologies, reporting; VATRC staff had 2wks hands-on training at NARI, PNG on various aspects of livestock – feed mill operations, feed formulation, poultry hatchery management;
    - Extension officers in PNG, VU, SI: learning of new technologies and practices available, skills in using of new technologies and practices
    - Capacity improved in NARI, SI, VU to implement large scale projects, develop and implement M&E plans
    - Infrastructure and facility improvement (Rain out shelter at NARI, MAL Tissue Culture Lab, scientific equipment, egg incubators for Kastom Gaden and VATRC, meteorological equipment for PNG, SI, VU)
- New partnerships established:
    - First collaboration between regional partners (PNG, VU, SI) to implement a Research for Development Project as lead partners
    - A new collaboration and partnership established with BOKU

2.2 Activities and results

Reporting period: 01. April 2015 – 14. February 2016

Activity No.	Activity description	Implementing Body	Status of implementation
Result 1: **Action effectively delivering outputs in a timely, transparent and efficient manner**			
1.1	Action coordination, planning and review; Steering Committee Meetings	NARI (Applicant), BOKU (Partner 1), MAL (Partner 2) & DARD (Partner 3)	In this reporting period another three Project review meetings were held with the project team including Component leaders, MAL and DARD sub-country leaders and other implementing staff (31 March – 1 April, 21-22 July, 29 September 2015). Minutes for each of the meetings are available on the project website http://ard.nari.org.pg/. During the last year of implementation no further formal ACC meeting was held. Final project workshops or meetings were held in all participating countries: • Solomon Islands (22 January 2016 – representatives from MAL departments, Kastom Gaden, Met services and other partner organisations • Vanuatu (4 December 2015 – DARD staged a mini-field day (**Annex 1**) at their HQ in Port Vila with key stakeholders and participating farmers from Malafau and Siviri), followed by a meeting by project team with DARD Management • PNG (4-5 February 2016) – representatives from all project partners (DARD, MAL, BOKU and representatives from various associates (FPDA, DAL, PNGWIADF), representatives from project sites in PNG and other stakeholders (see **Annex 2** for brief summary of the workshop) • Visit of the BOKU economist in November 2015 for final data collection for Economic Analysis of selected technologies (see **Annex 3** for Economic Impact Analysis Report)

1.2	Action offices established, staffed, equipped and managed	NARI, BOKU, MAL & DARD	Action offices at Applicant and Partner institutions and staff were managed as required to support action implementation. Year 4 Financial Reports and Year 5 budget and request for pre-financing submitted in July 2015; Year 5 eligible advance received in August 2015;
1.3	Action Inception Workshops	NARI, BOKU, MAL & DARD	Accomplished as planned during Year 1 from March to May 2011.
Result 2: **Suitable target smallholder communities in PNG, SI & Vu identified, needs-assessed, and participating in the research and development process**			
2.1	Identification of target community groups in areas of PNG, SI and VU at risk from drought, excess rainfall or sea water inundation	NARI, MAL & DARD	Completed and reported in full during Year 1.
2.2	Baseline surveys in target communities and farmer participatory workshops to assess needs, identify pilot sites	NARI, MAL & DARD	All related activities were completed in Year 1 and Year 2 of implementation and reported accordingly in respective interim narrative reports.
2.3	Community meetings for feed- back on interest, active involvement in pilot activities, challenges faced in implementing project activities, etc	NARI, MAL & DARD	Progressively held in selected locations as reported in previous progress reports
2.4	End of Action surveys and stakeholder workshops to get feedback from beneficiaries	NARI, MAL & DARD	• End of Action surveys were held in the three countries: o PNG (3-26 November 2015) o Vanuatu (1-4 December 2015) o Solomon Islands (18-22 January 2016)
Result 3: **Innovative water management & soil improvement strategies/systems to support agriculture under precipitation excess or deficit conditions available to smallholder communities in PNG, SI and Vu**			
3.1	Rural appraisal surveys to assess water accessibility and current water use/management by target communities in PNG, Solomon Islands and Vanuatu, and to identify pilot sites	BOKU, assisted by NARI, MAL & DARD	All planned work has been completed and reported in previous interim progress reports
3.2	Assessment of current and future impacts of climate change with respect to excess, deficit soil water content and salinity in	NARI, BOKU, MAL, DARD, World Vision – Vanuatu, ADRA	This activity has three milestones and all have been 100% achieved: **M 1. CC scenarios for excess, deficit soil water content:** Scenarios for PNG sites developed using MarkSim model, 1 report available 1 SLR study conducted at BUMA (SI) site

	PNG, SI and Vu and to identify suitable technologies to mitigate adverse impacts		1 report available) **M2. Soil water dynamics in SP mound system and effects of excess soil moisture:** Analysis conducted for PNG sites and 1 technical report available (cadetship report, project website) **M3. Meteorological instruments set-up and functional**: 3 automatic rain gauges set-up in Vu and SI each and instruments handed over to meteorological services of respective country. 3 AWS and 3 automatic rain gauges set-up in PNG. Instruments are NARIs property.
3.3	Develop and assess water harvesting methods, ground water availability & dynamics, irrigation techniques and management strategies at pilot sites in target communities in drought vulnerable parts of PNG, SI & Vu	NARI, BOKU, MAL & DARD	**M1. Water management technologies for domestic water use developed on-station for further site assessment** 100% completed – reported previously **M2. Suitable agricultural water management technologies identified** 100% completed – reported previously **M3. Implementation of agricultural water management pilot site activities completed** 3 RWH systems installed in Vu 1 RWH system installed in SI 1 RWG system installed in PNG Irrigation drip kit distributed and training conducted at each site Training on irrigation management scheduling facilitated for project staff from PNG, Vu and SI **M4. Implementation of domestic water management pilot site activities completed** 2 Trainings on water use and hygiene conducted 5 RWH systems and 1 shallow hand-dug well installed (PNG) 10 biosand filter constructed and installed at 2 PNG sites + 2 follow-up trainings
3.4	Develop and assess soil water and soil management technologies under excess, deficit soil water and saline conditions at benchmark sites in target communities of PNG, SI & Vu	NARI, BOKU, MAL & DARD	**M1. Soil and soil water management technologies for soil water deficit and soil erosion scenarios developed and evaluated on-station for further site assessment (100% achieved)** 100% completed – reported previously **M2. Water dynamics of sweet potato mound system and impact of excess rainfall evaluated on-station (100% achieved)** 18 Soil water monitoring sensors, 8 soil temperature and data logger purchased Sensors calibrated Soil water monitoring station set-up at NARI-HRC Aiyura Preliminary results (poster) presented at ISRR conference in Canberra (AUS) **M3. Impact of salt water intrusion on soil**

			conditions monitored and evaluated and strategies to cope with saline soil conditions due to rising sea water level identified (50% achieved) 6 soil water and salinity monitoring sensors and data logger purchased Salinity monitoring station set-up at Buma site SI **M4. Implementation of pilot site activities on soil and soil water management technologies for soil water deficit scenarios completed (100% achieved)** 4 different irrigation drip kits assembled and tested at NAR-HRC Aiyura Drip kits distributed to selected communities in PNG, SI and Vu Training for project staff conducted Trainings for farmers at each site facilitated
Result 4: **Diversification options for crop production and utilization available to smallholder communities in PNG, SI & Vu in areas affected by moisture stress, excess precipitation, or saline soil conditions**			
4.1	Source alternative sweet potato varieties, crops and crop varieties from national and international collections which are tolerant to precipitation excesses or deficits or saline soil conditions	NARI	**100% achieved** Previously reported
4.2	Screening of indigenous germplasm, locally bred and imported varieties of sweet potato and other crops/crop varieties under simulated conditions (*in vivo* and *in vitro*) to assess tolerance to drought, moisture excess and salinity condition , and to identify promising varieties		**M1: Tissue culture lab at Bubia operational** – 100% - previously reported **M2: Tissue culture lab at SI rehabilitated** – 100% - previously reported **M3: All target SP accessions initiated in TC** – 100% (previously reported) **M4: Protocols for *in vitro* screening of SP for drought and salinity standardized** – 100% previously reported **M5: Best-bet SP accessions for tolerance to drought and excess moisture identified for *in vivo* testing** – not achieved **M6: Best-bet SP accessions for tolerance to salinity identified for *in vivo* testing** – 50% **M7: Phenology grouping of PNG SP accessions established** – 100% (draft report available) 102 accessions assessed and 4 phenology groups based on time to maturity identified **M8: Protocols for screening of SP accessions for drought, excess moisture and salinity established** – 100% **M9: Best bet SP accessions with tolerance to soil moisture deficit identified for validation at pilot sites** – 100% 4/24 genotypes identified as drought tolerant **M10: Best bet SP accessions with tolerance to**

			soil moisture excess identified for validation at pilot sites 3/24 for excess moisture tolerance **M11: Best bet SP accessions with tolerance to soil salinity identified for validation at pilot sites** – 100% **M12: PT planting materials of popular farmer varieties available for re-distribution to farming communities** – 100% **M13: Rainout shelter constructed at Bubia** – 100%
4.3	Validation and piloting of sweet potato adaptability to different stresses at pilot sites and introduction of other crops and crop varieties in target communities in PNG, SI and Vu.	NARI, MAL, DARD	**Milestone**: Implementation of pilot site activities completed – 100% • Nerica rice evaluation trial completed with recommendations for promising accessions (report available, see project website) • Vegetable trials at Hisiu completed and farmer field days staged to show case work • Potato trials at Kiripia and Alkena completed and farmer field day staged • Wheat varieties received from CIMMYT and established for bulking. • Cassava and yam trials completed at all sites • Sweetpotato variety trials harvested at all PNG sites; completed at Vanuatu and Solomon Islands;
4.4	Piloting of selected improved cultivation practices for priority staple crops in target communities in PNG, SI, and Vu according to expressed needs	NARI, MAL, DARD	**Milestone**: implementation of pilot site activities completed – 100% • rice harvesting, postharvest and processing demonstrated; rice mill delivered at Yule Island and Middlebush, Vanuatu • trials on yam, sweetpotato and cassava production practices completed at all sites
4.5	Piloting of processing options of sweetpotato and cassava for food, feed, storage	NARI, DARD	**Milestone**: Implementation of pilot site activities completed – reported previously
4.6	Assessment of existing mechanisms for provision of quality seed to farming communities in PNG, SI, Vu and recommendations for improvement.	NARI, MAL, DARD	Activity was not implemented
Result 5. Livestock and fish production diversification options resilient precipitation deficits and/or deficits or soil salinity, and reliant on cost-effective locally produced feed/forages available to smallholder communities in PNG, SI and Vu			
5.1	Assessing the potential for improving farm productivity through diversifying livestock assets and improved	NARI, MAL, KGA DARD, VARTC	**M1: Preferred options for diversification and integrated use of resources are identified** 100% completed – previously reported **M2: Appropriate demonstration trials implemented by nominated model farmers**

	cyclical use of crop and livestock inputs in situations where excess rainfall, moisture deficit or soil salinity conditions are problematic		100% complete –further supply with breeding stock of fish, chicken, ducks and goats to sites in PNG, Vanuatu (esp chicken after Cyclone Pam as part of rehabilitation) and Solomon Islands (chicken, pigs, ducks)
5.2	Sourcing and identifying forages tolerant of excess moisture and saline soil conditions, e.g. grasses, legumes, and multipurpose shrubs such as Mulberry.	NARI, MAL, DARD	**M1: The need and type of forages identified** 100% complete – reported previously **M2: Implementation of pilot site forage development and assessment activities completed** Not implemented due to changed priorities at the beginning of the project
5.3	Pilot test diversified livestock feeding systems in smallholder communities in target communities in PNG, SI and Vu	NARI, MAL, DARD	**M1: Implementation of pilot site improved feeding and management demonstration activities completed – 100% completed** Activities were implemented in all sites that chose this technology option with emphasis on pig and chicken feeding and management systems. In Year 5 remaining activities esp at Tambul sites, Kopafo, **M2: Implementation of preferred livestock integration activities complete – 100% complete** remaining on-farm demonstrations for fish-duck integration at Tambul sites and Yule Is completed in Year 5;
5.4	Assessing existing mechanisms for supplying breeding stock, and demonstrating institutional or community-based breeding facilities	NARI, MAL, DARD	Activity not implemented
Result 6: Linkages and information/knowledge sharing mechanisms established and/or strengthened between researchers, extension providers and smallholders providing suitable conditions for smallholder participation/input in the research process and for dissemination/outscaling of new research-based technologies to smallholders in PNG, SI and Vu			
6.1	Promotion of internet based discussion forums/blogs relating to crops/cropping systems, livestock and water management	NARI	**M1: A Website and Web Blog established** 100% completed – previously reported (http://ard.nari.org.pg/; https://euardproject.wordpress.com/) **M2: Blog posts synthesised** Blog posts synthesised and sent through the website blog throughout Year 5 **M3: Summaries and lessons published/shared among members, partners and stakeholders** On-line database established to store and manage reports, information materials etc from the project
6.2	Establishment / strengthening of multi-stakeholder (including research-extension provider) forums and local institutional linkages	NARI, MAL, DARD	**M1: Review of institutional arrangements and networks at pilot sites in PNG, SI, Vu** 80% complete (Vanuatu and Solomon Islands) previously reported; not implemented in PNG **M2: Stakeholder workshop conducted in PNG** Not implemented **M3: Stakeholder workshop conducted in SI**

	at pilot sites in PNG, SI and Vu		100% implemented – previously reported **M4: Stakeholder workshop conducted in Vu** 100% implemented – previously reported **M5: A quarterly newsletter published** Four issues of project newsletter produced in Year 5 and posted to stakeholders (copies available on the website)
6.3	Resources and methodology developed for the dissemination of adaptation information to vulnerable smallholder communities in PNG, SI, Vu	NARI	**M1: Printed dissemination materials produced** Continued reproduction of printed information materials for dissemination to farmers and stakeholders during field days and other events **M2/3: Electronic dissemination materials produced** (incl. participatory video conducted) • A number of videos were produced on on-farm activities in Vanuatu and PNG and made available of DVDs (also see upload on website); topics included 1. Rope and washer pump technology, 2. Sweet potato silage technology for pig feed, and the 3. Biosand filter technology; 4. Food processing, silage technology, yam improvement and poultry production in Vanuatu) • Radio programmes produced by DARD in Vanuatu • PNG and Vanuatu telecast a series of public awareness on climate change and related stresses and what actions the communities need to take to be resilient and better still the efforts and interventions of the project in addressing those environmental challenges
6.4	Improved capacity and support services for the dissemination of adaptation information to vulnerable smallholder communities in PNG, SI, Vu	NARI, MAL, DARD	**M1: Staff (SI & Vu) exposed and skilled** • The week-long engagement in July 2015 for 3 officers from MAL (x2) and DARD (x1) at NARI Lae for experience sharing, exposing the participants to NARI's information and knowledge strategies, and having a brief hands-on training in selected competency areas. The program covered NARI's policies and standards, publication process, library and information systems, audio-visual production (video, radio), concepts and techniques of writing for the presses, graphics, media practices, selective information packaging, and community engagement; visit to 'The National' newspaper printing plant in Lae, PNG. • Hands-on training on Adobe video-editing software by NARI communication officer for staff in Vanuatu and Solomon Islands **M2: Appropriate but essential tools (software) sourced** • For improved and ongoing in-house production of audio-visual information materials, the project supported the Solomon Island and Vanuatu partner organizations with licensed video editing software packages each - Adobe Premiere Pro CS 6

			• Upgrade of NARI HQ server with appropriate software to better manage internet traffic **M3: Communication strategies produced** Activity implemented with MAL and DARD; an action plan has been developed with DARD but delays in change in leadership with the MAL Communication Department and progress in Solomon Islands was slow. Overall, the milestone was not fully achieved but discussions continue after the project closure in February 2016

2.3 Activities that have not taken place

a) Among the major activities only two activities were not implemented as planned. They are:

Activity 4.4 Assessment of existing mechanisms for provision of quality seed to farming communities in PNG, SI, Vu and recommendations for improvement.

Activity 5.4 Assessing existing mechanisms for supplying breeding stock, and demonstrating institutional or community-based breeding facilities.

As has been reported in previous interim progress reports, the Action had a slow start. It took longer than originally planned to mobilize all resources and the completion of the needs assessment surveys, reporting back to communities and development of pilot site implementation plans took longer than originally planned. This was partly due to the decision taken to work as much as possible in a participatory mode and get maximum involvement of target communities in the decision-making process. There were also considerable delays especially in the first three years with implementation and roll-out of activities in Solomon Islands and Vanuatu, partly due to changing personnel as Sub-country coordinators (Solomon Islands and Vanuatu) as well as changes as Senior Scientist level and the DARD leadership. Hence, especially in those countries implementation of pilot-site activities took almost until the official closure of the project.

Implementation of Activity 4.4 and 5.4 was planned to be done in the last 2 years of the project. However, this coincided also with the peak period of implementation of pilot site related activities and neither of the Partner Organisations had the capacity in terms of scientific staff time with necessary expertise to start with the implementation because all available staff assigned to the action were occupied with implementation of pilot level activities.

The project management supported by the ACC decided to request the EU Port Moresby office at the end of Year 4 for a no-cost-extension of approximately 6 months in which those Activities were to be implemented. However, the request was denied and it was decided to drop those activities to ensure that final site assessments will be done as required before the end of the project.

b) *Activity 5.2: Sourcing and identifying forages tolerant of excess moisture and saline soil conditions, e.g. grasses, legumes, and multipurpose shrubs such as Mulberry*

Also Activity 5.2 was only partly implemented. During needs assessments and subsequent participatory community selection process of pilot site actions it appeared that there was little interest by communities in grazing livestock species and the sourcing and assessment of forages tolerant to abiotic stresses was dropped from the activities to be implemented.

c) Overall, probably >90% of the planned pilot site activities were implemented in the three countries. **Annex 4A-I** for the respective PNG sites and country reports from Vanuatu and Solomon Islands.

Some activities, e.g. in the Result 3 Soil/Water Management had to be revised to meet project schedule and deadlines. By nature, effects of treatments for improving soil conditions, water management etc are longer term and require several seasons to be fully appreciated by target communities. With the initial delays in project implementation, there was not sufficient time to implement the planned activities and instead more feasible activities were chosen.

There were at times considerable delays in implementation in Solomon Islands and Vanuatu and some site activities were not or not fully implemented. Already mentioned were the delays in office

mobilization in both countries and changing project personnel due to a) non-performance or b) staff moving on to other jobs or positions. Other major reasons included:

Vanuatu: Cyclone Pam hit the country in March 2015 and had quite devastating effects on the work done so far by DARD in the three pilot sites. Farmers lost farm structures erected for the poultry activities, crop trials (notably yam and cassava) were destroyed and planting material lost. DARD staff were for several months re-assigned to assist with the disaster management.

Solomon Islands, Vanuatu, BOKU: During Year 4 and 5 it became increasingly difficult to transfer project funds from the PNG Main project account to partner accounts because of foreign currency transfer restrictions by the Bank of PNG and delayed approvals by BPNG to Westpac Bank to proceed with the transfer. Both, DARD and MAL did not have sufficient financial capacity to advance funds from other funding sources and implementation of pilot site activities was adversely affected.

Implementation of activities by the soil and water project team, located in Aiyura, Eastern Highlands Province was affected by several issues. A damaged bridge connecting Aiyura with the town of Kainantu prevented the project team accessing any of the project sites for a period of more than 6 weeks in 2014. There were other shorter term road blockages that hindered timely visits to project sites. Completion of activities in Kopafo (EHP) was disrupted due to a tribal fight that erupted in the second half of 2015 dividing the village and preventing full completion of soil/water activities at that site.

2.4. What is your assessment of the results of the Action?

Include observations on the performance and the achievement of outputs, outcomes, impact and risks in relation to specific and overall objectives, and whether the Action has had any unforeseen positive or negative results. (Please quantify where possible; refer to Logframe Indicators).

In 2013 the project Monitoring and Evaluation Plan was completed and used in the remaining time of the project to monitor implementation progress. A copy of the M&E plan is available on the project website (http://ard.nari.org.pg/). During the development of the M&E Plan, it was also necessary to revise the Logframe and relevant Indicators to reflect changes in priorities in the target sites that arose from the needs assessments earlier in the project. Indicators defined in the M&E Operations Plan matrix are used in the following assessment. Further information for this assessment has also been derived from the final pilot site assessments that were conducted for all sites (**Annex 4A-H**).

Result 1: Action effectively delivering outputs in a timely, transparent and efficient manner.

Overall, the assessment of implementation progress over the lifetime of the project was satisfactory. As reported in previous Interim Reports, progress of implementation was slow in the first 2 years, however, pace picked up and planned activities were as effectively rolled out as possible in Year 3-5 taking factors of the external environment into account that were beyond the control of the project such as tribal fights (case of Kopafo in PNG), natural disasters (case of Vanuatu with Cyclone Pam, all three countries with the El Nino in 2015), Finance policies by BPNG.

The Action was implemented in a transparent and accountable manner. The project accounts were audited as per Audit guidelines and all Audit reports were unqualified reports and accepted by the Donor. Information on accounts and audit reports was made available to project partners.
The Action Coordination Committee held annual meetings as per project schedule. The meeting minutes were promptly compiled and circulated to partners. The project team met on a regular basis and from Year 3 onwards met on a quarterly basis to discuss project implementation progress, arising issues or opportunities and revise if necessary implementation plans to responds to delays or other issues. Meeting reports were produced and circulated to the project team and other relevant project stakeholders.

The BOKU economist also delivered the planned economic impact analysis on interventions implemented by the project. There were initial delays and some personnel changes. The person later

appointed by BOKU to conduct the analysis visited PNG twice (July 2014 and November 2015) to familiarize himself with local conditions, discuss data collection and plan of action. During the second visit he was able to join the project team in some of the final assessments at project sites in PNG. The economic assessment report can be found in **Annex 3**. Due to lack of quantitative information on production area, yield of crops under local conditions, performance of livestock under traditional practice, market prices for most products, established economic benefits or economic impacts may only be taken as indicative. However, it shows that relatively simple improvements in agricultural production practices can result in substantial economic impacts. Table 1 shows some quantifiable benefits. The report in Annex 3 provides an explanation on the assumptions and the model that is basis for those figures. The report also highlights that there are numerous non-quantifiable economic impacts.

Table 1. Quantifiable economic impacts from EU ARD project interventions at pilot sites

	Tambul	Derin	Murukanam	Hisiu/Yule	Kopafo	
Pig Feed	948,433*	547,071		948,433	0	
Poultry	120,859		62,321	157,692	62,156	
Fish-Duck Integration			0			
Ducks			12,000			
(African) Yam					0	
Sweet Potato		0	0	0		0
Drip Irrigation		0		0		
Soil Management	0				0	540,000
Site Total	1,069,292	547,071	74,321	1,106,125	62,156	540,000
TOTAL	**3,398,965**					

*Figures are in PGK

Result 2: Suitable target smallholder communities in PNG, SI & Vu identified, needs-assessed, and participating in the research and development process

A summary of the achievements in Results 2 is provided in the relevant Component Report (**Annex 5**). This result was primarily concerned with establishing the capacity building needs of participating communities in the 11 pilot sites in the areas of water/soil management, crop diversification and management and livestock diversification and management to respond to challenges to agricultural production from climate change induced changes to weather patterns and seasons that affect their food security. In the course of project implementation, this result also included activities to monitor community participation and response to activities implemented and to gather views and opinions of community representatives on the final achievements of the project in their communities.

The project succeeded in implementing a customized set of capacity building activities that targeted identified constraints and opportunities in the different pilot sites and that were chosen by a majority of participating community members to be a priority for their community at the time. The project anticipated to target 100 households in each of the locations. During the needs assessment survey between 72 and 41 households were surveyed using the semi-structured survey instrument.

The next community engagements that were part of the process to agree on priorities per site were the reporting back workshops. Numbers varied here between 193 (Hisiu/Yule Island) community members being part of the prioritization process and voting on preferred options to only 19 in Malafau (Vanuatu).

Table 2. Needs Assessment Survey – number of household surveyed

	D	M	T	H	K	A	Hu	B	S	Ma	Mi
# **Households surveyed**	55	51	59	50	53	51	54	41	72	60	54
# **community members voted on priorities (Total, m/f)**	48 (24/18)	40 (30/10)	157 (115/42)	193 (99/94)	101 (74/27)	46 (25/21)	33 (13/20)	41 (28/13)	33 (26/7)	19 (10/9)	46 (28/18)

Sites: D – Derin, M – Murukanam, T – Tambul (Alkena/Kiripia), H – Hisiu/Yule Island, K – Kopafo, A – Aruligho, Hu – Hunda/Kena, B – Buma, S – Siviri, Ma – Malafau,

Participation during the various capacity building activities including learning workshops, demonstrations, also varied. Learning workshop sessions usually attracted between 20-40 participants and overall the total number of community members that participated in at least one of the learning workshops exceeded in a number of sites 100 households. In most activities after the learning workshops that were open to all interested community members, model farmers were selected to try out the new or improved technologies or practices and those numbers were generally between 4-20 community members depending on the technology tested. Table 2 shows summary of community members that participated in learning workshops conducted as part of major outputs to be achieved at pilot sites.

Participating community members were generally expressing positive views on any of the technologies and practices that they tried out or were able to validate themselves. However, at times concerns were expressed about continued access to certain ingredients (e.g. a concentrate to be added to feed formulations based on local feed).

Other feedback from communities can be found in **Annex 4A-I**.

Result 3: Innovative water management & soil improvement strategies/systems to support agriculture under precipitation excess or deficit conditions, identified/developed, piloted and available to smallholder communities in PNG, SI and Vu.

The detailed summary of achievements for this Result can be found in the Component report in **Annex 6** and the various pilot site achievement reports in **Annex 4A-I**.

a) Rural Appraisal surveys to assess water accessibility and current water/use management by target communities in PNG, SI and Vu and to identify suitable sites for pilot testing conducted.

The rural appraisals were conducted at the beginning of the project by Dr Dominik Ruffeis the post-doctoral fellow from BOKU who coordinated this component with the assistance of postgraduate students from BOKU. The findings have been reported (see **Annex 6** for a list of such reports) and the knowledge gained in the surveys was used to design appropriated interventions in the area of water management in respective pilot sites.

b) Assessment of current and future impacts of climate change with respect to excess, deficit soil water content and salinity in PNG, SI and Vu and to identify suitable technologies to mitigate adverse impacts completed.

The activities in this Result 3 outputs involved a mixture of field and desktop studies. There is an improved knowledge now on the utility of some of the available global climate models for developing climate change scenarios for various stresses like excess moisture, drought and salinity. There is also an increased knowledge on the impact of CC scenarios on soil water conditions and salinity and potential impact on crop production. Reports and relevant recommendations have been produced.

The project also assisted in increasing the capacity of NARI, DARD and MAL for monitoring relevant weather data especially rainfall with procurement and set up of automatic rain gauges and automatic weather stations. Equipments set up in Solomon Islands and Vanuatu were handed over to the respective meteorological services, while in PNG equipments were used in pilot sites but were retrieved at the end of the project as continued use by communities could not be ascertained. However, those equipments have increased NARI's capacity for weather monitoring and AWS have been set up securely at NARI establishments in the country.

c) Water harvesting methods, ground water availability & dynamics, irrigation techniques and management strategies in target communities in drought vulnerable parts of PNG, SI & Vu developed and assessed at pilot sites.

This Result 3 output was concerned with management of water for domestic use and agricultural use. During needs assessment surveys and reporting back workshop supported by the information from the water surveys, some pilot communities (Derin, Kopafo, Middlebush) were mostly concerned with improving their access to potable drinking water and relevant capacity building activities were incorporated in the site implementation plans. At the same time there was also great interest to improve their agricultural production during dry periods with simple irrigation measures. Achievements of the project include:

Adaptation of a Biosand filter system for production of drinking water (as per WHO standards) using any water source available. This system was successfully trialled and used in the two PNG sites at Derin and Kopafo. This technology greatly helped the Derin community with access to clean drinking water during the severe El Nino event in late 2015. The project has developed an extension booklet on this technology and produced a video that shows the construction of this system in a step-by-step mode. Both publications can be accessed on the project website.

The project also adapted and tested initially on-station the use of simple drip irrigation systems supported with simple mechanical pumps (e.g. treadle pump) or in conjunction with Rain Water Harvesting systems using tanks. Those systems were later trialled in the sites that had expressed interest in this technology (Kopafo, Hisiu, Middlebush, Malafau, Aruligho). All interventions were accompanied with relevant learning events including trainings, demonstrations and participatory assessments by communities. **Annex 7** shows an overview of the range of learning events conducted in the pilot sites for each of the major project results and **Annex 8** shows an overview of number of community members trained in the different major outputs that were achieved in the sites. Table 3 shows a summary.

Table 3. Summary of approximate number of community members with knowledge, skills and access to technologies in soil and water management in pilot sites

	PNG	**Solomon Islands**	**Vanuatu**
Approx. no. of people trained	197	70	33
male	123	47	22
female	74	23	12
Notable technologies/practices	6 Rainwater harvesting systems (RWH); 1 hand-dug well; 10 biosand filter; Irrigation drip kits	1 RWH system, Irrigation drip kits, Salinity monitoring station	3 RWH systems, Irrigation drip kits

The major outcome of this output is that in each of the pilot sites that elected to implement water management related activities there is now a greatly increased capacity to access potable water and improve their agricultural production through supplementary irrigation. While it is difficult to provide exact figures, it can be estimated that eg at Derin, PNG now about 1000 community members have now access to clean drinking water (based on a consumption of 2-4l/person/day). Baseline in all those communities was considered as little or nil knowledge and nil technologies available. A core group of community member are now equipped with skills, knowledge and the means to implement and there is a great willingness to share.

d) Soil water and soil management technologies under excess, deficit soil water and saline conditions developed and assessed at benchmark sites in target communities of PNG, SI & Vu

Issues with soil fertility were reported in almost all sites in PNG, Solomon Islands and Vanuatu but not all communities considered it a priority. The project did improve the knowledge of most pilot site communities on the soil fertility status of their food gardens. Soil samples were collected, analysed and results reported back to communities with explanations and recommendations on what can be done to improve soil fertility. In a few communities as per their priorities, demonstrations were established to show the effects of soil erosion and demonstration of management practices such as the use of vetiver hedgerows.

Increase of soil salinity due to climate change effects was one of the stresses to be considered in this project. However, initial surveys showed that those communities in coastal areas that had potentially problems with salinity as identified in desktop studies, in fact did not consider this a problem as they moved their food gardens inland in cases where there was a threat of salt water intrusion. The only site where salinity appeared to impact food production was at Buma, Solomon Islands, basically because the community consisted of settlers from another area and they could not move their gardens inland. The project established a salinity monitoring station at Buma. This is a long-term study and is still on-going with the MAL scientist continuing to monitor the situation.

Result 4. Diversification options for crop production and utilization available to smallholder communities in PNG, SI & Vu in areas affected by moisture stress, excess precipitation, or saline soil conditions

A more detailed overview of results achieved in this component can be found in the component report in **Annex 9** and the various site reports in **Annex 4A-I**.

a) Alternative sweet potato varieties, crops and crop varieties from national and international collections which are tolerant to precipitation excesses or deficits or saline soil conditions sourced

This output was fully achieved. Table 4 shows an overview of crops and number of crop varieties assembled and source of the materials:

Table 4. Overview of crops and crop varieties and their source assembled as part of the EU ARD project

Crop species	Number of varieties	Source
Sweetpotato (*Ipomea batatas*)	102	PNG National Germplasm collection (NGC)/
	20	CePaCT[1] climate ready collections (CRC)
	17	MAL Germplasm collection
	10	DARD/VATRC collection
Cassava (*Manihot esculenta*)	10	PNG NGC
	6	CePaCT CRC
	6	MAL collection
	20	DARD/VATRC collection
Yam (*Dioscera rotundata*)	1	PNG NGC
Yam (*Dioscera alata*)	20	CePaCT[1] CRC
Maize (*Zea mays*)	4/19	NARI collection/CIMMYT
Rice (*Oriza sativa*)	2	NARI released varieties
Rice (NERICA)	16	Africa Rice Centre, Benin
Wheat (*Triticum aestivum*)	4/98	NARI collection/CIMMYT
Vegetables (Cabbage, eggplant, capsicum, tomato)	4/6/7/7	AVRDC
Potato (*Solanum tuberosum*)	3	NARI released varieties (CIP)
Taro (*Colocasia esculenta*)	30	NARI released varieties, CePaCT

[1]CePaCT – Centre for Pacific Crops and Trees, Secretariat of the Pacific Community, Fiji

Due to quarantine restrictions all countries had to draw on their own plant genetic resources collections for the major staple crops. It was not possible to exchange directly between countries and due to limitations to tissue culture facilities in Solomon Islands and Vanuatu there were also only limited imports of tissue-culture materials from CePaCT into those countries.

b) Indigenous germplasm, locally bred and imported varieties of sweet potato and other crops/crop screened varieties under simulated conditions (*in vivo* and *in vitro*) and tolerance to drought, moisture excess and salinity condition assessed, and promising varieties identified.

This output was only partly achieved. Among the reasons, which have already been reported in previous interim reports was that the Principal Plant Breeder left NARI shortly after the project commenced and for various operational reasons his position remained vacant. Among the crop species, only sweetpotato varieties were screened *in vitro* and *in vivo* for stress tolerance to drought, salinity and excess moisture.

The major achievements can be summarized as follows:

- Increase capacity to conduct *in-vitro/in vivo* screening of crop varieties in PNG and MAL
    - Small tissue-culture facility at NARI MRC Bubia, Lae upgraded and functional
    - Tissue-culture lab developed at MAL, Solomon Islands
    - Screen house facility upgraded at MRC Bubia (Figure 1)
    - Rainout shelter facility developed at MRC Bubia (Figure 1)
    - 2 NARI junior scientists with increased knowledge and skills in screening sweetpotato in vivo for abiotic stresses
    - Protocols for drought, excess moisture and salinity screening of sweetpotato varieties developed for in vivo screening developed
    - Protocols for salinity screening of sweetpotato for in vitro screening adapted

Figure 1. Rainout shelter and screenhouse at NARI MRC Bubia

- Increased knowledge on crop varieties with tolerance to abiotic stresses
    - Identification of 4 sweetpotato varieties showing tolerance to drought and 3 varieties with tolerance to excess soil moisture conditions (published in a scientific paper - website) through *in-vivo* screening
    - Identification of salinity tolerant sweetpotato varieties among 38 tested *in vitro*

Unfortunately, the screening work of sweetpotato varieties *in vitro* did not progress well throughout the project. The staff assigned to the project was at time not cooperative and his contract with NARI was not renewed eventually. Due to commitments to other projects, the Institute was not in a position to reassign other staff to address the performance issue.

c) Validation and piloting of sweet potato adaptability to different stresses at pilot sites and introduction of other crops and crop varieties in target communities in PNG, SI and Vu

Details about the validation and piloting of sweetpotato and other crops in the different pilot sites in PNG, Solomon Islands and Vanuatu can be found in **Annex 4A-I** and **Annex 7 and 8**. The following

Table 5 shows in summary the list of crops and number of varieties that were validated and piloted in the different sites.

Table 5. Overview of crops and crop varieties validated and assessed in pilot sites

Crop species	Number of varieties	Sites piloted in
Sweetpotato	8 (excess moisture, drought each)	Murukanam, Derin, Tambul, Kopafo, Hisiu/Yule Island Aruligho
Cassava	9 6 20	Murukanam, Kopafo, Hisiu/Yule Aruligho, Hunda/Kena, Buma Middle Bush
Yam (*D. rotundata*)	1 1 1	Murukanam, Kopafo, Hisiu/Yule Aruligho, Hunda/Kena, Buma Middle Bush, Siviri, Malafau
Wheat	4	Tambul
Potato	4	Tambul
Maize	4	Tambul
Taro	34	Murukanam, Derin
Vegetables	Cabbages (4), eggplant (7), capsicum (6), tomato (7)	Hisiu
Rice	2 2	Yule Island Middlebush

The introduction of new crops or new improved crop varieties has now increased the capacity of the participating households to produce more food with many improved crop varieties producing higher yields with the same inputs and surplus can be sold in local markets for income generation. Introduction of early maturing varieties also enables household to get food supply back earlier after stress events (e.g. drought) or to deploy a range of different varieties or crops with different maturity times, hence widening the period of food availability. Introduction of crops such as African yam and rice provides households with options of food storage to bridge lean seasons or extended dry seasons. During final assessments and again during the final workshop in PNG, community representatives from Middlebush and Yule Island were rice was introduced expressed their excitement and gratitude towards for having now the skills and means (the project funded a rice mill each for those sites) to pursue rice production especially since they have experienced the value of stored rice during the severe drought during the 2015 El Nino event. Table 6 shows a summary of number of community members participating in learning events on crop improvement and diversification in pilot sites. **Annex 7 and 8** provide more details

Table 6. Number of community members with increased skills and knowledge using improved crop production practices, new crop species and improved varieties in PNG, Solomon Island and Vanuatu

	PNG	Solomon Islands	Vanuatu
Approx. no. of people trained	315	148	96
male	239	87	64
female	76	61	32
Model farmers	95	26	25

Introduction and exposure to vegetable production at Hisiu has increased aspirations by community members to tap into the lucrative fresh food market in the capital Port Moresby that is readily accessible for this community.

There was only limited spread of the crop varieties to secondary users. The major mode of implementation was that model farmers (usually 3-4 members of the community), who were interested and willing to invest their own labour and land resources established demonstration or on-farm trial plots. At the time of maturity a field day was organised for the community and any interested person could attend to provide their views on the performance, appearance and taste of the different varieties. At the end of the field day, available planting material was distributed to other interested farmers, however, because of low propagation ratios of the predominantly vegetatively propagated crops (sweetpotato, yam, cassava, taro) numbers of seed unit (sucker, cutting, headset) given to each farmer was small. In most cases it was only possible to implement 1 season of demonstration plots due to relatively long growing period of the crops, the need to service many sites and some other delays due to road closures, community unrest etc. The El Nino in 2015 had severe impacts on the planting material supply in many of the pilot sites and many model farmers lost a lot of their planting material.

d) Piloting of selected improved cultivation practices for priority staple crops in target communities in PNG, SI, Vu according to expressed needs

Details on the introduction and piloting of improved cultivation practices for priority staple crops can be found in **Annex 4A-I** and **Annex 7 and 8** which shows the type of learning events for improved cultivation practices that were conducted in the different pilot sites.

The improved cultivation practices that were introduced into pilot sites involved quite basic crop husbandry practices and techniques. For example the simple changes in planting technique at an angle for cassava and sweetpotato instead of erect and only using one tip or one cutting per mound can increase yields considerably. This was a major eye-opener for many participating farmers and there is a high likelihood of adoption for those simple improvements in crop practices as expressed during the final assessments conducted in each of the sites.

Another simple production practice that was introduced was the mini-setting technique for yam and taro which enables farmers to increase their amount of planting material if they have aspirations to expand their area of production. Model farmers who tried out this method and planted their gardens with seed from yam mini-setts reported that tubers are generally smaller than using the traditional head sett but they appreciated the value it helps them to establish bigger gardens. Some also noted that the smaller sized tubers growing from mini-sett seed are more marketable and provide opportunity for higher incomes.

e) Piloting of processing options of sweetpotato and cassava for food, feed, storage

Only in two communities (Kopafo, PNG and Middlebush, Vanuatu), participating households voted for the option of piloting of processing options of sweetpotato and cassava for food and storage. While in Middlebush, the mostly participating women quickly saw the opportunities in the different processing options especially in terms of supporting income generation by selling those locally made products to tourists visiting the volcano on Tanna, there was initially a much lesser acceptance at Kopafo. In fact some women were mocked by their neighbours for being involved in project activities which appear mostly based on internal jealousies or other disagreements. Only few women kept on processing their sweetpotato and cassava. However, during final assessments it was reported that those households that had stored their root crop flour, reported to have suffered a lot less from food shortages during the 2015 El Nino event as they would draw on their flour to produce food products.

f) Existing mechanisms for provision of quality seed to farming communities in PNG, SI, Vu assessed and recommendations for improvement communicated to policy makers

This result was not achieved. There were no activities implemented as explained in section 2.3.

Result 5. Livestock and fish production diversification options resilient to precipitation deficits and/or excess or soil salinity, and reliant on cost-effective locally produced feed/forages available to smallholder communities in PNG, SI and Vu

A more detailed overview of results achieved in this component can be found in the component report in **Annex 10** and the various site reports in **Annex 4A-I**.

a) The potential for improving farm productivity through diversifying livestock assets and improved cyclical use of crop and livestock inputs in situations where excess rainfall, moisture deficit or soil salinity conditions are problematic assessed

This output was fully achieved. The assessment was done as part of the initial needs assessment survey in all sites which led to the identification of preferred livestock diversification options. In most sites, farmers were less interested in introducing new small livestock species such as ducks or goats but opted instead to improve the production and management of their existing resources including pig, chicken and in some cases pond culture. There was also no need to import breeding stock from overseas which would have proven to be a lengthy process. The establishment of three small poultry egg incubators (one each for PNG, Solomon Islands and Vanuatu) proved invaluable as there are very little alternative breeding centres in either of the three countries and supply with breeding stock would have been difficult.

b) Sourcing and identifying forages tolerant of excess moisture and saline soil conditions, e.g. grasses, legumes and multipurpose shrubs such as Mulberry

Based on the needs assessment it was determined that none of the project sites have priority livestock activities that would need substantial improved forage development.

c) Diversified livestock feeding systems and husbandry practices in smallholder communities in target communities in PNG, SI and Vu piloted and assessed by communities

Details on the implementation of activities on diversification of livestock holding and improving feeding and management systems of priority livestock can be found in relevant pilot site reports in **Annex 4A-H and Annex 7 and 8**. Table 7 shows a summary of the number of community members participating in the different learning events conducted as part of this component in the different sites.

Table 7. Summary of community members participating in learning events in livestock diversification and management

	PNG	**Solomon Islands**	**Vanuatu**
Total no. participating	418	203	122
male	301	151	89
female	117	52	33
Model farmer	116	101	92

The implementation of all learning activities in the area of livestock diversification and management has generally drawn the biggest interest among community members in all the sites. An advantage here also proved to be that the cycles of participatory action research including training, demonstration, participatory assessment by model farmers and feedback sessions were relatively short and only took 2-3 months, hence a number of cycles could be implemented per site especially for the chicken and pig feeding technologies.

Livestock was only supplied to model farmers in the pilot communities when required to do the demonstration trials and primarily this was for poultry (ducks and chicken) and goats. For pigs, farmers own stock was used in the demonstrations of improved feeding systems using local feed sources (cassava, sweetpotato). Table 8 shows a summary of the number of livestock supplied to communities in the three countries. In those sites that chose diversification of livestock holdings as a priority, a credit scheme for livestock received. Farmers were expected to pass the same number of animals that they originally received from the project to the next farmers, hence repaying their debt in receiving the animals for no cost. This system was especially successful on Yule Island for goats and chicken.

Table 8. Summary of livestock supplied to pilot site model farmers in PNG, Vanuatu and Solomon Islands

Livestock species	PNG	Solomon Islands	Vanuatu
Chicken (broiler, layer, village chicken)	1450	995	160
Ducks	120	16	n/s
Fish fingerlings	1820	200	n/s
Pigs	n/s[1]	20	n/s
Beehives	n/s	6	n/s

[1]n/s – not supplied

d) Assessing existing mechanisms for supplying breeding stock in PNG, SI, and Vu and demonstrating institutional or community-based breeding facilities

This result was not achieved. There were no activities implemented as explained in section 2.3.

Result 6. Linkages and information/knowledge sharing mechanisms established and/or strengthened between researchers, extension providers and smallholders providing suitable conditions for smallholder participation/input in the research process and for dissemination/outscaling of new research-based technologies to smallholders in PNG, SI and VU

A more detailed overview of results achieved in this component can be found in the component report in **Annex 11**.

a) Internet based discussion forums/blogs relating to crops/cropping systems, livestock and water management established, used and promoted.

A project website (http://ard.nari.org.pg/) and information management system was established early in the project with the assistance from an external expert. One NARI staff received training on database establishment and management in New Zealand. The website can be accessed directly through the above URL or through a link on the NARI website. Further progress in this output was hindered with personnel changes in NARI. Only in Year 3 a more permanent appointment for the component leader position could be made. The Component leader also established a project blog (https://**euardproject**.wordpress.com) and posted approximately 50 items including pictures and stories.

The project database on the website was used by the project team to store a range of project related documents especially the large number of back-to-office and training reports from the various staff travelling to conduct learning events and following up with communities.

b) Regional multi-stakeholder (incl research-extension provider) forums and local institutional linkages at pilot sites in PNG, SI and Vu strengthened.

The project encouraged wider stakeholder participation to enhance improved collaboration and networking in the participating countries. As such four National Information Sharing and Networking Forums were conducted in the Solomon Islands and Vanuatu in 2014. The forums included agricultural organizations and divisions, disaster offices, educational institutions, development partners, the private sector, NGOs, the media, and lead farmers of various communities. They offered opportunities for advocacy and increased sharing of experiences as well as providing options for improved engagement and dissemination of climate change adaptation interventions (**Annex 11**).

For greater visibility, networking and sharing of technologies and positive news stories on project activities; a series of project newsletters were produced and circulated to project partners and stakeholders. Four newsletter issues were produced in 2015 (copies can be viewed on the project website) – which was also the ideal timeframe of the project when most of the information relating to

project activities and particularly the trial results and proven technologies were available for sharing with the stakeholders.

c) Resources and methodology developed for the dissemination of adaptation information to vulnerable smallholder communities in PNG, SI, Vu

Information on appropriate interventions for different climate change vulnerabilities were re-packaged in various information resources and delivered to interested stakeholders at different project sites during the course of the project. The contents and frequency of deliveries were determined by stakeholder priorities, types of technologies adopted and level of inputs. Information on the selected interventions were sourced from NARI (promising releases and recommendations), as well as new knowledge generated through field research at the project sites. They were re-packaged and/or communicated in the form of print publications, electronic dissemination materials and audio-visual products - booklets, posters, brochures, flyers, CDs/DVDs, thumb drives, email and online. Selected posters on drought coping strategies and NARI Toktoks were also printed and supplied (see **Annex 11** for details).

d) Improved capacity and support services for the dissemination of adaptation information to vulnerable smallholder communities in PNG, SI, Vu

Human capacity development through on-the-job training attachments was identified as a key input under the project for organizations capacity development and sustainability. Three officers involved in information and communication activities in the Solomon Islands and Vanuatu were engaged with PNG NARI's Information and Knowledge Programme in July 2015 as part of capacity development support by the project. The program covered NARI's policies and standards, publication process, library and information systems, audio-visual production (video, radio), concepts and techniques of writing for the presses, graphics, media practices, selective information packaging, and community engagement. Team members of the NARI I&K Programme at HQ contributed in delivering this program successfully.

For improved and ongoing in-house production of audio-visual information materials, the project supported the Solomon Island and Vanuatu partner organizations with licensed video editing software packages each - Adobe Premiere Pro CS 6. During the on-the-job training attachment in PNG, the SI and Vu participants were introduced to the software and briefly demonstrated on the basic editing process. The sourcing of the software enables them to produce their own appropriate information packages for television broadcast, DVD distribution to stakeholders and communication through other collaborative interfaces such as online, telephony, etc.

2.5 What has been the outcome on both the final beneficiaries &/or target group (if different) and the situation in the target country or target region which the Action addressed?

The Western Pacific EU-ARD project is a response to an identified need in PNG, SI and VU to assist farming communities in changing their traditional farming practices, food use and preparation as well as adopting strategies to diversify access to food so farming households can better manage the risks from climatic variability and global Climate Change to household food security. The expectation was that participating communities in the three Western Pacific Countries will use the knowledge, skills, technologies, practices, strategies that were introduced by the project team and partner organistions and make lasting changes to their farming technologies, practices and food use and preparation to ensure that household food production and supply is sufficient to meet household needs throughout the year independent of climatic risk factors.

The project has been successful to transfer a large range of new and improved technologies and practices through relevant learning activities into the community. During the initial needs assessment survey it had been established that the baseline for use of improved practices, access to technologies etc was nil to very low throughout the 11 pilot communities. The aim of the project was to involve approximately 100 households per pilot site. Figures on participation of community members in different learning activities in above sections and Annexes 3, 7 and 8 shows that approximate number of participants per learning activity range between approximately 20 to 50 but total number of community members that participated in at least one of the learning activities in the soil/water, crop

improvement and diversification or livestock components exceeds that target in some sites while in other sites the number fall short, e.g. Hunda/Kena in Solomon Islands or Murukanam in PNG. The largest numbers of trained households were achieved in the livestock component for chicken and pig feeding and management system trainings modules.

Table 9. Approximate number of community members exposed to at least one of the learning activities in pilot sites

	K	T	M	D	H	A	B	Hu	Ma	S	Mi
No of people trained	161	186	65	75	111	65	111	52	62	55	108

K- Kopafo, T – Tambul (Alkena/Keripia), M – Murukanam, D – Derin, H – Hisiu (incl Yule Island), A – Aruligho, B – Buma, Hu – Hunda/Kena, Ma – Malafau, S – Siviri, Mi - Middlebush

A major factor is the size of the community in the first place. For example, the estimate of total number of households for Hunda/Kena is only 80. The project was implemented over a period of 5 years and only in Year 3 site implementation gathered pace. It can be assumed that some households were not particularly interested or lost interest over the project implementation period.

The number of community members that actively tried out and practiced the gained knowledge or technologies for themselves is comparatively small in contrast. However, those model farmers now form a knowledgeable base in the community and as they have emphatically stated in the final assessments, they are more than willing to pass on their skills and knowledge to their community members and beyond. As this project still had a strong element of research in form of participatory action research, the emphasis was also not on distributing large number of materials or supporting large number of model farmers. Budget and HR resources were not available for such large scale technology transfer.

