Annual Research Report
2011

Seeds of Life
Fini ba Moris

‘Improved food security through increased productivity of major food crops’

Seeds of Life (Fini ba Moris) is a program within the Timor-Leste (East Timor) Ministry of Agriculture and Fisheries (MAF). The Governments of Timor-Leste and Australia collaboratively fund the program. Australian funding is through the Australian Agency for International Development (AusAID) plus the Australian Centre for International Agricultural Research (ACIAR) and is managed by ACIAR. The Centre for Legumes in Mediterranean Agriculture (CLIMA) within The University of Western Australia (UWA) coordinates the Australian funded activities.

Table of Contents

List of tables and figures

Tables

Figures

Foreword

It is my pleasure to release this year's Annual Research Report prepared by the Seeds of Life (SoL) program within the Ministry of Agriculture and Fisheries (MAF). This is the sixth year of research reports on the selection, evaluation and release of new, improved crop varieties to increase food security in the Democratic Republic of Timor-Leste.

Most of the research activities and seed production during the 2010-2011 dry and wet seasons were located in 19 Sub-Districts of the districts of Manufahi, Aileu, Baucau, Viqueque, Liquica, Bobonaro and Ainaro. All six agro-ecosystems were represented in these Districts with research sites spanning the nation from the north to the south coast ranging across low altitude, low rainfall to high altitude and higher rainfall environs. Non Governmental Organizatons and other agencies also assisted the spread of MAF released varieties in other districts. The Seeds of Life 3 program which commenced at the beginning of February, 2011 will encourage the multiplication of seed and pure planting material in all 13 Districts by the end of 2015.

All MAF/SoL varieties were initially evaluated on research stations in replicated trials. A large number of observations were made to ensure the correct characters were selected in potential entries for testing on farmers fields. Taste tests were included in farmer field days to gauge the farmers reaction to the most promising entries. All variety trials were managed without applying fertilizer and water to mimic farmer's conditions. One or two of the best cultivars emerging from the on-station research were then included in On-Farm Demonstration Trials (OFDTs). At least one farmer field day was held in each Sub-District to assist the selection of cultivars suitable for release. Seed was then multiplied and distributed to farmers by the MAF, NGOs and other organizations.

Seed availability is recognized as being a constraint to farmers adopting new varieties in Timor-Leste. Improving farmers' access to seed is increasing in importance for the Government both to increase access to higher yielding, high quality germplasm and to ensure farmers have sufficient quality seed at planting time. The MAF/SoL formal and informal seed multiplication programs are active in the districts working with seed producers, farmers and extension personnel to ensure they achieve this goal. We wish them the greatest of success.

The Australian Government is gratefully acknowledged for its financial support through the Australian Centre for International Agricultural Research and the Australian Agency for International Development.

H.E Mariano ASSANAMI Sabino
Minister of Agriculture and Fisheries
Democratic Republic of Timor-Leste

March, 2012

Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
ALGIS	Agricultural Land Geographical Information System
AEZ	Agricultural Ecological Zone
AP	Annual Plan
APC	Australian Program Coordinator
ATL	Australian Team Leader
AusAID	Australian Agency for International Development
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Centre
CIP	International Potato Centre
CLIMA	Centre for Legumes in Mediterranean Agriculture
CSPG	Community Seed Production Group
DSO	District Seed Officer
EoPOs	End-of-Program Outcomes
FAO	Food and Agriculture Organization
FSMG	Farmer Seed Marketing Group
FSPA	Formal Seed Production Advisor
GIS	Geographic Information Systems
ICRISAT	International Centre for Research in the Semi-Arid Tropics
IELTS	International English Language Testing System
IFSP	Informal Seed Production
IRRI	International Rice Research Institute
ISPA	Informal Seed Production Advisor
M&E	Monitoring and Evaluation
MAF	Ministry of Agriculture and Fisheries
NDA&H	National Directorate for Agriculture and Horticulture (MAF)
NDR&SS	National Directorate of Research and Special Services (MAF)
NDP&P	National Directorate of Policy and Planning (MAF)
NDACD	National Directorate of Agricultural Community Development (MAF)
NGOs	Non-Government Organizations
OFDTs	On-Farm Demonstrations and Trials
OJT	On the Job Training
OM	Office Manager
PDD	Program Design Document
PMT	Program Management Team
PSC	Program Steering Committee
RA	Regional Advisor
SEOs	Suco Extension Officer (MAF extension officer)
SoL	Seeds of Life
SoL3	Seeds of Life 3
SOSEK	Social Science and Economics (Sosial Ekonami)
SPC	Seed Production Coordinator
SPO	Seed Production Officer
STA	Short-Term Advisor
TAG	Technical Advisory Group
TL	Timor-Leste
UN	United Nations
UNTL	University of Timor Lorosae
UWA	University of Western Australia

Personnel

Ministry of Agriculture and Fisheries

H.E Mariano ASSANAMI Sabino	Minister, Ministry of Agriculture and Fisheries
Mr. Marcos da Cruz	Secretary of State for Agriculture & Forestry
Mr. Lourenço Borges Fontes	Director General and SoL Co- Leader
Mr. Gil Rangel da Cruz	National Director, Agriculture and Horticulture
Mr. Adalfredo do Rosario Ferreira	Director of Research and Special Services
Mr. Octavio da Costa Monteiro	National Director Policy and Planning
Mr. Januario Marcal de Araujo	National Director Community Agriculture Development
Mr. Manuel Xavier	Chief of Department for Research and Special Services
Mr. Moises Lobato Pereira	Research Manager, Darasula
Mr. Abril Fatima Soares	Research Manager, Aileu
Ms. Maria Fernandes	Research Manager, Betano (until June 2011)
Mr. Rafael Feliciano	Research Manager, Betano (from June 2011)
Mr. Teleforo Fernandes Moniz	Research Manager, Loes

Name	*District*	*Sub-District*
Ms. Armandina Marcal	Dili	
Ms. Anita Ximenes	Dili	
Ms. Octaviana Ferreira Agostinho	Dili	
Ms. Dorilanda da Costa Lopes	Bobonaro	Maliana
Ms. Deonisia Raquela Soares Brito	Aileu	Aileu Villa
Mr. Cipriano Martins	Aileu	Aileu Villa
Mr. Salvador de Jesus	Aileu	Remexio, Liquidoe, Laulara
Ms. Odete Ximenes	Baucau	Baucau Villa
Ms. Juliana de Jesus Maia	Manufahi	Betano
Ms. Ermelinda M.L. Hornai	Maliana	Maliana Villa
Mr. Antonio Pereira do Rego	Baucau	Venilale
Mr. Rojino Da Cunha	Baucau	Vemasse
Mr. Joao Bosco Pedro C.R. Belo	Baucau	Baucau Villa
Mr. Basilio da Silva Pires	Baucau & Viqueque	Venilale &Ossu
Mr. Marcos Vidal	Manufahi	Betano
Mr. Felisberto Soares	Manufahi	Betano
Mr. Rafael Feliciano	Manufahi	Betano
Mr. Jose da Costa Freygen	Liquica	Maubara
Mr. Jorge Amaral	Manufahi	Alas
Mr. Armindo Moises	Manufahi, Ainaro	Turiscai, Maubisse
Mr. Leandro C.R Pereira	Liquiça	Maubara
Mr. Mario Tavares Goncalves	Liquiça	Liquiça Villa
Mr. Luis da Costa Patrocinio	Bobonaro	Balibo
Mr. Luis Pereira	Dili	
Mr. Paulo Soares	Liquiça	Liquiça Villa
Mr. Mario da Costa	Viqueque	Viqueque
Ms. Maria Martins	Aileu	Aileu Villa
Ms. Isabel Soares Pereira	Dili	
Ms. Julieta Lidia	Dili	
Mr. Luis Fernandes	Baucau	
Mr. Amandio da Costa Ximenes	Viqueque	Ossu
Mr. Inacio Savio Pereira	Viqueque	Uatulari
Mr. Tobias Monis Vicente L. Agm	Liquiça	Maubara
Mr. Joao Paulo	Dili	

Mr. Agostinho Alves	Manufahi	Betano, Same, Alas
Mr. Laurentino Ximenes	Dili	
Mr. Sabilio dos Santos	Dili	
Mr. Fernando Soares	Liquiça	Maubara
Mr. Leon Mauleto	Bobonaro	Maliana
Mr. Julio Filipe	Baucau	Vemasse
Mr. Florindo Morais Neto	Dili	
Mr. Moises Sarmento	Viqueque	
Mr. Constantino da Costa	Baucau	
Mr. Luis Manuel Branco	Dili	
Mr. Luis Siki	Bobonaro	
Ms. Nelia Aniceto	Liquiça	
Mr. Andre Alves	Manufahi	
Mr. Feliciano Soares	Viqueque	
Mr. Francisco Gama	Dili	
Mr. Rui Amaral Pereira	Dili	
Mr. Antonio de Jesus	Aileu	
Mr. Pedro da Costa de Jesus	Baucau	
Mr. Orlando dos Santos da Lux	Ainaro	
Mr. Floriano de Fatima	Manufahi	
Mr. Marcelino Santos Lopes	Bobonaro	
Mr. Silvester Sarmento	Liquiça	

University of Western Australia

Dr. Harry Nesbitt. Australian Program Coordinator, Seeds of Life
Dr. William Erskine, Director CLIMA

Seeds of Life Office in MAF, Timor-Leste	
Mr. John Bruce Dalton	Australian Team Leader (from June, 2011)
Mr. Robert Williams	Research Advisor
Dr. Asep Setiawan	Seed Production Advisor
Ms. Myrtille Lacoste	Research/Extension Advisor (until April 2011)
Mr. Buddhi Kunwar	Informal Seed Production Advisor (from April 2011)
Mr. Martin Browne	Regional Advisor for Eastern Region
Mr. Nick Molyneux	Climate Change Advisor
Mr. Luc Spyckerelle	Monitoring and Evaluation Advisor (from February 2011)
Mr. Joseph Freach	Regional Advisor for Western Region (from April 2011)
Mr. Luis Aguilar	Regional Advisor for Central Region (from May 2011)
Mrs. Carla Da Silva	Office Manager
Ms. Ines Alves	Finance Officer
Ms. Cecilia da Silva Pires	Finance Assistant (from November 2011)
Mr. Apolinario Ximenes	Data Entry Specialist (OFDT Officer from October 2011)
Mr. Aquiles T. Maia Barros	Translator / Interpreter
Ms. Miguelina Ribeiro Garcia	Administrative Office
Ms. Alexandra Araujo	Administrative Assistant
Mr. Filomeno Cardoso	Logistics Officer (from July 2011)
Mr. Jeronimo Ribeiro	Logistics Officer (from July 2011)
Mr. Jonas Amaral	IT Officer (from April 2011)
Mr. Francedes Suni	Communications Officer (from October 2011)
Mr. Anibal da Costa	Training Coordinator (from December 2011)
Ms. Teresa Maria Pires	Admin Officer Eastern Region (from August 2011)
Ms. Liliana da Costa Cruz	Admin Officer Western Region (from September 2011)
Mr. Egas Vong	Admin Officer Central Region (from July 2011)

1. Overview of the Seeds of Life program

1.1 Introduction

"Seeds of Life (SoL)" (Fini ba Moris) is a program within the Timor-Leste (East Timor) Ministry of Agriculture and Fisheries (MAF) to address the underlying causes of food insecurity in Timor-Leste. These include low yields of staple crops, vulnerability of unfavourable seasons and natural disasters, lack of cash incomes to purchase food during periods of shortfall, post harvest losses and low market distributional capacities.

SoL entered its third phase (SoL3) at the beginning of February, 2011 and builds on the success of previous phases, maintaining a core focus on increasing yields by selecting and distributing improved varieties of superior genetic quality. It also has a secondary focus on analysing and developing strategies to overcome climate variability and change; improving agronomic practices to reduce weed burdens and increase soil fertility; reducing post harvest storage losses and improving input supply arrangements for seed.

The program concentrates on evaluating higher yielding varieties of crops currently cultivated by farmers in Timor-Leste. These are maize, sweet potato, cassava, rice and peanuts. A small amount of work is also conducted on some minor crops such as wheat, barley, potato and various bean crops.

During 2010-2011 the program's main activities were in the Districts of Aileu, Baucau, Viqueque, Bononaro, Manufahi, Ainaro and Liquica. On-farm trials spread from coast to coast across a range of agro-ecosystems (Figure 1). By the beginning of 2016 the aim is to have the foundations of a national seed system for Timor-Leste established, capable of providing a high level of access to seed of improved varieties to farmers throughout the country.

This is the sixth Annual Research Report prepared by Seeds of Life. The report summarizes the program's research, formal and informal seed production plus management activities and outlines progress made with communications and capacity building. Specific detail is provided of the research conducted during the year.

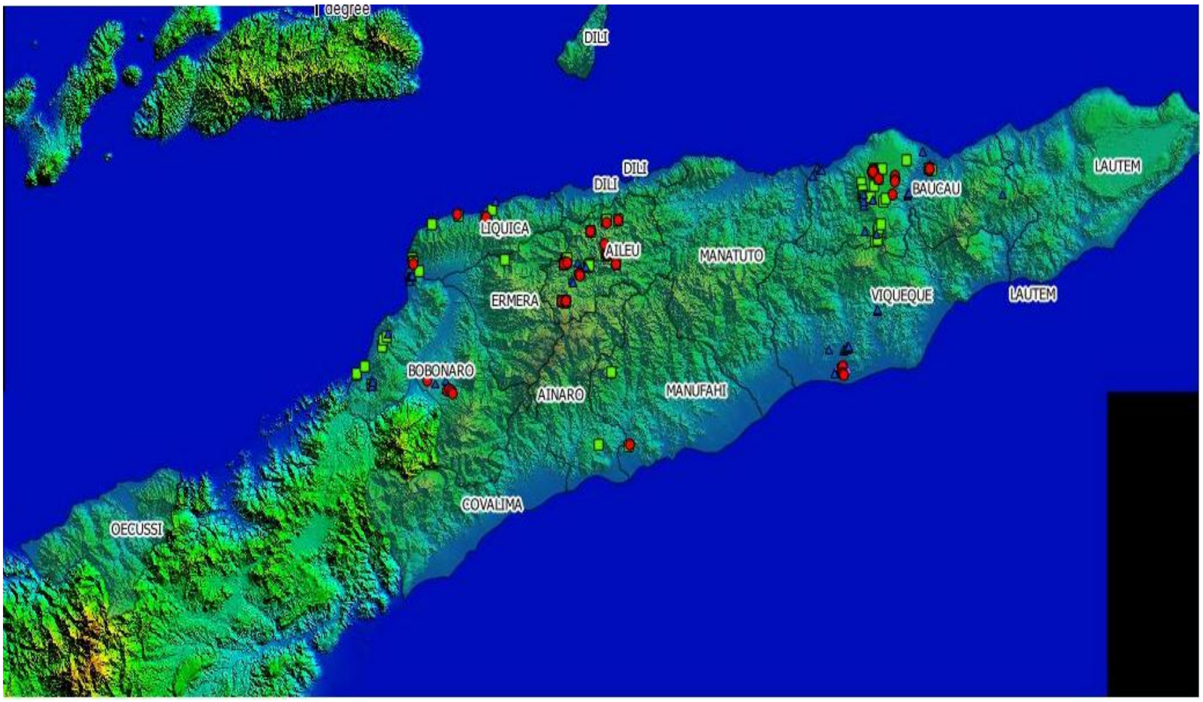


Figure 1. Selected research/demonstration sites in Timor-Leste 2010-2011 (● Sweet potato, ■ Rice, ▲ Maize)

1.2 Program summary, 2010-2011

The third phase of SoL was designed with four components possessing specific activities for each. These are a) Evaluation of improved food crop varieties, b) Formal seed production and distribution, c) Informal seed production and distribution and d) Seed system management. Capacity building is an integral part of the program and is imbedded in each component but a summary of the year's training activities are presented separately.

The activities and progress of each component for 2010-2011 are presented below:

Component 1: Evaluation of improved food crop varieties.

Component objective: Improved varieties of food crops identified and released.

Activities in this component include:

- National Agricultural Research Centres and Research Stations established
- Genetic material of potential improved varieties identified and sourced
- Potential new varieties evaluated on-station
- Potential new varieties evaluated on-farm
- Selected new varieties officially released
- Sufficient foundation seed being produced
- Capacity of MAF staff to manage the identification and release of new varieties strengthened

Towards the end of 2011, most of the buildings planned for construction had been either rehabilitated or constructed. These include accommodation and warehouse at TriLoka (Baucau) and warehouse at Corluli (Bobonaro). Temporary buildings were designed for erection at Kintal Portugal (Aileu) and Raimaten, (Bobonaro). The MAF allocated an area for cultivation on the Urulefa high altitude research station site in Maubisse and this will be utilized during the 2011-2012 wet season for the first time. A suitable site was also identified to conduct research on irrigated lowland rice and irrigated upland crops and for seed multiplication. This site 1.7ha in area is located near a main road and the main irrigation canal and is close to the water source. The site is in the suco of Raimaten, Maliana Sub-District of Bobonaro.

The irrigation system at Loes was being rehabilitated and improved during the period and extra buildings to house equipment designed. Betano, Loes and Darasula stations were manned by MAF professional staff and operating to a budget.

No new improved test entries needed to be imported for the main food crops during the year but 25 new wheat, 25 new barley varieties and 13 winged bean entries arrived from Australia plus 104 upland rice and 60 lowland rice varieties from IRRI, Philippines.

A total of 32 replicated wet season trials from 2010-2011 were evaluated during the year and are described in this report. Most of these trials and some dry season trials were conducted on one or more of the stations at Aileu, Betano, Loes or Darasula. In addition, trials on rice and crops needing high altitude environments (wheat, barley, potatoes and beans) were conducted on farmers fields. The number of entries in each trial varied from 13 to 106 depending on the crop. Farmer field days were held at the research stations and farmers observations were recorded for varieties showing potential for evaluation on farmer's fields. With this process, 10 elite peanut varieties were selected for consideration and included in 2011-2012 and 2012-2013 replicated trials. Additionally, 3 new sweet potatoes were identified for inclusion in 2011-2012 and 2012-2013 On-Farm Demonstration Trials (OFDTs).

A total of 375 OFDTs were conducted during the year. Of these, 118 were maize, 34 legumes, 81 sweet potato, 86 rice and 56 cassava. The OFDTs were installed across 7 districts and 19 Sub-Districts.

One new white maize variety was identified for release by the SoL team in June, 2011. This variety identified as P07 originated from the Philippines. The breeders have provided permission to release the variety in Timor-Leste and the variety release committee is awaiting the naming of the variety before officially releasing it to farmers.

Sufficient foundation seed was produced during the year to provide both the research and formal seed production programs. Extra foundation seed was also available for use by the MAF and sale to NGOs. On hand at the end of the year were 1500 kg of Sele and 3,500 kg of P07 maize stored at Betano station; 1 ha of cassava plants for cuttings at Loes and 1 ha at Corluli. Approximately 3000 m^2 of sweet potato seedling material were also grown at Loes and 800m^2 at Aileu. Two hundred panicles of Nakroma rice were selected for maintenance breeding and bulking as foundation seed in 2011.

Capacity building during the year included formal short courses and on-the-job training. These are detailed further in Section 8. In addition, three persons from UNTL were assisted through their final university year research theses and five East Timorese graduates were assisted with their post graduate training. Two Masters degree students were directly sponsored by SoL at a university in Indonesia. In addition, three students were assisted with gaining ACIAR, John Allwright scholarships for study in Australia.

Component 2. Formal seed production and distribution

Component objective: Sufficient high quality seed being produced through formal channels to maintain the genetic quality of released varieties.

Activities in this component include:

- Formal seed being produced through farmer contracts.
- Quality assurance systems established
- Technical extension support provided to contracted seed producers
- Seed grading, packing and storage facilities established
- Seed grading, packing and storage facilities established
- Formal seed distributed through preferred distribution channels
- Capacity of MAF staff to manage the production and distribution of formal seed strengthened.

Seed production officers (SPOs) contracted farmers to produce seed (and planting material) of the SoL varieties of maize, rice and sweet potato (See Section 9 Technology Recommendations). Two extra sweet potato multiplication fields (one in Liquica and one in Bobonaro) were established during 2011. All cassava multiplication for the program was at Betano or Loes research stations during the year.

Seed Production Coordinators (SPCs) and SPOs underwent training during the second half of the year to improve their understanding of seed quality regulation. High quality seed was maintained by rejecting up to 20% of that harvested and one technician was dedicated to the laboratory analysis of seed quality. A new rice cleaner was purchased to improve seed quality and seed germinators were delivered to Baucau, Aileu, Manufahi, Liquica, and Bobonaro seed warehouses for internal quality control purposes. The MAF/SoL seeds analyst has been asked by MAF to inspect imported maize seed germination rates prior to its distribution. Sampling and testing procedures have been implemented properly by staff and test results have been delivered to MAF.

New seed storage facilities were established at Darasula (Baucau), Maliana, Aileu and Loes and the facilities in TriLoka (Baucau) upgraded during the year. Construction of an additional warehouse in Viqueque was also commenced. Each warehouse is capable of storing 30t of seed and cleaning/grading rice and maize at 1t/hr.

All of the maize seed required for the SoL/MAF-Informal Seed Production (IFSP) and NGO-IFSP was produced and supplied. Some maize and rice seed for direct distribution by MAF and NGOs was also multiplied and delivered during the year. Extra sweet potato and cassava cutting sites were installed during the second half of the year to cater for the programs expanded needs.

Three formal training courses were held during the year on seed quality and seed multiplication. A study tour in Indonesia to discuss seed systems was also conducted. In addition, seed producers received regular visits from MAF/SoL seed production officers.

Component 3. Informal seed production and distribution

Component objective: Mechanisms for the production and distribution of seed through informal and market channels strengthened

No informal seed production component activities were conducted during the 2010-2011 wet season. However the program underwent an intensive planning period leading up to the wet season of 2011-2012. The activities are described as:

- Community Seed Production Groups (CSPGs) established
- Farmer Seed Marketing Groups established
- Focal seed merchants in local markets established
- Access to seed for vulnerable groups improved through seed fairs
- Systems linking informal seed producers with potential buyers enhanced
- Capacity of MAF extension staff to establish CSPGs strengthened

280 CSPGs were established by SoL/MAF in seven districts for seed multiplication and storage during the 2011-2012 wet season. NGOs also organized 446 groups to use SoL seed for multiplication as part of their rural development programs. Thirteen women only groups (5% of total 280 groups) were established. Of the 280 groups 103 were maize, 60 rice, 50 peanut, 27 cassava and 40 sweet potatoes. Total members were 3,815. (men 73%, women 27%).

A large number of training events were held to develop the capacity of MAF personnel to manage community based seed production and for the farmers themselves to implement the program. A total of 20 training events were held during the year and 32 socialization workshops reaching 2147 participants Seed groups from each of the 70 sucos involved attended the latter, totaling 1956 persons comprising 64% men and 36% women.

Component 4. Seed system management

Component objective: MAF capacity to manage the national seed system strengthened

Activities in this component include:

- Seed planning and management systems established
- M&E systems established
- Seed system gender strategy implemented
- Improved-variety technical and promotional materials developed
- Awareness of improved varieties increased
- Environmental and climate change impacts addressed
- Capacity of MAF staff to manage the national seed system enhanced

SoL developed an inventory system suitable for the program during 2010. This system will be expanded to encompass the National seed program.

Two additional MAF staff members were assigned to the Monitoring and Evaluation/Social Science and Economics (M&E/SOSEK) unit in August, 2011, bringing the total to four plus one advisor. These team members will work with the National Directorate of Statistics to complete a baseline survey on which the performance of SoL will be based. The M&E framework was reviewed early in the year (April, 2011) and the M&E manual drafted.

The MAF assigned two persons to work on gender in agriculture during the year. They, with the assistance of a short term gender advisor, spent two months developing a work plan for Gender in SoL. An action plan for each component was also developed and personnel were trained on Gender in Agriculture.

Scientific publications of SoL research were prepared and released during the year. These included 5 papers accepted by international journals indicating the high quality of research conducted by the program (See Section 10 References). Variety and technical recommendations in Tetun were also printed and distributed (See Section 8).

SoL activities received considerable publicity during the period both on local and international TV in addition to publicity in local press. The Australian Minister of Foreign affairs supported SoL activities on both radio and TV. The MAF Secretary of State HE Marcos da Cruz also visited SoL activities and publically expressed support for the program on local TV. A list of the publications, reports and some publicity events are presented in Section 8.

A climate change report addressing the extent of expected change in rainfall and temperature on agricultural activities was completed during the first six months of the year and field work on terraces conducted during the second half of the year. Two MAF staff were assigned to work on climate change.

MAF staff received considerable training during the year (see Section 9). One masters degree student in Australia also studying participatory plant breeding and seed distribution systems.

Program management

A major activity of SoL during the first year of the program was in setting up the program to operate effectively within the MAF and with other organizations, particularly nationally, on a regional and district basis. A program management team (PMT) was established with four directors, seven district directors, the SoL Australan Team Leader (ATL) and chaired by the MAF Director General. Three PMT meetings were held during the year plus one extra one during the visit of the Technical Advisory Group (TAG). The SoL Program Steering Committee (PSC) meets twice a year and gives high level governance oversight to the program. The PSC is chaired by the Minister of MAF and has representation from the Director General of MAF plus directors of the National Directorates for Research and Special Services (NDR&SS), Agriculture and Horticulture (NDAH), Policy and Planning (NDP&P) and Agricultural Community Development (NDACD). It also has representation from ACIAR, AusAID, UWA and SoL.

Three Regional Offices were established and operated during the year as planned and District coordinators joined regular meetings. Three Regional advisors were appointed and management systems established. Physical and financial management systems were established with the assistance of extra logistical and financial staff members. Charles Sturt University developed a communications strategy and re-established the SoL web page. Administrative guidelines were developed and the M&E Framework was reviewed and being implemented. The first TAG completed its report on November, 2011 and its recommendations were acted upon.

1.3 Rainfall

Introduction

Rainfall data for Timor-Leste have been collected intermittently for almost 90 years (SoL, 2010). In recent years, data has been compiled by SoL personnel conducting On-Farm-Demonstration-Trials (OFDTs) and by the Agricultural Land Geographical Information System (ALGIS) office in the MAF. Presented here are data from sites located reasonably close to the major research stations and are representative of the rainfall conditions under which much of the agronomic research was conducted during the 2010/2011 wet season. The main research stations are Quintal Portugal (Aileu); Betano (Manufahi); Urulefa (Maubisse, Ainaro); Loes (Liquica) and Darasula (rainfall represented here by that taken at Ostica, Baucau). Research was also conducted in Maliana (Bobonaro), Maubara (Liquica) and in higher altitude sites in Venelali (Baucau) and in Viqueque where rainfall data was collected. Rainfall for these sites are presented and described for 2010/2011. Comparisons are made with long-term averages of data collected during the Portuguese era.

Rainfall data for select sites

Timor-Leste experienced above average rainfall across most of the nation during the 2010 dry season. The higher than normal rainfall is illustrated in the rainfall comparisons from all OFDT sites presented as Figure 2 in SoL, 2010). As a result of the rain, farmers were unable to burn off their fields and plant maize. FAO/MAF surveys indicated that maize production from the (early) 2011 maize harvest was 80% below average. This was thought to be associated with reduced area planted and lower yield. Farmers tended to compensate the lower maize planting with an increase in the area planted to sweet potatoes and other root crops. The higher rainfall during the latter part of the dry season was particularly evident in the East of the country.

At the Quintal Portugal research site the rainfall was well above average at the beginning of the wet season except for the month of August (Figure 2). The highest rainfall month was in November rather than December but the remaining was reasonably “average”.

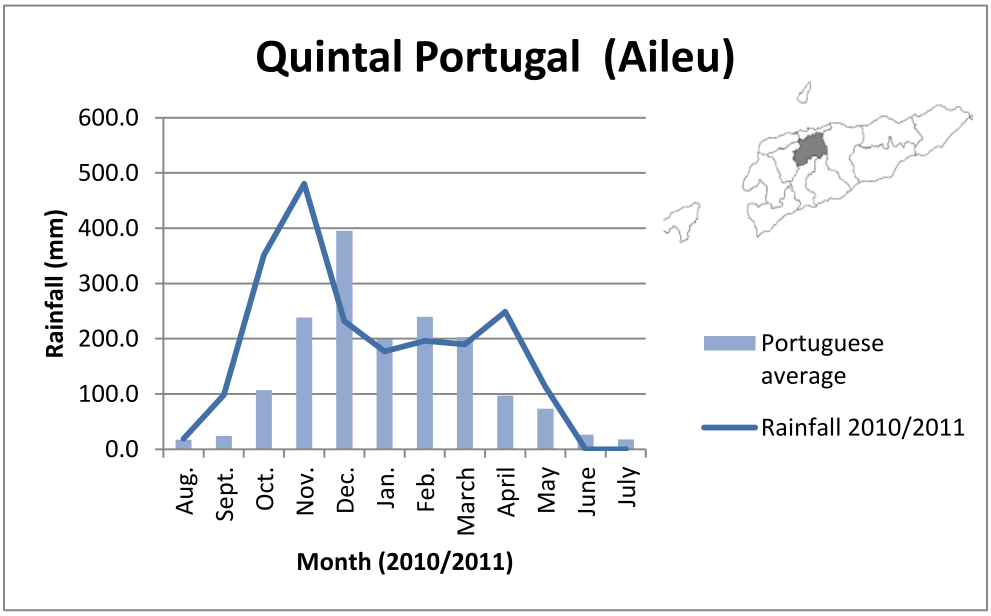


Figure 2. Rainfall (mm) at Quintal Portugal, Alieu, 2010/2011

At Betano, on the south coast in the District of Manufahi, the first three months of the year were extremely wet but rainfall during the main part of the wet season were near or below average. The early part of the 2011 dry season was above average (Figure 3).

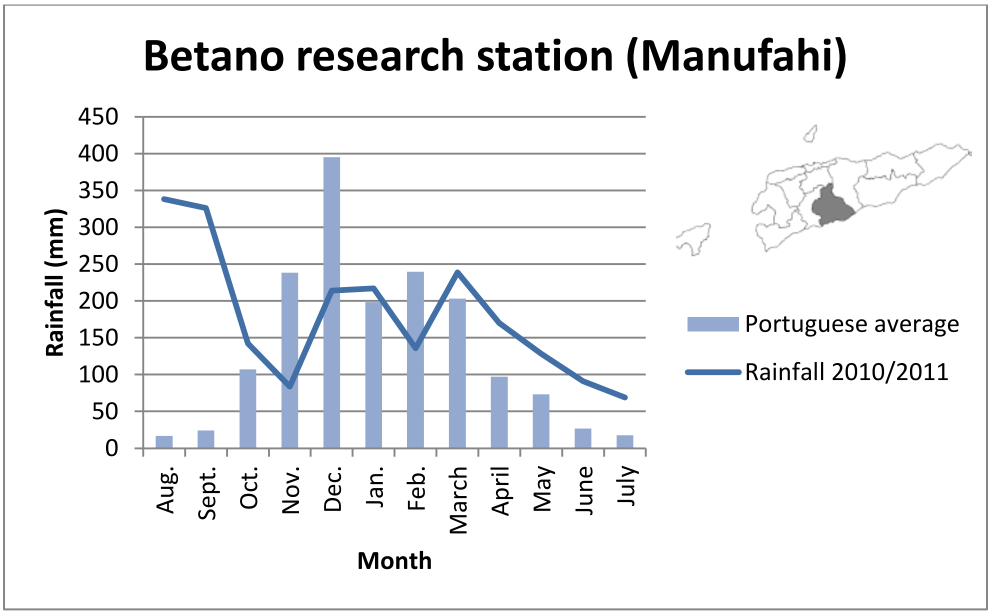


Figure 3. Rainfall at Betano, Manufahi, 2010/2011

Maubisse's 2010/2011 rainfall data indicated that the start of the wet season was above average as in most other AEZs but the weather dried off significantly before an extremely wet February and March (Figure 4). The start of the 2011 dry season appeared to be normal.

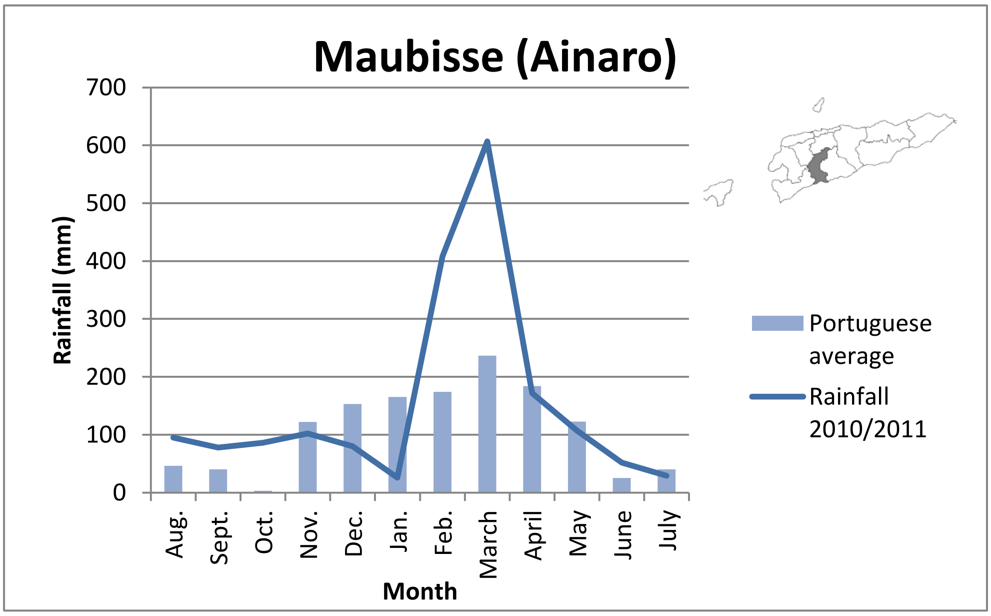


Figure 4. Rainfall at Maubisse, Ainaro, 2010/2011

In Maliana, the end of the 2010 dry season received above average rainfall but the main wet season (November – March) was average or below average. A dry May – July period indicated the dry season would receive normal or below average rainfall (Figure 5).

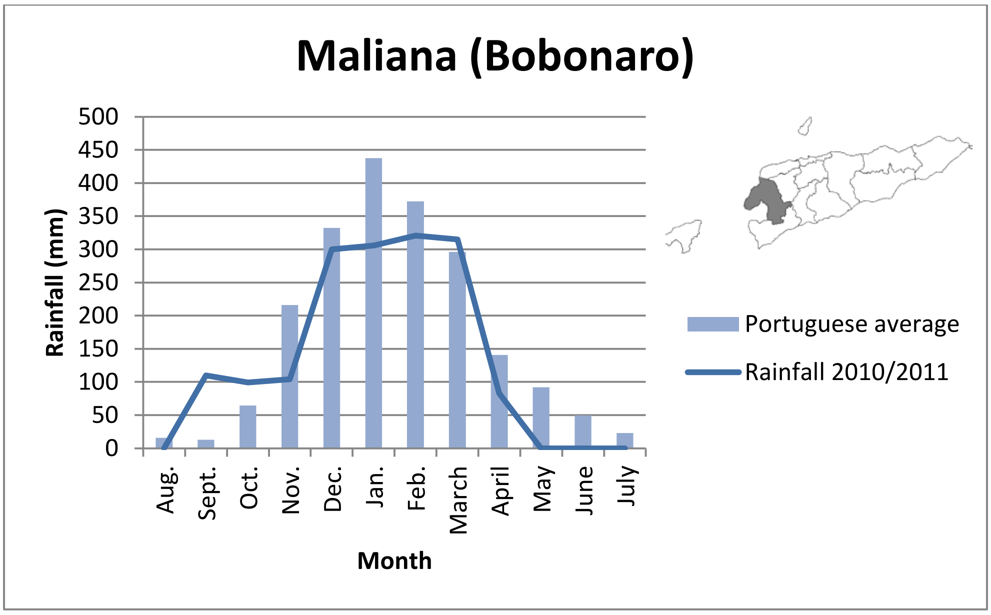


Figure 5. Rainfall in Maliana, Bobonaro, 2010/2011

As with other districts on the North coast, Liquica was dry in August but received above rainfall in the final quarter of 2010 (early in the 2010/2011 wet season) both in Maubara and at the MAF research station in Loes (Figure 6, Figure 7). The monthly rainfall was above average for most of the year in Maubara until the beginning of the dry season during which time it dried off (Figure 6). Towards the west of the District at Loes the rainfall in the month of January was particularly wet (Figure 7) but the remainder of the year was slightly below average. As in Maubara, the beginning of the dry season in Loes was also particularly abrupt.

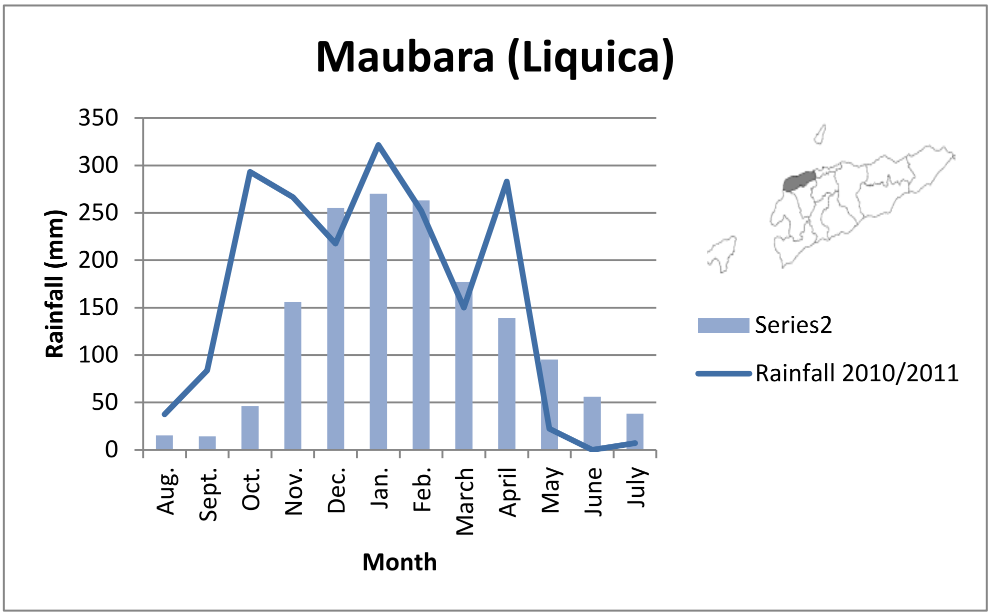


Figure 6. Rainfall in Maubara, Liquica, 2010/2011

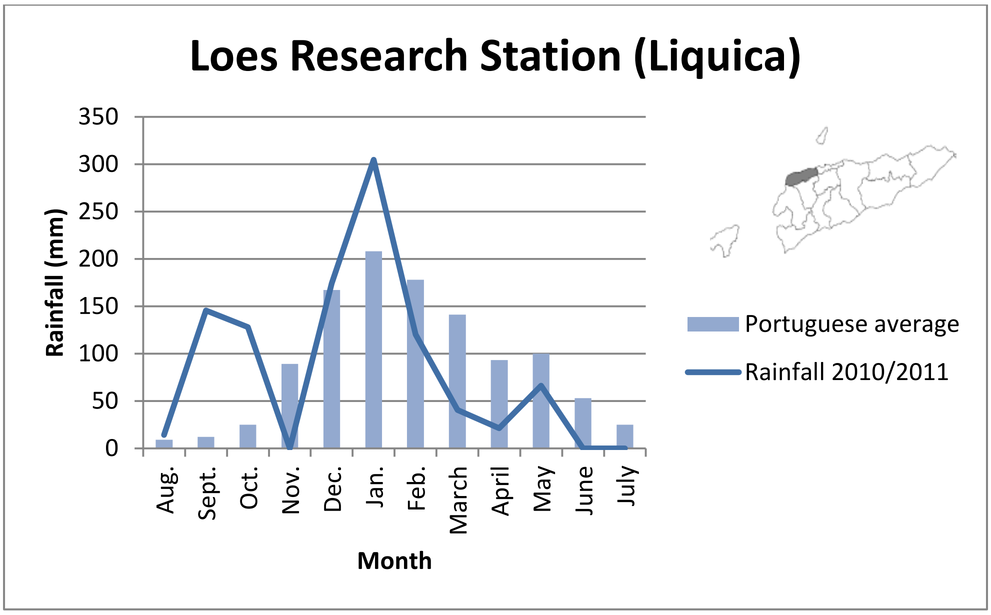


Figure 7. Rainfall at Loes research station, Liquica, 2010/2011

August was also dry in the East of the country on the North coast (Figure 8). In Ostico, Vemasse, Baucau the rainfall continued to be particularly high for the remainder of the wet season through to May, 2011 during which the weather dried (Figure 8)

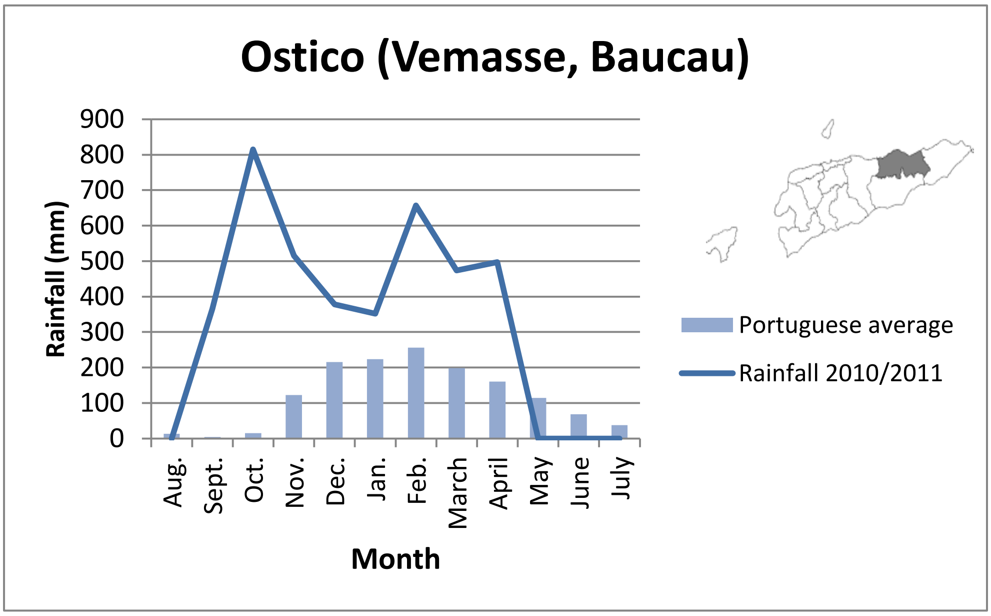


Figure 8. Rainfall in Ostico, Vemasse, Baucau, 2010/2011

Venilale's rainfall was one of the most 'normal' of all sites in 2010/2011 (Figure 9). The distribution and monthly rainfall were similar to the long-term average with less rain falling at the beginning of the wet season and at the end.