In general, those community members that participated have seen and experienced the introduced technologies and practices and through the participatory implementation mode were in a position to form their opinion on the usefulness of the technology/practice in their context. From the final assessments it became clear that some of the introduced technologies would not be adopted as they did not perform better than their own. This was e.g. observed in Kopafo that the introduced cassava varieties did not perform better than the local varieties and farmers did not plan to keep using them. Contrasting to that in all communities where the African yam (*Dioscera rotundata*) was introduced, farmers stated that this yam species better withstands drought and viewed it as an additional asset for their food production system (also see **Annex 3** for community assessment of technology performance). All introduced livestock technologies and practices found strong resonance with participating farmers. They could clearly see the improved performance of their livestock and mostly translated this into increased income earning opportunities. The economic impact analysis (**Annex 3**) e.g. calculated an annual cost advantage per farmer for using sweet potato silage technology for feeding pigs at K2,973. Table 10 shows a comparative analysis based on observations at Hisiu/Yule Island pilot sites of productivity of village chicken compared to improved chicken management practice.

Table 10. Productivity of the village chicken compared to improved management practice.

Parameter	**Scavenging village chicken**	**Improve management of village chickens.**
Age at mature weight (weeks)	>24	22-24
Egg production (eggs/hen/year)	30-35	>60
Egg weight (g)	30-45	>49
Mature weight (kg)	1-1.6	>1.8
Mortality rate (%)	Chicks >15 Adults 10-15	Chicks<5 Adults <5

In the context of the project increasing the food production capacity of pilot communities was interpreted in a broader sense and the project addressed the food availability, food access and food utilization components of food security. Early during the reporting back workshops and the participatory selection of priorities for each of the communities it became clear interventions that

offered economic advantages and options to earn additional cash income were strongly favoured over options that would purely help producing more of their own food.

In summary interventions supported different strategies to improve food production capacity:

- Increase capacity to produce more by using improved and higher yielding varieties, livestock feeding and management practices (e.g. PT sweetpotato, potato late blight resistant varieties, high yielding taro varieties, better livestock feeding systems with chicken and pigs growing faster and bigger, producing more eggs)
- Increase capacity to shorten the period of food shortage between the time when no more garden food in the old garden can be harvested and when the crops in the new garden become ready for harvest through diversification of the cropping system or soil water and fertility technologies (e.g. introduction of crop varieties with different maturity times, introduction of short duration crops like wheat, rice, drip irrigation systems, mulching)
- Increase capacity to maintain household food supply during periods of food shortage and maintain nutrient intake by storing food or being able to purchase food (e.g. storing rice, African yam, production and storage of sweetpotato/cassava flour, processing of staple flour into food products for sale at markets, selling of eggs, fish, ducks, pigs etc. to local and provincial markets)

Based on observations and the final assessments, overall there has only been limited spread of knowledge, skills and technologies to secondary users and beyond the pilot site communities. However, there are examples where through the efforts of project partners or project activities more people have already benefitted from being exposed to, participating in field days or receiving actual training and technologies. For examples the field days at Yule Island and Hisiu in October 2015 attracted a large number of visitors from around the pilot communities and model farmers were able to showcase their skills and the use of the new technologies and practices to neighbouring communities. This has created a great interest among those communities. The Central province Department of Agriculture Advisor also got a first-hand impression and has made plans to build on project achievements and support the further dissemination of project outputs. The current Member of Parliament pledged on that occasion support for the procurement of a tractor to the Hisiu Community.

Also in Vanuatu, DARD has received many requests from other parts of the country for access to and training on some of the livestock feeding systems especially the silage technology, processing of cassava into food products and rice production after hearing radio programmes or reading news articles on project activities in the pilot sites. The Vanuatu TVET sector strengthening programme made use of the introduced technologies and practices and conducted trainings on the silage technology and pig husbandry in other parts of the country (workshop report can be found on the project website)

The overall objective of the project anticipates that project outputs and outcomes make a contribution to the mitigation of climate change associated risks to food security and livelihoods for vulnerable smallholder communities in the three Western Pacific Countries. There is no doubt that Actions such as this project make a very important contribution to the mitigation and adaptation of subsistence agricultural systems to climate change associated risks and impacts. As a result of inefficient technology transfer mechanisms in countries like PNG, Solomon Islands and Vanuatu communities are starved of information on improved agricultural production practices and technologies and coupled with the low levels of education and poor access to new technologies and knowledge agricultural and rural development remains stagnant. Most of the technologies and practices introduced to communities through the project are very simple improvements but have the potential to result in large economic impacts (**Annex 3**).

The needs assessment survey at the beginning of the project showed that in general households are not too concerned about food security in general. Periods in the year where garden food is in short supply are normal occurrences and most communities have alternative food sources to draw on during those periods. It is also not considered a major issue to reduce the number of meals or have smaller meal sizes. Most households also supplement their food supply with food purchased from the store. Based on that, the interventions in the project have helped to strengthen those already existing strategies. The great interest of communities in any interventions that promised some economic returns is in line with

the strategy that cash income is viewed by communities as an important mean to overcome periods of low food supply. It is therefore important to continue to provide communities with access to improved technologies, options to increase their knowledge and skills and provide on-going technical support and with that enable communities to manage themselves the seasonal variability in weather and climate. Extraordinary natural disaster such as Cyclone Pam in Vanuatu or the strong El Nino event in 2015/2016 in the Western Pacific which can cause severe shocks to the food systems of communities cannot be mitigated through changes in agricultural production practices and improved technologies. Management of food security perils caused by those events continue external support in form of food or other aid.

Institutional capacity development outcomes:
Aside from the outcomes at the level of the target communities, the Action also resulted in a number of institutional capacity building outcomes. Capacity of staff to conduct participatory action research was improved in NARI, MAL and DARD. Staff gained additional skills and knowledge not only in technical areas but also in project management and administration. Four graduate scientists were supported through the Action to conduct their Cadetship training in NARI and contribute to the project with new scientific knowledge and outputs. They include:

- Promising drought and excess tolerant sweetpotato accessions identified
- Improved knowledge on sweetpotato virus prevalence and epidemiology in PNG
- Best performing NERICA rice variety/ies (1) for cultivation under upland rain-fed condition and (2) under lowland irrigated condition in Laloki (PNG) identified.
- Improved knowledge on soil moisture retention characteristics and available water capacity of soils to recommend suitable crops, soil and water management practices under present climate and future extreme environmental conditions
- Improved knowledge on maturity times and groupings of sweetpotato accessions.

The Action also contributed in capacity building in other areas including the upskilling of extension officers, developing research infrastructure and support with scientific and technical equipments. The following provide a summary of such outcomes:

- Skills and knowledge improved for scientists: 4 NARI cadet scientists trained under this project in areas of agronomy, plant protection, socio-economics, water and soil water management), MAL and DARD staff gained skills in project management, on-farm research methodologies, reporting
- Extension officers in PNG, VU, SI: learning of new technologies and practices available, skills in using of new technologies and practices
- Capacity improved in NARI, SI, VU to implement large scale projects, develop and implement M&E plans
- Infrastructure and facility improvement (Rain out shelter at NARI, MAL Tissue Culture Lab, scientific equipment, meteorological equipment for PNG, SI, VU)
- First collaboration between regional partners (PNG, VU, SI) to implement a Research for Development Project as lead partners
- A new collaboration and partnership established with BOKU

2.6 Please list all materials (and no. of copies) produced during the Action on whatever format

A large range of information materials, technical and trip reports, posters, videos and radio-programmes have been produced by the project. It is not feasible to attach copies of each of those items as part of this final report. Copies of most materials can be found on the project website (http://ard.nari.org.pg/). The following table shows a summarized list of major materials produced.

Table 11. List of materials produced during project implementation

Type of material	Medium/Occasion
News articles	
Trained farmers get free materials for on-farm trials	Vanuatu daily newspaper
Safe clean water for community	The National (PNG)
Middlebush – Farmers harvest first rice	Vanuatu daily newspaper
EU ARD Project Newsletter (4 editions)	Newsletter
Automatic Rain Gauge equipment for Meteo	Vanuatu Daily newspaper

NARI and DARD host Information and Networking Forum	Vanuatu Daily newspaper
UPDEIT LONG OL ACTIVITIES BLONG NARI EU-ARD CLIMATE JENJ ADAPTESEN PROJEK	Talemoat, Issue 2, 2013 (Newsletter DARD)
NARI starts 5-year El Nino study	The National
Mitigating risks on food security	The National (Focus column)
Ruffeis (2012) Know-how der BOKU gegen Hunger in Melanesien, BOKU News 1/2012.	Newsletter
400-egg incubator for Kastom Gaden Association	AgirkalsaNius March 2013
MAL targets feed solution for poultry farmers	AgrikalsaNius August 2013
Buma farmers back new yam variety	AgrikalsaNius September 2013
New agriculture technologies – key to mitigating climate change	AgrikalsaNius July 2014
Feed tested	Solomon Star (February 2015)
Poster	
How to grow your own capsicum	Farmer field day
How to make your own 30 days compost	Farmer field day
Soil sterilization for your vegetable production	Farmer field day
Vegetable Production Activities	Farmer field day
Progress in implementation of the Western Pacific EU-ARD project	Public events
Project Overview poster	Public events
Project Approach and Process Poster 1 (Needs assessment and Reporting back)	Final Site Assessments, Closing workshop
Project Approach and Process Poster 2 (Voting for preferred options and Results of prioritization)	Final Site Assessments, Closing workshop
Project Approach and Process Poster 3 (Implemented Actions)	Final Site Assessments, Closing workshop
Determination of Soil Moisture Retention Curve for Available Water Capacity and Crop Water Requirement under different Climatic Scenario in Papua New Guinea (Poster by Tai Kui)	Closing workshop
Sweetpotato PT technology	Closing workshop
Evaluation of Promising NERICA rice varieties under Upland (rainfed) and lowland (Irrigated) Environmental Condition in PNG (Laloki) (by Chesly Kobua)	Closing workshop
Rapid screening method for excess soil moisture, deficit soil moisture and salinity tolerance in Sweetpotato (by Cyril Atung)	Closing workshop
Sweetpotato Virus Disease Management (by Wilfred Wau)	Closing workshop
Scientific and technical reports	
Effect on Nutrient Digestibility and Nitrogen Balance in Grower Pigs Fed Three Forms of Blended Cassava Roots (Michael Dom et. al.)	Journal Sustainable Livestock Production in the Perspective of Food Security, Policy, Genetic Resources and Climate Change
Nutrient Utilization in Grower Pigs fed Boiled, Ensiled or Milled Sweet Potato Roots, Blended with a Wheat based Protein Concentrate (Michael Dom et. al.)	Asian Austral-asian Journal of Animal Sciences
Screening sweetpotato (*Ipomoea Batatas*) genotypes under soil moisture deficit condition using stress tolerance indices (Cyril Atung et al.)	Archives of Applied Science Research
Ruffeis D, Kui T, Loiskandl W (2015) *Water balance of sweet potato mounds in Papua New Guinea – The potential impact of climate change on sweet potato development and food security,*	[9th International Symposium of ISRR "ROOTS DOWN UNDER", Canberra, AUSTRALIA, OCT 6-9, 2015] *In: ISRR (Eds.), ISRR9-Poster Abstracts, www.isrr9.com.au*
Crops and Cropping Strategies to Maintain Food Security under Changing Weather Conditions in Papua New Guinea (Tai Kui et al.)	Abstract submitted for poster presentation 'Tropentag' 2016, Vienna (University of Natural Resources and Life Sciences, BOKU)
HOW TO CONSTRUCT , INSTALL AND USE BIO-SANDFILTER (BSF) FOR DRINKING WATER PURIFICATION	Extension booklet (draft)

Determination of Soil Moisture Retention Curve for Available Water Capacity and Crop Water Requirement under different Climatic Scenario in Papua New Guinea (Tai Kui)	Cadetship Final Technical report
Sweetpotato Virus Disease Management (Wilfred Wau)	Cadetship Final Technical Report
Evaluation of promising NERICA rice lines	Cadetship Final Technical Report
Schabschneider H (2014) *Evaluation of the agricultural Conditions in three ungauged watersheds in Vanuatu*,	*Master Thesis, BOKU University, Vienna*
Ulreich A (2013) *Evaluation of the soil and water conditions of smallholder communities in Papua New Guinea,.*	*Master Thesis, BOKU University, Vienna*
Knabl B (2013) *Rural Water Management in Papua New Guinea – Expectations towards Implementing Bodies*,	*Master thesis, University of Vienna*
Videos	
Rope and washer pump technology,	How to do it - video
Sweet potato silage technology for pig feed	How to do it - video
Biosand filter technology	How to do it – video
Food processing (DARD)	Project Field activities
Pig silage (DARD)	Project Field activities
Yam improvement (DARD)	Project Field activities
Poultry management (DARD)	Project Field activities
Activities and field day at Hisiu	Project Field activities
Other	
EU ARD project brochure	Public events
Technology booklet	Project Closing Workshop
28 Technology specific extension leaflets and booklets	See Annex 11 for the complete list
Yam Minisetting Pamphlet (MAL)	Farmers on site& general public during WFD 2014/15 shows in Honiara
Rope and Washer Pump Pamphlet	Farmers on site& general public during WFD 2014/15 shows in Honiara

2.7 Please list all contracts (works, supplies, services) above 10.000€ awarded for the implementation of the action

(since the last interim report if any or during the reporting period, giving for each contract the amount, the award procedure followed and the name of the contractor).

No single contract worth above Euro10, 000 was awarded during the implementation of the project.

2.8 Describe if the Action will continue after the support from the European Union has ended.

(Are there any follow up activities envisaged? What will ensure the sustainability of the Action?)

NARI:

NARI is a research institute with the main mandate of conducting research for development. The project has offered opportunity to further validate and pilot technologies, strategies and practices intended to help communities adapt to climate change associated risks and impacts. NARI also used this project to pilot different approaches in engaging with communities, using participatory tools to facilitate communities to set their priorities for improving agricultural productivity and food production. Valuable lessons have been learned, feed-back on technologies, practices and strategies received which can be applied in future projects or have pointed to gaps in research that need to be addressed in the future.

With a limited capacity to outscale or even upscale successful pilot actions, NARI relies on partner organisations engaged with agricultural and rural development work to build on the project outcomes. There have been good indications at least from some of the provincial DALs that participated to incorporate some of the implemented actions into their own programmes. Recently, a new funding opportunity from ECHO (European Commission Humanitarian Organisation) has been brought to NARI's attention. This EU supported initiative is primarily concerned with assisting communities

most affected by the recent El Nino drought in PNG. This presents an opportunity to build on some of the EU ARD project outcomes and lessons learnt.

Otherwise, NARI is working with a large range of partner organisations such as World Vision, Care International, Oxfam, Women in Agriculture Foundation, FPDA, Provincial and District DAL, Climate Change Development Authority, Children Fund etc. Many of the technologies, practices, strategies introduced to communities in this project, are already being further disseminated through other climate change adaptation initiatives with the assistance of those partner organisations. Insights into the usefulness, appropriateness, feasibility of piloted technologies can now be further communicated to those partners to better meet the needs of target communities.

MAL Solomon Islands:
The partnership between NARI and MAL through the course of the implementation of the EU ARD Project has grown and this is obvious in many areas which include; realising common issues affecting agriculture and livestock development, identifying capacity gaps/needs in both institution, support from NARI through research and technical mentoring and Information sharing between partner institutions.

Livestock feed research was a core part of the livestock activities the EU ARD Project has undertaken thus MAL Livestock Department has a lot of interest in doing further work with. Likewise, MAL Research has pursued the soil moisture dynamic studies as to establish moisture management systems to vulnerable Solomon Islands' communities.
The good partnership that has developed and matured over the years will go a long way when the understanding between NARI and MAL is formalised.

DARD Vanuatu:

Martin: The project have certainly re-enforce partnerships with DARD and Ministry of Livestock including VARTC in a lot of ways particularly in the areas of climate change mitigation related to the project activities and other R&D areas. Some of the approaches they learnt from their participation were incorporated into their farmer extension programs. Further, they have incorporated some policies (in poultry industry) in support of promoting maximum utilization of local feedstuffs.

2.9 Explain how the Action has mainstreamed cross-cutting issues

(such as promotion of human rights[3], gender equality[4], democracy, good governance, children's rights and indigenous peoples, environmental sustainability[5] and combating HIV/AIDS (if there is a strong prevalence in the target country/region)).[6]

In all three Western Pacific Countries, men are the main decision makers in the household and speak out in public meetings. Women are expected to stay in the background and not speak openly. During implementation of the Action, care was taken to encourage as much as possible the participation and involvement of women in all activities undertaken in the pilot communities. In order to ensure that views of women were picked up one way or the other, the project team that went out for the initial needs assessment survey and reporting back workshops consisted of both, male and female staff. Female staff had then the opportunity to talk with the women in their own setting away from the main meeting venue. Most of the interviews with representative households in the pilot communities were also done at the dwelling of the household. While the male head of the household would answer most questions, the wife was free to join and provide her views as well. During the reporting back workshops and voting sessions on priority options to be implemented, the information sessions were done jointly but voting sessions were done separately. This proved very important because even then

[3] Including those of people with disabilities. For more information, see "Guidance note on disability and development" at http://ec.europa.eu/development/body/publications/docs/Disability_en.pdf
[4] http://www.iiav.nl/epublications/2004/toolkit_on_mainstreaming_gender_equality.pdf
[5] Guidelines for environmental integration are available at: http://www.environment-integration.eu/
[6] To refer to EC Guidelines on gender equality, disabilities…

in some instances, the husbands tried to influence their wives on what vote to take but 'secret' ballots avoided most of the undue pressures exerted by husbands on their wives.

All learning events were open to both genders but as can be seen in the number of training participants in previous sections, generally, the majority of participants were male members of the community. Only for activities around so called 'female crops' such as sweetpotato or those targeting mostly the production of own food supplies, a larger number of females participated.

There were no direct actions taken for the mainstreaming of HIV/AIDS which has a high prevalence especially in the Highlands region of PNG. Needs assessment surveys did establish that the prevalence of HIV/AIDS in those particular pilot communities is very low. The response generally was that community members questioned did not know about any person affected by the disease, or that they did not consider it a problem currently, or that those affected by the disease would be well cared for by their families. In Solomon Islands and Vanuatu it was considered an even lesser problem and there were also no further direct actions taken.

2.10 How and by whom have the activities been monitored/evaluated?

(Please summarise the results of the feedback received, including from the beneficiaries.)

The Action has been monitored and evaluated at two different levels – internally by the project team and the Action Coordination Committee and externally through 3 ROM missions and the final assessment by representative of the pilot communities.

The internal assessment was guided by the Project M&E plan. Activities were monitored at site level based on the developed pilot site implementation plans as well as the overall Action level based on the project implementation plan that followed the outline of the Action as documented in the contract. Site coordinators and component leaders monitored on a quarterly basis the progress of implementation of activities and achievement of outputs and project results. The project team also had regular quarterly meetings to review the progress, discuss issues arising and make relevant adjustments to the project implementation schedules. This was also an opportune time to discuss and exchange experiences and draw out lessons learnt.

The external assessment by the three ROM missions was determined by the EC and facilitated through EU office in Port Moresby. Reports and summaries of the first two ROM missions have been previously provided in Interim Progress Reports. The report of the third ROM mission in August 2015 was never made available to the Project team.

The external assessment by representatives of pilot communities was conducted using a Focus group discussion. All pilot site final reports (**Annex 4A-I**) have a summary of responses. In very general terms, communities or those who participated in the Action in the communities overwhelmingly assessed the Action as very useful and expressed their gratitude to the donor, NARI, DARD, MAL for being able to participate and increase their skills and knowledge and be exposed to for them new and improved ways of producing and using food and associated technologies. One farmer at Hisiu expressed the following during the farmer field day that was held in October 2015 *"From the sale of vegetables, my second vision is to put up a high covenant building. I am really blessed. My big thank you to NARI for being with us for five years. They taught us lots of things that we didn't know, for example the rope and washer pump for sourcing bore water for farm irrigation. This system saves us a lot of labour work. Now, things are changing, life is changing, and I want to move with this change!"* – Ikupu Waki, model farmer at Hisiu, PNG; https://www.youtube.com/watch?v=aaX24Wpo2xo

Other farmer statements (also see posters of the closing workshop on the project website):
"With the knowledge gained, I can now grow and harvest more kaukau on the same piece of land and at the same time maintain soil fertility" – Puefa Pokea, model farmer at Tambul, PNG

"NARI's rice has done wonders for the community. While yam and cassava are common foods for the island, rice has performed well and provided an alternate food for families. Think about it – we can produce rice here at Yule" – Matilda Parau, model farmer at Yule Island, PNG

"I wasn't sure when planting only one vine of sweetpotato but it was really surprising when I harvested more tuber numbers and bigger sizes. It was a privilege learning such knowledge. I will continue practicing the new technique" – Model farmer at Aruligho, Solomon Islands

"I took interest and never turned back. Training on improved feeding and general management has helped me develop this ambition. Income from the sale of both egg and meat is good. Asians in Vila frequent my place for meat, which is encouraging" – Shem Loh, model farmer at Siviri, Vanuatu

2.11 What has your organisation/partner learned from the Action and how has this learning been utilised and disseminated?

NARI:
The Action initially posed a challenge to NARI as the Institute now had to move from being one of the 'partners' in a multilateral project to being the 'Lead partner'. The partnership with MAL in Solomon Islands and DARD in Vanuatu in a research for development project was also very new and a first of its kind. An important matter that emerged out of the Action is that PNG and PNG research organisations such as NARI have many things to offer to their partners in other Pacific Island Countries and vice versa. All three Western Pacific Countries rely on external grants and external support for agricultural research for development activities. There are mostly bilateral north-south interactions and partnerships with Australian and New Zealand organisation providing the bulk of the expertise and leadership. While this is much appreciated, the horizontal interactions between three PICs showed that expertise is available and can be well used to address the needs of smallholder communities. Such an horizontal exchange and utilization of expertise should be more encouraged and donors should recognize and support this.

Key to successful implementation onsite is a reliable contact person, who has a good standing within a community and is a well respected person. Another important aspect is to work with motivated model farmers and carefully select innovative lead farmers. While this is often not a decision a project team can and should make, a close collaboration with the community is necessary to identify suitable persons during the project initiation and implementation phase. This however might lead to issues within the community, when too much attention is given to single farmers.

Though the technologies implemented as part of interventions have being proven to be successful on-station, these were at times difficult to prove on-farm due to different perceptions of farmers or miss communication. Clear communication of the main objectives has proven to be of major importance for a successful intervention. In some cases the failure of the project team to clearly explain the purpose and goals of the project has lead to misunderstanding and miss interpretation of the planned activities. Therefore constant and unambiguous communication with the community is of highest essence for the success of project activities.

MAL Solomon Islands:
The Action has brought with it a wealth of skills, knowledge and learning experiences to MAL as an institution and the target beneficiaries. MAL has received a boost to its technical and institutional capacity in terms of research and development through this project partnership. The partnership has come at a right time to complement MAL's ongoing effort to strengthen its research capacity. Regular and consistent technical back stopping received from NARI expertise were overwhelming especially in specific research areas of crops, livestock and soil/water. The technical guidance received from NARI has helped every individual involved to acquire new skills and knowledge which will enhance their capacity in the respective place of work.

For instance, the soil unit of the MAL Research Department can now carry out the soil/water modelling for irrigation scheduling for prolonged dry areas and sea water inundation coupled with king tide impacts on soil moisture of coastal food gardens. This is one research studies among some of the crop and livestock studies destined to be undertaken in the near future by MAL.

Some of the new technologies derived from long years of NARI research work has prove to be technologies suitable for the target beneficiaries. Farmers have easily adopted and utilise these technologies.

DARD Vanuatu:
An input from DARD on this topic was not received.
It can be assumed that most of what was stated by the partners from MAL would also apply to DARD.

3. Partners and other Co-operation

3.1 How do you assess the relationship between the formal partners of this Action

(i.e. those partners which have signed a partnership statement)? Please provide specific information for each partner organisation.)

Partner 1	University of Natural Resources and Applied Life Sciences, Vienna (BOKU), University (Europe-Aid ID number: AT-2007-DPL-2711241106)	Throughout the project BOKU fully met its partnership commitments under this project. The assignment of a post-doc scientist in the area of water management was an invaluable contribution of BOKU as all three Western Pacific Countries have only very little expertise in this important area especially in regards to climate change adaptation. Dr. Dominik Ruffeis has proven to be a reliable and dedicated member of the project team and persevered throughout the 5 years at his base in Aiyura, Eastern Highlands Province with his family under at times trying conditions including a tribal fight that paralysed the Aiyura Valley for several weeks. Prof. Willibald Loiskandl from Boku provided the necessary support and facilitated several postgraduate students from BOKU to do their field work in PNG, Solomon Islands and Vanuatu which yielded important scientific information in soil water issues at pilot sites. BOKU also oversaw and facilitated the engagement of the specialist for the economic evaluation, Mr. Christian Treitler who visted PNG twice to gather required information for the economic impact analysis.
Partner 2	Ministry of Agriculture and Livestock (MAL), Solomon Islands, Government body	MAL delivered reasonably well on its commitments throughout the project. There were initial delays with the start-up of implementation in pilot sites. Staff assigned initially by MAL to the project as country sub-coordinator and senior scientist moved on and new staff had to be assigned. Mr. Jules Damutalau took over as country sub-coordinator and overall competently coordinated project activities in Solomon Islands. Also the project senior scientist, Mr. Jimi Saelea stayed in this position and provided his full support throughout the remaining time even though he was appointed as the Permanent Secretary of MAL in Year 3 of the project. Implementation of activities was affected due to delays in transfer of funds from PNG to Solomon Islands due to restrictions by the Bank of PNG to allow for larger foreign exchange transactions especially in Year 4 and 5 and some activities as a result could not be fully completed as planned.
Partner 3	Department of Agriculture and Rural Development (DARD) Vanuatu, Government Body (Europe-Aid ID number: VU-2009-FSD-1509831023)	DARD also delivered reasonably well on its commitments throughout the project. Similar to MAL, there were also a number of personnel changes in the first two years of the project which affected and delayed the engagement with pilot communities and implementation of site plans. Mr Antoine Ravo after taking over from the previous country sub-coordinator Peter Iesul in Year 3 made a great difference in driving the implementation in pilot sites in Vanuatu and ensuring that

		planned activities are implemented by the end of the project. The project senior scientist role in Vanuatu was assigned to Dr. Roger Malapa of VARTC after the DARD appointee Mr James Wasi was assigned to another role. Cyclone Pam had a major impact on the project. Not only did the cyclone destroy project trials and structures at pilot sites, the agricultural station and DARD Head Office in Port Vila was also substantially damaged. However, the country including DARD showed strong resilience in the face of adversity and were able to recover to some extent within a few months and DARD was able to complete pending project activities.

Contribution from MAL Solomon Islands on this topic:
The formal partners to the Action has their specific roles to play and they have done their part exceptional well. **BOKU** for that matter shows its commitment to the Action avails one of its prolific expertise to work fulltime supervising the soil/water activities in a more systematic and scientific way. Providing their Post graduate studens to certain project sites only adds strength to their commitment for the Action. **NARI** as the leading partner of the Action demonstrates supreme capability and efficiently coordinate available resources for the Action with diligence and responsibility. NARI has offered consistence support to MAL while executing the Action. The most invaluable contribution NARI made to **MAL** was through its human resources who are experience expertise in their own areas.

DARD of Vanuatu however has its sole mandate to implement the Action nationally thus its interaction with MAL as a partner is somewhat insignificant but has less influence on MAL's national efforts. Solomon Islands Meteorological Services (SIMS) and Water Resource Management Division (WRMD) are state owned authorities who have rendered important support in providing data and information for the Action implementation in the Solomon Islands. An understanding has been developed over the course of the Action and that they are avail their support to future climate change related undertakings.

A contribution from DARD for this section was not received.

3.2 Is the partnership to continue? If so, how? If not, why?

NARI, MAL and DARD have formed a strong relationship through the support of the European Union over the past 7-8 years. Aside from the current Action, there were and still are 5 other Actions supported by EU financed programmes that provide assistance in various areas of capacity building and agricultural research for development. NARI has also a formal MOU with MAL for continued collaborations. MAL has already approached NARI for further support in the area of livestock feed formulations based on local resources and also DARD has expressed their interest to further engage with the Institute on promotion of local rice production.

There are at present no plans or more importantly opportunities to continue the partnership with BOKU. A NARI staff has been invited by Prof Loiskandl to make a poster presentation at the 'Tropentag' conference to be staged in September 2016 including financial support for travel expenses. Such exposure is very important for the personal and professional development of young scientists in the country. Otherwise, the contacts to BOKU are very important and are much valued by NARI especially for developing future collaborations using EU funding.

3.3 How would you assess the relationship between your organisation and State authorities in the Action countries?

(How has this relationship affected the Action?)

NARI, MAL and DARD are all government funded organisations and throughout the implementation phase, the project enjoyed smooth and effective collaboration with other relevant Government institutions in Solomon Islands and Vanuatu as well as those in PNG. There were no major constraints

encountered. In Solomon Islands, MAL, the Solomon Islands Meteorological Service and the Water Resources Department worked closely with the project team on planned project activities and contributed where required. Likewise, in Vanuatu, DARD, VARTC, the Vanuatu Meteorological Service and the Department of Geology, Mines and Water Resources have all been readily collaborating with the project team. In both countries, two automatic rain gauges each were officially handed over the the respective meteorological services for initial use in the project but with the understanding that those agencies take ownership for continued use. On needs basis, partner institutions in the three countries handled all formal communications with the other State authorities on behalf of the project, and the project office did not have to deal with them directly. No operational problems of any kind were encountered during project implementation. Limited manpower and research facilities in all the countries appear to limit options for action.

3.4 Where applicable, describe your relationship with any other organisations involved in implementing the Action

- *Associate institutions*: all the nine recognised institutions across the three countries officially associated with the project have contributed to the project in various ways, and none of them expressed any concerns on their involvement in project activities. However, as always there are opportunities to improve the collaborations further, which are elaborated hereunder:
    - Department of Agriculture and Livestock (DAL) of PNG: continued efforts were made to involve provincial and district officers of DAL associated with the five project sites but with only limited success. There was a strong involvement of the Madang Provincial DAL in the two project sites, with district Rural Development Officers accompanying project staff during site visits and being available to monitor trials in the two Madang communities. In Central Province (Hisiu/Yule Island Project Sites) only after a new Provincial Agriculture Advisor was appointed the interest in project activities increased and the new Advisor pledged continued support. The closing workshop was also well attended by relevant Provincial Agricultural Advisors from all hosting provinces (Western Highlands, Eastern Highlands, Madang, Central) and the Director for Food Security from the National DAL. The presentations made by the project team, exhibits and displays on project activities and most of all accounts from community representatives on how communities valued the project contributions impressed the DAL reps.

    - National Weather Service (NWS) of PNG: The NWS was consulted on several occasions especially by the team working on the water/soil component in respect of weather forecasting services, the set up and management of weather stations and access to weather data.

    - Solomon Islands Meteorological Service: Solomon Islands Met services worked well with MAL and have officially taken over responsibility of two automatic rain gauges procured through the project and installed at two of the project sites.

    - Kastom Gaden Association (KGA) of Solomon Islands: Kastom Garden Association (KGA) has provided much needed support in terms of livestock supplies to the Action. KGA stepped up in its village chicken and duck breeding program through the course of the Action to upkeep the target beneficiaries needs for new supply of animals. They have also provided technical assistance through training and advice for the target beneficiaries.

    - World Vision (WV) Pacific Development Group: The PNG office collaborated well on specific activities in the soil/water component with the PNG project team, while in Vanuatu support due to the restructuring of the WV Pacific programme, ADRA (Adventist Development and Relief Agency) stepped in to work with the project team on water harvesting systems in Vanuatu. World Vision Solomon Islands were instrumental in the initial stages of the Action in providing their advisory and exceptional guidance in the surveys and design of activities.

    - Ministry of Mines and Energy – Water Resources Management Division of Solomon islands: the involvement of this government division was not much required based on the needs

assessment exercise. Experts from this division in Solomon Islands will weree invited as part of any stakeholder workshops.

- Vanuatu Meteorological Service: this associate institution was very supportive of project activities throughout the Action. It has also took over full responsibility for the management of newly set up weather stations installed in two of the project sites (Siviri and Malafau).
- Department of Geology, Mines and Water Resources of Vanuatu: The department continued to collaborate with project partner institutions and agreed to provide relevant data to support planning activities of the project.

- Vanuatu Agricultural Research and Technical Centre (VARTC): Senior management as well as technical staff of VARTC were actively engaged throughout the Action in all activities that involved them. They managed the poultry breeding and hatchery unit on behalf of DARD, and supplied breeding chicks for the project sites. One staff had a 2 weeks hand-on training program offered by NARI Livestock Program in Lae, PNG. It happened few months before the cyclone and this improved their capacity to manage the breeding and distribution of chickens. They were also involved in the supply of planting materials for staple crops.

- *Sub-contractor(s) (if any):*
  Only two sub-contracts of Euro 5000.00 each to KGA and VATRC, respectively were awarded as part of this work. The work with ADRA who replaced World Vision for domestic water supply and sanitation work in Vanuatu was based on a mutual understanding to complement the activities that ADRA and this project are implementing independently at the Middlebush project site.

- *Other third parties involved* (including other donors, other government agencies or local government units, NGOs, etc)
  PNG:
  - The Highland Piggery and Farmers and Association: this is a strong CVO active in the highlands of PNG. Their members were actively involved in the project at the Tambul site.
  - The Papua New Guinea Women in Agriculture Association (PNGWiA): this is a gender-based association promoting entrepreneurship by women. The Association has active units operating in two of the five project sites, and was instrumental in addressing emerging gender related issues at site level but also continues to promote the relevant technologies and practices within its network.

  Solomon Islands:
  - Vois Blo Mere Solomon Islands has been part of the Action from the start providing guidance to gender and women empowerment approaches. They also involved at the village level supporting women.
  - Quality Hatchery Ltd.: this private company interested in commercialising a broiler feed formulation being tested in Solomon Islands. They tested the feed and attended stakeholder consultation meetings.

  Vanuatu:
  - Department of Livestock (DL): DARD, the partner institution in Vanuatu, does not have expertise in livestock production because of the scope of its mandate. Thus the DL was invited by DARD to be directly involved in the project to take care of planned livestock related activities in Vanuatu. The department designated one of their livestock officers who took lead responsibility in this regards.
  - Farm Support Association (FSA): a local NGO involved in extension of agricultural technologies at village level; it was represented at all consultations in Vanuatu. Their farm input trading wing has been very useful in supplying inputs around project sites. They are therefore engaged in discussions about commercialising a feed formulation that the project is testing in Vanuatu.

3.4 Where applicable, outline any links and synergies you have developed with other actions.

PNG:

NARI has and still is implementing a number of climate change adaptation projects:

- 'Adapting clonally propagated crops to climatic and commercial changes' (DCI-FOOD/2010/230-267) - strong synergies weren developed by using some of the same project sites in PNG (Derin and Murukanam in Madang Province) for implementation of project activities that meet either of the projects objectives. Another EU funded project 'Enhanced food security through preservation and improvement of genetic diversity of sweetpotato and aibika in PNG and Solomon Islands' (EuropeAid/130381/D/ACT/ACP) also had direct links by developing crop varieties tolerant to climate change induced stresses.

Solomon Islands:

- Pacific Adaptation for Climate Change: this project is on-going covering wider areas of the country. Information generated in this project was made available for other areas through this Action.
- Enhancing resilience of communities in Solomon Islands to the adverse effects of climate change (SWoCK): a major broad project financed by the UNDP and complementary to this Action, with substantial complementarities with this Action.
- Rural Development Project (RDP) financed by the World Bank with focus on strengthening services, like agricultural extension.

Vanuatu:

- SPC-GIZ project on Coping with Climate Change in the Pacific Islands Region: this project operates in close collaboration with this Action and showed interested in extending proven technologies in Vanuatu beyond the three project sites.
- Increasing Resilience to Climate Change and Natural Hazard (IRCCNH): this multi-institutional project financed the World Bank was launched in December 2012. Its activities are complementary and synergistic to that of this Action.

3.5 If your organisation has received previous EU grants in view of strengthening the same target group, in how far has this Action been able to build upon/complement the previous one(s)?

(List all previous relevant EU grants).

EU/ACP (EuropeAid/127860/ACT/ACP) funded projects awarded to NARI indirectly supported this Action as they targeted agricultural researchers, research managers, extension staff in PNG, Solomon Islands and Vanuatu in building research skills and competencies in various areas and disciplines. There are no previous EU grants to our knowledge that supported any of the target groups in the various pilot sites.

3.6 How do you evaluate co-operation with the services of the Contracting Authority?

The Contracting Authority in this case was represented by the EU office in Port Moresby. Throughout the implementation of this Action the assigned Programme Officer, the Finance Officers and the Programme Manager provided their full support to the Action Coordinator. They provided guidance and were open to discuss any arising issues regarding the contract, budget queries or other queries. The presence of the Contracting Authority in the country and the option to seek personal contact either via telephone or even face-to-face meetings was very helpful for the effective and efficient management of the Action and should be something to be considered for all EU –funded actions especially in countries very distant to the EU Headquarters in Brussels. The local office was also in a much better position to appreciate the particular difficulties of implementing such an Action in the three Western Pacific Countries.

4. Visibility

How is the visibility of the EU contribution being ensured in the Action?

Many of the visibility actions have been reported in previous Interim Narrative Reports. Among the main actions were project signboards displayed in front of the project offices at Head Offices of Partner Institutions, site level sign boards (Figure 2) identifying relevant activities and actors.

Figure 2. Pilot site Signboard at Derin, PNG (after 5 years) and Hunda & Kena, Solomon Islands

All project assets, including field vehicles and office equipment were marked with project stickers. Project offices are also identified by similar stickers. The project used its own letter head with appropriate EU visibility marks included.

As part of visibility and publicity the Action also supported the printing of publicity T-shirts, caps and mugs with the project logos. Figure 3 shows a couple of sample items.

Those publicity items were given to project model farmers and field extension staff working directly on site level project activities. In all stakeholder and community level consultations, the contribution of EU has been acknowledged and recognised. The project held two National Information Sharing and Networking Forums for Vu and SI Stakeholders. The Vu workshop took place at the Melanesian Hotel, Port Vila, on June 26 2014, while in Honiara (SI), it was at the Hyundai Mall on August 15 2014.

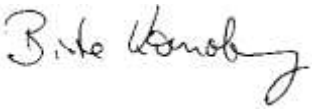
Figure 3. Project publicity shirts and mugs

An number of publicity articles were published in the local media outlets (new papers, radio, newsletters) reporting on project activities and acknowledging the support of the European Union. As reported in previous sections of this report quarterly issues of Newsletters of partner institutions, namely NARI Nius for NARI, Agrikalsa Nius for MAL and Talemaot for DARD published articles providing updates, promoting project work and recognising the contribution from EU. The NARI website (http://www.nari.org.pg/) ran short news stories related to the project and a project blog was also established (http://euardproject.wordpress.com) that supported the exchange of information and knowledge and provides a forum for discussion.

The European Commission may wish to publicise the results of Actions. Do you have any objection to this report being published on the EuropeAid website? If so, please state your objections here.

No objections at all

Name of the contact person for the Action: …**Birte Komolong**……

Signature: …  ……Location: ……**Lae**……

Date report due: ….**July 2016**……..…Date report sent: ……**June 2016**……

Annex 1: Final stakeholder engagements in Vanuatu – Impressions of the Mini-field day at DARD office Port Vila

Annex 2. Report of the Project Closing Workshop in PNG

Generation of a Agricultural technologies to mitigate climate change imposed risks to food security in smallholder farming communities in Western Pacific Countries

Summary of Final Project Workshop
4-5 February 2016

1. Introduction

The PNG National Agricultural Research Institute (NARI) in partnership with the Ministry of Agriculture and Livestock (MAL), Solomon Islands, Department of Agriculture and Rural Development (DARD), Vanuatu and the University of Natural Resources and Applied Life Sciences (BOKU) in Vienna, Austria is implementing the project "**Generation and adaptation of improved agricultural technologies to mitigate climate change imposed risks on food production within vulnerable smallholder farming communities in Western Pacific countries"** in PNG, Solomon Islands and Vanuatu. Nine other institutions in PNG, Solomon Islands and Vanuatu are also associated to the project. The project is funded by the European Union and has a timeframe of five years from 15 February 2011 to 14 February 2016.

The final project workshop was held from 4-5 February 2016 at NARI Sir Alkan Tololo Research Centre, Lae, PNG. The workshop brought together representatives of all partner organizations including DARD, MAL, NARI and BOKU and representatives from associate organizations such as FPDA and DAL and other stakeholders. Representatives from all five PNG project sites attended the meeting as well. A list of workshop participants can be found in Annex 1.

2. Programme

Project Closing Workshop –Programme
NARI Multipurpose Hall, SARTC, Bubia – 04-05 February 2016

Time	Event	Remark
Day 1: 04 February		
08:30 – 09:00 am	Registration and Morning Tea/ Coffee	Workshop participants arrive and register at the venue
09:00 – 09:15 am	Introduction of workshop program and participants	Birte Komolong
9:15 – 9:30 am	Welcome Statement	Dr. Sergie Bang, Director General of NARI
9:30 – 9:45 am	Welcome Statement	Mr. Adrien Mourgues, Attaché – Deputy Head of Cooperation
9.45 – 10:15 am	Overview of the project: objectives, admin arrangements, M&E framework, Site selection	Birte Komolong
10:15 – 10:45 am	**Tea/Coffee break (Group photo)**	
10:45 – 11:15 am	Needs assessment survey and Reporting back workshops, Final assessments – Methods and Approaches	Norah Omot
11:15am – 12.30pm	**Achievements PNG sites – 20-30min presentation per site plus 10min for questions/comments**	
	Tambul (Keripia, Alkena)	Jeremiah Ahizo/Kud Sitango
	Kopafo	Johannes Pakatul
Lunch (12:30-1:30pm)		
1:30pm – 3:30pm	**Achievements PNG sites – continued**	
	Murukanam	Elick Guaf
	Derin	Dominik Ruffeis
	Yule Island/Hisiu	Peter Gendua
3:30 – 4:00 pm	**Tea/Coffee**	
4:00 – 5:00 pm	Other component activities (Soil and water, Crop improvement)	Dominik, Elick
6.30 – 8.30pm Workshop Dinner (MPH) hosted by NARI DG		
Day 2: 05 February		

Time	Event	Remark
8:30 – 9.30am	Achievements – Solomon Islands	Jules Damutalau
9:30 – 10:30am	Achievements - Vanuatu	Mark Vurobaravu
10:30 – 11:00am	**Tea/Coffee**	
11:00 – 11:30am	Communication and Networking activities	Seniorl Anzu
11:30am – 12:30pm	Group interactions	EU ARD project team to moderate
1:30 – 2:30pm	Group presentations	
2:30 – 3:00pm	Closing remarks	
	End of workshop	

3. Workshop proceedings

Day 1:

The first day opened with welcome statements by the Director General of NARI, Dr Sergie Bang and the Deputy Head of Cooperation at the EU – office in Port Moresby, Mr Adrian Mourgues. The Action Coordinator Dr Birte Komolong then provided an overview of the project which was followed by the presentation of Dr Norah Omot, Component Leader Community Engagement describing the various approaches taken in the project to identify project site specific needs, engaging with the community, monitoring of community engagement and the final site assessments. The project team then presented the achievements for each of the PNG project sites (Derin and Murukanam in Madang Province; Kopafo in Eastern Highlands Province; Alkena/Kiripia in Western Highlands Province; Hisiu/Yule Island in Central Province). After each presentation there was opportunity for participants to comments, ask questions or otherwise make inputs into the discussion. Copies of the presentation can be found on the Project Website (http://ard.nari.org.pg/).

Day 2

Day 2 continued with presentations by partner organizations from MAL, Solomon Islands and DARD, Vanuatu with a summary of the achievements in the respective project sites. Final presentation was made by the Component Leader for Communication and Networking Mr Seniorl Anzu on the achievements in this component.

In the afternoon of Day 2 participants conducted a group exercise to get recommendations from different stakeholder groups on future activities. There were three groups with the following tasks:

Group 1 – Community reps

What are your recommendations for future assistance in climate change adaptation in your communities from your local institutions;
(what can you do; what can others do)

Group 2 – Donors, Prov DALs, stakeholders

What appear to be promising outputs to build on and how can this be done or how can we support

Group 3 – Researchers – Research gaps arising from this project

The recommendations of the groups are as follows:

Group 1 – Community representatives

- Water issues in communities need to be resolved (irrigation, drinking) – water is a limiting factor in outscaling or technologies and practices and needs to be addressed
- Need for financial assistance (eg materials, equipments, small machinery), e.g. need references to go to the bank that they certifies or confirms that the farmers have the knowledge and capacity to use such technologies
- In the villages, the trained farmers are now 'experts' on some of the technologies and available as a resource to take it to other places
- Those trained farmers wish to be recognized as 'Resource persons' and given opportunity to enter into an equal partnership with donors, provincial government, FPDA etc.

Group 2 - Donors, Prov DALs, stakeholders

- The technologies/practices introduced by the project are all found suitable, simple, appropriate and good
- Government now also puts emphasis on nutrition and income generation
- There is a need to upscale the achievements of this project
- There is a need to recognize model farmers as skilled and work with NARI, Extension services etc.
- There is a need to upskill the extension officers
- NARI to source new funding to out-scale and up-skill extension officers
- MOA/MOU with partners
- Most PDAL officers recommend that MOAs/MOUs should be put in place so that they know where and how they can contribute through such projects.
- If relevant partners are included in MOAs/MOUs then commitments can be made and acted upon
- This was seen as a setback for this project where some partners and stakeholders were a bit reluctant in participating in this project
- Need to out/upscale into new areas including other Pacific Island Countries like Solomon Islands and Vanuatu – NARI to try and secure funds (eg approach FAO)

Group 3 – Researchers

Livestock

- Pig Silage: Needs of crops for feed, time, resources required – information needed
- Specialization of crop and live stock farmers and exchange of material for feed
- Meet demands of pig farmers
- Different types of SP and Cassava have different nutrient profile → nutrient profiling
- Work on silage and native pigs, cross breeds need very good nutritional value

Crops – Sweetpotato

- SI and Vu: Grouping of SP varieties and evaluation until maturity, evaluate fairly
- Increased production: implications with soil fertility and soil water, soil salinity
- Cropping practice
- Field based evaluation
- Who is doing that? – Training needs and clear line in communication
- Capacity still a limiting factor, more capacity building needed
- PNG: Screening under different salinity, soil moisture conditions
- Use of biotechnology for screening of tolerance
- Identification of virus vectors and other hosts
- Economic impact assessment needed

Crops – Other

- For project 17 NERICA were selected
- Continue screening of other varieties
- Additional maize lines
- Agronomic characterization of new lines
- Economic evaluation of vegetable production and irrigation – cost-benefit analysis
- Seed system and quality of seeds, maintenance of seeds on farm level (food crops and vegetables)
- Cassava Starch extraction, production and cost-benefit analysis
- PT material and access for SI and Vu, on-station methods to get virus free planting material, evaluation of alternatives to tissue culture lab
- Bread fruit (seedless? But want more seeds) for salinity affected coastal areas
- Further evaluation of performance of vegetable under different stresses

Soil and Water

- Improved soil moisture and fertility management for farmers, more on farm trials and demonstrations required
- Who should do that?
- Better collaboration between Research and Extension
- In depth evaluation of different irrigation technologies and socio-economic impacts
- Holistic approach water-irrigation-crop-fish/duck systems
- Irrigation and vegetable production and value chain
- Crop water requirement and irrigation scheduling
- Local material for irrigation drip kits, testing and evaluation
- Weather stations
- Effect of soil moisture regimes on SP root storage development, root system characterization
- Nutrient dynamics of soil-crop system in different soil types and under different environmental conditions

The workshop closed with a vote of thanks by representatives of DARD, MAL, BOKU, DAL.

4. Other activities

As part of the final project workshop, the project team also staged a display of project posters outside of the workshop venue where participants got further information on the project activities and achievements.

Attachment 1. List of participants of the EU ARD Final Project Workshop

No.	Name	Institutions
1	Prof. Willibald Loiskandl	BOKU
2	Mark Vurobaravu (a/Dir)	DARD
3	Alistair Wate	VARTC
4	Lonnie Jonah	VU Dep Livestock
5	Jules Damutalau	MAL
6	Michael Ho'ofa	MAL Extension
7	Barnabas Keqa	MAL Livestock
8	Adrian Morgues	Attaché – Deputy Head of Cooperation, EU Delegation to PNG
9	Imelda Kavu	Program Officer, EU Delegation to PNG
10	Barnabas Krinko	Community Rep., Kopafo
11	Nancy Amos	Community Rep., Kopafo
12	Mr Fuapo Pokea	Community Rep., Alkena
13	Mr Joe Win	Community Rep., Kiripia
14	Mr. Joe Baupua	Community Rep., Yule Island
15	Mr Ikupu Vaki	Community Rep., Hisiu
16	Peter Kunou	Community Rep., Derin
17	Mathew Lawun	Community Rep., Murukanam
18	Mark Arek	Community Rep., Murukanam
19	Brown Konabe	DAL Dir Food Security
20	Godfried Save	DAL Madang
21	Mr Kila Gege	Principal Advisor, DAL Central
22	Mr Martin Pitt	Executive Manager, DAL Western Highlands Province
23	Mr Nefion Tarapi	A/Director, DAL Eastern Highland Province
24	Lucas Kiniwa	FPDA
25	Maria Linibi	President, Women in Agriculture Development Foundation
26	Johannes Pakatul	Co-Component Leader, Soil and Water, NARI HRC Aiyura
27	Dr. Dominik Ruffeis	Component Leader, Soil and Water, NARI HRC Aiyura
28	Tai Kui	NARI HRC Aiyura
29	Kud Sitango	NARI HRC Tambul
30	Jeremiah Ahizo	NARI HRC Tambul
31	Arthur Robert	NARI HRC Tambul
32	Clifton Gwabu	NARI SRC Laloki
33	Simon Sangi	NARI SRC Laloki
34	Philmah Seta-Waken	NARI SRC Laloki
35	Dr. Birte Komolong	Action Coordinator, NARI Head Office
36	Dr. Peter Gendua	Component Leader, Crop Diversification, NARI MRC Bubia
37	Dr. Norah Omot	Component Leader, Community Engagement, NARI Head Office
38	Seniorl Anzu	Component Leader Communication and Networking, NARI Head Office
39	Martin Lobao	Component Leader, Livestock, NARI MRC Labu
40	Elick Guaf	Component Leader, Crop Improvement, NARI MRC Bubia
41	Dr Sergie Bang	Director General, NARI
42	Sim Sar	NARI Head Office
43	Rama	Deputy Director General, NARI
44	Pikah Kohun	NARI MRC Labu

No.	Name	Institutions
45	Jeromy Kavi	NARI Head Office
46	Isidora Ramita	NARI MRC Bubia
47	Chesley Kobua	NARI MRC Bubia
48	Wilfred Wau	NARI MRC Bubia
49	Cyril Atung	NARI MRC Bubia
50	Jeffrey Waki	NARI MRC Bubia
51	Maima Sine	NARI MRC Labu
52	John Wamine	NARI Head Office

Annex 3. Economic Impact Analysis Report

Economic Impact Analysis
EU-ARD Project, Papua New Guinea

Christian Treitler
June 2016

In Papua New Guinea (thereafter, PNG), mixed farming by smallholders makes a very significant contribution to food and nutritional security, rural incomes and entrepreneurship, as the vast majority of PNG's population survives and indeed thrives in village based economies. Time honored farming practices and adaptations are the smallholders' strength in PNG, making the country less reliant on overseas importation of food and feed products. Smallholders of the 18th century quickly realized that sweet potatoes performed very well in PNG, and their efforts helped make sweet potato the most important crop in today's PNG. The EU-ARD Project focuses on another adaption to farming, namely adaption to climate change, now required in order to provide PNG's population continuing food security – especially necessary since the frequency and intensity of severe droughts (El Niño), interspersed by exceptionally wet conditions (La Niña), have increased over recent decades.

This report focuses on the economic benefit the EU-ARD Project brought to PNG, as it assesses initiatives in various communities across PNG from an economic point of view. The officers of the project did not collect any data specific to an economic impact analysis, but technical reports coupled with observations, estimates, known costs, other studies, and general market prices provide information to derive an economic impact of the project.

This economic impact analysis is based upon models using conservative assumptions. In particular, it assumes that only farmers who have received training within the EU-ARD Project will adopt the new technologies. It is very likely though that many other farmers will eventually switch to the new technologies when they witness the successes of their neighbors. Further, in the model cost advantages are pegged at the low end of most likely outcomes although communities can be more resourceful in harnessing all possible cost advantages. A more optimistic scenario could easily double the quantifiable economic impact of the EU-ERD Project. The models work with a terminal growth rate of 5% and a discount rate of 10%.

The main section of this report describes in detail how the economic value was assessed for each of the three components: livestock, crops, water & soil. The scope of this study is too narrow to discuss all statistical data on their merits. Some data also overestimate the economic impact while other data underestimate the economic impact. This report assumes that any errors in data cancel each other out due to the fairly large number of trials across various sites in Papua New Guinea. The economic impact analysis is summed up in Section Two. The economic values of each component's interventions are listed whether they can be quantified or not. Finally, Section Three briefly summarizes the salient results of this economic impact analysis, its overall reliability, and maps out future conditions that would make a future economic impact analysis more reliable.

Economic Impact

Livestock

The EU-ARD Project implemented five major improvements in various communities across PNG: (1) substituting commercially produced feed with locally produced crops, (2) integrating livestock farming practices, (3) introducing additional livestock, (4) changes in livestock management, (5) improved food processing techniques.

(1) Feed Ratios

Domestic livestock production is dependent on importing the majority of ingredients for commercial formatted rations at high cost, which diminishes any cost advantage local producers may have relative

to imported livestock products. Unfortunately the import of feed cannot be reduced on a large scale at this time since grain production in PNG is not yet well developed. Local producers can only gain a cost advantage if they can substitute these high cost imported feeds with locally produced crops such as sweet potatoes and cassava. The EU-ARD Project therefore focused on using locally available crops as feed for livestock, thus lowering the cost of feed to local farmers. The silage of sweet potatoes was introduced as pig feed, while sweet potato, taro, and cassava were used in combination with a NARI developed feed concentrate to raise broilers, egg layers, and pigs.

Pig Feed

In PNG pigs are generally raised for use at festive occasions, at ceremonies, for bride price payments, for settling disputes, and to fill social and community obligations, but also for general trading as pigs are sold live at villages and road sides. A full-grown pig fetches a price of about K1000. Most pigs are raised by pig farmers who own 1 to 6 pigs at a time. Traditionally untethered pigs forage through their environment to find food, thereby destroying gardens and fields used for raising crops. Feeding tethered pigs sweet potato silage instead has multiple benefits: (1) Silage preserves feed nutrients for up to seven months making silage very suitable for food security. (2) Pigs gain weight much faster. (3) Vegetable gardens and crop fields are protected from the pigs' foraging.

As for calculating an economic value for silage feed, this section utilizes some of Dr. Ian Black's findings and conclusions in "A short report on the profitability of village hybrid pig farming using silage as a feed source". He found that there was a very small economic benefit using sweet potato silage for pig feed once fertilization is taken into account since silage requires the farmer to fertilize the soil in order to maintain the production level of the soil. His study compared daily feed ratios under various scenarios that showed only an additional 2 percentage points of gross margin between commercial feed and feed combined with silage, the new technology introduced to farmers within the EU-ARD Project. Considering the potential errors due to the quality of data, this benefit is too small to warrant any special consideration.

EU-ARD provided farmers with materials for tethering, housing and feed production (silage). The total cost of buckets, knives, graters, polyethylene bags, tarpaulin, nails, and pig wire amounts to K400. The farmer is expected to provide other materials and labor of equal value, which makes for total start-up costs of K800. This model assumes a K400 annual maintenance and running cost, once new housing and feed techniques are established. (For details on the model's calculations, please refer to the Appendix to this report.)

The most extensive research was done in Tambul. This model will use the data derived from the Tambul trial. The pig trial in Tambul showed an average daily weight gain of 159 grams when an animal was fed the new feed as formulated and introduced by National Agricultural Research Institute (NARI). The conventional method led to a weight gain of only 65 grams per day. Assuming a similar growth trajectory during the entire feeding of the animal, an animal gains 52 kg in 43 weeks – versus 79 weeks if the animal is fed with the traditional method. (A pig brought to market weighs between 60 and 70 kilos and weighs a little less than 10 kg after weaning.) Based on Dr. Black's calculations adjusted for this analysis, the weekly cost of feeding one pig is K10.84, which translates into savings of K386 per pig in feed cost if the pig is fed the newly introduced silage feed and if the pig is properly housed.

As was the case with all project components, data collection was a challenge in the field study in Tambul for a number of reasons. (1) Model farmers did not feed sweet potato silage consistently, making it difficult to verify the benefits of silage feed across the board. (2) As pigs gained weight, it became more cumbersome and even risky to weigh large sized animals. (3) Pig holders expressed their inability to procure items needed for making silos, i.e., 100L buckets and polytene bags, which prevented this technique from being used more widely and quickly.

Despite the difficulties collecting data it is possible to calculate a relative economic impact of new techniques based on the cost savings. Further, the model includes the economic potential once new technologies are implemented by all interested farmers and spread through the communities.

Tambul
In Tambul 19 farmers received training initially. A total of 60 farmers showed interest in adopting the new methods and were trained in improved village pig production by the summer of 2014. Based on the assumption that all farmers raise three pigs at a time, the 6 farmers who participated in the trial can raise 18 pigs per year leading to an annual cost advantage of K2,973 compared to the traditional method. If a total of 20 farmers raise pigs to capacity in the following year, the present value of the economic gain is K13,893; when all of the 60 interested farmers raise pigs to capacity the economic gain is 36,097 in the second year and all ensuing years for which we assume a terminal growth rate of 5%. With a discount rate of 10%, these potential economic gains translate into a present value of K948,433 when compared to traditional methods.

Derin & Murukanam
It is expected that all 34 farmers who participated in the assessment will take up the new technology. It is also highly likely that additional farmers will pick up the technology once it is established in the community. (In Derin's Ward 9 alone some 20 farmers have indicated their interest in adopting the technology.) The present value for the potential economic impact amounts to K547,071.
Derin farmers were concerned about bottlenecks in the supply of sweet potato. If farmers cannot grow a sufficient amount of sweet potatoes the estimates for the economic value of the new feed and tethering technology is too high. Unfortunately there is not enough data available to make a more precise assessment by including this potential bottleneck.

Kopafo
The pig trial was going very haltingly in Kopafo since making silage didn't proceed well enough in the community and since farmers did not tether their pigs consistently. Three of 7 farmers completed all tasks during training and produced some 35kg of sweet potato silage each. (Fourteen additional farmers were interested and participated in training.)
The silage production during the project's intervention is not sufficiently large to have a significant economic impact. It is also doubtful that farmers will see an actual benefit of producing silage. As long as farmers do not actually experience an economic benefit it is quite difficult to make assumptions about the uptake of these techniques. Therefore, the immediate economic impact of the trials in Kopafo is negligible.

Hisiu
Some 60 farmers participated in training in October 2013. The community saw the benefits of the pig trials. Therefore all interested farmers are expected to adopt the new technologies within three years. The present value of these new technologies comes to K948,433.

Yule Island
Unfortunately the pig trial in Yule Island was not successful because a drought caused the sweet potato harvest to fail. Farmers could not see the benefits of the interventions, which makes it unlikely that these technologies will be adopted in the community.

Broiler Feed

Farmers were introduced to new feed ratios that utilize locally available crops like sweet potato, cassava, and taro. These crops were fed to poultry in combination with a concentrate developed by NARI. A few studies ("Improving the profitability of village broiler production in PNG", "Evaluation and assessment of the NARI Broiler Feed Concentrate….", "Feed efficiency and growth of broiler chickens fed cassava..…") have shown that this combination provides farmers with cost savings of 12% compared to commercial feed ratios. It is important to note that farmers and project coordinators stated that there were supply constraints with both ingredients, i.e., with concentrate feed and locally produced crops. These supply constraints need to be overcome for the intervention to reach its full economic potential. Commercial feed producers don't seem keen on developing the market for feed concentrate, which is a cheaper version for farmers and hence a version that leads to less revenue for commercial feed producers. However, there are a number of producers in Papua New Guinea (e.g.

Lae Feed Mills, Trukai, Goodman Fielder, CPC in Madang) who could compete in this market and thus take market share from other competitors. It may be necessary that NARI intervenes with these producers on behalf of farmers to ensure a steady supply of the concentrate.

This analysis is based on the data derived from the broiler trial in Tambul. Three model farmers raised a total of 308 day-olds in 17 batches, or 100 birds per year. The trials showed that the cost advantage of the two new feed techniques, concentrate mixed with sweet potatoes and concentrate mixed with cassava, were K2.15 and K1.15 per bird respectively for an average cost advantage of K1.65 when compared to commercial feed. (This result is in line with previous studies mentioned above.) The model will work with an average cost advantage to account for possible supply disruptions of sweet potatoes. Farmers in almost every community have mentioned sweet potato shortages. Therefore, farmers might be forced to use cassava even though sweet potatoes appear to be more economically advantageous.

Kopafo
At the outset 3 model farmers participated in the NARI concentrate trial. An additional 23 interested farmers participated in training. It is expected that all interested farmers will adopt the new feed within three years. Their potential cost savings with a 10% discount rate amount to a present value of K62,156.

Murukanam
Five model farmers participated in the NARI concentrate trial although one of them did not follow the instructions for the project closely. Therefore, only four farmers reaped the economic benefit of using the new feed ratios right away. The potential cost savings is K62,321. (This calculation assumes the same uptake in Murukanam as in Kopafo with a total of 15 farmers participating within two years.)

Hisiu
A total of 60 farmers received training in livestock management. Trials were very successful. Therefore, it is expected that all trained farmers will adopt the new techniques within three years. The net present value of the potential economic impact is K157,692.

Egg Layers Feed
Again, the data are derived from a trial in Tambul where NARI introduced a total of 110 egg layers. The feed cost per egg lead to a cost advantage of K0.15 only when the egg layers were fed universal concentrate mixed with sweet potatoes. When sweet potatoes were mixed with high-energy protein concentrate the new feed was too expensive since the chicken consumed more food. It cost an additional K0.07 per egg to produce one egg compared to commercial feed. This analysis therefore assumes that after the initial trial period only universal concentrate was mixed with sweet potatoes. It also assumes that an equal number of birds were fed each new feed ratio in the first year and that each chicken lays 220 eggs per year. (The study did not record the number of eggs each chicken laid but egg layers are bred to lay 200-250 eggs per year.) Within two years the number of egg layers should double in Tambul since the cost advantages are large enough to give other poultry farmers an incentive to produce eggs. Based on these assumptions the present value of the economic impact is K120,859.

(2) Integrated livestock farming practices for fish and ducks

Fish-Duck Integration
In the technical report "Using Integrated Livestock Farming Practices For Inland Fish And Duck Production" Arthur Roberts, Maima Sine & Martin Lobâo argue that "Further understanding is required to fully utilize the system as a potentially viable and sustainable practice for farmers." There were no hard data collected that could be used for an economic impact analysis, but it appears that the trials in three sites showed very promising results. For one, farmers seem to be very interested in adopting new techniques to raise livestock.

Farmers are more interested in ducks rather than fish despite beneficial integration between fish and poultry since raising fish does not show the same profitability as other livestocks does. Profitability comparisons show 61% profit margin for broilers, 57% for pigs, 62% for eggs, and only 10% for tilapia. Nevertheless, some 11,000 PNG farmers rely on fish for income.
This small margin coupled with a dearth of data will not yield reliable results for this economic impact analysis, which is why a quantifiable economic impact will not be calculated. However, the economic impact will be listed in Section 2, under the discussion of non-quantified benefits of the EU-ARD Project.

Murukanam
Despite a good production of duck eggs and thriving fish, the first model farmer decided to discontinue this integration since the site was located too far from his house. The farmer also mentioned that access to water was a problem. Farmers in the community were very happy with ducks since they fetched a higher price than broilers did. Ducks were sold for at least K50, drakes for at least K60, and broilers for K20-K40.

Derin
The two model farmers reported success with ducks and fish. One farmer even expanded his pond in expectation of raising more fish. Unfortunately there are no data available for this initiative.

Tambul
Thirty-four farmers were trained in integrating tilapia with Muscovy ducks, 22 were given material to build duck housing and ponds, and 5 farmers underwent baseline data trials.
Out of the 22 farmers who participated in the trial, the technical team of NARI determined that only 3 showed "very good progress" while 7 showed "good progress" meaning that farmers had success with poultry as well as with fish.

Duck/Rice Integration
Murukanam
A duck/rice integration was implemented in November 2013. However, this integration failed and will not be continued by any farmer in the community since the rice crop failed due to drought. However, ducks thrived. The failure of this integration is one example that shows how important the EU-ARD Project is when preparing PNG for the changing weather patterns.

(3) Introduction of additional livestock
Goat Rearing

Murukanam
One model farmer was given four does and one buck with the stipulation to pass on any off-springs to other farmers in the community so that goat rearing could spread through the community. The farmer could indeed double the amount of goats in his herd leaving him with a set of animals that he could pass on to another farmer. However, the farmer grew too attached to the animals, which curtails spreading the technology and lessens the economic benefit of the intervention. Other farmers complained that goats were too destructive. Fencing and proper management are therefore essential.
The emotional attachment to the goats indicates that PNG farm communities don't quite understand the economic benefit of goat rearing just yet. Another reason for slow uptake is the fact that there is no local demand for goat meat or milk. After all, goats are recently introduced livestock. At the same time, the success of rearing goats in Murukanam shows its economic potential in PNG.
Nineteen farmers participated in training on goat husbandry and management. Fencing materials were distributed to 6 model goat farmers.

Kopafo

At the outset of the project 19 farmers participated in training on goat husbandry and management. The EU-ARD Project distributed fencing materials to 6 model goat farmers. Unfortunately no subsequent reports or data are available to determine economic impact.

Ducks

Derin
The two model farmers reported success with ducks. In a second round a training workshop was attended by 34 participants, 15 selected model farmers and 19 were interested farmers. Of the selected model farmers, 5 were duck (integrated) farmers. Again, no subsequent data are available to determine economic impact.

Tambul
Twenty-three farmers participated in training and received materials to build housing for ducks. A total of 40 farmers were interested. Two trials were abandoned, and all ducks died in one trial. No additional data is available to determine economic impact.

Murukanam
Nov 2013 Duck/Rice Integration: This intervention failed and will not be continued by any farmer in the community since the rice crop failed due to drought. However, ducks thrived. The farmer reported having made K600 in one year on duck farming since there is healthy demand from Chinese buyers. No additional data is available to determine economic impact. Based on an annual gain of K600 and a growth rate of 5%, the terminal value of this one farmer's economic benefit is K12,000.

(4) Changes in livestock management

Changes in livestock management include tethering and housing for poultry and pigs. The economic impact of livestock management is already included in feed and in introduction of additional livestock since housing and tethering go hand in hand with these other interventions.

Pig Tethering
Farmers in Derin reported that pigs grew fatter and faster by just tethering them. They were also pleased that tethered pigs didn't destroy vegetable gardens and crop fields as they are scavenging for food. Derin is also a prime example of the positive effects of good leadership in the community, since pig tethering was introduced, enhancing the benefits.

Poultry Housing
As with pig tethering, poultry housing goes hand in hand with improved feed technology. Its economic impact is included in the section for feed, since the economic benefit of housing and feed cannot be separated easily.

(5) Food Processing

Silage Making
The economic impact of making silage is included in other sections of this analysis since silage is never produced for its own sake or for separate use.
Processing root vegetables into flour

Kopafo
Training for processing cassava and sweet potato into flour was conducted in Kopafo in three rounds starting in May 2013. A total of 7 model farmers participated in training. Twenty-eight additional interested farmers participated. The goal was to introduce techniques that increase the quality of the final product and to give flour longer storage life by, for example, soaking the root vegetables in lemon.

Unfortunately Kopafo farmers' healthy interest in food processing does not translate into wide spread adoption of the technique since farmers did not see the benefit of better quality and longer shelf life. At the end of the project the produced flour was still unused. The benefit of enhanced food security will be seen if there is a food shortage during the shelf life of the flours but this did not happen during the EU-ARD Project's lifespan.

Flour could also serve as a cash crop since it can be traded easily, but aside from technical support for production of flour a community like Kopafo also needs marketing support to tap into the cash potential of flour. Additionally in Kopafo flour has to compete with lucrative coffee and tomatoes for cash income. Besides these challenges, the social dynamics in Kopafo also made it difficult for this technique to get shared with others and accepted by the community. Therefore, the economic benefit of flour production is negligible.

Crops

Introducing new plant material and planting techniques to any community proved to be challenging for a number of reasons in many trials. In addition to these challenges, there are little data available that measure such basic parameters as improvement of yield or time saved using new planting techniques.

(1) (African) Yam

Kopafo

A few trials took place in Kopafo but none had an impact on the community for one reason or another such as a prolonged dry spell, pests, poor management, competition with coffee and tomato, and poor soil fertility of selected plots. When farmers don't experience success with new technologies, they and their cohorts will not take up this technology or the new plant materials. Therefore, the economic impact is negligible.

Hisiu

The yam trials were very successful and all participants reported an economic benefit. The new plant material and planting techniques will be maintained and even expanded in the community. Farmers also intend to access the market with their produce. There is no data available that would lead to a tangible economic impact.

Murukanam

As in Kopafo, the yam trials faced various challenges although the August 2014 trial did show good yield. The community also showed keen interest as 111 people attended the field day in August 2014. However, aside from these data points, no other usable data were collected to assess any yield improvement or the potential for the community to adopt the new plant materials and techniques.

(2) Cassava

Murukanam

As is the case elsewhere, trials faced a number of challenges but in the end the cassava trials were concluded successfully. A prolonged drought benefitted the trial since farmers could see first hand how the new varieties outperformed traditional plant material in adverse conditions. Not only did the new plant material survive the drought better it also showed a better yield and good taste. Therefore, it is likely that the community will use the new plant material and will disseminate it throughout the community and beyond over time. Alas, there are no data available that measure the yield improvement beyond farmers reporting "outstanding" performance. Thus, an economic value cannot be assigned to this successful trial with any credibility.

Kopafo

Once again, the trials were hampered by such adverse events like damage caused by cattle and goats, and excessive growth of weeds. Only one cassava variety that was cultivated in neighboring Aiyura

thrived. Still, there are no data available that would indicate the degree of success the variety provided.

Hisiu
The yam trials were very successful and all participants reported an economic benefit. The new plant material and planting techniques will be maintained and even expanded in the community. Farmers also intend to access the market with their produce. There is no data available that would lead to a tangible economic impact.

(3) Taro

Derin
Fourteen farmers participated in the trial that was harvested all at once, leaving the community with excess crop that could not be consumed or sold in a local market since there is really no local market for the staple food, taro, due to Derin's relative isolation. Almost all taro is grown for own consumption. The harvest trip report of November 21, 2014 recorded the successful trial although it does not include any concrete data. Farmers liked the durability of the NARI provided plants especially during droughts. Strong leadership in Derin also ensures a good rate of multiplication in the community. Again, there are no data about the degree of dissemination of plant material in the community.

Murukanam
Fifteen farmers participated in the trial that faced challenges from virus infection. Still, the new plant material performed well in the prolonged dry season relative to traditional plant material although the harvest report does not include any data for improved yield. As is the case in Derin, there is widespread interest in the community to use the new plant material but the distribution of plant material is going slower than in Derin, where community leadership is stronger. The excess harvest did not cause a problem in Murukanam since it could be sold at road-side markets.

(4) Sweet Potato

Derin
There are no usable data available for either a quantitative or a qualitative assessment of an economic impact.

Murukanam
The community saw the good performance of some varieties introduced by NARI but there are no usable data available for a quantitative assessment of an economic impact.

Tambul
The sweet potato trial was a resounding success as more than 52 farmers attended the field day. Trial farmers endorsed the new plant material and planting techniques (planting a single cutting rather than the usual practice of at least three cuttings per mound) as they reported "very big tubers per vince and per mound." The only problem in Tambul arose from rivalries within the community that slowed down the distribution of planting material to other community members. In any case, there are no data available in any technical or trip report that could be used for this economic impact analysis.

Kopafo
Seven farmers were selected although interest was far greater. The project could not accommodate more model farmers due to a shortage of planting material. The new planting material showed "extremely good" growth performance. This keen interest portends well for the future of using the new planting material leading to better food security in extreme weather patterns.
While there are technical data available on the excellent performance (dry-1tip 28.8 adjusted yield, dry-2tip 51.5; wet-1tip 44.2, wet-2tip 55.8), cost or revenue advantage are not available.

Hisiu/Yule Island

The yam trials were very successful and all participants reported an economic benefit. The new plant material and planting techniques will be maintained and even expanded in the community. Farmers also intend to access the market with their produce. There is no data available that would lead to a tangible economic impact.

Solomon Islands
Sweet potato activity ran into a number of issues specific to the site. Farmers reported that in the past that supposedly clean plant materials did not work well in the area. Further, they identified a problem of pest infestation that feed on SP roosts/vines; this is a problem common to swampy areas.

(5) Vegetables

Hisiu
The yam trials were very successful and all participants reported an economic benefit. The new plant material and planting techniques will be maintained and even expanded in the community. Farmers also intend to access the market with their produce. There is no data available that would lead to a tangible economic impact.

Water/Soil

The water and soil component included trials in irrigation, soil management and erosion, rainwater harvesting, wells, biosand filters, Community Led Total Sanitation (CLTS), and the installation of weather stations. In addition to these trials, one of the most important benefits of the water and soil component is the training of two NARI employees, Mr. Tai Kui and Mr. Hoffman Puampu, who gained expertise and research capacity in all of the trials listed above. The nature of PNG made it pertinent that Mr. Kui and Mr. Puampu are involved hands-on in all trials and not just as assistants to the component lead. After the conclusion of the EU-ARD Project, they can establish the same trials on their own in many communities across PNG drawing on the expertise they gained on this project. Communities like Murukanam that did not participate in water trials are convinced at the end of the EU-ARD Project that water will be a major issue going forward. Murukanam and other communities like it will be able to draw in the expertise of Mr. Kui and Mr. Puampu in the years to come.

Each person's expertise is valued at K13,500 per year or 25% of Mr Kui's annual employment cost. (The imminent high demand for water management expertise may very well underestimate the economic benefit of the expertise gained within the EU-ARD Project.) The terminal value at a growth rate of 5% amounts to an economic benefit of K270,000 per person.

(1) Drip Irrigation

The main objective of drip irrigation is two-fold. First, it allows for the efficient use of water in irrigation. Second, it creates the possibility for farmers to produce vegetables and crops during drought, thus to increase their income and to make them "food secure" during times when they could not produce stable food crops without drip irrigation. Note that drip irrigation is not necessarily meant to increase yield per se. In addition, drip irrigation allows farmers to keep their planting materials alive during extended drought and dry spells for fast post drought recovery.

Kopafo
Kopafo was selected as the prime site for water trials within the EU-ARD Project. Unfortunately unstable tribal relations made it difficult to implement all trials as planned and to collect data on drip irrigation. For example, the component planned to build a water harvesting and storage system for domestic and agricultural use (for irrigation) but tribal infighting kept delaying the trial until it had to be abandoned. Therefore, only one of three planned irrigation systems were built.

As late as October 15th, 2015 a system of drip irrigation at a selected demo plot was set up. PVC pipe, garden hose, bamboo and gravity fed drip kit were installed and the different systems of drip irrigation were demonstrated. This was especially important since the site suffered from a prolonged dry spell. Farmers spent many hours irrigating their fields with known irrigation practices, i.e., with bucket irrigation and flood irrigation. Not only are these irrigation system wasteful and deplete water holes

quickly, bucket irrigation is also particularly time consuming. Additionally, farmers abstain from planting new crops during such severe droughts, which will lead to challenging food shortage even when the drought will have subsided.

Drip irrigation is a method of irrigation that efficiently delivers water to the soil surface or the root zone; this is done by having the water drip slowly from small perforated holes onto the soil surface near the base of the plant. It can be installed inexpensively and involves less labor in irrigating of crops than the conventional bucket irrigation and flood irrigation do. It also uses much less water. Thus the advantages of drip irrigation are:

- Water conservation – water is efficiently supplied to where it is needed, i.e., at the very roots of the plants. Water is not wasted on leaves or soil, which reduces the chances for evaporation and run off.
- Reduction in weed growth – drip irrigation applies water to the root zone of the plants only. The spaces in between the plants remain dry, which reduces the chances of weed germination and growth.
- Reduction in plant stress.

It goes without saying that drip irrigation has a better chance to ensure food security in any community. Once set up, drip irrigation is also less time consuming giving farmers an economic benefit that will amortize the cost of setting up drip irrigation over time. Unfortunately tribal fights made it impossible to collect sufficient data to show the economic superiority of drip irrigation compared to any other irrigation method used in Kopafo.

Hisiu
Currently rope and washer pumps are used to irrigate vegetable crops as well as mulching to preserve soil moisture in dry sandy soils. Alas, rope and washer pumps didn't work as expected, which makes it hard for farmers to access water. Therefore, it is essential that drip irrigation kits are made available at the site to ensure food security. Unfortunately it was not possible to set up a drip irrigation system within the EU-ARD Project.

Derin
Water management training was performed to manage water during times of drought.

(2) Soil Management

Hisiu
Farmers have noticed a decline in productivity of their plots due to depleted soil conditions. Sixty farmers attended presentation about soil analysis and soil preservation. It is expected that farmers gained knowledge on the most pertinent soil fertility issues and on coping strategies to improve or at least sustain a certain level of solid fertility. It is almost impossible to assign an economic value to such a presentation at this time since the level of knowledge and implementation of strategies would have to be measurable.

It is clear that farmers benefit from knowledge about the most pertinent soil fertility issues in the area and about coping strategies to improve or at least sustain the level of fertility of their soils. Specific information was given regarding soil nutrients and plant nutrient requirements.

Tambul
At a June 2015 "harvest meeting" 38 farmers attended and agreed that some of the soil treatments yielded very big tubers per vine and tubers per mound although the successful harvest may also be the result of improved plant material and planting techniques. The community intends to follow the soil management technique by composting dried grass on sweet potato mounds.

Yule Island

Farmers noticed decline in yields in recent years. Therefore, crop production practices to improve soil fertility in these marginal soils are demonstrated in Yule Island for the local staple crops. Sixteen farmers participated in demonstration of soil improvement options and of results of soil analysis.
In March 2015 a number of soil management techniques were introduced: edge rows; legume crops inter-cropping and crop- rotations using peanuts, snake beans, dwarf beans, cow pea, pigeon pea, etc.; mulching for soil moisture conservation; using compost materials of local weeds and leaves. There are no data available that measure the performance of these techniques.

Kopafo
Eleven farmers were interested in learning about soil management and moisture conservation. On a demonstration plot farmers were shown the importance of hedge rows (for moisture conservation, erosion prevention & mulching), which was compared to conventional sweet potato farming system and natural fallow. However, a review of the trial concluded that farmers probably did not understand the concept of soil erosion and its effects on crop production. Therefore, the community will implement none of the techniques at this time.

(3) Rain Water Harvesting, Wells, and Biosand Filter

Derin
In 2014 wells were dug. In 2015 five tanks were installed that collect rainwater. Each one of these tanks supplies up to 100 people. These new supplies of water are meant to be used as drinking water. To that end biosand filters were installed which were very well received. While clean drinking water is not an agricultural activity in the narrow sense, it is part of the overall livelihood improvement option. It also provides the community with an economic benefit in the sense that it can avoid negative consequences of unclean drinking water like illnesses, trips to the clinic or even death.
The site was also used to conduct follow-up training for clean drinking water for the community (with 14 people participating) as well as for farmers from Derin and Murukanam. Community members increased their awareness of health, hygiene and sanitation issues. When clean drinking water activities will be implemented in Derin and Murukanam, the expertise of Mr. Kui's and Mr. Puampu's economic value will be felt.

(4) Weather Station
There is no direct economic benefit of installing weather stations but with them researchers and farmers can understand weather patterns better, which will allow them to adjust to these changing patterns.

Kopafo
A weather station was installed in Oct 2014 and will be removed at the end of the project.

Laloki
Meteo station installed in February 2015

Tambul
Meteo station installed in January 2014 and will be removed at the end of the project.

Derin
A rain gauge was installed in March 2014. The system will be removed after the end of the project, but manual rain gauge remains installed.
Murukanam
A rain gauge was installed in March 2014 and will be removed after the end of the project.

Additional Notes

Vanuatu

On March 6th 2015 Cyclone Pam hit Vanuatu and wreaked havoc on the island and all activities started within the EU-ARD Project. This event practically ended Vanuatu's participation in the EU-ARD Project that was not set up to address disaster relief.

Summary of Economic Impact

Quantifiable Benefits

All figures in PNG Kina. (1 Kina = 0.28 Euro)

	Tambul	Derin	Murukanam	Hisiu/Yule	Kopafo	
Pig Feed	948,433	547,071		948,433	0	
Poultry	120,859		62,321	157,692	62,156	
Fish-Duck Integration			0			
Ducks			12,000			
(African) Yam					0	
Sweet Potato		0	0	0		0
Drip Irrigation		0		0		
Soil Management	0				0	540,000
Site Total	1,069,292	547,071	74,321	1,106,125	62,156	540,000
TOTAL	**3,398,965**					

Non-Quantifiable Benefits

	Tambul	Derin	Murukanam	Hisiu/Yule	Kopafo
Pig Feed					
Duck/Rice Integration			Ducks thrived.		
Fish-Duck Integration	(Very) good progress.	Success.			
Ducks		Success.			
Goat Rearing			Progress delayed.		Unknown.
Pig Tethering		Pigs grew fatter and faster. No damage to beds and fields.			
Food Processing					Successful training and production.
(African) Yam			Good yield.	Success.High community interest.	
Cassava			Success.	Success.High community interest.	Mixed results.

	Tambul	Derin	Murukanam	Hisiu/Yule	Kopafo
Taro		Success. High community interest.	Success. High community interest.		
Sweet Potato			Success. Interest in some varieties.	Success.High community interest.	Success. Good community interest.
Vegetables				Success.High community interest.	
Drip Irrigation					Water conservation. Reduce weed growth. Reduce plant stress. Less labor. Higher food security.
Soil Management	Success. High community interest.			New know-how.	
Clean Drinking Water		Avoid negative consequences of unclean drinking water.			

Discussion

Within the EU-ARD Project the data collection for the purpose of this economic impact analysis was not on top of the agenda since the focus was on improving the technical success of agricultural activities so that smallholders in PNG can cope better with changing climate patterns. It is a pity that successful activities cannot be quantified better. The list of non-quantifiable benefits is extensive.
This analysis does not include incremental improvements in a community that may bring fruits further down the road. For example, duck-fish integration is a new technique in PNG. NARI gained valuable insights into duck-fish integration, which may make the second attempts of duck-fish integration within another project successful. In another example, pig feed and pig housing in Kopafo did not yield any quantifiable success within the EU-ARD Project. However, new pig rearing techniques will have tremendous payoffs due to Kopafo's extensive pig farming. The first trials may not have yielded an economic benefit but ensuing trials may draw on the experience farmers have gained in the EU-ARD Project. None of these economic benefits are included in this analysis.

Having said that, the numbers derived in this economic impact analysis are based on many assumptions and estimates, some of which will turn out to be inaccurate. Better economic and financial data would certainly avoid such inaccuracies but one has to weigh the quality of data against the cost of collecting this data.

It would most likely require a full time member of the project team who takes frequent trips to all project sites to tally up data for an economic impact analysis. Such an expense would divert funds away from the task at hand, namely implementing activities to fulfill the objective of the EU-ARD Project. Alternatively, decentralizing data collection to component leads would be an effective way to collect usable data. But sometime it is also difficult for field officers to collect extensive data when implementing activities in fairly remote areas. Once again their primary task is on the technical aspects at hand and on interacting with local farming communities. However, it would be very helpful if field officers were collecting more data even if the data is only of technical nature and not of economic nature.

The EU-ARD Project includes only a few failed activities most of which were the result of events beyond the control of project members. Other activities benefitted from events beyond the control of

project members. For example, it was an unfortunate "windfall" to the EU-ARD Project that a prolonged drought hit some communities in the second half of 2015, which made the communities very aware of the purpose of the EU-ARD Project, i.e. of trying to implement activities so that smallholders can better cope with changing weather patterns.
In conclusions, a combined summary of the quantitative and qualitative economic impact of the EU-ARD Project reveals a successful project with lasting benefits to all communities that participated. When the benefits of these activities spread beyond the few communities that participated, the economic impact will be certainly much larger.

Appendix:
Economic Benefit Model

Pig Feed and Tethering (Tambul)

	Year 1	Year 2	Year 3	Terminal
farmers	5	20	60	60
pigs/farmer	3	3	3	3
pigs/year	18	72	217	217
Set-Up Cost	4,000	12,000	32,000	0
maintenance	0	2,000	8,000	24,000
Feed Savings	6,973	27,893	83,678	83,678
Profit/Loss	2,973	13,893	43,678	59,678
Discounted	2,973	12,630	36,097	896,733

Broiler Feed and Housing (Kopafo)

	Year 1	Year 2	Year 3	Terminal
Farmers	3	10	23	23
Birds/Year	300	1000	2300	2300
Cost Advantage	495	1,650	3,795	75,900
Discounted PV	495	1,500	3,136	57,025

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Dr Phil Glatz, Dr Workneh Ayalew, Dr Ian Black, Janet Pandi, Janet Deklin, Monica Mazi, Michael Dom, Fred Besari, Rod Ingersoll, Christine Gee, Klaus Neumeier, Anton Kaupa, Andrew Mari, William Kerua, Bonnie Keoka, Dr Gariba Danbaro, Dr Peter Manus, Douglas Maip, Havini Vira, Eleo Dowa, Dr Norah Omot, Dr Pikah Kohun, Elly Solomon
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"Evaluation and assessment of the NARI Broiler Feed Concentrate on bird performance in selected sites around Papua New Guinea"
Janet Pandi, Workneh Ayalew, and Phil Glatz

"Feed efficiency and growth of broiler chickens fed cassava blended with a universal concentrate diet at finishing phase: an on-farm study in Jiwaka, Papua New Guinea."
Jeremiah Ahizo, Fred Besari, Janet Pandi, Pikah J. Kohun and Phil C. Glatz
NARI, 2015

"Using Integrated Livestock Farming Practices For Inland Fish And Duck Production"
Arthur Roberts Maima Sine & Martin Lobâo
NARI EUARD
8/27/2015

Annex 4A. Pilot Site Report for the Kopafo (dry highlands)

Mr. Johannes Pakatul, HRC- Aiyura,

1. Project Site Description.

Eastern Highlands is the only highlands province receiving rainfalls of less than 2000mm per annum (Allen and Bourke, 2009). The Ungai-Bena District is the driest area with monthly rainfall during the dry season ranging from 51–102mm (June – August). Kopafo with a population of more than 3,000 is located between the altitudes of 1500 - 1600 meters from the valley to the foothills with 14 hamlets (Figure1). The rolling grasslands are the dominant vegetation with patches of Casuarina and coffee near human habitation along the valley floors and near streams and river banks. Many topsoils are hydrandepts due to the deposition of volcanic ash soils. Humitropept soil type is dominating among the soil types of non-volcanic origin, which is a young and moderately weathered soil (Bleeker, 1983). More than 50 % of the studied and predominant soils are clay (Ulreich, 2016). Potassium is the most limiting nutrient in Kopafo soils; an important nutrient for tuber crops. Coffee and tomato are dominant income sources for farmers followed by livestock sales within the community. The impacts of dry seasons are severely experienced by the farming communities in these areas. Bush fires are the frequent hazards faced by the communities during the dry seasons.

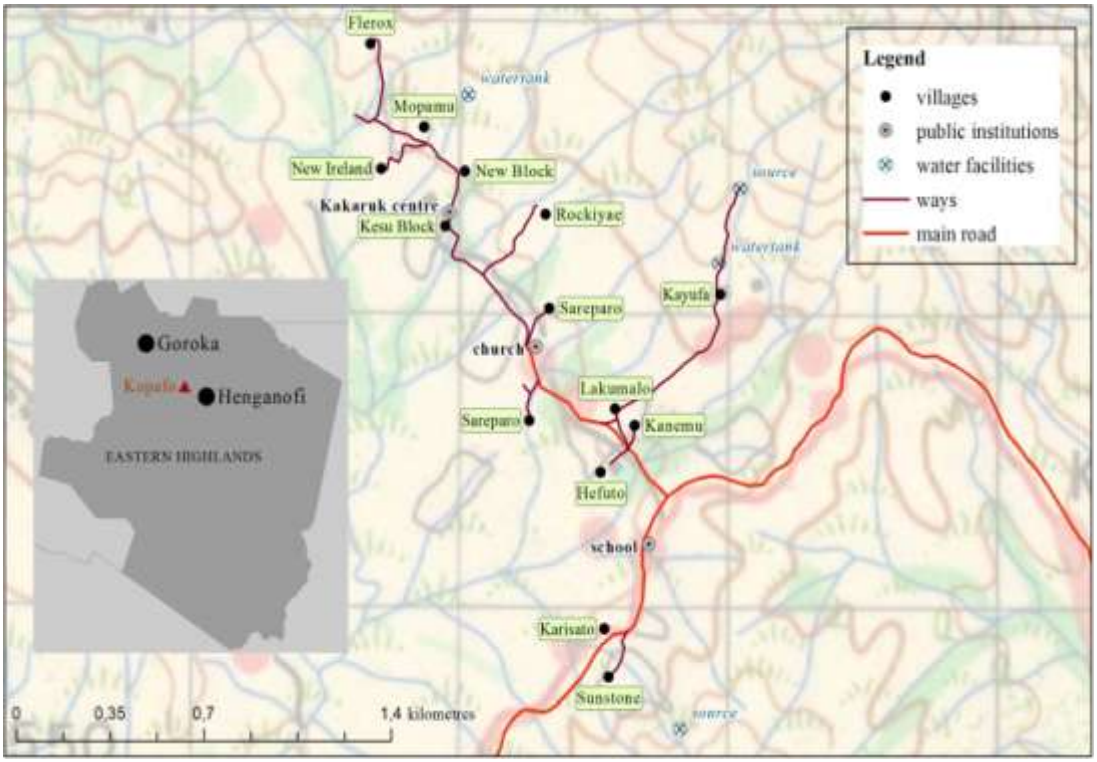

Figure 1. Villages hamlets , public institutions and water sources at Kopafo community (Ulreich, 2016).

2. Site Selection & Prioritization.

The Kopafo site was selected based on its known characteristic as a dry highlands area located alone the Okuk Highway. The initial fact finding site assessment visit revealed the following site specific characteristics which were slotted into SWOT analysis.

Table 1. Kopafo SWOT analysis.

Strengths:	**Weaknesses:**
• Grow a range of different staple crops besides sweet potato; when SP not sufficient they draw on other staples • Grow yam that can be stored (but kept in gardens) • coffee as cash crop and other options like citrus, tomatoes, yams (marihuana) • close to provincial centre and market • streams do not dry up easily during dry season • Generally good and sufficient access to water • Farmers water crops (only high value crops) using buckets	• Do not use or no access to improved planting material • Decline in soil fertility and no action • Extended drought periods but also continuous rain and swampy soils in low lying areas • Pest and Diseases (esp. SP weevil, insects) and no action taken • No to little food storage to draw on in extended drought periods • Land tenure system and land size holdings • Livestock and people use same source of water • Excess labour, not much other economic activities that could absorb labour around • Erosion at hillside gardens due to heavy rainfall • Contamination of water sources by freely grazing cattle during dry season**.**
Opportunities:	**Threats:**
• Interested in new practices and technologies. • Introduction of goats (need less land to feed) • Soil moisture conservation and soil conservation measures especially in uphill areas • Introduction of simple micro-irrigation technologies and supplementary irrigation • Water resource management • Improving soil fertility (improved mound system) • Introduction of varieties resistant to Pest & Diseases and drought. • Use of PT system for sweet potato. • Relatively close to provincial centre	• Stealing incidences during dry periods – social peace • Relative closeness to provincial centre (cheap cost of lamb flaps – no interest in livestock; labour drift, entertainment,) • Population growth (land shortage) • More irregular weather patterns • Marijuana cultivation.

In a first of its kind project for the National Agricultural Research Institute (NARI), community members were engaged in a reporting back workshop to list their major constraints during drought conditions. Each community member was invited to participate in the prioritization of the major constraint in their area and wished to do something about it (Table 2). Only the top three to five priorities were considered for addressing by the project. These constraints were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Kopafo.

	Options voted on in Kopafo	**Men**	**Women**	**total**
1.	Improving the production of sweet potato	23	13	38
2.	Improving the production of other staple crops	32	5	37
3.	Introduction of grain crops in my farming system	7	1	8
4.	Using some of my staple crops for livestock feed	43	8	51
5.	Using some of my staples crops for processing into flour etc	32	5	37
6.	Increasing consumption of home=grown meat protein	9	6	15
7.	Producing more meat from my livestock holding	10	8	18

Options voted on in Kopafo	Men	Women	total
8. Diversifying my livestock holding	10	3	13
9. Improving grazing practices and land management	6	4	10
10. Increasing soil moisture to increase food production	12	6	18
11. To protect and improve the soil of my garden for more food production	4	3	7
12. To have better mounds for stable yields	4	5	9
13. To improve my families health by protecting our water source and manage it better	32	14	46
Total votes	**224**	**81**	**307**
No. Farmers	**75**	**27**	**102**

The priorities can be summarized as greater number of farmers practicing value addition for staple crops through livestock feeding and improved management and use of available water sources for domestic use. Four technical components (Table 2) of livestock, crop improvement, crop diversification, soils and water team were involved to address the outcomes of these priorities during the lifespan of this project.

3. Interventions implemented at the site and summary of achievements

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Kopafo communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output.

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at Kopafo Pilot site.

	Outputs.	Farmers Trained	Male farmers	Female Farmers	Model Farmers
O1(a)	Increased capacity of interested farmers in Kopafo community for using improved pig and goat feeding practices (a. Pig feeding).	32	21	11	4
O1(b)	Increased capacity of interested farmers in Kopafo community for using improved pig and goat feeding practices (b. Goat feeding).	19	12	7	3
O2	Increased capacity of interested farmers in Kopafo community for using improved chicken feeding practices.	26	17	9	7
O3	Increased capacity of interested farmers in Kopafo community for processing sweet potato and cassava into other food products	35	20	15	7
O4	Community has an improved capacity to manage available water sources for domestic and agricultural uses.	14	10	4	10
O5	Increased capacity by participating farmers to use improved soil management practices addressing constraints of soil erosion, water deficit and fertility.	61	31	30	5
O6	Farmer-preferred drought tolerant sweet potato varieties identified and available to the Kopafo community.	27	17	10	8
O7	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Kopafo Community.	78	65	13	6
08	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Kopafo Community.	25	11	14	3

Model farmers were identified amongst the farmers themselves, based on their interests and past experiences. The model farmers volunteered to take on new innovations using their land for crop variety trials, and livestock pen/ shed for livestock husbandry demonstration trials. These were mostly interested and resourceful or knowledgeable in their selected areas and other areas as well. The success of the project depended on the pro-activeness of the model farmers. Model farmers in one technical component were also able to participate in other areas based on his interests. For example, the model farmer for broiler chicken was also the model farmer in food processing or other components . The attendance of farmers depended on the local factors and the weather. Funerals, graduations and tribal conflicts and market days affected the farmer participation levels, but farmers made up for it in the next trainings. Not all farmer trainee names were listed by the visiting NARI staff, as it was difficult especially during field days.

The planned activities under each of the technical components were delivered through field demonstration trials, training demonstrations and field days and culinary and taste preferences for the introduced crop varieties were also done. Table 4 shows a summary of technologies or innovations introduced and farmer impressions during implementation.

Table 4. Technologies/ innovations disseminated as part of project interventions at Kopafo pilot site and farmer impressions.

Output	Description of intervention	Innovation	Farmer impressions during implementation
O1 (a)	Increased capacity of interested farmers in Kopafo community for using improved pig and goat feeding practices (a. Pig feeding).	SP silage and concentrate technologies.	• Improved pig weight gains/growths fed with the NARI introduced feed silage). • Pork tasted better for pigs fed with silage. • Silage feed reduces labour for pig feed preparation.
O1 (b)	Increased capacity of interested farmers in Kopafo community for using improved pig and goat feeding practices (b. Goat feeding).	SP silage and concentrate technologies.	• Improved feeding options using silage and pasture is seen to be good, though not all goats went for the silage feed.
O2	Increased capacity of interested farmers in Kopafo community for using improved chicken feeding practices.	Broiler concentrate feed technologies	• Introduced feed technology using low energy (LE) concentrate using cassava and sweet potato was very good and raised profits by 50% compared to the standard commercial feeds. • The NARI feed concentrate (LE) is not available in commercial shops for the projects sustainability.
O3	Increased capacity of interested farmers in Kopafo community for processing sweet potato and cassava into other food products	Low tech post harvest food processing technologies	• Farmers appreciated the cassava flour making skills acquired during the project that was used in the 2015 drought period. • Post harvesting technique to preserve, store and make cassava flour enabled women to increase their daily income. • Many farmers regretted later missing out on these post harvest trainings.
O4	Community has an improved capacity to manage available water sources for domestic and agricultural uses.	• Biosand filter water purification technologies. • Treadle pump and drip irrigation.	• Treadle pump to overhead tanks and low cost low tech drip irrigation to tomato and other crops was exciting. • Farmers mentioned that irrigation technologies would have been a top priority, had they been aware of the implications of their voting the priority project outcomes at the initial stage of the project.
O5	Increased capacity by participating farmers to use improved soil management practices addressing constraints of soil erosion, water deficit and fertility.	Erosion controls using hedge rows and drip irrigations	• Farmers received good training and information on the eroded soils on hillsides. • The increased number of collected bags of eroded soils at the base of the hills was an eye opener and informative to see soil erosion.

O6	Farmer-preferred drought tolerant sweet potato varieties identified and available to the Kopafo community.	Drought tolerant SP varieties	• Introduced practice of *one vine cutting planted on horizontal orientation* per SP mound yielded more and bigger SP than normal practice. • Introduced SP varieties did not do better than local varieties, because of the drought situation in 2015.
07	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Kopafo Community.	Yam husbandry practices (mini-setting; staking; density); new yam species	• Mini-setting yam seed techniques were new and received with excitement. • Stalking of African yam received higher yields than local varieties.
08	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Kopafo Community.	Drought tolerant, low cyanide cassava varieties	• Cassava varieties introduced were not excitedly received as they have local varieties. • Post harvest technologies in cassava were well received.

4. Challenges during Project Implementation.

Despite the very good site specific plans that were developed to implement project activities, project staff encountered certain issues that need mentioning that affected the project activity schedules (Table 5). Farmers also were culturally obliged to attend and participate in some important village activities like attending funeral ceremony of deaths in the village or other important village activities that they thought were more pressing to attend to than to attend NARI trainings. Social disturbances along with physical damage to road infrastructure due to adverse weather conditions along the main Okuk Highway had negative implications to the project activities. We were not able to conduct on farm drip irrigation studies with the farmers at the right time when postgraduate BOKU students were in the country for that work, but the work was done later by NARI staff. Other work by the technical components was delayed because of the road blockage. Planning anything during the peak coffee harvesting season also proved futile, as many farmers did not attend to our trainings. Table 5 list issues that affected the project implementations; either delayed or some stopped activities. During tribal fights or when there were family feuds we were only able to work with farmers that not involved or either side of the conflict. One of our leading yam model farmers and in soil and water she was denied the last work we had to do with drip irrigation on her tomato plots because of family feuds.