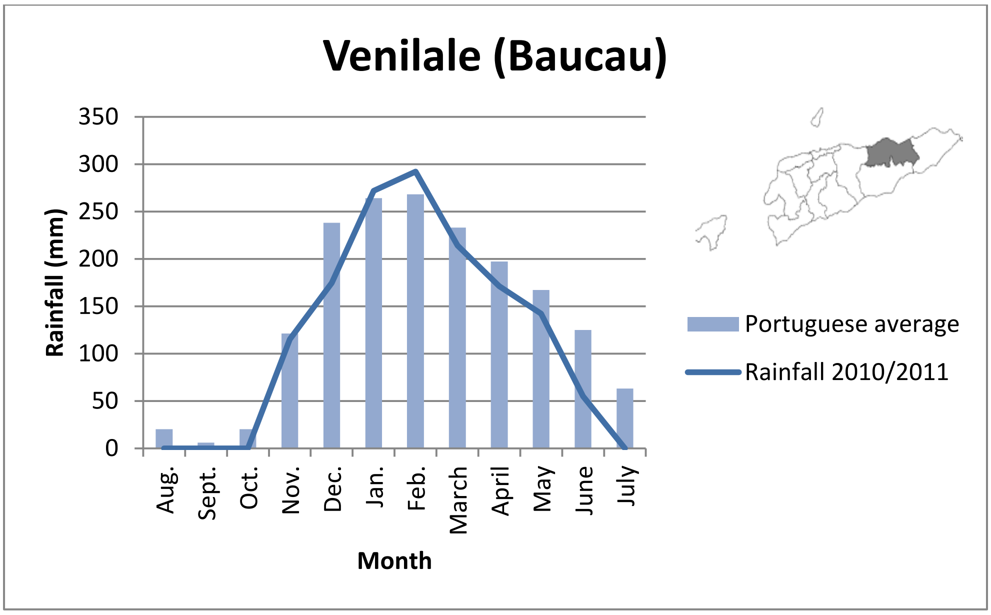


Figure 9. Rainfall in Venilale, Baucau, 2010/2011

Apart from a dry August, heavy rains leading up to November also prevented farmers from “burning off” in preparation for planting upland crops during the 2010/2011 wet season. The rainfall during the growing season in Viqueque (Figure 10) was more erratic than at other sites, However this can be expected in an environment experiencing a bimodal rainfall pattern as in Viqueque.

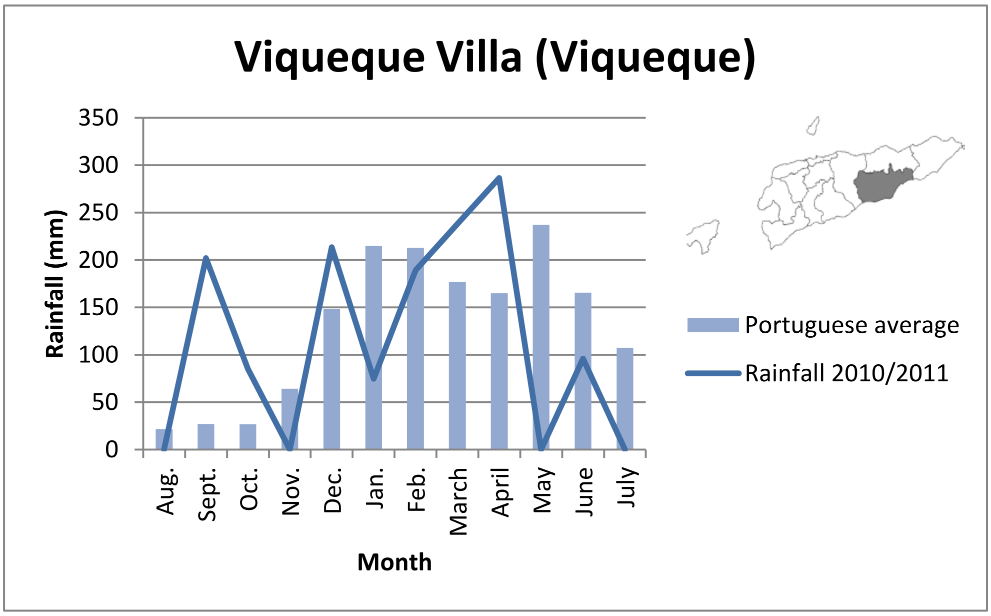


Figure 10. Rainfall in Viqueque Villa, Viqueque, 2010/2011

Rainfall Summary

The rainfall patterns compared with comparable means for each of the sites mentioned above are summarized in Figure 11. The name of the data collector is mentioned on the map. Twelve of the fourteen sites experienced a very wet start to the growing season but a normal dry season was expected for 2011. Bimodal rainfall patters are generally found on the South coast.

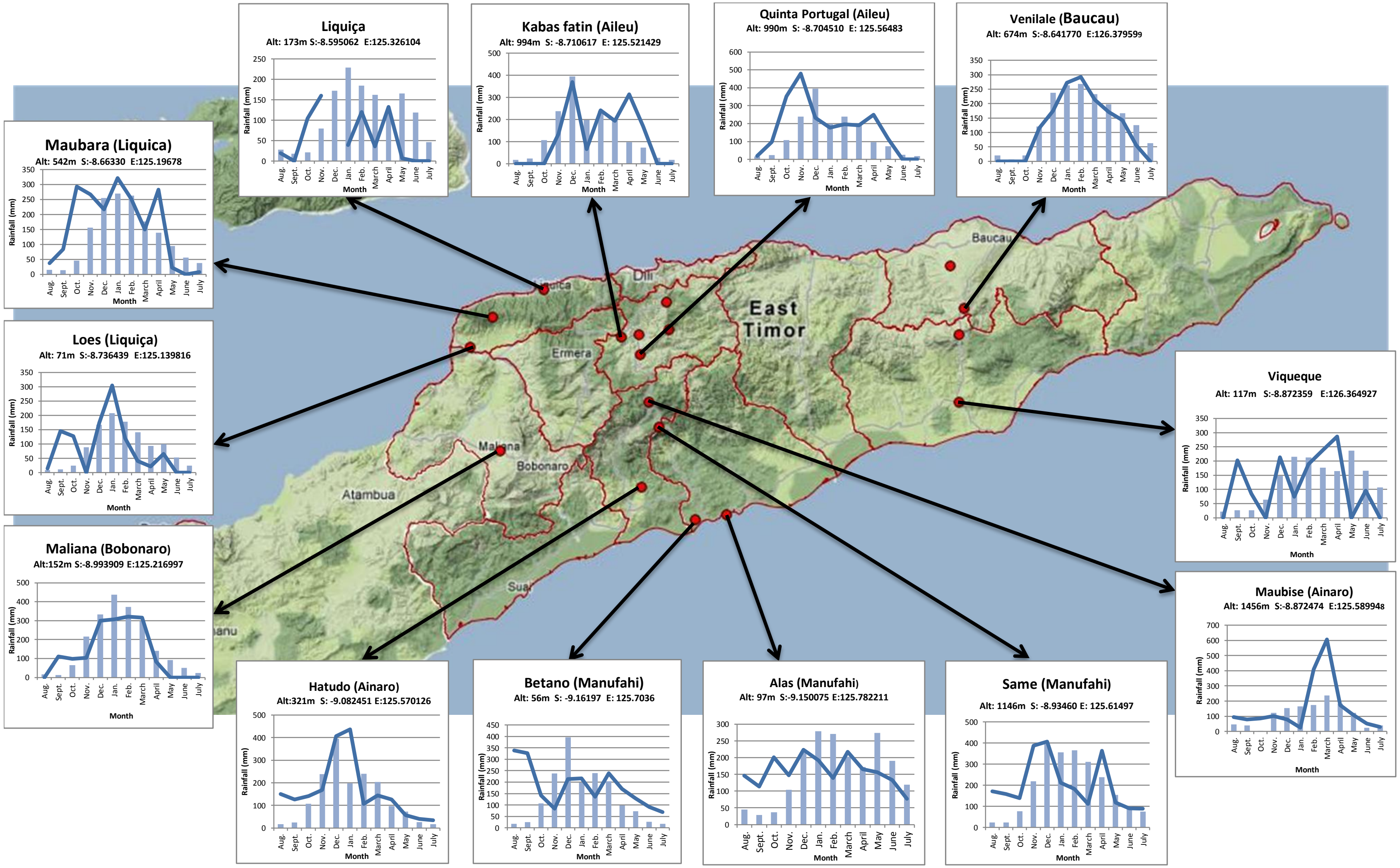


Figure 11. Summary of rainfall patterns in Timor-Leste during 2010/2011

2. Evaluation of new germplasm

2.1 Maize

2.1.1 Observation and replicated maize trials, 2010-2011

A new range of maize (*Zea mays* L.) populations were initially evaluated during 2010/2011. These 36 populations were sourced from CIMMYT Zimbabwe. A list of the names and their disease susceptibility are presented in Table 1.

Table 1. a) White maize populations and b) disease incidence in entries 2010/2011.

Number	*Variety*	*Code (following seasons)*	*Disease incidence at Loes, Wet season*	
			No. plants	Disease score*
1	07 SADVE		67	4
2	07 SADVE 2		59	4.5
3	07 SADVE 3	S07	No plants	
4	08 SADVE 2	S08	No plants	
5	08 SADVE 1		No plants	
6	081ROEE01		52	4-+
7	09 SADVE-F2	S09	No plants	
8	091ROEE01		65	4.5
9	091ROEE02		44	4.5
10	ECA-STRIGOFF-VE-209		45	3.5
11	L.LALICA		25	0
12	NYAVADZA		23	4
13	SC513		37	2.5
14	SCA-STRIGOFF-VL-133		37	4
15	V P082		9	0
16	VP 05191		32	3
17	VP041		5	0
18	VP0711	V11	8	0
19	VP0715	V15	No plants	
20	VP0717		19	0
21	VP0719		15	0
22	VP0720		23	0
23	VP0730		10	0
24	VP0735		6	0
25	VP0741	V41	2	0
26	VP077		15	0
27	VP083	V83	No plants	
28	VP084		4	0
29	ZM 401		59	2
30	ZM 432		31	2
31	ZM 523		36	0
32	ZM309		22	1
33	ZM421		30	2
34	ZM521		5	0
35	ZM525F LINT		23	2
36	ZMPOP1		16	1

*Score ranges from 0 (no disease to 5, sever symptoms on most plants

The population set represented a wide range of genetic material that may be appropriate to Timor-Leste. The populations included released varieties (e.g. ZM421, ZM521 and ZM523) in some African countries. These three released varieties have been identified as drought and acid soil tolerant. Quite a few of these populations have been evaluated in large multi environment trials in Africa, and are considered to be broadly adapted. Many of them have been selected under low nutrient conditions. All the populations have white grain, are open pollinated varieties and are public domain. As such, all can be used freely in Timor without any royalties being paid. Many of these populations have considerable resistance to diseases that are common Africa, such as Grey Leaf Spot. As Downy Mildew is not a major disease in Africa, the resistance of these new populations to Downy Mildew is unknown. However, an Observational Trial was conducted during the wet season of 2010-2011 to measure disease incidence in these newly introduced varieties.

Methods and materials

The initial testing of all 36 populations occurred in Betano during the second season (planted in May 2010), also known as the dry season. It was anticipated that these populations were early to mature, so a local short-season corn was chosen as the local control. However, the populations grew for a longer period than the local, so it is not used in the comparison. Due to the large number of entries, the plot size was restricted to 2.5 m wide and 3.75 long. Each plot consisted of 5 rows (at 75 cm spacing) and single seed hills, planted at 25 cm spacing. The experiment was fully replicated three times, in a randomised complete block design.

In the dry season trial at Betano, there was almost no disease observed in any of the entries. Most of the populations were then grown during the 2010/2011 wet season at Loes research station. Loes is a lowland site, that often shows a range of diseases of maize during the wet season. These observation plots were planted in December 2010, each population was planted as an unreplicated plot, 5 m long and 4 rows at 75 cm spacing.

Most severe disease symptoms were recorded in March 2011 after all the populations had flowered, but before leaf senescence. A wide range of observed symptoms were consistent with leaf rust, leaf blight, downy mildew, and cob smut. Each population was given a disease reaction score from 0 to 5, with 0 being no disease symptoms and 5 being all plants with major symptoms.

A series of 6 follow-up replicated trials were conducted in the 2010/11 wet season and 2011 dry season. The wet season trials were conducted at Betano, Aileu, Loes and Darasula research stations, and the dry season trials were conducted at Loes and Betano. Each trial consisted of 15 entries in a randomized complete block with three replicates, the plots being 5 m x 5 m in size.

Table 2. Name code and source of 15 entries used in six trials, 2010/2011

Code	*Full name*	*Source*
Har12	V036=PopDMRSRE(MOZ)F2	CIMMYT Zimbabwe
M45	Local Fatulurik	Timor-Leste
M47	Local Kakatua	Timor-Leste
P07	CMU Var 12	Philippines
P11	CMU Var 10	Philippines
P7H12	Cross of P 07 and Har 12	Timor-Leste
S07	07SADVE3	CIMMYT Zimbabwe
S08	08SADVE2	CIMMYT Zimbabwe
S09	09SADVE-F2	CIMMYT Zimbabwe
Sele	LYDMR	CIMMYT India
Suwan 5	Suwan 5	Thailand
V11	VP0711	CIMMYT Zimbabwe
V15	VP0715	CIMMYT Zimbabwe
V41	VP0741	CIMMYT Zimbabwe
V83	VP083	CIMMYT Zimbabwe

Seven rows were planted per plot with 75 cm row spacing and 25 cm between hills. Depending on seed supply, one or two seeds were planted per hill, which if required, were later thinned to one plant per hill. Gaps were reseeded in an attempt to achieve a consistent plant stands, though plant stand was highly variable. None of the trials were either fertilized or irrigated, with the exception of Aileu which had 15 kg N/ha and 15 kg P/ha applied to the trial at the three leaf stage. Wet season trials were planted from November 2010 to January 2011 and dry season trials were planted in May and June 2011 (Table 3).

Table 3. Planting and harvest details of maize varietal trials, 2010/11 and 2011

Location	*Season*	*Number of entries*	*Number of replicates*	*Planting date*	*Harvest date*	*Days to maturity*	*Mean yield (t/ha)*
Betano	Second	37	3	20/6/2010	06/10/2010	128	0.94
Betano	Wet	15	3	20/12/2010	06/04/2011	108	2.52
Betano	Second	15	3	13/06/2011	26/9/2011	118	2.08
Aileu	Wet	15	3	17/11/2010	30/5/2011	195	0.42
Loes	Wet	15	3	15/12/2010	14/3/2011	90	0.24
Loes	Dry	15	3	12/05/2011	12/9/2011	104	2.47
Baucau	Wet	15	3	14/01/2011	02/05/2011	109	0.05

Yield components

A number of parameters was recorded during plant growth, starting with emergence rates at 2-3 weeks. At harvest, the cobs of the two outside rows were dried separately and put aside for taste and weevil tolerance testing. Yield and yield components were evaluated from the five central rows. The numbers of plants and cobs were counted and the fresh weight of the latter measured. After drying, cobs were weighted again with and without sheathes. Total grain weights (after threshing) were recorded to calculate final yields and the weight of a random sample of 100 seeds recorded for seed weights.

The data of each trial were analysed separately using GenStat Discovery 4 in order to determine varietal effects. Yield advantages were calculated from the resulting predicted means over the average of the locals.

Correlations between genotype yield and the yield components were tested within each location using correlation coefficient.

Results

Disease symptoms in observational trial

Only some introduced varieties planted at Loes to observe disease incidence grew well in the wet conditions at Loes. However, the conditions were reasonable for the expression of fungal diseases. Eight of the tested populations showed severe disease symptoms, level of 4 or worse (Table 1). Generally the populations coded ZM showed very few disease symptoms, while the VP code populations were the least affected. Both of these codes are based on populations developed by CIMMYT, and had been selected for disease resistance. Some of these populations were particularly resistant to disease loads in Timor-Leste and will be used as part of the selection criteria for the national program. The genetic background of the populations that showed significant disease symptoms were unknown at publication.

Yields and yield advantages in replicated trials

In the initial trial at Betano during the second season in 2010, there were significant differences between test populations for grain yield, cob size and seed weight, but not for cobs per plant and plant density (Table 4).

Table 4. Yield and yield components 36 populations, Betano, dry season 2010.

Variety	*Yield (t/ha)*	*Cob size (g)*	*Weight 100 seed (g)*	*Cobs/plant*	*Plant density (plants/m²)*
VP0715	1.4	60	32	1.3	1.77
09SADVE-F2	1.3	53	33	1.2	2.00
07SADVE3	1.3	57	33	1.2	1.93
VP0711	1.2	65	27	1.2	1.67
VP0741	1.2	62	33	1.3	1.57
08SADVE2	1.2	47	38	1.2	1.93
ZM401	1.2	67	32	1.4	1.27
VP083	1.2	69	31	1.5	1.23
VP0720	1.1	59	32	1.4	1.33
ZM423	1.1	61	30	1.3	1.40
08SADVE1	1.0	50	36	1.3	1.63
VP077	1.0	50	32	1.3	1.67
ZM523	1.0	52	36	1.4	1.40
VP041	1.0	50	33	1.3	1.67
ZM525F LINT	1.0	49	30	1.3	1.80
ZM521	1.0	57	32	1.3	1.37
VP0717	1.0	41	33	1.4	1.67
VP0735	0.9	48	33	1.4	1.50
VP082	0.9	55	34	2.0	1.27
07SADVE2	0.9	41	29	1.3	1.63
ZM421	0.9	50	31	1.5	1.20
VP084	0.9	45	28	1.4	1.50
VP0730	0.9	43	35	1.3	1.53
091ROEE01	0.8	41	26	1.4	1.43
07SADVE	0.8	42	32	1.3	1.53
SCA-STRIGOFF-VL-133	0.8	51	27	1.3	1.30
SC513	0.8	41	30	1.3	1.53
VP0719	0.8	37	28	1.3	1.63
091ROEE02	0.8	37	33	1.3	1.90
ECA-STRIGOFF-VE-209	0.8	52	29	1.2	1.37
NYAVADZA	0.8	55	24	1.4	1.07
VP05191	0.8	64	33	1.3	0.97
081ROEE01	0.7	45	29	1.6	1.53
ZM309	0.7	40	27	1.2	1.47
ZMPOP1	0.3	24	29	1.6	1.20
L.LALICA	0.3	13	20	1.2	1.63
Mean	*0.94*	*49.2*	*30.8*	*1.35*	*1.51*
F.prob	*<.001*	*<.001*	*0.008*	*0.79*	*0.29*
LSD (P<0.05)	*0.31*	*20*	*7.1*	*ns*	*ns*
CV %	*21*	*25*	*14*	*15*	*28*

The average yield across all varieties was quite low (0.94 t/ha) as a result of a very low plant stand (1.5 plants/m^2) and some water stress during the season. Although the yield was relatively low, genotype yield ranged from 1.4 to 0.3 t/ha. The two lowest yielding populations were 2 local check varieties from Africa (ZMPOPI and L. Lalica), and the highest yielding populations were some of the improved entries.

The grain yield among the varieties was positively correlated with the average weight of cobs (g) and less tightly to 100 seed weight (Figure 12).

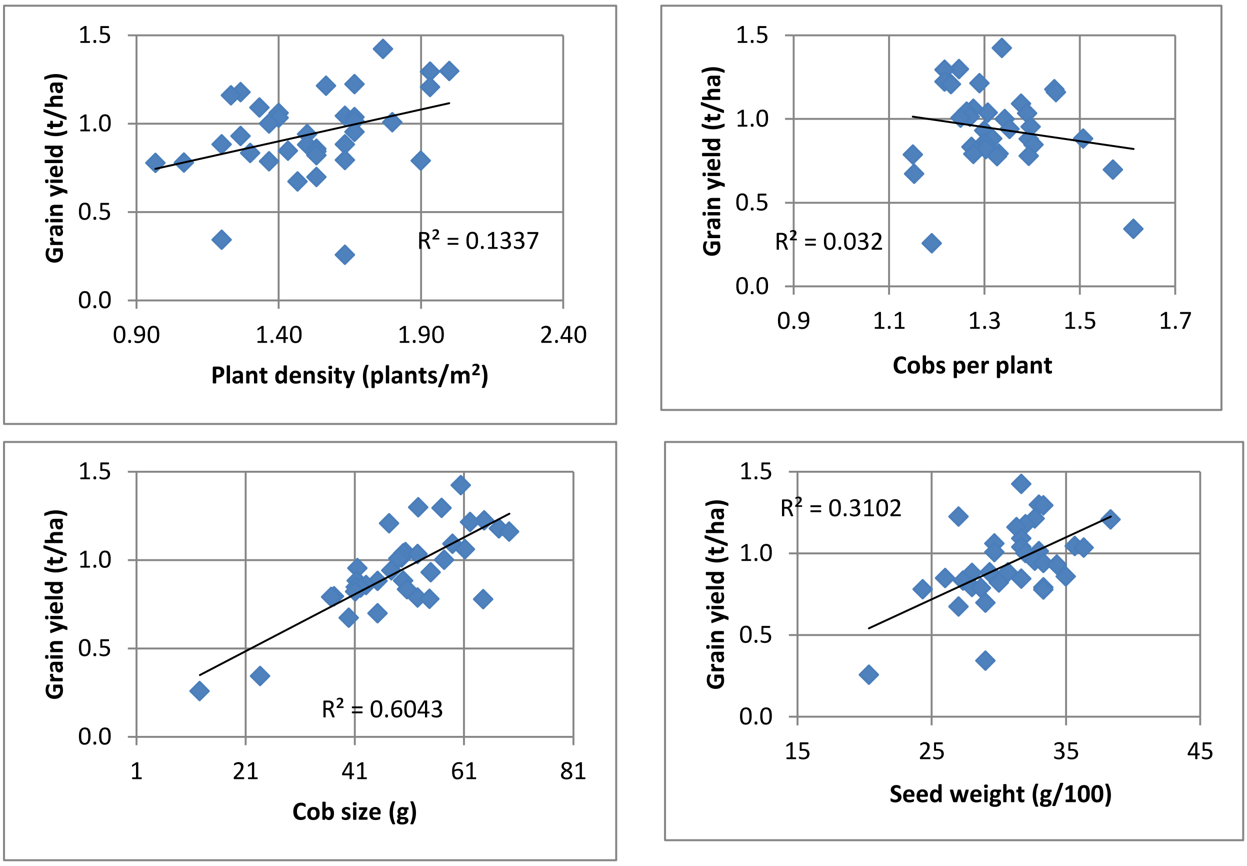


Figure 12. Correlation between yield and yield components for 36 maize populations.

Multi-location testing

Based on the testing of the 36 CIMMYT populations in Betano, 7 populations were continued into multi-location testing across four sites in the wet season and two sites in the second season in 2011. These were compared with currently released and other test varieties from Timor-Leste. The list of all genotypes are presented in Table 5. The local controls were M45 and M47.

Maize yields in Baucau were extremely low (mean 50 kg/ha). This was due to the late sowing in Baucau. It has been observed for many years that late sown maize crops in Baucau generally produce next to no commercial yield. The reasons for this are unknown, but for late planting (more than 6 weeks after first rain) the plants fail to thrive, are very short, often look wilted and only a small number of plants flower and produce cobs. There is generally no obvious external pest attack, but there is likely to be soil grubs, stem borers and possibly mites attacking the maize. Because of this, the results from Baucau were not used in estimating average yield performance. Yields in Loes were also very low (mean 0.24 t/ha), generally due to flooding at establishment that drastically reduced plant density. As a result of very low yields and a large resultant error at each of these two sites, their yields were not used in later analyses.

Table 5. Maize yields and yield advantages, four of six sites 2010/11

Variety	Grain yield (t/ha)							Yield Advantage (%)
	Loes wet	*Loes dry*	*Baucau wet*	*Aileu*	*Betano wet*	*Betano dry*	*Mean yield*[a]	
P07	0.09	2.9	0.02	1.0	3.2	1.9	2.3	40%
Sele	0.35	3.5	0.10	0.8	2.9	1.6	2.2	37%
P11	0.10	2.7	0.00	0.5	3.3	1.9	2.1	30%
V41	0.06	2.6	0.04	0.4	2.4	2.9	2.1	29%
Suwan 5	0.92	2.5	0.05	0.7	2.9	2.2	2.0	27%
V15	0.50	1.9	0.03	0.1	3.6	2.6	2.0	27%
V11	0.14	2.4	0.06	0.2	3.0	2.6	2.0	26%
V83	0.04	2.0	0.06	0.6	2.7	2.5	1.9	20%
S07	0.17	2.6	0.04	0.4	2.5	1.5	1.8	10%
S09	0.07	2.7	0.04	0.3	2.0	2.0	1.8	9%
M47	0.23	2.4	0.01	0.3	2.1	2.1	1.7	6%
S08	0.07	1.7	0.02	0.2	2.7	1.8	1.6	1%
P07H12	0.59	2.6	0.05	0.3	1.8	1.4	1.6	-3%
Har12	0.21	2.6	0.15	0.1	1.4	2.1	1.5	-4%
M45	0.13	2.2	0.08	0.4	1.4	2.0	1.5	-6%
Mean yield	*0.24*	*2.47*	*0.050*	*0.42*	*2.52*	*2.08*		
Local yield	*0.18*	*2.28*	*0.05*	*0.35*	*1.75*	*2.04*		
F.Prob	*0.13*	*0.14*	*0.060*	*0.37*	*0.01*	*0.06*		
LSD (P<0.05)	*ns*	*ns*	*ns*	*ns*	*1.12*	*0.86*		

[a] Does not include Baucau and Loes wet season.

There was significant variation in grain yield between the maize populations for both seasons at Betano and the dry season in Loes. At each of these sites grain yield was above 2.0 t/ha. Although there was no significant yield differences between varieties at Aileu, the data was still used in the combined yield analysis.

Mean yields across the four analyzed sites was highest for the two recommended varieties Sele and P07 (37 and 40% above locals respectively). Following the top two varieties, a number of the introduced populations showed a yield advantage of 20 to 30% above the local checks. These include the Philippine variety P11 (CMU Var 10) and recent introductions with the initial prefix VP. This list includes V41, V15, V11 and V83. The rest of the test populations had a yield advantage of 10% or less above the local checks.

Yield components

Maize yield and yield components for the four sites included in the multi-location testing analysis (Loes wet season, Aileu wet season, Betano wet season, Betano dry season 2010/2011 or 2011) summarized in Table 5 are presented are detailed in the Table 6, Table 7, Table 8 and Table 9 below.

At Loes during the wet season, maize yields were high averaging 2.5t/ha (Table 6). This can be attributed to the good plant populations at 3.3 plants/m^2 which yielded an average of 0.9 cobs/plant.

Although there was good plant establishment in Aileu (3.3 plants/m^2), the number of cobs/plant was less than half of that observed in Loes and Betano (Table 7). Cob size and number of seeds/cob were also reduced.

Table 6. Maize yields and yield components, Loes 2010/11

Variety	*Yield (t/ha)*	*Plants/m^2*	*Cobs/plant*	*Seeds/cob*	*Seed weight (g/100)*	*Cob weight, seeds only (g)*
HAR12	2.6	3.4	0.9	295	29	85
M45	2.2	3.7	0.8	240	30	72
M47	2.4	3.2	0.9	254	31	81
P07	2.9	3.9	0.9	277	30	84
P07H12	2.6	3.2	0.9	312	29	90
P11	2.7	3.8	0.8	284	32	90
S07	2.6	3.4	0.8	305	32	97
S08	1.7	2.9	0.8	246	30	74
S09	2.7	3.0	0.9	314	32	102
Sele	3.5	3.8	1.0	281	30	85
Suwan 5	2.5	3.7	0.8	250	30	75
V11	2.4	2.9	0.9	289	31	91
V15	1.9	2.4	1.0	268	30	81
V41	2.6	3.9	0.9	250	30	75
V83	2.0	2.5	0.9	284	31	89
Mean	2.5	3.31	0.89	277	31	85
F.prob	0.138	0.0	0.2	0.37	0	0.20
LSD (P<0.05)	ns	1.0	ns	ns	ns	ns

Table 7. Maize yields and yield components, Aileu 2010/11

Variety	*Yield (t/ha)*	*Plants/m^2*	*Cobs/plant*	*Seeds/cob*	*Seed weight (g/100)*	*Cob weight, seeds only (g)*
Har 12	0.1	1.6	0.3	198	18	35
M45	0.4	3.7	0.5	255	28	71
M47	0.3	3.6	0.3	201	34	68
P07	1.0	3.5	0.7	329	28	92
P11	0.3	1.6	0.5	251	29	72
P7H12	0.5	3.7	0.4	298	28	84
S07	0.4	3.7	0.4	253	38	97
S08	0.2	3.7	0.4	340	33	114
S09	0.3	3.9	0.3	211	38	81
Sele	0.8	4.0	0.6	286	28	80
Suwan 5	0.7	3.2	0.5	164	23	37
V11	0.2	3.5	0.4	223	20	44
V15	0.1	3.7	0.2	215	14	31
V41	0.4	3.7	0.3	285	31	90
V83	0.6	3.9	0.4	211	23	49
Mean	0.42	3.40	0.42	248	28	70
F pr.	0.37	<.001	0.451		0.889	0.157
LSD (P<0.05)	ns	0.69	ns		ns	ns

The differences in yield between entries in the trials conducted at Betano during the 2010/2011 wet season (Table 8) and the 2011 dry season (Table 9) were significant. Although there was poor plant establishment during the wet season (Table 8), each plant possessed one cob/plant on average and the cobs were large possessing a large number of seeds/cob. Sele, P07, V15, V11 and P7H12 performed well compared with the local controls P45 and P47.

During the 2011 dry season, the trial at Betano also yielded reasonably well (2t /ha) without fertilizer (Table 9). The plant density was higher than during the wet season trial, but the number of cobs/plant were similar. The lower yield during the dry season (2.0 t/ha compared with 2.5 t/ha) was due to a smaller cob size with less seeds/cob. Seed weight was also slightly reduced.

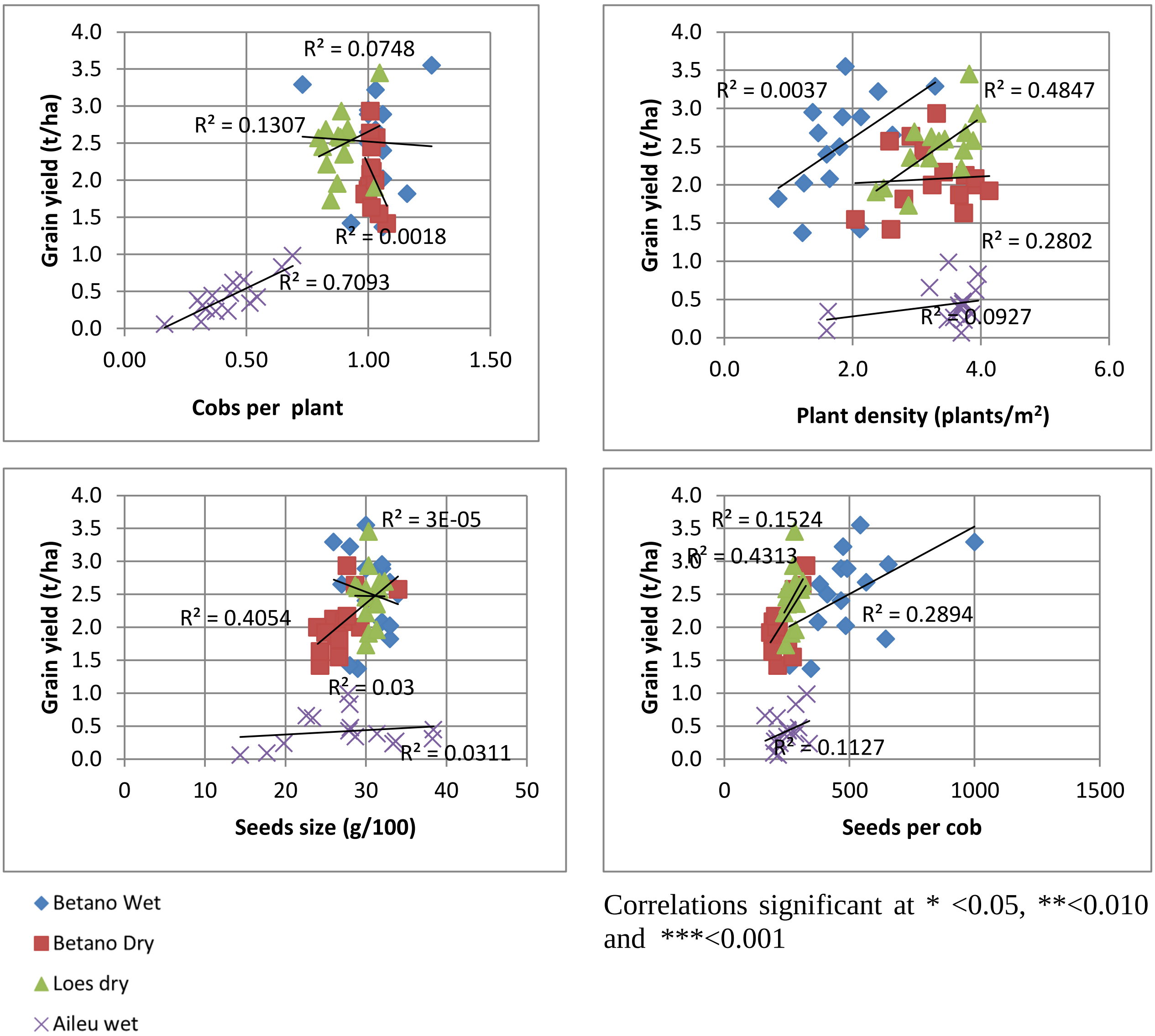
Table 8. Maize yields and yield components, Betano 2010/11

Variety	Yield (t/ha)	Plants/m^2	Cobs/plant	Seeds/cob	Seed weight (g/100)	Cob weight, seeds only (g)
H12	1.4	1.2	1.06	346	29	100.3
M45	1.4	2.1	0.93	261	28	73
M47	2.1	1.6	1.03	375	32	120
P07	3.2	2.4	1.03	475	28	133
P11	1.8	0.8	1.16	645	33	213
P7H12	3.3	3.3	0.73	1000	26	260
S07	2.5	1.8	1.00	412	34	140
S08	2.7	1.5	1.03	567	33	187
S09	2.0	1.2	1.06	485	33	160
Sele	2.9	2.1	1.06	467	30	140
Suwan5	2.9	1.8	1.00	491	32	157
V11	3.0	1.4	1.00	656	32	210
V15	3.6	1.9	1.26	543	30	163
V41	2.4	1.6	1.06	467	30	140
V83	2.7	2.6	1.00	381	27	103
Mean	2.5	1.83	1.03	505	30	153
F.prob	0.01	<.001	0.26	0.04	<.001	
LSD (P<0.05	1.12	0.7001	0.287	250	2.464	

Table 9. Maize yields and yield components, Betano 2011

Variety	Yield (t/ha)	Plants/m^2	Cobs/plant	Seeds/cob	Seed weight (g/100)	Cob weight, seeds only (g)
H12	2.1	3.8	1.0	215	26	56
M45	2.0	3.9	1.0	217	24	52
M47	2.1	3.9	1.0	194	27	53
P07	1.9	3.7	1.0	194	26	51
P11	1.4	2.6	1.1	213	24	52
P7H12	1.9	4.1	1.0	185	25	46
S07	1.5	2.0	1.0	272	27	72
S08	1.8	2.8	1.0	254	27	67
S09	2.0	3.2	1.0	209	29	60
Sele	1.6	3.7	1.0	194	24	47
Suwan5	2.2	3.4	1.0	204	28	57
V11	2.6	2.6	1.0	279	34	95
V15	2.6	2.9	1.0	312	29	90
V41	2.9	3.3	1.0	326	28	91
V83	2.5	3.1	1.0	263	30	81
Mean	2.08	3.28	1.02	235	27	65
F.prob	0.057	<.001	0.032	0.1	0.119	0.005
LSD (P<0.05	0.865	1.44	0.041	78.7	5.902	27.74

Various significant correlations between yield and yield components are presented in Figure 13. In Aileu, yield was correlated with cobs per plant, and plant density had a significant effect on grain yield in Betano and Loes dry season. As the size of the seed increased in the Betano dry season, so did grain yield, and the larger cobs resulted in higher yields in Betano at both the wet and dry season. No disease (including Downy mildew) damage was recorded in at any of the testing sites.



Correlations significant at * <0.05, **<0.010 and ***<0.001

Figure 13. Correlations between yields and yield components, maize 2010/11

Conclusions

The two recommended varieties (Sele and P07 were the top yielders in maize testing during the year. The yield advantage of these varieties was approximately 40% over the local controls. Although a number of recently introduced populations yielded better than the local populations, unfortunately, none of them were better than the newly released varieties.

2.1.2 Maize On-Farm Demonstration Trials 2010-2011

In the 2010-2011 wet season, On-Farm Demonstration Trials (OFDTs) were established in 13 Sub-Districts of Timor-Leste to test whether improved varieties could outperform local maize populations on farmers' fields under local agronomic conditions. The tested varieties were selected from previous research on four research stations around Timor-Leste and criteria included being white maize, open pollinated, downy mildew resistant, and weevil resistant. White maize is highly prized in the Western part of the country, and considered to be equally preferential to yellow maize in the East.

Materials and methods

Populations named Har12P07 and P07 were tested against the MAF released yellow variety Sele and a local check. P07 is a released variety from Central Mindanao University named CMU Var 12. P07Har12 is the third generation of a population cross between P07 and a population named Har 12 (full name: V036=PopDMRSRE(MOZ)F2) from CIMMYT Zimbabwe.

A total of 102 OFDTs were established across all the Agro-Ecological Zones (AEZ) in Timor-Leste, incorporating 13 Sub-Districts in the Districts of Aileu, Ainaro, Baucau, Bobonaro, Liquica, Manufahi and Viqueque. One or two researchers worked in each Sub-District and their target was to establish 15 maize OFDTs each. The 2010/11 growing season was difficult, particularly for maize crops, due to continuous and heavy rains in many areas of the country throughout the previous dry season. Conditions unsuitable for planting and crop failures were widely reported. Of the 102 OFDTs established, however, 86 successful harvests for each of the 4 tested varieties were recorded.

Each researcher used their own contacts to identify participating farmers. This was often through consultations with the Chefe de Suco, with MAF extension and other staff, or farmers that were already known to the staff.

MAF staff explained to farmers that the SoL program would not be giving away extra seed or fertilizer, but aimed only to trial the new varieties. The researchers were careful to explain that the evaluations were one of the stages of research and they were not sure how the varieties would perform. Limited amounts of seed were given to farmers and only a small area (5 m x 5 m) of each variety was planted.

The researchers gave 200 g seed packets of the test maize varieties to the farmers. Local varieties used at each site were chosen by collaborating farmers, and were generally the normal full-season maize variety grown on that farm. Local variety seed was supplied by the collaborating farming family, and therefore was unique to each test location.

Each OFDT site was marked out by string or bamboo by the researchers so that each variety was planted in a 5 m x 5 m plot. These plots were arranged side by side along contour lines. The order in which they were planted at each site was allocated randomly and there was no replication.

Generally, the researchers were present with farmers during planting. This was a goal but was not always possible to achieve due to the number of sites for which each researcher was responsible, but for the majority of sites it was realized.

Researchers visited the site an average of 6 times from planting to harvest. At each visit they recorded different information about the OFDT. These data collection protocols monitored progress of the trial/demonstration. In-season measurements included plant height, identification of pests and diseases in each plot, wilting and other plant symptoms.

At harvest, staff recorded the fresh weight of cobs from the whole plot (25 m^2). A sub-sample of 5 cobs was taken from the fresh cobs at harvest time, and only grain from these cobs were threshed and dried. The ratio of dried grain to the cob fresh weight was used to convert the total fresh weight of cobs to amount of grain weight per plot, and then converted to tons per hectare. Farmers kept the produce from each OFDT, except for the small sample taken for analysis.

Site characterization

Latitude, longitude, and elevation were recorded at all sites using a 12 channel GPS receiver (Garmin ETrex) to an accuracy of ± 6m. In addition, the slope of the land was defined at each site as was the orientation of the test location. Based on elevation and location, each site was allocated to a particular Agro-Ecological Zone (AEZ) (ARPAPET 1996). AEZs are numbered from 1 to 6, starting with 1 in the lowlands of the north coast to 6 in for the lowlands of the south coast (Table 10).

Table 10. Definition of the 6 agro-ecological zones in Timor-Leste

AEZ	*Location*	*Elevation*
1	Northern coast	0-100m
2	Northern slopes	100-500
3	Northern uplands	>500m
4	Southern upland	>500m
5	Southern slopes	100-500
6	Southern coast	<100m

All sites for OFDTs in the 2010/11 cropping season were tested for soil pH using Manutec test kits. The test kits are designed for in-field use. Composite samples of soil were collected from each plot and sieved through a 2 mm sieve to remove rocks, large clods etc. A small amount of soil was placed on a white slide and indicator fluid added. After thorough mixing, a white powder was added to the surface of the soil/indicator mixture. The white powder assumed the color of the indicator, and pH value identified by comparing that color with a standard color sheet.

Soil texture (Table 11) was estimated using a field based ribbon test method. Prior to testing, a handful of surface soil was sieved and water added to make a malleable bolus. This wet soil was formed into a round ball, and then attempts made to form a ribbon with the wet soil. The length of the ribbon (in cm) was measured and compared to a reference table which staff carried with them in the field, and the ability to form a U shape and a donut shape with the ribbon was used as a further indicator to describe soil texture.

Table 11. Determining soil texture characteristics.