There was some mockery and banter for women who attended the post harvest trainings by some members of the community but these skills proved very crucial and profitable for those women who attended the sessions during the *2015 El Nino* drought period and some farmers regretted not attending those training sessions for food processing for storing and cooking with flour for both domestic consumption and sales, when they saw the success of others.

Table 5. Issues of significance that impacted the project implementation schedules

Issues arising during implementation and lessons learnt		**Type of action required/suggested taken to resolve problems and delays etc.**
1	People have other activities/happenings more pressing to attend to than NARI work. e.g. graduations, funerals, etc.	Communication with lead model farmers was critical at the initial stages and plan activities.
2	The nominated and trained model farmers did not impart their new knowledge with other members of the community. Cultural and clan related issues were raised as the reason. This prevalent problem should be considered while nominating the next lot of model farmers.	Discuss candidly practicalities of information and knowledge sharing within the communities between the clans, etc. Community members should be advised of the disadvantage they have because of this latent problem.
3	Coffee season, tomato buying days, school work, village court days, deaths are few village activities that farmers focus their attention and will not attend to trainings.	Keep in touch with the farmers and consult days before travelling.
4	False rumours spread around by some people and had high expectations of "pilot project" term.	Proper explanations of the project were done to those spreading false rumours, as well as others and address head-on.
5	Road blocks, bridge collapsed alone the main highway.	Delayed work plans implementations and irrigation

		on site were not done by BOKU students as planned.
6	Tribal fights between clans.	Some of the remaining activities had to be cancelled
7	2015 El Nino Impacts on Kopafo.	Soil conservation trial was discontinued to the impact of El Nino.

Although some soil conservation work had to be discontinued because of the impacts of the 2015 El Nino drought conditions, it was also an appropriate time to demonstrate drip irrigation technologies using simple low cost locally available materials. The easy to handle project distributed treadle pumps were taken to water sources where water was pumped up the 4 meters high overhead tank and later supplied to the crops using locally available bamboo pipes, pvc or rubber pipes.

5. Final Assessments and Comments

There was a lot of excitement, hype and expectations from the European Union funded project in Kopafo, and locals had their interpretations of the "pilot project" site as Kopafo. The initial slow implementations of the activities as planned reduced the momentum of the project and some farmers lost interests for a while. The new approach of farmers taking a lead role in what they expect from the project in terms of their local priorities was a new approach that also was breaking traditional extension approaches and may have astounded many farmers, who expected NARI officers to tell them what they should have and what not to have in their communities. The engagement of the womenfolk in all these community consultations and giving equal importance to their views was also new approach to a male dominant highlands society.

Final site assessments in Kopafo took place in November 2015. The following Tables 6 and 7 show a summary of responses on technology performance and responses of representative farmers during focus group discussions.

Farmers mentioned in the final site assessment meeting that water harvesting and irrigation technologies would have been the priority one in the project had the farmers knew of the implications of their voting and prioritizing constraints in the first workshop after they had endured the *2015 El Nino* induced droughts.

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Table 6: Technology performance in Kopafo Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improved management and feeding practices of pig/goat for food and income	Better				Yes, but no access to concentrate so resort to usual feed	High, Pig experience faster growth rate extremely well.	
Processing and Value addition of Sweet potato for food	Better					Medium, more awareness needs to be done to ignite the interest	Yes, baked with flour 50t/scorn
Improved management and feeding systems for chicken	Better				Yes	High, chicken perform better, more profit/income	Yes, K30
Improved production practices and farmer preferred sweet potato varieties (3 varieties)	Same	2000-2500 m^2	1250 m^2	Similar sizes as 2000-2500 m^2 or more.		Medium, perform similar to traditional practice	Own consumption
Improved production practices for cassava and farmer-selected varieties	Poor	≈20 m^2-100 m^2/Plot	≈30 m^2/Plot	No, results were not favorable as the traditional practice/varieties		Low Interest for the introduced cassava because of its poor performance.	Own consumption
Improved production practices for yam and farmer-selected varieties	Better	162 m^2	≈100 m^2	Similar or greater that 162 m^2.		High, introduced yam was able to thrive during drought condition	Own consumption
Improved management and use of available water source for domestic use	Better					High, more people access clean drinking water and also for irrigation	

Table 7: Responses from Focus Group at Kopafo during final assessment on food production and priorities

Periods of Food Shortage	• Farmers confirmed that food shortage is usually experienced during the months of June to July and August to November and is usually caused by changing weather pattern from a dryer weather to a heavy rainfall weather pattern. • Normally June- July the place normally gets drier and the following months the place experience heavy rainfall till December. During this transitional periods, food crops that perform well in dry periods couldn't perform well resulting in food decline and vice versa for rainy periods. For instance, SP as their staple food yield well in dry season but not in wet season: that's when people run short of energy food but do rely on vegetables till late December
Views on whether improved technologies would improved food shortage period	• The model farmers responded that especially yam and introduced cassava processing and preservation technology were able to sustain them during the drought periods. • With the post harvest technology farmers were able to process their cassava and store and use them during the prolonged El Nino caused drought and such is proposed to be used to solve the food shortage experience during the year. • These introduced technologies were able to solve the food shortage situation. However, these vital technologies have to be disseminated into the community to more members and are used by other members of the community in order to reduce the food shortage problem faced by the community members.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• The farmers acknowledge the research process from problem identification to implementation selected appropriate technologies to solve identified needs. • Most of the intervention selected was appropriate and relevant/important; • The farmers mentioned that the time they voted was the time that most of the farmers were marketing their livestock (cattle, goats) and there was a lot of cash flow in the community of Kopafo therefore, most of them voted without really looking into the real issues affecting the community. • It was mentioned that every need as identified and technologies implemented were relevant and they still remain important to the community. • The farmers also thought that there are a lot water logged areas where fish pond construction is possible and they still have interest in inland fish farming given the availability of water.

Annex 4B. Pilot Site Report for Tambul (Alkena and Kiripia)

by Jeremiah Ahizo, NARI HHRC Tambul

1. Project Site Description

Alkena and Kiripia are two ethnic communities in the Tambul/Nebilyer (5.9250° S, 144.0110° E) district of the WHP. The altitude in Tambul/Nebilyer varies from 800 m in the lower Kaguel Valley to over 4,000 m on the upper slopes of Mt. Giluwe. Yearly rainfall is around 2,300 mm to 4,000 mm with an average temperature range of 18-20 °C while humidity ranges vary from 65-75 %. The staple sweet potato (*Ipomoea batatas* L.) is mainly grown for consumption whilst the Irish potato (*Solanum tuberosum*) crop and vegetables such as broccoli (*Brassica oleracea italica*) and cauliflower (*Brassica oleracea capitata)* are main income earners for most of the population. Livestock such as pigs, poultry, fish, goats and few cattle are also raised for both customary obligations and income or for own consumption (Hansen *et al*., 2001). Farmers from these two communities are part of the 15 % of PNG's population that inhabit the upper highland areas (>2,000 masl). With the threats imposed by climate change, farming communities in the high altitude areas are becoming more susceptible to frost, drought and excessive soil moisture conditions. People are vulnerable to excessive soil water and frost damage during prolonged wet and dry periods respectively (Hansen *et al*., 2001). This compels a major threat to food security especially with challenges to cultivation of the staple sweet potato. Sweet potato, is grown for both human and livestock consumption, playing a central role in high altitude semi-subsistence farming systems.

2. Site selection and Prioritization

The two communities were selected due to their vulnerability to frost, drought and excessive soil moisture conditions imposed by the changing climate. Through this project, proven agricultural technologies and improved farming practices were introduced as interventions into high altitude farming systems to improve resilience to threats imposed by the changing climate. These interventions were identified and prioritized based on farmer preferences captured via a needs assessment survey conducted in Alkena and Kiripia. Table 1 shows the initial SWOT analysis for the site.

Table 1. Tambul site SWOT analysis

Strengths:	**Weaknesses:**
• Access to land • No crop and livestock with significant cultural importance to prevents use • Interested and willing to try new things because they realized that there are problems in yield etc • SP system is a good working system that caters for all their need • More enterprise oriented (selling livestock, buying feed) • Availability of family labour • Able to maintain their own planting material (seed-system) • Use of sequential harvesting to prolong availability of SP (construction of mounds) • Aware of effects of climate change • Heavy rains but soil dries up quickly • No water shortage	• Land shortage • Use of same piece of land, less slash and burn; decline in soil fertility • Only one major staple crop used for food, sale, livestock, social obligations • Excess water (heavy rainfall) • Not enough water during dry season, poor quality • Water quality issues – Humans and animals use the same water source • Soil erosion close to rivers and creeks • Pest and Diseases (esp SP weevil, scab, viruses, taro beetle); no action taken • Only use of own planting material and • from within the community (no access to improved technologies) • Rely on store goods to bridge periods of food shortage; • Tuber rotting – Combination of saturated soils after heavy rainfall and following high solar radiation

Opportunities:	**Threats:**
• Bring in new crop varieties • Introduce new species • Introduce soil improvement and soil conservation practices • Improved drainage and mounds • Introduction of inland aquaculture • Improving livestock production (focus pig, chicken) • Options for improvement through use of long term stored feed • Intensification by increasing productivity from enhanced use of available land and financial resources • Improved water management –Multiple Use System • Improved water supply • Introduction of simple water purification techniques • Improving available cash income opportunities (potatoes, pig and broiler production...) • Farmers enterprise oriented	• Increased livestock production may affect already poor water supply and quality • More irregular weather patterns • Longer dry season • High population increase (land shortage, cultivation in vulnerable landscapes) • HIV/AIDS • Increased disease pressure in livestock when numbers increase

In a first of its kind project for the National Agricultural Research Institute (NARI), community members were engaged in a reporting back workshop. Each community member was invited to participate in the prioritization of the major constraint in their area and wished to do something about it (Table 2). Only the top three to five priorities were considered for addressing by the project. These constraints were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop at Tambul pilot sites (Keripia and Alkena)

	Voters (Kiripia)		
Options voted on in Kiripia	**Women**	**Men**	**Both**
1. Producing more Kau Kau from the same piece of land	7	23	30
2. Introduction of new crops or new varieties of other crops	5	29	34
3. Making better use of Kau Kau through processing into livestock feed	3	12	15
4. Increasing production of pig and chicken for food and income	3	29	32
5. Increasing production of sheep and goats for food and cash income	0	6	6
6. Increasing fish and duck production for food and cash income	0	11	11
7. Improved mound system and drainage for increasing Kau Kau production	1	0	1
8. Protecting and improving soil on my plot	4	1	5
9. Protecting our water	0	1	1
10. Soil and water conservation to manage moisture stress during the dry season	1	2	3
Total votes	**24**	**114**	**138**
No. farmers	**8**	**38**	**42**

Options voted on in Alkena	**Voters (Alkena)**

	Women	Men	Both
1. Producing more Kau Kau from the same piece of land	9	20	29
2. Introduction of new crops or new varieties of other crops in my farming system	12	47	59
3. Making better use of Kau Kau through processing into livestock feed	25	51	76
4. Increasing production of pig and chicken for food and income	27	61	88
5. Increasing production of sheep and goats for food and cash income	0	7	7
6. Increasing fish and duck production for food and cash income	13	23	36
7. Improved mound system and drainage for increasing Kau Kau production	0	11	11
8. Protecting and improving soil on my plot.	15	0	15
9. Protecting our water	0	2	2
10. Soil and water conservation to manage moisture stress during the dry season	0	10	10
11. Soil and water conservation to manage excess moisture during the wet season	0	2	2
Total votes	**101**	**232**	**333**
No. farmers	**34**	**77**	**111**

The interventions that followed involved farmer trainings, farmer-field-days and on-farm demonstrations of prioritized agricultural technologies and farming practices for crop and livestock production. These farming technologies were developed by NARI, in collaboration with relevant partner organizations, through continuous research and development efforts.

3. Interventions implemented at the site and summary of achievements

The implementation process involved an Adaptive Participatory Research Approach (APRA) (

Figure 1) for both the crop and livestock components. Farmers within each community were selected and trained via specific selection criterions that more or less differ according to component and in each prioritized interventions. Farming equipment, livestock (ducks, chickens and fish), stock feed, seeds and other materials required were then distributed to farmers and on-farm demonstration trials using prioritized technologies conducted. The implementation and dissemination processes were refined through farmer views and responses gauged from farmer and community feedback assessments.

The community feedbacks and constant farmer interactions proved crucial in streamlining the dissemination approaches so as to adequately respond to farmer needs. However there is still much to be done in terms of measuring the effectiveness of the dissemination approaches in each of the priority interventions implemented.

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Tambul communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output.

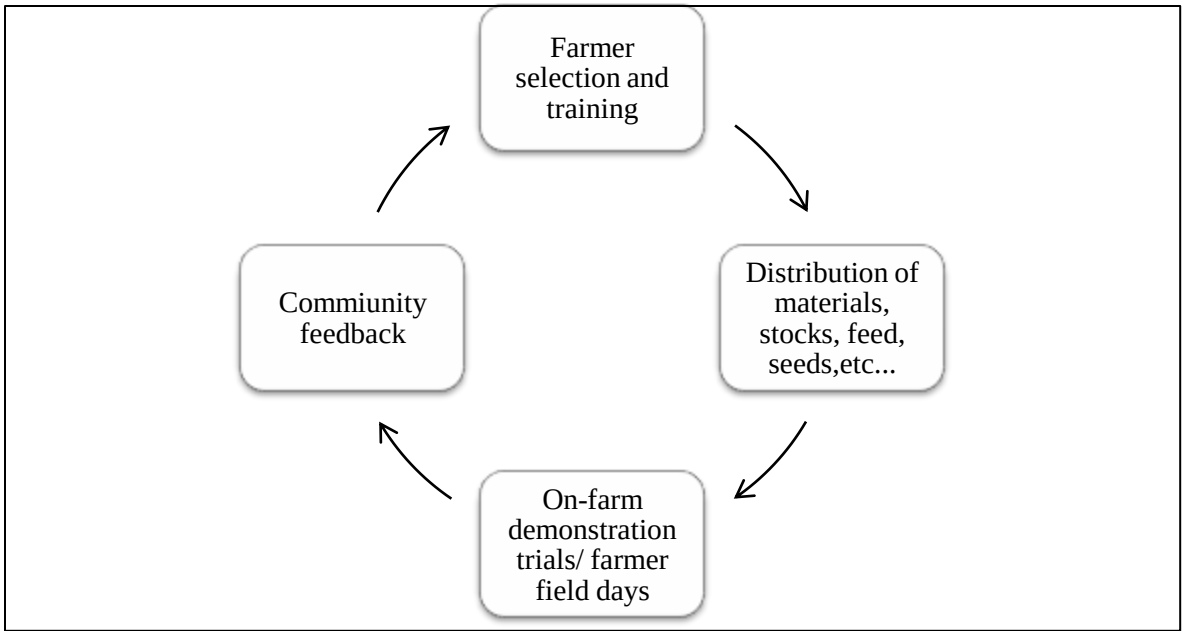


Figure 1 Shows a schematic diagram of the implementation cycle of project activities in the two Tambul sites.

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at Tambul Pilot sites.

Output	Description of output/ intervention	Farmers trained	Model farmers	Trials implemented
O1	Capacity for growing potatoes using improved locally acceptable production practices and PLB resistant varieties	22	8	8
O2	Farmer-preferred cold tolerant maize varieties identified and made available	40	6	6
O3	Capacity for growing wheat using improved locally acceptable production practices	20	5	5
O4	Cold tolerant rice varieties suitable for Tambul conditions identified	[Activity discontinued]		
O5(a)	Increased capacity for using improved pig feeding and management practices based on sweet potato (SP) as feed	163	23	15
O5(b)	Increased capacity for using improved chicken feeding and management practices based on SP as feed	56	23	23
O6	Increased capacity for using integrated livestock farming practices for inland fish and duck production	34	22	22
O7	Farmer-preferred excess moisture tolerant SP varieties identified and made available	85	6	6
O8	Increased capacity of farmers to use improved soil fertility management practices in SP production	38	16	22

There were some highlights (**Error! Reference source not found.**) on the priority interventions implemented through the project in Alkena and Kiripia. Though some technologies proved to be successful, others such as maize did not receive much attention as anticipated. The underlying reasons are still unclear but could be attributed to the each farmer's own perceptions and priorities in using a particular technology.

Table 4 Shows few highlights on some of the technologies disseminated as part of project interventions in Tambul.

Output	Description of intervention	Tech./farming practice	Farmer impressions
O1	Capacity for growing potatoes using improved locally acceptable production practices and PLB resistant varieties	Using PLB resistant varieties and improved management practices	• Farmers observed crop resistance to PLB and other morphological features during flowering stage. • Farmers observed increased potato tuber yield • Farmers observed reduced cost of growing PLB tolerant irish potato varieties compared to sequoia which is expensive
O2	Farmer-preferred cold tolerant maize varieties identified and made available	Cold tolerant maize varieties	• Though maize varieties introduced were affected by frost farmers were still interested to grow maize but expressed concern regarding seed supply.
O3	Capacity for growing wheat using improved locally acceptable production practice	Frost tolerant wheat varieties	• Wheat is one of the crop that is tolerant to frost and it withstood the impact of recent frost • Farmers learnt that wheat is one of the potential crops that can be grown to address food security and provide food period during and after frost experienced as in 2015.
O5(a)	Increased capacity for using improved pig feeding and management practices based on SP	SP ensiling and concentrate technologies	• Improved growth performance of growing pigs compared to those under conventional system • Improved quality of SP as feed for pigs • Observed ensiled SP as a means of storage over longer periods
O5(b)	Increased capacity for using improved chicken feeding and management practices based on SP	Concentrate technologies	• Observed significant cost savings of 15-20 % in raising broiler chickens [NARI concentrate + SP] • Produced table-eggs for consumption and income
O6	Increased capacity for using integrated livestock farming practices for inland fish and duck production	Duck-fish integration farming practice	• Observed improved growth performance and general body conformation of Tilapia fish and Muscovy ducks • Farmers were able to sell fish/ducks for income
O7	Farmer-preferred excess moisture tolerant SP varieties identified and made available	Moisture tolerant SP varieties	• Improved productivity through improve soil fertility management practices in SP production [increased marketable tuber yield]
O8	Increased capacity of farmers to use improved soil fertility management practices in SP production	Composting in SP mounds	

Some farmers were observed to be leaning more towards technologies that will generate more income while others were more concerned with food security for their families. A few farmers were only keen in trying out the new concepts promoted through the project. However there is still very high interest in most of the technologies disseminated and most community members have expressed their desire for the project period to be extended as well as expanded to other communities also vulnerable to climate change imposed hazards. Table 5 shows some additional information on the performance of some of the technologies compared to farmers traditional technologies and practices.

Table 5. Some highlights of the technologies implemented based on on-farm demonstration trial results.

Output	Description of output/ intervention	Conventional system yield	Intervention yield	Improvement
O1	Capacity for growing potatoes using improved locally acceptable production practices and PLB resistant varieties	Seeds weight used for multiplication: 0.24t (95net bags)	0.83t produced from 0.5 ha and distributed to farmers	71.2 % produced and distributed to the farmers.
		Production cost for sequoia Var. at 0.5 ha is PGK5366.00[7].	Production cost for CIP clones at 0.5 ha is PGK 4113.00. This cost is without fungicides application	CIP clones reduced 23 % of production cost compare to sequoia
O2	Farmer-preferred cold tolerant maize varieties identified and made available	Yield in kg/ha: 0t/ha No record at initial stage	Yield in kg/ha: 0.128t/ha	Yield increase:0.128t/ha
O3	Capacity for growing wheat using improved locally acceptable production practices	Yield in kg/ha:5.25-24.5t/ha	Yield in kg/ha: 27t/-72t/ha	Yield increase:22.0 - 48t/ha
O5 **(**a)	Increased capacity for using improved pig feeding and management practices based on sweet potato (SP) as feed	Average live weight gains of 65g per day	Average live weight gains of 160 g per day	146 % improvement in growth rates
O5 **(**b)	Increased capacity for using improved chicken feeding and management practices based on SP as feed	Live weight/bird:2.7 kg Profit margin/bird: PGK[8]20.85	Live weight/bird:2.8 kg Profit margin/bird: PGK 23.00	Weight difference:3.57% Profit increase:10.31 %
		Egg/bird/day:3 Cost/egg: PGK 0.89	Egg/bird/day:3 Cost/egg: PGK 0.74	Difference: 0 % Profit increase:16.85 %
O6	Increased capacity for using integrated livestock farming practices for inland fish and duck production	SGR[9]/ day in 127 days: 18.96 % Average Biomass :366 g	SGR/ day in 127 days:28.79 % Average Biomass: 2129 g	SGR increase: 9.83 % Average Biomass: 1763 g gained from each intervention pond
O7	Farmer-preferred excess moisture tolerant SP varieties identified and made available	Yield in kg/ha:2.4-22t/ha	Yield in kg/ha:3.4t/ha- 16t/ha	Yield increase: 1.0—9t/ha
O8	Increased capacity of farmers to use improved soil fertility management practices in SP production	Yield in kg/ha:2.4-22t/ha	Yield in kg/ha: Significant Increase in yield	Yield increase:Significant yield increase noted. yet to analyse data

[7] Costs inclusive of fungicides and spraying
[8] PGK is Papua New Guinea's currency the Kina.
[9] SGR is Specific Growth Rate for Tilapia

4. Challenges during Project Implementation.

Though the technologies implemented as part of interventions have being proven to be successful on-station these were at times difficult to prove on-farm due to the low literacy level of farmers. The arrival of drought and frost towards the back end of the project period has severely affected the availability of sweet potato and has made it impossible to feed poultry with sweet potato thus other possibilities in using cassava was considered. However the use of feeding livestock with root and tuber crops remains to be both a challenge and an opportunity in producing livestock feed through the Mini-Feed Mill concepts. Sweet potato, Irish potato and maize were severely affected whilst most wheat varieties being evaluated on-station withstood frost conditions and these could also be further screened for frost tolerance. Often planned activities had to be deferred in such cases as well as other instances when there are deaths within selected communities.

Table 6. Some challenges faced during implementation of interventions.

Challenge	Effect on interventions	Approach taken
Road blockages and deteriorating road conditions	Delay in implementation of planned activities	Stocking up of feed (concentrates) Defer planned activities to a suitable date
Drought	Drying up of fish-ponds in integrated facilities	Use alternate water source (where applicable)
Frost	Damage to sweet potato, potato and maize	Alternate feed options for livestock Replant crops when conditions are suitable
Death in the project sites [*Haus krai*]	Delay of planned activities	Defer planned activities to a suitable date
Farmer illiteracy	Understanding the technical aspects of the interventions	Using simplified TokPisin and pictures in explanations/Trainings, etc… Using model farmers with some educational background and experiences to explain difficult concepts in local language
Lack of district extension services	Closer monitoring and evaluation of demonstration trials	Timely follow up visit to farmer fields Use of mobile communications

Constant evaluation of dissemination approaches; feedbacks from technology dissemination procedures and studies on technology adoption are invaluable for refining dissemination approaches and success in technology transfer and are areas that can be explored by social researchers. Collaborative efforts between research and extension bodies are vital for widespread and effective diffusion of agricultural technologies and strengthening research and extension linkages which is currently a constraint in the project and project sites.

5. Final Assessments and Comments

The interest in all the interventions introduced remains to be very high in the two communities. The onset of drought and frost has affected many of the interventions especially sweet potato, potato, maize and livestock interventions that involved feeding pigs and poultry with sweet potato. Most fish ponds also dried up within that period. This has made the communities to realise the importance of water, diversifying agricultural activities and growing frost tolerant crops such as wheat. The communities have become aware of the effects of climate change and the strategies to at least cushion its effects. Since agriculture is the mainstay for most people in the two communities the prioritized interventions had proven beneficial but further support is needed from the government to help farmers recover and continue with the interventions after frost. Most seeds and crops have succumbed to frost therefore there is a need to redistribute seeds and planting materials to the affected communities. The supply and accessibility of farmers to source poultry concentrates still remains a challenge.

Final site assessments at Tambul pilot sites took place in November 2015. The following Tables 7 -10 show a summary of responses on technology performance and responses of representative farmers during focus group discussions.

Table 7: Technology performance in Alkena Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improved production practices for potato and PLB resistant varieties	Better,	Less than ≈1 ha	Establish after research - ≈10, 000, operating for commercial purpose	1ha+		High- less labor input, performs similar to previous variety introduced	≈K4000
Improved production practices for wheat Farmer selected wheat varieties	Medium	162 m^2		60-70 + m^2. But no further production (need milling machine to continue cultivation)			
Excess moisture tolerant sweet potato varieties	Better	≈ 180 m^2	≈24 m^2	180 + m^2 Frost damaged most SP vines slowed down garden expansion			
Improved pig/chicken feeding practices with sweet potato	Better				Yes	Chickens and pigs performed extremely well under the introduced feed and management system	Chickens K30 Pig- were not sold
Inland fish and duck integration	Better				Yes		Ducks-K20-K50
Improved soil fertility management practices for sweet potato	Better, SP improved performance						

Table 8: Responses from Focus Group at Alkena during final assessment on food production and priorities

Periods of Food Shortage	• June – August, November to December is experienced usually due to the excess moisture.
Views on whether improved technologies would improved food shortage period	• Given the frost negative impact which affected the SP potato which is the staple crop for both animal and livestock, has really confused whether the food shortage period can be solved using the intervention introduced or not. • However, regardless of the confusion, farmers mentioned if they continuously do what they were told, they will be able to store enough feed for pigs, poultry or make money to cater for the food shortage period. • Farmers also mentioned that wheat is one of the grain crops that can be used to help in the times when frost is experienced. Wheat is one of the crop that can withstand the damaging effect of frost and able to provide food for the farmers in the community.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• Reflecting back on the interventions voted and has been implemented farmers mentioned that those interventions are important to the community of Alkena. • However, given the effect of climate change causing prolonged drought and also frost phenomena, many of the respective interventions under crops and livestock were badly affected. • In the drought condition, farmers realize that, water is now an important need for almost all operations like for fish, pig, human and irrigating for crops. Therefore, almost all farmers agreed that water should have been voted as their number one priority.

Table 9: Technology performance in Kiripia Community as assessed by representative community members

Technology	**Performance -Better -Same -Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)? -Yes -No**	**General Interest from the community- High (H) Medium (M) Low (L) Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	**New Practice**	**Plan to Expand, If yes by how many**			
Improved production practices for potato and PLB resistant varieties	Better	≈162 m^2	≈162 m^2	Yes, 162 m^2+ but seeds destroyed from frost		High, CIP clones performed better without labor input required	Not sold,

Improved production practices for wheat Farmer selected wheat varieties	Better	Previously not planted	≈100 m^2	Yes, 100 + , but need mill		Medium-High, Given the there is need for milling machine increase interest, wheat withstood the frost damaging impact	Not sold,
Cold tolerant maize varieties,	Same	≈162 m^2	≈162 m^2	≈162 m^2		Low-Medium, the varieties perform similar to local ones.	Not marketed
Excess moisture tolerant sweet potato varieties	Better	≈162 m^2	≈100 m^2	≈162+ m^2		High, Improved marketable tubers, more number of tubers	Own consumption
Improved pig/chicken (broiler/layer) feeding practices with sweet potato	Better				Yes	High, improved growth rate and better performance,	Eggs marketed K1.00/egg Chickens-K30 Pigs not marketed, drought affected production
Inland fish and duck integration	Better				Yes	High, Farmers expressed interest to continue	Ducks-K15,
Improved soil fertility management practices for sweet potato	Better				Yes	Medium, need more dissemination to create interest	

Table 10: Responses from Focus Group at Alkena during final assessment on food production and priorities

Periods of Food Shortage	• During the initial baseline survey, community members mentioned that, food shortage is usually experience in the months of **June-August and Nov-Dec**, • However, when ask during the final EU-ARD assessment, it was mentioned that given the El-Nino induced drought and frost, they were not able to confidently confirm the duration of food shortage.
Views on whether improved technologies would improved food shortage period	• Farmers mentioned that the interventions introduced were better and were able to be used to provide food and also generate income to cater for the times of food shortage as experienced.. • However, given the El Nino, induced drought and frost had damaged most of the crops and also livestock. • However, many farmers expressed the sentiment that given the interventions and the skills learnt; farmers can now learn to think of different ways to make food available for both animal and humans during the food shortage periods and also cater for such phenomena as the El Nino induced drought and frost

	damages. • Since wheat can withstand frost, farmers mentioned that there is need for a milling machine to encourage farmers to continue wheat production within their established gardens.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• Farmers mentioned that the interventions voted and implemented were and are still important. However, given the El Nino, induced drought and frost phenomena, farmers realized that water is important to maintain crops production and also supply water to both animals and human for consumption. • If they had to vote again, water would be selected as their number one priority as most of the village lived along the mountain ranges and access to water for to livestock, own consumption and irrigation purpose is difficult prolonged draught or during dry sunny periods. • It was also mentioned that wheat can be able to withstand the impact of frost therefore they will also vote for wheat. • SP is an important staple for both animal and human therefore, farmers mentioned that water and SP will be the first two important interventions to vote followed by wheat.

Annex 4C. Pilot Site Report for the Hisiu/Yule Island (dry/saline)

by Peter Gendua, NARI, MRC Bubia

1. Project Site Description.

The Hisiu and Yule Island are two communities belonging to the Kairuku ethnic group of the Kairuku/Hiri district of the Central Province. The Hisiu people live on the mainland from the coastal sea front on the old Hisiu Coconut plantation on the sandy and alluvial flat to the seasonally inundated swampy areas inland covered with savanna grassland and semi-deciduous thicket, while the Yule Island community live on the Island (originally called Kairuku) on the beach ridges on the rolling foot hills, covered with savanna grassland and semi-deciduous thicket. On Yule Island and along the coast to the southeast (Hisiu), it occupies low spurs, interfluves and foot slopes, covered with a savanna comprised of mid-height Themeda and Imperata grass and scattered Euctalyptus trees. The altitude in Hisiu and Yule Island varies from sea level to 400 m on the upper slopes of the rolling hills of Yule Island. Average annual rainfall at Kairuku (Yule Island) is around 1230 mm and 84% of this rain is received between December and April and only 16% between May and November. On the Mainland (Hisiu) there is a high rainfall gradient from the coast inland, and the coastal dry season is more severe than it is inland. Banana and cassava are the most important staple crops; coconut and yam (D. *esculenta*) are important crops; other crops are sweet potato, Alocasia taro, yam (D. *alata*) and Amorphophallus taro. Separate gardens are made for banana and yam. Two plantings of yam are made before a long fallow. Yam is staked and banana is propped and wrapped. Yam and sweet potato are planted on small mounds. Banana may produce up to 5years if cared for. Agriculture is highly seasonal and dry season food shortages are common. Seafood is important for supplementing diets and sale for cash income. Villages are surrounded by extensive coconut stands from the old plantation, fruit and nut trees. Root crops and banana, which are obtained from the inland and Bereina people in exchange for fish and shellfish, are important source of food. Processed food purchased using remittances from people working in Port Moresby is also very common and important

Livestock such as pigs and poultry, are also raised for both customary obligations and income or for own consumption. Farmers from these two communities are part of the 20 % of PNG's population that inhabit the dry savanna environments. With the threats imposed by climate change, farming communities in the dry savanna areas are becoming more susceptible to drought conditions. People are vulnerable to drought during prolonged dry periods (Hansen *et al*., 2001). This compels a major threat to food security especially with challenges to cultivation of the staple banana, yams and sweet potato.

2. Site Selection & Prioritization.

The Hisiu/Yule Island site was initially selected for salinity stress environment because the villages were situated along the coastline and the Island environment but later through discussion with the community it was found that most of the villagers don't cultivate their crops near the sea but farm or cultivate the inland areas and only live or have their villages near the sea. The same ethnic group (Kairuku people) live both on the mainland (Hisiu) and on the Island (Yule Island) and the site is similar to and part of the Port Moresby climatic condition where it has distinct dry and wet seasons. The two communities were selected due to their vulnerability to drought and suspicion of salinity conditions imposed by the changing climate. Through this project, proven agricultural technologies and improved farming practices were introduced as interventions into the farming systems to improve resilience to threats imposed by the changing climate. These interventions were identified and prioritized based on farmer preferences captured via a needs assessment survey conducted in Hisiu and Yule Island. The interventions that followed involved farmer trainings, farmer-field-days and on-farm demonstrations of prioritized agricultural technologies and farming practices for crop and livestock production. These farming technologies were developed by NARI, in collaboration with relevant partner organizations, through continuous research and development efforts.

The initial fact finding site assessment visit revealed the following site specific characteristics which were slotted into SWOT analysis.

Table 1. Project site SWOT analysis.

Strengths: • Barter system in place (fish for food) with Mekeo people (banana/betelnut) – esp Yule Islanders • Barter system for mainland to increase diversity in banana varieties (long orange fleshed; does not grow in Hsiu) • Grow yam that can be stored • Number of protein sources esp wild (fish, bandicoot) • Grow several different staple crops that are well adapted to environment, FG – Banana most important as it is unseasonal) • Tourism potential and spin-off opportunities in food production • Soil moisture conservation technologies • Good community management on Yule islands (Chieftain system)	**Weaknesses:** • Yule Islanders rely on barter system to access staple crops • Hsiu – swamp used for fishing infested with aquatic weed • Reliance on remittances from working relatives in POM – no incentives for food production • Only small type income generation (run-down coconut blocks, betelnut) • Not so much motivation to look after livestock with wild sources available • Barter system as disincentive to develop business approach in selling livestock • Access to water, water quality, period shortage • On mainland (other villages besides Hsiu) issues with salinity esp during high tide and strong winds, salt water intrusion in water wells • Only use of own planting material and from within the community • Use of traditional practices (slash and burn, shifting) • P&D (taro beetle, other beetles, rots, rats) • Excess/deficit moisture
Opportunities: • Introduction of new varieties (corn, cassava) • Introduction of new crops • Interested small livestock production • Increased food production to sell in POM • Increased livestock production on Yule Island (declining fish stocks) • Introduction of improved feeding (Willing to buy feed from the market) • Sale of puppy tree bark to Chinese (K5/kg – extracting and used as incense)	**Threats:** • More irregular weather patterns • Yule Island – rising sea level • Declining fish stocks esp Yule Island • Further population increase (ensuing land shortages)

In a first of its kind project for the National Agricultural Research Institute (NARI), community members were engaged in a reporting back workshop to list their major constraints and opportunities during drought conditions. Each community member was invited to participate in the prioritization of the major constraint and opportunities available in their area and wish to do something about it (Table 2). Only the top three were considered for addressing by the project. These constraints and opportunities were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop and women and girls were given opportunity to vote separately and independently of the men and boys.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Hisiu and Yule Island.

Options voted on at Hisiu	Voters		
	Women	Men	Both
1. Improving water logging on my crop fields	3	5	8
2. Improving production of banana, yam and cassava	17	12	29
3. Improving management of pigs and chicken using staple crops	11	7	18
4. Improving soil fertility and stop decline in soil fertility	3	10	13

5. Introducing new crops or crop varieties in my farming	11	9	20
6. Integrating management of pigs, chicken, ducks and fish	0	4	4
7. Managing soil and water salinity	9	4	13
8. Adding value to my staples through processing into feed and food	1	5	6
9. Diversifying my livestock holdings for food and income	8	8	16
10. Protecting our water sources	5	2	7
Total votes	**68**	**66**	**134**
Total voters	**22.67**	**22**	**42**

Options voted on at Yule Island	Voters		
	Women	**Men**	**Both**
1. Improving water logging on my crop fields	0	0	0
2. Improving production of banana, yam and cassava	23	25	48
3. Improving management of pigs and chicken using staple crops	0	2	2
4. Improving soil fertility and stop decline in soil fertility	9	13	22
5. Introducing new crops or crop varieties in my farming	25	25	50
6. Integrating management of pigs, chicken, ducks and fish	0	7	7
7. Managing soil and water salinity	0	1	1
8. Adding value to my staple crops through processing into feed and food	9	13	22
9. Diversifying my livestock holdings for food and income	12	12	24
10. Protecting our water sources	0	1	1
Total votes	**78**	**99**	**177**
No. Farmers	**26.0**	**33.0**	**59**

The priorities can be summarized as improving production and diversifying their staples (banana, yam and cassava) and improving management of pigs and chicken using staple crops and diversification of their livestock holdings. Followed by adding value to their staple crops through processing into feed and food and the forth priority was improving soil fertility and stop decline in soil fertility. The priorities identified were addressed with different appropriate interventions by four technical components of livestock, crop improvement, crop diversification, soils and water teams from NARI and partners to address the outcomes of these priorities during the lifespan of this project.

3. Interventions implemented at the site and summary of achievements

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Hisiu and Yule Island communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output.

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at the Hisiu/Yule Island Pilot site.

	Outputs achieved in Hisiu/Yule Island	**Farmers Trained**	**Male farmers**	**Female Farmers**	**Model Farmers**
O1	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Hisiu/Yule Island Community	43	24	19	4
O2	Capacity for growing rice using locally appropriate production practices and varieties developed in Hisiu/Yule Island Community	35	23	12	3
O3	Capacity for growing cassava using improved locally	25	17	8	4

	acceptable production practices and farmer-selected varieties increased in the Hisiu/Yule Island Community				
O4	Farmer-preferred drought tolerant sweet potato varieties identified and available to the Hisu and Yule Island communities				6
O5	Capacity for growing vegetables (tomato, capsicum and beans) using improved locally acceptable production practices and locally performing varieties increased in the Hisiu/Yule Island community.	20	11	9	5
O6	Increased capacity of interested farmers for using improved pig feeding and management practices	42	36	6	3
O7	Increased capacity for using improved chicken feeding and management practices based on SP (or cassava) as feed	41	24	17	5
O8	Livestock holdings of interested farmers in Hisiu/Yule Is. diversified and capacity for livestock management improved : (a) Fish-Duck Integration	56	46	10	3
O9	Livestock holdings of interested farmers in Hisiu/Yule Is. diversified and capacity for livestock management improved : (b) Goat management	29	29	0	3
O10	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.	16	13	3	3

Model farmers were identified and nominated amongst the farmers themselves, based on their interests and past experiences. The model farmers volunteered to take on new innovations using their land for crop variety trials, and livestock pen/ shed for livestock husbandry demonstration trials. These were mostly interested and resourceful or knowledgeable in their selected areas and willing to try new ideas and technologies in other areas that they don't know as well. The success of the respective projects or demonstrations depended on the pro-activeness of the model farmers. Model farmers responsible for one demonstration were also able to participate in other areas based on his/her interests. For example, the model farmer for broiler chicken was also the model farmer in food processing or other components such as evaluating cassava varieties or yam production technology demonstration trials, if he/she chose to. The attendance of farmers for different learning events, technology demonstrations and meetings depended on the local social factors such as funerals, graduations, tribal conflicts, market days and of course the weather sometimes affected the farmer participation levels, but most farmers do made up for it in the next learning event or demonstrations. Not all farmer trainee names were listed by the visiting NARI staff, as it was difficult especially during field days.

The planned activities under each of the technical components were delivered through field demonstration trials, training demonstrations and field days. Table 4 shows an overview of the technologies and practices that were introduced for each output and some farmer responses gathered during implementation.

Table 4. Technologies/ innovations disseminated as part of project interventions at Hisiu/Yule Island pilot site and farmer impressions.

Out put	Description of intervention	Innovation	Farmer impressions
O1	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Hisiu/Yule Island Community	Yam cultivation practices (mini-setting demos).	• Stalking of African yam received higher yields than local varieties • Many farmers wanted to expand their African yam.
O2	Capacity for growing rice using locally appropriate production practices and varieties developed	Rice production technology	• The introduction of new rice mill created positive impact and many members of the community interested

	in Hisiu/Yule Island Community		to grow rice. • The rice farmers expressed that they will grow more rice and store them for consumption during drought and food shortage periods.
O3	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Hisiu/Yule Island Community	Drought tolerant cassava varieties	• Communities preferred their own local varieties
O4	Farmer-preferred drought tolerant sweet potato varieties identified and available to the Hisiu and Yule Island communities	Drought tolerant SP varieties	• Farmers wanted to keep all the introduced cassava varieties
O5	Capacity for growing vegetables (tomato, capsicum and beans) using improved locally acceptable production practices and locally performing varieties increased in the Hisiu/Yule Island community.	Improved & vegetable production techniques	• One farmer bought a second hand vehicle from vegetable sales. • Farmers have expressed that with the introduction of vegetables into their cropping system, they are now able to have diversity in the daily diet and earn a little income from the surplus that they produce.
O6/7	Increased capacity of interested farmers in Hisiu/Yule Island community for using improved chicken and pig feeding and management practices	SP silage and broiler concentrate technologies.	• Pigs fed on sweetpotato silage gives tastier meat. • The NARI feed concentrate (LE) is not available in commercial shops for the projects sustainability.
O8	Livestock holdings of interested farmers in Hisiu/Yule Is. diversified and capacity for livestock management improved : (a) Fish-Duck Integration	Introduction of ducks and integration with fish ponds	• Not only protein but as a means of recreation, they do enjoy watching the ducks. They stated that some of their ducklings are killed by eagles • Elisabeth said she had already identified her buyers for her ducks in Port Moresby
O9	Livestock holdings of interested farmers in Hisiu/Yule Is. diversified and capacity for livestock management improved : (b) Goat management	Introduction of goats as a new livestock species	• The goat population has increased and the couple has passed 5 goats to the other interested farmers, Elisabeth and John Warupi
O10	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.	mulching, composting, planting of leguminous hedge rows using *Glyricidia sepium*, *Mucuna* spp. and planting other legumes crops and plants	No comments available

4. Challenges in Project Implementation.

Despite the very good site specific plans that were developed to implement project activities, project staff encountered issues that affected the project activity schedules Table 5 provides an overview of some of those issues. Generally the farmers and community participation at Yule Island was much better and well coordinated compared to the Hisiu component. The Yule Island community activities, demonstrations, trials and other activities were coordinated very well by Mr. Joe Baupua, a local community leader, while Hisiu community leaders had differences among themselves which affected some of the planned activities. A prolonged drought in 2013 and the El Nino in 2015 affected some crop demonstrations especially the upland rice cultivation demonstrations at Hisiu.

Table 5. Issues of significance that impacted the project implementation schedules.

Issues arising during implementation and lessons learnt		Type of action required/suggested taken to resolve problems and delays etc.
1	People have other activities/happenings more pressing to attend to than NARI work. e.g. graduations, funerals, etc.	Communication with lead model farmers was critical at the initial stages and plan activities.
2	Some of the nominated model farmers especially from Yule Island had migrated to the city (Port Moresby) and abandoned the demonstration trials	The abandoned activity or trials were brought to the village project coordinator and assigned to new farmers or taken care of some relatives.
3	Differences among the different clan leaders had lead to many model farmers abandoned their activities	Divide activities and demonstration equally among the different clans and their leaders.
4	Some model farmers don't want to share the results and materials with other farmers.	Quick meeting between NARI, Village Coordinator and the farmers concern resolved the problem and materials and information shared.
5	The prolonged drought in 2013 had impacts on Hisiu and Yule Island rice demonstration plots.	Rice production demonstration plots at Hisiu were discontinued due to the impact of prolonged drought.

6. Final Assessments and Comments

There was a lot of excitement, hype and expectations from the European Union funded project in Hisiu and Yule Island communities as the communities' expectation of the term project as free handouts of materials and cash. The general perception and the expectations in the community when the project idea was taken to the village was that NARI or the project was going to start something big and visible, with reference to a structure or building like they have seen in other projects. That perception was cleared through community meeting and discussions. The new approach of farmers taking a lead role in what they expect from the project in terms of their local priorities was a new approach that also was breaking traditional extension approaches and may have astounded many farmers, who expected NARI officers to tell them what they should have and what not to have in their communities. After working with the model farmers and them applying the introduced technologies during the 2015 drought period, farmers highly appreciated the project going to their village especially the Yule Island community, which is isolated on the Island away from the Hiri-Tano Highland and the Mainland. The engagement of the womenfolk in all the community consultations in giving equal importance to their views was also new approach to a male dominant Melanesian society. The women members of the community were lead model farmers and carry of the technology and innovations demonstrations and verification trials. Some farmers lost interests along the way but many continued to the end of each planned activities saw the benefit for both food and income generation.

There were no law and order related problems faced by the NARI project team while working in the areas for the five years project duration. Farmers mentioned in the final site assessment meeting that water harvesting and irrigation technologies would have been the priority one in the project had the farmers knew of the implications of their voting and prioritizing constraints in the first workshop after they had endured the *2015 El Nino* induced droughts. The following Tables 6 - 9 summarize the information gathered during the final assessments at Hisiu and Yule Island, respectively.

9. References.

Allen, B.J., T. Nen, Bourke, R.M, Hide, R.L. Fritsch, D. Grau, R., P. Hobsbawn and S. Lyon (1996). Agricultural Systems of Papua New Guinea. Working Paper No. 15.Central Province. Text Summaries, Mapsm CODE Lists and Village Identification. The Australian National University, ACT 0200, Australia.

Table 6: Technology performance in Hisiu Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improved production practices for yam and farmer-selected varieties	Better	≈2000-2500 m^2.	≈200 m^2	≈1000 -2000 m^2 as more seeds are available.		High, yams were bigger and longer	K16-K20 per yam
Production practices for rice	Better		24 m^2, 30 m^2,	>100 m^2		High, cater for food shortage, resource available.	Own consumption
Improved production practices for cassava and farmer-selected varieties	Better	≈2000 m^2	Researched plots- 100 m^2	≈ more than 100 + m^2		High, tubers were bigger and long	-Own consumption
Drought tolerant sweet potato varieties	Better,	≈160	• ≈50 m^2 for research • 600 m^2	≈600m^2 +		-High, > tubers, better sizes -Shorter duration to reach maturity	
• Improved production practices for vegetables	Better,					High, all the vegetables planted were able to thrive well with good/ quality harvest results. Farmers wanted to continue.	• K1/ heap- • K40 per noodles carton- (Gordons- Open Market) • K6-K8 per kilogram in supermarkets (Dynesty) • Egg plant-50t and 30t per egg plant • Chilly- K80-K100 per 20 Kg • K6/kg x 6kg = k36

Improved chicken/pig feeding and management practices	Better,				Yes	High, more birds, eggs for food and income Pigs grow better	
Ducks/pond integrated farming	Better				Yes, but all fish died caused by drought	Medium, more awareness to be done	
Rope and Washer Pumps	• Poor, difficulty in pumping water when the table is low, so the pump lay idle and the villagers again had to use the old practice of taking the water out of the well. • Need other means						

Table 7: Responses from Focus Group at Hisiu during final assessment on food production and priorities

Periods of Food Shortage	• Feb-April-, food shortage is usually caused by rainfall-excess soil moisture damaging cassava and other food crops. • Given the geographical location of the community, farmers stressed that staple food like cassava and yam becomes harden and becomes unpalatable during the rainy periods.
Views on whether improved technologies would improved food shortage period	• Iit was mentioned that food shortage can be managed if they plant know they plant food on the higher land with proper drainages and also plant when the swamp dries up according to the current cropping calendar and also weather patterns. • It was also noted that another way forward is for them to grow vegetables and sell them to buy food (rice etc…) to sustain them during food shortage period. • Many who accepted and implemented the interventions are experiencing financial and also other associated benefits while others who were not doing it were still facing food shortage.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• Most of them mentioned that the choices made five years ago, still remain important today however, if they are to vote again, water would be one of the most important element voted for because it is important and would help in irrigating the gardens and drinking as well. • Water is important for irrigation of crops, animals and human consumption therefore it was mentioned vital for further development.

Table 8: Technology performance in Yule Island Community as assessed by representative community members

Technology	**Performance -Better -Same -Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)? -Yes -No**	**General Interest from the community- High (H) Medium (M) Low (L) Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	**New Practice**	**Plan to Expand, If yes by how many**			
Improved production practices for yam and farmer-selected varieties	Better	81 m^2	400 m^2	400+ m^2		Medium, interest growing, last long, drought tolerant,	
Production practices for rice	Better		100 m^2	200 + m^2		High, better yield, reduced food cost, food security in food shortage period. 11 farmers using the tech.	
Improved production practices for cassava and farmer-selected varieties	Better	400 plus m^2	200 m^2	200+ m^2		High, high yielding, diversification	
Drought tolerant sweet potato varieties	Better	50 m^2	162 m^2	50 m +		High, high yielding	
Improved chicken/pig/ducks feeding and management practices	*Better, for ducks and Chickens *Poor (Pig)				Yes, continue only with duck and chickens but pig failed due to drought impact on sweet potato.	Medium, interest is growing slowing given the drought impact…	K1.00/Egg
Livestock (goat, ducks) holdings and improved capacity for management	Better, goats thrives, Better, Ducks survived					Medium, destructive behavior, newly introduced	

Table 9: Responses from Focus Group at Hisiu during final assessment on food production and priorities

Periods of Food Shortage	• It was mentioned that food shortage is usually experienced in February to April and is usually caused by transition from old to new gardens. When all the food from the older garden is used up that is where food shortage is being experience in the village generally.
Views on whether improved technologies would improved food shortage period	• The farmers mentioned that with those introduced practices like rice, cassava, African yam is cultivated and stored, can be used to solve the problem for food shortage generally faced on the Island. • Livestock can also be sold for income and used to buy food to solve the food shortage problem to also manage food security issue.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• It was mentioned that since the new crops were introduced and the project is at its initial stage and their priorities are still the same and they want to continue use the interventions introduced.

Annex 4D. Pilot Site Report for the Derin (wet lowlands)

by Dr Dominik Ruffeis, HRC Aiyura

1. Project Site Description

Figure 1: Map of Papua New Guinea highlighting Derin study site.

Derin is located in the Transgogol area of Madang district on a depositional flood plain and in a dense forest area at 145.61℉ and 5.35℃S at an elevation of 52.43 meters above sea level. The site represents a low land excess moisture area in PNG. The Derin area covers 3 council wards of wards 7, 8 and 9 of Transgogol LLG. It has a population of 1, 002 with 600 male and 502 females with low to moderate access to services.

Madang is a high rainfall lowland area, having average monthly rainfall ranging between 110 mm – 410.7mm with an annual rainfall between 3000 and 4000 mm/y. Out of these, the month of March has the highest rainfall of 360 mm while the month of September found to have the lowest average rainfall of 13.6mm. The rainfall data derived from National Weather Service of PNG for the last nineteen years (1996-2014). Due to the climatic conditions Derin is classified as area with low drought vulnerability.
The average annual monthly maximum temperature of the area ranges from 30.4℃ - 31.4℃ and minimum temperature from 23.8℃- 24.2℃. There is no greater variation in the minimum and maximum temperature all year around. Lowest and highest temperature rise or fall at 1℃ below the minimum or above maximum temperature (Figure 2).

The Derin landform is classified as composite alluvial plain formed through fluvial action. The landform on either side of the area is hilly terrain with weak or no structural control. The parent material of the soil in terms of its geological formation is sedimentary rocks under unconsolidated alluvial deposits. Having all detrital materials of recent age deposited by flowing water and/or gravity. They encompass fluviate, colluvial (scree), lacustrine and alluvial fan deposits composed of sand, gravel, silt, mud, clay, or angular rock fragment. The topographic position of the area is categorized as valley bottom flat (local low area in the landscape, undulating) to lower slope (PNGRIS, 2008).

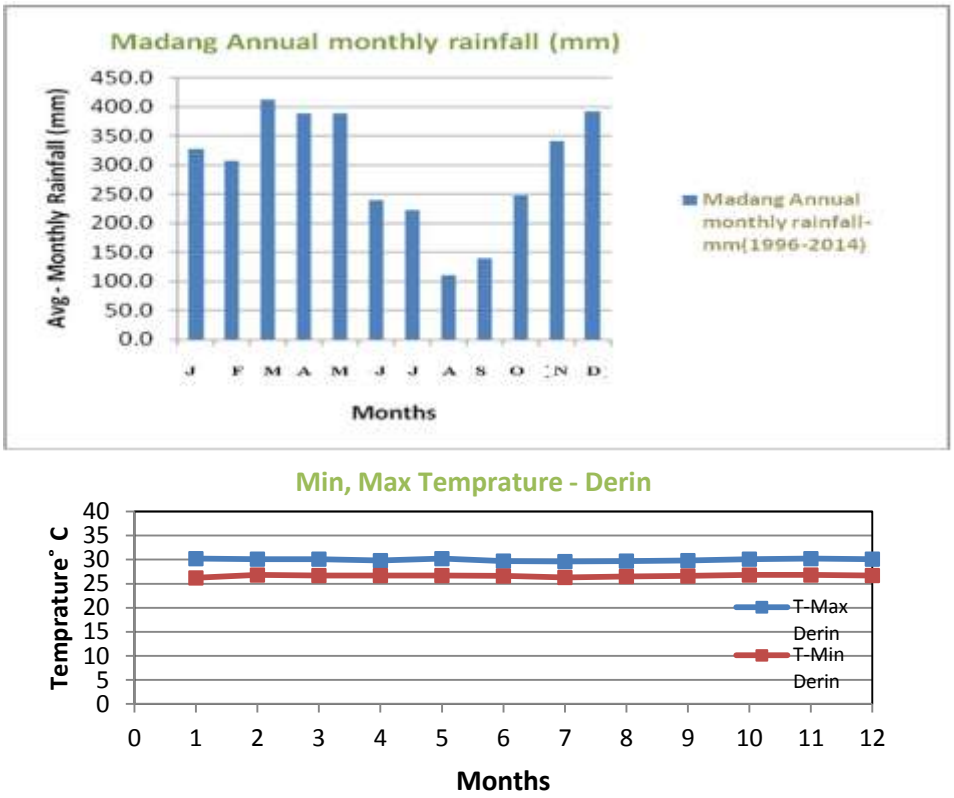


Figure 2: Mean monthly rainfall and minimum and maximum temperature at Madang (Source: NWS of PNG, 1996-2014)

The main great soil groups for the site along this composite alluvial plain are Fulvaquents, Haplaquolls and Hapludolls. The Fulvaquents are of order of Entisols with sub order Aquents, which are alluvial, young alluvial and recently alluvial soil. Haplaquolls is under the order Mollisols and suborder Aquolls, having poorly drained old alluvial soils and gleyed pelosols. Whereas the Hapludolls which are under order Mollisols and suborder Udolls, are young alluvial soils, imperfectly to well drain old alluvial and black clay soils (PNGRIS, 2008). The soil developed on recent or older alluvial or colluvial deposits and shows little or no profile development (Bleeker1983).

In the early 1970s JANT, a Japanese Logging company practiced clear fell logging by cutting down 73,000 ha of rain forest in the Transgogol Valley after purchasing the logging right (CFA, 2011). As a result water table rose that changed some of the agricultural potential land to disadvantage land (back swamps) in the low lying areas of the valley. Slash and burn farming system is mostly practiced, where the secondary forest and grass land are normally cut down and burned for gardening. Taro, yam, cassava, banana, and sweet potato are major stable food crops normally mix cropped with vegetables, corn, bean, and sugarcane etc. The tuber crops are normally harvested before the rainy season starts, due to rotting of tubers under excessive soil moisture. Many of the farmers prepare and store sago as an alternate staple food during wet season. Cocoa, coconut and betel nuts are cash crops for the villagers. They transport them to Madang market and cocoa buying points for income or sometimes betel nut buyers directly go to the village and purchase them in bags. A lot of people use to get involved in growing and milling rice but milling became a problem to and farmers stopped to grow rice. Domestic pigs and village chickens as well as broiler chickens and few ducks are kept by some villagers. Consideration for safe drinking water needs to be taken as ducks and free roaming pigs pose a threat to water sources. Water for drinking and washing is sourced from the same river and some unprotected springs and wells. Derin community area is and used to be a logging area and swamps drained which heavily impacted community's water sources in quantity and quality.

Taro, yam and SP don't grow well during rainy season due to water logging. Only 3-4 farmers grow African yam. During rainy season cash from cocoa and beetle nut is used to buy store goods to complement banana and sago as major food source. During prolonged dry seasons, all water sources dry up and people obtain water by digging holes in the sand on the dried river beds or collecting water from water sources further away from their area.

2. Site Selection and Prioritization.

Collected information from FGD and baseline survey was summarized and analysed using SWOT methodology (Table 1). The following are other pertinent observations made during the initial needs assessment.

- In general Derin community had influx of 'easy' money from logging project in the past, which made them dependant on this income source and more vulnerable towards climate change, due to lack of alternative strategies for food production under changing climatic conditions. Community has not recognized opportunities arising from their good access to provincial markets or is not interested to invest much labor into potential enterprises. Ready access to markets may be capitalized on for sale of high demand livestock products, particularly meat and eggs from poultry. The community used the same water source which is also used by animals and livestock.
- One main water source which is usually accessed by both livestock and humans which was considered to be unsafe for human consumption and of its poor quality.
- Children often times are affected by water borne disease which parents (mothers) had to spend more time looking for cure in the Hospital and clinics

Table 1. Derin SWOT analysis

Strengths: • A variety of different staple crops are grown • Options are available to bridge periods where major staple is not available (Yam grown for storage; SP and banana non-seasonal; also sago and breadfruit available during food shortages) • Cash crops are grown (cocoa/coconut, betelnut, mustard) • Variable cultivation practices for SP, both mounds and flatbeds • Traditional system to save own seed • Variety of sources of livestock/protein with focus on chicken and ducks • Strong cultural beliefs • Project has been done using Acacia for soil improvement and cash income (pulp)	**Weaknesses:** • Not a lot of varieties per staple crop • Food storage (yams) but also used for social obligations • Use of own planting material only and from within the community • Using shifting cultivation, slash and burn • Decline in soil fertility and no use of practices to maintain yield • Pest and Diseases (esp. SP weevil, taro beetle other insects, TLB) and no action taken • Excess water and waterlogging, flooding and food shortage during that period • No reliable water source • Community does not appear to be keen to invest in technological solutions • Livestock only fed on HH scraps, own foraging • Relatively strong cultural beliefs
Opportunities: • Relatively close to provincial centre and markets • Introduction of non-traditional yams • Introduction technologies and practices to improve livestock production • Introduction of new crop varieties • Soil and Water management practices • Low tech sand filter for simple and basic drinking water purification • Improved knowledge on soil and soil fertility improving practices (Acacia system further dissemination) • Suitable for taro and vegetables • Link up with WASH or similar programs	**Threats:** • More irregular weather patterns • Population growth and shortage of land for farming • Logging destroyed natural forest • Increase in diseases • Bogia Coconut Syndrome, cocoa pod borer • Not interested labor intensive technologies

Based on SWOT analysis potential site activities per project component were identified and selected for the reporting back workshop and community prioritization and voting session. Community members were engaged in a reporting back workshop. Each community member was invited to participate in the prioritization of the major constraint in their area and wished to do something about it (Table 2). Only the top three to five priorities were considered for addressing by the project. These constraints were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Derin

Options voted on in Derin	Voters		
	women	**men**	**both**
1. improving soil fertility to increase the yield of my crops	2	14	16
2. improving management and feeding of pigs for food and income	10	19	29
3. improving drainage to mitigate negative impact of water logging on food crops	2	0	2
4. Improving the production of taro and/or sweet potato	8	10	18
5. integrating management of chickens, ducks and fish for food and income	0	8	8
6. protect tubers from influence of heavy rain and hot sun	0	0	0
7. introduction of other/new crops or crop varieties in my farming system	4	4	8
8. Diversifying livestock holdings to increase food (meat, eggs, milk) production	0	14	14
9. improve soil fertility for better production of my staple foods	0	1	1
10. Using some of my staple crops for livestock feed or other processing	3	1	4
11. Protecting our water source to improve our livelihood	13	31	44
Total Votes	**42**	**102**	**144**
Total Voters	**14**	**34**	**48**

Some observations made during voting session:

- The community showed keen interest in the issues and discussions and were very attentive.
- The councilor appeared to have a negative attitude towards women (e.g. women voted on pig management and feed and he commented they do not cart feed for pig; someone mentioned 3 women were standing for election and he said they were wasting their time, etc)
- One blind old woman was attentive and managed to make her vote with assistance of a young woman. She told the young woman were to place her stickers.
- One man objected to separate voting by women because he was concerned his wife may vote on different issues to him – which is exactly the purpose of the chosen approach.
- The issues were randomized when listed for voting unlike other sites where issues were listed by components.
- Although the gender groups did separate voting in separate buildings, with no influence from either group on the other, both groups voted the same top 3 priorities.
- Women were diplomatic in their voting. They were confident and did not try to influence others.
- Community appeared to be well tuned in and aware of what is happening around them, e.g. climate change and other things.

3. Interventions implemented at the site and summary of achievements

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Kopafo communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output.

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at Derin Pilot site

Output	Description of output/ intervention	Farmers trained	Model farmers	Trials implemented
O1	Capacity for improved management and use of available water sources for domestic use increased in Derin Community	68	6	6
O2	Increased capacity of interested farmers in Derin community for using improved pig feeding and management practices	54	10	10
O2b	Increased capacity of interested farmers in Derin community for using duck fish integration systems	2	2	2
O3	Farmer-preferred excess moisture tolerant sweet potato varieties identified and available to the Derin community	18	n/a	n/a
O4	Farmer preferred Taro varieties identified and available to the Derin community	34	5	5

Despite his initial negative attitudes during the needs assessment and reporting back workshop, the Derin councilor was one of the main drivers for the successful implementation of the project activities. He was keen to take over the role of a local organizer and used his position and the project to politically benefit and improve his standing within the community. To some extended this had a positive impact on implementation, because he understood to bring the message across to other farmers. Especially the distribution of materials for specific activities was well and centralized organized through the councilor. He monitored the agreed contributions through the community, which were set as priorities prior to the project team planned interventions. On one hand this bears the risk of one person making decisions whom to involve in project activities, but clearly makes it easier to convey messages to a wider community and organize activities and monitor implementation thereof while the project team is not onsite. However he was not actively trying to involve more women, who would especially have been very important for all water related activities. The project team had to take extra effort to get important messages with respect to water and hygiene across to female members of the community. Table 4 shows a summary of technologies or innovations introduced and farmer impressions during implementation.

Table 4. Technologies/ innovations disseminated as part of project interventions at Hisiu/Yule Island pilot site and farmer impressions

Output	Description of intervention	Tech./farming practice	Farmers response and impressions
O1	Capacity for improved management and use of available water sources for domestic use increased in Derin Community	CLTS (Community led total sanitation) assessment	• Villagers upstream heavily contaminate the water source • Majority of people don't build latrine, and don't have the attitude of going to the pit latrine toilets. • Some toilet huts looked disused and very old, & track to the toilet was bushy as an indication of toilet not being used • People just walk into the nearby bushes and defecate. • The increased number of free roaming livestock (chicken and pigs) seen in the villages feed on them.
		Hygiene awareness and planning workshop (PHAST)	• Hygiene aspects of water and sanitation were well received by community and health implications understood • Community was happy to see that their main concern and priority was addressed • Community collaborated well and agreed to the terms set prior the construction of the RWH systems

		Construction of rain water harvesting and shallow hand dug well including water management training	• Involved households and communities were very pleased with this activity and contributed to their given tasks
		Training on water purification and construction and use of BSF and SODIS	• Activity was seen as a major benefit to the communities and a lot of effort was taken to get necessary skills to build and maintain the systems
		Training on water purification and construction and use of BSF and SODIS - Follow-up and in depth training at Aiyura for selected farmers of Murukanam and Derin	
O2	Increased capacity of interested farmers in Derin community for using improved pig feeding and management practices	Improved pig management and feeding 1. Supplementary feeding 2. Silage 3. Pig shed and fencing	• The idea of keeping pigs inside pens was well taken up by the community • Pigs posed a greater problem of destroying gardens which lead to creating local disputes among the villages. • Farmers who have pigs inside pens generally observed weight gains. • Waste is managed better. • Due to a directives given to killing all stray pigs has resulting in many pigs going missing, forcing farmers to quickly build sheds for their pigs. • Organized distribution of materials through the councilor put genuinely interested farmer in a good position
O2b	Increased capacity of interested farmers in Derin community for using duck fish integration system	Pond and duck house construction and management	• Only farmers with a reliable water source are able to establish a system.
O3	Farmer-preferred excess moisture tolerant sweet potato varieties identified and available to the Derin community	1. Early maturing high yielding 2. High soil moisture tolerant sweet potato varieties 3. Improved planting practice (1 tip @ 180°)	No comments available
O4	Farmer preferred Taro varieties identified and available to the Derin community	New Taro varieties tested	• Farmers were not happy that all taro in their gardens were harvested at once, those varieties actively growing should not to be harvested • Farmers produce only for consumption and economic activity is low. Selling taro is not considered priority for the community

4. Challenges during Project Implementation

Key to successful implementation onsite is a reliable contact person, who has a good standing within a community and is a well respected person. Another important aspect is to work with motivated model farmers and carefully select innovative lead farmers. While this is often not a decision a project team can and should make, a close collaboration with the community is necessary to identify suitable persons during the project initiation and implementation phase. This however might lead to issues within the community, when too much attention is given to single farmers.

Though the technologies implemented as part of interventions have being proven to be successful on-station, these were at times difficult to prove on-farm due to different perceptions of farmers or miss communication. Clear communication of the main objectives has proven to be of major importance for a successful

intervention. In some cases the failure of the project team to clearly explain the purpose and goals of the project has lead to misunderstanding and miss interpretation of the planned activities. Therefore constant and unambiguous communication with the community is of highest essence for the success of project activities.

Table 5. Issues of significance that impacted the project implementation schedules

Challenge	Effect on interventions	Approach taken
Road blockages and deteriorating road conditions	Delay in implementation of planned activities	• Defer planned activities to a suitable date
Establish trust between project team and community	Delay of planned activities and extended implementation period	• Adequate number of meetings and FGD
Communication between project team and community	Understanding the technical aspects of the interventions and cultural implications	• Using simplified TokPisin and pictures in explanations/Trainings, etc… • Using model farmers with some educational background and experiences to explain difficult concepts in local language • Have a suitable contact person and innovative lead farmers • Take sufficient time to explain objectives of the project
No contact to local and regional district administrators	Lack of sustainability of interventions and long-term impact and dissemination of knowledge	• Closer collaboration with community and especially lead farmers

Constant evaluation of dissemination approaches; feedbacks from technology dissemination procedures and studies on technology adoption are invaluable for refining dissemination approaches and success in technology transfer and are areas that can be explored by social researchers. Collaborative efforts between research and extension bodies are vital for widespread and effective dissemination of agricultural technologies and strengthening research and extension linkages which is currently a constraint in the project and project sites.

5. Final Assessments and Comments

Final site assessments in Derin took place in November 2015. The following is a summary show a summary of responses on technology performance and responses of representative farmers during focus group discussions. Further information can be found in Tables 6 and 7.

Assessments and comments as per output category:

O1 Capacity for improved management and use of available water sources for domestic use increased in Derin Community Water Tanks

Five rain water harvesting systems (RWH) were distributed and assembled in specific strategic locations identified by the local members of the community of Derin. These tanks cater for rain water collection and storage for use during dry season. The tanks however were empty after the prolonged El Nino induced drought. In each of the 5 locations where the tanks are located, water committees were formed to maintain the tanks and also monitor water rations for the community members. Additional water management training was conducted to raise awareness for these issues. It however depends on the community members and their leaders to continue maintaining the function of the water committees.

The shallow hand dug well was one of the options for accessing water. However, the construction of the well was very laborious therefore only one well was installed.

The introduction of the biosand filter technology was well received by the community members. This technology significantly benefits the community members by providing safe drinking water which simultaneously also reduce health risk associated with poor quality of water and waterborne diseases. Female members mentioned the reduced need to make use of health services.

O2 Increased capacity of interested farmers in Derin community for using improved pig feeding and management practices

Farmers were trained how to keep pigs in fenced pig house with roof and were also introduced to new feeding techniques (silage) which greatly improved the pigs' performance in terms faster growth rate and weight gains. The model farmers responded positively and mentioned that with the introduction of the pig husbandry and management practices the pigs perform much better than the tradition or cultural practice of free ranching. In addition the technologies also solved other related problems of destroyed food gardens and polluted water sources through free roaming pigs.

O3 Farmer-preferred excess moisture tolerant sweet potato varieties identified and available to the Derin community

Farmers mentioned that the number and size of tubers of the introduced SP varieties are better compared to the traditional or local varieties/practices. The introduced varieties are larger in sizes but have fewer tubers compared to the local varieties which have more tubers which are smaller in sizes. Form these observations, farmers prefer to keep and cultivate both varieties utilizing traditional and improved cropping practices.

O4 Farmer preferred Taro varieties identified and available to the Derin community

Due to the El Nino induced drought, most of the planted taro died except 2 to 3 varieties. Those varieties that survived performed well and also better compared to the traditional ones. Farmers also mentioned their better taste and bigger comb sizes. The traditional plots/gardens are bigger in sizes (2500-5000 m2) compared to the plot size used for the demonstrations. There is a growing interest among farmers for certain NARI taro varieties which performed extremely well during the drought.

General observation:

In general, the interest in all the interventions introduced through the project remains to be very high in the community. Community members mentioned that the priorities selected during the needs assessment were relevant and appropriate and met the needs of the community.

1) Cash benefits from the introduced interventions

Given the demand for pig, there is already a market available, and some model farmers are already engaged in selling pigs at market price for about K800–K1000 depending on the sizes and demand.

2) General interest in the community

The community members and other surrounding communities showed a lot of interest in both introduced types of crops especially taro. The increased yield and quality of the crop convinced farmers to adopt the improved practice and introduced new technologies.

3) Likelihood of further adoption of different introduced technologies

Positive responses from farmers regarding the tangible (changes in crops yield, changes in pig performance etc…) and intangible benefits (general improvement in the health and welfare of community members) are an indicator that introduced technologies will be accepted and adopted by the community. Farmers are requesting for more seeds which shows that after the drought, more adoption and extension is expected within and around neighboring communities as well.

Table 6: Technology performance in Derin Community as assessed by representative community members

Technology	**Performance -Better -Same -Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)? -Yes -No**	**General Interest from the community- High (H) Medium (M) Low (L) Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improved management and feeding of pigs for food and income	Better				Yes	High-Pigs perform better than local practice	K800-K1000/pig
Improved production practices and farmer preferred taro varieties (34 Var)	• Taro-2-3 varieties (Better)- • Others either same or poor	2500-5000 + m^2).	Less than 1000 m^2 Planted only for experimental plots. Most suckers damaged	Size depends on seed availability		High- Certain varieties were able to withstand the drought Better Taste size, color and taste	Own consumption
Improved production practices and farmer preferred sweet potato varieties (8 varieties)	SP- Same	400-420 m^2	400-420 m^2 (1 vine planted in an horizontal orientation	No clear confident response		Medium- No preference for the new introduced practice	Own consumption
Improved management and use of available water source for domestic use	The water harvesting Systems, shallow well and the biosand filter all were appropriate, relevant and useful to the community members as they address their water needs.						

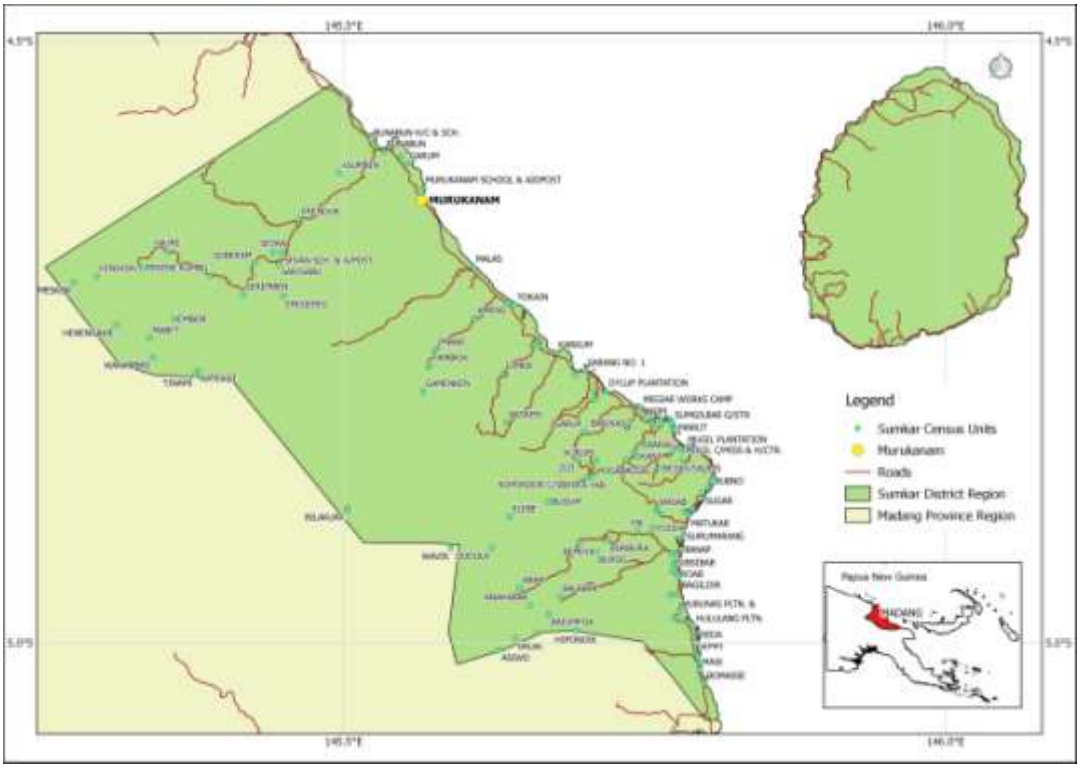
Table 7: Responses from Focus Group at Derin during final assessment on food production and priorities

Periods of Food Shortage	September to January, caused by shifting from old to new gardens.
Views on whether improved technologies would improved food shortage period	Pig production is seen as the way forward and also taro production has the potential to improve food security and availability during the food scarce period. However, the water component has been the highland has it important for health and welfare of children and mothers.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	The interventions voted were of high importance therefore farmers were glad having made those choices. "The interventions chosen were important and applicable to our situation and needs". Water, an important need in the community was solve to some degree through the biosand filter, shallow water well and tanks which were set up. Furthermore, given the 2015 drought El Nino induced draught, they have access clean and safe drinking water and it impacted their welfare/livelihood positively. It was said that the decision made five years ago (2012) was relevant and appropriate to the needs identified within the communities. 'The choices made were the best and they help solve our basic needs which water is one of them.'

Annex 4E. Pilot Site Report for the MURUKANAM (dry lowlands)

by Elick Guaf, NARI MRC Bubia

1. Project Site description



The MURUKANAM Community is located 145.57˚E and 4.63˚S in Ward 3, Sumgilbar Local Level Government, Bogia District, Madang Province, Papua New Guinea. It has a natural dry lowland site with an annual precipitation of 3380 mm, annual mean temperature of 26˚C. The wet season runs from October to April while the dry season is from May to September. The minimum average precipitation in the wettest quarter is 1038mm and the driest quarter is 526mm and the mean temperature of the warmest quarter is 27˚C and the coldest is 26˚C. The community is situated on mainly savannah grass land with an undulating landform at 70masl. Access to Murukanam is by all weather roads. Income to household is from betlenut (*Areca catechu*) and small cocoa and coconut holdings. The major farming system is subsistence food crop and village livestock consisting native pig breeds and village chickens. Major staple crops include ***Dioscorea esculenta*** yam, banana spps, ***Colocasia esculenta*** taro, sweetpotato, cassava, ***Xanthosoma saggitifolium*** taro, sago and breadfruit. Most of the crops produced is consumed at the household with scraps feed to the livestock. Most of the planting materials is acquired from their old gardens and where extra material is require it is sourced from extended members of the family. A negligible quantity is obtained from outside the family circle and only in cases where unique taste and high volume of yield of popular staple is discovered. A major cause of low food production are soil water extremes the excess and deficit, soil fertility and pests & diseases. Low food production for the household has been observed however practices to sustain food production is limited to long fallow

2. Site selection and prioritization

Murukanam was selected as a site in the lowland of PNG that has a pronounced and at times extended dry season. The initial fact finding site assessment visit revealed the following site specific characteristics which were captured through a SWOT analysis

Table 1. SWOT analysis for Murukanam

Strengths: • Cash crops available (cocoa/coconut, betlenut) and cash income • Range of protein sources • Access of land for gardens • Grow a range of different staple crops (undecided on most important) • Alternate food sources available when some staples are in short supply (yam that can be stored, SP and banana non-seasonal) • Good access to services • Farmers generally don't rely on food crop production	**Weaknesses:** • Availability of sources of cash income prevents venturing in other enterprises (livestock) • Availability of range of wild protein sources – less drive to invest in livestock • Lack of motivation to improve water access and quality • Water sources used by livestock & people (pollution, water quality) • Periodic water shortage in food gardens • Irrigation and watering the food crops is not an option • Lack of concern for water sources (Inappropriate use of pesticides etc for fishing) • Not so easy access to land for alternative livestock based enterprises • No use of or access to improved planting materials for food crops • Yield reduction but may not sure about key issue (Decline in soil fertility, Pest and Diseases (esp. SP weevil, taro beetle other insects, TLB and no action taken) • Food crops grown on less fertile land and suffer severe moisture and fertility stress • Don't want to spend too much time on food production (change to 'unsustainable practices') • Use of traditional practices in food crop production
Opportunities: • Labor saving food crop production techniques (increase efficiency) • Improving feed-systems for livestock • Introduction of improved varieties • Soil moisture conservation practices • Soil fertility improvement techniques • Interested in new practices and technologies • Good access to services and developing different businesses • Increase of food production (by settlers) to sell to • Introduction of improved water resource management practices • Simple water purification technologies • Domestic water supply system, which needs support from the community	**Threats:** • Increasing threat of Feral pigs and cattle destroying garden • Increase in stealing (people concentrating on betlenut and not food crops, so they steal) • HIV/AIDS (increasing risks with betlenut/dry coconut trade) • More irregular weather patterns • Longer dry season • Cocoa pod borer, BCS • Potential social unrest (landowners vs settlers) • Farmers don't pay a lot of attention to food crop production, which leaves the less prepared for times of drought

As in the other sites, community members were engaged in a reporting back workshop to list their major constraints to agricultural production throughout the cropping calendar. Each community member was invited to participate in the prioritization of the major constraints and opportunities in their area and (Table 2). Only the top three to five priorities were considered for inclusion in the project. These constraints were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Murukanam.

Options voted on in Kopafo	Voters		
	Women	Men	Both
5. Integrating management of chickens, fish and ducks for food and income	5	18	23
1. Improving Production of banana, yam, taro, etc	4	15	19
2. Introduction of new crops or new varieties of other crops in my farming system	5	13	18
9. Improving the soil of my plots to have stable and sustain food crop production	8	5	13
11. Protecting our water sources to improve our livelihoods	0	13	13
6. Diversifying livestock holdings to increase food (meat, milk, eggs) production	0	11	11
4. Improving management and feeding of pigs to save food gardens and gain cash income	6	3	9
10. soil moisture conservation to have stable and sustain food crop production	0	7	7
3. Adding value to my staple crops through processing into feed and food	5	0	5
7. introduction of grazing animals in natural pastures and plantations to diversify livestock holdings	0	3	3
8. Protecting the soil of my plots to have stable and sustain food crop production	0	0	0
Total votes	33	88	121
Total voters	10	30	40

3. Interventions implemented at the site and summary of achievements

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Murukanam communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output.

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at Murukanam Pilot site

	Outputs.	Farmers Trained	Male farmers	Female Farmers	Model Farmers
O	Increased capacity for using integrated livestock farming practices for inland fish, ducks and chicken production by selected farmers in Murukanam community	11	9	2	7
O2	Improved capacity for using integrated goat -coconut system by selected farmers	6	4	2	1
O3	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Murukanam Community	61	37	24	3
O4	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Murukanam Community	15	12	3	3
O5	Farmer-preferred drought tolerant sweetpotato varieties identified and available to the Murukanam community	32	17	15	3
O6	Farmer preferred Taro varieties identified and available to the Murukanam community	27	17	10	3
O7	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.	16	13	3	0

The planned activities under each of the technical components were delivered through field demonstration trials, training demonstrations and field days and culinary and taste preferences for the introduced crop varieties were also done. Table 4 shows a summary of technologies or innovations introduced and farmer impressions during implementation.

Table 4. Technologies/ innovations disseminated as part of project interventions at Murukanam pilot site and farmer impressions.

Output	Description of intervention	Innovation	Farmer impressions during implementation
O1	Increased capacity for using integrated livestock farming practices for inland fish, ducks and chicken production by selected farmers in Murukanam community	Introduction of ducks and duck-fish farming techniques	The intervention was well accepted. However ponds were established near flowing stream. Most of the fingerlings are washed away in occasional flooding washing away most of the fingerlings. Ducks were prone to stealing. The original concept of fish/duck integration was adopted but modified by environment and nature and now the farmer is only looking after fish without ducks.
O2	Improved capacity for using integrated goat -coconut system by selected farmers	Introduction of goats; grazing system in coconut blocks	Goats were distributed with the concept that a farmer would grow the herd and distribute to the next interested member of the community. There was only one model farmer .The model farmer received training in all goat husbandry practises, reared 17 from 5 goats. There was no further distribution owing to farmers' hesitation that goats have destructive behaviour and can destroy food gardens and vegetation difficult to control, other interested farmers did not have night house to get goats.
O2	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Murukanam Community	Yam husbandry practices (mini-setting; staking; density); new yam species	With the establishment of the improved yam practises, the farmers expressed great satisfaction and confidence that with introduced technology and Rotundata yam cultivation practises, they can plant and narrow the food shortage period.
O3	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Murukanam Community	9 Drought tolerant, low cyanide cassava varieties	Cassava varieties with short maturity duration can be used to provide food while the farmers establish new gardens.
O4	Farmer-preferred drought tolerant sweetpotato varieties identified and available to the Murukanam community	Planting techniques, 8 improved varieties;	There were about 3 model farmers/ families involved in cultivating the 9 introduced SP. They only planted the trial plots and did only 1 harvest. Due on set of the drought and its severity, farmers were not able to extend the plots but were only preserving the seeds (vines) in low laying areas waiting for the rain to continue planting. Some introduced varieties have many smaller tubers, some with no tubers and others with some have few but bigger tubers. Introduced sweet potatoes survived the drought with taste as good as the local varieties while others taste differently, with varying sizes and number of tubers. Some varieties were totally free of disease while most traditional varieties were attacked by disease and pest (SP weevil).
07	Farmer preferred Taro varieties identified and available to the	Improved varieties; taro	The introduced varieties have comb small to bigger sizes, some taste good while others not good and white

	Murukanam community	beetle management	to purple flesh colour.
08	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.	Soil fertility status and measures to improve	(Soil survey showed depletion of specific soil nutrients. Farmers were taught on how to management soil nutrient through reforestation)

4. Challenges and Suggestions during Project Implementation.

The use this technology dissemination model for the project is noble. However, most of the improved technologies especially for food crop species, varieties and the cultivation practices were not available in NARI. The flexibility in the project to package technologies for dissemination to the communities was utilized to assemble and select appropriate technologies for the respective communities. There was however insufficient project time for adoption to the communities.

There was also the understanding the nature of technologies and appreciation of the technologies that were assumed appropriate for introduction into communities. Besides, some technologies were not readily accepted into the communities. An example is that for the goat integration. That goat was a new livestock species to most members of the community where goat is perceived by members of the community a destructive animal where there is no proper fencing. Those that adopted were unable to sell their goats in their community and the neighboring communities. Besides, the distance Madang commercial center is a long travel on public motor vehicle apart from the need for special transport for the animals.

Work implementation plan are disrupted especially where there is death in the community. The culture is such that there is at most times no work done after time and money is spent based on planned project activities. Cultural ceremonies, church meetings, economic activities like cacao and coconut, market of betlenut plus other project activities are major factors that directly have influence on participation of members of the community.

Table 5. Issues of significance that impacted the project implementation schedules

Issues arising during implementation and lessons learnt		**Type of action required/suggested taken to resolve problems and delays etc.**
1	The unexpected long dry season affected rice fields and the planned rice and duck integrated farming did not proceed as planned when the rice field failed. Rice was planned rather late in the previous year	Livestock activities that rely on crops will have to take account of cropping calendars as well as variability of the rainfall pattern.
2	Inland fish farming is difficult to maintain in a dry environment like Murukanam. The current and future planned activities in fisheries will have to rely heavily on water from river streams, and hence the fish ponds will have to be located on the river banks.	Fortunately there are a few all season river streams in Murukanam and all aquaculture related activities will be related to the rivers.
3	During the teams trip to train farmers on the different yam cultivation/production technology (24th November – 1st December, 2013) a death occurred in the community and at the same time a major church event held for two days in the community thus affected the number of farmers' attendance during the training.	The death (of an elementary student) occurred on first night of the team's arrival in the village so the team donated store food and cash in line with the cultural obligations or requirements. After participating in the cultural requirements, the team was allowed to freely carry out their planned activities in the village, but first on the sites at Dibor and Tawa and then after the burial conducted the training and planting in the main village of Sharman
4	Due to some differences between the community members the yam trials at all three (3) sites were not well managed. Both the African yam evaluation trial evaluation/demonstration trials at Sarman and Tawa were over grown by weeds. It was noted that the trials site at all three sites were managed only by the model farmer and their household but with little or no assistance from the communities from those 3 respective sites.	Model farmer Mr. Jeffery Tamor and his wife took the initiative to maintain the trial site at Sarman (African yam, cassava and taro evaluation/demonstration trials) by hiring church women groups in the community has labour to weed and manage the trial site. The women were paid K2.29 per hour every Tuesdays and Thursday from 6am – 8am. The model farmer and his wife

		commented that hiring labour seem to be the only way to manage the trial site. They asked if the project could step in and assist them hire labour to maintain the trial site

5. Final Assessments and Comments

The project utilized a suggested model for participatory dissemination of improved technologies with a lot of flexibilities in what and how to disseminate these technologies. It allowed for establishment of system of planning, monitoring progress and processes. It provided the window for better management of dissemination of improved technologies, allowed for packaging of the technologies and building of capacity for institutional strengthening. The project also provided opportunity for collaboration between institutions in Papua New Guinea, Solomon Islands, Vanuatu and Boku University, Austria.

The Murukanam community is a sample community that presented the challenge to introduction of improved technologies with good road access, availability of market for cacao and coconut and close to the sea where members of the community have access to protein sources from the ocean. Sales of betlenut is a lucrative activity in the region because of the road links to other centers like Lae, Goroka, Simbu, Mt Hagen, Wabag and Mendi. The collaborating members of the community who participated at the trainings and facilitation of the activities are now informed of alternative technologies and practices for income generation. They have acquired skills in organizing themselves and members of the community to manage climate change imposed stresses like drought.

Table 6: Technology performance in Murukanam Community as assessed by representative community members

Technology	**Performance** **-Better** **-Same** **-Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)?** **-Yes** **-No**	**General Interest from the community-** **High (H)** **Medium (M)** **Low (L)** **Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	New Practice	Plan to Expand, If yes by how many			
Farmer-preferred taro varieties	Better (taste and bigger combs)	≈5000 -10, 000 m^2	≈ 162- for research only, El Nino destroyed lot of seeds.	Yes, depend on seed availability	• Fish and Duck (Yes) • Goats (Not really) • Goats were newly introduced and farmers are not familiar and also because of its destructive behavior.	• Duck & Fish (H)- easy to look after, for protein & income generation • Goat (L)- Not easy to look after-	• Duck (Yes), K50- • Drakes-K60, • Eggs (K1) • Chickens K40 • Goats were quite difficult to sell as villages were not familiar with goat meat
Improved practices for yam and farmer-selected varieties	Better (withstood drought)	≈2000+ m^2	≈162m^2 Experimental plots,	Yes, bigger but size depend on seed availability Farmers have distributed seeds to other farmers as well.			• Farmers were not able to sell other crops because they were not able to make garden during the El Nino induced drought.
Improved production practices for cassava and farmer-selected varieties	Some were Better, able to withstand drought condition	2500 + m^2	10 m by 10 m (100 ^{2}m)	Yes, larger than the experimental plot (100+ m^2) depending on the cuttings. Farmers have also distribute cuttings to other villages			
Farmer preferred drought tolerant sweet potato varieties	Some, Better (Taste, sizes) others were same	≈2500+m^2	≈100 m^2	Yes, depend on seeds/cuttings			
Improved knowledge and skills on soil	*Soil survey showed depletion of specific soil nutrients. Farmers were taught on how to*						

fertility constraints, their causes and how to address these	*management soil nutrient through reforestation*		

Table 7: Responses from Focus Group at Kopafo during final assessment on food production and priorities

Periods of Food Shortage	August to December
Views on whether improved technologies would improved food shortage period	• Farmers expressed their satisfaction on the introduced taro, sweet potato, cassava and yam varieties, • Improved crop varieties especially cassava and African yam, they can plant and narrow the food shortage period to some extent. • Also some cassava which are have short maturity duration can be used to provide food while the farmer work establish their new gardens.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• Interventions voted which still remain important for the benefit of the community. • Farmers failed to vote for water and water became a major problem during the drought as most of the crops and livestock introduced suffered under water deficit condition. • Some farmers were

Annex 4F. Pilot Site Report for ARULIGHO, GUADALCANAL – SOLOMON ISLANDS

By Jules Damatalu, MAL Solomon Islands

MAP OF SOLOMON ISLANDS

Part of the Solomon Islands Map depicting the 3 Project Sites (with the red dots)

1. Site Description

The Aruligho site is located on Guadalcanal Island west of the Solomon Islands Capital City, Honiara and is approximately one hour drive from the city. This area of three settlements hosts approximately 125 households. The site was selected for extreme soil moisture deficit which is evident from data that this specific site receives more rainfall in November-December period but experience prolonged dry spells over the other months of the year. The heavy clay to sandy soil types common in this area has complicated soil moisture availability for crop growth.

The farm land of this specific site can be generally categorized into two areas. The first one would be land areas which are prone to periodic flooding near to small streams that drains most of the topsoil and contains stony subsoils almost to the surface. This farm soils are believed to be fertile but are moderate to low in potassium status. Cultivation is hampered by stones but otherwise the choice of crops is wide. The second farm soils are situated on steep slopes adjacent to incising streams. These soils are moderately fertile but under grassland there may be a deficiency in sulfur. Apart from this the land can be used for a wide variety of annual and perennial crops.

Staple food crop in the area includes; Sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*) and banana (*Musa*). Common vegetable grown include slippery cabbage (*Abelmoschus manihot*), watermelon (*Citrillus lanatus*) and cucumbers (*Cucumis sativus*). The fruit tree crops are grown mainly for cash includes mango (*Magnifera indica*), star fruit (*Averrhoa carambola*), ngali nut (*Canarium indicum*), avocado (*Persea americana*), guava (*Psidium guajava*) and pawpaw (*Carica papaya*).

Generally, the farmers adapt the predominant slash and burn (shifting cultivation) farming method incorporated with the prominent mix and intercropping system. Some farmers employ semi commercial farming in the production of water melon, guava and pineapple to sale at the city market. The main sources of income for these villagers are from subsistence and semi-commercial farming, non-farming activities and remittances from relatives who work in the city.

2. Site Selection & Prioritization

This SWOT Analysis was derived from the baseline survey conducted to assess the site needs.

Table 1. SWOT analysis for Aruligho

Strengths:	**Weakness:**
• Proximity to capital and market • Commercial cash crop production • Good infrastructure and transport • Farmers are already exposed to some new technologies • Easy access to new technologies • Potential linkages to other NGOs and Government services • Willingness to collaborate • Very good access to urban markets and services • Good access to land for food production (≤2ha) • Have food and cash crops for income • Household food in good proportion from different sources • Four major protein meats (fish, mutton or lamb, pork, chicken • Much of the meat for household food is bought at the market or supermarket • Active main market • A strong interest in a variety of livestock	• Decreasing number of rainfall events • Increasing temperatures • Loss of soil fertility • Soil erosion • Moisture stress during various stages of crop growth • Food shortage – system do not allow sufficient food for a period of 10-12 weeks • Food not stored in during period of shortages • Strong reliance on purchased meat protein • Strong reliance on relatives/friends/other villagers – communal life • Few people have knowledge of improved livestock feeding (17.6%) • Fair use of pasturage • Less people kept livestock (36%)

Opportunities: • Good scope for improved technologies for soil improvement, soil moisture conservation, upgrade of supplementary irrigation, water harvesting and water recycling • Good access to services and developing different business • Potential for meat market – presently? • Scale? • Pigs bought by a number of household • Strong prioritization for chickens, pigs and ducks	Threats: • Population growth • Urban center – decreasing availability of labour due to mitigation to Honiara and seasonal work options • Low investment in intensive agriculture due to other income options • Total loss of soil fertility • Vatukulau community – prolonged drought periods and flooding result in food shortages • VC –Population increase resulting in limited land and short fallow period • Duidui community – flooding resulting in sand being deposited on cropping field • Strong reliance on relatives/friends/other villagers – communal life? • Livestock rely heavily on household gardens and kitchens • Exposure to coastal events • Socio-economic challenges from urban environment

The project has employed a participatory process to come up with the priority issues of the community. The process includes identifying the needs through conducting a baseline survey in the community, reporting back the findings to the villagers through a community workshop and thereafter allows the villagers to priorities their issues through vote where all genders have equal opportunity to express their views.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Aruligho

Options voted on in Aruligho	Voters		
	Women	**Men**	**Both**
1. Improve production of cassava and sweet potato	13	20	33
2. Protect the soil of my plot from erosion for sustained food production	7	16	23
3. Diversify my livestock holdings for food and income	3	0	3
4. Introduce variety of crops and staples or other crops	1	5	6
5. Improve the fertility of my soil for higher productivity	10	3	13
6. Improve utilization of staple crops through processing for food and feed	7	0	7
7. Manage and protect my water resources	4	6	10
8. Manage and protect my crops during times of drought	8	4	12
9. Improve feeding systems for chicken and pigs	4	21	25
10. Protect my crops from too much water and hot sun	6	0	6
Total Votes	**63**	**75**	
No. of farmers	**21**	**25**	**42**

3. Interventions implemented at the site and summary of achievements

Table 3. Planned interventions developed for the prioritized issues identified

Selected Issues	Planned Interventions
1. Improve production of cassava and sweet potato	• *Pathogen tested planting materials for sweet potato and cassava* • *Farm Field schools for pilot testing sweet potato and cassava varieties*
2. Improve feeding systems for chicken and pigs	• *Training and demonstration on improved management of chicken and pigs* • *Demonstration of lower cost feeding systems for chicken and pigs* • *Distribution of breeding stock (Chicken and ducks)*
3. Improve soil fertility for higher productivity & protect the soil from erosion for sustained food production	• *Training and demonstration on soil erosion and moisture management* • *Soil fertility improvement and management demonstration*

3.1 Site Achievement per Site Outputs

3.1.1 Farmer-preferred drought tolerant sweet potato varieties identified and available to the Aruligho community

- *4 field trials and demonstrations were conducted and established, 4 lead farmers participated. 8 SPC/MAL sweet potato varieties were introduced with new improve practice using 1 vine cutting per mound, 2 sets of trainings complementarily conducted with the establishment of the trials, 23 and 18 farmers were trained respectively, a field day to evaluate the different SP varieties was also organized*

3.1.2 Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Aruligho Community

- *6 SPC/MAL varieties of cassava were introduced, new technology of 1 cutting per mound introduced, 3 field trials/demonstrations were etablished, a training was conducted simultaneously where 27 farmers participated, a field day was successfully conducted where local media and other stakeholders were well represented*

3.1.3 Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Aruligho community

- *3 field demonstration were set up, a new technology of yam minisetting was introduced and taught to 27 farmers who participated, the training was conducted simultaneously with the establishment of the trials, 3 lead farmers were engaged in this undertaking, minisett size and spacing were evaluated with these 3 trials*

3.1.4 Increased capacity of interested farmers in Aruligho community for using improved chicken and pig feeding and management practices

- *A total of 8 trainings on housing and feeding management were conducted, 2 each for broiler, village chicken and pigs, 28 lead farmers in total participated, 84 farmers attended all trainings*

3.1.5 Increased capacity of interested farmers in Aruligho community for raising other new livestock animals (Goats, Ducks and Bees) with appropriate management practices

- *A joint training was conducted for goat and duck farmers, 23 farmers participated*

3.1.6 Increased capacity by participating farmers to use improved soil management practices addressing constraints of soil erosion, water deficit and fertility.

- *3 trainings were conducted, 1 each on soil fertility management, soil erosion management and importance on soil moisture & Irrigation, 3 demonstration/trials were established with 3 lead farmers, 34 farmers altogether attended the trainings*

4. Challenges during Project Implementation

Table 4 shows a summary of some of the issues that were encountered at Aruligho during project implementation.

Table 4. Issues of significance that impacted the project implementation schedules

LESSONS LEARNT (Issues arising during implementation)		**ACTION TAKEN (Decisions made by the project office in addressing the issue)**
1	Some lead farmers are reluctant or are not serious enough to pursue their roles as lead farmers in looking after the demonstrations and sharing the knowledge with other interested farmers	Agriculture extension officer on-site was advised to take up the role to regular maintain the abundant demonstration plots
2	Misunderstanding among farmers of Duidui settlement on selecting and identifying lead farmers for project activities	The project team visited the settlement and meet with the elders and women and communicate the purpose and the objectives of project and it is well received - resolved
3	Prolonged drought destroys 2 complete yam demonstration plots and these plots are situated on a very sandy soil type	The project team have to select a new site – need to do a better site selection for the demonstrations
4	Attendance and participation of farmers – some villagers missed important training/workshops	Institute better communication between the extension officer on the ground with the lead farmers. Awareness of the activity should be done well ahead of schedule training

6. Final Assessments and Comments

Overall farmer have shown great interests in receiving new farming technologies developed and implemented by the project. The NARI broiler high energy concentrates feed results has raised eyebrows of the participating rural farmers and other interest has been received from farmers outside of the project sites. The rate of adoption of some of the new technologies may be lower than expected but what has transpired over the 4 years has changed the mindset of the farmers to some extent and more so the awareness of climate change and its impact on food production to the rural populace. Final assessments at Aruligho were conducted in January 2016. A summary of responses is shown in Tables 5 and 6.

Table 5: Technology performance in Aruligho Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improve production of cassava and sweet potato (SP)	Better, more tubers (Cassava & SP)	-Cassava (Sizes depend on family needs & willingness of farmers) -SP (70 m^2)	-Cassava-100 m^2 -SP -100 m^2	100+ m^2(Both Cassava & SP)		High, given the improvement in yield Performance of crops (Cass & SP)	Sweet Potato sold for SD$10/heap
Improve feeding systems for chicken and pigs	Better				Yes	High, fast growth with higher $ value in short period of time Chicken- improved performance, increase income	Pig, SD 2000 Broiler- SD 100 Egg-SD $4
Improve soil fertility for higher productivity & protect the soil from erosion for sustained food production.	Better, Vetiver is shown to have some positive result in reducing top soil erosion and retain soil nutrient.					Medium, need to be promoted and benefits made known	
Manage and protect my water source	Better, provide water for domestic use and irrigation during dry periods					Medium, only one tank was introduced, need more of such	

Table 6: Responses from Focus Group at Aruligho during final assessment on food production and priorities

Periods of Food Shortage	• **July to November is still the usually time food shortage is experienced which is usually caused by moisture deficit conditions (dry season).**
Views on whether improved technologies would improve food shortage period	• Farmers have said that through the project now they understood the effect of climate change on food security, and many intent to adopt the technologies and continue to produce food for their household and also for income when there is surplus to be food secured during the dry periods (food shortage). • Improved practice for cassava is also proven to be one of the interventions that can provide food for farmers during the food shortage period therefore farmers expressed their interest to continue cultivating cassava. • Pig and poultry farmers have now understood the importance of planning their operation to cater for the time of food shortage. • Those who have not adopted and practice the technologies have said that they still experience food shortage. • Farmers were encouraged to continue practice and share the practice/knowledge/skills learnt to others for improved welfare and livelihood overtime.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	• Most of the interventions introduced still remain important in the community. However, farmers have mentioned that water is one of the main important needs in the community. Water is needed for cooking, drinking and also for irrigation purpose. • Water is needed for gardening to produce food during the dry season where most of the place in Aruligho experience dry season. • A farmer also mentioned that since sun is usually strong and reduces the time for gardening, a need in the community to increase crop production in the community would be small farm machines like power tiller to substitute and maximize labor input. • Although the chickens grew well with the concentrate technology, a question was raised on the availability and accessibility of the concentrate and how farmers have access to the concentrate in Solomon Islands. • Some farmers thought that the project will continue to provide resources for them therefore, it is important to inform/educate the model farmers at the initial stage of the project.