Texture	*Description*	*Length of soil ribbon*
Sandy	The soil stays loose and separated, and can only be accumulated in the form of a pyramid.	Nil
Sandy Loam	The soil contains enough silt and clay to become sticky, and can be made into the shape of a fragile ball.	15-25 mm
Silty Loam	Similar to the sandy loam, but the soil can be shaped by rolling it into a small, short cylinder. Soil has a 'silky' feel.	25 mm
Loam	Contains almost the same amount of sand, silt and clay. Can be rolled into a 15 cm long (approximately) cylinder that breaks when bent.	25 mm
Clay Loam	Similar to loam, although the cylinder can be bent into a U shape (without forcing it) and does not break.	40-50 mm
Fine Clay	The soil cylinder can be made into the shape of a circle, but shows some cracks.	50-75 mm
Heavy Clay	The soil cylinder can be shaped into a circle, without showing any cracks.	>75 mm

From Agricultural Compendium for Rural Development in the Tropics and Subtropics' (1989) and B McDonald et al. (1990).

Analysis

Data from the protocols was first entered into an MS Excel spreadsheet database before being transferred for further analysis to GenStat Discovery Edition 3. Yield data were analyzed by ANOVA (Unbalanced Model) in a range of methods. The model of the analysis always included variety and AEZ as factors in the model once the other location factors of District and Sub-District had been tested. As elevation was shown to have an impact on crop yield between sites, elevation was included as a co-variate in testing across factors in the analyses.

The influence of a wide range of factors on maize yield was tested. In turn, each factor was added to the model, one at a time. If they were significant, the factor was kept in the model, and if they were non-significant the factor was discarded. Once a significant factor was identified, the interaction of that factor and variety was also tested for significance at the p = 0.05 level.

Results

Testing environments

OFDTs were conducted at a variety of elevations, soil textures, and soil pH ranges representative of the typical growing conditions in Timor-Leste (Table 12). The sites ranged from nearly sea level in Viqueque to over 1470m in Aileu. More low elevation (<150m) sites were tested than in previous years, and the majority of the sites fell between 550 m and 1150 m above sea level.

Table 12. Distribution of maize OFDT sites by elevation, 2008 to 2011.

Elevation (m)	*Locations 2008/09 (%)*	*Locations 2009/10 (%)*	*Locations 2010/11 (%)*
0-150	27	28	34
150-350	15	14	6
350-550	12	10	4
550-750	12	11	12
750-950	12	15	13
950-1150	10	11	16
1150-1350	7	4	7
1350-1550	3	5	7
>1550	2	2	0

Soil pH of the testing sites ranged from 5.5 to 8 with an average of 6.7. (Table 13) No sites this year fell into the most extreme levels of acid or alkaline soils, which follows a trend over the last several years in which increasing numbers of sites fall within a more desirable pH range. This suggests an increased ability of Sol researchers to pick suitable sites.

Table 13. Distribution of soil pH across maize OFDT sites 2008 to 2011.

Soil pH	*Locations 2007/08 (%)*	*Locations 2008/09 (%)*	*Locations 2009/10 (%)*	*Locations 2010/11 (%)*
4.5	2	1	0	0
5	3	2	2	0
5.5	9	12	6	10
6	11	18	18	19
6.5	13	18	30	22
7	24	14	19	25
7.5	9	14	16	19
8	15	16	7	5
8.5	12	9	1	0
9	3	2	0	0

Both soil pH and elevation differed statistically (Fprob <.001) among Sub-Districts, (Table 14) which has been the case for the last several years.

Table 14. Soil pH and elevation of maize OFDT locations, 2008 to 2011.

District	*Sub-District*	*2009-10*		*2010-11*	
		Elevation	*Soil pH*	*Elevation*	*Soil pH*
Aileu	Aileu	943	6.3	1166	6.1
Aileu	Laulara	1219	6.1	1285	5.5
Aileu	Liquidoe	1268	6.5	1255	5.8
Aileu	Remexio	988	5.9	1007	6.2
Ainaro	Hatudo	254	7.4	274	na
Baucau	Baucau	529	6.9	511	6.5
Baucau	Vemasse	497	6.6	781	7.1
Baucau	Venilale	830	7.5	770	7.3
Bobonaro	Balibo	150	7.1	31	7.2
Liquica	Liquica	291	6.7	169	6.9
Liquica	Maubara	181	6.9	27	7.4
Manufahi	Same	274	7.4	302	6.8
Viqueque	Viqueque	44	6.3	15	6.9

na Not available

Figure 14 shows the regression that higher elevation sites tend towards lower pH values. Data from recent years indicates that there is a decline in pH of approximately ½ to 1 pH unit per 1000m of elevation. The trend from this year's OFDT sites was stronger than in recent years with 63% of the variation in pH being explained by elevation. With the omission of Venelale and Vemasse where a large number of limestone outcrops have an alkalizing effect, 91% of variation among the Sub-Districts is explained by their elevation.

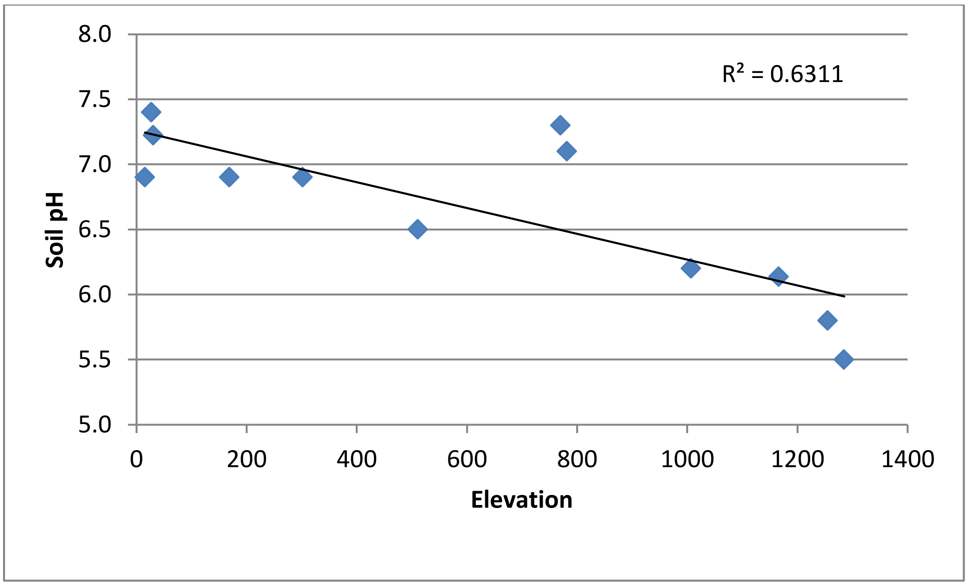


Figure 14. Effect of elevation on soil pH for maize OFDT sites, 2010/11.

All soil textures were represented in this year's trials, with sandy loam and clay loam being the most common types. (Table 15)

Table 15. Distribution of soil texture of maize OFDT, 2008-2011

Soil texture	*Locations 2009/10 (%)*	*Locations 2010/11 (%)*
Sandy	0	1
Sandy Loam	20	27
Silty Loam	11	13
Loam	14	14
Clay Loam	23	22
Fine Clay	23	15
Heavy Clay	8	8

Trial losses

Of 102 OFDTs planted, 16% were not harvested for reasons ranging from animal damage to drought. While this was similar to the number of losses in recent years (18%, 17%, 18%, and 25% over the last four years, respectively) the adverse conditions of the 2010/11 wet season prevented many trials from being planted and the total number of trials was lower. Reports from many areas of the country indicated that many maize farmers did not plant a crop due to high rainfall. Where trials were lost, the reasons were mainly predation by animals or plots not being harvested in the presence of Sol researchers.

Variety

Yields of the released yellow variety Sele were significantly higher than local maize populations. (Table 16) This was due to larger cob weights as was the case in all previous testing years. Among the white maize lines, cob size was also larger than the local.

Table 16. Yield components for OFDT maize varieties over all OFDTs, 2010/11

Variety	*Yield (t/ha)*	*Density (plants/m^2)*	*Cobs/plant*	*Seeds/cob*	*Seed weight/cob (g)*	*Seed weight (g/100)*
Local	1.53	5.02	0.81	170	42.0	29.4
Har12P07	1.77	5.07	0.81	196	48.9	29.4
P07	1.85	5.16	0.84	204	51.4	29.6
Sele	2.05	5.15	0.85	199	53.8	32.6
LSD ($P \leq 0.05$)	*.36*	*ns*	*ns*	*ns*	*8.1*	*1.6*
*Variety*AEZ LSD*	*ns*	*ns*	*ns*	*ns*	*ns*	*ns*
*Variety*District LSD*	*.96*	*ns*	*ns*	*ns*	*ns*	*4.69*

No interaction was found this year for yield or any yield component and AEZ. There was, however, a significant interaction between variety and district for both yield and seed size. The unusually large seed size found in local maize in Baucau district was similar to the seed size of modern varieties such as Sele and Arjuna. This suggests that modern varieties available to farmers are being planted as "locals" alongside the improved varieties in the trials. This is consistent with widespread distribution of modern varieties in the district by organizations such as MAF, FAO, AECID, World Vision, and local NGOs. By omitting Baucau district from this year's results, and thus comparing the introduced varieties to a more accurate representation of local maize, all three introduced varieties gain a substantial further advantage in yield over local varieties.

When compared using data from all districts, variety P07 just failed to reach a significant advantage over the local check and Har12P07 did not produce a significant difference in yield. With Baucau excluded, however, both varieties show a significant yield advantage over local maize. (Table 17) These increases were obtained without the use of fertilizer, pesticides, or any outside inputs and required no changes to the farmer's standard agronomic practices.

The performance of P07 was more impressive in 2010/11 with a yield advantage of 46% over the local compared to 40% in 2009/10. It had similar number of cobs per plant to Sele. While a slightly higher plant density was the main determinate for Sele outperforming P07 last year, cob weight gave Sele the advantage in 2010/11.

Table 17. Yield advantages with/without Baucau district 2010/11

Variety	*Yield (t/ha) all districts*	*Yield (t/ha) excluding Baucau*
Sele	2.05 (34%)	2.05 (54%)
P07	1.85 (21%)	1.95 (46%)
Har12P07	1.77(16%)	1.88 (40%)
Local	1.53	1.34
LSD (P<0.05)		0.39

Figures in brackets indicate yield advantage over Local variety

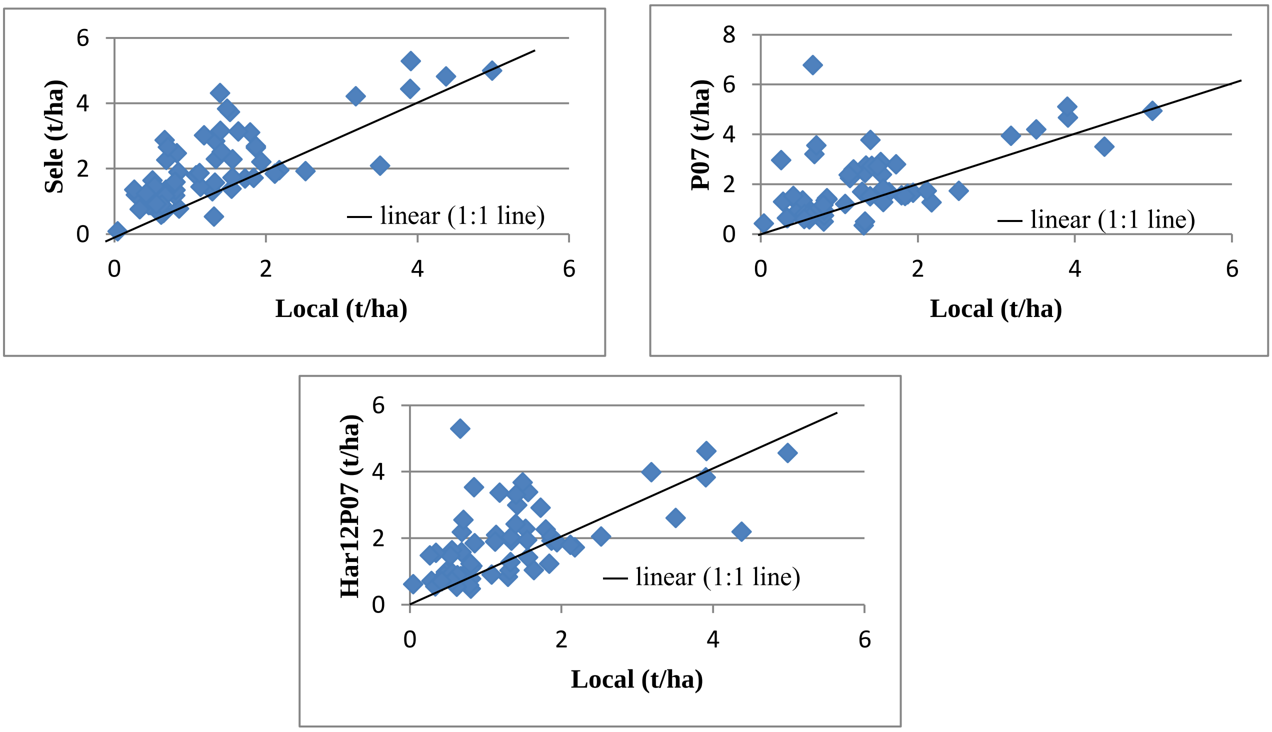


Figure 15. Yield of 3 test populations vs local population excluding Baucau, 2010/11.

The graphs in Figure 15 demonstrate the varying yield advantages of the improved varieties over local maize populations. In all three graphs, the majority of points lie above the linear 1:1 line plotted through the data points. This is a graphical representation of the results from the ANOVA, showing the yield advantages for Sele (54%), P07 (46%), and Har12P07 (40%).

Maize yields for local, Har12P07 and Sele tended to increase as plant density increased to 5 plants/m² and then leveled off thereafter, but the effect was not as clear as in recent years. P07 produced approximately the same yields across all densities. There was no statistically significant interaction between plant density and variety for yield, and therefore no reason to recommend different planting densities for the tested varieties.

Table 18. Effect of crop density on yield for OFDT maize varieties, 2010/11.

Plant density ($plants/m^2$)	*Local (t/ha)*		*Har12P07 (t/ha)*		*P07 (t/ha)*		*Sele (t/ha)*	
< 1	-	(0)	-	(0)	-	(0)	-	(0)
1 – 2	0.69	(4)	2.45	(2)	2.37	(4)	1.17	(2)
2 – 3	1.52	(12)	1.18	(12)	1.29	(8)	1.87	(9)
3 – 4	1.10	(18)	1.86	(14)	2.15	(20)	1.82	(21)
4 – 5	1.53	(18)	1.72	(23)	2.10	(18)	2.29	(17)
5 – 6	1.31	(12)	2.09	(14)	1.40	(16)	2.18	(14)
6 – 7	1.26	(9)	1.16	(8)	1.11	(5)	1.41	(8)
7 – 8	2.12	(1)	1.93	(2)	2.25	(2)	2.31	(4)
> 8	3.08	(11)	2.49	(11)	1.87	(13)	2.53	(11)

* Figures in brackets indicate the number of observations.

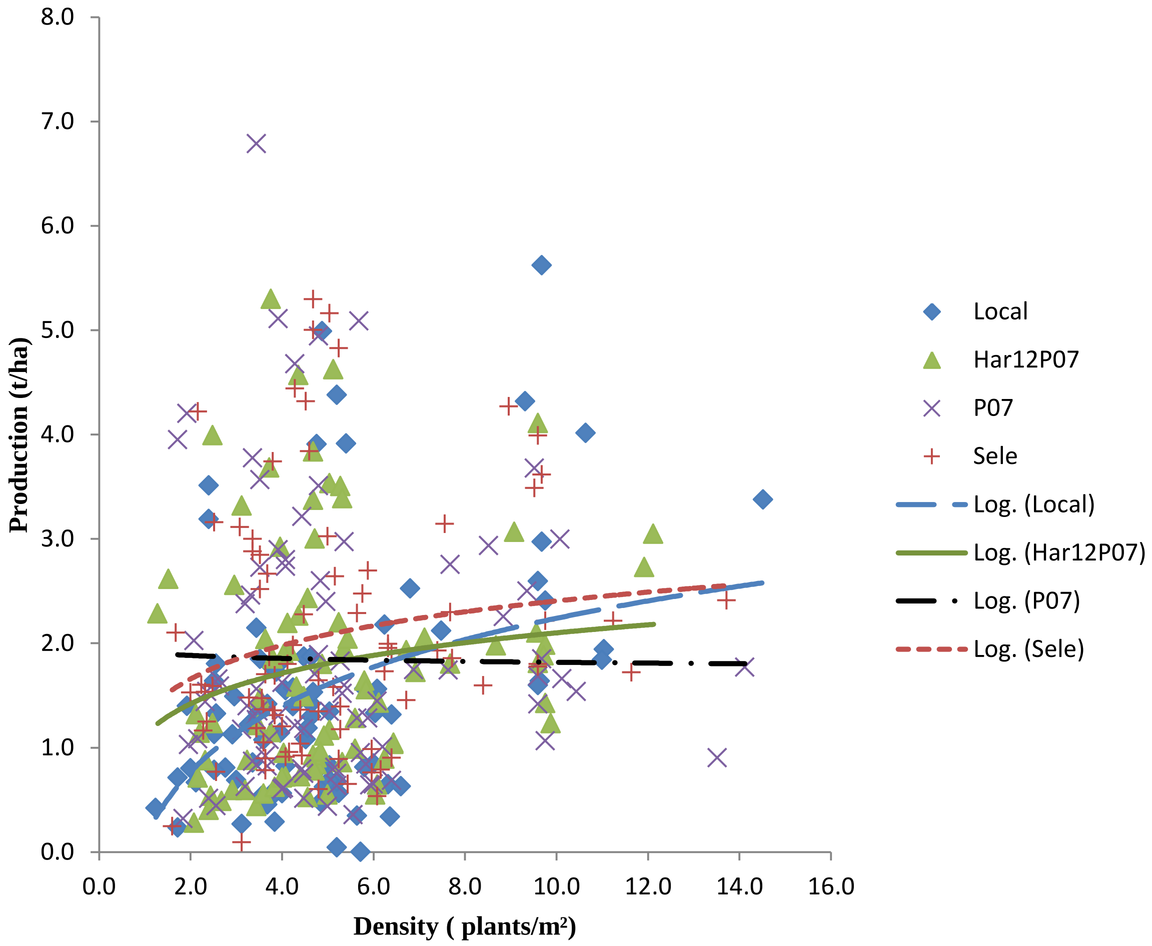


Figure 16. Regression graph comparing plant density and yield.

Districts

All introduced varieties produced the highest yields in Balibo Sub-District. (Table 19) Sele produced the lowest yields in Aileu and P07 in Baucau. Baucau Sub-District has produced the highest yields in two of the last four testing years. The highest yield advantages for both Sele and P07 were found in Viqueque, with Same and Hatudo also producing large advantages over local maize populations.

Both Sele and P07 produced a yield advantage when compared with the local check in each district, though both were marginally lower than local varieties in some Sub-Districts. (Table 19) Sele has maintained a 36% to 54% yield advantage over local varieties when tested on farmer's fields over all testing years. P07 has maintained approximately a 43% yield advantage over the last two years, which is double its performance in in 2008/9. As P07 had low plant stands in 2008/9, it is likely that he sharp increase in P07 yields after its first on-farm testing year is due to the high quality seed produced by SoL.

Table 19. Maize OFDT grain yield and yield advantage by Sub-District 2010/11

District	*Sub-District*	*Local (t/ha)*	*Har12P07 (t/ha)*	*P07 (t/ha)*	*Sele (t/ha)*	*Yield advantage Sele over local*	*Yield advantage P07 over local*
Aileu	Aileu	0.7	1.1	1.0	1.1	57%	43%
Aileu	Laulara	2.2	1.7	1.3	2.0	-9%	-41%
Aileu	Liquidoe	1.9	1.7	1.5	2.0	5%	-21%
Aileu	Remexio	2.0	1.8	1.7	2.0	0%	-15%
Ainaro	Hatudo	0.9	2.0	2.8	2.0	122%	211%
Baucau	Baucau	1.3	0.7	.9	1.4	8%	-31%
Baucau	Vemasse	1.4	1.0	1.4	1.4	0%	0%
Baucau	Venilale	3.4	2.5	2.3	2.9	-15%	-32%
Bobonaro	Balibo	3.2	3.4	4.2	3.9	22%	31%
Liquica	Liquica	1.4	1.7	1.4	2.1	50%	0%
Liquica	Maubara	0.9	1.2	1.2	1.5	67%	33%
Manufahi	Same	1.7	2.5	2.5	3.1	82%	47%
Viqueque	Viqueque	1.0	2.8	3.2	2.6	160%	220%
Average		*1.53*	*1.77*	*1.85*	*2.05*	*34%*	*21%*

Agro Ecological Zones (AEZ) and yield

Yields for all varieties in each AEZ are outlined in Table 20. Like previous years, there was no statistically significant interaction between AEZ and variety for yield. Yields for all introduced varieties were lowest in AEZ 2 and highest in AEZ 6, while local varieties produced their lowest yields in AEZ 4 and highest in AEZ 1. Average yields for improved varieties were higher on the South facing AEZs, while locals produced higher average yields on North facing AEZs. Sele produced a yield advantage over local varieties in all AEZs, and P07 outperformed the local in all but AEZ 3.

Table 20. Maize OFDT mean yield by AEZ, 2010/11

AEZ Class (See *Table 10*)	Local (t/ha)		Har12P07 (t/ha)		P07 (t/ha)		Sele (t/ha)		Yield advantage P07 over local (%)	Yield advantage Sele over local (%)
1 Northern coast	1.7	(22)	2.1	(23)	2.2	(23)	2.4	(23)	29%	41%
2 Northern slopes	1.1	(4)	1.3	(4)	1.2	(4)	1.6	(4)	9%	45%
3 Northern uplands	1.6	(44)	1.4	(44)	1.4	(44)	1.7	(44)	-13%	6%
4 Southern upland	0.8	(2)	1.8	(2)	2.7	(2)	2.1	(2)	238%	163%
5 Southern slopes	1.1	(4)	2.7	(4)	2.5	(4)	2.4	(4)	127%	118%
6 Southern coast	1.4	(9)	2.7	(9)	3.0	(9)	3.0	(9)	114%	114%

*Figures in brackets denote the number of trials harvested.

Elevation and yield

Figure 17 plots the yield for each variety against elevation. The similar slopes of the fitted lines for each introduced variety show the similar inverse relationships between elevation and yield. The slope of the local fitted line is somewhat different, however, indicating that elevation has less effect on yield for local varieties. Sele still outperforms local varieties to over 1,250 m, which represents the vast majority of growing areas in Timor-Leste, but the graph shows the extent to which local varieties are adapted to the varying elevations across the nation. The wide range of characteristics of the growing areas throughout the country present a challenge to new varieties, but the graph shows that yield advantages can be maintained over a wide range of elevations.

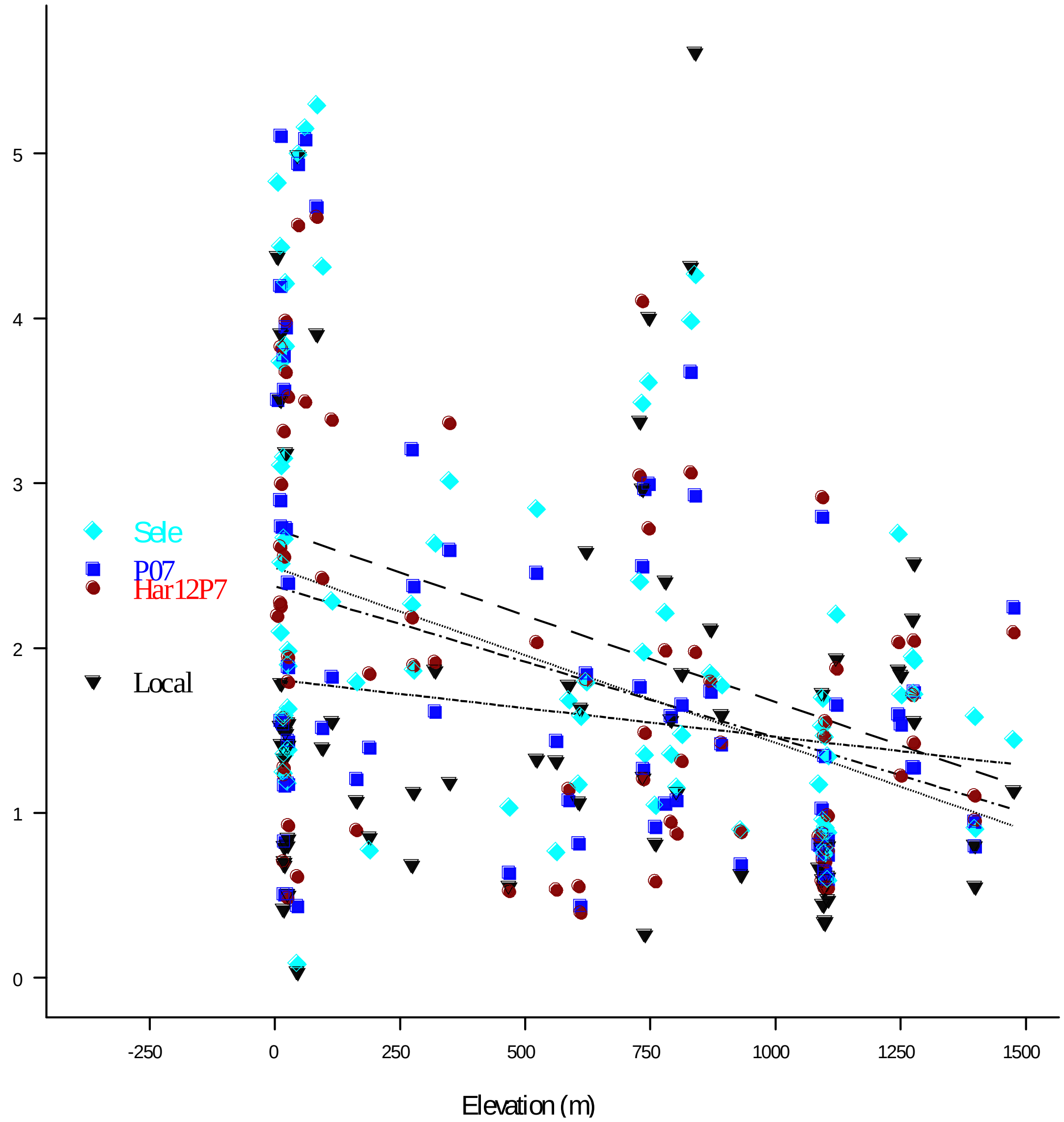


Figure 17. Regression graph comparing elevation and yield.

While the main purpose of OFDT research is to evaluate new varieties on-farm for release, it also provides the opportunity to study the effects of various agronomic factors and to evaluate their effect on yield. This provides valuable data on how Timorese farmers manage their maize crops and deal with barriers to production. Of all of the factors tested, only ‘mixed planting/monoculture’, ‘random/line planting’, and ‘soil pH’ proved not to be significant, the latter most likely due to the narrower range of soil pHs tested this year. See references presented in Section 10 for methodology.

Table 21. Various factors affecting maize OFDT yields, 2007-2010

Factor	*F pr. 2010-2011*	*Significant 2010-2011*	*Significant 2009-2010*	*Significant 2008-2009*	*Significant 2007-2008*
Variety	.029	✓	✓	✓	✓
AEZ	.062	✓	✓	✓	✓
Sub-District	<.001	✓	✓	✓	✓
Number of seeds per hill	<.001	✓	✓	✓	×
Planting distance	.003	✓	×	×	✓
Soil pH	ns	×	✓	✓	✓
Soil color	<.001	✓	✓	✓	✓
Soil texture	.011	✓	✓	✓	×
Number of staff visits	<.001	✓	✓	×	✓
Random or line planting	ns	×	✓	✓	×
Slope class	.001	✓	✓	×	×
Number of weeding events	.013	✓	✓	×	×
Mixed planting of monoculture	ns	×	✓	×	×
Gender of the head of household	.006	✓	×	×	×
Tools used for land preparation	.010	✓	×	-	-

Seeds per hill

Number of seeds planted per hill significantly affected maize yields. (Table 22) Past data has shown that the vast majority of farmers in Timor-Leste plant 2-3 seeds per hill and that optimum grain yields are typically produced at these planting densities.

Table 22. Influence of seeds per hill on OFDT maize yields, 2010/11.

Seeds per hill at planting	*Average yield of four tested varieties (t/ha)*	*Number of plots*
1	2.1	4
2	1.6	152
3	2.2	135
4	1.3	52
LSD (P<0.05)	*0.72*	

Soil pH

The range of soil pHs tested this year was narrower than in previous years (see Table 13), which accounts for this being the first year where soil pH did not achieve significance. As no sites were tested with extreme pHs, yields were more consistent across the tested range.

Table 23. OFDT yield by soil pH for all maize varieties, 2010/11.

Soil pH	5.5	6.0	6.5	7.0	7.5	8.0
Number of plots	28	64	64	88	71	16
Mean yield (t/ha)	1.3	1.3	1.9	1.9	2.3	1.8
LSD: ns						

Soil colour

Light brown soils were both the most commonly encountered and highest yielding soils in 2010/11. (Table 24)

Table 24. Effect of soil color of maize yield 2010/11.

Soil color	*Yield (t/ha)*	*Number of plots*
White	0.8	4
Red	1.6	84
Black	1.7	56
Dark brown	1.7	60
Light Brown	2.2	103
LSD (P<0.05)	*0.7*	

Soil texture

Except for sandy soils which produced low yields, the various soil textures did not differ significantly from each other. (Table 25) Fine clay soils produced the highest yields.

Table 25. Impact of soil texture on maize yield 2010/11.

Soil texture	*Yield (t/ha)*	*Number of plots*
Sandy	0.8	4
Sandy Loam	1.9	100
Silty Loam	1.8	43
Loam	1.7	48
Clay Loam	1.6	68
Fine Clay	2.1	48
Heavy Clay	1.9	32
LSD (P<0.05)	*0.66*	

Researcher visits to OFDTs

The number of researcher visits to OFDTs has a significant effect on yields (Table 26), as it has in all but one previous testing year. Researchers visited the sites from 2 to 11 times with an average of 6 visits. In other years, yield has increased with the number of visits, but that is not the case this year. Yields are similar for the range of 1 to 8 visits, and then reduce as the number of visits increases.

Table 26. Effect of number of researcher visits on farm maize yield 2010/11.

Number of visits	*Average yield (t/ha)*	*Percent of observations*
2	1.8	1
3	1.5	3
4	2.1	6
5	2.2	8
6	2.0	29
7	1.4	22
8	2.0	16
9	1.5	13
11	1.0	1
LSD (P<0.05)	*0.84*	

Farmer's preference for maize populations

Farmer field days were held during the harvest season in which farmers were asked to rate each variety according to a number of characteristics (Table 30) and whether each was a reason that would encourage them to replant each variety. Over 100 farmers participated in the field days, of which 62% were female. Sele continued to be highly valued for its cob size this year, with P07 also scoring well in this area. P07 scored highest for tightness of sheaths and was the highest ranked introduced variety in the weevil resistance category. Given the tremendous importance that Timorese farmers place on weevil resistance and similar responses in this category last year, this meets an important criterion in supporting the release of the variety. Also similar to last year were the nearly identical colour preferences for Sele and P07 suggesting that quality of color is important to Timorese farmers but that yellow and white maize are equally prized. Overall, P07 and Sele were highly ranked when compared to local maize, while Har12P07 tended to score lower.

Table 27. Farmer responses (%)* to maize varieties 2010/11.

Characteristic	*Har12P07*	*Local*	*P07*	*Sele*
Big cobs	19	21	86	100
Big kernels	27	13	81	77
High yield	34	15	90	100
Full cobs	40	44	75	100
Color	30	71	100	98
Tight sheaths	35	50	76	66
Taste	29	67	79	95
Weevil resistant	27	95	75	55
Wind resistant	25	32	79	90
Overall positive responses (%)	30	45	82	87

* Many farmers made more than one choice from each criterion.

Conclusions

After five years of research station trials and three years of testing on farms, it was decided that variety P07 should be recommended for release. The variety has consistently performed well with yield advantages around 40% compared to local maize. It has been rated nearly as highly as Sele by Timorese farmers, and its white color is often preferred over yellow maize by farmers in large areas of the country. P07 was accepted for release by the Variety Release Committee and was awaiting an official name at the time of this writing.

The released variety Sele continues to rate well both in yield and in farmer preference across all areas of Timor-Leste. Data across all testing years show that it is well adapted to the various conditions encountered across the nation and that it consistently outperforms local varieties regardless of elevation, soil conditions, etc.

2.2 Sweet potato

2.2.1 Sweet potato replicated trials, 2010-2011

Sweet potato (*Ipomoea batatas (*L.) Lamb.) clones tested by SoL have been introduced from the International Potato Centre (CIP) regional office in Indonesia over the past 10 years. Sweet potato variety trials have been conducted on a set of 12 clones (including 2 local checks) for a number of years, allowing the selection of three varieties for release in 2007 (CIP 01, 06 and 07 under the names of Hohrae 1, 2, 3 respectively).

Since the 2008-2009 wet season, additional sweet potato clones are being investigated in replicated trials and compared with local checks and with the Hohrae released varieties. Clones which performed well in previous observational trials are also being included, depending on the quantity of available planting material (see SoL 2010 for clone details)

Methods and materials

The 2011 replicated trials were conducted at Betano, Baucau, Aileu and Loes research stations. Each consisted of a randomized complete block design with three replicates, the plots being 5 x 5 m in size. Stems for planting were sourced from Loes. One cutting per hill was planted with a 100 x 50 cm spacing (i.e. 2 plants/m²). The trials were neither fertilized nor irrigated except in Aileu (15 kg/ha of N and P) where the lack of station area does not allow for fallow. Trials were planted in January and February 2011 and harvested between the end of May and August 2011 (Table 28).

Table 28. Planting and harvest details of sweet potato varietal trials, wet season 2011

Location	*Season*	*No. of entries*	*Number of replicates*	*Planting date*	*Harvest date*	*Days to maturity*	*Mean yield (t/ha)*
Aileu (K. Portugal)	Wet	15	3	15 /2/ 2011	17 /8/ 2011	183	8.0
Betano (Same)	Wet	16	3	06 /1/ 2011	23 /7/2011	198	12.5
Loes (Maubara)	Wet	15	3	27 /1/ 2011	30 /5/ 2011	123	4.7
Baucau (Fatumaka)	Wet	15	3	18 /2/ 2011	11 /7/ 2011	143	1.8

Yields, yield components and yield advantages

At harvest, the number of plants, the number and weight of tubers of various types and the total production were recorded for each plot.

In order to determine varietal effects, the data of each trial was analysed separately using spatial analysis modules under GenStat Discovery Edition 4. Depending on the presence of row and/or column effect in the yields, different tests were performed.

Table 29. Statistical tests used in the analysis of the 2010/11 sweet potato varietal trials

Station	*Row/col effects*	*Test*	*Type*
Aileu	Yes, Column	REML	AR1 Random on Column
Betano	No	ANOVA	One-way in Randomized blocks
Loes	No	ANOVA	One-way in Randomized blocks
Baucau	Yes, Column	REML	AR1 Linear on Column

Yield advantages were calculated from predicted means over the local averages. The existence and degree of correlation between the predicted means of the yields and of the other parameters were then identified using Simple Linear Regressions. As yields ranges differed greatly from one trial to another, individual regressions were run (as opposed to running regression over all data sets) in order to determine whether correlations were significant. The percentage of variability accounted for is equivalent to an adjusted R^2.

Farmers' preferences

Farmers' field days were conducted at Loes and Betano stations at harvest time in order to assess the farmer's preferences of sweet potato varieties and to determine the traits that farmer's value. The numbers of tested varieties (including two local) and participants are detailed in (Table 30).

Table 30. Sweet potato taste tests during farmers' field days, 2011.

Station	*No. of varieties tested*	*No. of participants*	*Proportion of women*
Betano	11	44	18 %
Loes	11	25	20 %
Total	14	69	17 %

As part of the field day, farmers inspected the freshly harvested tubers of all varieties. All the tubers of one replicate were displayed to allow the farmers to judge the yields as well as other characteristics for each variety. Afterwards, farmers were presented with boiled samples and asked to evaluate taste characteristics. Farmers were asked whether they generally liked the varieties and how sweet they were, this criterion being highly regarded to define the eating quality of sweet potato. Finally, all the participants were asked whether they were willing to plant the varieties.

To analyse farmers' preferences, Unbalanced ANOVAs were run checking for the effect of station, variety and gender. Correlations with Simple Linear Regressions were then calculated over the varieties predicted means.

Results

Yields and yield advantages

Yield variation across years was noticeable especially at Betano, usually the lowest yielding site on this occasion being by far the highest yielding (12.5 t/ha versus 6.4 t/ha on average). This can be explained by the unusual La Nina weather pattern experienced in this season. Betano, usually a drought prone site, received abundant rainfall between planting and harvest. Aileu also proved productive, probably aided by the small quantities of fertilizer applied.

Variation of growing conditions within individual sites was also found. This proved significant in both Aileu and Baucau with differences in production going across the research block. REML analysis rather than ANOVA was therefore used on data from these sites, which better accounted for differences in productive capacity within these sites.

The research site in Baucau changed from that used in previous years. Where land was rented at Fatumaka for previous years' research, a site acquired by MAF at Darasula Aldeia was used to conduct research for the first time in 2010/11. Although less than 4 km apart, the new MAF site was significantly different from the land at Fatumaka. Darasula was much more karst in nature with more variable soil depth compared to the universally deep soil found throughout Fatumaka. The new research area had been cleared of shrub just prior to planting. The aforementioned allied to late planting and a high disease (leaf scab) burden contributed to the Baucau site having by far the lowest yield in this season.

Table 31 presents the yields achieved at each site for all tested varieties as well as the corresponding yield advantages over the local checks.

Yield variation across years was noticeable especially at Betano, usually the lowest yielding site on this occasion being by far the highest yielding (12.5 t/ha versus 6.4 t/ha on average). This can be explained by the unusual *La Nina* weather pattern experienced in this season. Betano, usually a drought prone site, received abundant rainfall between planting and harvest. Aileu also proved productive, probably aided by the small quantities of fertilizer applied.

Variation of growing conditions within individual sites was also found. This proved significant in both Aileu and Baucau with differences in production going across the research block. REML analysis rather than ANOVA was therefore used on data from these sites, which better accounted for differences in productive capacity within these sites.

The research site in Baucau changed from that used in previous years. Where land was rented at Fatumaka for previous years' research, a site acquired by MAF at Darasula Aldeia was used to conduct research for the first time in 2010/11. Although less than 4 km apart, the new MAF site was significantly different from the land at Fatumaka. Darasula was much more karst in nature with more variable soil depth compared to the universally deep soil found throughout Fatumaka. The new research area had been cleared of shrub just prior to planting. The aforementioned allied to late planting and a high disease (leaf scab) burden contributed to the Baucau site having by far the lowest yield in this season.

Table 31. Sweet potato yields and yield advantages, 2010/11

Variety	*Yield (t/ha)*				*Average*			*Yield advantage (%) within site*			
	Aileu	*Betano*	*Loes*	*Baucau*	*St. dev.*	*Yield (t/ha)*	*Yield adv. (%)*	*Aileu*	*Betano*	*Loes*	*Baucau*
CIP 72	11.8	33.2	13.0	1.1	13.4	14.8	254	212	206	778	86
CIP 71	8.6	32.8	14.7	2.3	13.1	14.6	249	127	203	893	276
Loc. Mutin		*11.8*				*11.8*					
Hohrae 3	11.7	17.0	9.3	2.8	5.9	10.2	145	210	57	529	357
CIP 83	16.0	16.2	1.6	2.7	8.1	9.1	119	323	50	8	342
Hohrae 2	14.3	12.1	2.9	3.9	5.7	8.3	99	277	11	99	536
CIP 70	9.6	14.5	4.3	2.6	5.4	7.8	86	154	34	189	327
CIP 73	7.9	9.3	4.6	1.3	3.6	5.8	38	109	-14	210	112
CIP 77	12.6	6.1	1.1	2.5	5.2	5.6	33	232	-43	-28	300
CIP 68	2.5	7.7			3.7	5.1	22	-35	-29		
CIP 8			6.7	2.6	2.9	4.7	11			356	321
CIP 4			7.1	1.9	3.6	4.5	7			379	208
Loc. Atabae	*4.8*	*9.8*	*2.8*	*0.4*	*4.0*	*4.5*					
CIP 76	5.6	6.9	2.1	0.6	2.9	3.8	-9	49	-37	42	3
Hohrae 1	6.6	5.6	0.5	0.8	3.2	3.4	-19	74	-48	-63	34
Loc. Aileu	*2.8*					*2.8*					
CIP 65	3.2	3.0			0.1	3.1	-26	-16	-72		
CIP 78	2.5	0.8	0.4	0.2	1.0	1.0	-77	-34	-93	-74	-62
Loc. Loes			*0.1*	*0.8*	*0.5*	*0.5*					
F/Chi Sq. Prob..*	*<0.001**	*<0.001*	*<0.001*	*<0.001**							
LSD (P≤0.05)	*2.0*	*5.0*	*4.4*	*0.2*							
*%CV / F Statistic**	*5.7**	*24*	*56*	*6.3**							
Mean site	8.0	12.5	4.7	1.8	4.8	6.4					
Mean locals	*3.8*	*10.8*	*1.5*	*0.6*	*4.6*	*4.2*					

In 2011 with a yield advantage of 2.5 times the local varieties, test varieties CIP 71 and CIP 72 out yielded the released Hohrae 3, the highest yielding variety in previous years. Both test varieties were first trialled the previous year with CIP 72 being one of the top yielding varieties in that year also (CIP 71 had only one trial location in 2010). The next highest yielding after CIP 71 and CIP 72 were the top yielding varieties from the previous year, Hohrae 3 and CIP 83, both with yield advantages well over 100%. Another released variety, Hohrae 2 also performed well having a yield advantage of double the local varieties. Three test varieties as well as the introduced Hohrae 1 variety underperformed the local checks.

Yield components and other parameters

The predicted means for the yield components and other parameters associated with the yields are detailed in Table 32. Yield was divided into marketable and non-marketable. Non-marketable usually included tubers which were small or grew from secondary roots. The quantity of the latter tends to vary between varieties. Though not very saleable a sizeable proportion of the non-marketable component can still be consumed. What becomes apparent when examining the table above is that, invariably local varieties have a much greater proportion of production in this category compared with the introduced lines. Locals not only loose out to test varieties on production but also on the value of the product.

Table 32. Sweet potato yields and yield components, replicated trials 2010/11

Trial	Variety	Yield (t/ha)	Plants /m² at harvest	Tubers /plant	Weight of 10 tubers (kg)	No. of marketable tubers /plant	Weight of marketable tubers /plant (kg)	No. of non marketable tubers /plant	Weight of non marketable tubers /plant	Trial	Yield (t/ha)	Plants /m² at harvest	Tubers /plant	Weight of 10 tubers (kg)	No. of marketable tubers /plant	Weight of marketable tubers /plant (kg)	No. of non marketable tubers /plant	Weight of non marketable tubers /plant
AILEU	CIP 72	12	1.9	5.3	1.2	1.7	0.5	1.1	0.1	BAUCAU	1.1	1.9	1.4	0.4	0.5	0.0	0.9	0.0
	CIP 71	8.6	1.8	3.7	1.4	2.0	0.4	1.6	0.1		2.3	1.9	2.2	0.6	1.0	0.1	1.2	0.0
	Loc. mutin																	
	Hohrae 3	12	1.7	2.5	2.2	1.8	0.6	0.4	0.0		2.8	1.9	1.6	0.9	0.9	0.1	0.8	0.0
	CIP 83	16	1.9	4.3	2.1	2.4	0.7	1.7	0.1		2.7	2.0	1.8	0.7	1.1	0.1	0.7	0.0
	Hohrae 2	14	1.9	3.5	2.3	2.2	0.7	1.2	0.1		3.9	2.0	1.3	1.5	0.9	0.2	0.4	0.0
	CIP 70	9.6	1.9	4.4	1.1	2.5	0.4	2.3	0.0		2.6	1.9	1.8	0.8	0.9	0.1	0.9	0.0
	CIP 73	7.9	1.9	2.8	1.4	1.5	0.3	1.5	0.1		1.3	2.0	1.5	0.5	0.5	0.0	0.9	0.0
	CIP 77	13	2.0	4.7	1.5	2.2	0.5	2.0	0.1		2.5	1.9	1.9	0.7	0.8	0.1	1.2	0.0
	CIP 68	2.5	1.6	2.8	0.7	1.8	0.2	1.2	0.0									
	CIP 8										2.6	1.9	2.5	0.5	1.0	0.1	1.4	0.0
	CIP 4										1.9	1.9	1.6	0.6	0.8	0.1	0.7	0.0
	Loc. Atabae	*4.8*	1.5	*7.3*	*0.5*	*0.2*	*0.0*	*7.4*	*0.3*		*0.4*	*1.9*	*0.7*	*0.3*	*0.2*	*0.0*	*0.5*	*0.0*
	CIP 76	*5.6*	1.8	2.2	1.1	1.3	0.2	1.5	0.1		0.6	1.9	1.2	0.3	0.4	0.0	0.8	0.0
	Hohrae 1	6.6	2.0	0.9	2.6	1.0	0.3	0.0	0.0		0.8	1.9	0.6	0.8	0.2	0.0	0.3	0.0
	Loc. Aileu	*2.8*	*1.9*	*6.0*	*0.2*	*0.0*	*0.0*	*6.2*	*0.2*									
	CIP 65	*3.2*	1.7	1.2	1.4	0.9	0.2	0.3	0.0									
	CIP 78	*2.5*	1.8	1.6	0.5	0.4	0.1	1.4	0.0		0.2	2.0	0.6	0.2	0.1	0.0	0.4	0.0
	Loc. Loes										*0.8*	2.0	0.9	0.5	0.3	0.0	0.6	0.0
	MEAN	8.0	1.8	3.5	1.3	1.5	0.4	2.0	0.1		1.8	1.9	1.4	0.6	0.7	0.1	0.8	0.0
	F/Chi Sq Prob	*<0.001*	*0.025*	*0.002*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*0.003*		*<0.001*	*n.s.*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
	l.s.d. (p≤0.05)	*2.0*	*0.1*	*0.8*	*0.3*	*0.1*	*0.1*	*0.9*	*0.0*		*0.2*	*0.0*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*	*0.0*
	F Statistic	*5.7*	*2.6*	*4.8*	*7.3*	*5.0*	*6.9*	*6.5*	*4.4*		*6.3*	*0.8*	*11.4*	*5.2*	*6.4*	*5.1*	*5.9*	*8.9*
LOES	CIP 72	13	2.0	6.5	1.0	4.4	0.6	2.1	0.4	BETANO	33	2.0	10	1.7	3.0	1.0	7.1	0.7
	CIP 71	15	2.0	4.4	1.6	4.4	0.7	0.0	0.3		33	1.8	4.7	4.4	2.8	1.6	1.8	0.3
	Loc. mutin										*12*	*1.5*	*9.4*	*0.9*	*0.4*	*0.1*	*9.0*	*0.7*
	Hohrae 3	9.3	2.0	3.0	1.7	2.7	0.5	0.3	0.2		17	1.7	4.0	2.6	1.3	0.6	2.7	0.3
	CIP 83	1.6	2.0	1.5	0.5	1.1	0.1	0.3	0.1		16	2.0	4.8	1.9	1.0	0.4	3.8	0.4
	Hohrae 2	2.9	2.0	1.1	1.5	1.1	0.1	0.0	0.1		12	1.4	3.5	2.5	1.6	0.6	1.9	0.3
	CIP 70	4.3	2.0	2.2	0.9	2.2	0.2	0.0	0.1		15	1.9	5.1	1.6	1.5	0.4	3.5	0.3
	CIP 73	4.6	2.0	2.3	1.0	2.3	0.2	0.0	0.1		9.3	2.0	2.9	1.8	1.3	0.3	1.6	0.1
	CIP 77	1.1	1.9	0.7	0.7	0.7	0.1	0.0	0.0		6.1	1.9	2.1	1.5	1.0	0.3	1.1	0.1
	CIP 68										7.7	1.8	5.4	0.8	0.8	0.2	4.6	0.3
	CIP 8	6.7	2.0	4.3	0.8	4.3	0.3	0.0	0.3									
	CIP 4	7.1	2.0	3.6	1.0	2.7	0.3	0.9	0.2									
	Loc. Atabae	*2.8*	*1.9*	*4.1*	*0.4*	*0.0*	*0.0*	*4.1*	*0.1*		*9.8*	*1.5*	*13*	*0.5*	*0.0*	*0.0*	*13.4*	*0.7*
	CIP 76	*2.1*	2.0	1.4	0.7	1.4	0.1	0.0	0.1		6.9	1.9	2.7	1.2	0.6	0.2	2.2	0.2
	Hohrae 1	0.5	1.9	0.3	1.0	0.3	0.0	0.0	0.0		5.6	1.6	1.0	5.0	0.7	0.2	0.3	0.2
	Loc. Aileu																	
	CIP 65										3.0	1.6	1.2	1.0	0.1	0.0	1.0	0.1
	CIP 78	*0.4*	2.0	0.4	0.5	0.4	1.1	0.0	0.0		0.8	1.7	1.4	0.4	0.2	0.0	1.2	0.0
	Loc. Loes	*0.1*	*1.3*	*0.1*	*0.3*	*0.0*	*0.0*	*0.3*	*0.0*									
	MEAN	4.7	1.9	2.4	0.9	2	0.3	1	0.1		12.5	1.7	4.8	1.9	1.1	0.4	3.7	0.3
	F Prob	*<0.001*	*n.s.*	*<0.001*	*<0.001*	*<0.001*	*n.s.*	*<0.001*	*<0.001*		*<0.001*	*0.005*	*<0.001*	*0.025*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
	l.s.d. (p≤0.05)	*4.4*		*1.9*	*0.4*	*1.6*		*1.0*	*0.1*		*5*	*0.3*	*3.2*	*2.5*	*0.7*	*0.2*	*3*	*0.3*
	% CV	*56*	*15*	*47*	*25*	*49*	*169*	*110*	*53*		*24*	*11*	*41*	*81*	*40*	*24*	*49*	*58*

In Aileu and Baucau more than 75% of the tuber weight was deemed marketable whereas in the higher yielding sites of Betano and Loes this proportion was 55% and 69% respectively. There was poor correlation between overall yield and the proportion of marketable yield but the higher yielding varieties always tender to have the largest marketable quantity of tubers.

The released Hohrae varieties along with CIP 83 consistently produced the largest tubers. CIP 71 produced the second largest tubers in Loes and Betano. A strong and significant correlation was found between the yield and the tuber weight in only one station out of four (Baucau: R^2=0.65). Baucau and Loes displayed a strong R^2 for yield being dependent on the number of tubers per plant (Figure 18).

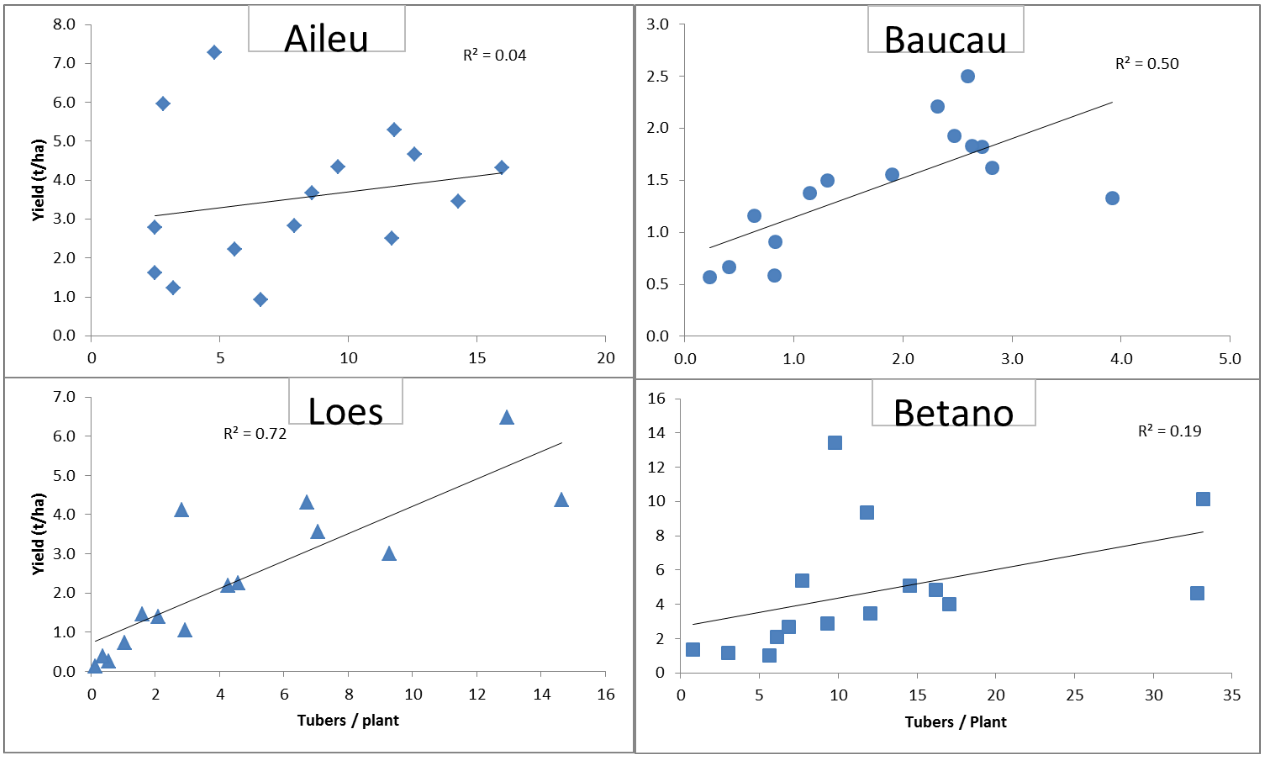


Figure 18. Correlations between yield and tubers per plant, sweet potato 2010/11

Farmers' preferences

Participants from the two field days ranked the varieties significantly differently. This may be due to differing personal tastes from the different areas or variation in the taste of the same variety grown and prepared at the two different stations. A gender effect on farmer opinion was not evident.

Table 33 presents the overall results for both farmer field days while Figure 19 displays the correlations between taste and overall perception.

Table 33. Farmers' preferences, sweet potato FFD results, 2011

Variety	*No. of stations*	*No. of respondents*	*Like (%)*	*Felt moist %*	*Felt crumbly (%)*	*Sweet (%)*	*Average yield (t/ha)*
CIP 8	1	25	80	12	68	80	6.7
CIP 70	1	69	80	16	61	82	9.4
CIP 4	1	25	76	52	60	68	7.1
L. Mutin	*1*	*44*	*75*	*16*	*64*	*74*	*12*
CIP 71	2	69	72	10	77	55	24
L. Loes	*1*	*25*	*68*	*56*	*44*	*60*	*0.1*
CIP 83	2	69	65	46	36	65	8.9
L. Atabae	*2*	*69*	*62*	*46*	*49*	*59*	*6.3*
Hohrae 2	2	69	59	14	61	45	7.5
CIP 72	2	69	57	67	35	70	23
Hohrae 3	2	69	48	55	42	52	13
Cip68	1	44	45	73	11	68	7.7
CIP 73	2	69	39	68	29	49	7.0
Hohrae 1	2	69	36	68	35	54	3.1
LSD (P<0.001)			*19*	*18*	*19*	*19*	
%CV			*81*	*101*	*101*	*79*	

FFD = Farmer Field Day

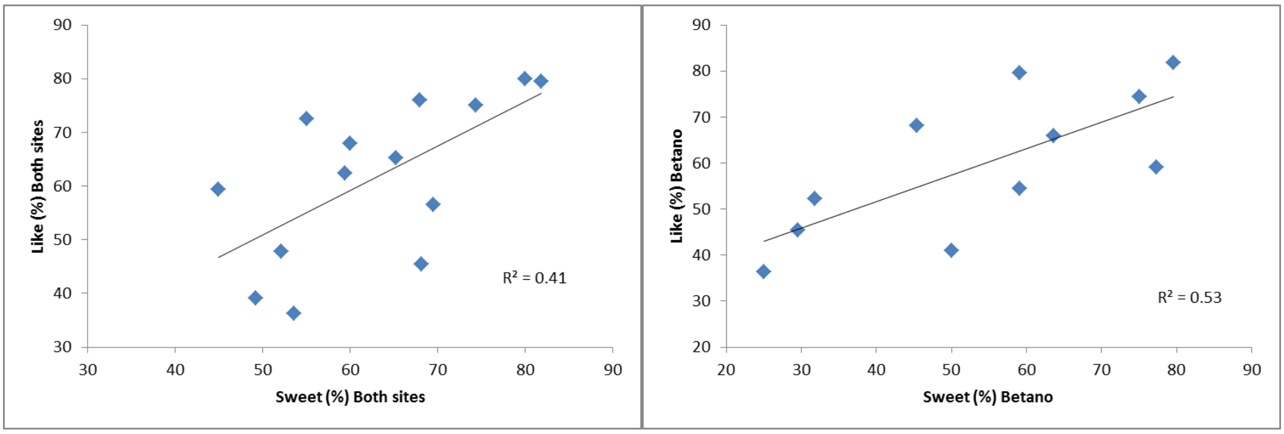


Figure 19. Correlations between farmers' perceptions of sweet potato varieties, 2011

Few strong relationships between the various qualities by which farmers ranked the different varieties were found in 2011. Yield performance had almost no correlation with the number of farmers that liked a variety. There was generally a good correlation between the proportion that liked a variety overall and those which found that variety sweet to taste Figure 19. This was particularly the case for the field day conducted at Betano research station.

Conclusions

The top four ranked varieties were rated only at one of the sites. This goes a long way to explain a station interaction when all data was analysed together. CIP 71, the highest ranked variety tested at both sites had the best yield of 24 t/ha averaged over the two stations (Betano and Loes). CIP 72, the highest yielding variety overall (4 stations) ranked low in the combined taste tests. It did however rank in 5th position at the Betano field day. Both of these varieties ranked better overall than Hohrae 3 which has a history of wide acceptance by farmers and holds good promise for further investigation.

2.2.2 Sweet potato multi-year and multi-location trial analysis

Materials and methods

23 successful sweet potato variety trials were implemented by SoL over the period from 2005 to 2011 (6 years) at 6 different sites (Aileu, Betano and Baucau x 2, Maliana and Loes), testing the performances of 21 varieties (including 3 local varieties as controls). Some varieties were not included in all trials and some trials were not conducted at every site every year.
The dataset containing the majority of the varieties is presented in Table 34. It comprises 238 data points, i.e. variety per environment combinations. An environment (here synonymous of trial) is defined by the site, year and season (for instance Betano wet season 2009, Loes wet season 2010, etc.). All data points are ANOVA or REML predicted means from 3 replicates, 2 in some cases.

Cross-site analysis was conducted using the GGE BiPlot program in order to evaluate the performances and consistency of the tested varieties across years and locations (genotype / environment). With new lines being tested for the first time in 2010, data was chosen which examined how the best of these varieties compared against more established Hohrae and local varieties across both years on the different stations. This allows easy visualisation of the yield ranking and its variability between sites in different years.

Table 34. All SoL sweet potato replicated variety trials over 2005-2011 (238 data points)

Yield (t/ha) /trial Variety	W06 AIL	W06 BAU	W06 MAL	W07 AIL	W07 BET	W07 MAL	W08 AIL	W08 BET	W08 BAU	W08 MAL	W09 AIL	W09 LOE	W09 MAL	W09 BET	W09 BAU	W10 AIL	W10 BET	W10 LOE	W10 BAU	W11 AIL	W11 BET	W11 LOE	W11 BAU	No. Trials	St. dev.	Ave yield (t/ha)	Yield adv. (%)
CIP 02	2.0	0.0	1.4	13.5	0.6	2.6	6.2	9.5																8	4.8	4.5	-40
CIP 03	2.7	2.2	2.8	14.2	0.3	0.8	9.7	2.6	3.5	9.9														10	4.7	4.9	-33
CIP 05	2.8			10.6	0.1	0.4	15.6	0.2		0.8														7	6.2	4.4	-42
CIP 15	10.2		1.7	18.5	0.6	2.3	28.5	11.0			2.7			10.3	3.1									10	8.9	8.9	9
CIP 04			2.0	34.9		0.3	28.4	11.4	6.9	10.4	10.2	30.0	4.4	18.1	9.7	12.7	2.8	1.4	2.5			7.1	1.9	18	10.5	10.8	46
CIP 08	23.5	2.2		16.7	0.0	1.3	26.0	17.0			10.5			11.6	3.6	5.8	3.6	7.3	6.8			6.7	2.6	16	7.9	9.1	29
CIP 17	11.1		0.1	42.4	0.7	0.3	17.9	0.5	2.9		11.1	9.7	1.6	4.4	3.9	11.4	1.1	10.5	2.9					17	10.4	7.8	8
Hohrae 3	4.8	1.3	3.6	26.5	5.2	1.9	20.5	23.3	6.8	12.8	20.4	35.9	4.8	30.2	6.6	20.5	1.0	12.1	4.3	11.7	17.0	9.3	2.8	23	10.1	12.3	76
Hohrae 2	24.1	4.8	5.6	23.9	1.7	2.7	23.7	8.1	5.7	9.8	18.7	24.3	5.6	15.6	4.8	11.4	1.1	7.6	6.3	14.3	12.1	2.9	3.9	23	7.8	10.4	48
Hohrae 1	16.8	2.8	0.3	29.6	2.8	0.1	30.1	14.2	5.8	8.3	18.1	7.3	5.3	12.5	2.8	17.2	0.6	1.3	1.1	6.6	5.6	0.5	0.8	23	8.9	8.3	18
L. Mean		*0.7*		*9.8*			*16.1*	*1.7*				*3.5*	*0.6*	*5.2*	*0.5*	*28.2*	*2.1*	*2.4*	*0.4*					*12*	8.4	5.9	-15
L.Mutin		*0.6*	*2.4*	*8.7*			*25.3*	*1.9*			*26.7*	*0.9*		*32.9*	*0.7*	*10.4*	*2.9*	*0.1*	*0.1*		*11.8*			*14*	11.3	9.0	22
L. Atabae											*Total no. of data points:238*					*15.4*	*1.4*	*6.5*	*0.8*	*4.8*	*9.8*	*2.8*	*0.4*	*8*	5.2	5.2	-11
CIP 70											*(including 14% locals)*					9.9	1.1	4.0	2.2	9.6	14.5	4.3	2.6	8	4.8	6.0	2
CIP 72																3.7	11.4	12.8	2.9	11.8	33.2	13.0	1.1	8	10.1	11.2	89
CIP 73																12.8	1.2	8.7	2.6	7.9	9.3	4.6	1.3	8	4.3	6.0	2
CIP 76																4.5	1.3	7.2	1.5	5.6	6.9	2.1	0.6	8	2.7	3.7	-31
CIP 83																16.9	2.6	10.6	4.4	16.0	16.2	1.6	2.7	8	6.8	8.9	46
CIP 64																	0.6	2.5	0.8					3	1.1	1.3	-29
CIP 66																4.9								1		4.9	-95
CIP 71																	1.7			8.6	32.8	14.7	2.3	5	12.8	12.0	263
Mean site	10.9	1.8	2.2	20.8	1.3	1.3	20.7	8.5	5.3	8.7	14.8	15.9	3.7	15.6	4.0	12.4	2.3	6.3	2.6	9.7	15.4	5.8	1.9	11.3	7.4	7.4	17.3

Notes: AIL = Aileu, BET = Betano, BAU = Baucau, MAL = Maliana, LOE = Loes. W06 = wet season 2005-2006.

Results

The average yield of the entire dataset (23 environments, 238 data points) was 7.4 t/ha (st.dev. = 7.4). Yield averages from trial to trial varied from 1.3 t/ha to a maximum of 20.8 t/ha (wet seasons 2007 of Aileu and Maliana respectively), with about half the sites performing within 2.5-12.5 t/ha. Across the previous 5 years, the Aileu site tended to be the only site that performed over 10 t/ha with the other sites recording lower average yields. However in 2011 the station at Aileu failed to average double figures on yield with Betano comfortably more than this.

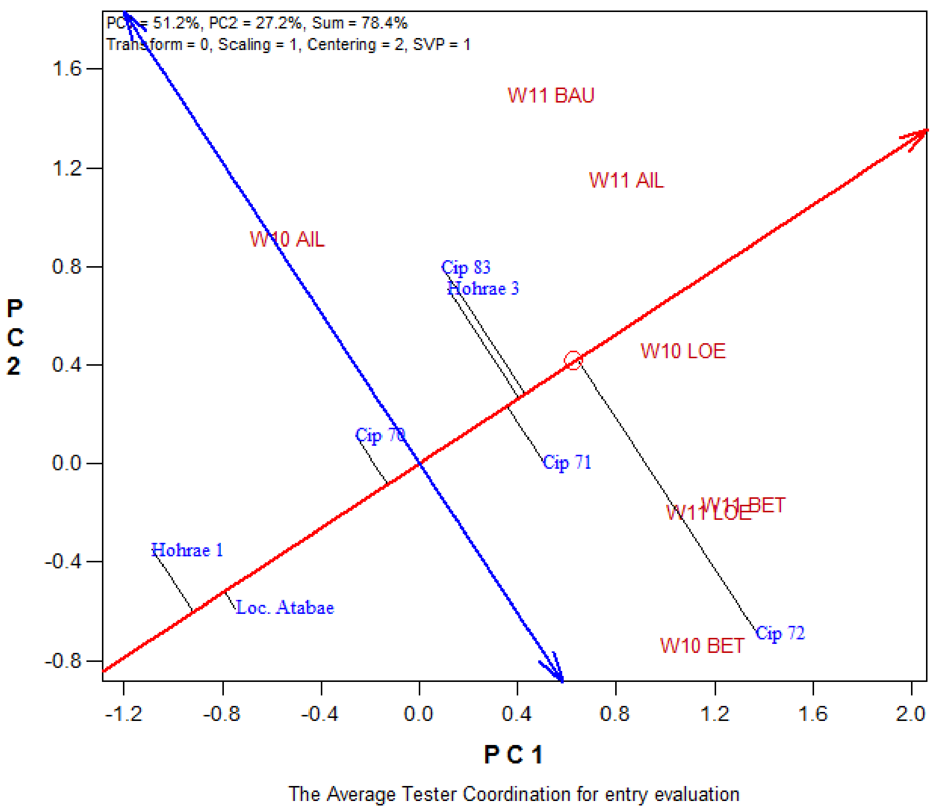


Figure 20. Biplot analysis (7 varieties in 7 environments), 2010-2011

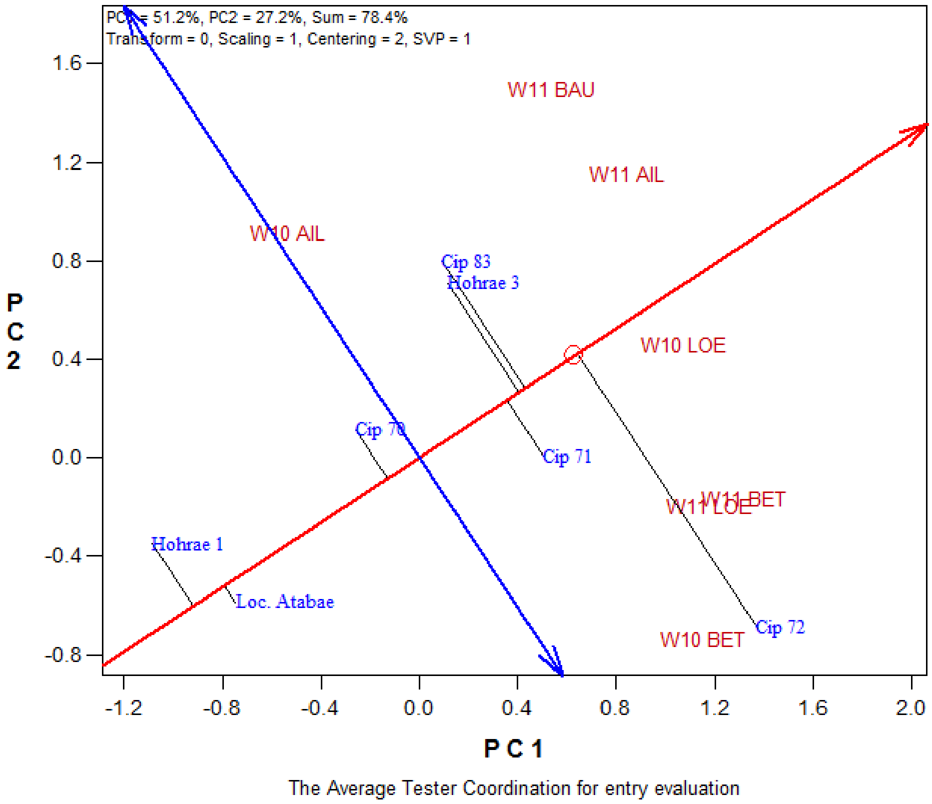


Figure 20 In Figure 20, the biplot which investigates the performances of 7 varieties in 7 environments plotted along with the 'means versus stability'. The results, which represent 78% of the observed variation, show CIP72, CIP 83, Hohrae 3 and CIP 71 to outperform the other varieties. While CIP 72 was the best performing overall it was also the most variable given the length of its scalar line. Both CIP 71 and 72 proved to have an advantage at the lowland stations in what were very different growing seasons.

Hohrae 3 again proved its worth as a released variety and had a remarkably similar performance across environments to CIP 83.

Conclusions

Over 6 years, SoL conducted 23 successful varietal sweet potato trials on 21 varieties, representing a total of 238 individual data points (variety per environment combinations). Results varied significantly both by genotype (varieties) and environment (locations, years, season).

A first phase of the clones evaluation led to the release of three varieties. Among them, Hohrae 3 confirms its position as the reliable standard but two new varieties have overtaken it on yield in 2010/11. After two years of trials with new varieties, CIP 71, CIP 72 and CIP 83 are looking particularly impressive. Some of these may also present additional nutritional value in the form of vitamin A (currently being analysed).

The on-farm suitability and consistency of those two potential candidates is being further investigated in the OFDT programme.

2.2.3 Sweet potato On-Farm Demonstration Trials 2010-2011

Six sweet potato varieties that had performed well on research stations were evaluated on-farm during the 2010/11 wet season. The trials took place across fifty-five locations in 12 Sub-Districts of Timor-Leste with the objective of finding varieties that produced high yields and met a wide range of criteria of acceptability for Timorese farmers. At each location, the promising sweet potato varieties were grown alongside a local variety provided by the farmer. As such, the local check at each site could be a different variety but represented what the farmer would normally plant.

Materials and methods

The materials and methods used in the 2010/11 sweet potato OFDTs were similar to previous years. Seven districts, including Aileu, Ainaro, Baucau, Bobonaro, Liquiça, Manufahi, and Viqueque, were included in the year's trials and the sites represented a wide variety of elevations, terrain, and soil conditions. Five of the six agro-ecological zones (AEZs) found in Timor-Leste were represented, and altitudes ranged from near sea level to 1,470 m.

The tested varieties for 2010/11 were: Hohrae 3, and CIP 4, 8, 17, 72, and 83. Four of these varieties (Hohrae 3 and CIP 4, 8, and 17) had been tested in OFDTs in the previous wet season. At a few sites, the varieties Hohrae 1 and 2 were also tested, but the very small number of cuttings available meant that no meaningful results could be interpreted from the data.

The trials were planted in 5 x 5 m plots at densities of 1 to 2 plants/m^2. Plots were monitored regularly by researchers and the hosting farmers for any sign of disease, poor growth, etc.

In previous years, it was found that the farmers would harvest the trial plots throughout the season, precluding a harvest estimate. As for cassava, a sample of 5 plants was dug by the researchers with the farmers to obtain harvest data. The remaining area was harvested as the farmer determined. By identifying 5 plants that the researcher and farmer would harvest together, on the one day, an estimate of the yield was made possible. For each plant, the researcher recorded the number of tubers per plant, the weight of tubers from the 5 plants and perceptions of the farmers regarding each test entry. In each Sub-District there was a farmer field day held at one of the OFDT sites. A number of local farmers were present at each field day and gave comments on the new varieties.

Site characterization

A number of characteristics were recorded for each site including soil pH, color, texture, latitude, longitude, and elevation (see Section 2.1.2). Soil texture was recorded based on a ribbon testing method, pH was measured with a mobile testing kit, and color was classified according to a list of 7 pre-determined colors. A number of management factors were also recorded from each hosting farmer.

Analysis

Similar to other OFDT analysis, data was collected in Excel and then summarized and analyzed using Genstat Discovery Editions 3 and 4. Yield data was analyzed using ANOVA (Unbalanced model) in a range of methods. First, main effects and the interactions between variety and District, Sub-District, and AEZ were tested.

Further to this main analysis, the influence of a wide range of factors on sweet potato yield was tested. The model of the analysis always included variety and AEZ as factors in the model. As elevation was shown to have an impact on crop yield between sites, elevation was included as a co-variate in all the analyses. In turn, a range of factors were added to the model, one at a time. If they were significant, the factor was kept in the model, and if they were non-significant the factor was discarded. Once a significant factor was identified, the interaction of that factor and variety was also tested for significance at the P = 0.05 level.

Results

Fifty five trials were established in the 2010/11 wet season with harvest data collected on forty four sites. The trials came from a range of environments and conditions commonly found in Timor-Leste. As with other root crops such as cassava, measurement of yields is difficult and some trials are lost. This is mainly due to animal predation, often from cattle, buffalos, and wild or domestic pigs. In areas of greater food insecurity, harvest times may be difficult to control as other sources of food may not be available.

Testing environments

Sweet potato OFDTs were conducted in a range of environments that varied by soil texture, soil pH, slope, and elevation. All AEZs were represented this year except for the Southern uplands, and elevations ranged from sea level to 1,470m in Aileu (Table 35).

Table 35. Distribution of sweet potato OFDT sites by elevation, 2010/11.

Elevation (masl)	Locations 2008/09 (%)
0-100	21
100-200	11
200-300	8
300-400	2
400-500	8
500-600	8
600-700	8
700-800	0
800-900	2
900-1000	9
1000-1100	4
1100-1200	0
1200-1300	13
>1300	8

Soil pH, elevation and texture

Soil pH of the OFDT sites ranged from 4.5 to 8.5 with an average of 6.5. Among Sub-Districts, Remexio had the most acidic soils with an average of 5.5 and Balibo the most basic with an average of 7.8. As demonstrated in previous years (see maize OFDT chapter), there is a general negative correlation between soil pH and elevation (Table 36).

Table 36. Mean soil pH and elevation, sweet potato OFDTs by Sub-District, 2010/11.

Sub_District	Soil pH	Elevation
Laulara	5.5	1272
Remexio	5.5	1039
Maliana	5.6	219
Aileu Villa	6.2	1136
Lequidoe	6.3	1261
Balibo	6.8	387
Liquica	6.8	294
Baucau Vila	7	460
Hatudo	7	275
Same Villa	7	103
Viqueque Villa	7.1	16
Maubara	7.5	20
LSD (P<0.05)	0.32	

Variety

As in previous years, the introduced varieties produced higher yields than local varieties with the released variety Hohrae 3 performing the best. (Table 37) Hohrae 3 tubers were nearly 2.5 times larger than those from local varieties which not only results in a higher yield but also makes them more marketable in Timor-Leste.

Table 37. Yield components for OFDT sweet potato varieties, 2010/11.

Variety	*Yield (t/ha)*	*Tubers per plant*	*Weight per tuber (g)*
CIP 17	4.3	2.1	110
CIP 4	6.2	1.8	175
CIP 72	4.0	1.8	100
CIP 8	11.3	2.8	207
CIP 83	9.3	2.6	185
Hohrae 3	13.4	2.7	242
Local	4.0	1.7	108
LSD (P<0.05)	*9.6*	*1.6*	*151*
F prob.	<.001	*.004*	*<.001*

Districts

The highest yielding Sub-Districts were Same Vila, Viqueque Vila, and Balibo but there was no significant interaction between Sub-District and variety for sweet potatoes. Hohrae 3 performed better than the local check in every Sub-District and had the most consistent yield advantage of all of the introduced varieties. (Table 38)

Table 38. Sweet potato OFDT tuber yield (t/ha) by Sub-District 2010/11.

Sub-District	CIP17	CIP4	CIP72	CIP8	CIP83	Hohrae 3	Local
Aileu Villa	4.2	2.8	*	5.2	*	6.0	3.3
Balibo	*	*	*	14.2	*	19.9	8.3
Baucau Vila	*	*	*	14.7	13.5	21.4	0.8
Hatudo	*	16.0	*	4.0	*	12.0	8.0
Laulara	*	*	1.08	*	1.5	1.9	0.5
Lequidoe	2.4	*	1.56	3.4	1.6	3.1	0.9
Liquica	*	4.3	3.20	*	3.4	8.2	*
Maliana	*	*	8.42	*	5.9	6.9	*
Maubara	8.3	*	*	6.1	4.5	7.9	3.4
Remexio	*	*	2.68	*	2.3	3.5	1.7
Same Vila	*	9.2	*	21.2	*	18.0	8.0
Viqueque Vila	*	5.9	*	16.2	*	19.9	9.0

Interaction Varietyx Sub-District: non-significant at P<0.05
* = No data

Agro ecological zones (AEZ) and yield

Yield results for each variety are outlined in Table 39. The highest yields were found on the Southern coast and Southern slope AEZs. As no interaction was found between variety and AEZ, there is no reason to recommend different varieties for different AEZs. Hohrae 3 performed well across all AEZs and was the highest yielding variety in all except for the Northern slopes.

Table 39. Sweet potato OFDT mean yield by AEZ, 2010/11.

AEZ	CIP17	CIP4	CIP72	CIP8	CIP83	Hohrae 3	Local	Mean yield
1 Northern coast (0-100m)	8.3	*	*	8.1	4.9	11.2	2.9	6.55
2 Northern slopes (100-500m)	*	4.6	5.7	15.2	10.4	12.6	0.4	8.83
3 Northern uplands (>500m)	3.9	2.8	1.8	9.6	10.7	12.1	2.7	7.64
4 Southern uplands (>500m)	*	*	*	*	*	*	*	*
5 Southern slopes 100-500m)	*	12.6	*	12.6	*	15.0	8.0	12.67
6 Southern coast (<100m)	*	5.9	*	17.7	*	22.6	10.3	16.06
Total	6.12	6.52	3.72	12.65	8.67	14.71	4.86	
Interaction Variety x AEZ non-significant at zP<0.05								

Agronomic factors affecting yield

A wide range of factors were analyzed for their effect on sweet potato yield. Though the main purpose of OFDTs is to analyze the suitability of improved varieties to local conditions in Timor-Leste, the process of testing these varieties on farmer's fields provides an opportunity to collect data on agronomic factors and site conditions and their effect on sweet potato yield. Several of the tested factors including Variety, Sub-District, AEZ, soil pH, elevation, soil texture, and slope were shown to have a significant effect on yield. Weeding before planting was included in the data collected on this year's trials, but this proved to be non-significant. A significant yield advantage was obtained, however, when two cuttings were planted per hole instead of one.

Table 40. Significance of management factors affecting sweet potato yield.

Factor	*Significance P<0.05*		
	2010/11	*2009/10*	*2008/2009*
Variety	✓	✓	✓
Sub-District	✓	✓	✓
AEZ	✓	✓	✓
Soil pH	✓	✓	✓
Soil color	ns	✓	ns
Elevation	✓	ns	ns
Soil texture	✓	✓	✓
Slope of land	✓	✓	✓
Plant in lines or not	✓	ns	ns
Mixed planting or monoculture	ns	ns	ns
Weeding before planting	ns	-	-
Cuttings planted per hill (1 or 2)	✓	-	-

Soil pH

The effects of soil pH were less consistent than in previous years with no clear trend apparent in this year's data. (Table 41). In previous years, yields were higher in soils with a pH of near neutral, lower in acidic soils (pH<6) and in alkaline soils (pH>8).

Table 41. OFDT yield by soil pH for all sweet potato varieties, 2010/11.

Soil pH	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5
Mean yield (t/ha)	3.7	2.4	5.1	8.3	12.0	7.4	13.2	11.9
LSD (P<0.05) 8.7								

Soil texture

The highest sweet potato yields were found in Sandy loam soils, contrary to trends from previous years where heavier textured soils tended to produce higher yields. (Table 42)

Table 42. Impact of soil texture on sweet potato yield, 2010/11.

Soil texture	*Yield (t/ha)*
Sandy loam	13.6
Silty loam	8.4
Loam	2.6
Clay loam	10.2
Fine clay	8.9
Heavy clay	5.7
LSD (P<0.05)	*4.8*

Soil slope

The impact of soil slope on sweet potato yields shows that yields tend to decrease at slopes greater than 8% (Table 43).

Table 43. Impact of soil slope on sweet potato yield 2010/11.

Soil slope class	*Yield (t/ha)*
0-2%	8.0
2-5%	12.8
5-8%	7.1
8-15%	3.8
15-30%	5.7
LSD (P<0.05)	*9.6*

Topography

In previous years, sweet potato yields have been the lowest in terraced soils with high slope areas also producing lower yields. While the latter is the case again in 2011-2012, terraced areas produced the highest yields (Table 44).

Table 44. Impact of topography on sweet potato yield 2010/11.

Soil slope class	*Yield (t/ha)*
Low slope soils	9.1
High slope soils	3.4
Terraces	12.2
LSD (P<0.051)	*4.8*

Farmer's preference for sweet potato clones

Field days were held during the sweet potato harvest in which farmers were asked to rate local and introduced varieties according to a number of criteria (Table 45). As in last year's evaluation, the released variety Hohrae 3 received the most positive responses. It was most highly prized for its large, easy-to-sell, tubers and outscored all other varieties in all criteria. The other varieties including the local rated poorly, with CIP 8 rating well. It scored on par or better than all other CIP varieties in all categories, and outscored the local in most criteria. Incidental comments from farmers attending field days indicated that the smoother skin of CIP 8 is a desirable characteristic.

Table 45. Farmer responses (%) to sweet potato varieties 2010/11.

Characteristic	*Hohrae 3*	*CIP83*	*CIP72*	*CIP17*	*CIP8*	*CIP4*	*Local*
Grows well	26	2	3	14	14	11	18
Big yield	26	4	3	10	15	7	7
Short season	25	4	3	11	15	9	3
Resists rot in ground	20	4	3	9	11	10	13
Tastes good	22	1	3	14	15	5	14
Good colour	24	1	3	13	13	5	15
Diversifies diet	26	2	3	11	15	6	17
Sells for a good price	27	4	3	10	15	6	10
Produces medial tubers	24	4	3	15	15	12	11
Big tubers	27	2	3	9	14	10	8
Will plant again	24	4	3	11	14	6	16
Overall positive responses (%)	25	3	3	12	14	8	12

The very low preference values for CIP83 and CIP72 are due to the small number of field days that included testing these two varieties. CIP83 has a similar yellow flesh to Hohrae 3, and should be tested in a wider range of locations in the coming years.

Conclusions

The released variety Hohrae 3 continued to be the best performing and most highly desired variety. Local sweet potato varieties rated poorly both in yield and in farmers' preference, which suggests that further research into improved varieties is worthwhile and much needed. CIP 83 and CIP72 show some potential, but further research will be required to evaluate them fully. They will be included in OFDT research in 2012.

2.3 Cassava

Cassava (*Manihot esculenta* Crantz) is cultivated by approximately 85% of farmers in Timor-Leste. Its roots are an important source of carbohydrate, especially during periods when grain supplies are dwindling prior to the main maize harvest. Farmers often dig the roots one by one from the plant as required when the roots are large enough to harvest at about 12 months of age. The main harvest periods are during the wet season when the soils are reasonably soft. The late harvest precludes the description of the 2010-2011 replicated trials in this report but the small number of on-farm trials conducted during 2009 and 2011 are presented below.

2.3.1 Cassava On-Farm Demonstration Trials 2009-2011

Cassava OFDTs were established in three Sub-Districts of Timor-Leste in the wet seasons of 2009/10 and 2010/11. The purpose of the trials was to measure the performance of two MAF released varieties Ailuka 2 and Ailuka 4 against local varieties on farmers' fields. These trials followed two previous years of OFDT testing of cassava, including 2007/08 testing of the two Ailuka varieties and 2008/09 testing of 4 other promising introduced varieties. Root crops, and particularly cassava, are notoriously difficult to test on-farm in Timor-Leste as predation by animals and premature harvest by farmers often cause trial failures. During the 2007/08 season, no trials could be successfully harvested and only farmer feedback data could be collected about the varieties. Cassava is treated as a reserve or backup food in Timor-Leste, and the usual practice is to harvest tubers from the plants as needed throughout the year.

Materials and methods

Cassava OFDTs were established in the Sub-Districts of Maliana, Aileu Vila and Viqueque Vila in 2009/10 and in Viqueque Vila in 2010/11. To mitigate the large number of premature harvests that occurred in the first year of on-farm testing, the protocol to include harvesting the whole plot was amended. Under the new system, five plants in each test plot were marked and it was agreed that the farmer would harvest these plants together with the researcher. While this system proved to be more effective, trial failure for the 2008/09 season was still over 50%. Eight sites produced yield data in 2009/10 and another 8 in 2010/11. While these results do not constitute enough data for a thorough analysis, the results are presented here as an indication of how the varieties performed.