Annex 4G. Pilot Site Report for BUMA, MALAITA – SOLOMON ISLANDS

1. Site Description

Buma community is located approximately 30 kilometers south of Auki Township, the provincial capital of Malaita Province. The community was selected for soil salinity induced by the rising sea level and affecting food production. The village comprises of 75 households unit who are mainly subsistence farmers.

The land is generally flat while most of the farming area is lower than 2 meter above sea level. The soil is deep brown, very poorly drained soil derived from the reddish brown peat organic accumulations. Freshwater swamps appear in patches to the fringes of the most gardening areas. Fertility is low due to un-weathered organic deposits which influence the soil to be acidic with medium to high nutrient reserves. In some areas stony sands from coral detritus is common, low excessively in available and nutrient reserves but calcium is in excess.

Sweet potato (*Ipomoea batatas*), cassava (*Manihot esculenta*) and giant swamp taro are the main staple food crop in the area. Common vegetable grown include slippery cabbage (*Abelmoschus manihot*), tomato (*Solanum lycopesicum*) and other common traditional leafy shrubs.

Generally, farmers adopt the traditional slash and burn (shifting cultivation) farming system. Mix and intercropping cropping patterns are widely practiced in this area. Most of these coastal farmers are subsistence that depends on their garden produce to consumption. The weekly market provided at the centre of the village provides an excellent avenue for the villagers to sell or barter farm produce for money or other non-farm products. The main sources of income for these villagers are non-farming activities and fishing. Cash remitted from family members and relatives paid employment outside of the village also a regular source of income.

2. Site Selection & Prioritization.

This SWOT Analysis was derived from the baseline survey conducted prior to the to assess the site needs.

Table 1. Buma SWOT Analysis

Strengths: • Very good access to markets and services • Good access to land for food production • Have food and cash crops for income • Some form of barter system exists • Household food from various sources • Variety of meat proteins (fish, pork, chicken) • Can afford to buy fish and meat for food • Active village markets • Strong interest in a variety of livestock • Wide range of staple crops • Staple is mainly used for food • Staple is also sold for family income • Sources of planting materials of staple from own garden, as well as from markets, MAL, KGA • Also grow cocoa and coconuts (copra) – perennial cash crops	**Weakness:** • Prevalent worsening soil salinity • Seasonal water logging • Food shortage; food stored for only 4 weeks (1month) • Strong reliance on own gardens • Strong reliance on reliance on relative/friends/other villagers – communal life • No one has knowledge of improved livestock feeding (0%) • No use of pasturage; heavy reliance own garden and chicken waste • Staples difficult to store
Opportunities: • Good scope for interventions in soil improvement and water logging • Potential for meat market – presently? Scale? • A majority keep livestock (71.9%)	Threats: • Rising sea levels • Exposure to coastal events • Staple is sold for family income • Sources of planting material for staple from own

• Local chicken and pig markets • Strong prioritization for pigs, chickens and ducks • Staple used for livestock feed as well as income	garden, as well as relatives and friends

The project has employed a participatory process to come up with the priorities of the community. The process includes identifying the needs through conducting a baseline survey in the community, reporting back the findings to the villagers through a community workshop and thereafter allows the villagers to priorities through voting.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Buma

	Voters		
Options voted on in Buma	Women	Men	Both
1. Improve the fertility of my soil for higher productivity	8	20	28
2. Improve production of cassava and sweet potato	6	4	10
3. Diversify my livestock holdings for food and income	4	11	15
4. Protecting the soils of my plot from erosion	0	6	6
5. Introducing varieties of current staples and other root crops	6	8	14
6. Protect my crops from too much water in the soil	1	14	15
7. Improve utilization of staples through processing for food and income	0	0	0
8. Improve feeding of chicken and pigs	11	12	23
9. Managing my food crops and garden from high tide	3	9	12
Total Votes	**39**	**84**	**123**
No. of farmers	**13**	**28**	**41**

3. Interventions implemented at the site and summary of achievements

Table 3. Planned interventions developed for the prioritized issues

Selected Issues	Planned Intervention
1. Improve soil fertility for higher productivity & protecting my crops from too much water in the soil	• *Training and demonstration on enhanced soil fertility management* • *Training and demonstration on managing cropping cycles to allow harvest before king tides* • *Training and demonstration on improve soil drainage practices* • *Introduction of crops varieties tolerant to water logging*
2. Improve feeding of chicken and pigs and diversify my livestock holdings	• *Training and demonstration on improved management of chicken and pigs* • *Demonstration of lower cost feeding systems for chicken and pigs* • *Distribution of breeding stock (Chicken, ducks and goats)*
3. Introducing varieties of current staples and those of other crops and improving production of staples	• *Propagation and dissemination of clean planting material* • *Farmer Field Schools on best practices for sweet potato cultivation from site selection to harvest* • *introduction of African yam* • *training and demonstration of utilization of sago for food and feed*

3.1 Site Achievement per Site Outputs

3.1.1 Increased capacity by participating farmers to use improved soil fertility management practices

- *3 trainings were conducted, 1 each on soil fertility management, soil erosion management and importance on soil moisture, 3 demonstration/trials were established with 3 lead farmers, 34 farmers altogether attended the trainings*

3.1.2 Impact of salt water inundation on soil properties analyzed and farmers' capacity to deal with potential adverse impacts enhanced.

- *A general awareness on CC and Its impacts (sea-level rise focused) was conducted on project site where 84 villagers attended, a sea-level rise and garden elevation survey was conducted and documented, Salinity Monitoring(Automatic Rain gauge) station installed and operational*

3.1.3 Increased capacity of interested farmers in Buma community for using improved chicken and pig feeding and management practices

- *A total of 5 trainings on housing and feeding management were conducted, 1 for broiler, 2 each for village chicken and pigs, 18 lead farmers in total participated in demonstrations and trials, 177 farmers attended all trainings*
- *A joint training was conducted for goat and duck farmers, 17 farmers attended, 7 lead farmers participated in the demonstrations*
- *A training was conducted for 15 interested bee farmers, 3 bee hives established and maintained at a central location for the interested farmers*

3.1.4 Farmer-preferred excess moisture tolerant sweet potato varieties identified and available to the Buma community

- *4 field trials and demonstrations were established, 4 lead farmers participated. 8 SPC/MAL sweet potato varieties were introduced with new improve practice using 1 vine cutting per mound, 2 sets of trainings complementarily conducted with the establishment of the trials, 12 and 10 farmers were trained respectively, a field day was held to evaluate the different SP varieties, the 12 Buma community high school year 7 students actively participated in this undertaking*

3.1.5 Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Buma community

- *3 field demonstration were set up, a new technology of yam minisetting was introduced and taught to 18 farmers who participated, the training was conducted simultaneously with the establishment of the trials, 3 lead farmers were engaged with this demonstration trial, the technology was well adopted with the 3 lead and other interested farmers continuously produce*

3.1.6 Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Buma Community

- *6 SPC/MAL varieties of cassava were introduced, new technology of 1 cutting per mound introduced, 3 field trials/demonstrations were established, a training was conducted simultaneously where 36 farmers participated, a field day was successfully conducted where a good number of farmers from outside the project site also attended*

4. Challenges during Project Implementation

Table 4 shows a summary of issues that arose during project implementation at Buma.

Table 4. Issues of significance that impacted the project implementation schedules

LESSONS LEARNT (Issues arising during implementation)		ACTION TAKEN (Decisions made by the project office in addressing the issue)
1	Some lead farmers are reluctant or are not serious enough to pursue their roles as lead farmers in looking after the demonstrations and sharing the knowledge with other interested farmers	Agriculture extension officer on-site was advised to take up the role to regular maintain the abundant demonstration plots
2	Change of Lead farmer on site – the initial selected farmer migrate to other location or town	The project team swiftly get a replacement for the migrated lead farmer.
3	Accessing livestock breeds (pig, ducks and goats) in turn discourage some farmers	The project team has to convey to the farmers of the difficulty in accessing and transporting these animal breed.
4	Delay of funds from headquarters in NARI PNG has negative impacts on the implementation of some of the activities on site	The project t team communicates clear messages to the site technicians explain the situation

5. Final Assessments and Comments

Overall farmer have shown great interests in receiving new farming technologies developed and implemented by the project. The NARI broiler high energy concentrates feed results has raised eyebrows of the participating rural farmers and other interest has been received from farmers outside of the project sites. The rate of adoption of some of the new technologies may be lower than expected but what has transpired over the 4 years has changed the mindset of the farmers to some extent and more so the awareness of climate change and its impact on food production to the rural populace. Final assessments were conducted at Buma in January 2016. A summary of this assessment is shown in Table 5 and 6.

Table 5: Technology performance in Buma Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improving production of sweet potato and cassava	Better, more number of tubers Cassava, more tubers	N/A	N/A	N/A			N/A
Capacity for growing using improved yam production practices and farmer-selected varieties	N/A						
Improve feeding systems for chicken and pigs and diversifying my livestock holdings for food and income	Chicken – Broiler and Layer (Better) Pigs (Better)				Yes Yes	High, improved growth & body size of broiler observed within growing period.	N/A SB$100
Improved soil fertility for high productivity and crop protection from excess water in the soil	N/A						
Manage my water for irrigation and domestic use	Better, more convenient to use for household purpose and for livestock.					Medium,	

Table 6: Responses from Focus Group at Buma during final assessment on food production and priorities

Periods of Food Shortage	It was confirmed that food shortage is still the same as mentioned during the baseline survey which was usually experience in the months April to August and usually due to rainy periods which affect food productions. It was commented that, farmers need to re-identify the cropping calendar under the changing climatic condition to be able to be food secure or reduce the food gaps.
Views on whether improved technologies would improve **food shortage period**	The various crops, (cassava &sweet potato) and the improved production practice have been proven to be successful and therefore, farmers express their interest to continue with the various practice. Some mentioned that various banana varieties can be planted among other existing crops because it can survive their environmental stress and still become productive.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	Farmers mentioned that the interventions are according to their needs and therefore remain important under the changing climatic condition. However, through the implementation of the interventions farmers learnt new skills and knowledge.

Annex 4H. Project Site Report for HUNDA/KENA, WESTERN PROVINCE, SOLOMON ISLANDS

1. Project Site Description

Hunda/Kena communities were selected for the excess moisture soil condition. Hunda and Kena are situated to the southern part of Kolombaranga Island in the Western Province. Kolombaranga in the local dialect meaning "Water King" hence reflects its prime character of receiving consistent prolonged heavy rainfall in a year. The 2 communities have about 80 households who depend on agriculture for subsistence, income and employment.

The landform in this area is hilly with steeper slopes creating this portion of land susceptible to soil erosion. Soil fertility was somewhat very low as it consists mainly of subsoil. In some areas soils are shallow and stony which offers hindrances to root development of food crops and generally other plants. Soil fertility is higher at the lower areas adjacent to the hills. To the coast narrow beaches with coconut palm is common but surrounded by either saline or fresh water swamps making drainage difficult.

Their main staples grown are cassava and sweet potato however, their major income earner is betel nut. The farmers have access to the massive township markets of Gizo to the west and Noro to the east. Most farmers practice the ever common slash and burn (shifting cultivation) farming system. Cropping system practice is mainly mixed farming. Most of these coastal farmers are subsistence that depends on their garden produce to consumption and so as their abundance marine resources. The villagers also receive remissions from relatives on paid employment outside of the village.

2. Site selection and Prioritization

This SWOT Analysis was derived from the baseline survey conducted prior to the to assess the site needs

Table 1. Hunda/Kena SWOT analysis

Strengths:	**Weakness:**
• Good access to urban markets and services • Good access to land for food production • Have cash and food crops for income, and can afford to purchase meat for household consumption • Some form of barter system exists • Household food from a variety of sources • Variety of meat protein (fish, pork, chicken) • Active village markets; access Gizo market • Some practice food storage • Some farmers buy feed from markets • A majority keep livestock (68%) • In close proximity to Ringi Research Station for an easy technology dissemination • Agriculture is the main source of livelihood after logging stopped • Favorable environmental conditions for agricultural activities • Labor is easily available • Wide range of staple crops, mainly used for food but also sold for income • Sources of planting materials of staple from own garden, KGA and MAL • Also grow cocoa and coconut(for copra) – perennial cash crops	• Seasonal food shortages exists; system do not allow sufficient for a period of 4 weeks • Strong reliance on reliance on relative/friends/other villagers – communal life • Very few knowledge of improved livestock feeding (10.8%) • Very little use of pasturage • Food not stored during period of shortages • Soil is highly erosion prone, and quick loss of nutrients • Fast and steep yield decline • Water logging in low lying areas • Pest and disease • Water resource not wisely used; willingness to invest, maintain and manage is missing • Weak infrastructure • Staples cannot be stored

Opportunities: • Good access to services and developing different businesses • Good scope for interventions in soil fertility improvement, soil conservation, management of waterlogging and RWH • field trials can be done in Ringi • Potential for chicken and pig markets • Strong prioritization for pigs, chickens and ducks • Abundant marine fishing • Staple used for income generation and livestock feed as well.	Threats: • Excess rainfall; water logging causes flooding • Too hot prolonged dry weather • Increase incidences of pest such as red nose , SP weevil, taro beetle, caterpillar and wild pigs • Exposed to coastal weather events • Weak cohesiveness within the community • Villagers are mainly waiting for external funds and investments, not proactive • Villagers are scattered • Most people have small plots of land • Inputs in agriculture is rather low • Sources of planting material of staple from own garden, relatives and friends

The project has employed a participatory process to come up with the priorities of the community. The process starts with identifying the needs through conducting a baseline survey in the community, reporting back the findings to the villagers through a community workshop and thereafter allows the villagers to priorities through voting in the end.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop at Hunda/Kena

Options voted on at Huna/Kena	Voters		
	Women	Men	Both
1. Improve the fertility of my soil for high productivity	15	12	27
2. Improve production of cassava and sweet potato	5	12	17
3. Diversify my livestock holdings for food and income	7	5	12
4. Protect my crop from too much water in the soil	1	0	1
5. Introduce different varieties of current staples and other root crops	8	7	15
6. Improve feeding of chicken and pigs	13	3	16
7. Protect soils of my plot from erosion for sustained food crops production	6	0	6
8. Improve utilization of staples through processing for food and feed	5	0	5
Total Votes	**60**	**39**	
No. of farmers	**20**	**13**	**33**

3. Interventions implemented at the site and summary of achievements

Table 3. Planned interventions developed for the prioritized issues

Selected Issues	Planned Intervention
1. Improve the fertility of my soil for high productivity	• *Training and demonstration on soil fertility management* • *Management of soil fertility in the use of mucuna and vertiver grass* • *Extend the use of compost and mulching* • *Intervention to slash and burn practice*
2. Improve production of cassava and sweet potato; together with introducing different varieties of current staples and other root crops	• *Propagation and dissemination of clean planting material* • *Training and demonstration of rapid multiplication of planting material* • *introduction of African yam, beans and island cabbage*

	• *Farm field school on nest cultural practices on sweet potato from site selection to post harvest handling*
3. Improve feeding of chicken and pigs; together with diversification of livestock holdings	• *Training and demonstration on improved management of chicken and pigs* • *Demonstration of lower cost feeding systems for chicken and pigs* • *Distribution of breeding stock (Chicken, ducks and pigs)*

3.1 Site Achievement per Site Outputs

3.1.1 Increased capacity by participating farmers to use improved soil fertility management practices addressing constraints of soil erosion, excessive soil moisture and fertility

- *2 trainings were conducted, 1 each on soil fertility management and soil erosion management, 1 demonstration/trials was established with 1 lead farmers, 25 farmers altogether attended the trainings*

3.1.2 Farmer-preferred excess moisture tolerant sweet potato varieties identified and available to the Hunda-Kena community

- *2 field demonstrations were established, 2 lead farmers participated. 8 SPC/MAL sweet potato varieties were introduced with new improve practice using 1 vine cutting per mound, 1 set of training complementarily conducted with the establishment of the trials, 17 farmers were trained,*

3.1.3 Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in the Hunda-Kena community

- *2 field demonstration were set up, a new technology of yam minisett was introduced and taught to 22 farmers who participated, the training was conducted simultaneously with the establishment of the trials, 2 lead farmers were engaged with this demonstration trial, the technology was well adopted with the 1 lead and other interested farmers still producing yam through minisetts*

3.1.4 Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in the Hunda/Kena Communities

- *6 SPC/MAL varieties of cassava were introduced, new technology of 1 stalk per mound introduced, 2 field demonstrations were established, a training was conducted simultaneously where 22 farmers participated, a field day was successfully conducted where 54 farmers actively participated*

3.1.5 Livestock holdings of interested farmers in Hunda-Kena community diversified and capacity for livestock management improved

- *4 trainings on housing and feeding management were conducted, 2 each for village chicken and pigs, 12 lead farmers in total participated in demonstrations, 45 farmers attended all trainings*
- *1 training was conducted each for duck and goat farmers, 12 and 6 farmers attended respectively, 5 lead farmers participated in the duck and 2 in goat farming*

4. Challenges during Project Implementation

Table 4 shows a summary of some issues that arose during implementation of project activities at Hunda/Kena.

Table 4. Issues of significance that impacted the project implementation schedules

LESSONS LEARNT (Issues arising during implementation)		ACTION TAKEN (Decisions made by the project office in addressing the issue)
1	Weak cohesiveness within the community, especially between the 2 communities of Hunda and Kena – differences in religious beliefs	The project team consults and decided that in conducting trainings – run separate trainings at 2 different locations
2	Model farmers are mostly very old men and women and that they are not active to participate - Hunda and Kena has a high percentage of old people and very young children	The project team decides then that lesser activities be carried out on the site compared to the other 2 project sites
3	Accessing livestock breeds (pig, ducks and goats) in turn discourage some farmers	The project team has to convey to the farmers of the difficulty in accessing and transporting these animal breed.
4	Delay of funds from headquarters in NARI PNG has negative impacts on the implementation of some of the activities on site	The project t team communicates clear messages to the site technicians explain the situation

5. Final Assessments and Comments

The Hunda/Kena Project site receives lesser interventions and actions compared to the other 2 project site in the Solomon Islands; this is merely due to lesser number of active farmers willing to become lead farmers. Identifying and selecting lead farmers is somewhat a difficult task. However, selected lead farmers have shown determination to carry out tasks over the duration of the specific demonstrations. adoption of the introduced technologies may be lower but what has become apparent over the project years has changed the livelihood of some of the participating farmers, more so the awareness of climate change and its impact related to food production has been attained. Final assessments were conducted in January 2016 and the following Table 5 and 6 show a summary of the responses.

Table 7: Technology performance in Hunda/Kena Community as assessed by representative community members

Technology	Performance -Better -Same -Poor	Area Cultivated (for crops)			Do they plan to continue in the future (livestock)? -Yes -No	General Interest from the community- High (H) Medium (M) Low (L) Give Reason	Engage in Market. If Yes, What is the price?
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improve production of sweet potato (SP) and cassava; together with introducing different varieties of staple crops and those of other crops	**Sweet Potato (same)**	SP- 27 m^2	27 + m^2	Yes, 27 + m^2		SP-Medium, prefer traditional practice Cassava-High, prefer introduced intervention given improved performance	Own Consumption
	Cassava (Better), more tubers	Cassava- smaller 100 m^2	100 m^2	Yes, 100 + m^2			
	Yam		50-100 m^2	Less than 50 +m^2			
Improving feeding of pigs and chicken; together with diversification of livestock holdings	**Broiler (Better) & Layer (Better)** **Pig (Same)**				Yes, Yes Yes	High, good meat, egg, income Pig, Medium, not properly implemented.	Broiler Bird S$ 50-100 Eggs-S$ 4.00
Diversify my livestock holding (Ducks)	**Better**				Yes, wanted to continue	High, ducks thrive well.	Own consumption
Improve fertility of my soil for high productivity	**N/A**						

Table 8: Responses from Focus Group at Alkena during final assessment on food production and priorities

Periods of Food Shortage	May to July was confirmed as the period food shortage is experienced and is caused by dry sunny periods and also the change of whether patterns from rainy to sunny periods.
Views on whether improved technologies would improve food shortage period	Each of the interventions has contributed and continue to provide food to the village. This includes interventions such as improved production practices for cassava, sweet potato, yam, including livestock management. The interventions have the potentials to generate income and also provide food as well.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	The interventions chosen were important and remain important however it was mentioned that the farmers need to change their attitude to really experience the benefits that comes with the interventions. Although, there was an established water supply system, members also mentioned that they face difficulty in accessing water during dry sunny periods. Some of the interventions that were included were not completed like improved feeding and management of pigs and goats, ducks therefore farmers questioned whether this will be completed or not.

Annex 4I. Project Site Report for Vanuatu Project Sites

By Antoine Ravu, DARD, Vanuatu

BACKGROUND

In Vanuatu, three sites were chosen earlier in this project to implement each component activities, the respective communities are Malafau and Siviri on Efate Island, and Middle Bush on Tanna Island. According to rapid assessments and focus group discussions that had been carried out, involving stakeholders from these communities, farmers experience the following problems there:

- Malafau: excess soil moisture (stress) and water logging on cropping plots
- Siviri: soil moisture deficit (stress), and other soil water constraints
- Middle Bush: seasonal excessive soil moisture and water logging (stress) as well as soil moisture deficit during the peak dry season.

1. Project Site description

1.1. Geographical Location of Vanuatu

Vanuatu is a small island country located in the South West of the Pacific Ocean; it is composed of 83 small islands that stretch out over 1200 km primarily from north to south in an approximate Y-shape and covers a total land area of 12,190 km^2 of which 15.3% share is agricultural land with a humid tropical climate[10]. The country has a population of 234,023 people (2009 census), mainly distributed in the rural areas where 75% depend entirely on Agriculture and rural development.

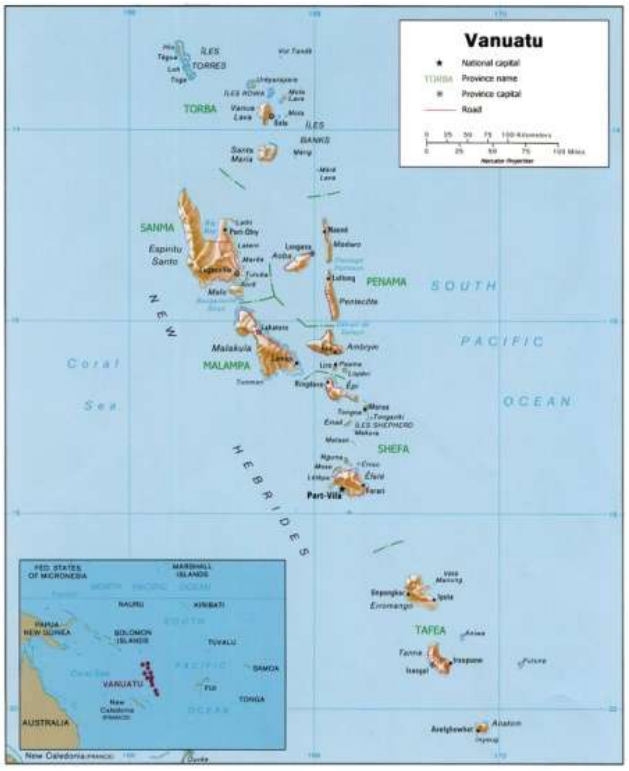


Figure 1: Bathymetric and topographic map of Vanuatu, Oceania (Gaba, 2009)

1.2 Site Locations

Of the three project sites two (Siviri and Malafau) are located on Efate island, which is a central island on which also the capital Port Vila is situated. The third site is located on central Tanna, an island about 200 km south of Efate (Schabschneider, 2014) (Figure 2).

1.2.1 Siviri

Siviri is a small village in the north of Efate, at Undine Bay (Picture 2). This site as it is defined in the project consists of four villages: Siviri, Paunagisu, Emau and Sama with a total of 193 households. The village Siviri itself is situated on the first limestone terrace of the island (around 5 m above sea level, at 17°31'S/168°19'E). This side of the island always vulnerable to dry condition and gardening is done on mostly rocky (lime stone) areas with predominant vegetation of Leaucaena and Acacia. The most important food sources are local root crops (i.e. cassava and yam), coconut milk, fresh fish, fruit trees, and imported food staff like rice and corned beef.

[10] http://www.tradingeconomics.com/vanuatu/agricultural-land-sq-km-wb-data.html

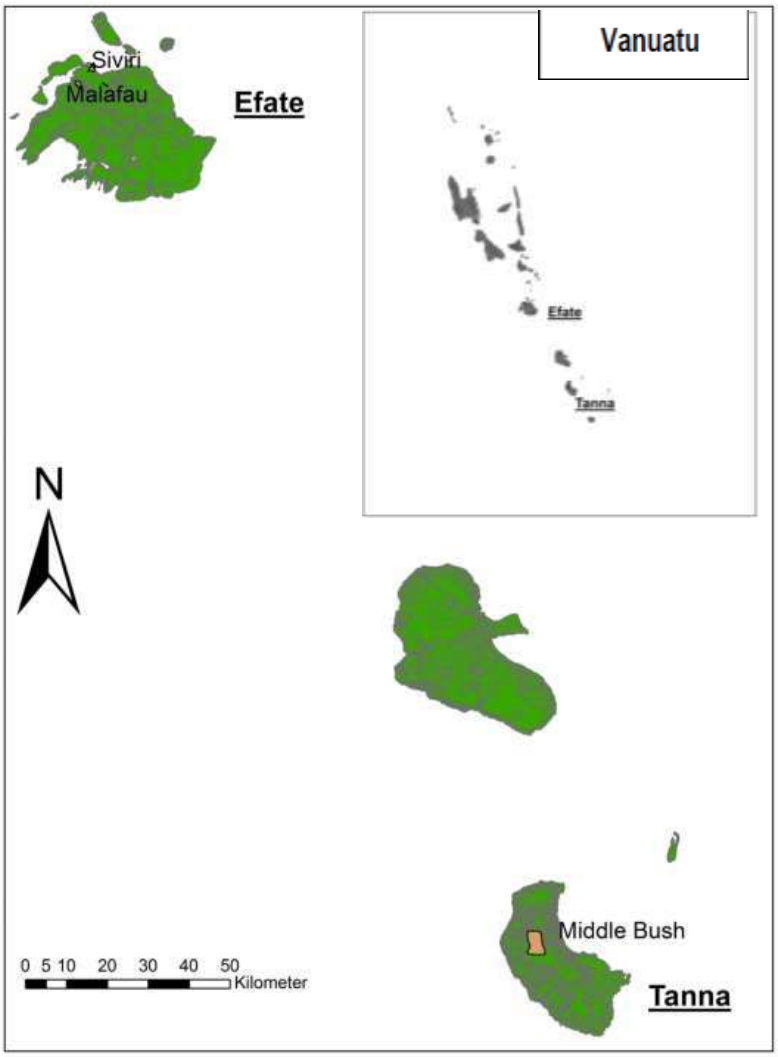


Figure 2: Location of the project sites within Vanuatu

Charcoal making from Leucaena and Acacia is the main income for households. The community also involves in tourism as it is home to the unique underwater cave. Kayaking is also a tourist activity in the community. The main denomination is the Presbyterian Church.

This Community like other communities outside Port Vila has access to tar- sealed road and telecommunications. The main land transport is trucks and buses. Essential services such as School and aid- posts are located within the community. The community has access to Agriculture extension services. There is good community cohesion (weekly work etc…) and Strong community social structure headed by the chiefs.

1.2.2 Malafau

Malafau is a small and new village in northern Efate (Picture 2); the area became populated around 2005 after an exodus of a part of the villagers of Siviri due to a church conflict. The project site itself comprises of four villages: Moso (on Moso Island), Malafau, Tanoliu and Meten that make up a total of 214 households. These communities are connected by quality tar sealed road about 35 minutes' drive from Port Vila.

The village Malafau itself is situated on the windward side of the island about 2 km below mountains therefore vulnerable to spillover effects. It can experience very wet conditions during the wet season from December to July. According to the project initial household assessments, 97% of farmers ranked flooding to be a common hazard in the community with high devastating levels whereby 5 % planted crops that are resilient to wet conditions. The main food sources are local root crops (i.e. yam and sweet potato), banana, fresh fish, coconut milk, fruit trees, vegetables and imported food staff like rice and corned beef. The main income is through selling of garden crops (mainly vegetables), fish and charcoal at the Port-Vila main market. The community has access to efficient land transport and Agriculture extension services. Essential services such as schools and aid post are located in the neighboring village of Tanoliu. The community has access to good portable water. The Main denomination is Assemblies of God (AOG). There is good community cohesion (community work is every Monday) and strong community social structure headed by the chiefs.

1.2.3 Middle Bush

Middle Bush is a rather densely populated region in the centre of the island of Tanna (Picture 2). Located more than 210 km south of the other two project sites, it is situated on a high plane at more than 300 m above sea level and comprises the following villages, located around 19°27'S/169°18'E: Lamak, Launapheuw, Loulipang, Launamilo, Loupikas, Lauaru, Lenemita, Lowehau,
Louwaula, Loujiaru, Euel, Lenaken, Lamak, Jupik (Epuk), Lounaukiam Apen, Loumiai, Laul,Lounauru, Launalou, Lounauru, Latuan, Lowiaru, Ilimanga, Lamnatu, Lamneau, Lounuwao Tuan, Kaunamelkin and Lanupu Pin Nipin with an estimate of 371 households (Schabschneider, 2014). The area has its history of water logged conditions due to high rainfall coupled with high water table. These communities always experience prevailing overcast conditions. The maximum amount of rainfall recorded on a rain event is 150mm. It receives 3500mm rainfall annually. It has volcanic soil that is favorable of growing vegetables, root crops (i.e. sweet potato, cassava and taro), kava and coffee.

Sweet potato is the staple food sources and about 70 % of the vegetable production on Tanna is produced in these communities. The main commodity is coffee and a substantial number of farmers owned cattle farms. The main cash income for farmers is through selling of vegetables, dry coffee beans, taro and sweet potato. Very good access to government services and public transport, located in the vicinity of the white grass airport and drive is about 20 minutes. There is good reception of both the Telecom Vanuatu Limited (TVL) and Digicel. The Agriculture field officer is stationed in this community and due to the agricultural activities carried out in this community extensions services has been regular and robust. Farmers still use horse as a main transport. There is good community cohesion.

2. Site selection and prioritization

Approximately over 294 farmers were interviewed through a semi-structured questionnaire on the three vulnerable selected sites (Siviri, Malafau and Middle Bush) affected with drought (excessive soil moisture) and flooding (excess soil moisture), which was followed by a farmer's group discussion workshop in 2012 to capture the interested feedback of the sample population and appraisals were made respectively. The initial fact finding site assessment visit revealed the following site specific characteristics which were captured through a SWOT analysis

Table 1a. SWOT analysis for Siviri

Strengths:	**Weaknesses:**
• Good water supply • Good access to land and enough land available • Good access to services • Grow a range of crops • Not much concerns regarding food security	• Yield decline (soil fertility, pest and disease) – • Use of traditional production methods esp for soil fertility management; reliance of long fallow will not sustain system in the long run if population increases (only

• Mulching relatively common practice (60%) • Grow cash crops • Have a wide variety of meat protein sources • Existing consumer demand for a variety of meats • A variety of garden feeds available • Local market for livestock sale appears strong • Farmers are already exposed to some technologies • Easy access to new technologies • Potential linkages to other NGO and government services	50% practice long fallows >5yrs) • Pest and diseases on island cabbage, yam, banana, SP • More buying of seafood and fresh meat from butcheries and less buying of local livestock produce • Over half the available feed come from kitchen scraps or natural pasture – so there is low maintenance of animals (= low performance?) • Buying more livestock than selling • Moisture stress during various stages of crop growth • Water logging in heavy soils • Very shallow soils
Opportunities: • Improving access to improved planting materials • Processing of staple crops and value addition for storage and/or sale including tourists • Fresh meat, chicken, pig and goat etc is in demand and local markets exist for buying and selling • There is some animal feed available from local markets • Major market in nearby town • There is existing demand for meat from game animals • Soil fertility improvement, • Soil water conservation, • Strategies to mitigate adverse effects of waterlogging, • Supplementary irrigation	**Threats:** • Erosion of the shore line (but gardens are further inland) • Increasing occurrence of cyclones • More unpredictable seasons • Any health or quarantine restriction on keeping and sale of local animals at local markets? • Need to know the dependence on garden crops and ability to increase feed production • Are there processing needs (fresh, frozen, salted, cooked) or is live sale acceptable? • Are there any pricing effects with social value of animals and location of market etc? • Population growth • Urban center – decreasing availability of labor due to migration to Port Vila and seasonal work options

Table 1b. Swot analysis for Malafau

Strengths: • Access to land • Good access to services (road, market in capital city) • Do not experience much real food shortages • Some members of community have contracts with supermarkets/hotels for sale of crops (only?) • Several sources for water (groundwater, river, rainwater tanks) • Grow a range of crops • Have a wide variety of meat protein sources • Existing consumer demand for a variety of meats • A variety of garden feeds available • Local market for livestock sale is present • A good proportion of feed comes direct from	**Weaknesses:** • Use of traditional production methods esp for soil fertility management; reliance of long fallow but cannot sustain system due to population pressure on land • Hardly any pest and disease control applied • Problems with excess water during high rainfall • Soil erosion up-stream affecting water quality • Water accessibility and quality and no management of water sources • Reliance on own planting material • Soil erosion has deepened and widened river mouth and salt water intrusion further up river; crabs move inland and damage crops (banana) • More buying of fresh meat from butcheries and

gardens • Fishing is popular • Commercial cash crop production • Farmers are already exposed to some technologies • Easy access to new technologies • Potential linkages to other NGO and government services	less buying of local livestock produce • Up to 45% of feed comes from kitchen scraps • Buying more livestock than selling • Increasing temperatures • Moisture stress during various stages of crop growth • Water logging in heavy soils
Opportunities: • Improving access to planting materials (in general and for rehabilitation after cyclones) • Processing of staple crops for storage and value adding • Interested in receiving planting material for any new crop (grain legumes, soybean etc) or improved crop varieties • Fresh meat, chicken, pig and goat etc is in demand and local markets exist for buying and selling • There is some animal feed available from local markets • Major market in nearby town • There is existing demand for meat from game animals • Soil fertility improvement, • Soil water conservation, • Strategies to mitigate adverse effects of water-logging, • Supplementary irrigation	**Threats:** • Increasing population and effect of availability of land and shortening of fallow periods • Cyclones affect food production • Also heavy rain and flooding occurs • Logging upstream affects community – soil erosion and deepening of river mouth • Salt water intrusion – erosion of shore line • More unpredictable seasons and uncertainty about planting times • Any health or quarantine restriction on keeping and sale of local animals at local markets? • Need to know the dependence on garden crops and ability to increase feed production • Are there processing needs (fresh, frozen, slated, cooked) or is live sale acceptable? • Are there any pricing effects with social value of animals and location of market etc? • Urban center – decreasing availability of labor due to migration to Port Vila and seasonal work options

Table 1c. SWOT analysis for Middlebush

Strengths: • Growing a large range of crops – staple crops and vegetables • Community is using vegetables in meals and aware of beans as protein source • Regular consumption of beef and other animal protein sources • Using rainwater tanks • Use of mulching and composting known and practiced in the community • Coffee as cash crop??? • Have a wide variety of meat protein sources • Existing consumer demand for a variety of meats • Selling livestock more than buying • Local market is very strong – most buy meat locally • Strong interest in all different livestock • Potential linkages to other NGO	**Weaknesses:** • Insufficient capacity to store enough water for all and poor access to alternative water source • Poor quality of creek water • Use of traditional production methods esp for soil fertility management; reliance of long fallow but cannot sustain system due to population pressure on land • Excess and scarcity of water affecting crops yields • Pest and diseases affect crop yields and nothing done about it • Reliance on own planting material • Limited marketing opportunities (small local and town market); Inadequate infrastructure and transport • Almost everyone has interest in all the livestock species – less chance for specialization and trade? • Over half the feed comes from kitchen scraps • Limited variety of feeds • Groundwater layer only at greater depth

Opportunities:	**Threats:**
• Improving access to improved planting materials • Processing of staple crops and value addition for storage and/or sale including tourists • Strong demands for meat and a good local market • Soil fertility improvement, • Soil moisture conservation, • Supplementary irrigation, • Water harvesting and water recycling	• Increasing population and potential land shortages; shortening of fallows • Floods after heavy rainfalls • More unpredictable seasons/climate/weather • Sustainability of stock • Timely and secure marketing arrangements • Limited variety of feeds • Volcanic ash • Cyclones

As in the other sites, community members were engaged in a reporting back workshop to list their major constraints to agricultural production throughout the cropping calendar. Each community member was invited to participate in the prioritization of the major constraints and opportunities in their area and (Table 2). Only the top three to five priorities were considered for inclusion in the project. These constraints were later converted to project outcomes and prioritized based on their needs and understanding of the concept. Both gender had a fair representation in the workshop.

Table 2. Results of a voting exercise options addressing agricultural production constraints and opportunities at the workshop in Siviri (2a), Malafau (2b) and Middlebush (2c).

Table 2a				
No.	**Options voted on in Murukanam**	**Women**	**Men**	**Both**
1	Improving management of soil water to reduce effect of drought	3	13	16
2	Improving production of meat and eggs for, chicken and ducks using garden crops for home consumption	1	3	4
3	Improving production of staples (banana, cassava Fiji taro)	3	13	16
4	Integrating livestock and crop production to improve yield from livestock and crop	2	8	10
5	Adding value to my staple crops through processing into food and feed	2	2	4
6	Keeping chicken, ducks and pig for higher cash income	4	22	26
7	Draining excess soil moisture from water logged plots for good crop production	1	0	1
8	Introduction of other / new crops or crop varieties into my farming system	2	13	15
	Total Votes	**18**	**74**	**92**
	No. of farmers	7	26	33
Table 2b. Malafau				
No.	**Options voted on in Malafau**	**Women**	**Men**	**Both**
1	Draining excess soil moisture from water logged plots for good crops production	5	1	6
2	Improving production of meat and eggs from chicken and ducks using garden crops for home consumption	2	3	5
3	Improving production of staples (banana, yam, cassava)	3	5	8
4	Integrating livestock and crop production to improve yield from livestock and crops	0	2	2
5	Improving soil fertility of my plots for sustainable and improved crop production	1	4	5
6	Adding value to my staple crops through processing into food and feed	1	2	3
7	Keeping chicken, ducks and pigs for higher cash income	8	7	15
8	Improving management of soil water to reduce effects of	1	2	3

	drought			
9	Introduction of other / new crops or crop varieties into my farming system	6	4	10
	Total Votes	**27**	**30**	**57**
	No. of farmer	9	10	19

Table 2c. Middle Bush

No.	Options voted on in Middle Bush	Women	Men	Both
1	Protecting food gardens and soils from heavy rains and surface run off	0	0	0
2	Improving production of meat and eggs from chicken and ducks using garden crops for home consumption	10	8	18
3	Improving production of staples (Fiji taro, kumala)	2	3	5
4	Introduction of new technologies to protect food gardens during the dry season	3	0	3
5	Integrating livestock and crop production to improve yield from livestock and crops	3	14	17
6	Adding value to my staple crops through processing into food and feed	3	25	28
7	Keeping chicken, ducks and pigs for selling	9	6	15
8	Improving soil fertility of my plots for sustainable and improved crop production	5	1	6
9	Introduction of other / new crops or crop varieties into my farming system	7	0	7
10	Protecting water resources to have safe and secure access for household use	12	27	39
	Total votes	**54**	**84**	**138**
	No. of Farmers	18	28	46

The top ranking for both the male and female members of the community were:

- Improving management and feeding of chickens and pigs to increase food (meat & egg) production and higher cash income.
- Introduction of other / new crops varieties (cassava, yam, sweet potato & rice) into the communities farming system.
- Protecting and managing water resources to have safe and secure access for household use.

3. Interventions implemented at the site and summary of achievements

Table 3 shows an overview of outputs achieved and participation of different community members in relevant learning workshops and demonstrations that were conducted in Vanuatu communities. There were usually a number of learning events conducted per output and some community members chose to participate in only one of the events while others participated in all events for that output..

Table 3. The various outputs and participation of community members in relevant technology demonstration and learning events at Vanuatu Pilot sites

	Outputs	Activity	Sites	No. of trainings	Farmers Trained	Male farmers	Female Farmers	Model Farmers
O1	Increased capacity of interested farmers in Siviri, Malafau & Middle Bush community for using improved/local chicken, pig feeding and management practices	Poultry improvement	Siviri	2	28	21	7	16
			Malafau	3	47	38	9	16
			Middle Bush	3	36	22	14	19
		Value Addition to feed – Pig silage	Siviri	1	34	28	6	18
			Malafau	1	3	2	1	3
			Middle Bush	2	48	33	15	20

O2	Capacity for growing cassava, yam and Sweet Potato (SP) using improved locally acceptable production practices and farmer - selected varieties increased in the Siviri, Malafau & Middle Bush Community.	Cassava	Siviri	1	2	2		2
			Malafau	1	13	9	4	3
			Middle Bush	1	16	11	5	1
		Yam	Siviri	2	5	3	2	2
			Malafau	2	7	5	2	2
			Middle Bush	2	10	7	3	1
		Sweet Potato	Siviri	2	32	25	7	2
			Malafau					1
			Middle Bush	3	29	17	12	2
O2b	Capacity for growing rice using locally appropriate production practices and varieties developed in Middle Bush Community.	Rice planting	Middle Bush	2	37	24	13	2
O2c	Greater diversity of crops species and varieties maintain by selected farmers in Malafau & Middle Bush community – vegetables – tomatoes & cabbages.	Vegetables	Malafau	1	18	6	12	3
			Middle Bush	2	37	13	24	4
O3	Increased capacity of interested farmers in Middlebush community for processing sweet potato and cassava into other food products.	Value addition to food – flour, starch, chips, pop, baked & fried products	Middle Bush	4	57	9	48	17
O4	Community has an increased and improved capacity to manage available water sources for domestic and agricultural uses.	Soil & Water Management	Siviri	1	11	7	4	1
			Middle Bush	2	23	15	8	2

The model farmers were identified by the project field technician with the help of the DARD extension officer through a baseline survey based on the farmers' interest and past experience. The model farmers agreed to work closely with the project team to take on new innovation using their land for crop trials and livestock husbandry demonstration trials. These are mostly interested and resourceful in their selected areas and other area as well. The success of the project depended on the pro-activeness of the model farmers. In most cases the model farmers were also participating in other areas / activity based on his / her interest. For instance the model farmer for sweet potato was also the model farmer in poultry management and or other components.

Field demonstration trials, training demonstrations and field day were the main planned activities delivered under each of the technical components. Table 5 shows a summary of technologies introduce and farmer impressions during implementation particular for crop, livestock and food processing interventions.

Table 4. Technologies/ innovations disseminated as part of project interventions at Vanuatu pilot sites and farmer impressions

Output	Description of intervention	Innovation	Farmer impressions during implementation
O1	Increased capacity of interested farmers in Siviri, Malafau & Middle Bush community for using improved/local chicken, pig feeding and management practices	▪ SP silage concentrate technology	▪ Fast growth rate and improved pig weight gains with the NARI introduced feed silage ▪ Silage feed reduces labour for pig feed preparation. ▪ Reduced social conflict
		▪ Chicken feed technology	▪ Introduced feed technology using copra meal, meat meal and lime was very successful that increased production (egg) and fast growth, raise profit by 30% compare to traditional feeding.
O2	Increased capacity for growing cassava, yam and Sweet Potato (SP) using improved locally acceptable production practices and farmer - selected varieties increased in Siviri, Malafau & Middle Bush Community.	▪ Yam husbandry practices adaptable to drought & excess rainfall.	▪ Farmers appreciated the techniques of planting yam comparing mini-setting seeds technology; staking vs non-staking; low and high density techniques. ▪ Increased production of yam seeds and conserve introduced varieties.
		▪ SP varieties that is tolerant to drought & high soil moisture.	▪ Farmers appreciate the techniques introduced of planting one vine cutting on horizontal orientation per SP mound that produced higher yield compare to normal practice using 3-4 vines. ▪ The effect of El Nino and TC Pam in 2015 has caused the introduced SP not do better than the local varieties.
		▪ Cassava varieties that are drought tolerant and tolerant to high soil moisture.	▪ 20 cassava varieties were introduced and trial out in Middle Bush performs very well but unfortunately damaged by TC Pam. ▪ Over 2000 cuttings of cassava were distributed after TC Pam
O2b	Capacity for growing rice using locally appropriate production practices and varieties developed in Middle Bush Community	▪ Two new rice varieties of NR 1 & 15 introduced at Middle Bush	▪ Farmers were happy to accept new rice varieties. ▪ Address food security needs of the community and reduces household spending. ▪ Positive respond regarding the rice mini rice machine which motivate planting of rice.
O3	Increased capacity of interested farmers in Middlebush community for processing sweet potato and cassava into other food products.	▪ New technologies of food processing introduced in the community.	▪ Farmers especially women's were happy to learn new technology of food processing that helps them generate high household income be selling their food products.
O4	Community has an increased and improved capacity to manage available water sources for domestic and agricultural uses.	▪ Construction of 10,000L water tank for the community for agricultural uses ▪ Training of soil fertility improvement and construction of tunnel house.	▪ Community was happy to see that their main concern and priority was addressed. ▪ Community collaborated well and agreed to work closely with DARD and future projects.
O5	Print Materials distributed to	Booklets, leaflets, posters,	▪ The communities were happy that the print

	farmers.	& DVD's	materials and DVD's are all in "bislama" translation that is easy for them to read and understand. ▪ Farmers are happy with their own photo used in the print materials which eventually motivate them to share their experiences to other interested community members.

4. Challenges and Suggestions during Project Implementation

The key challenges encountered at the implementation course of the project is the destruction of TC Pam and the prolong period of *Le Nino* induced drought in 2015. These has entirely affects the crop demonstration plot, livestock and food processing trials which makes most farmers lost interests for a while. Involvement of the community to the project activities is also determine by their cultural obligations in the village like attending marriages and funeral ceremony of death and national events such as the independence day celebration. Another important aspect is that training and demonstration of farming techniques often target male farmers for example in Middle Bush women's groups are thought to be only interested in food processing.

Frequent follow up and monitoring of the project activities by project field technicians and the agriculture officers often delays due to bad weather and commitment of officers to other programs and projects. It is important to carefully select model farmers that are motivated and innovative leader farmers. Field technicians always find it difficult to visit all farmers in a day since farmers' lives in areas located far away from the main community center. For some instance, the agriculture extension officer that owns a motorbike routinely visits those model farmers and report on the progress of each activity. Relocation of agricultural extension officers and changed of project country Sub - Coordinator also affects and delay implementation of the activities which requires clear explanation by the component leaders of the purpose and goals of the project that certainly lead to misunderstanding and miss interpretation of the planned activities. The soil and water component was delay until the final year of the project because of the changes on contract from World Vision to ADRA. Lack of technical expertise by the agriculture officer develops a stronger collaboration between DARD and the Vanuatu Agriculture Research Training Center (VARTC) to implement most of the project activities. The involvement of the DARD and VARTC officers in short training at NARI PNG has eventually increased capacity of the technical human resources. Dissemination of project information to the public have better create stronger linkages between DARD, NGO's and projects to use the technology introduced by the EU-ARD Project. The key challenges were summaries in table 6 below in this regards.

Table 5. Issues of significance that impacted the project implementation schedules

Issues arising during implementation and lessons learnt	**Type of action required/suggested taken to resolve problems and delays etc.**
Destruction of TC Pam and prolong period of *Le Nino* induced drought in 2015	Communicate with model farmers and find out the level of damage caused. Carry out damage assessments and identify farmers and developed rehabilitation work plan. Work with farmers that experience less damage on their livestock and crops.
Frequent monitoring and follow up of project activities	Field technicians and agriculture extension officer provide weekly reports on the day to day progress of the activities.
Delays of implemented activities	Appointment of agriculture officers as local team leader of each component to take lead in implementation of the activities.
Lack of expertise by agriculture officers	Draw up quarterly plans and request for NARI scientist to travel to Vanuatu and conduct trainings for farmers and agriculture officers.
Establish trust between project team and the	Keep in touch with the farmers and agriculture

community	extension officer and training days before travelling.
Training and demonstration of farming techniques often target male farmers.	Target both men and women for training as appropriate.

5. Final Assessments and Comments

The final site assessment in Vanuatu took place in December 2015. The responses in technology performance and responses of representative farmers during focus group discussions are summarized as follows. Further information can be found in Tables 6 and 7.

Siviri

Yam model farmers mentioned in the final site assessment meeting that the technologies of yam mini-set, yam density and staking is very useful mainly for seed production that certainly will increase production on a small piece of land. Farmers are not able to make comparison on the yield of both traditional and new technology due to the destructive TC Pam which destroyed the crop trial plot. However, it is anticipated that the yam technology introduced was disseminated to other nearby communities and plot size was also intend to increase in the future.