The trials were conducted on farmers' fields with no changes to their normal practices. District based researchers located farmers who were interested in hosting trials. At each site, the researchers laid out test plots of 5m x 5m and planted 25 cassava cuttings with 1m x 1m spacing. The hosting farmer provided the local variety for testing. This resulted in a different 'local' at each site but gives an accurate indication of what farmers in Timor-Leste typically plant.

In each plot, five plants were marked by the researcher and it was agreed that they would be harvested together with the farmer on a single day. This helps to mitigate trial failure due to random harvesting by the farmer. From the five plants harvested, an estimation of total yield was made.

Site characterization

The average elevation for harvested trials was 17 meters above sea level over both years. Previous data showed that cassava is planted from sea level to altitudes of 1200m in Timor-Leste with yields decreasing as elevation increases. Soil characterization was done as in Section 2.1.2. The average soil pH was 6.7 in 2009/10 and 7.4 in 2010/11. All trials were planted in soils classified as loams with the majority planted in sandy loams with light brown color. All yield data was collected in Viqueque Vila Sub-District, but the locations of the sites were different between the two years.

Results

2009/10 OFDTs

Ailuka 2 produced the highest yields with 14 t/ha followed by the local variety with 11.3 t/ha. Ailuka 4 produced both a low number of tubers and a low tuber weight resulting in a yield of 7.5 t/ha. Insufficient data was collected from these trial for statistical analyses. However, the average of the 8 sites is presented in Table 46.

Table 46. Yield components for cassava OFDTs 2009-2010.

Variety	*Yield (t/ha)*	*Tubers per plant*	*Weight per tuber (g)*
Ailuka 2	14.0	7.9	301
Ailuka 4	7.5	8.0	98
Local	11.3	9.0	105

2010/11 OFDTs

The results from the 2010/11 trials (Table 47) were more conclusive and though they represent only a small number of sites, were analyzed using ANOVA (Unbalanced model). Ailuka 2 produced significantly higher yields than the local variety due to significantly larger tuber size. Ailuka 4 failed to achieve a significant difference in yield or any yield component despite producing yields of 33.2 t/ha and 47 t/ha in the previous two years of replicated trials at Betano Research Station in the same AEZ.

Table 47. Yield components for cassava OFDTs 2010-2011.

Variety	*Yield (t/ha)*	*Tubers per plant*	*Weight per tuber (g)*
Ailuka 2	12.2	9.1	126
Ailuka 4	5.8	8.0	73
Local	5.0	7.5	64
LSD ($P<0.05$)	5.12	ns	39.9

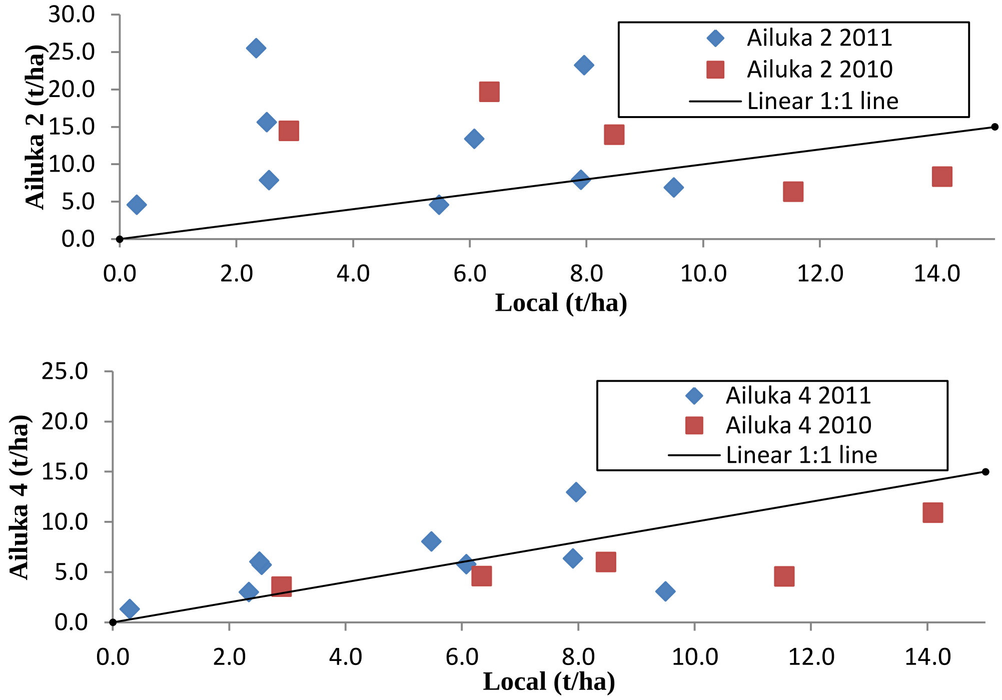


Figure 21. Yield of 2 test versus local populations 2010 and 2011.

Figure 21 is a graphical representation of the yield data of Ailuka 2 and Ailuka 4 versus local populations over both testing years. It can be seen that Ailuka 2 out-yielded the local variety at the majority of sites in both years as represented by the points above the 1:1 line. Ailuka 4 did not outperform the local in the 2009/10 trials although it had a higher but non-significant yield compared to the local in 2010/11.

Conclusions

While conducting cassava OFDTs presents a number of difficulties, they provide a valuable insight into cassava cultivation in Timor-Leste. Cassava remains an important contributor to the food security of Timorese farmers as it can be stored in the ground and harvested when needed. The 2009-2011 OFDTs provide support for the high yielding Ailuka 2 variety, but more widespread testing in the coming years will be necessary. Further OFDT testing of cassava could include other improved varieties that show promise, such as Ca 107 which performed well in the 2008/09 trials, or testing of some of the better local varieties. The local *Mantega* variety produces fairly modest yields but scores extremely well in taste tests and is highly prized among Timorese farmers.

2.4 Rice

2.4.1 Irrigated rice observational trials, 2011

Thirty three new rice (*Oryza sativa* L.) entries were imported from the International Rce Research Institute (IRRI), Philippines in October 2010 for evaluation in Timor-Leste. They were part of the International Finegrain Aromatic Rice Observational Nursery (IRFAON) selected by IRRI breeders for their adaptation to conditions similar to those found in Timor. Six control varieties were also tested which were test varieties in early 2010. The details of the varieties' origin and code given to each variety are given in Table 48. The varieties came from a range of locations around the world including Africa, but most were sourced from more than 8 Asian countries.

Table 48. Details of irrigated rice varieties in observation trials, wet season 2011

Variety	*Origin*	*SoL code*
BM9855	Vietnam	M01
Chokot (ACC32567)	Japan	M02
CT9900-2-2-M-M	CIAT	M03
CT9509-17-3-1-1-M-1-3P-1	CIAT	M05
IDSA64	Ivory Coast	M06
IR62266-41-6-2	IRRI	M07
MRQ50	MARDI	M08
MRQ74	MARDI	M09
RR180-1	India	M10
WAB450-11-1-1-P1-HB	Africa Rice Coast	M12
YN2610-2-2-2-1-2-1	Myanmar	M13
PR26645-B-7	Philippines	M17
IR71146-97-1-2-1-3	IRRI	M18
IR76993-49-1-1	IRRI	M19
IR77512-128-2-1-2	IRRI	M20
IR77542-551-1-1-1-1-2	IRRI	M24
IR77734-93-2-3-2	IRRI	M26
IR78119-24-1-2-2-2	IRRI	M27
IR78545-49-2-2-2	IRRI	M28
IR78554-145-1-3-2	IRRI	M29
IR79478-67-3-3-2	IRRI	M31
IR81166-39-1-2-3	IRRI	M32
IR81173-64-2-1-2	IRRI	M33
IR81352-65-2-1-3-3	IRRI	M34
IR77537-24-1-1-3	IRRI	M35
PR33315-2B-3-1-2-2	Philippines	M36
Basmati370	Pakistan	M37
IR50	IRRI	M38
IR64	IRRI	M39
IR72	IRRI	M40
PSBRC2(IR32809-26-3-3)	IRRI	M41
PSBRC18(IR51672-62-2-1-)	IRRI	M42
PSBRC64(IR59552-21-3-2)	IRRI	M43
Nakroma	Control	N1
President	Control	N2
PSBRC82	Control	N3
Angelica	Control	N4
Matatag2	Control	N5
PSBRC80	Control	N6

The small quantities of available seed allowed the planting of single replicate observation plots at four sites, Betano, Baucau, Atabae and Aileu during the wet season of 2011. Planting details are as shown in Table 49. At harvest, the production of each plot was recorded.

Table 49. Planting and harvest details of peanut varietal trials, 2011

Site	*No. of entries*	*Plot size (m)*	*Planting date*	*Transplant date*	*Harvest date*	*Days to maturity*
Betano	60	1.5 × 2	11 Feb 2011	2 March 2011	6 June 2011	115
Baucau	60	1 × 2	21 Jan 2011	4 Feb 2011	20 June 2011	150
Aatbae	60	1 × 2	6 Feb 2011	7 March 2011	8 June 2011	122
Aileu	60	1 × 2	2 Feb 2011	28 Feb 2011	22 June 2011	140

Results and discussion

A number of the sites suffered predation during the course of the year. Baucau suffered rat and bird damage and Atabae had cattle eat some plots. However all varieties were able to be harvested with an average performance used as a basis for selection. Given the small area tested and the variation in plot size between locations a standardised value for each variety in a given location was used. This consisted of the yield difference from the mean divided by the standard deviation from the mean. The result was then averaged across locations. There was no rice disease reported on any variety at any location, and no obvious insect damage at any site, As such , no selection could be made based on resistance to potential insect and disease risk.

As these were observation trials, other characteristics were used to narrow the number of entries for replicated trials to be conducted at a later date. Two varieties were selected based on favourable comments from local farmers. These were M01 and M12. M01 was selected for further testing due it its short growing season while M12 was chosen based on its large seed size. The local farmers suggest the large grain size would be unattractive to finches at the end of the season, and would reduce the risk of loss to birds nearing harvest.

In total 16 varieties were chosen from the IRFAON nursery for further testing along with five high yielding checks and four local checks detailed in Table 50.

Table 50. Selected irrigated rice varieties for further evaluation

Variety	*Origin*	*SoL Code*	*Index value (St. dev. from mean)*
IR 77734-93-2-3-2	IRRI	M26	1.36
IR 77542-551-1-1-1-1-2	IRRI	M24	1.32
Basmati370	Pakistan	M37	1.04
Matatag 2	Control	N5	1.02
IR 81352-65-2-1-3-3	IRRI	M34	0.90
Nakroma	Control	N1	0.88
IR 72	IRRI	M40	0.77
PSBRC 82	Control	N3	0.76
IR 76993-49-1-1	IRRI	M19	0.68
IR 77512-128-2-1-2	IRRI	M20	0.66
IR 78554-145-1-3-2	IRRI	M29	0.59
PSBRC 80	Control	N6	0.52
IR 79478-67-3-3-2	IRRI	M31	0.50
PSBRC 18(IR 51672-62-2-1	IRRI	M42	0.50
IR 81166-39-1-2-3	IRRI	M32	0.43
RR 180-1	INDIA	M10	0.23
PR 26645-B-7	Philippines	M17	0.05
President	Control	N2	-0.24
YN 2610-2-2-2-1-2-1	Myanmar	M13	-0.42
BM 9855	Vietnam	M01	-0.68
WAB 450-11-1-1-P1-HB	Africa Rice	M12	-1.02
Local	Atabae	Control	
Local	Baucau	Control	
Local	Betano	Control	
Local	Aileu	Control	

2.4.2 Upland rice observational trials, 2011

One hundred new upland rice entries were imported from IRRI, Philippines in October 2010 for evaluation in Timor-Leste. They were part of the International Upland Rice Observational Nursery (IURON) selected by IRRI breeders for their adaptation to conditions similar to those found in Timor. Two control varieties were also tested alongside the test varieties in unfertilised plots. Their details are given in Table 48. Table 48 also details an assessment of brown spot on most of these varieties as well as time to flowering.

Table 51. Details of trialled upland rice varieties, wet season 2011

Variety	*Origin*	*SoL Code*	*Brown spot susceptibility**	*Flowering*
Zhonghua 10	China	R001	+	Normal
WAB880SG14	Africa rice	R002	+	Normal
IR 83750-B-B-131-1	IRRI	R003	+	Normal
IR 82639-B-B-103-4	IRRI	R004	-	Late
IR 83749-B-B-65-1	IRRI	R005	+	Late
IR 83749-B-B-55-1	IRRI	R006	-	Normal
IR 82310-B-B-67-2	IRRI	R007	-	Normal
IR 82589-B-B-117-2	IRRI	R008	+	Late
IR 83754-B-B-40-2	IRRI	R009	+	Normal
IR 83754-B-B-46-4	IRRI	R010	+	Normal
Vandana	India	R011	-	
IR 82589-B-B-138-2	IRRI	R012	-	Late
IR 82635-B-B-32-4	IRRI	R013	-	Late
IR 82635-B-B-82-2	IRRI	R014	-	Late
IR 82638-B-B-147-1	IRRI	R015	+	Normal
IR 82639-B-B-118-3	IRRI	R016	-	Late
IR 83384-B-B-102-3	IRRI	R017	+	Early
IR 83749-B-B-46-1	IRRI	R018	-	Early
IR 82589-B-B-51-4	IRRI	R019	-	Late
IR 82589-B-B-114-3	IRRI	R020	+	Late
IR 82589-B-B-114-4	IRRI	R021	-	Late
IR 82589-B-B-124-2	IRRI	R022	-	Late
IR 82589-B-B-13-3	IRRI	R023	-	Late
IR 82589-B-B-2-2	IRRI	R024	++	Late
IR 82590-B-B-98-2	IRRI	R025	+	Normal
IR 82616-B-B-64-3	IRRI	R026	-	Normal
IR 82635-B-B-143-1	IRRI	R027	+	Late
IR 82635-B-B-47-2	IRRI	R028	+	Late
IR 82635-B-B-58-1	IRRI	R029	-	Late
IR 82635-B-B-88-2	IRRI	R030	+	Late
IR 84135-11-6-B-B	IRRI	R031	+	Late
IR 82635-B-B-25-4	IRRI	R032	+	Normal
IR 82635-B-B-145-1	IRRI	R033	-	Late
IR 82639-B-B-140-1	IRRI	R034	+	Late
IR72876-62-2-2-2	IRRI	R036	-	Late
IR 82589-B-B-2-3	IRRI	R037	-	Late
IR 82589-B-B-44-2	IRRI	R038	+	Late
IR 82589-B-B-84-3	IRRI	R039	+	Early
IR 82635-B-B-47-1	IRRI	R040	-	Late
IR 82635-B-B-72-2	IRRI	R041	-	Normal
IR 82635-B-B-75-2	IRRI	R042	-	Late
IR 83747-B-B-81-1	IRRI	R043	-	Normal
IR 82639-B-B-3-3	IRRI	R044	-	Normal
IR 82635-B-B-93-2	IRRI	R045	+	Normal

IR 82589-B-B-121-3	*IRRI*	*R046*	*-*	*Late*
IR 82589-B-B-149-4	IRRI	R047	+	Early
IR 82589-B-B-36-2	IRRI	R048	+	Normal
IR 82589-B-B-95-2	IRRI	R049	-	Late
IR 82590-B-B-102-4	IRRI	R050	+	Normal
IR 82590-B-B-32-2	IRRI	R051	+	Late
IR 83750-B-B-30-3	IRRI	R052	-	Late
IR 84984-27-1	IRRI	R053	-	Normal
IR 82589-B-B-7-2	IRRI	R054	+	Late
IR 82590-B-B-87-4	IRRI	R055	+	Early
IR 78914-B-22-B-B-B	IRRI	R056		
IR72860-107-3-1-2	IRRI	R057	-	Late
IR 82635-B-B-59-2	IRRI	R058	+	Late
IR 83748-B-B-15-4	IRRI	R059	+	Late
IR 81422-B-B-200-4	IRRI	R060	-	Late
BP277D-MR-2-8	Indonesia	R061	+	Late
IR 55419-04	IRRI	R062	-	Late
BIO530-A-5-10-1-2-8	Indonesia	R063		
IRAT 112	Ivory Coast	R064	-	Early
IR 77298-14-1-2-10	IRRI	R065	-	Early
IR 83222-161-1-1-1-1-1-1	IRRI- Korea	R066	++	Late
IR 70175-22-1-1-2-2	IRRI	R067		
IR71137-184-3-2-3-3	IRRI	R068		
IR 78937-B-3-B-B-1	IRRI	R069	-	Late
IR 78937-B-3-B-B-2	IRRI	R070		
IR 78940-B-22-B-B-B-SB 1	IRRI	R071		
KMP 34	India	R072	-	Late
CT 15673-8-4-7-1-4-M	CIAT	R073	+	Late
CT 15672-2-2-4-1-1-M	CIAT	R074	+	Late
IR 60080-46A	IRRI	R075	-	Late
CT 15671-15-4-2-2-2-M	CIAT	R076		
CT 15691-4-5-2-2-1-M	CIAT	R077	-	Late
CT 15765-13-3-6-1-1-M	CIAT	R078	+	Late
CT 15671-15-1-4-1-5-M	CIAT	R079	+	Late
IR 78942-B-2-B-B-1	IRRI	R080	-	Late
CT 15672-12-1-1-2-3-M	CIAT	R081	+	Late
CT 15679-17-1-2-1-2-M	CIAT	R082	-	Late
CT 15679-17-1-4-1-1-M	CIAT	R083	+	Late
CT 15691-4-3-1-1-2-M	CIAT	R084	-	Late
CT 15716-6-1-2-1-5-M	CIAT	R085	+	Early
UPL RI-5	Philippines	R086	-	Late
CT 15679-17-1-1-1-4-M	CIAT	R087	-	Late
CT 15679-17-2-3-1-4-M	CIAT	R088	-	Late
CT 15691-4-3-4-1-3-M	CIAT	R089	-	Late
CT 15691-4-3-4-5-1-M	CIAT	R090	-	Late
CT 15699-1-5-3-1-3-M	CIAT	R091	-	Late
IR 43	IRRI	R092	+	Late
CT 15671-16-1-7-1-1-M	CIAT	R093	+	Late
CT 15673-8-1-4-1-1-M	CIAT	R094	+	Late
CT 15765-13-7-2-1-2-M	CIAT	R095	+	Late
CT 15696-3-3-5-1-1-M	CIAT	R096	-	Late
CT 15675-2-2-3-1-2-M	CIAT	R097	-	Late
PR 26703-3B-PJ 7	Philippines	R098	-	Late
WAB 881-10-37-18-9-P 1-HB (NERICA 16)	Africa rice	R099	-	Early
SOMALY2-023-3-5-1-2-1	Cambodia	R101	+	Normal
PR 26703-3B-PJ 25	Philippines	R102	-	Early
Local Lahoten	Timor-Leste	RLL	-	Normal
Local Mutin Belit	Timor-Leste	RLM	-	Normal

* - not present, + present, ++severe incidence

The small quantities of available seed allowed the planting of single replicate observation plots at three sites, Betano, Baucau, and Aileu during the wet season of 2011. However due to predation and other issues, it was only in Baucau that any production was recorded. This was planted on January 19th 2011. The time of harvest varied between varieties. Most plots in Baucau had some production.

Results and discussion

Baucau suffered some bird damage. Site differences seemed to be the main determinant for yield however. Twenty three varieties from the IURON nursery with sufficient harvested seed as well as three local varieties were put forward for further replicated evaluation (Table 52).

Table 52. Selected upland rice varieties proposed for replicated evaluation

Variety	*Origin*	*SoL code*
WAB 881-10-37-18-9P1-HB	Africa rice	R099
PR26703-3B-PJ7	CIAT	R098
CT15716-6-1-2-1-5-M	CIAT	R085
IR 83748-B-B-15-4	IRRI	R059
CT15691-4-3-4-5-1-M	CIAT	R090
CT15679-17-1-1-1-4-M	CIAT	R087
IR82589-B-B-121-3	IRRI	R046
IR82635-B-B-93-2	IRRI	R045
IR83750-B-B-131-1	IRRI	R003
IR82635-B-B-88-2	IRRI	R030
IR82635-B-B-25-4	IRRI	R032
IR82635-B-B-32-4	IRRI	R013
IR84984-27-1	IRRI	R053
IR82589-B-B-149-4	IRRI	R047
IR82653-B-B-72-2	IRRI	R041
CT15671-16-1-7-1-1-M	CIAT	R093
IR83749-B-B-55-1	IRRI	R006
CT15691-4-3-1-1-2-M	CIAT	R084
IR83750-B-B-30-3	IRRI	R052
SOMALY2-023-3-5-1-2-1	Cambodia	R0101
CT15673-8-1-4-1-1-M	CIAT	R094
IR83747-B-B-81-1	IRRI	R043
Local Lahoten	Timor-Leste	RLB
Local Mutin Belit	Timor-Leste	RLL
Local Belit mean	Timor-Leste	RLBM

2.4.3 Rice On-Farm Demonstration Trials 2010-2011

Rice On Farm Demonstration Trials (OFDTs) were established in 4 districts and 8 Sub-Districts of Timor-Leste in the 2010/11 season. The trial objective was to determine if promising new rice varieties, identified in replicated trials performed well on farmers' fields with no extra changes to inputs or agronomy. One line, PBSRC 80 had been assessed on-farm in the previous two years. To this PBSRC 82 was added as well as a small number of plots of two other test varieties, Angelica and Matatag 2.

Materials and methods

Fifty five OFDTs were sown in five of the six agro ecological zones (AEZs) in Timor-Leste. These included the Sub-Districts of Aileu, Balibo, Baucau, Maliana, Ossu, Vemasse, Venilale and Viqueque. They were monitored by ten researchers. Farmers received 5 kg bags of the recommended variety, Nakroma as well as 100 g of seed of test varieties when available. They supplied their own seed to establish a plot of the local variety which was used as a check for the new varieties. Seed which they ordinarily planted included old Portuguese varieties (e.g. Nona Portu), and more recent releases from IRRI (e.g. IR64) and some were hybrid rice varieties.

Seeds were usually first planted in a nursery before seedlings were transplanted to a paddy field. As in previous years, the actual area planted to each variety (plot size) varied according to each farmer's bunded paddy area. In most cases Nakroma, other test varieties as well as whatever local variety the farmer generally used were grown side by side in one paddy. Where possible, a 5 m x 5 m area was used for each plot. However at some sites smaller sample sizes were taken. Much of the process for establishing rice OFDTs was similar to that described in the maize OFDT chapter.

Researchers visited the sites an average of 6.8 times from planting to harvest. At each visit they recorded different information about the OFDT. Data collection protocols monitored progress of the trial/demonstration. In-season measurements included plant condition, identification of pests and diseases, wilting and other plant symptoms.

After harvest, the wet threshed grain was weighed. A sample of the grain was also weighed, then dried and weighed again. The ratio of dry grain to wet grain from this sample was used to convert the weight of the harvested plot into a dry weight equivalent. All of the weights quoted in the Results and Discussion section are for paddy rice (dry, threshed, un-milled weights).

Analysis

Data from the 55 harvested trials was first entered into an MS Excel spreadsheet database before being transferred for further analysis to GenStat Discovery Edition 4. Rice yield data was analyzed by ANOVA (Unbalanced Linear Model) with variety and AEZ as constant factors in the model once the other location factors had been tested. However this model was not as robust as with the other crops tested on farm due to the low proportion of trials (17%) tested in the southern Sub-Districts.

Due to a shortage of seed for the test varieties, analysis of yield data was conducted on two sets of data. Firstly Nakroma was compared with the local check as each was harvested in 53 OFDT sites. This gave a large quantity of sites on which to ascertain further data on the production benefits of the released variety over varieties farmers would ordinarily grow. Secondly, analysis was conducted over only those trials where yield data was recorded for an additional test variety. This allowed test varieties to be compared to both released and local varieties in a much more balanced way given that the production data from the latter was only included if there was also data from test varieties on the same site.

The influence of a wide range of factors on rice yields was tested. In turn, each factor was added to the model, one at a time. If they were significant, the factor was kept in the model, and if they were non-significant the factor was discarded. Once a significant factor was identified, the interaction of that factor and variety was also tested for significance at the $P < 0.05$ level.

Results and discussion

Testing environments

Rice OFDTs were conducted on a wide range of soil textures, pH, slope and elevation. Elevation of OFDT sites ranged from about sea level to almost 1,100 m in Aileu Sub-District.

Forty four percent were planted at sites below 100 m elevation. The same percentage of trials was planted at sites over 500m.

The average soil pH across the OFDT test sites was 7.1, ranging from 5.5 to 8.5. Only four of the sites could be described as acid in content, (pH 5.5 or below). Like the previous year, a high proportion of 25% of sites were defined as alkaline soils (pH 8.0 or above). 65% of soils were classified as clays.

Trial losses and seed restrictions for planting

Of the 58 trials entered into the database 55 contained production data. Nakroma was harvested from 53 of these and local from 54. The number of OFDTs established with the various test varieties was much more restricted due to insufficient seed at planting. Of these varieties PRSRC 80 and PBSRC 82 had the greatest number of trials harvested with 15 and 11 OFDTs respectively. Seed availability at time of nursery establishment was the predominant reason why yield data was not recorded for all varieties at harvest time.

Variety

Like previous years, Nakroma again proved to have a significant yield advantage over local varieties. It also out performed PSBRC 80 on this occasion (Table 53).

Table 53. Rice yields of OFDT 2008/09 to 2010/11

	Mean predicted yield (t/ha)			*Yield advantage (%)*		*LSD*
Variety	Local	Nakroma	PSBRC 80	Nakroma	PSBRC 80	*(P=0.05)*
2008/09 (71 sites)	3.2	3.8	3.3	18	4	0.5*
2009/10 (51 sites)	2.9	3.8	3.5	32	21	0.7
2010/11 (53 sites)	2.8	3.5		28		0.7*

*significant for a pair wise comparison between mean yields of Nakroma and local only

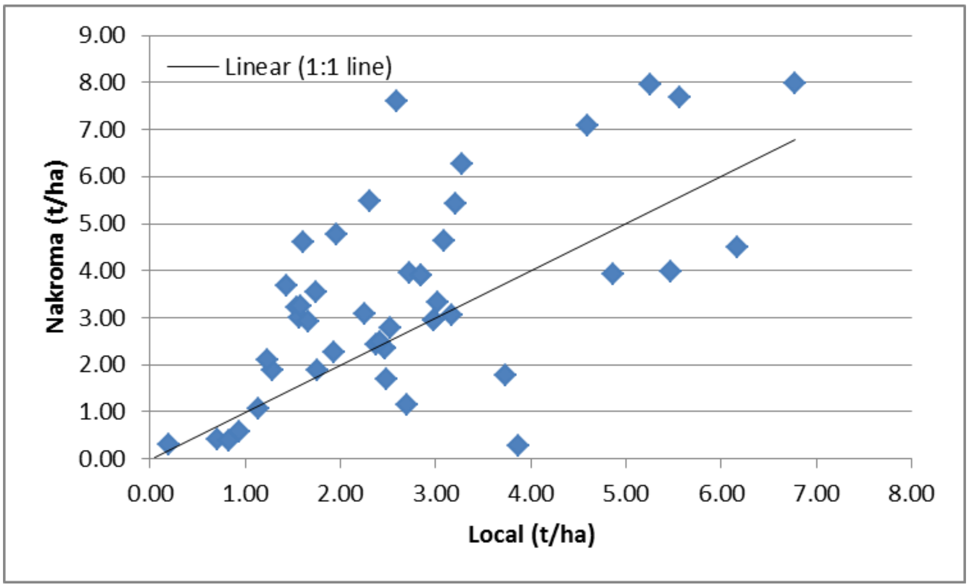
In the data set only including Nakroma and the local check, Nakroma had a significantly higher yield than the local check (F Pr. = 0.03). The higher yield of Nakroma (28%) was similar to other years (Table 53). In the subset of data from trials containing local varieties, Matatag 2 did out-yield both local and Nakroma (Table 54). When tested separately against local, although still not significant, with a P value of 0.07 it demanded further testing in OFTDs.

Table 54. Rice yields of OFDT varieties 2010/11

	Mean predicted yield (t/ha)					
Variety (17 sites)	Local	Nakroma	PSBRC 80	PSBRC 82	Matatag 2	Angelica
ns (P < 0.05)	2.4	3.3	3.0	2.5	4.2	2.1

Figure 22 demonstrates graphically the yield relationship between the local and two other varieties at each site. It can be seen from the graphs that with Nakroma and Matatag that most of the data points lie above the 1:1 line that is plotted through the aggregate of local yield data. The difference in scale of the axes in the graph with Matatag 2 also demonstrates some wide differences of yield above local at the same sites.

It is worth noting that in three of the 9 sites where yield data was available for Matatag 2 a hybrid variety acted as the local check. This gives further encouragement that Matatag 2 can be competitive in future trials.



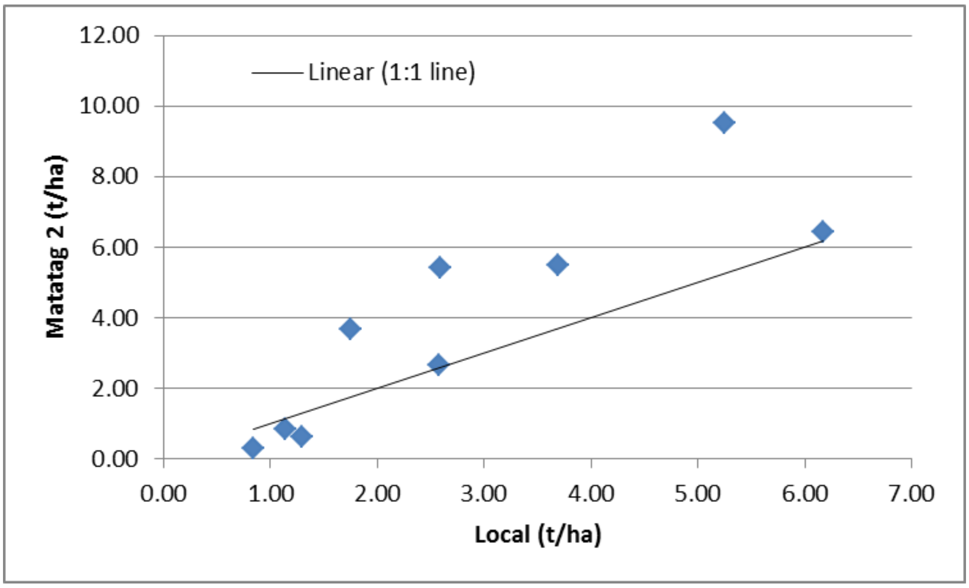


Figure 22. Yield of Nakroma and Matatag 2 versus the locals 2010/11

A significant difference in yield between Sub-Districts was evident (F Pr. <0.001). Most varieties yielded best in Baucau Sub-District and worst in Ossu (Table 55). In this yield table the yield figures contained in brackets come from a much greater number of trials and are therefore more reliable estimates of Sub-District effect. The other figures come from only the trials that contained a test variety. There was no significant interaction between variety and Sub-District. This suggests that the higher yield of Nakroma is consistent across Sub-Districts and there is no reason to recommend different varieties for different Sub-Districts.

Table 55. Mean OFDT rice yields (t/ha), Sub-Districts, 2010/11

District	Sub-District	Sub-District mean yield (t/ha)	Yield of local, (t/ha)	Yield of Nakroma (t/ha)
Aileu	Aileu	2.7	2.5	3.0
Baucau	Baucau	5.3	4.1	6.6
	Vemasse	3.3	3.0	3.7
	Venilale	2.4	2.4	2.5
Bobonaro	Balibo	3.0	2.2	3.8
	Maliana	2.7	2.9	2.4
Viqueque	Ossu	2.0	1.9	2.1
	Viqueque	1.9	2.1	1.7

Agro Ecological Zones (AEZ) and yield

Yield results for each variety in each AEZ (see table in maize chapter) where tested are presented in Table 56. There was a significant effect (F Pr. < 0.001) of AEZ on rice yield from locations that included test varieties depicted in this table. However when the data set that included the larger number of locations where only Nakroma was grown next to a local variety was analyzed, AEZ was not found to be significant (F Pr. = 0.063). There was no interaction between variety and AEZ with either data set. The northern part of the country where most trials were located yielded best. There was no clear trend for crop yield variation as elevation increased from AEZs at low elevations to those on higher ground, but the lower yields were found at the highest altitude (AEZ 4). This is consistent with maize yields that decrease with altitude.

Table 56. Mean yields (t/ha) of rice OFDTs containing test varieties by AEZ, 2010/11

AEZ	AEZ mean yield (t/ha)	Yield of Local, (t/ha)	Yield of Nakroma (t/ha)	Yield of PSBRC 80 (t/ha)	Yield of PSBRC 82 (t/ha)	Yield of Matatag (t/ha)	Yield of Angelica (t/ha)
1	4.1	2.8	5.4	6.2	2.9	3.7	3.1
3	4.0	3.1	4.6	3.5	4.4	6.8	2.9
4	1.3	1.9	1.9	2.1	0.3	0.3	0.3
6	2.0	2.1	1.9	1.8	1.7	3.3	1.6

Agronomic factors affecting yield

The influence of a wide range of characters was tested for effect on the yield of rice (Table 57). The data set that contained most trials (Nakroma and Local) was used for this purpose. Most were found to not have an influence on grain yield. Those that did included variety, Sub-District and soil texture.

Table 57. Significance of factors affecting rice yield, OFDTs 2007 to 2011

Factor	*Significance (p=0.05)*			
	2007/08	2008/09	2009/10	2010/11
Variety		✓*	✓	✓
AEZ	×	✓	✓	×
Sub-District		✓	✓	✓
Elevation	✓	×	✓	×
Seedlings per hole				×
pH	×	×	✓	×
Soil texture	×	✓	×	✓
Soil colour	×	✓	✓	×

*significant for a pair wise comparison between mean yields of Nakroma and Local only

Fertiliser application

Six of the fifty seven sites reported using Triple Superphosphate and Urea as a basal application. One location reported using Urea as a top-dress after planting.

Seedlings per hill

The OFDT sites were split 50:50 between those planting 1 (3.1 t/ha) or 2 (3.5 t/ha) seedlings per hill. While this did not reach significance, at a P value of 0.061 it did approach it.

Soil texture

Soil texture had a significant effect on rice yield across the test sites. Silty loam yielded the highest followed by fine clay and clay loam (Table 58). Those soils classified as loam were the lowest yielding. No interaction of soil texture and variety was evident.

There was no effect of soil colour on yield reversing the soil colour/texture effects from 2009/10.

Table 58. Effect of soil texture of rice yield 2010/11

Soil colour	*% of OFDTs harvested*	*Yield (t/ha)*
Sandy Loam	13	2.5
Silty Loam	13	4.4
Loam	8	1.9
Clay Loam	33	3.1
Fine Clay	32	3.2
LSD ($P<0.05$)		

Effect of farmer management on yield

Little effect of farm management on yield was found in 2010/11 (Table 59). It is nonetheless interesting to examine the trend in farmer practices over a four year period. The overwhelming use of tractors to cultivate rice paddies continued in 2011 with 87% of farmers now using tractors as a result of the ongoing MAF agricultural mechanization program. As in previous years, the use of tractors had no effect on subsequent rice yields.

In 2011, the vast majority of farmers continued the practice of soaking seeds before sowing. Unlike the previous two years, higher rice yields were recorded where seeds were pre-germinated prior to planting but no significant effect was found.

Table 59. Significance of management factors affecting OFDTs from 2007 to 2011

	Factor	2007/08		2008/09		2009/10		2010/11	
		% farmers using	Yield (t/ha)	% farmers using	Yield (t/ha)	% farmers using	Yield (t/ha)	% farmers using	Yield (t/ha)
1.	Cultivate with buffalo	54	4.5	19	4.0	13	3.9	6	4.9
	Cultivate with horse	11	3.5	2	3.3	2	1.2	7	2.9
	Cultivate with tractor	34	3.5	79	3.3	85	3.4	87	3.1
	LSD (P=0.05)		ns		ns		ns		ns
2.	Pre-germinate seeds	97	4.3	98	3.5	96	3.3	93	3.2
	No pre-germination	3	5.0	2	4.9	4	5.4	7	2.1
	LSD (P=0.05)		ns		ns		1.4		ns
3.	Broadcast seeds	4	6.8	4	4.7	6	3.8	5	3.3
	Transplant seedlings	96	4.2	96	3.3	94	3.4	95	3.1
	LSD (P=0.05)		1.6		1.0		ns		ns
4.	Transplant < 2 weeks	6	5.3	24	3.1	28	3.1	31	3.4
	Transplant 2-4 weeks	58	4.3	51	3.2	62	3.3	50	3.3
	Transplant > 4 weeks	35	4.0	25	3.7	11	4.7	19	3.2
	LSD (P=0.05)		ns		ns		1.0		ns
5.	Plant in lines	47	4.4	65	3.1	80	3.3	89	3.0
	Plant random	53	4.2	35	4.2	20	3.7	11	4.0
	LSD (P=0.05)		ns		0.5		ns		ns
6.	Wide planting distance	15	3.1	34	3.2	30	3.6	32	3.2
	Close planting spacing	85	4.5	66	3.6	70	3.3	68	3.0
	LSD (P=0.05)		0.9		ns		ns		ns
7.	Applied fertilizer	3	4.4	30	3.1	10	3.4	14	2.9
	No fertilizer used	97	4.3	70	3.6	90	3.0	86	3.2
	LSD (P=0.05)		ns		ns		ns		ns
8.	No weeding	36	4.2	42	3.4	26	2.6	28	2.2
	Weeded once	43	4.3	38	3.5	42	3.7	57	3.4
	Weeded > once	22	4.7	21	2.8	34	3.7	15	3.3
	LSD (P=0.05)		ns		ns		0.7		1.0

The unexpected result from the previous years in which the small minority of farmers who simply broadcast seeds had higher yields than those who went to the trouble of transplanting seedlings, was repeated again in these trials. Although this difference was not significant in 2010/11 and broadcast data from all years was derived from only a small number of observations, further investigation of possible reasons why this occurred is warranted.

Fifty percent of farmers transplanted after the recommended time in the nursery (approximately. 3 weeks) in 2010/11. There was no benefit found in terms of increased yield by transplanting early.

Similarly, there was a steady increase in the number of farmers planting in lines over time, but like the previous years, yields from trials where farmers continued to plant randomly were higher than those planted in lines. There was however not a significant difference in yield between line and random planting or between wide and close spacing in 2010/11.

Venilale and Ossu were the only Sub-Districts where the majority ($^{2}/_{3}$) of farmers had fertilizer applied. Fertilizer was also applied at one site in Baucau and Maliana with the other Sub-Districts not recording any fertilizer application. With the Sub-Districts where fertilizer use was most prevalent being among the poorest yielding, there was no advantage evident from its use.

Weeding was the only management factor from Table 59 that was found to significantly improve yield in 2010/11. Seventy two percent of farmers weeded at least once. There was no effect of the number of extra times the ground was weeded. A number of programs in Timor-Leste are encouraging the use of SRI (system for rice intensification) and ICM (integrated crop management) methodologies which assist with the weeding process.

Farmer's preference for rice populations

After harvesting the OFDTs, farmers gave reasons about why they may want to continue using each variety. Nakroma received the most positive feedback. Most of the reasons given for farmers' desire to continue using Nakroma included good establishment, high productivity and good grain size. A number of plant architecture traits also found favor including a relatively short plant height that mitigated the lodging risk, combined with long heads which had good grain numbers but which were not susceptible to shedding.

The short time to flowering as well as well as adaptability to irradiance found in Timor-Leste was also viewed positively in Nakroma. The eating quality of the grain was well received amongst farming families with many commenting positively on the oil content of the grain. Only one respondent expressed disaffection with the variety.

Due to the limited number of trials established with test varieties it was not possible to get a good account of farmer preferences for these varieties. From the limited number of comments received, Angelica was highlighted by the number of negative opinions it elicited. One farmer liked it but seven were critical. Reasons included poor productivity, dislike of the taste and grains prone to fracturing.

Of other varieties planted, IR64 and a Hybrid received positive comments on yield while Portuguese-era varieties Porto and Rambo had the opposite response.

Local varieties also received some positive comments about their production characteristics, taste and crop architecture. Others found that plants were susceptible to lodging. While some farmers recognized the lower production with local varieties, many wanted to continue planting some as they had always planted it and saw it as adapted to, or of their land.

Conclusions

In 2010/11, Nakroma once again proved to be a consistent performer, demonstrated its yield superiority over existing local varieties across the country. Some test varieties out-yielded Nakroma but given the limited number of results for these, a significant advantage could not be determined. Similarly farmer opinion remained positive towards Nakroma with insufficient data for the test varieties. Matatag 2, with a limited number of trials out yielded Nakroma and deserves further investigation into its suitability to be grown in Timor-Leste.

Data recorded on farmers management over the period from 2006-11 suggest that despite farmers gradually adopting recommended practices (*e.g.* using tractors, transplanting earlier, planting in lines and applying fertilizer etc.), this had not been translated into significant yield improvement. This indicates the need for greater emphasis on both agronomic research and extension to assist farmers to successfully apply improved rice growing methods and therefore fully realize the demonstrated yield potential of new varieties such as Nakroma.

2.5 Peanuts

2.5.1 Replicated trials, 2010-2011

Peanut (*Arachis hypogaea* L.) lines tested by SoL were sourced from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. These were selected by ICRISAT breeders for their resistance to early and late blight and adaptation to conditions similar to those found in Timor. Most of those included in the replicated trials were imported in late 2009. They were planted out in single plot observation trials at Loes and Betano in January 2010 (as described in 2010 Annual Research Report) from which sufficient seed was harvested to establish the replicated trials reported below. Peanut variety trials have been conducted for a number of years which allowed the selection of a big-seeded variety, Utamua (PT 05) for release in 2007.

During the 2010-2011 cropping season, four peanut replicated trials were conducted at Aileu, Baucau, Betano, and Loes. Due to the large number of recently imported varieties thirty varieties were planted on each trial, double that of previous years. Characteristics of the varieties used in the trials are as presented in Table 60. Local checks were similar to the previous years' trials.