Sweet potato was experimental during off-season (December –April) period and the outcome shows high production yield compare to cultural practices. New sweet potato varieties were introduced into the community. The idea of inviting farmers to the field day has developed more interest whereby farmer are exposed to the innovations applied in the field and interact with extension and research officer. Farmers come to accept and understand contributing climatic factors that affects their crops demonstrated by the EU-ARD project team. Sweet potato is regard as a main food security crop to the community with potential to increase production in future using the technology respectively.
With the introduction of feeding and good management practices of keeping village chicken farmers are more interested to work with the project at initial implementation of the activity. However for some circumstances few model farmers lost interest to some extent especially when they committed to other cultural obligation.

Malafau

The crop model farmers (i.e. yam and cassava) were very happy with the technology introduced at their plot and are more interested to share their knowledge with the communities. A female model farmer stress that the technique of planting yam without staking could withstand drought and control pest attack, the idea of farmers taking a leading role in what they expect from the project in terms of their local priorities was a new approach that also was breaking traditional extension approaches and may have astounded many farmers, who expect EU-ARD project team to tell them what they should have and what not to have in their communities. Few successful chicken model farmers managed to hatch their own eggs. The steps of formulating chicken feed using copra meal, meat meal and lime is beneficial to the farmers, and some farmers are now using commercial feeds to raise their chicken for egg production. Farmers selling village chicken at a price of 1,500 VT and eggs for 30 VT to locals and 50 VT to restaurant owners. Young chicks reared after TC Pam was raised up to an acceptable weight and sold to restaurant owners at price of 1,000VT.

With the construction of the new water tank (10,000L) for the community to irrigate their crops it has generate interest of the leaders in the communities to establish a water committee that oversee the management of water used to irrigate crops and other purposes. The project has increased farmers capacity of keeping village chicken and crop management. There are high participations of men than women in the project.

Middle Bush

There was a lot of excitement in Middlebush for crop f (sweet potato, yam, cassava & rice) and livestock (chicken & pig). There is equal involvement of men and women which shows an effective dissemination of information share to the entirely population. Two field days were organized by the EU-ARD project on sweet potato and yam harvest. Planting materials of new crop varieties (sweet potato and yam) were eventually distributed to majority of the community members, farmers

mentioned in the final site assessments meeting that they will continue to use the improved farming technology and expand their farm size.

Middle Bush community are not new to rice planting and with the introduction of the two (2) new rice varieties of NR 1 & 15 and the mini rice machine, it has encouraged high interest of farmers to plant rice and expand their farm size. These have set a new approach of agriculture extension officer to facilitate trainings of rice planting conducted by the farmers. The Middle Bush communities now setup a new rice farmers association that consists of 70 registered farmers that is responsible for the day to day schedule of rice planting. Interested farmers throughout the country and DARD are now sourcing rice seeds from the farmers' association. A lot of people use to get involved in growing and milling rice but milling became a problem to even when farmers stopped to grow rice.
Farmers were trained how to keep village chickens in fenced and were also introduced to new feeding techniques which really improved egg production and performance in terms of faster growth rate. The model farmers responded positively and mentioned that keeping village chickens in fenced is much better that the traditional or cultural practice of free ranching. In addition the technologies have supported the farmers to generate sufficient income to meet their basic needs such as school fees and transport. It also address protein needs of the communities, for example parents normally boiled local eggs for their children to take with them to schools. There is high demand of village chickens at the market and farmers were able to increased supply.

Pig silage making technology capture interest of most farmers in Middle Bush. Model domestic pig farmers mentioned confidently that the technology is much better than the cultural practices because is save energy and time of feeding their pigs, the pigs perform faster growth rate and weight gains, and also solved other related problems of destroyed food gardens and polluted water sources through free roaming pigs.

The introduction of food processing technology was well received by the community members. This technology significantly benefits the community members by providing them with adequate income and employment opportunity. Female members mentioned the need of preserving their crops during disaster period for instance cyclone Pam.

The construction of two water tanks (10,000L) at Napil and Nasitua community have addressed the needs of post-harvest management of coffee and irrigated crops mainly vegetables. Male members mentioned also that the technology significantly benefits the community members by providing safe drinking water which simultaneously also reduce health risk associated with poor quality of water and waterborne disease.

References

Schabschneider, H. (2014). "Evaluation of Agricultural Conditions of three ungauged Watersheds in Vanuatu". University of Natural Resources and Life Sciences, Vienna.

Table 6a. Technology performance in Siviri Community as assessed by representative community members

Technology	**Performance** **-Better** **-Same** **-Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)?** **-Yes** **-No**	**General Interest from the community-** **High (H)** **Medium (M)** **Low (L)** **Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	New Practice	Plan to Expand, If yes by how many			
Improved Production Practice for growing yam, cassava, and SP using improved locally acceptable production practices and farmer-selected varieties	Yam- Not sure, destroyed by cyclone.	40 m x 20 m Inter/mix cropping	Research plot: 30 m x 15 m Extended Plot: + 162 m^2	+162 m^2		Higher, Help in Seed multiplication.	
	SP- Better Yield	0.5 Ha (mix cropping)	Research Plot Range: 6 m x 6m -100 m by 100 m.	+100 m x 100		High, New Varieties perform better; can be grown in and off season.	
Improved management and feeding practices for chickens	Better,					High, improved performance (weight gain), More eggs, Income earning activity	1200vt/rooster 800vt/hen 40vt/egg
Improved management and feeding practices for goats	Better, (newly introduced practice)				Yes	Medium, interest growing,	

Table 7a: Responses from Focus Group at Siviri during final assessment on food production and priorities

Periods of Food Shortage	N/A
Views on whether improved technologies would improved food shortage period	N/A
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	N/A

Table 6b. Technology performance in Malafau Community as assessed by representative community members

Technology	**Performance -Better -Same -Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)? -Yes -No**	**General Interest from the community- High (H) Medium (M) Low (L) Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	**New Practice**	**Plan to Expand, If yes by how many**			
Improved Production Practice for growing yam, cassava, and SP using improved locally acceptable production practices and farmer-selected varieties	**Yam,** large sets better than miniset in terms of size Introduced variety (Better)	+162 m^2	Research Plot size: 10 m x 10 m Extended Plot: + 400m^2	+ 400 m^2		Higher, miniset help seed multiplication, seedlings distributed Large sette wanted more than miniette	
	Cassava (Introduced practice, Poor)	25m x 10 m	Research Plot: 8m x 15 m	Farmer prefer Traditional practice(vertical planting)			
Improved management and feeding practices for chickens	Better, (growth rate and weight gained, collected eggs)				Yes	Higher, improved growth, income earning activity and food security	*500vt/rooster *Eggs 30 vt to locals and 50 vt to chiness people (restaurant owners) *Young chicks-

							1000vt.
Improved management and use of available water sources for domestic use	Better, Needed in Tannliu, Malafau Area					Generally interested	

Table 7c: Responses from Focus Group at Middle Bush during final assessment on food production and priorities

Periods of Food Shortage	Not a big issue, but experience shortage of food such as vegetables during months of November and December due to climate extremes such as drought
Views on whether improved technologies would improved food shortage period	N/A
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	N/A

Table 6c. Technology performance in Middle Bush Community as assessed by representative community members

Technology	**Performance -Better -Same -Poor**	**Area Cultivated (for crops)**			**Do they plan to continue in the future (livestock)? -Yes -No**	**General Interest from the community- High (H) Medium (M) Low (L) Give Reason**	**Engage in Market. If Yes, What is the price?**
		Old practice	**New Practice**	**Plan to Expand, If yes by how many**			

Improved management and feeding practices for pigs and chickens	Better, (chicken-Broiler and Layers) Feed better				Yes, cyclone PAM destroyed the setup so they were slowly pickling up.	High, improved practices improved performance for pigs/broiler/layers- more eggs, income generation	Pigs- Chicken-1500 Layer- Eggs-40vt/egg -60vt/egg *Chicken price (broiler) imported 1800vt, 1850vt in lenakel.
	Pig, Better				Yes, continue after the cyclone destroyed SP.	High, A lot of farmers trained	
Improved management and use of available water sources for domestic use	Better, tanks provided water for irrigation and for household use					Medium, tanks provided water for irrigation and for household use	
Value addition to staple crops into food products for food and income	Better, ***Cassava Chips** ***Cassava Flour** ***Sweet Potato Pops**					High, (80+ interested) –seen as an income activity and for food during. Other communities also showed interested and women model farmers helped in further trainings	100vt/chip and 50vt SP poops, flour for storage
Improved Production Practice for growing yam, cassava, rice and SP using improved locally	Yam-Stalking better,	Yam (162 m^2)	Yam (162 m^2)	Yam (162 + m^2)		High, better yield, food and can be stored longer.	Own Consumption

acceptable production practices and farmer-selected varieties							
	Yield Not Sure, Cassava, destroyed by cyclone PAM)	Cassava (162 m^2)	Research Plot: Cass- (1400 m^2)	Cass-1400 + m^2 depending one seeds) Destroyed by cyclone Pam)		High,	
	Rice –yodana Better,		Rice (-40 m by 50 m)- 1400	Rice-1400 m^2		High, yotana performed better, followed by N1, used for food during cyclone Pam. Distributed to other 10 farmers	
	Better (SP), 2 varieties perform better	SP (162 m^2)	SP (9 m^2)- Research plot size	SP-162+ m^2		High, Interest, grow in any months, distributed already	

Table 7c: Responses from Focus Group at Middle Bush during final assessment on food production and priorities

Periods of Food Shortage	December to March
Views on whether improved technologies would improved food shortage period	Rice can be stored for a long time and also preserving and preserving techniques (cassava and Sp) is proven helpful during the cyclone and other extreme weather condition. Processing and preservation of the techniques of cassava and Sp can be used to preserve food to be used in extreme conditions.
5 Years ago, communities voted on certain priorities. Do these still remain important or have now changed?	All the interventions implemented are still important even today. Although cyclone Pam hit and destroyed most of the intervention that were implemented, the farmers were able to recover and continue with the interventions. Under the changing climatic condition, the farmers mentioned that if they were to vote again, rice would be their first priority given that it can survive cyclone and also last longer to be used as food.

Annex 5. Result 2 – Component Report

Component/ Expected Project Result:	Suitable target smallholder communities in PNG, SI and Vu identified, needs-assessed, and participating in the research and development process

1. Achievement of the output and milestones in the component including what was not achieved and why?

O	Milestones	Expected Date of Achievement	Actual Date of Achievement
A1	**Information gathering exercises to identify suitable target community groups in areas of PNG, SI and Vu at risk from drought, excess rainfall or sea water inundation**		
M1	Suitable target community groups identified based on desktop review and appraisal visits	Q3 2011	Q4 2011

- Output and milestone achieved.
- A total of 11 target communities in PNG (5), SI (3) and VU (3) at risk from drought, excess rainfall or sea water inundation were identified
- In PNG GIS was used to identify risk areas based on PNGRIS and MASP database – In Vanuatu, sites were selected initially based on field observations of potential risks associated with climate change. Ground truthing and surveys followed to confirm on-ground situations
- Target sites were determined based on risk and access

O	Milestones	Expected Date of Achievement	Actual Date of Achievement
A2	**Baseline surveys in target communities to collect primary information on food security etc. and farmer participatory workshop to assess needs of target communities agree potential solution options & help identify pilot sites**		
M1	Survey instruments and methodology developed	Q4 2011	Q3 2011
M2	Surveys conducted in three countries	Q4 2011	Q4 2011
M3	Data analysed for all countries	Q1 2012	Q1 2012
M4	priority interventions within project framework determined for each of the pilot sites in PNG, SI, Vu	Q3 2012	Q3 2012

- Outputs and milestones achieved.
- Baseline surveys were conducted in Year 1. The purpose was to establish constraints and opportunities in relation to food crop and livestock production, socio-economic setting, awareness on climate change
- The method used included:
  - Household survey and focus group discussions were conducted in target sites using structured and semi-structured questionnaires respectively.
  - Both research instruments were developed and pre-tested prior to administration.
  - Teams composed for the data collection exercise, comprised of NARI staff and partner organizations
  - Enumerators and Team Leaders then underwent Baseline survey training
  - Data collection commenced at end April-end May 2011 for PNG,
  - Data collection for Solomon Island and Vanuatu commenced in early and mid Nov 2011, respectively.

- Data collection was completed for all sites at end 2011
- Data analysis commenced in Year 2 – 2012 and was completed in 1st Quarter
- Data was analyzed using SPSS

- Community Reporting Back workshops
  - The Purpose was to inform communities on constraints and opportunities and discuss options to address them.
  - The method used: The project engaged a participatory approach to ensure that interventions delivered by the project are well targeted to achieve positive changes on farms and impact on farmers' livelihoods. This was a new research approach undertaken by NARI, where communities are actually engaged to set priorities for research interventions.

- Presentation of issues Identified from needs assessment
  - From needs assessment data, the Research Team processed production issues identified for crops, livestock and soil into simple messages. This was also done for water and socio-economic issues.
  - Simple messages were then translated into pictorial form in posters.
  - Messages on posters were presented mostly in plenary sessions
  - Farmers were allowed to verify information on issues
  - Adequate time was then allowed for discussions
  - Adequate time was also allowed for poster reviewing

- Presentation of options for research, based on issues identified
  - After viewing pictorial presentations of issues, farmers then viewed a list of possible options for addressing the issues.
  - Adequate time were allowed for farmers to do this and to identify issues of interest to them
  - Below is an example of options for research, for a target site.
    - ❖ Improving the production of sweetpotato
    - ❖ Improving the production of other staple crops
    - ❖ Introduction of grain crops in my farming system
    - ❖ Using some of my staple crops for livestock feed
    - ❖ Using some of my staple crops for processing into flour and other products

- Voting Process
  - Following the viewing of pictorial and research options presentations, the voting
  - process was explained to farmers
  - Farmers were separated into male and female groups and each voted separately
  - 3 stick-on dotes were allocated to each farmer for voting

- Priorities Identified
  - Following the voting sessions, votes were tallied separately for women and men at first, then combined
  - Priorities were then identified based on combined votes
  - These priorities were presented back to communities the next day
  - Farmers were given time to verify their agreement and raise any concerns
  - Refer to site reports for respective priorities

Following the reporting back workshops and prioritization exercises, interventions were identified. The process included:

- Preliminary Interventions identified during the CRBWs (E.g PT SP, pig and chicken feeding practices)
- Further Analysis and prioritization of Interventions, for implementation (E.g. Unpacking community priorities)
- Research Team developed Operational Plans, with required resources and timeline
- Interventions were targeted more towards helping farmers producing food for themselves or to generate income to help purchase food
- Interventions were of various nature e.g. for improving productivity, i.e. higher yield; lower cost of production e.g. feed; diversify options for food security to narrow period of food shortage experienced periodically or seasonally.
- Following this, components implemented respective project activities at the target sites.
- Refer to site reports for respective roll-out plans.

O	Milestones	Expected Date of Achievement	Actual Date of Achievement
A3	**Annual Community feedback meetings held in pilot sites in PNG, Si, Vu**		
M1	Meetings held in PNG sites	Q4 2013 Q4 2014 Q4 2015	Q4 2013 Q4 2014 Q4 2015
M2	Meetings held in SI sites	Q4 2013 Q4 2014 Q4 2015	- Q4 2014 Q4 2015
M3	Meetings held in Vu sites	Q4 2013 Q4 2014 Q4 2015	- Q4 2014 Q 2015

- Outputs and milestones achieved.
- During the life of the project, a number of community assessments were conducted to assess social dynamics, interest and participation of farmers on newly introduced technologies in the community. The findings revealed that:
  - The majority of farmers involved with the project thought that the process
  - taken to identify issues, prioritize those issues, and to identify and select farmers to be involved, was very good
  - The level of interest expressed by farmers in the target communities varies from very high in PNG to medium in Solomon Islands and low in Vanuatu.
  - Farmers in PNG were found to engage more the knowledge gained from the project than counterparts in Vanuatu and Solomon Islands
  - A copy of the report is attached in the Attachment at the end of this report

O	Milestones	Expected Date of Achievement	Actual Date of Achievement
A4	**End of Action surveys and stakeholder workshops to get feedback from beneficiaries**		
M1	Survey instruments and methodology developed	Q2 2015	Q4 2015
M2	Surveys conduced in three countries	Q3 2015	Q4 2015
M3	data analysed and report completed	Q4 2015	Q2 2016
M4	Stakeholder workshops held in PNG	Q4 2015	Q4 2015
M5	Stakeholder workshops held in SI	Q4 2015	Q4 2015
M6	Stakeholder workshop held in Vu	Q4 2015	Q4 2015

- Output and milestones achieved.

The Purpose of the final assessment was to assess:
- perceived performance of introduced technologies vs existing technologies. For this, mostly qualitative information was collected. Quantifiable data were collected from on-farm trials.
- general interest in the community on introduced technologies
- perceived likelihood of further adoption of technologies
- perceived views on whether use of improved technologies would help bridge gaps of food shortage
- whether farmers would vote for a different priority based on current observations on technologies delivered

The method used was Focus Group Discussion using semi-structured questionnaires. Assessments commenced and completed for all sites in 2015; November in PNG, December in Vanuatu and January 2016 in Solomon Island.

Preliminary Results
- The research approach taken to engage communities in voting for research interventions was seen to be a success. Evidence: In most sites, farmers say they will vote again for same priorities.
- Nevertheless, very different responses observed from site to site, on the interventions, reflecting the strong influence of micro-environment (social, cultural, economic, etc) on technology interest and use.

A copy of the report is available separately.

2. Modifications in implementation plans at sites for this component and overall component plan and why were the modifications necessary

On going assessments were carried out during the life of the project rather than at the end of the year except for 2015. This was so that farmers who entered earlier in the projects are assessed, so in the event that they move on later towards the end of the project, we would have still captured required information from them. Also annual feedback meetings were done by components and not all components together, due to some components progressing in their activities faster than others.

For final assessments focus group discussions were used instead of survey. We thought this was an appropriate method to get feedback from the community as a collective body, on what was useful or not, their interests in the process used and technologies introduced, and likely future use and sustainability.

3. Achievements for the overall Component objectives and Results – Provide the consolidated indicator information to support your statements on achievement of the Component Result/Objective

Result 2: Suitable target smallholder communities in PNG, SI & Vu identified, needs-assessed, and participating in the research and development process		
A1	**Information gathering exercises to identify suitable target community groups in areas of PNG, SI and Vu at risk from drought, excess rainfall or sea water inundation**	
Milestones		**Activity and output**
M1	Suitable target community groups identified based on desktop review and appraisal visits	Survey reports available Finalized list of sites
A2	**Baseline surveys in target communities to collect primary information on food security etc. and**	

	farmer participatory workshop to assess needs of target communities agree potential solution options & help identify pilot sites	
Milestones		**Activity and output**
M1	Survey instruments and methodology developed	Survey instruments and methods use in data collection available
M2	Surveys conduced in three countries	Report in surveys in 3 countries
M3	Data analysed for all countries	Data available for 3 countries SWOT analysis available for 3 countries Analyzed data available for 3 countries
M4	priority interventions within project framework determined for each of the pilot sites in PNG, SI, Vu	Report on community reporting back workshops available Report on priority setting by communities available Report on interventions available for 3 countries
A3	**Annual Community feedback meetings held in pilot sites in PNG, Si, Vu**	
Milestones		**Activity and output**
M1	Meetings held in PNG sites	Analysis on community feedback available
M2	Meetings held in SI sites	Analysis on community feedback available
M3	Meetings held in Vu sites	Analysis on community feedback available
A4	**End of Action surveys and stakeholder workshops to get feedback from beneficiaries**	
Milestones		**Activity and output indicator**
M1	Survey instruments and methodology developed	Instruments and method used in data collection available
M2	Surveys conducted in three countries	Report on surveys available for 3 countries
M3	data analysed and report completed	Report available for 3 countries
M4	Stakeholder workshops held in PNG	Report on workshop available
M5	Stakeholder workshops held in SI	Report on workshop available
M6	Stakeholder workshop held in Vu	Report on workshop available

4. Technical Reports and other type of publication (popular or technical) produced or planned to produce

- Report on needs assessment analysis – draft report only
- Report on process used in reporting back workshop – draft report only
- Report on final assessment analysis – to be compiled

5. Lessons learnt or any other relevant or notable observations as part of implementation

The approaches used in engaging farmers to prioritize their needs and assessment of their participation were relevant and very useful. This approach should be considered replicating in NARI projects, where appropriate. The M&E plan was also quite useful to ensure appropriate information and their records are generated for M&E of the project activities and results.

6. Other capacity building achievements in the component (organizational, individuals, research capacity etc)

- Capacity building of cadets in data collection and analysis.
- A junior economist applied methodology gained from PGD to collect and analysis data from community participation assessments
- knowledge gained by research team on participatory action research

Attachment. "Assessing the farmers' attitude in participatory research and technology adoption" - Pre-assessment

by Eleo Dowa, ENABLING ENVIRONMENT PROGRAMME, PNG National Agricultural Research Institute

Background Introduction

The PNG National Agricultural Research Institute Europena Union Agriculture Research for Development (NARI EU ARD) project aimed at assisting farmers through agricultural innovative technology intervention on selected sites of Papua New Guinea, Solomon Island and Vanuatu who are experiencing the impact of Climate change related stresses. This study report is an activity under the NARI EU ARD project that aimed towards assessing the attitude of model farmers in relation to (1) the participatory research approach undertaken and (2) the technology adoption using the participatory research approach.

Methodology

Model farmers were interviewed using the structure questionnaire in the participating sites which included Tambul, Kopafo, Hisiu-Yule, Derin, Murukanam (PNG), Aruligho, Hunda-Kena and Buma (SI), Malafau and Siviriand MiddleBush (VU). The questionnaire designed comprised farmer's personal details and information on technology utilised and theLikert scalestatements, whichwere used to capture farmer's attitude

A total of 144 model farmers (66 females)were interviewed following the simple random/ convenience sampling method and the data was entered into SPSS to generate basic descriptive statistics, tables and graphs for the write-up.

Data description

There were 13 strategic planned interventions of which 10 were implemented in the sample data collected area where a total of 144 model farmers were interviewed. Female model farmers made up 66 out of the 144 of the model farmers in total.

Gender * Strategic Intervention * Country of Origin Cross tabulation												
Country of Origin		**Strategic Intervention**										**Total**
		Cassava/Sweet Potato Poultry Feed	**Cassava Var**	**African Yam**	**Village Chicken Management**	**Improved feeding system(silage for**	**Livestock Diversification**	**Improved crop production practice**	**Crop Diversification**	**Integrated livestock farming-duck**	**Post-harvest and processing**	
PNG	Female	4		2	2	1	6			0	3	18
	Male	1		2	1	12	12			7	4	39
	Total	**5**		**4**	**3**	**13**	**18**			**7**	**7**	**57**
SI	Female	5	5	0	4	1	1	0	0			16
	Male	4	3	2	2	0	0	1	1			13
	Total	**9**	**8**	**2**	**6**	**1**	**1**	**1**	**1**			**29**
VU	Female	2		1	12	7					10	32
	Male	2		2	16	6					0	26
	Total	**4**		**3**	**28**	**13**					**10**	**58**
Total	Female	11	5	3	18	9	7	0	0	0	13	66
	Male	7	3	6	19	18	12	1	1	7	4	78
	Total	**18**	**8**	**9**	**37**	**27**	**19**	**1**	**1**	**7**	**17**	**144**

Variables that will be used to assess the farmers involvement in the project includes (1) level of community participation, (2) level of interest, (3) attitude level (knowledge, believe and action). Find below is the descriptive information;

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
COMMUNITY_PARTICIPATION	144	0	15	9.65	4.02
INTEREST_LEVEL	144	0	30	18.55	9.89
KNOWLEDGE	144	0	30	20.55	9.44
BELIEVE	144	0	30	17.81	11.31
ACTION	144	0	30	20.47	8.75
ATT(KNOW,BELIEVE,ACTION)	144	0	90	58.83	25.38

Category Determination

To determine the categories within each variable (low, medium and high), variables that fell between one and 50 percent of the score range received a low rating (50% as first category) while the scores between 50 % plus one to the mean plus one standard deviation falls in the second category (medium category). Any scores that fell above the medium category were included in the third category or High. Table below presents the interpretation

Variable	Highest expected score=A	Mean=B	Std. Deviation=C	50% of A=D	(D+1) to (B+C)=E	Scores above the upper limit=E+1 to A
				First Category (Low)	Second Category (Medium)	Third Category (High)
COMMUNITY_PARTICIPATION	15	9.65	4.02	0 to 8	9 to 14	15
INTEREST_LEVEL	30	18.55	9.89	0 to 15	16 to 28	29-30
KNOWLEDGE	30	20.55	9.44	0 to 15	16 to 30	
BELIEVE	30	17.81	11.31	0 to 15	16 to 29	30
ACTION	30	20.47	8.75	0 to 15	16 to29	30
ATTITUDE_AGRREGATE(K,B&A)	90	58.84	25.38	0 to 45	46 to 84	85-90

2. Findings

From the guide above, data were entered into SPSS and data generated as follows

2.1. Community Participation

COMMUNITY_PARTICIPATION BY COUNTRY				
	LOW	MEDIUM	HIGH	Total
Papua New Guinea	45.6% (26)	24.6% (14)	29.8% (17)	100.0% (57)
Solomon Islands	37.9% (11)	51.7% (15)	10.3% (3)	100.0% (29)
Vanuatu	25.9% (15)	70.7% (41)	3.4% (2)	100.0% (58)

During the initial project phase, community gatherings were done and the community participated together to identify and prioritise issues as well as select farmers who would be involved in the project implementation phase.

Farmers views were gathered on what they thought about the participatory approach of the project. The results showed that more than 50% of model farmers in all countries indicated high level of

agreement (medium + high).With Vanuatu at 74.1%, Solomon Island (62%) and Papua New Guinea (54.4%), all strongly indicated that the process taken to identify issues, prioritise issues and identifying and selecting farmers was very good.

2.2. Interest Level

	INTEREST			
	Low	**Medium**	**High**	**Total**
PNG	8.8%(5)	56.1%(32)	35.1%(20)	100.0%(57)
SI	37.9%(11)	55.2%(16)	6.9%(2)	100.0%(29)
VU	58.6%(34)	34.5%(20)	6.9%(4)	100.0%(58)
Total	34.7%(50)	47.2%(68)	18.1%(26)	100.0%(144)

- PNG Medium to high
- SI Low to Medium
- VU Low to Medium

As per the table, the interest level for PNG model farmers are much higher than that of Solomon Island and Vanuatu with PNG at 91.2% (medium+high), Solomon Island (62.1%) and then followed by Vanuatu at 41.4%. It was also observed that the level of interest generated among the interested farmers was enormous throughout all three countries.

From the comments by interested farmers, it is visible to conclude the project stirred interest within the project sites (An assessment can be done to assess the spread of interest from the project site to neighbouring villages). From the interested farmers comments/question (Ref Apedix 1) , the livestock intervention including the livestock diversification, improving feeding system and village chicken management received a lot of comments or questions as compared to other interventions.

2.3. Attitude

2.3.1. Knowledge

	KNOWLEDGE		
	Low (<= 15.00)	**Medium (16.00 - 30.00)**	**Total**
PNG	5.3%(3)	94.7%	100.0%(57)
SI	3.4%(1)	96.6%	100.0%(29)
VU	50.0%(29)	50.0%	100.0%(58)
Total	22.9%(33)	77.1%(111)	100.0%(144)

The Knowledge of farmers across 3 countries are at low and medium only. PNG and Vanuatu farmers indicated having medium level of knowledge on the use of the technologies offered at 94.7% and 96.6% respectively while Solomon Island had half of its model farmers having medium level of knowledge.

This indicated that

- Training organised to develop the farmers capacity needed continuous rolling out for farmers to fully know how to utilised individual technologies
- Farmers are not confident on how to utilise the technology yet
- The farmers eventhough trained may require a push or fine tuning before training other farmers

There were indications from comments that farmers even though were trained, still needed more training because they were not that confident to train other farmers. On the other hand, there are situations in PNG where farmers have already done extension work to their neighbouring villages like Alkena site in the case of Silage and Murukanam site for African Yam and Taro. Taking off for technology (adoption and spread) may involve a lot of participants and intervention and therefore a

good facilitation of information and knowledge sharing from researchers to farmers and among farmers themselves is very important.

2.3.2. Believe

	BELIEVE			
Country	**Low**	**Medium**	**High**	**Total**
PNG	19.3%(11)	63.2%(36)	17.5%(10)	100.0%(57)
SI	31.0%(9)	62.1%(18)	6.9%(2)	100.0%(29)
VU	51.7%(30)	44.8%(26)	3.4%(2)	100.0%(58)
Tota	34.7%(50)	55.6%(80)	9.7%(14)	100.0%(144)

Farmers indicated their believe on the technology. While some technologies had a high level of believe (Food processing/Value addition in Middle Bush, VU) and Taro (Derin, PNG and Yam/Taro, Cassava/Yam, etc), other site have low level of believe in the technology (e.g. Silage in Kopafo, PNG). PNG and SI indicated medium to high level of believe at 80.7% and 69% respectively while VU indicate 48.2% medium to high level of believe.

2.3.3. Action

	ACTION			
	Low	**Medium**	**High**	**Total**
PNG	5.3%(3)	78.9%(45)	15.8%(9)	100.0%(57)
SI	20.7%(6)	75.9%(22)	3.4%(1)	100.0%(29)
VU	58.6%(34)	39.7%(23)	1.7%(1)	100.0%(58)
Total	29.9%(43)	62.5%(90)	7.6%(11)	100.0%(144)

- PNG medium to high
- SI Low to medium
- VU low to medium

PNG indicated medium to high level of action while the other two counterparts indicated low to medium level of action. This implied that PNG farmers are utilising the knowledge gained from this project more than the SI and the VU farmers

It is very important to note that, even though the interest level of farmers is very high, there are only few who are active in utilising the technology.

4. Conclusion

Solomon Islands and Vanuatu farmers mostly had low to medium level of interest, believe, community participation and action as compared to PNG farmers who mostly had medium to high level in most of the all of the variables under study.

These may occur because of the socio-economic endowments that farmers are exposed to.

All in all, the project had stimulated a lot of interest within the project site and a follow up project to enhance the activities of the current project need greater attention to affect the lives of the farmers who are currently facing climate change related stresses.

5. Appendix

5.1. Interested farmers questions and comments

Strategy	What questions were they asking about your project/technology?
Cassava/Sweet Potato Poultry Feed	What are the benefits of using the concentrate? How can we join the model farmer groups? How did you mix sweet potato and concentrate? How did you join the mode farmer groups? What was the performance of the feed compared to the commercial feed? how did you start? Who funded the project? Are there anything available for interested farmers? We will be lucky like you if we had participated in the project; were also have cassava and we are interested; How did you get into the project? How long had this new technology being practiced by you? Why were you given the project and what about us? How many of your birds died?
Cassava Var	Sharing of ideas to interested farmers and relatives; Where did they brought these cassava varieties; Which one is good for rainy season; Which one is good for feeding pigs? How long would this project be implemented in the community? Did the project achieved some good results? Did the project planned to set up other sites in the Western Province?
African Yam	The other farmers visited and asked of how I did the stalking (Yam house)? Some farmers asked about how I planted the seeds and about the training Some farmers did ask on How we plant the yam? How about the small tuber cutting? Will it yield to its expectation? happy with the project
Village Chicken Management	Others wanted him to share female chickens; how did you become the model farmer? How do you make feed? How do you mix feed? How do you manage your layers? How is it kept? Why is your chicken decreasing (fowl fox)? Those participated in the project are lucky; is it easy to look after the chicken? Where did you get your chicken? How did you get the project?
Improved feeding system(silage for pig,NARIConcerntrate)	How did you look after the pig ,they seem to grow well? How do you prepare silage? How much SP per meal? How do they grow? Do the pigs like your feed? Do they grow fast? How many SP do you feed them per meal? What feed did you feed your pig and how did you do it? How did you get the technology to grow your pigs? Can you train us on how to use the technology? What feeds do you feed pigs? Can you teach us the technology you learnt from NARI? How do you make silage? What are the ingredients? What did you do to feed your pigs that made them grow that big? How do we mix the silage? How long does it take to ferment? How many times a day do you feed? Do you let them scavenge? How did you look after the pigs? What did you feed them? How do I get training? How did you get your materials?
Livestock Diversification	We will be lucky like you if we had participated in the project; were also have cassava and we are interested; sharing of ideas to interested farmers and relatives Where did they brought these cassava varieties; Which one is good for rainy season; Which one is good for feeding pigs? why is your chicken decreasing (fowl fox) How did you get into the project? The use of goat: How will you utilise the goats; How do you look after the goats? Villagers asked to get goats from her How is that female ducks lay eggs without male ducks? , How to feed the ducks? How to get the layer chickens?; Frequency of egg bearing. ; Asked to buy the layers.; What food to feed and how often?; How to help the female to bear eggs? Asked if they would get some chick from them. What food to feed?; Why not let the ducks out of the cage? How can we get involved? who will get the money once you raise the chicken?
Improved crop production practice	can this technology yield the way it was planted (sustained yield)?2.where does those vines/cuttings comes from?3.what type of measurement for the plots?
Crop Diversification	What varieties were they? how long will it take for harvest?
Integrated livestock farming-duck and fish	How do get involve in project? Ducks destroying eggs, how to prevent this; How did you get those ducks and fish? How did you get involved in the project? How did you join the project? How to get materials for fencing? How do you feed and manage fishponds?
Post harvest and processing	How to make flour using cassava? Steps of processing cassava to powder; can it be done with other staples like sweet potato; How do you do cassava flour? how do you bake using cassava flour? steps involved in processing yams; are the steps similar to other food crops like cassava, sweet potato, etc

Annex 6. Result 3 - Final Component Report Soil and Water

Component/ Expected Project Result:	**Soil & Water Component**

1. Achievements for the overall component objectives and results

A summary of component related activities per result category A1 to A4 for the soil and water component is given in this section of the report.

Soil & Water Component		
A1	**Rural Appraisal surveys to assess water accessibility and current water/use management by target communities in PNG, SI and Vu and to identify suitable sites for pilot testing**	
Milestones		**Activity and output indicator**
M1	Survey instruments and methodology developed	Data sheets for data collection, questionnaire and methodology developed
M2	Surveys conducted in three countries	Reports on surveys
M3	Survey data analysed and report completed	Data compiled and analyzed (report available), 1 report written and 3 Master theses completed
A2	**Assessment of current and future impacts of climate change with respect to excess, deficit soil water content and salinity in PNG, SI and Vu and to identify suitable technologies to mitigate adverse impacts**	
Milestones		**Activity and output indicator**
M1	CC scenarios for excess, deficit soil water content and rising sea water level developed	Scenarios for PNG sites developed using MarkSim model, 1 report available 1 SLR study conducted at BUMA (SI) site 1 report available)
M2	Impact of CC scenarios on soil water conditions and salinity analysed and potential impact on crop production determined	Analysis conducted for PNG sites and 1 technical report available (cadetship report)
M3	Meteorological instruments set-up and functional	3 automatic rain gauges set-up in Vu and SI each and instruments handed over to meteorological services of respective country. 3 AWS and 3 automatic rain gauges set-up in PNG. Instruments are NARIs property. Records summarized in 1 report
A3	**Develop and assess water harvesting methods, ground water availability & dynamics, irrigation techniques and management strategies at pilot sites in target communities in drought vulnerable parts of PNG, SI & Vu**	
Milestones		**Activity and output indicator**
M1	Water management technologies for domestic water use developed on-station for further site assessment	Biosand filter prototype developed and tested with mobile water test kit in combination with SODIS at NARI-HRC Aiyura. Results compiled and 1 report available.
M2	Suitable agricultural water management technologies identified	Irrigation surveys conducted at selected sites in PNG, SI and Vu, results compiled and report available. 4 suitable irrigation options (drip kits) tested and evaluated at NARI-HRC Aiyura
M3	Implementation of agricultural water management pilot site activities completed	3 RWH systems installed in Vu 1 RWH system installed in SI 1 RWG system installed in PNG Irrigation drip kit distributed and training conducted at each site Training on irrigation management scheduling facilitated for project staff from PNG, Vu and SI
M4	Implementation of domestic water	2 Trainings on water use and hygiene conducted

	management pilot site activities completed	5 RWH systems and 1 shallow hand-dug well installed (PNG) 10 biosand filter constructed and installed at 2 PNG sites + 2 follow-up trainings
A4	**Develop and assess soil water and soil management technologies under excess, deficit soil water and saline conditions at benchmark sites in target communities of PNG, SI & Vu**	
Milestones		**Activity and output indicator**
M1	Soil and soil water management technologies for soil water deficit and soil erosion scenarios developed and evaluated on-station for further site assessment	Soil surveys conducted for selected site and soil samples collected and chemical and physical parameters analysed Results analysed and 1 report available. Soil conservation demonstration plot designed, constructed and tested at NARI-HRC Aiyura 1 plot constructed at one PNG site and 2 plots constructed at 2 SI sites. Trainings conducted on site Data collected and 1 report compiled
M2	Water dynamics of sweet potato mound system and impact of excess rainfall evaluated on-station	18 Soil water monitoring sensors, 8 soil temperature and data logger purchased Sensors calibrated Soil water monitoring station set-up at NARI-HRC Aiyura Preliminary results (poster) presented at ISRR conference in Canberra (AUS)
M3	Impact of salt water intrusion on soil conditions monitored and evaluated and strategies to cope with saline soil conditions due to rising sea water level identified	6 soil water and salinity monitoring sensors and data logger purchased Salinity monitoring station set-up at Buma site SI
M4	Implementation of pilot site activities on soil and soil water management technologies for soil water deficit scenarios completed	4 different irrigation drip kits assembled and tested at NAR-HRC Aiyura Drip kits distributed to selected communities in PNG, SI and Vu Training for project staff conducted Trainings for farmers at each site facilitated

Additional information for Activity 3

Milestone 3:

Initially World Vision was selected as a partner to support the project and Vanuatu project partner DARD in all water related activities. After a decision was made by WV Vanuatu not to collaborate in this project, ADRA (Adventist Development and Relief Agency) was able to assist DARD to implement water related project activities at the Tanna site Middle Bush and in Malafau. ADRA assisted DARD in planning and construction of the RWH tank systems for irrigation activities and vegetable production in Malafau and Middlebush. ADRA constructed a full fletched water supply system (pump and gravity fed) including toilets at the project site Middlebush and organizes PHAST sessions and trainings on proper hygiene. In addition to ADRAs water supply system in Middle Bush, two RWH ferro-cement tank systems were constructed for the purpose of irrigation demonstration and vegetable farming. ADRA did the construction of the tank systems. The two sites which were selected at Middlebush, NAPIL and NASITUAN training centers were selected to guarantee the sustainability of this activity and one site at Malafau.

Milestone 4:

Derin pilot site was one of the site that chose domestic water management as one of the priorities. As an associated partner, World Vision Madang was entrusted to facilitate a three day planning and awareness workshop to identify a suitable water supply system and to improve knowledge and practice of good hygiene and water use. This workshop was held using adapted versions of CLTS (Community led total sanitation) and PHAST (Participatory, Hygiene and Sanitary Transformation) methodologies and concepts. Major events of this planning and awareness session were:

- Transect walk, encircled the meeting area to identify open defecation (CLTS).

- Drawing of a village map and located their households with and without toilets (CLTS).
- Demonstration of flies' as a medium of feces (germs) transmission and explain other modes of transmission (CLTS).
- Conduct group discussions and involve farmers to realize the importance of hygiene, proper water management and health themselves (CLTS).
- Tippy Tap demonstrated as a hand washing technique as well as other technology like BSF and Solar Disinfection (WADI device).
- Identified possible site for the establishment of roofing iron water harvesting and hand dug well. Allocated task to the community as well as ours for implementation (PHAST).
- Water committee established (PHAST).

In total a number of 55 community members participated during the 3 days workshop. About 15% were female. Unfortunately most women were just in an observing position, which is critical due to the fact that in most communities women are responsible for water and hygiene matters. Refresher trainings tried to cater for this problem and mainly focused on female participation.
Suitable sites were identified by the community members to establish 5 roof water harvesting systems and 1 hand dug well. A potential site for the well was already identified during exploration drilling exercises early 2013. In accordance with the locations of the water harvesting schemes and the well, members of a water committee were identified by the participants. Agreement was reached that iron roofs, cement, gutter and tanks were provided by the project and the other inputs for building and structures for the RWH schemes were sourced by the community. Labor input was provided by the community to install the hand dug well and the RWH systems. 5 RWH schemes were successfully installed in June 2014 and are available to the community. An official handing-over ceremony of the 5 RWH systems to the communities was be held. The water committee members met three times since their appointment.

At Kopafo pilot site the priority was on management of water sources for domestic and agricultural use. An irrigation survey was conducted to establish baseline on water use for agricultural production and a general soil and water survey was conducted by a BOKU Master student. Model farmers were identified and suitable irrigation technologies identified. Work on development of water source and establishment of storage systems for irrigation activities had to be delayed until dry season. The impact of El Nino and the resulting extended drought in 2015 made all involved farmers realize the importance of irrigation for crop production and management of their seedlings. Another graduate student of BOKU was identified to implemented research work on irrigation and comparative analysis of low tech micro irrigation schemes, including commercially available drip kits, and systems made of locally available material such as PVC pipes, bamboo and garden hose. The student commenced work early June 2014, however due to a collapse of a main bridge, which did not allow any travels to the study site, work could not be completed as planned. Instead the testing of different low-tech irrigation systems was done at NARI-HRC Aiyura station under supervision of the soil and water component leader. Later on a detailed planning and design of the irrigation system was done in close collaboration with the selected model farmers according to irrigated crops, locality and available water source. Due to the ongoing tribal fight only one out of three planned storage and irrigation systems was established and is now available to the selected model farmers. Material was delivered and farmers were trained to construct and maintain the system themselves.

Additional information for Activity 4

Milestone 3:

Buma was the only pilot site in the project where salt water intrusion appeared to be a current or emerging issue for agricultural production. Soil samples were collected and a mobile soil test kit used to measure potential salt content in different soil depth. It was decided to install a soil salinity monitoring station to monitor and analyse long-term effects of salt water inundation and king tides on soil properties and potentially agricultural land. Specialized equipment to monitor soil salinity status and soil water content at Buma was delivered early 2014 but could only be installed later in 2015 due

to initial problems with sensor calibration. This is a long-term monitoring station and MAL has taken ownership to continue this work and collect data and do the monitoring after the end of the project.

Milestone 4:
At Hisiu, Yule Island, Murukanam, Tambul activities comprised of collecting soil samples to assess the soil fertility status of these sites. The samples were sent to Kila Kila laboratory for further analysis and results complied in a technical report. After processing of the results suitable technologies for soil fertility management and cropping strategies for respective soils and sites were identified and farmer trainings organized. This varied from site to site, e.g. for Hisiu site and it was agreed to integrate the activities of the soil and water component into the vegetable evaluation and irrigation trials conducted by the crop component at Hisiu. Whereas on Yule Island, a farmer training was conducted and demonstration plots on mulching, composting, planting of leguminous hedge rows using *Glyricidia sepium*, *Mucuna* spp. and planting other legumes crops and plants established.

2. Modifications in implementation plans at pilot sites for this component and overall component plan and reasons for modifications

- Inclusion of soil topic in water component
- Soil fertility demo at Murukanam cancelled due to shortage of staff
- Development of 2 (out of three) sites cancelled due to ongoing tribal fight
- Irrigation work included at Aruligho site
- O3 Buma/SI Impact of salt water inundation on soil properties analysed and farmers capacity to deal with potential adverse impacts enhanced was replaced by installation of soil water and salinity monitoring station and assessment study of sea water level rise on land use and awareness session.

3. Technical Reports and other type of publication

A number of different publications were produced during the project implementation phase. The publications were published through a number of different media outlets and mainly served the visibility activities of the project. One scientific poster was presented at scientific conference ISRR in Canberra, Australia. Two publications in scientific journals and two technical reports are still planned.

Source	Reference and title
BOKU News article	Ruffeis (2012) *Know-how der BOKU gegen Hunger in Melanesien*, BOKU News 1/2012.
Articles in NARI Nuis	Ruffeis (2015) *Biosand filter provides safe drinking water for Derin during drought*, NARI Nuis, Vol 18, Issue 4, p.4
Project newsletter articles	Various articles published in project newsletter
Articles on website and webblog	Various articles published on project web blog
Thematic poster presentations at 3 different PNG agricultural and cultural shows	Various posters on climate change, soil conservation, irrigation and biosand filter presented at Goroka Show, Morobe Show, NARI Innovation day, Obura Wonenara Agricultural Show
Scientific poster presentation at IRSS conference in Canberra, AUS	Ruffeis D, Kui T, Loiskandl W (2015) *Water balance of sweet potato mounds in Papua New Guinea – The potential impact of climate change on sweet potato development and food security*, [9th International Symposium of ISRR "ROOTS DOWN UNDER", Canberra, AUSTRALIA, OCT 6-9, 2015] In: ISRR (Eds.), ISRR9-Poster Abstracts, www.isrr9.com.au
Cadetship project report	Kui T (2015) *Soil Moisture Retention Curves for selected soils under different Climatic Scenario and their relationship to selected crops in Papua New Guinea*, NARI cadetship report.
Three BOKU Master Theses	Knabl B (2013) *Rural Water Management in Papua New Guinea – Expectations towards Implementing Bodies*, Master thesis,

	University of Vienna.
	Ulreich A (2013) *Evaluation of the soil and water conditions of smallholder communities in Papua New Guinea*, Master Thesis, BOKU University, Vienna.
	Schabschneider H (2014) *Evaluation of the agricultural Conditions in three ungauged watersheds in Vanuatu*, Master Thesis, BOKU University, Vienna.

4. Lessons learnt and relevant or notable observations as part of implementation

Key to successful implementation onsite is a reliable contact person, who has a good standing within a community and is a well respected person. Another important aspect is to work with motivated model farmers and carefully select innovative lead farmers. While this is often not a decision a project team can and should make, a close collaboration with the community is necessary to identify suitable persons during the project initiation and implementation phase. This however might lead to issues within the community, when too much attention is given to single farmers.
Though the technologies implemented as part of interventions have being proven to be successful on-station, these were at times difficult to prove on-farm due to different perceptions of farmers or miss communication. Clear communication of the main objectives has proven to be of major importance for a successful intervention. In some cases the failure of the project team to clearly explain the purpose and goals of the project has lead to misunderstanding and miss interpretation of the planned activities. Therefore constant and unambiguous communication with the community is of highest essence for the success of project activities.

Constant evaluation of dissemination approaches; feedbacks from technology dissemination procedures and studies on technology adoption are invaluable for refining dissemination approaches and success in technology transfer and are areas that can be explored by social researchers. Collaborative efforts between research and extension bodies are vital for widespread and effective dissemination of agricultural technologies and strengthening research and extension linkages which is currently a constraint in the project and project sites.

5. Other capacity building achievements in the component (organizational, individuals, research capacity etc)

Especially in the fields of water and agriculture, capacity of involved staff was lacking. Therefore it was necessary to train involved persons first before actual field level implementation was possible, which also caused some delays in implementation of certain activities. Capacity building in Vanuatu (DARD) and Solomon Islands (MAL) turned out to be especially challenging, due to the bigger distance and the involved travelling. In PNG and the involved cadets and technical officers were trained on a regular basis on the job over a period of three years, which greatly improved their capacity in soil and water related topics. The cadet will remain with NARI and therefore will be able to use his new knowledge and skills to develop research work in respective climate, soil and water topics and broaden the NARIs research scope.
Since capacity building was not specifically part of the project output, it was difficult to implement extra capacity building activities. For future projects and depending on the scope and thematic focus a capacity building component is highly recommended.