Table 60. Variety details, replicated peanut trials, 2010/11

SoL Code	*Name*	*Botanical type*	*Seed skin colour*
Utamua (PT 05)	ICGV 88438	Spanish bunch	Brown
PT 10	*Local Darasula*	*Timorese local*	*Brown*
PT 21	*Local Mean*	*Timorese local*	*Red*
PT 22	*Local Boot*	*Timorese local*	*Brown*
PT 14 *	ICGV 96165	Virginia	Red
PT 20 **	ICGV 99017	Spanish bunch	Brown
PT 101**	ICGV 99027	Spanish bunch	Brown
PT 107**	ICGV 99033	Spanish bunch	Brown
PT 108**	ICGV 99036	Virginia	Red
PT 109**	ICGV 99046	Spanish bunch	Red
PT 110**	ICGV 99050	Virginia	Brown
PT 117*	ICGV 97087	Spanish bunch	Brown
PT 122*	ICGV 97094	Spanish bunch	Brown
PT 124*	ICGV 97120	Spanish bunch	Red
PT 125*	ICGV 98077	Spanish bunch	Brown
PT 126*	ICGV 98087	Spanish bunch	Red
PT 128*	ICGV 98089	Spanish bunch	Brown
PT 130*	ICGV 98100	Spanish bunch	Brown
PT 131*	ICGV 97100	Virginia	Brown
PT 132*	ICGV 97131	Virginia	Brown
PT 133*	ICGV 97135	Virginia	Brown
PT 134*	ICGV 97137	Virginia	Brown
PT 135*	ICGV 97142	Virginia	Brown
PT 136*	ICGV 98180	Virginia	Brown
PT 137*	ICGV 98184	Virginia	Brown
PT 138*	ICGV 98187	Virginia	Brown
PT 139*	ICGV 99167	Virginia	Brown
PT 140*	ICGV 99169	Virginia	Brown
PT 141*	ICGV 99171	Virginia	Brown
PT 142*	ICGV 99174	Virginia	Brown
PT 143*	ICGV 00061	Virginia	Brown

* Medium-duration cycle   ** Foliar disease resistant

Methodology

Yields, yield advantages and yield components

Trials were grown in Aileu, Baucau, Betano, and Loes during the wet season of 2010-2011. A total of 27 new varieties were tested in each trial together with the recommended Utamua variety (PT 05) and two local varieties which acted as local checks.

Aileu and Baucau contained two replicates of each variety while Betano and Loes contained three. Complete randomized blocks were used with a smaller plot size of 2.5 x 2.5m used due to the number of varieties evaluated and seed supply except in Aileu which used 2.5 x 5m. Planting hills (one seed per hill) were spaced at 45 x 20cm at Aileu and Betano and 40 x 20cm at Loes and Baucau corresponding to maximum plant densities of 11 and 12 plants/m² respectively. No fertilizer or irrigation was applied apart from at Aileu where 15 kg/ha of N and P was applied given that the lack of station area does not allow for fallow. Trials were planted between November 2010 and January 2011 and harvested from April to July 2011 (Table 61).

Table 61. Planting and harvest details of peanut varietal trials, 2010/11

Location	*Number of entries*	*Number of replicates*	*Planting date*	*Harvest date*	*Mean yield (t/ha)*
Aileu (Kintal Portugal)	30	2	30/11/2010	Mid June 2011	0.39
Baucau (Darasula)	30	2	20/01/2011	Mid June 2011	0.13
Manufahi (Betano)	30	3	15/12/2010	Mid April 2011	0.73
Liquica (Loes)	30	3	16/12/2010	May 2011	1.17

A number of parameters were recorded during plant growth, starting with emergence rates. Flowering as well as the impact of diseases was monitored.

At harvest, all plants were dug, dried and weighed. The weight of fresh and then dry pods were measured. Yield and plant densities were measured from the whole plot. Yield components were also measured in Betano research station. Yield components (pod and seed dry weight, number of seeds per pod, percentage of good pods) were obtained from plot samples of 100 pods. The number of pods per plant, the shelling percentages (from dry weights) and the seed yield (without shell) were obtained from the previous parameters.

Data at each site were analysed separately using GenStat Discovery Edition 4 where analysis of variance or REML analysis was used in order to determine varietal effects. The analysis performed depended on the presence of row and/or column effects on yield (Table 62).

Table 62. Statistical tests used in the analysis of the 2010/11 peanut varietal trials

Station	*Row/Col effects*	*Test*	*Type*
Aileu	No	ANOVA	One-way in Randomized blocks
Baucau	Row	REML	AR1 Random on Row
Betano	Column	REML	AR1 Random on Column
Loes	No	ANOVA	One-way in Randomized blocks

Yield advantages were calculated from the resulting predicted means over the average of the local varieties. The existence and degree of correlation between the predicted means of the yields and of the other parameters were then examined using a Simple Linear Regression. The percentage of variability accounted for is equivalent to an adjusted R^2.

Results

Yields and yield advantages

Table 63 presents the dry pod yields at each site for all tested varieties, as well as yield advantages over the local checks.

Table 63. Peanuts yields and yield advantages over local, 2010/11

Variety	*Yields (t/ha)*				*Averages*		*Yield advantage (%) within site*			
	Aileu	*Baucau*	*Betano*	*Loes*	*Yield (t/ha)*	*Yield adv. (%)*	*Aileu*	*Baucau*	*Betano*	*Loes*
Utamua (PT 05)	0.68	0.33	1.17	2.31	1.12	86	46	17	42	10
PT 142*	0.49	0.42	0.34	2.97	1.05	75	5	45	-59	42
PT 101**	0.39		1.26	1.22	0.96	59	-15		54	-42
PT 131*	0.51	0.16	0.86	2.09	0.91	50	10	-45	5	0
PT 138*	0.94	0.34	0.49	1.77	0.88	46	102	18	-41	-15
PT 117*	0.09	0.09	1.43	1.47	0.77	28	-81	-69	74	-30
PT 132*	0.76	0.10	0.72	1.30	0.72	19	64	-65	-12	-38
PT 141*	0.44	0.07	0.56	1.78	0.71	18	-5	-74	-32	-15
PT 14 *	0.38	0.23	1.23	0.95	0.70	16	-17	-21	50	-55
PT 128*	0.26	0.05	0.68	1.80	0.70	16	-45	-84	-17	-14
PT 124*	0.45	0.13	0.72	1.45	0.69	14	-4	-53	-13	-31
PT 133*	0.28	0.11	0.87	1.48	0.69	14	-39	-63	6	-29
PT 137*	0.79	0.11	1.04	0.77	0.68	13	70	-60	27	-63
PT 136*	0.28		1.04	0.70	0.67	12	-40		27	-67
PT 125*	0.62	0.17	0.39	1.43	0.65	8	33	-41	-52	-32
PT 134*	0.39	0.07	0.78	1.30	0.64	5	-15	-74	-5	-38
PT 110**	0.71	0.20	0.51	1.09	0.63	4	54	-29	-38	-48
PT 20 **	0.39	0.08	1.35	0.65	0.62	3	-16	-71	65	-69
PT 143*	0.43	0.21	0.71	0.99	0.59	-3	-7	-25	-13	-53
PT 135*	0.62	0.18	0.32	1.20	0.58	-4	34	-37	-61	-43
PT 107**	0.31	0.03	1.51	0.45	0.58	-5	-33	-91	84	-79
PT 140*	0.24	0.03	0.96	0.92	0.54	-11	-48	-90	16	-56
PT 21	*0.17*		*0.45*	*0.72*	*0.44*					
PT 109**	0.39	0.05	0.42	0.89	0.44	-27	-15	-81	-48	-57
PT 122*	0.21	0.14	0.49	0.59	0.36	-41	-55	-51	-40	-72
PT 130*	0.07	0.03	0.16	1.01	0.32	-47	-84	-91	-81	-52
PT 22	*0.01*	*0.09*	*0.69*	*0.48*	*0.32*					
PT 108**	0.19	0.12	0.24	0.58	0.28	-54	-60	-59	-71	-72
PT 126*	0.22	0.04	0.23	0.43	0.23	-62	-54	-87	-71	-79
PT 139*	0.07	0.05	0.35	0.36	0.21	-66	-84	-83	-57	-83
PT 10		*0.04*			*0.04*					
F/Chi Sq. Prob.	*0.105*	*0.131*	*<0.001*	*<0.001*						
LSD (P=0.05)	0.54	*0.08*	*0.11*	0.96						
%CV / Wald/df	*65*	2.4	7.5	50						
Mean site	0.39	0.13	0.73	1.17	0.60					
Mean locals	*0.09*	0.06	0.57	*0.60*	*0.27*					

* Medium-duration cycle ** Foliar disease resistant

Variation among sites was very noticeable with Aileu and Baucau stations yielding particularly poorly. The failure of these sites to produce a reasonable yield was also a major factor in no significant varietal effects being found at these locations. Inter-site variation was reinforced by the mean yield across all sites of 0.6 t/ha being similar to the standard deviation. Establishment within and between site was also very variable.

The released variety, Utamua returned to the top yielding position after yielding particularly poorly the previous year. Yield at Betano station also contrasted favourably with that achieved the previous year when all varieties were compromised by drought stress. It was a much more productive site on this occasion following a wet season with abundant rainfall. Loes was the most productive site despite having poor establishment, primarily caused by inundation in some plots after planting.

After Utamua the top yielding variety was PT 142 with 1.05 t/ha, which corresponds to a yield advantage of 75% above locals. It also comfortably out yielded Utamua in Loes, the highest yielding site. However in Betano its yield of 0.34 t/ha was well below the average of that site. PT 101, while ranked 2nd best new variety in the above trials ranked outside the top 10 when those results were combined with the initial evaluation in 2010. It was also not included for further evaluation. The other top 10 yielding varieties were included for further analysis (Table 64).

Table 64. Varieties selected for further trialing in 2011/12

SoL Code	*Name*	*Botanical type*	*Seed skin colour*
Utamua (PT 05)	ICGV 88438	Spanish bunch	Brown
PT 10	*Local Darasula*	*Timorese local*	*Brown*
PT 21	*Local Mean*	*Timorese local*	*Red*
PT 22	*Local Boot*	*Timorese local*	*Brown*
PT 14 *	ICGV 96165	Virginia	Red
PT 20 **	ICGV 99017	Spanish bunch	Brown
PT 124*	ICGV 97120	Spanish bunch	Red
PT 131*	ICGV 97100	Virginia	Brown
PT 132*	ICGV 97131	Virginia	Brown
PT 133*	ICGV 97135	Virginia	Brown
PT 134*	ICGV 97137	Virginia	Brown
PT 136*	ICGV 98180	Virginia	Brown
PT 137*	ICGV 98184	Virginia	Brown
PT 138*	ICGV 98187	Virginia	Brown
PT 141*	ICGV 99171	Virginia	Brown
PT 142*	ICGV 99174	Virginia	Brown

* Medium-duration cycle ** Foliar disease resistant

Yield components and other parameters

Yield component data were only collected for Betano research station. The predicted means for the yield components are detailed in Table 65.

Yield components, like yield had significant varietal differences at Betano. Utamua, the sixth best yielding at this site was third best for both pod weight and pods per plant. It ranked very low however for shelling percentage. Both local varieties rated well for a number of yield components. PT 101, high yielding at the best two sites had the greatest number of pods per plant at Betano.

Little correlation was found between the yield components and overall yield. Apart from plant density (Figure 23), when investigated using linear regressions, the percentage of variability accounted for (adjusted R^2) was negligible.

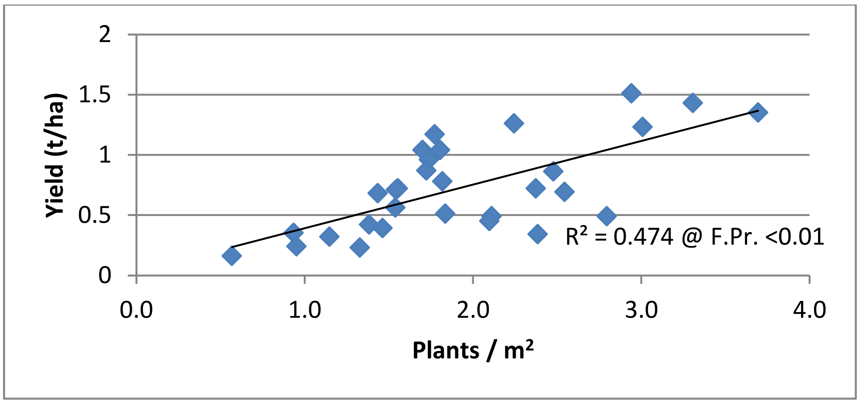


Figure 23. Correlation between yield and plant density at Betano research station

Table 65. Peanut yields and yield components, Betano replicated trial 2010/11

Variety	*Dry pod yield (t/ha)*	*Plants/m^2 at harvest*	*Weight of 100 pods (g)*	*Pods / plant*	*Seeds / pod*	*Weight of 100 seeds (g)*	*Shell (% dry weigh*
PT 107**	1.51	2.9	113	44	1.7	77	70
PT 117*	1.43	3.3	111	32	1.8	72	64
PT 20 **	1.35	3.7	138	29	1.4	93	68
PT 101**	1.26	2.2	102	60	1.8	76	76
PT 14 *	1.23	3.0	123	39	1.9	85	70
Utamua (PT 05)	1.17	1.8	140	51	1.7	87	63
PT 137*	1.04	1.8	127	50	1.8	83	64
PT 136*	1.04	1.7	120	49	1.8	78	64
PT 140*	0.96	1.7	104	58	1.9	71	67
PT 133*	0.87	1.7	114	45	1.9	84	76
PT 131*	0.86	2.5	123	20	2.0	87	69
PT 134*	0.78	1.8	123	35	1.9	90	72
PT 132*	0.72	1.6	125	34	1.9	82	66
PT 124*	0.72	2.4	60	20	1.6	70	77
PT 143*	0.71	1.5	115	40	1.7	92	79
PT 22 (Local)	*0.69*	*2.5*	*134*	*23*	*2.0*	*101*	*77*
PT 128*	0.68	1.4	107	47	1.6	61	57
PT 141*	0.56	1.5	96	47	1.9	66	69
PT 110**	0.51	1.8	55	42	1.8	32	59
PT 138*	0.49	2.1	94	26	1.5	77	82
PT 122*	0.49	2.8	97	22	2.0	79	84
PT 21 (Local)	*0.45*	*2.1*	*161*	*19*	*2.2*	*111*	*67*
PT 109**	0.42	1.4	104	28	1.7	87	84
PT 125*	0.39	1.5	92	26	1.6	60	68
PT 139*	0.35	0.9	84	51	2.0	63	72
PT 142*	0.34	2.4	75	16	1.5	44	64
PT 135*	0.32	1.1	96	36	1.7	66	73
PT 108**	0.24	1.0	155	20	0.9	46	22
PT 126*	0.23	1.3	69	23	1.8	46	65
PT 130*	0.16	0.6	*	*	*	*	*
Mean site	0.73	*1.9*	*109*	*36*	*1.8*	*72*	*68*
Chi Sq. Prob.	*<0.001*	*<0.001*	*<0.001*	*0.022*	*0.001*	*<0.001*	*<0.001*
LSD (P=0.05)	*0.11*	*0.30*	*7.6*	*4.1*	*0.04*	*3.8*	*3.0*
Wald/df	*7.5*	*3.3*	*4.2*	*2.1*	*3.3*	*5.2*	*5.1*

Conclusions

The primary aim of the above research was to select among the large number of newly imported varieties. Two of the research locations provided very disappointing results severely limiting the useability of yield data for the purpose of selection. Some varieties were identified as disease susceptible and these were dropped from further evaluation.

The recovery in yield performance of Utamua gives further reassurance to its value as a recommended variety following disappointing results the previous year.

Local varieties were amongst the lowest yielding when averaged across all sites but where yield components were recorded in Betano were amongst the best performers in pod and seed weight and seeds per pod.

Results from the fifteen varieties entered for evaluation in 2011/12 will enable a thorough examination of the new varieties included in this selection across a wider number of environments in a multi-year analysis.

There were insufficient entries with potential to be included in OFDTs during the wet season of 2010-2011

2.6 Temperate cereals

2.6.1 Wheat and barley replicated trials, 2010

The results presented in this section are from a second year of replicated trials conducted on wheat (*Tritium aestivum* L.) and barley (*Hordeum vulgare* L.). Previous trials were conducted during the dry season of 2009 and wet season of 2009/2010 (SoL 2010).

Materials and methods

Twelve wheat varieties and 15 barley varieties selected from trials conducted in 2010 were evaluated during 2011. Designations/names of these populations are presented in Table 66.

Table 66. Population details, replicated cereal trials, 2011

Wheat varieties	*Barley varieties*
Barham	Bichy 2000
Yitpi	ND 19119-5-3
Young	2ND 25316
Yenda	Fitzroy
Janz	Grout
Livingston	ND 23074
Gladius	Naked barley
Chara	ND 24175
H 46	Shepherd
Correl	ND 24519-1
Darrimut	2ND 25473
Local Titboa	Local Aisnata
	Canela
	2ND 25454
	2ND 25610

Replicated trials of each species were carried out at the three sites of Brigada (Maubisse), Holorua (Same) and Lariguta (Ossu). Trials consisted of 3 replicates in a randomized complete block design with each plot being approximately 1.5 m^2 (2 m x 0.75 m) with 6 or 7 rows and 27 hills per row (two seeds per hill). The plots were neither fertilized nor irrigated as per farmers' practices in Timor-Leste. Dry season trials were planted in May and June and harvested September and October, 2011 (Table 67).

Table 67. Planting and harvest details of cereal varietal trials, 2011

	Location, harvest year	*Season*	*No. of replicates/ entries*	*Planting date (2011)*	*Harvest date (2011)*	*Days to maturity*	*Rain fall (mm)*	*Altitude (masl)*	*Mean yield (t/ha)*
WHEAT	Brigada, 2011	Dry	3/12	23-May	Sep.	110	282	1200	1.5
	Holarua, 2011	Dry	3/9	10-May	Sep.	120		731	0.2
	Lariguta, 2011	Dry	3/9	7-Jun	Oct.	115		948	0.7
BARLEY	Brigada, 2011	Dry	3/12	24-May	Sep.	110	282	1200	1.7
	Holarua, 2011	Dry	3/12	10-May	Sep.	120		731	0.4
	Lariguta, 2011	Dry	3/9	7-Jun	Oct.	115		948	1.4

Results

Wheat

Wheat yields and yield components from the trials at Brigada, Holarua and Lariguta, are presented in Table 68, Table 69, and Table 70.

Brigada

At Brigada the best performer was Yitpi at 2.3t/ha (Table 68). This entry was slightly below average for height but was above average for tillers/plant, head length and grains/head. Most introduced varieties showed higher yields than the local, Titboa, which was very tall and produced a long head (8.2 cm). The average height of Titboa was 92.2 cm, 28.8 cm higher than the tallest introduced variety, Barham (63.4 cm). This might be explained by the fact that western wheat varieties have been selected for semi-dwarfism.

Table 68. Wheat yields and yield components, Brigada, 2011

Variety	*Yield (t/ha)*	*Tillers per plant*	*Plant height (cm)*	*Head length (cm)*	*Grain per head*	*Seed weight 100 (g)*
Yitpi	2.3	5.8	54.6	6.6	38.7	4.9
Barham	1.7	5.4	63.4	6.9	29.9	5.5
Gladius	1.4	4.0	50.9	6.3	23.9	5.0
H 46	1.6	4.8	57.5	7.0	34.3	4.9
Livingston	1.3	5.8	59.3	6.6	25.3	5.6
Young	1.6	7.1	54.7	5.7	30.8	4.8
Correl	1.3	5.1	51.9	6.0	28.7	5.4
Janz	1.5	6.4	50.2	6.3	30.9	5.0
Chara	1.6	5.1	58.8	6.6	28.0	5.8
Derrimut	1.2	6.4	52.1	6.8	36.8	4.2
Local Titboa	1.2	6.6	92.2	8.2	25.3	4.4
Yenda	1.0	2.5	32.4	3.3	18.2	3.3
Mean	1.5	5.4	56.5	6.4	29.2	4.9
Fprob	<0.001	0.16	<.001	0.03	0.32	0.10
LSD (P=0.05)	0.41	ns	14.8	2.1	ns	ns
CV (%)	15.0	31.6	15.5	19.4	30.4	18.0

Holarua

In Holarua, the local, Titboa, was also taller than the test varieties (39.3 cm higher than the next tallest variety) and had long heads (Table 69). All grain yields were low at this site but most introduced varieties out yielded the local. The fungal disease, Wheat Leaf Rust (*Puccinia triticina*), was prevalent in Holarua (shown in Table 69 as Leaf Spot infection). The local Titboa was significantly more susceptible to Leaf Rust than the improved Australian varieties. It showed nearly 100 % more damage than Young for example. Livingston and Barham were particularly resistant and plots of these varieties could be easily visually identified on the randomized plots in the field. The varieties Livingston and Chara were the best performers at this site.

Table 69. Wheat yields and yield components, Holarua, 2011

Variety	*Yield (t/ha)*	*Plant height (cm)*	*Head length (cm)*	*Tillers per plant*	*Seeds per head*	*Leaf spot infection (%)*	*Head blight (%)*
Janz	0.40	47.4	4.7	2.2	10.6	12.3	0.0
Yenda	0.27	45.8	5.1	2.0	7.3	15.0	5.7
Silvester	0.26	54.3	5.3	1.9	7.8	15.0	4.3
Derrimut	0.26	51.8	5.6	3.7	6.8	13.3	0.0
Barham	0.23	44.6	6.8	2.2	10.5	8.3	0.0
Yitpi	0.19	41.2	5.0	2.2	7.7	13.3	20.0
Local Titboa	0.16	93.6	8.4	2.0	17.8	33.3	1.0
Livingstone	0.15	49.9	4.7	2.1	4.5	8.3	28.7
Young	0.14	41.3	4.2	1.6	7.3	16.7	15.0
Mean	*0.23*	*52.2*	*5.5*	*2.2*	*8.9*	*15.1*	*8.3*
Fprob	*0.02*	*<.001*	*0.001*	*0.93*	*0.24*	*0.017*	*0.3*
LSD (P=0.05)	*0.13*	*12.75*	*1.66*	*ns*	*ns*	*0.13*	*ns*
CV	*33.4*	*14.2*	*17.5*	*78.8*	*61.4*	*33.3*	*192*

Lariguta

Grain yields during the dry season in Lariguta were low compared with Brigada and were not significantly different from each other (Table 70) despite their reasonable head length and the number of tillers/plant being quite high.

Table 70. Wheat yields and yield components Lariguta, 2011

Variety	Yield (t/ha)	100 seed weight (g)	Head length (cm)	Tillers/plant
Barham	0.40	3.3	6.4	4.4
Chara	0.64	4.5	7.6	4.1
Correl	0.53	3.8	5.5	5.2
Derrimut	0.53	3.5	6.6	4.3
Gladius	0.55	4.1	5.4	5.4
H 46	0.77	4.3	5.7	5.4
Janz	0.72	4.2	5.7	5.7
Local Titboa	0.78	3.8	7.1	5.2
Livingston	0.83	4.8	7.6	5.3
Yenda	0.97	4.2	5.2	5.2
Yitpi	0.42	3.6	7.3	3.5
Young	0.68	3.9	5.3	4.9
Mean	*0.65*	*4.0*	*6.3*	*4.9*
F pr.	*0.17*	*0.19*	*0.01*	*0.53*
LSD (p=0.05)	*ns*	*ns*	*1.42*	*ns*
%cv	*35.4*	*14.3*	*13.3*	*23.9*

Wheat grain yield comparison across years

Grain yields of test wheat varieties are compared across years and seasons in Table 71. Insufficient seed was available for each variety for every trial but if all available data were compared, the most productive varieties were Yitpi and Gladius followed by H46, Chara and Young. The top two possessed yield advantages of 25% and 20% respectively over the local Titboa. The best of these varieties will be included in further trials in 2012.

During 2011, a number of diseases were identified in the wheat trials which may be selected against in future introductions. These were Crown Rot (*Fusarium pseudograminearum*), Head Scab (*Fusarium graminearum*) and Wheat Leaf Rust (*Puccinia triticina).* It was observed that it is possible to reduce the incidence of Head Scab incidence by rotating wheat with non-cereals and that control management strategies could include fallow and strategic burning. Wheat

Leaf Rust will flourish in high elevation environments and can only be controlled with the use of fungicides or use of resistant varieties. Timor-Leste farmers are reluctant to use fungicides and varietal resistance tends to break down with pathogen evolution. As shown in Holarua, the local variety is susceptible to leaf rust and imported varieties need to possess resistance to this disease to perform consistently well in the wheat environments of Timor-Leste.

Table 71. Mean wheat yields across locations and seasons 2009-2011

	Yield(t/ha)						*Mean*	
Variety	*Rotutu 2009 Dry*	*Mbs 2009 Dry*	*Mbs 2010 Wet*	*Brigada 2011 Dry*	*Holarua 2011 Dry*	*Lariguta 2011 Dry*	*Yield (t/ha)*	*Yield advantage (%)*
Yitpi	1.20	1.30	1.40	2.3	0.19	0.42	1.14	25
Gladius	1.50	0.60	1.40	1.4		0.55	1.08	20
H46	0.40	1.20	1.40	1.6		0.77	1.07	18
Chara	1.10	1.10	0.70	1.6		0.64	1.04	14
Young	-	1.10	1.60	1.6	0.14	0.68	1.03	14
Correll	1.60	1.10	0.60	1.3		0.53	1.03	14
Barham	-	1.10	1.60	1.7	0.23	0.40	1.01	12
Derrimut	1.50	1.10	1.10	1.2	0.26	0.53	0.95	5
Janz	1.20	1.20	0.70	1.5	0.40	0.72	0.95	5
Loc. Titboa	*1.10*	*1.10*	*1.10*	1.2	0.16	0.78	0.91	0
Livingstone	0.90	1.00	1.20	1.3	0.15	0.83	0.90	0
Yenda	1.50	0.90	0.40	1.0	0.27	0.97	0.83	-8
Silverstar					0.26		0.26	-71
Mean site	1.2	1.1	1.1	1.5	0.2	0.7	0.9	
F prob	*<0.001*	*ns*	*0.004*	*<0.001*	.387	*.500*		
LSD (P=0.05)	*0.5*	-	*0.6*	0.4	ns	*ns*		
%CV	*8.5**	*36.7*	*33.5*	*15*	*36*	*72*		

Mbs - Maubisse

Barley

As mentioned above, barley trials were conducted alongside the wheat trials at Brigata, Holarua and Lariguta. Although the trials were installed in a similar manner and grew under similar conditions, barley grain yields were high at both Lariguta and Brigada but low in Holarua (compared with higher wheat grain yields only at Brigata). However, there was no significant difference between grain yields of entries at each site (Table 72) although the local (Aisnata) performed well at each site. The local entry was also taller at each site and significantly so at Brigata (Table 72). Grain size was approximately 6g per 100 seeds and head length at approximately 7 cm. Although no yield differences were discernible in 2011, the results were compared with those from the dry season of 2009 and wet season of 2009/2010. The results of this comparison are presented in Table 73. These results also indicate that the local variety, Aisnata, on average, yielded 20-60% more than the introduced varieties indicating that other improved varieties need to be evaluated in Timor-Leste.

Table 72. Barley yields and yield components at Brigata and yields at Lariguta and Holarua

Variety	*Yield (t/ha)*	*Tillers/ plant*	*Plant height (cm)*	*Head length (cm)*	*Seeds/ head*	*100 seed weight (g)*	Yield Lariguta (t/ha)	Yield Holarua (t/ha)
Local Aisnata	2.2	5.0	77.6	8.7	24.8	5.2	2.2	0.45
Fitzroy	2.0	9.4	37.4	6.8	20.3	5.9	1.9	0.56
Shepherd	1.8	9.0	41.8	6.7	20.8	5.3	1.8	0.53
Bichy 2000	1.8	5.7	60.8	7.6	21.9	6.5		
ND 24175	1.8	7.2	55.9	6.8	21.5	6.3	0.9	0.41
Naked barley	1.7	7.0	56.1	7.8	23.8	4.9	2.1	0.31
ND 19119-5-3	1.7	5.6	61.0	7.3	21.4	6.4		
ND 23074	1.6	5.6	46.8	7.0	21.3	6.5	1.5	0.53
2ND 25473	1.6	8.1	55.2	6.5	19.3	6.3	1.1	0.35
ND 24519-1	1.6	7.5	45.5	8.9	24.4	6.0	1.5	0.27
2ND 25316	1.4	7.5	48.2	7.1	18.1	6.0	1.6	0.43
Grout	1.3	11.3	36.9	7.7	18.0	5.5	0.7	0.43
Mean	1.7	7.4	51.9	7.4	21.3	5.9	1.4	0.42
Fprob	0.518	0.009	<.001	0.051	0.056	0.011	0.55	0.53
LSD (P=0.05)	ns	3.0	9.2	ns	ns	0.9	ns	ns
CV (5)	27	24	10	12	12	9	53	48

Barley varieties in the trials were observed to be infected with a number of pathogens. Included were Crown Rot (*Fusarium pseudograminearum*), Head Scab (Fusarium graminearum), Barley Yellow Dwarf Virus (BYDV) and a spot form of Net Blotch (*Pyrenophora teres*). As observed with wheat, Crown Rot can be controlled by rotating barley with non cereal crops. BYDV may be controlled by controlling insect vectors and Net Blotch was observed only in susceptible varieties (such as Shepherd). Net blotch may be controlled by selecting resistant varieties.

Table 73. Barley yields across locations and seasons 2009 – 2011

Variety	*Yield (t/ha)*							*Mean*		
	Trc 2009 Dry	*Rtt 2009 Dry*	*Mbs 2009 Dry*	*Mbs 2010 Wet*	*Brigada 2011 Dry*	*Holarua 2011 Dry*	*Lariguta 2011 Dry*	*Yield (t/ha)*	*St Dev*	*Yield advantage (%)*
2ND 25316	0.6	2.3	3.6	1.2	1.4	0.43	1.6	1.6	1.08	-23
2ND 25454	0.5	1.1	1.4	0.9		0.46	0.7	0.8	0.36	-59
2ND 25473	0.4	1.2	2.8	1.1	1.6	0.35	1.1	1.3	0.84	-41
2ND 25610	0.3	1.1	2.2	1.5		0.26	0.0	0.9	0.86	-63
Bichy 2000	0.1	0.9	3	2.2	1.8			1.6	1.13	-23
Canela	0	0.9	2.6	2		0.58	0.6	1.1	0.98	-46
Fitzroy	0.7	1.9	3	0.4	2.0	0.56	1.9	1.4	0.96	-28
Grout	0.5	2.2	2.4	0.7	1.3			1.5	0.86	-32
Loc. Aisnata		*1.8*	*3.8*	*2*	2.2	0.45	2.2	2.0	1.12	0
Naked barley	-	1.4	3.3	0.5	1.7	0.31	2.1	1.5	1.09	-25
ND 19119-5-3	0.1	1.8	1.9	1.3	1.7			1.4	0.74	-34
ND 23074	0.1	1.7	2.5	1.8	1.6	0.53	1.5	1.4	0.81	-33
ND 24175	0.3	1.5	2.8	1.5	1.8	0.41	0.9	1.3	0.83	-37
ND 24519-1	0.6	1.9	2.7	1.6	1.6	0.43	1.6	1.5	0.80	-28
Shepherd	1.2	2.3	3.7	0.3	1.8	0.53	1.8	1.7	1.17	-20
F prob		*0.001*	*0.001*	*0.011*	*0.518*	*0.387*	*0.5*			
LSD (P=0.05)		*0.8*	*1.6*	*1*	*ns*	*ns*	*ns*			
*%CV / Walf/df**		*32.3*	*2.5**	*52.9*	*24.2*	*36*	*72*			
Mean	0.4	1.5	2.7	1.2	1.7	0.42	1.3	1	1.5	

Trc = Turascai, Rtt = Rotatu, Mbs = Maubisse

2.7 Potato

European potatoes (*Solanum tuberosum* L.) are often grown by farmers in the cool environments of higher altitudes of Timor-Leste. Potatoes are a high value crop and have been a source of cash income for highland farmers for many years. They are often found for sale in local markets, or as chips in restaurant dishes. The crop does have production problems. Potatoes in Timor and the tropics are particularly infected by fungal diseases such as Late Blight (*Phytophthora infestans*) and White Mould (*Sclerotinia sclerotiorum*). Susceptible varieties that are infected by these diseases have rots on the stems and tubers resulting in low yields.

After screening a number of introductions from the Regional Office for East, South East Asia and the Pacific (ESEAP) of the International Potato Centre (CIP) in previous years, the resistant clones have been included in replicated trials in Maubisse and Ossu. The objectives of these trials were to a) identify resistant varieties that maintain resistance to the field pathogens, and b) identify varieties that can yield in Timor-Leste conditions.

2.7.1 Potato replicated trials, 2011

Material and methods

Replicated trials of a range of potato varieties were implemented in Maubisse (Ainaro) and Ossu (Viqueque) during the 2011 dry season. Seven and five introduced varieties (at Ossu and Maubisse respectively) were trialled, in addition to the some local checks. In Maubisse, one variety was sourced from a local supermarket. Two of the varieties from Bogor (Tenggo and Berolina) had been extensively trialled in several locations in Indonesia and have proved to be resistant to *Phytophthora sp*. All introduced varieties were previously sourced from CIP and planted in Maubisse. Tubers for both trials were sourced from Maubisse.

Each variety was planted with 40 cm spacing between and within rows in a plot 2 x 1.2 m, resulting in 15 hills. Yields were calculated from the tuber weight per plot. Planting and harvesting details are detailed in Table 74.

Table 74. Planting and harvest details of replicated potato trials, 2011

Trial location and altitude (masl)	*No. of entries*	*No. of reps*	*Planting date*	*Harvest date*	*Days to maturity*	*Mean yield (t/ha)*
Maubisse (Ainaro) 1660	7	2	1/4/2011	12/07/11	102	4.4
Ossu, (Viqueque) 940	8	2	30/3/2011	6/07/11	97	1.8

Disease impact was evaluated by recording the number of plants badly infected (wilted and spotted leaves) or dead from disease during growth. At harvest, tuber numbers and weight were also recorded, with distinction between edible and damaged tubers. From these data, the number of tubers per plant and the weight of 10 tubers were calculated.

GenStat Discovery 4 was used to determine correlations (Simple Linear Regression) between yield and yield components.

Results

All varieties except E07 germinated well with a resulting plant stand above 4.4 plants/m^2. It appears that E07 is not well adapted to the storage conditions in Maubisse. The poorest performing varieties in terms of yield and disease performance were the local check and a variety sourced from the supermarket in Dili. Both suffered blight like symptoms on all plants, and yielded less than half of the best performing entries.

Table 75. Potato yield and yield components, Maubisse, dry season 2011

Variety	*Code*	*Blight infection rate (%) 2 months after planting*	*Plant density at harvest, per m²*	*Number of tubers / plant*	*Tuber weight (g)*	*Yield* (t/ha)*
369034.13	E02	22	5.4	3.4	42	7.7
Tenggo 1	ET1	36	5.0	3.9	37	7.0
39184.5	E01	14	5.4	3.1	34	5.8
395195.7	E03	85	4.4	2.8	35	4.2
390043.37	E07	57	3.2	2.4	39	2.9
Supermarket	WS	100	5.9	2.8	13	2.3
Local Maubisse	LM	100	5.2	1.8	8	0.8
MEAN		59	4.9	2.9	30	4.4
Fprob		0.004	0.001	0.003	0.012	0.002
LSD (P=0.05)		36.6	1.3	1.2	20	2.7
CV %		25	13	21	29	29

* including damaged tubers inedible but fit for animal consumption (10% of the total yield on average)

The best performing varieties were E01, E02 and Tenggo 1. All of these had relatively low disease infection rates, and yields above 5.5 t/ha. Yield was highly correlated with the level of disease infection and number of tubers per plant.

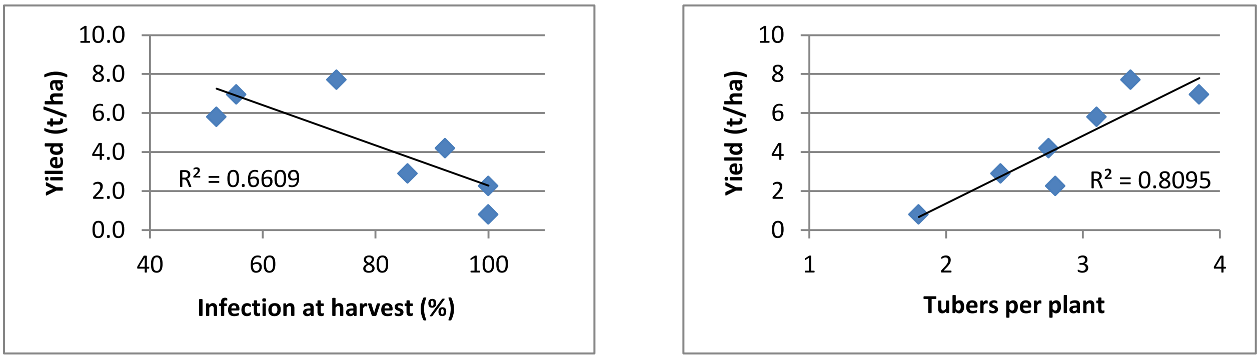


Figure 24. Impact of disease incidence and tuber number on potato yield, Maubisse 2011

Yield was reduced with an increase in disease incidence, and increased with more tubers per plant (Figure 24).

Tuber yield was much lower in Ossu, achieving only half the yield of Maubisse (1.8 t/ha, Table 76), although the level of infection was much lower. There were no significant differences between the varieties, mostly because of the limited replication (2) and variable field in terms of drainage and fertility.

It was most surprising that although the local potato from Maubisse had a high rate of disease infection at Maubisse, it had a low infection at Ossu. This suggests the diseases at the two locations are different.

Table 76. Potato yield and yield components, Ossu, dry season 2011

Variety	*Code*	*Blight infection rate 2 months after planting*	*Plant density at harvest, per m²*	*Number of tubers/ plant*	*Tuber weight (g)*	*Yield* (t/ha)*
390043.37	E7	53	5.0	2.9	23.1	3.7
395195.7	E3	10	4.8	2.0	21.5	2.3
Local Maubisse	LM	10	5.8	2.3	13.4	2.2
393371.58	E5	7	4.2	1.5	41.4	2.1
396034.13	E2	53	5.0	1.7	18.9	1.9
39184.5	E1	13	5.2	1.5	13.7	1.3
Tenggo 1	ET1	20	3.5	1.1	25.9	1.2
Berolina	EB	20	1.9	0.2	40.0	0.2
Mean		23	4.4	1.6	23.1	1.8
F. Prob		0.7	0.07	0.035	0.13	0.57
LSD (P <. 0.05)		ns	ns	1.0	18	ns
CV %		141.2	21.9	25.8	29.5	42.8
E.7(390043.37)		53	5.0	2.9	23.1	3.7

The severity of observed disease symptoms were not correlated with yield in Ossu, but high yield was correlated with more tubers per plant (Figure 25).

As in other years, disease symptoms appeared worse on some varieties than on others. The most obvious symptoms were wilting of the whole plant, yellowing-spotted leaves, and a rotting of the stem near the soil surface. It is unclear form either site of the dominant disease is due to potato late blight (*Phytophthora infestans*) or bacterial wilt (*Ralstonia solanacearum*). Both of these serious diseases of potato have been recorded in Timor-Leste.

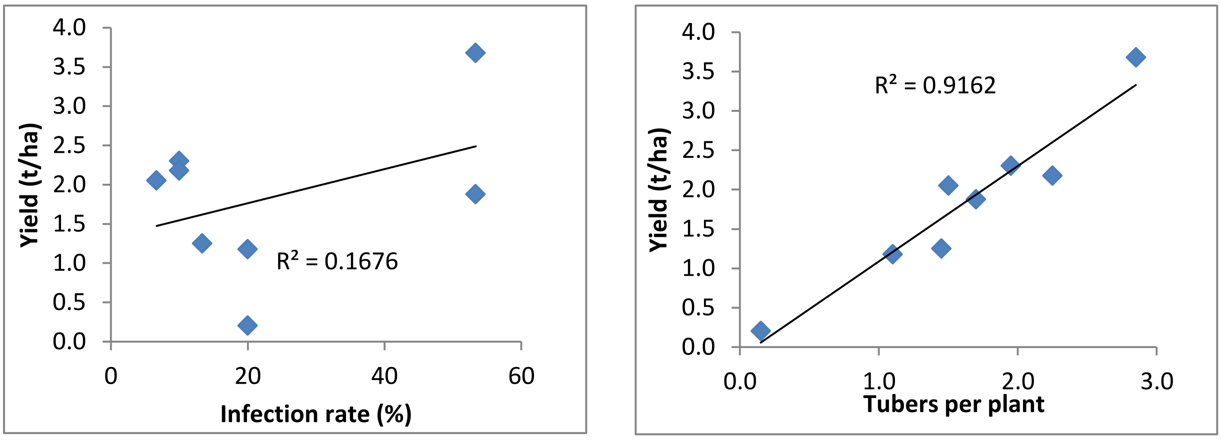


Figure 25. Impact on disease incidence and tuber per plant on potato yield in Ossu 2011

Conclusions

The incidence of disease and the use of presumed diseased material from last year's testing makes it difficult to recommend any varieties form this set of testing. It is recommended that fresh potato material for the most promising clones be reintroduced to Timor-Leste for further testing.

It is further recommended that some disease testing be associated with the variety evaluation in future years. The use of pocket diagnostic test strips should be used to monitor disease in future experiments.

2.8 Winged beans

2.8.1 Winged Bean Observation Trials 2010-2011

The winged bean (*Psophocarpus tetragonolobus* (L.) DC) is a climbing legume cultivated in Africa, Southeast Asia, and the South Pacific. Noted for its high protein content and capacity to fix nitrogen, the winged bean shows great potential to improve food security in Timor-Leste. All parts of the plant except the stock are edible and it readily adapts to even poor quality soils. (Mnembuka & Eggum 1995) It thrives in humid tropical areas of high rainfall and is cultivated in Papua New Guinea at altitudes from sea level to 2,200m. (Claydon, 1983) Preference for the most desirous edible portion of the plant varies by region with young pods, leaves and shoots eaten raw or cooked in PNG, ripe seeds parched and eaten in Java, and tubers eaten raw or cooked in Myanmar where they are cultivated unstaked in large plots. (Hymowitz & Boyd, 1977) In Timor-Leste it is known in various eastern districts as Duhaen, Wewe, Lari Lari or Duae and is usually consumed as a wild food or grown in small quantities as a garden vegetable. There are reports of all parts of the plants being consumed and it does not seem to be present either cultivated or wild in the western part of the country. Improved varieties, identified by their longer pod length (25-35 cm as opposed to 6-10 cm for locals), have been found being grown in Laulara and Turiscai subdistricts.

Seed for twelve improved winged bean varieties originating from a variety of nations were sourced from the Australian Tropical Crop and Forages Collection (ATCFC). They were grown alongside two Timorese local varieties sourced from Luro in Los Palos district and Laga in Baucau (Table 77). As the quantities of seed obtained were small, the aim of the 2010-11 observation trials were to check whether the new entries would grow, flower and set seed in Timor-Leste, to produce sufficient seed for more extensive trials in 2012, and to assess the most suitable location among the SoL research stations. Trials were planted in the wet season in Aileu, Maubisse, Betano, Loes, and at the Dili office. Plot size depended on the number of seeds available, but was generally 2 x 2 m. The winged beans were grown on trellises with one seed planted per trellis. In Aileu, all varieties germinated but none survived to flower. Although the plants grew and flowered in Maubisse (Hori kiik elevation 1650 m) there was no seed set. No germination was achieved at Betano, so the only seed source was from Loes (20 masl). A minimum of 50 grams of seed was harvested from each variety where seed set occurred with some varieties producing up to 1 kg. As the number of seeds available varied no yield data were recorded but sufficient seed was produced to allow for further trials on research stations in 2012 and OFDTs of the varieties where the most seed was obtained.

Table 77. Winged bean varieties for 2010/11 observation trials.

Code	*Origin*	*No. Seeds imported*	*Produced seed*
DN Indo	Indonesia	15	*
DN N6	Nigeria	15	*
DN N8	Nigeria	50	
DN PNG12	Papua New Guinea	50	
DN PNG31	Papua New Guinea	50	*
DN PNG10	Papua New Guinea	30	
DN PNG13	Papua New Guinea	50	*
DN PNG16	Papua New Guinea	50	
DN PNG01	Papua New Guinea	50	
DN P14	Philippines	15	
DN SL10	Sri Lanka	50	*
DN T4	Thailand	15	*
DN Luro	Local	-	*
DN Laga	Local	-	*

3. Seed production and distribution

Introduction

Gaining access to good quality improved seed is an important step towards increasing agricultural productivity. To address this issue, SoL has steadily increased the amount and improved the seed quality of its released varieties. SoL commenced formal seed production in 2008. Multiplication is done by seed growers who are contracted to multiply foundation seed which was initially supplied by MAF research stations. MAF/SoL seed officers monitor its production to ensure seed certification steps are followed. These steps need to be implemented properly by growers in order to produce high quality seed. Field inspection and laboratory seed testing are two mechanisms used by seed inspectors to monitor quality.

Field inspections are made prior to planting, during vegetative, growth and prior to harvest to ensure the seed being produced is pure and true-to-type. The seed inspector will check the originality of the seed source, inspect the cultivated area to evaluate the chance of volunteer plants growing from a previous crop, see if the field is properly isolated from similar crops and then review the number of off-types, during the vegetative stage and at harvest. He/she will also inspect the processing facilities to make sure that they are free from any contaminants such as inert matter, plant debris, and seed of other varieties. Then, a representative seed sample will be taken for testing to evaluated its purity, germination rate, and moisture content.

A seed lot will be declared certified if it passed both the field inspections and laboratory tests to meet certification standards. Seed certification in most countries is identified with an official label attached to the seed bag.

Most of the certified seed produced by SoL is distributed through MAF-SoL, directly by MAF to farmers in the districts, and to farmers via NGOs. Seed distributed through MAF-SOL is used for research, OFDTs, Informal Seed production (IFSP) and further Formal Seed production (FSP) while seed distributed through MAF and NGOs are used mostly for improving food security.

Informal seed production is the production of quality seed by seed growers without inspection from seed officers. The SoL informal seed production program will commence in 2012.

3.1 Seed production: rice, maize, and peanut (2010/2011)

SoL contracted growers to multiply rice, maize and peanut seed in the 6 districts of Aileu, Baucau, Bobonaro, Manufahi, Liquica and Viqueque where MAF seed officers were based during 2010/2011.

Contract growers were selected by seed officers on the basis of whether they were:

a) Progressive farmers or be within a progressive farmer group,
b) Possessed at least 3-5 ha of clean land,
c) Fields could be isolated from similar crops
d) Fields were located close to infrastructure such as roads, irrigation, drying floor, warehouse, etc.

About 50 ha of maize field, 25 ha of rice field and 30 ha of peanut field were identified for seed production in the rainy season of 2010/2011 (Table 78). It has been noted that many of corn and peanut field failed to produce seed mainly because of excessive rain, flooding, and by cattle or mouse damage.

Table 78. Contracted production area and number of growers, 2010/2011

	Contracted area (ha)			*# Contracted seed growers**		
District	Nakroma	Sele	Utamua	Nakroma	Sele	Utamua
Aileu	3.5	0	0	3	0	0
Baucau	18	4	18	8	2	8
Bobonaro	6.0	20	4	6	20	4
Liquica	0	6.5	0	0	6	0
Manufahi	0	17	0	0	28	0
Viqueque	8	5.5	1.0	7	11	4
Total	35.5	53	23	24	77	16

Note: * Contract growers can be groups or individuals

The amount of clean seed produced from all districts during this period was:

- Rice (Nakroma) 48.7 t
- Maize (Sele) 25 t
- Peanut (Utamua) 3 t

3.2 Improved rice, maize and peanut seed distribution

Seed harvested from 2009/2010 was distributed for planting in the wet season of 2010/2011. This seed supported the SoL research program (mainly OFDTs) and further seed production. Seed was also distributed to farmers directly through MAF (some purchased by FAO) and by NGOs. Distributed was:

- Rice (Nakroma) 50 t
- Maize (Sele) 32.5 t
- Peanut (Utamua) 17 t

All disbursed seed needed prior approval by the National Director of Agriculture and Horticulture (NDAH). Most of the seed was distributed through MAF (85%) with support from FAO (45 t of rice, 20 t maize and 10 tons of peanut seed). About 8% of the seed was distributed through NGOs and 7% by MAF-SoL.

3.3 Production and distribution of sweet potato and cassava stem cuttings.

Sweet potato

Stem cuttings of the three sweet potato varieties released by SoL/MAF in 2007 (Hohrae 1, Hohrae2, and Hohrae 3) were multiplied in the districts of Manufahi, Aileu, Viqueque, Liquica, Bobonaro and Baucau. Approximately 0.4 ha of field was planted at a spacing of 50 x 50 cm (a plant population of 80,000 plants/ha). After 2 months, one plant produced an average of 4 cuttings approximately 25 cm long (32 stem cuttings/m^2). Based on that estimation, 128,000 cuttings can be harvested every two months from 0.4ha and four harvests would yield 512,000 cuttings. This number of cuttings is sufficient to plant 12.8ha of sweet potato.

In 2010/2011, 22,080 sweet potato cuttings were distributed, mostly in the districts of Liquica, Manufahi and Baucau (Table 79). Most of the cuttings (78%) were distributed through the MAF/SoL program and 22% directly from the grower to nearby farmers.

Table 79. Production area of sweet potato and cassava cuttings, 2010-2011.

District	*Sweet potato*		*Cassava*	
	Area (m^2)	*Distributed stem cuttings*	*Area (ha)*	*Distributed stem cuttings*
Aileu	400	0	0	0
Baucau	200	3,500	0	0
Bobonaro	200	0	1	0
Liquica	3000	16,850	1	0
*Manufahi**	200	1,730	1	19,995
Viqueque	200	0	0	0
	4200	22,080	3	19,995

Note: * = In Betano Research station

Cassava

MAF released two high yielding, good quality cassava varieties, Ailuka 2 and Ailuka 4, in August 2009. Both varieties were introduced by CIAT to Timor-Leste for evaluation in 2001.

Cassava fields were established at Loes-Liquica (1 ha), Corluli-Bobonaro (1 ha), and Betano-Manufahi (1 ha) on August 2009, December 2009 and February 2011, respectively. The planting distance was 1 x 1m (equal to a population of 10,000 plants/ha). To stimulate branching, the plants were pruned at a height of 40 cm. On average, each plant possessed three stems at harvest.

A 1 m stem of cassava can produce about four (25cm long) cuttings. A 1 ha field can produce about 480,000 cassava stem cuttings/planting season. In 2010/2011, SoL distributed about 19,995 cassava stem cuttings (Table 79). Most of these were allocated for MAF-SoL program (68%) and the remainder for NGOs (32%).

SoL seed distribution compared with national seed requirements

Assuming seeding rates of 25 kg/ha for rice, 20 kg/ha for maize and 200 kg/ha for peanut, the distributed seed for 2010-2011 was sufficient to sow 1,949 ha of rice, 1,256 ha of maize, and 16 ha of peanut. Given that the total planted area of rice, maize, and peanut in Timor-Leste was 38,069 ha, 75,804 ha and 3,350 ha, respectively in 2009/2010 (MAF-NDA&H statistics), SoL's formal seed production supplied more than 5% of national rice requirement during 2010/2011 (Table 80). This amount is expected to increase in future years to provide sufficient seed for the informal seed production program.

Table 80. Contribution of SoL to national seed requirements, 2010-2011

Crop/variety	*Est. planted area (ha)*	*Seed rate (kg/ha)*	*National seed requirement (t)*	*Distributed seed 2010/2011 (t)*	*% of national seed requirement (%)*
Rice/Nakroma	38,069	25	952	50.1	5.3
Corn/Sele	75,804	20	1,516	32.5	2.1
Peanut/Utamua	3,350	200	670	17.0	2.5
Sweetpotato/Hohrae 1, 2 and 3	4,879	40,000*	195 mill*	22,080*	0.01
Cassava/ Ailuka 2 and 4	6,936	10,000*	694 mill*	19,995*	0.003

*stem cuttings

4. Farming systems research

4.1 Maize and velvet bean systems

A long-term rotation experiment was continued at Betano research station during 2010-2011. The aims of the research were to test the effect of velvet bean rotation on maize yields, and to test the common belief that using tractors to till the soil is the best way to prepare the land. The use of Round-Up (a selective herbicide) was also included in the trial to compare with labour costs and to determine whether it allowed an earlier start to the season. Four planting/harvest cycles have now been completed over the course of the experiment with one season (dry season 2009) not being planted due to lack of rain.

At Loes, a similar trial was recently established to investigate the effect of the method of tillage, application of Round-up, and velvet bean rotation on maize yields. The dry biomass of weed and velvet bean was also recorded to assess the suppressive effect of velvet bean on the weed burden and the amount of velvet bean mulch produced as weed control by hand is a highly labour intensive operation.

Methods

The design of the long term rotation experiment at Betano is as described in previous annual reports. The trials were laid out in a randomized complete block design with 40 x 20 m plots. Five treatments were applied in three replicates to compare mechanical ploughing as opposed to the farmers' practice of no tillage, with or without Round-Up and velvet bean (Table 81). When velvet bean was included in a treatment, it was sown 30 days after the maize crop.

Table 81. Velvet bean/maize cropping systems trial treatments, Betano 2011

No.	*Treatment/Factor*				*Treatment*
	Tractor	*Round-Up*	*Hand prep.*	*Velvet bean*	
1.	X				Tillage (mechanical)
2.		X			Round-Up
3.	X			X	Combination Tillage/Velvet bean
4.		X		X	Combination Round Up/ Velvet bean
5.			X	X	Combination Hand preparation/ Velvet bean

In Loes, an extra treatment was added compared to the Betano experiment. The Loes Experiment is a factorial combination of three land preparation methods with and without velvet bean as a multicrop. The three methods of land preparation are, 1) mechanical tillage, 2) weeding by hand, and 3) application of roundup with no soil tillage (Table 82.). The inclusion of all combinations of all factors allows for interaction effect to be measured for each of the treatment structures. Plots of 20 x 12 m were laid out in randomized complete block design with four replicates. One of the replicates was affected by flooding, however, and only the remaining three were included in the analysis.

Table 82. Velvet bean/maize cropping systems trial treatments, Loes 2011

No.	*Treatment/factor*				*Treatment*
	Tractor	*Round-Up*	*Hand prep.*	*Velvet bean*	
1.	X				Tillage (mechanical)
2.		X			Round-Up
3.			X		Hand preparation
4.	X			X	Combination Tillage/ Velvet bean
5.		X		X	Combination Round Up/ Velvet bean
6.			X	X	Combination Hand preparation/ Velvet bean

Note: In all cases, sowing was done by placing seeds in holes made with a planting stick (standard farmers' practice)

At planting time, weeds and if need be, residual velvet bean, were slashed manually (as a tractor would have crushed the velvet bean pods) when not sprayed with Round-Up. Prior to planting, the soil was tilled with a tractor or not, depending on the treatment. Maize was planted with two seeds per hill at a planting distance of 75×50 cm (2.6 plants/m^2) in Betano and at 75 x 25 cm (5.33 plants/$m^{2)}$ in Loes. Velvet bean was planted approximately a month later with a 1 plant/m^2 density (one seed per hill). The plots without velvet bean were weeded twice, as farmers commonly do. The weight of wet and dry weed or velvet bean biomass was measured through 5 samples (quadrats of 1m^2) prior to planting and prior to harvest. At harvest, the number of maize plants was counted as well as the number of cobs per plot. The production per plot was weighed, prior to and after drying, as well as the weight of 100 seeds.

Table 83. Planting and harvest details of velvet bean trials, 2010/11

Location	*Season*	*Number of replicates*	*Planting date*	*Harvest date*	*Days to maturity*	*Rainfall (mm)**	*Mean yield (t/ha)*
Betano	Wet	3	20 Dec. 2010	12 April 2011	113	500	1.9
Betano	Dry	3	16 June 2011	17 October 2011	123	301	2.5
Loes	Wet	3	16 Dec 2010	4 April 2011	109	406	2.2
Loes	Dry	3	27 June 2011	28 October 2011	123	307	1.9

* Total rainfall from 1 week prior to planting to one week prior to harvest.

Results were analyzed in GenStat Discovery 3 using ANOVAs (Unbalanced ANOVA for the factors analysis and ANOVA One-Way in Complete Randomized Block for the overall cropping system treatment). For the Loes factorial combination trial, a Two-Way ANOVA was used to investigate the method of land preparation, planting of velvet bean, and the interaction of the two factors.

Results - Betano

In the Betano wet season trials, plots planted into velvet bean mulch produced significantly higher yields (77% overall yield advantage) than plots that had not been planted with velvet bean. All three land preparation methods produced similar results when paired with velvet bean and no significant difference was found among them. While there were no significant differences in plant density or the number of cobs per plant, significantly larger cobs were produced in the plots with velvet bean resulting in higher yields.

As in the 2009/10 Betano trials, weeds were fully absent from plots cultivated with velvet beans at harvest. Given the cost and scarcity of labour for weeding, this finding represents an important potential benefit to Timorese farmers. Production of velvet bean mulch followed the previous year’s trend with mechanical tillage producing the highest biomass followed by Round-Up and hand weeding. The results of the 2010/2011 wet season trials are presented in Table 84:

Table 84. Maize-velvet bean replicated trial results, Betano wet season 2010/11

Treatment	Dry biomass at harvest (t/ha)		Maize yield (t/ha)	Plant density at harvest (plant /m^2)	No. cobs /plant	Cob weight (g) (seeds only)	Seed weight (g/100)
	Weeds	V.bean					
Tillage & velvet bean	0	11.2	2.5	2.0	1.3	100	28.7
Round-Up & velvet bean	0	10.4	2.2	1.7	1.1	111	32.3
Hand weeding and velvet bean	0	8.6	2.1	1.8	1.1	105	30.3
Tillage (mechanical)	4.3	0	1.3	1.7	1.1	69	30.3
Round–Up	4.7	0	1.3	1.9	1.1	62	29.7
F prob	*<0.001*	*<0.001*	*0.04*	*0.65*	*0.73*	*0.008*	*0.18*
LSD (P<0.05)	*1.6*	*1.9*	*0.8*	*ns.*	*ns.*	*26.3*	*ns.*
%CV	*48.9*	*17.5*	*24*	*17.4*	*21.1*	*15.6*	*5.4*

The dry season trials produced similar results with the velvet bean treatments resulting in significantly higher yields (333% overall yield advantage) compared to the non-velvet bean treated plots. Plant density and number of cobs per plant again did not differ significantly, with greater cob weights resulting in the higher yields. An interesting difference between the wet and dry season trials is the significant difference among the three land preparation methods when paired with velvet bean. Mechanical tillage with a tractor produced the best results, followed by application of Round-Up and hand preparation. This supports the commonly-held belief among Timorese farmers that ploughing with a tractor is the best method of land preparation. The impact of these three methods of land preparation will be tested in future years. The results of the dry season trials are presented in Table 85.

While velvet bean did not entirely prevent weed growth as it had in the wet season trials, it did result in a significant reduction in the weed burden compared to non-velvet bean plots. In the dry season trial there was a very low amount of velvet bean growth. This was a result of little seed produced during the wet season, and poor germination of the seed planted after the maize crop was established. Velvet bean is a short-day plant and requires the short days in the dry season to induce flowering. As the wet season crop was harvested in April, there was no time for the crop to flower and set seed. As a result, there was no fresh seed in the dry season crop to germinate. Unfavorable soil moisture 1 month after resulted in very poor velvet bean germination once the crop was established.

Table 85. Maize-velvet bean replicated trial results, Betano dry season 2011

Treatment	Dry biomass at harvest (t/ha)		Maize yield (t/ha)	Plant density at harvest (plant /m^2)	No cobs /plant	Cob weight (g) (seeds only)	Seed weight (g/100)
	Weeds	V.bean					
Tillage & Velvet bean	0.26	0.38	4.6	2.1	2.0	106	38.6
Round-Up & Velvet bean	0.33	0	3.6	2.0	1.8	100	32.6
Hand weeding and velvet bean	0.28	0.43	2.3	2.0	1.8	63	33.4
Tillage (mechanical)	0.39	0	1.1	2.2	1.5	35	31.4
Round -Up	0.37	0	1.0	2.0	1.5	32	30.3
F prob	*0.034*	*<0.001*	*<0.001*	*0.55*	*0.307*	*<0.001*	*0.092*
LSD (P<0.05)	*0.08*	*0.18*	*0.85*	*ns.*	*ns.*	*20.4*	*ns.*
%CV	*14.5*	*57.9*	*17.9*	*7.9*	*18.6*	*16.2*	*9.8*

Table 86 outlines the average overall maize yields both with and without velvet bean since the long-term trial was started in 2009. Velvet bean consistently had a significant effect on maize yields and the benefits of the intercropping system are clear. Further trials in the coming years will provide useful data on the long term effects of the system. Continuing this line of research is supported by the fact that Timor-Leste farmers accept the practice and have been using the system for a number of years in some districts and that the system is successful in countries with bimodal wet seasons similar to Betano.

Table 86. Maize yield with and without velvet bean over three years at Betano

Treatment	*Maize yield (t/ha)* Wet season 2009/10	*Wet season 2010/11*	*Dry season 2011*
Velvet bean	0.5	2.3	3.5
No velvet bean	0.26	1.3	1.05
Yield advantage	*83%*	*77%*	*333%*
F prob.	*0.043*	*0.001*	*<.001*
LSD (p<0.05)	*0.2*	*0.48*	*1.1*
%CV	*43*	*21.7*	*37*
V. Bean dry weight at harvest (t/ha)	9.0	10.1	0.4
Rainfall from planting to harvest (mm)	400	500	301

Results - Loes

In the Loes wet season trials there was no significant difference in maize yields but this may have been due to sampling errors. While in Betano the yield was calculated by weighing the grain produced from the entire plot, in Loes only a 5 x 5 m sample was taken to calculate yield data. The characteristics of the samples taken may not have been representative of the true characteristics of the plots. Biomass data were collected using the same method as Betano, however, with velvet bean treated plots resulting in a significant reduction in the weed burden. Weed biomass was reduced from an average of 4.4 t/ha in non-velvet bean plots to an average of 0.5 t/ha with the velvet bean treatments. In plots where velvet bean was planted, an average of 7 t/ha of mulch was produced.

Table 87. Maize-velvet bean replicated trial results, Loes wet season 2010/11

Treatment	*Dry biomass at harvest (t/ha)* Weeds	*V.bean*	*Maize yield (t/ha)*	*Plant density at harvest (plant /m²)*	*No cobs/ plant*	*Cob weight (g)*	*Seed weight (g/100)*
Tillage & Velvet bean	0.9	8.9	2.8	2.0	1.4	170.7	35.7
Hand weeding and velvet bean	0.7	4.4	2.5	2.2	1.4	155.3	34.3
Round-Up and velvet bean	0.0	7.9	2.2	2.2	1.4	155.0	35.0
Tillage (mechanical)	4.4	0.0	2.2	2.1	1.2	161.3	34.3
Hand weeding	3.4	0.0	1.8	1.8	1.3	165.3	34.0
Round-Up	5.3	0.0	1.7	2.2	0.9	154.3	35.7
F prob.	*.013*	*<.001*	*.405*	*.764*	*.402*	*.717*	*.747*
LSD (P<0.05)	*3.0*	*3.8*	*ns.*	*ns.*	*ns.*	*ns.*	*ns.*
%CV	*67.7*	*58.7*	*29.5*	*18.7*	*26.6*	*9.5*	*4.9*

In the first season of the experiment, planting of velvet bean had a significant effect on the weed burden but not on maize yields. This was also the case in the first season of the Betano trials and suggests that the benefits of velvet bean are cumulative and results may not be seen in the first season that velvet bean is planted. Land preparation method did not significantly affect maize yields or biomass of either velvet bean or weeds. No interaction between land preparation method and planting of velvet bean was found (Table 88).

Table 88. Land preparation method/velvet bean trials Loes wet season 2010/11

Factor (number of modalities)	*Maize yield*	*Dry biomass V.bean at harvest*	*Dry biomass weeds at harvest*
Factor 1: Land Preparation method (3)	ns.	ns.	ns.
Factor 2: Velvet bean (2)	ns.	***	***
Interaction (6)	ns.	ns.	ns.

F prob.: ***<.001 **<.010 *<.050

In the following dry season trials in 2011, there was a significant difference in maize yields with plots treated with velvet bean producing a mean yield of 2.3 t/ha as opposed to 1.5 t/ha without (i.e. a 53% yield advantage). The Loes 2011 dry season trials are the only example from either location where velvet bean did not have a significant effect on the biomass of weeds. An average of 3.7 t/ha of velvet bean mulch was produced.

Table 89. Maize-velvet bean replicated trial results, Loes dry season 2011

Treatment	*Dry biomass at harvest (t/ha)*		*Maize yield (t/ha)*	*Plant density at harvest (plant /m^2)*	*Seed weight (g/100)*
	Weeds	*V.bean*			
Tillage & Velvet bean	2.5	3.7	3.3	2.8	29.3
Hand weeding and velvet bean	3.1	4.6	2.8	3.0	28.0
Round-Up and velvet bean	2.5	2.8	0.9	1.8	24.7
Tillage (mechanical)	2.8	0	1.7	2.9	29.0
Hand weeding	3.1	0	1.3	2.4	25.3
Round-Up	3.7	0	1.4	2.7	25.3
F prob.	*.72*	*<.001*	*0.03*	*0.17*	*0.001*
LSD (P<0.05)	*ns.*	*.13*	*1.5*	*ns.*	*2.1*
%CV	*34.1*	*38.2*	*43.1*	*20.5*	*4.3*

As in the previous planting cycle, no interaction was found between the two factors but land preparation method had a significant effect on maize yields and velvet bean nearly achieved significance in this area (Table 90). Low plant densities in the Round-Up and velvet bean treated plots could not be explained but resulted in low yields which reduced the overall effect of velvet bean.

Table 90. Land preparation method/velvet bean trials Loes dry season 2011

Factor (number of modalities)	*F prob.*		
	Maize yield	*Dry biomass V.bean at harvest*	*Dry biomass weeds at harvest*
Factor 1: Land Preparation method (3)	0.041	0.138	0.700
Factor 2: Velvet bean (2)	0.053	<.001	0.319
Interaction (6)	0.099	0.138	0.614

Table 91 outlines the mean yield for plots with and without velvet bean for the duration of the experiment at Loes. While velvet bean alone has not achieved a significant effect on maize yields, a positive effect can be seen with yield advantages for plots planted with velvet bean increasing over time.

Table 91. Maize yield with and without velvet bean from Loes replicated trials.

Treatment	*Maize yield (t/ha)*	
	Wet season 2010/11	*Dry season 2011*
Velvet bean	2.5	2.3
No velvet bean	1.9	1.5
Yield advantage	32%	53%

Conclusions

The Betano and Loes experiments confirm the conclusions of previous trials outlined in past SoL Annual Research Reports that velvet bean intercropping significantly reduces the weed burden on maize. The effect was often sufficient to completely eliminate weeds at harvest time. As weeds represent the limiting factor for Timorese farmer's ability to produce more food, velvet bean merits further study and may become an important method of weed management in Timor-Leste. Velvet bean has been shown to have significant effects on maize yields, with the benefits accruing quickly. Even in trials where the effect was not shown to be significant, a positive effect could still be seen. The trials will be continued in 2012 in both locations.

5. Social science research

5.1 Farmer baseline data survey (*Buka Data Los*)

Each year SoL collaborates with a large of farmers who are interested to take part in the OFDT program. As part of their involvement, the farmers plant several 25 m^2 plots with different varieties, to assess how these varieties perform under normal farmer management conditions (as compared to on-station trials). During the 2010-2011 growing season, 277 of the farmers who participated in OFDTs in seven districts (Ainaro, Aileu, Baucau, Bobonaro, Liquiça, Manufahi and Viqueque) completed the survey. This number is substantially smaller than the number of OFDTs in 2009-2010 (480) due to adverse weather conditions.

The OFDT farmers are surveyed and interviewed to obtain information on their livelihood status and current farming practices each year. This survey is termed *Buka Data Los* (BDL) which means 'looking for true or reliable data' in Tetun. The BDL survey provides information on the number of members in each household, whether the house is headed by a male or female, the type of crops grown, food security by household, reasons for crop failures or poor yields and a measurement of household wealth. This data assists in evaluating the results of the OFDTs and for comparison across years, thereby serving as a baseline for the OFDTs[1]. For 2010-2011, BDL data was available for 277 farm households, but was not always complete for each of these households.

Farmer household and gender participation

Each farm household member in Timor-Leste plays a role in the farm operation. Young boys, for example, tend animals and older family members perform light duties such as milling grain. In 2010-2011 most farm households participating in OFDTs had between four and ten members to distribute the workload, with an average of 6.2 persons per household (Table 92). A good proportion of the household members were children reflecting of the nation's high annual birth rate. The larger households (greater than 10) accounted for approximately 4% of the population and most likely represents the inclusion of extended family members (e.g. grand parents).

Although farm households operate as production units, the head of household is considered to be the most senior person in house. Often this is a male but regularly females provide overall leadership in the house. During 2010-2011 34% of the surveyed OFDT households were reportedly headed by women and 66% by men (Table 93). This compares with 26% and 74% respectively in the 2009-2010 survey.

[1]In October 2011, SoL conducted a large-scale baseline survey involving 1,800 households in all 13 districts. The findings of this baseline survey will be published in a separate report in 2012.

Table 92. Number of members of OFDT households, by District

Members per household	*Ainaro*	*Aileu*	*Baucau*	*Bobonaro*	*Liquica*	*Manufahi*	*Viqueque*	*Total households (Number)*	*(%)*
1			2		1		3	6	2.7
2			2	1	2		4	9	4.0
3		1	3	1	1	1		7	3.1
4	2	9	4	5	1		3	24	10.7
5		10	10	9	5	2	2	38	17.0
6	1	11	15	11	4	1	2	45	20.1
7		7	8	7	4	1	12	39	17.4
8		5	14	3	1		2	25	11.2
9		2	3	4	2	1		12	5.4
10		2	4	3	1		1	11	4.9
11					2	1		3	1.3
12			2	2				4	1.8
13									
14									
15				1				1	0.4
Total	*3*	*47*	*67*	*47*	*24*	*7*	*29*	*224*	*100*

Table 93. Gender participation as heads of households, 2010-2011

District	*Sub-District*	*OFDT Farmers*		*Percentage*	
		Male	*Female*	*Male*	*Female*
Ainaro	Hatu-Udo	3	3	50	50
Aileu	Aileu Vila	26	24	52	48
	Liquidoe	5	4	56	44
	Remexio	7	3	70	30
	Laulara	1	3	25	75
Baucau	Baucau	25	15	63	38
	Vemasse	10	3	77	23
	Venilale	17	4	81	19
Bobonaro	Maliana	17	13	57	43
	Balibo	20	1	95	5
Liquiça	Liquiça	6	3	67	33
	Maubara	13	3	81	19
Manufahi	Same	4	6	40	60
Viqueque	Ossu	6	1	86	14
	Viqueque	22	9	71	29
Total		*182*	*95*	*66*	*34*
		277		*100*	

Cropping patterns

Farmers in Timor-Leste grow a wide range of crops to spread the risk of failure in one or more commodities. A list of food crops cultivated by farmers conducting OFDTs in 2010-2011 is presented in Table 94. The risk of crop failure is also reduced though intercropping. The key food crops grown during the year were maize, cassava, pumpkin and sweet potato. Household consumption from harvest of these was supplemented with cowpea, taro, peanut and a wide range of other traditionally grown species. Irrigated rice was cultivated by just under 30% of the respondents, and dry-land rice by 10% of them.

Only a small number of farmers reported growing bananas and papaya, even though these are often grown in gardens near the houses. The main reason for such low reporting may be that these crops were not mentioned in the list of crops on the BDL questionnaire form; it was only when a farmer specifically mentioned these that they were added under “other”.

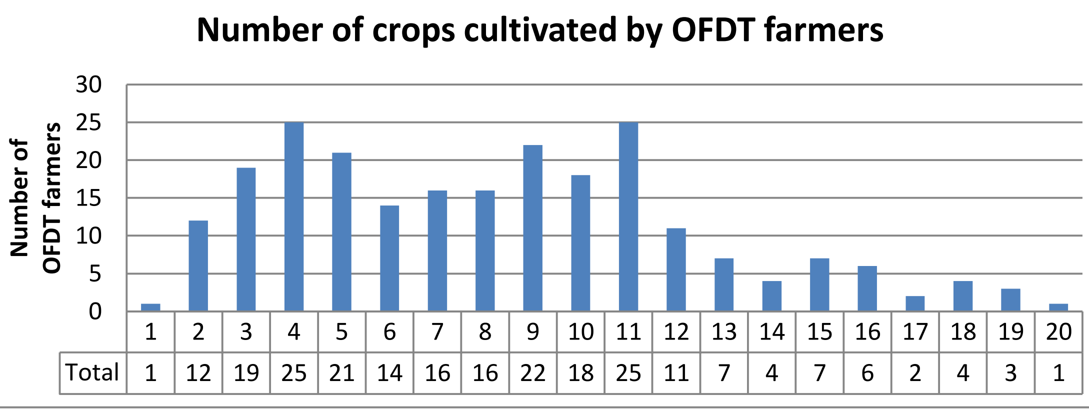
Table 94. Food crops planted in house gardens or bush gardens

Crops planted	*Total*	*% of total respondents*
Long season maize (*Zea mays* L.)	194	83%
Cassava (*Manihot esculenta* Cranz)	192	82%
Pumpkin (*Cucurbita spp*)	173	74%
Sweet potato *(Ipomea batatas* L.)	172	74%
Short season maize (*Zea mays* L.*)*	157	67%
Snake bean (*Vigna unguiculata subsp. Sesquipedalis* (L.) Verdc)	142	61%
Taro (*Colocasia esculenta (*L.) Schott*)*	126	54%
Peanut (*Arachis hypogaea L*.)	114	49%
Cucumber (*Cucumis sativus)*	106	45%
Kumbili (wild yam) (*Dioscorea spp.)*	94	40%
Arrowroot (*Maranta arundinacea* L.*)*	79	34%
Irrigated rice (*Oryza sativa* L.*)*	68	29%
Bengkoang/Sinkumas tuber (yam bean) (*Pachyrhizus erosus* L.*)*	65	28%
Bitter bean (*Phaseolus lunatus* L.*)*	54	23%
Maek (elephant foot's yam) (*Amorphophallus paeoniifolius*(Denst. Nicolson)	46	20%
Mung bean (*Vigna radiate (L.*) Wilczek	36	15%
Sorghum (*Sorghum bicolor* L.)	35	15%
Upland rice (*Oryza sativa* L.*)*	24	10%
Red bean (*Phaseolus vulgari* L.*)*	23	10%
Potato (*Solanum tubersosum* L.)	11	5%
Papaya (*Carica papaya* L.*)*	9	4%
Banana (*Musa spp*)	2	1%
Tomato (*Solanum lycopersicum* L.)	2	1%
Foxtail millet (*Panicum italic* L.)	1	0.4%
Egg plant (*Solanum melongena* L.)	1	0.4%

N=234

The distribution of the number of crops cultivated by the OFDT farmers (Figure 26) shows that, if possible, farmers prefer to cultivate several crops to reduce the risk of loss of food or income due to crop failure. Some 75% of the farmers cultivate between 3-11 crops.

Table 94 also shows that tuber crops are prominent key staples for farmer households. Some of these (cassava and sweet potato for example) can be harvested over a period of time and provide valuable supplements to maize and/or rice and/or replace them during lean times. Tubers store well in the ground and are also harvested opportunistically as wild products from surrounding forests.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Total	1	12	19	25	21	14	16	16	22	18	25	11	7	4	7	6	2	4	3	1

Number of crops

Figure 26. Number of crops cultivated by OFDT farmers

It is also interesting to observe to what extent OFDT farmers who grow maize, rice, peanuts, cassava and/or sweet potato also grow one or more of the other crops. Figure 27 shows the number of OFDT farmers who grow any combination of these five crops. To be able to show all the combinations of the five crops – from single crop to a combination with one, two, three or all four other crops –each of the five crops is represented by two areas in the Figure: a full circle adjacent to the name of the crop, and a segment opposite it (to be able to show combinations with the two opposite crops).

Figure 27 shows that the two most popular combinations (grown by 38% of the OFDT farmers) are the five crops, or the combination of peanuts, cassava, maize and sweet potato. Crop combinations that involve maize are also more popular than combinations without it.

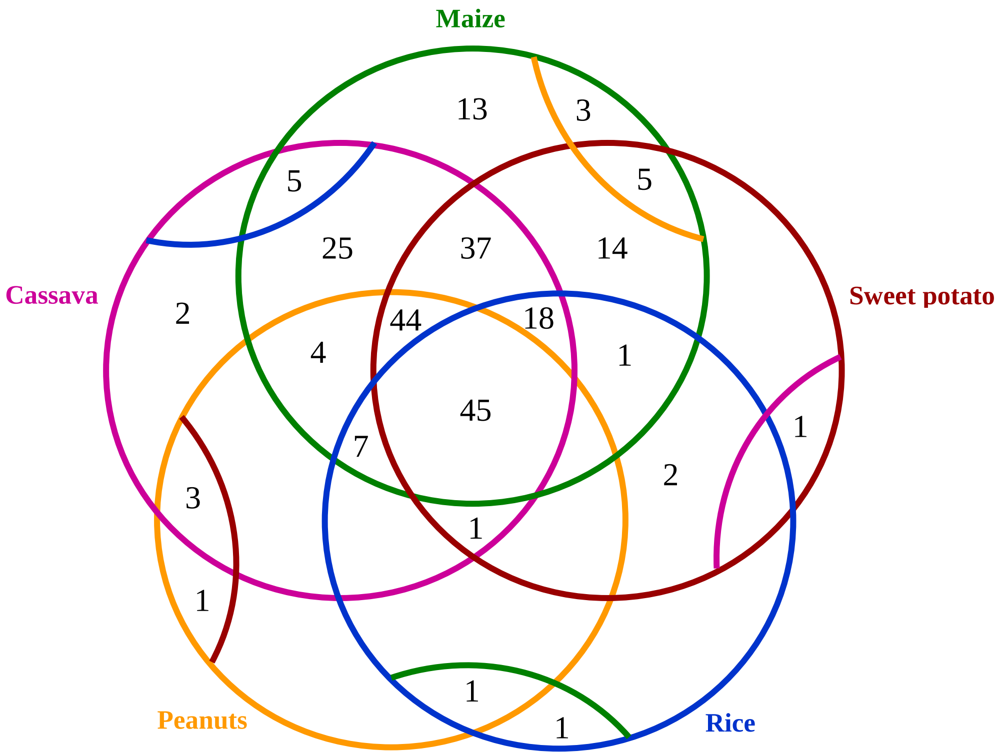


Figure 27. OFDT farmers who grow one or more of the five key crops (N=233)

Food security

Data from the survey provided an indication of maize production adequacy for domestic consumption among the participant farmers. (Table 95). Respondents were asked whether they considered their last maize harvest was either insufficient to cover their annual needs, sufficient or they considered they had a surplus.

The percentage of farmers who considered that their maize harvests were particularly poor in 2009-2010 (to eat during the 2010-2011 growing season) was 21%. The number of male OFDT farmers who reported they did not have enough maize was slightly higher than the percentage of female farmers. Comparing the reported maize insufficiency with the figures of previous years (Table 96) shows that the percentage in 2010-2011 for insufficiency was higher than in 2009-2010, but lower than it was in the two years before that. Maize insufficiency is particularly high in Manufahi (71%) and Ainaro (67%). At the opposite end of the spectrum, the percentage of farmers who had a marketable surplus (7%) was the lowest of the last four years. These results highlight the importance of crop diversification into tubers and other crops to spread the risk of a poor maize harvest.

Table 95. Respondent measures of food sufficiency (maize)

	Insufficient	*%*	*Sufficient*	*%*	*Surplus*	*%*	*Total*
Ainaro	2	67	1	33			3
Aileu	14	25	36	64	6	11	56
Baucau	9	13	56	80	5	7	70
Bobonaro	9	19	36	77	2	4	47
Liquiça	9	36	16	64			25
Manufahi	5	71	1	14	1	14	7
Viqueque			22	92	2	8	24
Male	18	23	53	66	9	11	80
Female	30	20	115	76	7	5	152
Total	*48*	*21*	*168*	*72*	*16*	*7*	*232*

N=232

Table 96. Respondent food security over years (maize)

Year	*Insufficient %*	*Sufficient %*	*Surplus %*	*Number of respondents*
2007-2008	38	47	15	502
2008-2009	29	54	17	262
2009-2010	16	73	11	354
2010-2011	21	72	7	232

The BLD questionnaire also asks the farmers who reported they did not have sufficient maize reserves in which month they ran out of stock. Figure 28 shows the situation in 2010-2011. Based on the responses from 41 OFDT farmers, some 40% of them ran out of maize by July. This is better than in 2010 (when 40% of those who reported not having enough stock ran out in June) but a little worse than in 2009 when the 40% point was halfway July-August.

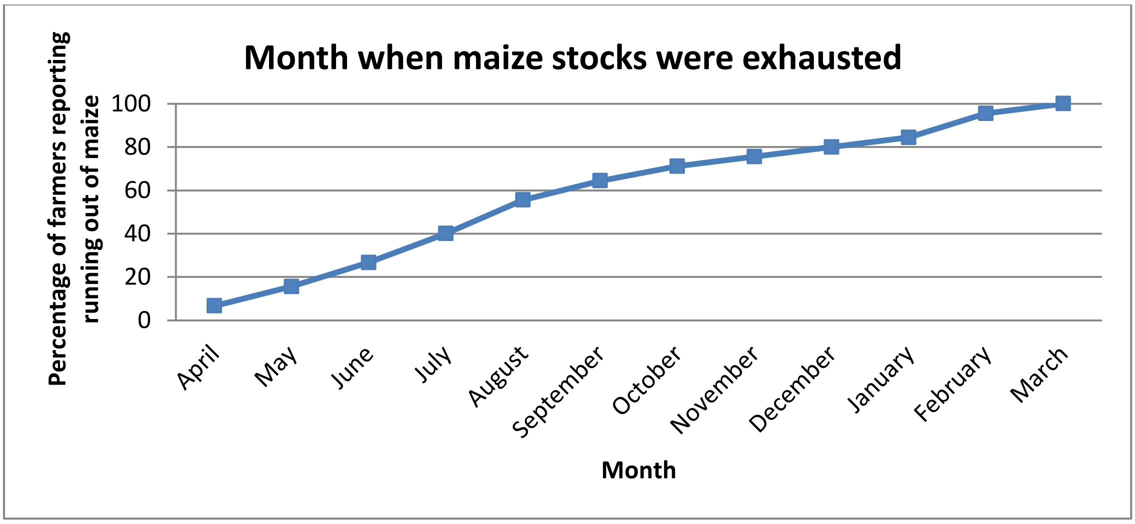


Figure 28. Maize sufficiency in farm households (2010-2011)

The BDL recorded data from 47 farmers on causes of crop damage in 2010-2011 (Table 97). Weather related factors were the most common. Lack of rain was mentioned by 60% of the farmers who provided information on crop damage, but it is unclear whether this refers to the late start of the rainy season – as specifically mentioned by 17% of the farmers – or to a lack of rain during the rainy season. There were also 12 farmers who reported crop damage because of too much rain. In 2010-2011 attacks by rats were also a major cause of crop damage. Damage by strong winds, which particularly affects local taller varieties of maize, were less a cause of damage than in 2009-2010 (when it accounted for 38% of the damage, compared to 4% this year).

Table 97. Farmer's perceptions of factors reducing harvest yields by district

District	*Cause of crop damage*						
	Lack of rain	*Too dry / late planting*	*Too much rain*	*Rats attack*	*Strong winds*	*Pests*	*Livestock*
Ainaro	2						
Aileu	7	5	10	14	1		
Baucau	1		2	1			
Bobonaro	8	1				1	1
Liquiça	3	2		1	2	1	
Manufahi	7						1
Total	*28*	*8*	*12*	*16*	*3*	*2*	*2*
% of causes	*39*	*11*	*17*	*23*	*4*	*3*	*3*
% of farmers reporting damage	*60*	*17*	*26*	*34*	*6*	*4*	*4*

The most common practices of storage of maize seeds and seeds of other crops are presented in Table 98. By far the most common practice was storing the maize above the fireplace or somewhere else in the house (91% of respondents). It is believed that the smoke and dry atmosphere above the fireplace reduces weevil damage. Other storage techniques included storage in a tree (to reduce rat and other animal damage) or in baskets. The use of improved storage techniques such as air tight silos, jerry cans and grainpro plastic bags remained infrequent. These improved storage techniques are designed to reduce oxygen levels in the containers to a level in which weevils cannot survive.