List of capacity building activities:

1. Water and soil research related capacity building for DARD in Vanuatu and MAL in Solomon Islands:

- Irrigation and irrigation scheduling
- Soil sampling
- Soil fertility management
- Plant health
- Soil conservation and erosion
- M & E

2. NARI Cadet and technical field officer

- Project management (Planning, implementation, M&E, Reporting)
- Participatory and community led research
- Oral and poster presentation
- Development of research methodologies
- Data collection and management
- Soil & water dynamics (Soil physics)
- Soil fertility, Soil conservation and erosion
- Irrigation and irrigation scheduling
- Water source development
- Water purification, Water sampling, quality and testing
- Meteorology and climate data management
- Computer modelling & simulation

Annex 7: List of learning events conducted in pilot sites in PNG, Vanuatu and Solomon Islands

	Output	Technology/innovations demonstrations and trainings
C	Greater diversity of crops species and varieties maintained by selected farmers in pilot site communities (cassava, sweetpotato, yam, rice, breadfruit, wheat, corn, taro,)	Yam: introduction of African Yam (*Dioscorea rotundata*)
		Cassava: PNG • 9 cassava varieties (high yielding, low cyanide content – lowland environments) • 9 cassava varieties (high yielding, low cyanide – highland environments Solomon Islands: • 6 cassava varieties (high yielding) • Participatory evaluation of cassava varieties and selection of best performing varieties
		Sweetpotato: PNG and Solomon Islands: • 8 early maturing, excess moisture tolerant varieties • 8 early maturing, drought tolerant varieties • 8 PT varieties (Highland environment) • Field day and participatory assessment of varieties
		Taro: 34 high yielding, taro leaf blight resistant varieties Field day and participatory assessment of varieties
		Vegetables: • 4 varieties of cabbages • 6 varieties of capsicum • 7 varieties of tomatoes, eggplants • Participatory evaluation of different vegetable varieties
		Rice: 2 upland rice varieties
		Potato: 4 potato late blight resistant varieties
		Wheat: 2 recommended wheat varieties
C	Capacity for growing crops (sweetpotato, cassava, yam, vegetables, rice) using locally appropriate production practices improved in pilot site communities	**Yam:** • Training on the yam mini-setting and nursery practices conducted • Yam production technology demonstration trials (staking options, density options)
		Sweetpotato: • Planting technique of 1 tip/mound • Planting technique of horizontal planting vs 45deg angle • Use of Pathogen-tested planting materials

		• Participatory evaluation of practices
		Cassava: • Plant technique – 1 cutting per mound in horizontal orientation
		Rice: • Training of interested farmers on the paddy field development and nursery practices conducted • Demonstration trial plot comparing different varieties and cultivation practices established • Pest and disease control training and demonstrations conducted • Participatory evaluation of rice varieties and appropriate cultivation practices and selection of best performing varieties and practices based on farmer assessment • Training and demonstration on harvesting, drying and processing practices successfully conducted • Milling and milling machine maintenance
		Vegetables: • Training on Soil sterilization • Vegetable seed sowing from nursery to transplanting • Compost making • How to make and apply Plant Derived Pesticides • Crop husbandry practices: building raised beds, transplanting, pruning, staking, fertilizer application, pesticide application, mulching, irrigation • Seed saving techniques
	Increased capacity of interested farmers in pilot site communities for processing sweet potato and cassava into other food products	• Training needs assessment • Training on processing of cassava, sweetpotato, banana into dried chips, flour • Training on use of staple crop flour into secondary products (buns, pops, dry mumu, cakes etc)
L	Increased capacity of interested farmers in pilot site communities for using improved chicken feeding and management practices	• Improved poultry (chicken) management practice (chick quality management, feeding, housing, health and disease, general welfare, selection and breeding • On-site practical training on feed formulation for layer/meat birds, including mixing & pelleting of formulated diets
	Increased capacity of interested farmers in pilot site communities for using improved pig feeding and management practices	• SP silage and concentrate technologies training • Pig management (housing, feeding, healthcare, breeding, general welfare) training • Comparative feeding trials
	Livestock holdings of interested farmers in pilot site communities diversified and capacity for livestock management improved :	**Ducks:** • Improved poultry (duck) management practice (housing, feeding, healthcare) • Fish-Duck Integration training (Housing, Feeding, Breeding and Reproduction, fish and duck keeping and general welfare) and demonstration) **Goats:** • Goat management training (feeding, breeding and reproduction, healthcare, general welfare) • Model farm demonstrations • Goat – coconut integration (training and demonstrations)

SW	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.	• Reporting back workshops on soil nutrient analysis and status • Demonstration plots on mulching, composting, planting of leguminous hedge rows using *Glyricidia sepium*, *Mucuna* spp. and planting other legumes crops and plants
	Increased capacity to practice sustainable soil management to address soil erosion, water deficit and fertility in pilot site communities	• How to build a Rope & Washer Pump • How to install and use a Drip Irrigation System in vegetable plots • Demonstrations plot for erosion control using vetiver and pineapple hedgerows • Training on soil management (Linkages between soil erosion, soil fertility loss and problems with soil water deficit affecting crop development in the early stages) • Improved fallow training and demonstration trials
	Capacity for improved management and use of available water sources for domestic and agricultural use increased in pilot site communities	• CLTS (Community led total sanitation) assessment • Hygiene awareness and planning workshop (PHAST) • Construction of rain water harvesting and shallow hand dug well including water management training • Training on water purification and construction and use of Biosand filter and SODIS • Training on water purification and construction and use of BSF and SODIS - Follow-up and in depth training at Aiyura for selected farmers from participating communities

Annex 8a. Overview of number of community members participating in learning events and number of model farmers in the major components of soil/water, crop and livestock interventions in PNG pilot sites

	PNG Sites	Kopafo		Derin		Tambul		Murukanam		Hisiu/Yule Is	
	Outputs.	**Farmers Trained**	**Model Farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**
S W	Community has an improved capacity to manage available water sources for domestic and agricultural uses.	14 (10/4)[11]	10	68 (53/15)	6						
S W	Increased capacity by participating farmers to use improved soil management practices addressing constraints of soil erosion, water deficit and fertility.	61 (31/30)	5			38 (16/22)					
S W	Farmers have knowledge and skills on most pertinent soil fertility constraints and their causes to address limitations on crop production.							14 (10/4)		16 (13/3)	3
C	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in communities	78 (65/13)	6					29 (22/7)	3	43 (24/19)	5
C	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in communities.	25 (11/14)	3					15 (12/3)	3	25 (17/8)	4
C	Farmer-preferred excess moisture or drought tolerant sweet potato varieties identified and available communities	27 (17/10)	8	18 (n/a,n/a)	3	85 (n/a, n/a)	6	32 (17/15)	4		6
C	Farmer preferred Taro varieties identified and available to the Derin community			34 (n/a, n/a)	5			27 (17/10)	5		
C	Increased capacity of interested farmers for processing sweet potato and cassava into other food products	35 (20/15)	7								
C	Capacity for growing potatoes using improved locally acceptable production practices and PLB resistant varieties					22 (22/0)	8				

[11] Total number of farmers (male/female)

	PNG Sites	Kopafo		Derin		Tambul		Murukanam		Hisiu/Yule Is	
	Outputs.	**Farmers Trained**	**Model Farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**
C	Farmer-preferred cold tolerant maize varieties identified and made available					40 (na, na)	6				
C	Capacity for growing wheat using improved locally acceptable production practices					20 (16/4)	5				
C	Capacity for growing vegetables (tomato, capsicum and beans) using improved locally acceptable production practices and locally performing varieties increased in communities									20 (11/9)	5
C	Capacity for growing rice using locally appropriate production practices and varieties developed in communities									35 (23/12)	3
L	Increased capacity of interested farmers for using improved pig feeding and management practices	32 (21/11)	4	54 (50/4)	10	163 (94/69)	23			42 (36/6)	3
L	Increased capacity of interested farmers in communities for using improved goat feeding and management	19 (12/7)	3							29 (29/0)	3
L	Increased capacity for using improved chicken feeding and management practices based on SP (or cassava) as feed	26 (17/9)	7			56 (41/15)	23			41 (24/17)	5
L	Livestock holdings of interested farmers in selected communities diversified and capacity for livestock management improved: duck fish integration systems			2 (2/0)	2	34 (32/2)	22	7 (5/2)	7	56 (46/10)	3
L	Improved capacity for using integrated goat - coconut system by selected farmers							6 (4/2)	1		

Annex 8b. Overview of number of community members participating in learning events and number of model farmers in the major components of soil/water, crop and livestock interventions in Solomon Islands and Vanuatu

		Aruligho		Hunda/Kena		Buma		Siviri		Malafau		Middlebush	
	Outputs.	**Farmers Trained**	**Model Farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**
S W	Community has an improved capacity to manage available water sources for domestic and agricultural uses.											23 (15/8)	2
S W	Increased capacity by participating farmers to use improved soil management practices addressing constraints of soil erosion, water deficit and fertility.	19 (16/3)	3	26 (13/13)	1	25 (18/7)	3	11 (7/4)	1				
S W	Impact of salt water inundation on soil properties analyzed and farmers' capacity to deal with potential adverse impacts enhanced.					84 (44/40)	n/a						
C	Capacity for growing yam using improved locally acceptable production practices and farmer-selected varieties increased in communities	28 (22/6)	3	22 (15/7)	2	19 (5/14)	3	5 (3/2)	2	7 (5/2)	2	10 (7/3)	1
C	Capacity for growing cassava using improved locally acceptable production practices and farmer-selected varieties increased in communities.	27 (21/6)	3	22 (12/10)	2	35 (9/26)	3	2 (2/0)	2	13 (9/4)	3	16 (11/5)	1
C	Farmer-preferred excess moisture or drought tolerant sweet potato varieties identified and available communities	32 (25/7)	4	17 (10/7)	2	21 (4/17)	4	32 (25/7)	2		1	29 (17/12)	2
C	Increased capacity of interested farmers for processing sweet potato and cassava into other food products											57 (9/48)	17
C	Capacity for growing vegetables (tomato, capsicum and beans) using improved locally acceptable production practices and locally performing varieties increased in communities									18 (6/12)	3	37 (13/24)	4
C	Capacity for growing rice using locally appropriate production practices and varieties developed in communities											37 (24/13)	2

		Aruligho		Hunda/Kena		Buma		Siviri		Malafau		Middlebush	
	Outputs.	**Farmers Trained**	**Model Farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**	**Farmers trained**	**Model farmers**
L	Increased capacity of interested farmers for using improved pig feeding and management practices	44 (34/10)	28	17 (10/7)	12	79 (44/35)	18	34 (28/6)	18	3 (2/1)	3	48 (33/15)	20
L	Increased capacity for using improved chicken feeding and management practices based on SP (or cassava) as feed	56 (43/13)	28	18 (12/6)		96 (61/35)		28 (21/7)	16	47 (38/9)	16	36 (22/14)	19
L	Increased capacity of interested farmers in communities for using improved goat feeding and management	23 (18/5)	n/a	18 (13/5)	2	19 (12/7)	7						
L	Livestock holdings of interested farmers in selected communities diversified and capacity for livestock management improved: duck or bee management	Duck 23 (18/5)	n/a	Ducks 18 (13/5)	6	Bees 15	1 demo						

Annex 9. Result 4 – Final Component report Crop Improvement and Diversification

Component/ Expected Project Result:	**Annex 9. Crop Improvement and Diversification Component**

1. Achievements for the overall component objectives

A summary of component related activities per result category A1 to A4 and A6 for the sweetpotato component is given in this section of the report.

Crop Diversification-SWEETPOTATO		
A1	**Source alternative sweet potato varieties, crops and crop varieties from national and international collections which are tolerant to precipitation excesses or deficits or saline soil conditions**	
MILESTONE		Activity and Output Indicator
M1	Collection of SP varieties and accessions sourced from different national and international collections assembled at Bubia	Sweetpotato 102, CePaCT 14
M2	Other crops and crops varieties from national and international collections sourced and assembled at Bubia	98 wheat, 19 CIMMYT + 3 local Maize, 16 NERICA rice, 10 cassava, 3 yam, 2 Irish potatoes, 7 tomatoes, 6 capsicum, 4 cabbages, 7 egg plants
M3	On-Station screening and selection on good storageroot yield of climate ready SP varieties introduced from CePaCT-SPC	Sweetpotato 102, CePaCT 14
M4	Collection of SP and other crop varieties available for pilot site testing assembled in SI	8 cassava, 10 sweet potatoes, 1 yam
M5	Collection of SP and other crop varieties available for pilot site testing assembled in Vu	2 rice varieties, 12 cassava, 2 yam
A2	**Screening of indigenous germplasm, locally bred and imported varieties of sweet potato and other crops/crop varieties under simulated conditions (in vivo and in vitro) to assess tolerance to drought, moisture excess and salinity condition , and to identify promising varieties**	
MILESTONE		**Activity and Output Indicator**
M1	Tissue culture lab at Bubia operational	TC lab fully operational
M2	Tissue culture lab at SI rehabilitated	Fully rehabilitated but not operational
M3	All SP accessions initiated and maintained in TC (Germplasm collections, collections from CePaCT, popular farmer varieties)	Germplasm maintained in TC at Bubia
M4	Protocols for *in vitro* screening of SP for drought and salinity standardized	Protocols developed and report available
M5	Best-bet SP accessions for tolerance to drought and excess moisture identified for *in vivo* testing	22 varieties tested (4 promising accessions for drought and 3 for excess moisture tolerance identified); published in scientific journal
M6	Best-bet SP accessions for tolerance to salinity identified for in vivo testing	22 Varieties tested and promising accessions for salinity tolerance identified
M7	Phenology grouping of PNG SP accessions established	Phenology grouping identified and draft report available
M8	Protocols for screening of SP accessions for drought, excess moisture and salinity established	Protocols developed and tested and report available
M9	Best bet SP accessions with tolerance to soil moisture deficit identified for validation at pilot sites	7 accessions for PNG lowlands, 10 accessions for PNG highlands
M10	Best bet SP accessions with tolerance to soil moisture excess identified for validation at pilot sites	7 accessions for PNG lowlands, 10 accessions for PNG highlands

M11	Best bet SP accessions with tolerance to soil salinity identified for validation at pilot sites	Soil salinity was not identified as a problem for PNG sites
M12	PT popular farmer varieties available for re-distribution	Established on-station for cleaning
M13	Rainout shelter constructed at Bubia	completed
A3	**Validation and piloting of sweet potato adaptability to different stresses at pilot sites and introduction of other crops and crop varieties in target communities in PNG, SI and Vu**	
MILESTONE		**Activity and Output Indicator**
M1	Implementation of pilot site activities completed	See Annex 3 and 7 Sweetpotato trials in all project sites; yam and cassava variety evaluations at 9/11 pilot sites; taro variety evaluations at 2 sites; potato variety evaluations at 1 site; introduction of rice, vegetables at 2 sites each
A4	**Piloting of selected improved cultivation practices for priority staple crops in target communities in PNG, SI, Vu according to expressed needs**	
MILESTONE		**Activity and Output Indicator**
M1	Implementation of pilot site activities completed	See Annex 3 and 7 Yam, cassava, sweetpotato practices; rice and vegetable production practices introduced
A5	**Piloting of processing options of sweetpotato and cassava for food, storage**	**Activity and Output Indicator**
M1	Implementation of pilot site activities completed	Processing of sweetpotato, cassava and yam to flour and products from flour introduced to 2 sites
A6	**Assessment of existing mechanisms for provision of quality seed to farming communities in PNG, SI, Vu and recommendations for improvement**	
MILESTONE		**Activity and Output Indicator**
M1	Desktop review of seed supply systems in PNG, SI, Vu	Not implemented
M2	Stakeholder workshop on seed supply systems held in PNG	
M3	Stakeholder workshop on seed supply systems held in SI	
M4	Stakeholder workshop on seed supply systems held in Vu	
M5	Policy brief submitted to relevant Government bodies in PNG, SI, Vu	

Additional information on Activity 2:

Milestone 2:

The Tissue culture laboratory in SI was rehabilitated and completed but due to lack of reliable clean water and back up generator the laboratory is not used for tissue culture. This is a matter for MAL to resolve as there were not sufficient funds to address this issue budgeted in the project.

Additional information on Activity 3:

Activities for Hisiu and Yule Island were dependent on identification of appropriate sweetpotato varieties for soil moisture deficit for the lowlands sites from the results of the Bubia on-station screening work. The sweetpotato germplasm assembled at Bubia was subjected to a screening and grouping for time to maturity or phenology grouping work. The early maturing group of varieties was subjected screening for tolerance to soil moisture stress. The sweetpotato varieties were also subjected to Enzyme-linked Immunosorbent Assay (ELISA) screening for known viruses after which the varieties free of known viruses were multiplied at and Bubia and transported to the site for the planting in the on-farm demonstration plots at selected sites in Hisiu and Yule Island. At harvest planting material from the demonstration plots were distributed

Hunda/Kena: Activities on crop diversification were completed. However, there was no further distribution of the planting material due to inconclusive results from the on-farm trial owing to use of planting material from the field and may have high loads of viruses impacting on yield. Beside, the farming system on Hunda/Kena which is mainly under approximately 50% shade also influences the yield of sweetpotato

2. Modifications in implementation plans at sites for this component and overall component plan and reasons for modifications

- Time to maturity grouping of sweetpotato germplasm in Papua New Guinea added as an activity:
    - There are three major physiological growth phases in sweetpotato and they at the both above ground and below ground establishment, the storage root initiation and the bulking phases. This development phases are critical under stress condition. Sweetpotato cultivars at short maturity duration synchronies establishment phase with late maturity varieties while the initiation and bulking are delayed in late maturity varieties.
- Use of sweetpotato planting material free of known viruses in PNG and use of root sprouts in SI and Vu.
    - The tissue culture laboratory in the Solomon Islands was not operational to cater for the use of tissue culture planting material in the on-farm trials. Vanuatu did not opt to receive the infrastructure. The next best option was the use of root sprouts for the on-farm demonstration plots.

- The introduction and demonstrations of tissue cultured crops germplasm imported from SPC such as anthracnose resistant yam (*D. alata*), cassava and other were not mass multiplied as expected thus was not taken to the fields at Murukanam in PNG and Aruligho in Solomon Islands and the planned milestones were cancelled.
- The on-station bread fruit propagation experiment at NARI –Laloki for the Hisiu site was cancelled because of staff turnover and negligence thus it also affected the Siviri site output for bread fruit propagation.
- The vegetable evaluation work incorporated the irrigation systems and technologies.
- The NERICA Rice variety evaluation on station at Laloki was as an output in the Hisiu/Yule Island pilot site activity.

3. Technical Reports and other type of publication

The majority of the publications are trip reports, news letters, posters and the news paper in all PNG, SI and Vu. One scientific poster was presented at scientific conference ISRR in Canberra, Australia. Two publications in scientific journals and two technical reports are still planned.

Source	Reference and title
Newspaper article in PNG (The National), one newspaper article each in SI and Vu	Potential of NERICA rice in PNG (by Chesly Kobua & Peter Gendua)
Articles in NARI Nuis	African yam technology trialed at Murukanam
Poster presentations at Morobe Show, NARI Innovations shows	1. African yam production technology Evaluation of Promising NERICA Rice in under Upland (rain fed) and Lowland (irrigated) Environment condition in PNG (Laloki)
Survey Report	Wilfred Wau (2013) *Sweetpotato Diseases Survey.*
	Food crop production baseline survey report – Hisiu Pilot site (By Peter Gendua)
Cadetship project report	DISEASE MANAGEMENT *Papua New Guinea*, NARI cadetship report.

	Chesly Kobua (2016), Evaluation of Promising NERICA rice Lines under irrigated and upland Environmental Condition of PNG. NARI cadetship report

5. Lessons learnt and relevant or notable observations as part of implementation

There was little knowledge on past and current activities at the pilot project site selection. There were other organizations implementing similar innovations for example increase diversity of staple food crops for food security. Availability of this information would inform on introduction of unique and appropriate improved technologies.
Project design needs to incorporate necessary flexibility to enable the project team to change the implementation strategy or approaches, e.g. the sweetpotato component was meant to use hybrid lines for adaption to the stress environs. The change to use of sweetpotato PT material allowed for the use of chain actions that lack capacity to ensure timely implementation of activities to ensure facilitation of the next action.

Key to successful implementation onsite is a reliable contact person, who has a good standing within a community and is a well respected person and this person should lead by example. Another important aspect is to work with motivated model farmers and carefully select innovative lead farmers. While this is often not a decision a project team can and should make, a close collaboration with the community is necessary to identify suitable persons during the project initiation and implementation phase. This however might lead to issues within the community, when too much attention is given to single farmers. Clear communication of the main objectives has proven to be of major importance for a successful intervention. In some cases the failure of the project team to clearly explain the purpose and goals of the project has lead to misunderstanding and miss interpretation of the planned activities. Therefore constant and unambiguous communication with the community is of highest essence for the success of project activities.

Constant evaluation of dissemination approaches; feedbacks from technology dissemination procedures and studies on technology adoption are invaluable for refining dissemination approaches and success in technology transfer and are areas that can be explored by social researchers. Collaborative efforts between research and extension bodies are vital for widespread and effective dissemination of agricultural technologies and strengthening research and extension linkages which is currently a constraint in the project and project sites. The concept of farmer (model farmers) taking lead and ownership in identifying the constraints and opportunities and implementing the interventions and assessing and identifying the best varieties, technologies and innovation through the participatory approach was a very good concept and future project should follow these participatory approach and concept.

5. Other capacity building achievements in the component (organizational, individuals, research capacity etc)

The recruitment and engagement of cadets to work on the project was a very good concept where the cadets gain valuable experience and will remain with NARI and therefore will be able to use his new knowledge and skills to develop research work in respective climate and food security topics and sustain NARIs research and development agenda. Since capacity building was not specifically part of the project output, it was difficult to implement extra capacity building activities. For future projects and depending on the scope and thematic focus a capacity building component is highly recommended.

Annex 10. Result 5 – Final Component report Livestock diversification and Management

Component/ Expected Project Result:	**Livestock Component** Result: Livestock and fish production diversification options resilient precipitation deficits and/or deficits or soil salinity, and reliant on cost-effective locally produced feed/forages available to smallholder communities in PNG, Solomon Islands and Vanuatu

1. Achievements for the overall Component objectives and Results

Result 5: Livestock and fish production diversification options resilient precipitation deficits and/or deficits or soil salinity, and reliant on cost-effective locally produced feed/forages available to smallholder communities in PNG, SI and Vu		
N°	Expected Result/ Activity/ Milestone	Activity/ Output indicators
A1	**Assessing the potential for improving farm productivity through diversifying livestock assets and improved cyclical use of crop and livestock inputs in situations where excess rainfall, moisture deficit or soil salinity conditions are problematic**	
M1	Preferred options for diversification and integrated use of resources are identified	List of identified options for diversification and integration and reported in technical reports for identified sites
M2	Appropriate demonstration trials implemented by nominated model farmers	Annex 3 and 7 Introduction of ducks and goats
M3	Participatory technology assessment workshops held in all sites	Conducted at the end of implementation cycle
A2	**Sourcing and identifying forages tolerant of excess moisture and saline soil conditions, e.g. grasses, legumes and multipurpose shrubs such as Mulberry**	
M1	The need and type of forages identified	• List of identified forage species -ie. Mulberry. Others include gliricidia & leucena including *Brachiaria decumbens*, para, setaria and signal grasses introduced to Hisiu/Yule sites
M2	Implementation of pilot site forage development and assessment activities completed	Not implemented due to changed priorities at pilot sites
A3	**Pilot test diversified livestock feeding systems and husbandry practices in smallholder communities in target communities in PNG, SI and Vu**	
M1	Implementation of pilot site improved feeding and management demonstration activities completed	Annex 3 and 7 Chicken and pig feeding systems based on sweetpotato and cassava
M2	Implementation of preferred livestock integration activities completed	Annex 3 and 7 Fish-duck integration, goat-coconut integration,
M3	Participatory technology assessment workshops held in all sites	• Reports of workshops available •
A4	**Assessing existing mechanisms for supplying breeding stock in PNG, SI, and Vu and demonstrating institutional or community-based breeding facilities**	
M1	Selected breeding stock of livestock supplied to model farmers and established	• List & numbers of relevant stocks distributed to preferred sites available in appropriate technical & mission reports
M2	Desktop review of breeding stock supply systems in PNG, SI, Vu	• Review completed and disseminated to relevant stakeholders
M3	Stakeholder workshop on breeding stock supply systems held in PNG	Not implemented

M4	Stakeholder workshop on breeding stock supply systems held in SI	Not implemented
M5	Stakeholder workshop on breeding stock supply systems held in Vu	Not implemented
M6	Policy brief submitted to relevant Government bodies in PNG, SI, Vu	Not implemented

Additional information on Activity 3

Milestone 1:

Implementation of feeding system options using local resources involved a series of activities targeting six milestones The strategic aim was to increase the resilience of smallholder village farming systems by enabling efficient feed storage and maximized use of available sweet potato crop harvest as livestock feed, particularly for grower pigs. Identification and selection for initial and subsequent rounds of model farmers were conducted based on two levels – first community leaders identify and recommend to the project site coordinating team list of potential farmers within their communities, second the project site coordinating team carried out physical on-farm visits including needs assessment and made the final selection using an eight point selection criteria (Table 1); which was also used for selection of farmers for other interventions.

Table 1. Selection criteria used in the selection of model farmers for on-farm demonstration of technologies

No.	Lead model farmer selection	Yes	No
1	Past experience/farming expertise/hardworking	□	□
2	Innovative & must/can be a role model	□	□
3	Willingness to participate & share information	□	□
4	Able to communicate	□	□
5	Good behavior/ trustworthy/ acceptable to community	□	□
6	Have existing stocks (pig, poultry, fish)	□	□
7	Willing to meet 50% of on-farm cost	□	□
8	Residency and proximity in the community	□	□

For chicken feeding system demonstrations, selected farmers were assisted with materials (eg. wires) to subdivide their sheds into two 2mx2m rooms for on-farm demonstration study comparing - (a) commercial feed verses introduced NARI concentrate blended with sweet potato for broiler chickens in confinement, and (b) semi-intensive with occasional feeding for crossbred against the introduced NARI concentrate blended with sweet potato for broiler chickens in confinement.

Milestone 2:

The integrated livestock farming practice involved the introduction of GIFT tilapia fish which is the most preferred and emerging fish cultured species in the region because of its fast growth rate and high tolerance to different climatic conditions. Unlike fish monoculture where most people are familiar with the Integration of fish and duck is a new concept that provided diversified options for the farmers in terms of protein and cash income. Participatory research action approach used was similar to those for pigs and poultry.

2. Modifications in implementation plans at sites for this component and overall component plan and why were the modifications necessary

- Inclusion of on-farm farmer field training under milestone 5 for the three livestock interventions for the two Tambul sites
- Inclusion of fish integration for Hisiu, Derin and Murukanam sites
- Due to unavailability of high/low energy poultry concentrates the universal concentrates were used as a substitute in poultry feeding towards the end of the project.

3. Technical Reports and other type of publication (popular or technical) produced

Type/title of document	Author(s)	Remarks
Journal/ Conference papers		
Effect on Nutrient Digestibility and Nitrogen Balance in Grower Pigs Fed Three Forms of Blended Cassava Roots	**Dom. M** et. al	Journal Sustainable Livestock Production in the Perspective of Food Security, Policy, Genetic Resources and Climate Change
Nutrient Utilization in Grower Pigs fed Boiled, Ensiled or Milled Sweet Potato Roots, Blended with a Wheat based Protein Concentrate	**Dom. M** et. al.)	Asian Austral-Asian Journal of Animal Sciences
Challenges in agricultural technology dissemination: experiences in the Western Highlands of PNG.	**Ahizo. J** & Lobao. M.	Abstract submitted to the UOG International Conference on Agricultural Extension in November 2016.
On-farm study on responses of juvenile tilapia (O*reochromis niloticus)* fish yields cultured under an integrated farming system tested in the high altitudes of Papua New Guinea	**Roberts. A** et. al	Abstract to be submitted to S&T Conference, NARI/Unitech in November 2016
Household processing of sweet potato, cassava and yam into flour: A case study at Kopafo communities, Eastern Highlands Province of Papua New Guinea	**Ramita, I** & Lobao. M	Abstract submitted to the Univ. of Goroka International Conference on Agricultural Extension in November 2016.
News articles in national news papers		
Using Integrated Livestock Farming Practices For Inland Fish And Duck Production.	**Roberts. A** et. al.	Published in NARI EUARD / Aug 2015
Benefits of locally produces livestock feed technology at Kiripia	**Ahizo. J**	Published, NARI/EUARD Project News 2016
Empowering drought affected communities	**Ahizo. J** & Amben. S	Published, The National Focus Article/2016
Strategies for feeding for inland pond fish using local feeds	**Sine. M** & Roberts. A	Published, The National Focus Article/11 Sep 2015
Improved use of local feed resources for mitigating the effects of escalating food prices in PNG: a contribution for food security policy dialogue	**Ayalew. W**	Published, **The National Focus Article/ Oct 2015**
Technical reports		
Mitigating the effects of climate change by introducing an improved village pig feeding and management systems in Tambul, Papua New Guinea	**Amben, S** & Dom. M	Draft report
Using integrated livestock farming practices for inland fish production to mitigate climate change effects in Tambul, Papua New Guinea	**Roberts, A**	Draft report
Increasing smallholder farmers' capacity for improved poultry feeding practices based on sweet potato in Tambul	**Ahizo. J**	Draft report
Increasing capacity of farmers in the Kopafo community using processing techniques and value addition of sweet potato and cassava for home consumption during prolonged dry seasons.	**Ramita. I**	Draft report
Improved livestock husbandry skills and stockmanship to mitigate the effects of climate change in Hisiu village and Yule Island, Central Province - Papua New Guinea.	**Sengi. S**	Draft report
Increased capacity of interested farmers in Kopafo community for using improved chicken feeding practices	**Solomon. E**	Draft report

Adaptation of livestock farming practices and technologies to enhance livelihoods in times of prevalent climate changes	**Tarabu. J**	Draft report
Training manual/Extension materials		
Fish-duck integration training module for Tambul smallholder farmers, NARI Livestock Research Centre, Tambul, PNG	**Roberts, A & Sine, M**	Used in project trainings and ongoing NARI livestock farmers training programs
Village chicken, duck and goat farmers field school training module for Hisiu & Yule Island communities. NARI Livestock Research Centre, Laloki, PNG	**Sine. M & Sengi. S**	Used in project trainings and ongoing NARI livestock farmers training programs
Training manual: Poultry and Pig Husbandry, Feeds & Nutrition Practical Hands-on Training. NARI Livestock Research Centre, Lae, PNG		Used in project trainings and ongoing NARI livestock farmers training programs
Poultry farmer-field school: Training module, Tambul, PNG	**Ahizo. J**	Used in project trainings and ongoing NARI livestock farmers training programs

4. Lessons learnt or any other relevant or notable observations as part of implementation

Successes achieved in all interventions in the Tambul sites and few for other PNG sites are possibly due to good awareness of the project site staffs in those locations.

Another important lesson that has significant impact on the successful implementation onsite is the commitment of reliable community leaders who help select genuine model farmers and are able to motivate and encourage them to implement what is required from the model farmers. Part of the achievements in sites like Derin, Yule and Tambul are a result of committed community leaders' engagement in the implementation process.

The active role of collaborating partners such as the District DPI at Tambul sites and World Vision for Derin/Murukanam have contributed to the successful implementation of the interventions at those sites unlike other sites (Kopafo) which was obviously lacking.

It is important to note also that the reduced interest observed among some of our model farmers in some sites like Murukanam and Derin sites is not only associated with their preference for other high value farm enterprises such as cocoa. It was observed later that interest in one or two of the interventions (such as livestock integration) had increased. There seem to be two groups of farmers: - risk takers and risk averse farmers. The former are those who have shown their interest initially and engaged as model farmers. These farmers are anxious to trial out new ideas and technologies and hope that these new ways of farming practices could change or benefit them later on before they decide whether or not to adopt or not to adopt. Similar group of farmers are observed in other project sites especially in the highlands. The latter group seemed to be apparent among farmers in the two sites in Madang they seemed to wait and observe the performance and benefits gain by risk taking farmer who were engaged as model farmers before they decide whether to adopt or not to adopt. A standard farmer selection criterion taking into account such groups of farmers could have been done to identify suitable model farmers for onsite studies.

5. Other capacity building achievements in the component (organizational, individuals, research capacity etc)

There is no specific and planned capacity building activities under the component. Related capacity building action are generally on need base to support the implementation of planned activities identified for each site. Capacity building actions achieved for organization, individuals, and research in the project sites include the following.

PNG:

- NARI Technical and project field staff
- Technical officers involved in the project were trained on a regular basis on the job over the duration of the project. This assistance greatly improved their capacity in to implement the livestock related interventions for the selected sites.
    - Related on-farm livestock participatory action research approach
    - Development of research protocols
    - Development of training manuals
    - Monitoring & evaluation of onsite research trials
    - Data collection & analysis
    - Reporting
- Project support provided for research activities (feed analysis) related to the project for a PhD student for NARI studying at the University of Adelaide. The student will remain with NARI and will be able to use his new knowledge and skills to develop research works related on a range of areas including climate, livestock practices and broaden the NARIs research scope.
- Livestock related capacity building for collaborating District DPI officers
    - Livestock feed formulation
    - Feed ingredient mixing

Solomon Islands/Vanuatu:

- Livestock related capacity building for MAL, SI, DARD, Department of Livestock and VATRC, Vu officers include a two days training on;
    - Livestock feed formulation
    - Feed ingredient mixing

- The purchase of an incubator for Kastom Garden Inc. and VATRC to supply poultry for project sites was accompanied with a week capacity building training covering
    - Specifications for incubator operations
    - Management & incubation of fertile eggs
    - Management of young chicks and ducklings
    - Feed and feeding practices
    - Health & disease control measures
    - Packaging and distribution of poultry

- 2 wks on-the-job training on livestock management and feeding practices, feeding formulation, hatchery and feed milling operations, etc for one VARTC staff conducted at NARI, PNG

Annex 11. Result 6 – Final Component report Communication and Networking

Component/ Expected Project Result:	Improved information exchange and networking among stakeholders for increased research and dissemination of technologies in PNG, SI and Vu

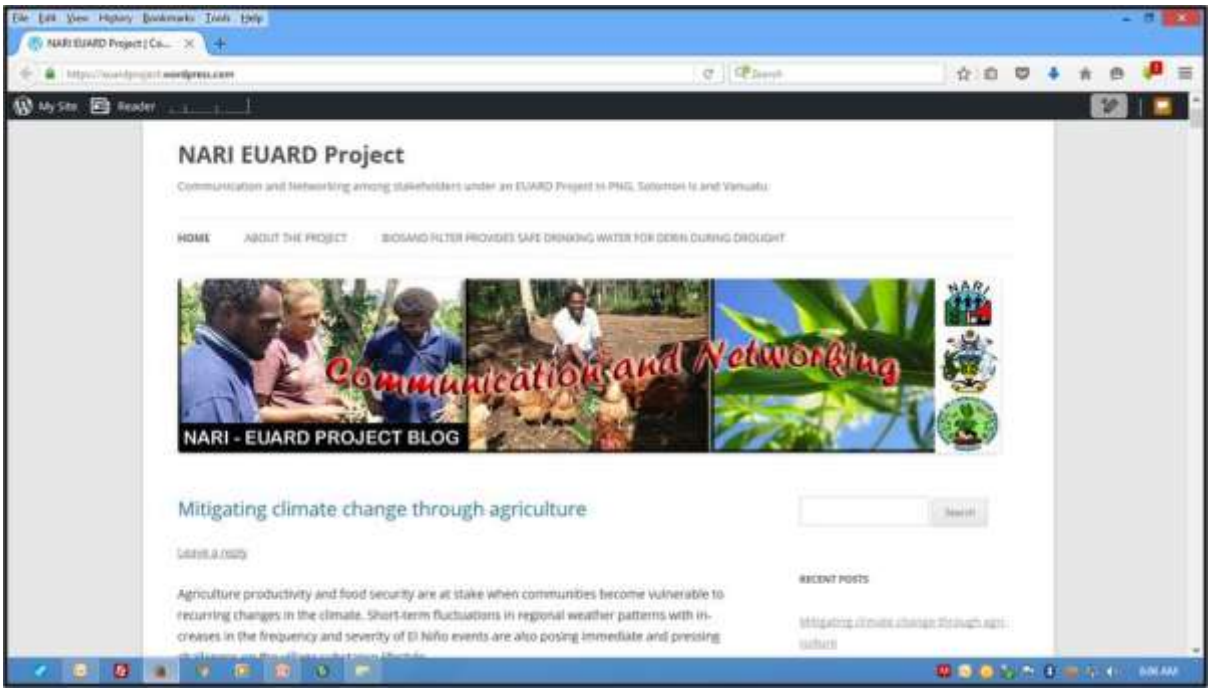
The Communication and Networking component of the NARI-EU ARD Project was about establishing and/or strengthening linkages and information/knowledge sharing mechanisms between researchers, extension providers and smallholders; providing suitable conditions for smallholder participation/input in the research process and for dissemination/out-scaling of new research-based technologies to smallholders in PNG, Solomon Island and Vanuatu.

The component was integral and dependent on the other five components in networking and communication and therefore its outputs were partially determined by the progress or success of the other components in terms of reporting, generation of research information and their availability. The activities under this component were only undertaken between 2014-2015 across the three Western Pacific Countries based on agreed annual work plans. The other components were in crop improvement, crop diversification, livestock development, soil and water management and socio-economics.

OUTPUT 1: Online Collaboration, Information Sharing and Knowledge Management

1.1 Blogging

With the increased use of simple and open source internet-based applications and services for development, a project blog site was established and maintained between 2014-2015. The rational was not only to enhance increased online collaboration and networking but also for increased visibility of project activities across all components and sites, and promote internet-based discussion forums on research and development; establish multi stakeholder forums; disseminate proven adaptation options, and share information on positive achievements. The approached supported the project in enhancing increased online (blogging) collaboration and sharing of information, resources and experiences on crops/cropping systems, livestock, and soil and water management. Up to 50 items, including stories and pictures, were posted on the project blog site, whose URL is https://**euardproject**.wordpress.com.



Awareness was made on the site's availability as an online discussion forum and source of information. The project team and stakeholders at large were invited to contribute and further share the forum content through their network. While followers enjoyed its content, hardly anyone attempted to engage in forum discussions as anticipated. However members of the project components utilized the platform in sharing their achievements, improved information and news stories.

1.2 Online Database System

As part of information management system, a project database was established and maintained throughout the project life. This online database system contained pages for components and activities, reports, people, organisations, library, calendar and discussions. It enabled the project management team to manage various inputs, monitor progress and generate appropriate reports as required. This simple and user-friendly platform also allowed instant access to and manipulation of data for various uses. Over 300 data was entered into the system with unaccounted reports generated from the database during the project period.

OUTPUT 2: National Stakeholder Forums

The project encouraged wider stakeholder participation to enhance improved collaboration and networking in the participating countries. As such four National Information Sharing and Networking Forums were conducted in the Solomon Islands and Vanuatu in 2014 during the months of March (Solomon Islands and Vanuatu), June (Vanuatu) and August (Solomon Islands).

These engagements were unique in which the wider agriculture and rural development stakeholders were involved. They included agricultural organizations and divisions, disaster offices, educational institutions, development partners, the private sector, NGOs, the media, and lead farmers of various communities. The forums offered opportunities for advocacy and increased sharing of experiences as well as providing options for improved engagement and dissemination of climate change adaptation interventions.

2.1 Stakeholder Introduction

The initial consultation meetings in March 2014 were basically brief introductory sessions intended to meet with potential national stakeholders in SI (March 10) and Vanuatu (March 12); sensitize the need to establish and/or strengthen linkages and information/knowledge sharing mechanisms between researchers, extension providers and smallholders; establish networks; initiate planning of activities; and invite them to participate in the process. A NARI team comprising Dr Workneh Ayalew, Dr Norah Omot, Martin Lobao and Seniorl Anzu were on this mission.

The focus was on identifying current practices of information sharing and networking, perceptions of difference levels of stakeholders (researchers, extensionists, farmers, others), and some of the major challenges that hinder effective networking and information / knowledge sharing among actors.

The SI stakeholder consultation meeting on 10 March was attended by 28 representatives. The Vu stakeholder consultation meeting on March 12 attracted 24 participants. In both instances the participants agreed to formalize the establishment of national agricultural information exchange networks (forums) at least once in a year.

2.2 National Stakeholder Forums

In June 2014 the Vanuatu stakeholder workshop was conducted following the establishment of Terms of References. The event was replicated in the Solomon Islands in August.

The objectives of these workshops were to:

- Take stock of and document current practices on networking and information sharing in SI and Vanuatu
- Identify positive practices/channels in networking and information sharing that need strengthening
- Identify new/alternative mediums of networking and information sharing for consideration
- Develop a work plan for strengthening and establishing networking and information sharing practices for stakeholders for the next 12 months
- Agreeing on the terms of reference

2.3 Forum Agenda

The forums considered the following areas, besides others, in a bid to establish and strengthen information sharing and networking among partners. The main questions were: What is there currently? Who does them? How do we do better? What else can we consider?

Information dissemination channels

- Publications – (eg. technical reports, scientific papers, training manuals, farmer guides/leaflets, proceedings, information bulletins, extension booklets, etc).
- Communication and awareness materials – newsletters (eg. Talemaot – quarterly), posters, banners, pamphlets, video shows
- Libraries /information centres
- Public Events – trade show, agriculture show, yam festival (farmer exhibits), farm demonstrations, field days, commemorations (eg WFD), training
- Mainstream Media – newspapers, TV shows, radio programs/talkback show
- Online Spaces – websites, blogs, social networking
- MAIS Resources – awareness, training
- Resource centres – do we have some?
- Communication – mobile coverage, cell phones, emails, etc.
- Human Resource Capacity
- IT skills
- Library/Documentation skills
- Communication/media skills

- Knowledge management skills
  - Graphic skills
  - Capacity development

  [What is the current skills level, who is there? What qualification? What capacity support/development is required?]

Infrastructure and Facilities/Resources

- Network and IT service/support
- Hardware & software
- Internet, websites, emails
- Libraries (management, size, location, purpose)
- Databases (library catalogue, agricultural statistics, etc)
- Policies, guidelines, strategies
- Risk management (virus, loss, etc)

The Vanuatu workshop was attended by 25 representatives from the wider community while 30 participated in the Solomon Islands meeting.

Participants of the Stakeholder Workshop on Communication and Networking in Vanuatu

Participants of the Stakeholder Workshop on Communication and Networking in the Solomon Islands

2.4 Quarterly Project Newsletters

For greater visibility, networking and sharing of technologies and positive news stories on project activities; a series of project newsletters were produced and circulated to project partners and stakeholders. Four newsletter issues were produced in 2015 – which was also the ideal timeframe of the project when most of the information relating to project activities and particularly the trial results and proven technologies were available for sharing with the stakeholders. They tend out to be consolidated and ready-made information resources easily accessible and enjoyed by the project team and stakeholders.

OUTPUT 3: Improved Resources and Methodology

Information on appropriate interventions for different climate change vulnerabilities were re-packaged in various information resources and delivered to interested stakeholders at different project sites during the course of the project.

The contents and frequency of deliveries were determined by stakeholder priorities, types of technologies adopted and level of inputs. Information on the selected interventions were sourced from NARI (promising releases and recommendations), as well as new knowledge generated through field research at the project sites. They were re-packaged and/or communicated in the form of print publications, electronic dissemination materials and audio-visual products - booklets, posters, brochures, flyers, CDs/DVDs, thumb drives, email and online. Selected posters on drought coping strategies and NARI Toktoks were also printed and supplied.

Most information resources were re-packaged in simple English however there were instances where some of them were translated into local *Lingua Francas*, for instance *Bislama* for Vanuatu and *Tok Pisin* for PNG – which were accepted for ease of understanding by rural farmers.

3.1 Information Packaging and Sharing – Publications

A range of information packages in the form of print publications were developed for farmers and other stakeholders. These publications included posters, booklets and brochures. They were developed in consultation with subject matter specialists for ease of accuracy (scientific data) and presentation.

Brochures

Booklets

Posters

List of print publications re-packaged under the EU-ARD project.

No	Technology	Publication Type			Copies printed
		Brochure	Booklet	Poster	
1	African Yam	√		√	400 brochures, 2 posters
2	Cassava		√		25 booklets
3	How to grow your own capsicum		√	√	25 booklets, 2 posters
4	Drought tolerant banana	√			350 brochures
5	Sterilizing soil for nursery		√	√	20 booklets, 2 posters
6	Rope and washer pump			√	4 posters
7	Sweet potato silage for pig feed	√	√	√	400 brochures, 30 booklets, 4 posters
8	NARI broiler concentrate	√		√	400 brochures, 4 posters
9	Upland rice varieties for the lowlands	√		√	400 brochures, 4 posters
10	Taro management		√	√	30 booklets, 2 posters
11	Tomato	√	√		200 brochures, 20 booklets
12	Yard long bean	√	√		200 brochures, 20 booklets
13	Early maturing sweet potato	√		√	100 brochures, 1 poster

	for the highlands				
14	Growing wheat	√		√	100 brochures, 1 poster
15	Growing vegetables - Sowing	√			350 brochures
16	Growing vegetables – Transplanting	√			350 brochures
17	Making banana chips	√		√	350 brochures, 1 poster
18	Making cassava chips	√		√	350 brochures, 2 posters
19	Making cassava crisps	√			350 brochures
20	Making flour out of sweet potato	√			350 brochures
21	Making jam from pineapples	√		√	350 brochures, 2 posters
22	Making sweet potato doughnuts	√			200 brochures
23	Making sweet potato strips	√		√	350 brochures, 2 posters
24	Making noodles from cassava flour	√			200 brochures
25	Making sago pops	√			200 brochures
26	Making starch out of cassava	√			350 brochures
27	Mixed improved fallow	√			200 brochures
28	Rice preservation and storage	√			100 brochures

Several other posters on priorities and interventions were developed for the evaluation exercise in all the sites and the final project closing workshop.

3.2 Public Awareness through Mainstream Media

For advocacy, public awareness and visibility; the mainstream media was extensively used in sharing positive developments arising from project activities in all the three countries. NARI used the two daily newspapers (*Post Courier and The National*) for regular reporting – not only on stories from PNG sites but also from the other two countries. The weekly Farming pages in *The National* newspaper ran most of the stories however the NARI Focus Column in *The National* and weekender features of both dailies featured a lot of the details of the project objectives, activities and achievements. In the Solomons; *Solomon Star* and *Sunday Isles* captured a lot of the project activities as public good while in Vanuatu, *Vanuatu Daily Post* did a fantastic coverage on project activities which went on for a while.

LOCAL NEWS

Scientist: Most experts are not good communicators

.... NARI-EW ARD stakeholders strengthen information sharing mechanism

3.3 Electronic Dissemination Materials

The television and radio technologies were utilized as mediums to disseminate climate change adaptation information. Radio programs and news packages were popular in Vanuatu on the project. Television stations in PNG and Vanuatu telecast a series of public awareness on climate change and related stresses and what actions the communities need to take to be resilient and better still the efforts and interventions of the project in addressing those environmental challenges.

Similar stories and news packages were published online on the NARI website (www.nari.org.pg) and other online news sources such as the PNG LOOP news (www.pngloop.com).

3.4 Video Production

Audio-visual information packages were produced through the video technology for distribution to stakeholders learning resources. Three video resources were packaged on water management and livestock feeding practices as demonstrations through step-by-step processes. The videos describe how farmers can develop and use innovative technologies in managing resources and adapt during extreme conditions such as drought when water and food resources become scarce. The video resources are on the:

1. Rope and washer pump technology,
2. Sweet potato silage technology for pig feed, and the
3. Biosand filter technology.

Other videos were produced on field activities of some of the project sites in PNG and Vanuatu. Project field activities in the Vanuatu, and Project field activities in PNG with prominence to Hisiu and Yule Island.

3.5 Methods of Delivery

The information materials were shared with partners and stakeholders including farmers through a number of avenues such as farmer trainings, field days, farmer visits, workshops, and other engagements. Soft copies of the publications were shared with two partner countries for printing (with translation where possible) and distribution to local development partners, extension agencies and farmers.

Information on early maturing and drought tolerant crop varieties formed the basis of the contents, while interventions on improved cropping and livestock systems were paramount. Technologies relating to value addition and optimal use of local food resources were equally considered as they become handy in climate stress situations, when food supplies get scarce. Providing options for crop diversification and engaging in farm activities for cash income will support communities in harsh times thus such information were packaged for the selected sites under this initiative.

Much of the information materials were distributed during field days - such as those that were held in Hisiu and Yule Island sites (PNG) and in Port Vila (Vanuatu).

Information posters attract Yule Island farmers

Farmers enjoying information displays at Hisiu

Vanuatu farmers collecting information

Vanuatu farmers display posters

OUTPUT 4: Capacity and Support Services

4.1 On-the-job Competency Skills Development

Human capacity development through on-the-job training attachments was identified as a key input under the project for organizations capacity development and sustainability. Three officers involved in information and communication activities in the Solomon Islands and Vanuatu were engaged with PNG NARI's Information and Knowledge Programme in July 2015 as part of capacity development support by the project.

From Solomon Islands were Ben Rakai and

Obed Senipitu of the Ministry of Agriculture and Livestock, and Mark Vurobaravu from Vanuatu's Department of Agriculture and Rural Development. They were active members of this project's field information activities back in the two countries.

The week-long engagement was about experience sharing, exposing the participants to NARI's information and knowledge strategies, and having a brief hands-on training in selected competency areas. The activities were delivered based on NARI's existing practices, particularly in the production, management and sharing of information and knowledge. The program covered NARI's policies and standards, publication process, library and information systems, audio-visual production (video, radio), concepts and techniques of writing for the presses, graphics, media practices, selective information packaging, and community engagement. Team members of the NARI I&K Programme at HQ contributed in delivering this program successfully. The team also visited The National newspaper's printing plant in Lae in which they learnt about the daily operations of the media agency and its complete printing process.

4.2 Improved Capacity with Technology – Video Editing Software

For improved and ongoing in-house production of audio-visual information materials, the project supported the Solomon Island and Vanuatu partner organizations with licensed video editing software packages each - Adobe Premiere Pro CS 6. Premiere Pro is one of the professional software package widely used in the industry all over. NARI already has the same software and therefore didn't require one.

Television and video technology was highly prioritized as an important tool for public awareness in the two countries. Traditionally agriculture and other development partners utilize this technology to engage with the masses. The project partners already have video cameras but lacked the editing tool, and therefore were out-sourcing editing jobs to the private sector which has had financial implications. During the on-the-job training attachment in PNG, the SI and Vu participants were introduced to the software and briefly demonstrated on the basic editing process. The sourcing of the software enables them to produce their own appropriate information packages for television broadcast, DVD distribution to stakeholders and communication through other collaborative interfaces such as online, telephony, etc. The partners were impressed with this support which will enable improved production of audio-visual productions with improved quality and presentation.

4.3 Communication Strategies for Partner Organizations

Despite improvements in the way DARD and MAL engage with stakeholders and disseminate information, much of these are undertaken without having in place specifically defined frameworks for networking and communication efforts. Under the project, communication strategies were proposed and initial consultations were held. However the development of these strategies is now work in progress due to further developments.

Consultation on communication strategy in Vanuatu

For Vanuatu, a suggestion was put forward for a ministerial strategy (rather than an agriculture strategy for DARD only) which should also incorporate communication requirements for fisheries, quarantine/ bio-security, livestock, and forestry. DARD requested that this exercise be delayed and taken up through another regional initiative with CTA/SPC partnership. Dialogue is still

on-going on this contribution involving NARI.

With Solomon Islands, change in leadership at PR/Communication division has had some delay in picking up on the schedule however dialogue is ongoing and progress will be made when MAL communication plans are finalized, which will capture how and when this activity can be factored in.

At project conclusion, the development of communication strategies is work in progress which NARI will continue to follow up and conclude before the end of September 2016.

Annex 12. Transfer of Ownership of Assets