Table 98. Storage methods for maize seed (and other crops)

Method	*Ainaro %*	*Aileu %*	*Baucau %*	*Bobonaro %*	*Liquiça %*	*Manufahi %*	*Viqueque %*	*Average %*
Above the fireplace	93	100	82	96	79	100	23	82
Inside the house			3	2	8		68	9
Jerry can	2		6					2
Hang in a tree			3		4		5	2
Drum	2			2	8			2
Sack	2		4					2
Woven basket	2							0.4
Purchase in market			1					0.4
Tied up							5	0.4
Total # of respondents	*57*	*3*	*67*	*47*	*24*	*7*	*22*	*227*

Economic status and strategies

The socio-economic standing of the farmers participating in the OFDTs was assessed to evaluate the range and average level to determine whether SoL was directing its varietal evaluation program correctly. The program aims to direct its activities towards an appropriate range of farmer families. Two levels of general household wealth were measured. These were the house type and household ownership of purchased consumer goods.

The standard residential housing among farmers participating in OFDTs is presented in Table 99. House style and quality are a widely used proxy for relative economic standing and tend to correlate well with household financial capacity. Roof type is a common indicator of household wealth with farmers opting for a waterproof galvanized iron covering if they can afford it. A majority (70%) of participating farmers did have galvanized iron or corrugated asbestos roofs in 2010-2011. This is lower than the 79% reported in 2009-2010 (Table 101), which could be an indication that the OFDT farmers in 2010-2011 were on average a bit poorer than the previous year. This assertion is also supported by the condition of walls and floors. In 2010-2011 some 61% of the OFDT farmers lived in houses with walls made of wood or sago palm (bebak), where the previous year the percentage was 54%. The percentage of walls with half brick or full brick was the same as in the previous year. In 2010-2011, 70% of the farmers had non-cement or non-tile floors, whereas it was 65% the previous year.

Table 99. House types across the seven Districts

District	*Ainaro*	*Aileu*	*Baucau*	*Bobonaro*	*Liquiça*	*Manufahi*	*Viqueque*	*Average*
N=	*3*	*58*	*70*	*50*	*25*	*7*	*24*	
	%	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Tin/board roof	67	95	66	78	56		42	70
Basic thatch roof	33	5	34	22	44	100	58	30
Wood / sago palm walls	67	47	53	78	80	100	54	61
Full block wall		34	33	8	12		25	24
Half block wall		17	10	14	8		21	13
Tin	33	2	4					2
Non-cement floor	100	59	70	62	88	100	79	70
Cement / floor tiles		41	30	38	12		21	30

Even though the housing conditions of the OFDT farmers seem to indicate that they were on average poorer than the OFDT farmers of 2009-2010, their ownership of consumer goods was better than of the OFDT farmers in the previous year (Table 100 and Table 101). Ownership of mobile phones continued its upward trend, and the percentage of motorbikes also doubled with the previous year. Even the percentage ownership of cars and diesel generators was respectively double and three times what it had been in 2009-2010. The results of the baseline study will allow an assessment to what extent the figures of the OFDT farmers are representative for their respective districts, and for Timor-Leste as a whole.

Table 100. Wealth measures by key commodity ownership

District	*Ainaro*	*Aileu*	*Baucau*	*Bobonaro*	*Liquiça*	*Manufahi*	*Viqueque*	*Average*
N=	*3*	*58*	*70*	*50*	*25*	*7*	*24*	
	%	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Mobile phone	33	72	69	74	32		71	65
Motorbike		26	26	14	8		42	22
Car			13		4			4
Diesel generator		10	21					9
Solar power			11					3

Table 101. Wealth measures across years

Description	*2006-07*	*2007-08*	*2008-09*	*2009-10*	*2010-11*
	%	*%*	*%*	*%*	*%*
Tin/board roof	na	76	69	79	70
Full block wall	na	19	17	24	24
Half block wall	na	22	10	13	13
Cement / floor tiles	na	34	22	35	30
Mobile phone	3	10	6	43	65
Motorbike	5	5	3	11	22
Car	2	3	1	2	4
Diesel generator	3	3	2	3	9
Total # of respondents	340	502	362	354	237

Conclusion

The BDL survey provided a good measurement of the farmer households participating in SoL OFDTs during 2010-2011. Most of the data indicate that OFDT farmers were subsistence farmers cultivating a wide range of crops to reduce the risk of food shortages. A small percentage of farmers did, however, start running out of stored maize early in the year. This loss of carbohydrate was most likely made up through the consumption of tubers, and in some cases, subsidized Government rice.

In 2010, there appeared to be signs of improvement in the wealth and wellbeing of OFDT farmers, especially for consumer goods. All of these indicators will be measured again in 2011 to see if these trends continue, but a more detailed picture of farmer conditions in Timor-Leste, also in the districts where SoL is not yet active, will be provided by the baseline survey.

6. Climate change research

This section discusses the current food security situation and agricultural production systems in Timor-Leste, and drawing on the recent climate change and population predictions (SoL 2011; Molyneux 2011, Molyneux *et al*, 2011), describes a likely future food security environment which extrapolates on the available scientific articles related to climate change in Timor-Leste. An in-depth analysis of the current food and nutrition security situation is provided and an outline is made for a plan to implement proposed interventions.

The main recommendations are:

- Identify and establish climate change tolerant cultivars of staple crops
- Increasing crop diversity to include more legumes (pigeon pea, cowpea, winged bean, sword bean, sweet bean), and other nutritious foods as well as new tubers to increase food security.
- Introducing/expanding terracing/ Sloping Agricultural Land Technologies (SALT). Conservation farming of steep land with organic fertiliser will improve yields while reducing erosion, improving water retention in soils, improving soil stability and increasing soil depth.
- Mucuna/velvet bean or lablab cover cropping. This will improve maize yields through increasing nitrogen. Improving ground cover will increase organic content in soils as well as suppressing weeds.
- Introduction of inorganic fertilizer. Inorganic fertilizer applications will increase production of small-scale farmers and enabling the sale of surplus produce in markets. Increased income for farmers will lead to increased food availability for communities.
- Grain storage to decrease post-harvest losses of grain crops
- Water harvesting and storage to reduce drought risk in drought prone/high rainfall variability locations.

Key interventions should focus on maintaining and building up the foundations of crop production – seed, soil, water and sunlight. Adapting seed to climate change will be addressed through Component 1 utilising the temperature and rainfall change information gained in 2010-2011 (SoL, 2011, Molyneux, 2011). Future 'likely' climate conditions will need to continue to be taken into account throughout SoL's identification and importation process of new varieties from international varietal research centres.

Sunlight remains consistent over time with few solid scientific reports producing usable predictions of UV changes with climate change; however both soil and water are already proving to be negatively influenced by human activities. Degraded soil and unreliable water availability are proving to be hugely inhibitive to achieving yield/ha rates necessary to feed the current population. The main interventions should therefore focus on soil health, nutrients and water. Improving the soils through increasing organic content and the biological fixation of nitrogen (or external inputs of nitrogen) are fundamental to sustainable settled agriculture systems. Ensuring this hard-earned carbon and nutrients remain in-situ through reducing erosion and encouraging build-up of organic matter will be essential to achieving increased food production on the steep slopes of Timor-Leste's mountainous interior. Ensuring water is available at critical times during the growing season will be instrumental in increasing yields into the more-variable rainfall future; it will also provide incentive for farmers to invest more in other inputs creating a virtuous cycle of investment and reward.

Tending to the increased production of crops is the most important theme. Climate change is expected to reduce overall output of crops in tropical areas by about 10%. Increasing yearly average production by, for example 20% will address the deficit and go some way to helping to feed the expanding population. However, increasing average production does not take into account drought or inundation years where whole crops fail, or as in 2010, cannot be planted.

In these situations and as a general rule for subsistence farmers it is important to have a diversity of crops and cultivars.

Having the ability to plant a range of crops or choose which species or cultivars to plant depending on the rainfall allows farmers to both adapt that year's production to that year's particular climatic situation, but also have a production safety net in the event that some crops fail. Sweet potato and cassava are currently both staple crops and emergency foods, while taro, arrow root and sago palm are traditionally utilized when there is very little else to choose from. While these foods are absolutely essential for providing calories and basic nutrition during the 'hungry season', they are very low in micro-nutrients and protein and their consumption does little to reduce the incidence of wasting and stunting. Improving the choice and nutritional value of these and other emergency foods is important for reducing the severe malnutrition rates in upland areas where these foods are most frequently eaten. Increasing edible legume cultivation and production would go some way to improving the dietary and specifically protein composition of Timorese meals, both during normal and lean times. Provision of hardy, drought tolerant, high yielding and culturally acceptable edible legumes such as pigeon peas, lablabs and velvet beans should be a major focus of any food and nutrition security building strategies.

Agricultural mapping by Suco

The maps below were produced through utilising the newly available suco-by-suco agricultural production data provided by the 2010 Census conducted by the National Statistics Directorate. The maps do not contain absolute information, but rather use percentages of farmers producing one crop or another to provide information of the relative importance of each crop in every suco.

The maps provide information on maize, rice and coffee, which are the two main food crops and the main cash crop produced in Timor-Leste. Information is also available for cassava and fruit crops, and can be added as required. For the purposes of understanding agricultural production and its constraints in Timor-Leste, it was decided that an indicator of economic poverty and an indicator of proximity to infrastructure would be beneficial visualisations to use as layers for planning purposes. As such there are also maps of areas in which the populous live on an average of less than 80c per day, and as a proxy for proximity to infrastructure/government assistance, access to health clinics has been used. While this does not give a satisfactory indication of a suco's ability or difficulties in accessing roads or social assistance or to take products to market, it is the only data available that takes similar barriers into consideration and as such may be useful.

The map presented in Figure 29 shows the percentage of households in each suco that state that they are farmers. The darkest green areas around Maliana and towards Liquica, and throughout the central highland backbone of the country indicate the highest farmer percentages in the country.

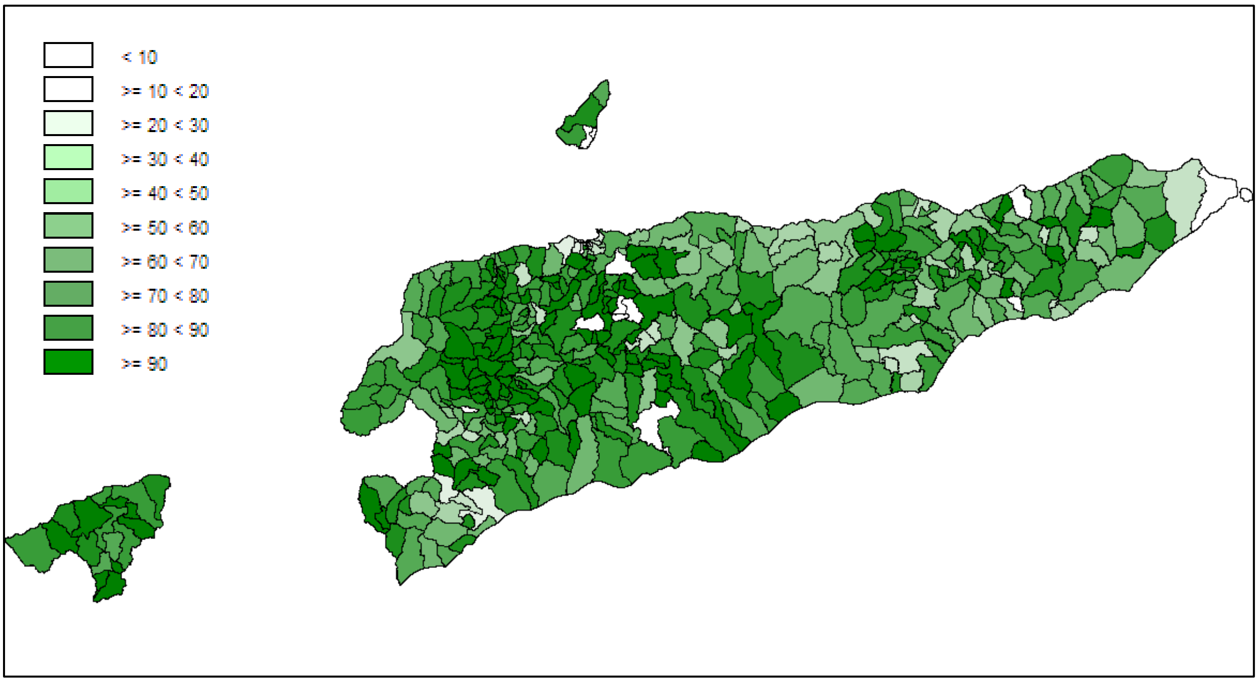


Figure 29. Percentage of farmers in each Suco stating that they are farmers (2010)

Figure 30. shows the suco-by-suco main agriculture production crop, based on the percentage of farmers that grow each crop in that suco. Sucos where two crops are within 10% of each other are given a dual rating.

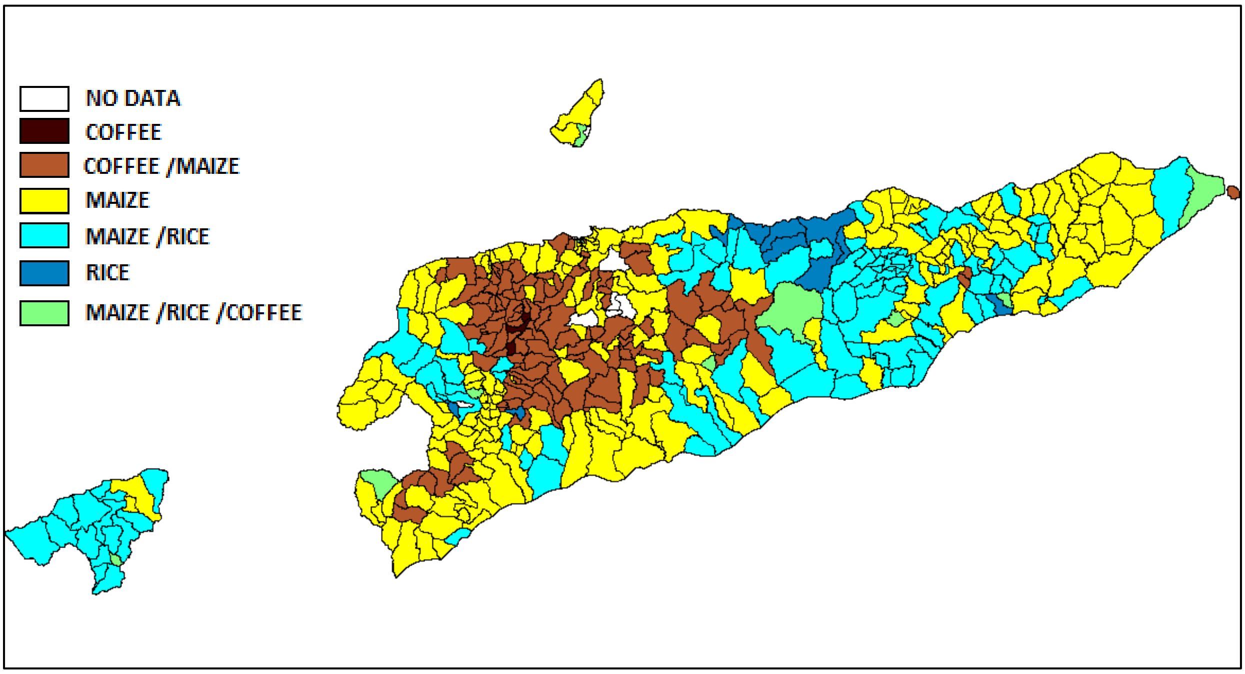


Figure 30. Percentage of farmers stating they grew crops

Figure 31 allows visualisation of the differences in maize production throughout the sucos of Timor-Leste. Bright yellow Sucos have up to 100% of farmers producing maize, while the darkest grey have less than 10% of farmers growing maize. The pattern appears to show the strongest maize production in the mid to high latitudes and towards the west of the country.

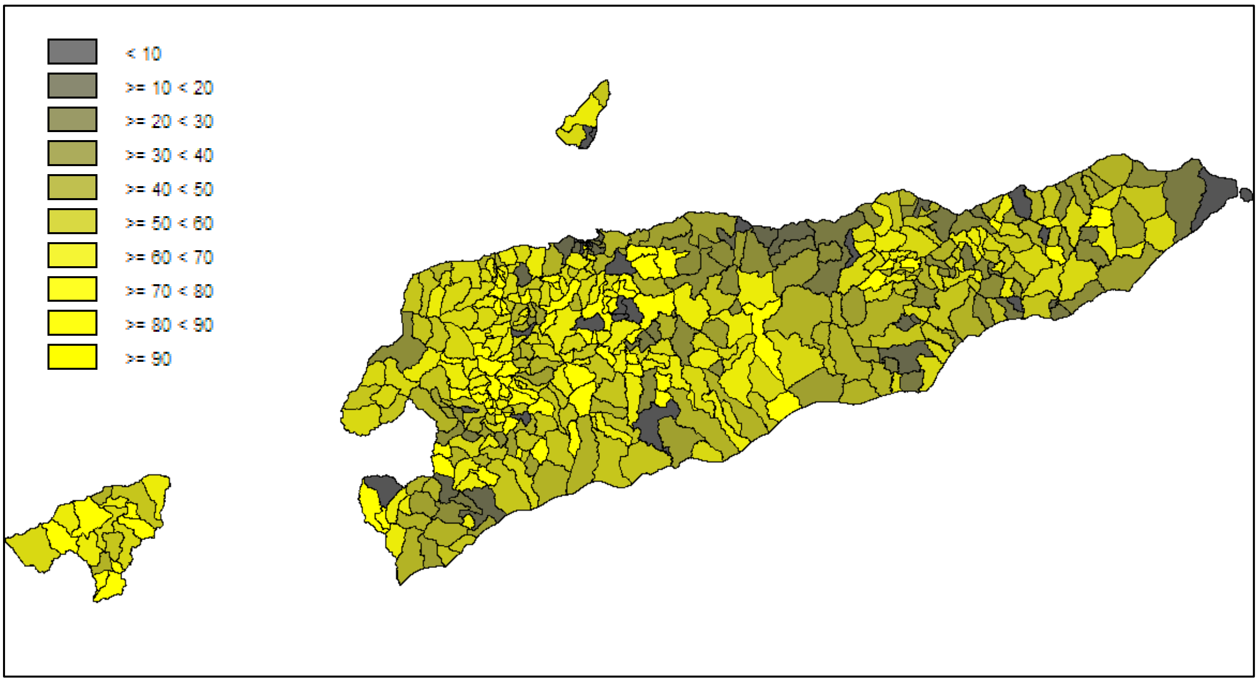


Figure 31. Percentage of farmers growing maize, 2010

Coffee production in Timor-Leste is presented as a percentage of farmers by suco in Figure 32. The high density of dark brown around the mid-elevation central region (Ermera, Ainaro, Covalima and Aileu) and the then lightening towards the higher elevations around Mt Ramelau signifies the temperature range of the coffee varieties grown in Timor-Leste and will likely change as temperature increases.

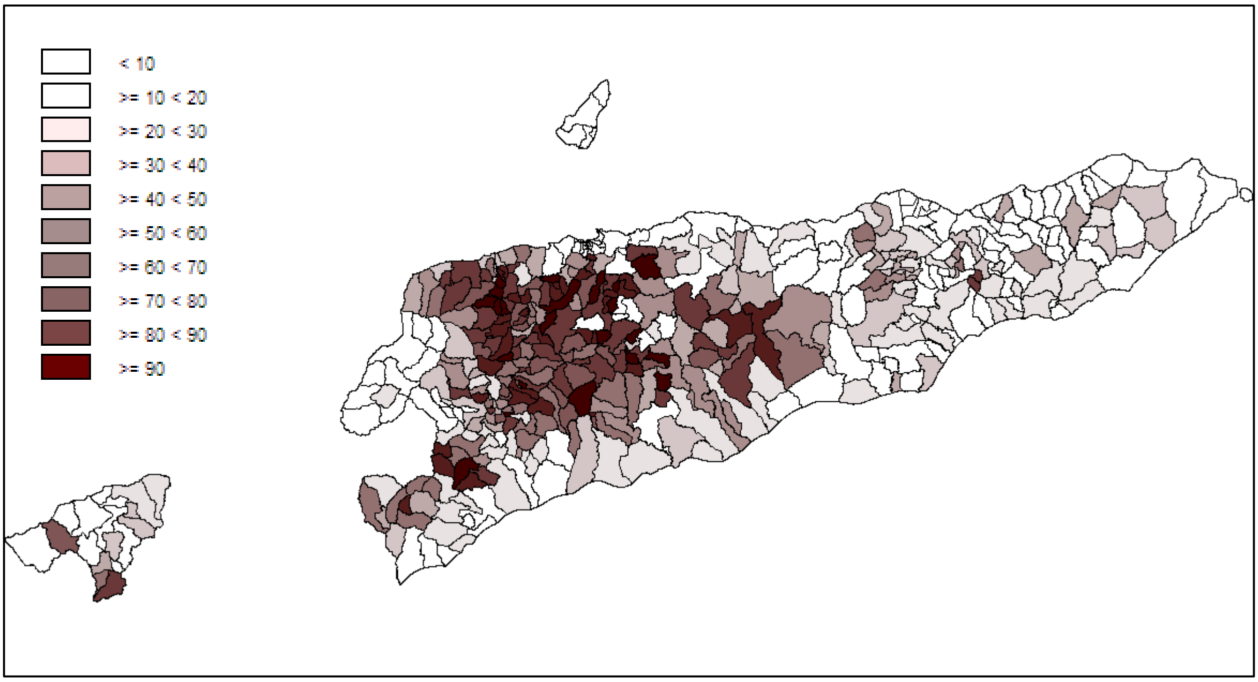


Figure 32. Percentage of farmers growing coffee, 2010

Rice distribution as presented in Figure 33 shows three hotspots for percentage of farmers growing rice, they are; Venilale in Baucau district, Cailaco Sub-District in Bobonaro district (and the surrounding sucos), and throughout Oecussi district (much of the rice grown in Oecussi is dry-land (upland) rice). There are also a number of sucos around Natabora in the south of the country with high percentages of households involved in rice production, and another area in Luro, Lautem district with high percentages of rice production. It is unclear whether the rice production is paddy or dry-land rice for any of the data throughout the country.

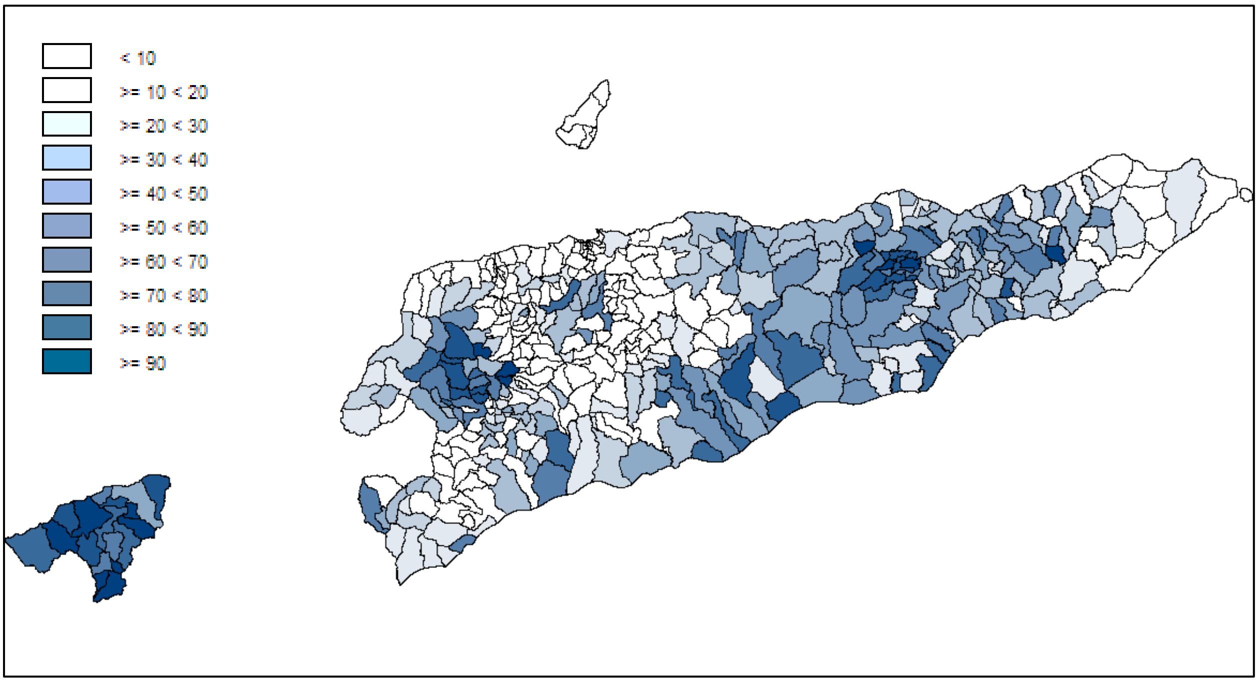


Figure 33. Percentage of farmers growing rice, 2010

These maps assist the analysis of food production and consumption by suco. As crop yields become available each season it will also be possible to map those areas most affected by lower or higher yields and assist planners to address such issues.

7. Communication and technology dissemination

Seeds of Life activities were disseminated through a number of different avenues during 2010-2011 as presented below:

Audience	*Communication medium*
Farmers	• Direct contact with SoL OFDT research staff • Farmer field days • Research results meetings • Informal and formal seed multiplication workshops • Socialization workshops
MAF district staff	• Ongoing liaison with SoL district staff & leaders • Farmer field fays • Research results meetings
NGO & agency partners	• Ongoing liaison with SoL district staff & leaders • Research results meetings • Website • Publications
Timorese public	• Print, radio and television news stories • Conferences • Tetun-language publications
Australian & international public	• Website • Print and radio news stories • International conferences • English-language publications

Farmer field days

Farmer field days were organized by SoL staff in all Sub-Districts where OFDTs were established. Attendance at each field day was approximately 20 farmers who were involved in both the harvest and measurement of crop yield. Approximately 50% of the attendees are women. These field days allowed an exchange of ideas between the farmers and research staff. In the case of sweet potato, cassava, peanuts and rice the harvest was cooked and tasted. The attributes of each variety were then discussed.

Field days were also held on research stations. These were designed to engage the farmers in evaluation of potential varieties early in the trial process and before they reached the farmers' fields. Taste tests were incorporated into the field day to examine promising entries.

Research results meetings

Research results meetings were held during the year during which researchers analysed their own data. At one meeting in September 2011, the sweet potato replicated trials were analysed and selections made for future OFDTs. Presentation of research results were also made at day-long meetings where the years' research results were discussed. The meetings provided a valuable opportunity for SoL to engage with local farmers, district administration, MAF district staff and NGO staff. Papers were also presented at international conferences

Publications

A list of the years' publications, program reports, conference presentations, local and international media events are presented below:

Lacoste, M, Borges F., L., Williams, R and Erskine, W. Varietal Diffusion in Marginal Seed Systems: Participatory Trials initiate Change in East Timor, 31p. Accepted by Journal of Crop Improvement, December, 2011, DOI: 10.1080/15427528.2011.651775

Marcal Gusmao, Kadambot H. M. Siddique, Ken Flower, Harry Nesbitt, Erik J. Veneklaas Water deficit during the reproductive period of grass pea (Lathyrus sativus L.) reduced grain yield but maintained seed size 37p. Accepted by Journal of Agronomy and Crop Science, 2011.

Molyneux N, 2011. Seeds of Life: Adapting for food security. Issues, Vol 94. March, 2011

Neil C. Turner, Nicholas Molyneux, Sen Yang, Youcai Xiong, Kadambot H. M. Siddique (2011). Climate change in south-west Australia and northwest China: challenges and opportunities for crop production. Crop and Pasture Science 62(6) 445-456

Nicholas Molyneux, Gil Rangel da Cruz, Robert L. Williams, Rebecca Andersen and Neil C. Turner. Climate change and population growth in Timor-Leste: Implications for food security. 30pp Accepted for publication by Ambio, 2011

Partners. ACIAR Journal. March-May, 2011. A country farms its future.

Shepherd C.J, McWilliam A. (2011) Ethnography, Agency, and Materiality: Anthropological perspectives on rice development in East Timor. East Asian Science, Technology and Society: An International Journal 5:189–215

SoL, 2010 Annual Research Report, 2010, Seeds of Life, April, 2011, 238p (English and Tetun editions)

Variety Fact Sheet, Cassava (Tetun), fifth printing March, 2011

Variety Fact Sheet, Maize (Tetun), fifth printing March, 2011

Variety Fact Sheet, Peanuts (Tetun), fifth printing March, 2011

Variety Fact Sheet, Rice (Tetun), fifth printing March, 2011

Variety Fact Sheets, Sweet Potato (Tetun), fifth printing March, 2011

Williams, R., Borges F., L., Andersen, R., Lacoste M., Johansen C. and Nesbitt., H. On-farm evaluation of introduced maize varieties and their yield determining factors in East Timor 22pp. Submitted to Field Crop Research, 2011

Williams, Robert; Rebecca Anderson, Armandina Marcal, Luis Pereira, Luis Almeida and William Erskine. Exploratory Agronomy within participatory varietal selection: The case of peanut in East Timor. 11 p. Accepted by Experimental Agriculture, December, 2011. DOI:10.1017/S0014479711001207.

SoL 3 reports

Communication Action Plan, Seeds of Life. Chris McGillion, Charles Sturt University, Bathurst, Australia, 1p, October, 2011

Communication Strategy, Seeds of Life. Chris McGillion, Charles Sturt University, Bathurst, Australia, 50p, October, 2011

Gender Action Plan, Seeds of Life. Endah Agustiana, December, 2011. 2p

Gender Strategy Seeds of Life. Endah Agustiana, December, 2011. 24p

Guidelines for Informal Seed Production of Maize in Timor-Leste. Buddhi Kunwar and Asep Setiawan, MAF. May 2011 26p

Informal seed Production: An Introduction, Buddhi Kunwar, MAF, May 2011, 3p

Seeds of Life Phase 3. Program Design Document. Volume 1. Main Report. 63 p

Seeds of Life Phase 3. Program Design Document. Volume 2. Appendices. 187 p

Seeds of Life Monitoring and Evaluation Review. April, 2011. Geoff Moyle 45p

Seeds of Life, 2011 Agricultural Interventions for improving food and nutritional security in Timor-Leste; with reference to Contemporary Predictions of Climate Change and Population Pressure. A policy and planning paper for the Ministry of Agriculture. 57p

Seeds of Life Program, Monitoring and Evaluation Manual (October, 2011) In draft

Strategy for Promotion of Gender Equality in Informal Seed Production. MAF/Seeds of Life, August 2011 p4

Strategy for Capacity Building of MAF Extension Staff to implement Informal Seed Production, MAF/Seeds of Life September 2011 2p

Summary Recommendations of Major Crops – Maize, Peanuts, Paddy, Cassava and sweet Potato. Buddhi Kunwar and Asep Setiawan, MAF. August 2011 5p

Timor-Leste media coverage

A Voz de Suara Timor Lorosae, *MAP Lansa Projeito Fini Ba Moris*, 29 June 2011, Edisaun No. 9040 Tinan XVIII

Benefits of informal seed production. August, 2011. Broadcast on Maliana Community Radio.

Bi-weekly updates on Sol activities on Maliana Community Radio.

CPA weekly show “Povu Nia Matenek” 13 April 2011. Seeds of life farmers and staff featured

Enjoy magazine – Timor-Leste. Climate change and its effects on agriculture in Timor-Leste by Valentina Gjuraj. Report in Tourism and Business magazine on Climate Change report. November, 2010.

Jornal Agrikultura. February, 2011. Signing ceremony for SOL 3 (with large photographs) on front cover

Jornal Agrikultura, July, 2011. Reporting SoL variety seed production at Betano Research Station, District of Manufahi.

Revolusaun Verde Hamosu Problema ba Toos Nain. Aug-2011. Timor Post Newspaper

Seeds of Life distributes 24,956kg of seed. Article on Timor Post P6, 25 January, 2012

Televisaun De Timor-Leste (TVTL), July 12, 2011, Visit of Mr Kevin Rudd, Australian Minister of Foreign Affairs to SoL activities

Timor Post, *MAFP Lansa Projetu Fini Ba Moris Tinan Lima*, 29 June 2011

TVTL. Visit of Australian Minister for Foreign Affairs visit to Seeds of Life activities in Maliana 11 July, 2011

TVTL broadcast of SoL team participation in the First Lady’s Cup. August, 2011.

Video of Research Advisor’s presentation at the Lao T Hamutuk forum on Seed Policy. August, 2011.

TVTL. Variety release of P07, Ministry to name new variety. 15 Nov.

TVTL broadcast of MAF Secretary of State, Marcos da Cruz visit to Aileu, 19 January, 2012

Conference presentations

Felisberto A. Soares, Joao Bosco da Costa, Leandro C.R. Pereira Abril de Fatima ho Robert L. Williams. *Varidade ba batar balu, bele hetan produsaun aas, ho bele tahan ba fuhuk.* 'Knowledge, Attitudes and Skills for Timor-Leste's Development: an Opportunity for Dialogue' 4 July 2011.

Marcos Correia Vidal ho Robert L Williams - *Lehe bele hasae produsaun batar iha Timor-Leste.* 'Knowledge, Attitudes and Skills for Timor-Leste's Development: an Opportunity for Dialogue' 4 July 2011

Luis Fernandes, LuisPereira, Armindo Moises and Robert L. Williams. *Hili varidade ai horis trigu (titboa ho asinata) nian nebee resultadu diak hamutuk toos nain sira.* 'Knowledge, Attitudes and Skills for Timor-Leste's Development: an Opportunity for Dialogue' 4 July 2011

Australian media coverage

ACIAR. A country farms its future. Partners. March-May 2011.
http://aciar.gov.au/files/node/13748/a_country_farms_its_future_92962.pdf

ACIAR Blog, 9 January 2012. Timor-Leste PhD graduate.
http://aciarblog.blogspot.com/2012/01/timor-leste-phd-graduate.html

Minister of Foreign Affairs webpage has a selection of images from his visit to SoL in Maliana.
http://gallery.foreignminister.gov.au/Photo-Gallery/Visit-to-East-Timor-July-2011/17966129_s9NjPK#1375934150_zHpcGh8

Radio Australia, 11 July, 2011. Kevin Rudd, Minister of Foreign Affairs Interview with Phil Kafcaloudes, Radio Australia spoke about the Seeds of Life visit conducted the previous day.

UWA News. 11 July, 2011. Hunger-beating 'Seeds of Life' for Timor-Leste.
http://www.news.uwa.edu.au/201107113737/business-and-industry/hunger-beating-seeds-life-timor-leste

UWA News. 22 August, 2011. UWA helps to sow the seeds of a new life.
http://www.news.uwa.edu.au/201108243844/features/uwa-helps-sow-seeds-new-life
Seeds of hope are being sown in Timor-Leste,. ABC News Online, Stephanie Dalzell. 7-Sep-2011. http://www.abc.net.au/news/2011-09-07/seeds-of-life-feature/2875464

UWA Institute of Agriculture, December 2011. Seeds of Life: continuous low cost supply of superior seeds in Timor-Leste.

UWA News. 15 November, 2011. UWA's first PhD from Timor-Leste to address hunger.
http://www.news.uwa.edu.au/201111154138/alumni/uwas-first-phd-timor-leste-address-hunger

Website **http://www.seedsoflifetimor.org/**

8. Capacity building

Capacity building

Capacity building for 2011 in terms of training was closely related to the requirements identified by consultants from the IRRI training department in 2006. In that study it was suggested that the SoL training program reaches all levels of personnel working in the seed system of Timor-Leste. Training requirements include a) on-the-job training, b) short term courses, c) field work and field days, d) farmer workshops and e) long term post graduate training.

In 2011, SoL provided the opportunity for MAF personnel to learn on-the-job while conducting research and multiplying both formal and informal seed. In addition, formal training was provided as short courses to MAF personnel, NGOs and farmers. The farmers also had the opportunity of joining larger, less formal, socialization groups to familiarize themselves with multiplying good quality seed on their own farms or as CSPGs. Two Suco informal seed production socialization workshops were held in 2011 with 1956 farmers attending. There was also communication and gender workshops.

The table (Table 102) below summarizes the training opportunities provided during 2011.

Table 102. Training opportunities provided by discipline and type of training 2011

Discipline/Type of Training	*MSc students overseas*	*No.trainees in short-courses overseas*	*No.trainees at in-country short-courses*	*Total training Days*
Technical (variety selection,statistics,maths,diseases,etc)	2	2	184	650
Seed production technology	1		32	79
Informal seed production			211	269
Social science/gender	2		124	391
English/communication		9	131	740
Farmer socialization workshops			1956	1956
Total	5	11	2638	4085

*Total training days are the number of trainees multiplied by the number of training days.

A total of 2654 training opportunities were provided. Sixty six percent of the opportunities were awarded to male participants while 34% were offered to female participants. Statistics, data analysis, mathematics and other technical training as well as informal seed production were the major focus of the training during the year followed by English and social science of seed production.

Five MAF staff (or ex MAF staff members) were studying for MSc degrees during this period. Three ACIAR funded John Allwright scholars attended courses at the University of Western Australia, with two studying social science and one focused on agronomy (plant breeding). The two staff directly sponsored by SoL studied plant breeding and seed science technology at Bogor Agricultural University in Indonesia.

The total number of training days during the year for short-term courses (excluding the farmer socialization workshops) was 2129 or equivalent to 8 training opportunity days per working day. This is equivalent to a total of 8 MAF staff attending training every working day of the year.

The impact of the capacity building efforts of SoL can be observed from the latest competency assessment of the staff conducted in 2010. It revealed that, with the exception of the ‘Research Methodology’, competency which received mixed results, performance of staff in other competencies such as field work, Farmers field days, and general agronomy showed tremendous improvements (40-50% improvement).

This competency assessment identified four types of positions among the SoL professional team, namely, OFDT, research station researchers, seed production officers and socio-economic researchers. SoL staff were asked to score their skills or knowledge on a scale of 1-4 corresponding to 0-100% in terms of capacity building objectives. A total of 4,400 competencies are categorized as follows: agronomy, research methodology, field work, farmers' field days, mathematics, computer skills, monthly reporting and work attitude. Some competencies are common to all positions, others more specific.

Overall, a steady improvement of 15% every year has been observed in terms of the skills and knowledge of the staff and this has been attributed to the considerable time and resources involved in the training of MAF staff directly involved in SoL activities.

The SoL training program is working with the MAF to raise the capacity of its staff to implement a national seed system. There is currently 1 PhD and 8 MSc degree holders in the MAF/SoL directorates (Table 103). SoL will continue to support long term training in MAF to reach the level identified by the 2006 training needs study (Table 104). English language training is included to facilitate literature searches, use of computer programs and the pursuit of international training opportunities.

Table 103. Educational levels in 4 MAF/SoL Directorates

MAF Directorate	*Staff*
Research & Special Services	4MSc (Agronomy, GIS Resource Management, Livestock) Other – BS, Diploma and Technical HS
Agriculture & Horticulture	1 PhD (Maize) 1 MSc (Administration) Other – BS, Diploma and Technical HS
Agricultural Community Development	1 MSc (Communication) Other – BS, Diploma and Technical HS
Policy & Planning	2 MSc (Socio-Economics, Natural Resource Management) Other – BS, Diploma and Technical HS

Table 104. Long term qualification goal for MAF personnel

National Research Institutions	40% MSc, 30% BSc, 30% diploma holders
District level	1 MSc level crops extension specialist trained in general agronomy and crop management, 1 BSc level on plant protection extension specialist trained in entomology and pathology, and one extension specialist with diploma in livestock extension
Sub-District level	3 to 4 extension staff at diploma level for each district
Suco-level	A suco extension officer and 2-3 locally trained lead farmers as para-extension staff to promote technologies in their respective target areas

9. Technology recommendations

9.1 Released and potential varieties

Nine improved crop varieties identified by SoL/MAF had been released by the MAF at the end of 2011. Other crop varieties were evaluated on research stations and on farmers' fields during the year. After a number of years of evaluation, one white maize variety was accepted by the Varietal Release Committee (VRC) for release on 15 November, 2011 and was awaiting official naming at the end of 2011. The characteristics of this variety are presented below.

The first seven varieties identified by SoL were released by the VRC on 8 March 2007. Two of the seven varieties are yellow maize, three sweet potato, one rice and one peanut. All released varieties had undergone evaluation under on-station conditions over the period 2000-2005. In the 2005/06 wet season, both replicated trials and non replicated on-farm trials were established, the results of which are presented in the Annual Research Report for 2006 (SoL, 2006). A similar program of installing replicated and on-farm trials continued during the dry season of 2006 and wet season of 2006/07, the dry season of 2007 and wet season of 2007/08. These trials were described in the Annual Research Reports for 2007 and 2008 (SoL, 2007, 2008). Some of these varieties were further evaluated in 2008-2009 and 2009-2010 and 2009-2011 in comparison with local varieties and some potential new releases.

Two cassava varieties were released by the MAF on 27 August, 2009 and multiplied in 2009-2010 for distribution to seed producers. Both varieties were bred at the Indonesian Legumes and Tuber Crops Research Institute (ILETRI) (sometimes referred to as RILET) or selected by the Center Research Institute of Food Crops (CRIFC). The responsible breeders from ILETRI attended the VRC meeting chaired by the Minister of Agriculture and Fisheries and were present when the varieties were officially released. Both varieties were evaluated over at least 13 sites (13 sites for Ca26 and 16 sites for Ca15), are high yielding and considered by farmers to be either sweet or very sweet. These varieties were released as Ai-Luka 2 and Ai-Luka 4. A description of the newly released cassava varieties is presented SoL, 2009. A detailed description of the results leading to the release and productivity information after release is presented in earlier reports (SoL, 2008; SoL 2009). An update on the variety selection results for each crop is presented below.

9.1.1 Maize

Sele and Suwan 5

Of the two released varieties, Sele and Suwan 5, Sele is by far the most popular with farmers and seed multiplication and distribution has been concentrated on this variety. In 2011 32.5 tons of Sele seed was distributed. Sele is yellow grained and, for yellow maize, possesses characteristics preferred by most of the population. It is high yielding, possesses good pounding characteristics and is sweet to eat. It also appears to perform particularly well in drought conditions. Descriptions of these characteristics and farmers reactions to Sele are summarized in SoL, 2008.

Sele continued to perform well in replicated trials and in OFDTs during 2011 (See Chapter 2.) as it did in earlier years (Table 105, Table 106). As the preferred released variety, it was also used as a standard against which other varieties were measured. Most of the entries in the replicated trials in 2011 were white grained as these varieties are preferred by farmers in many parts of Timor-Leste. White grained P07 was included in OFDTs for the third year in 2011. This variety demonstrated good progress during the year and has been recommended for release in 2011. Another variety included in OFDTs in 2011 was a third generation cross between a variety from CIMMYT, Zimbabwe named Har 12 in earlier SoL evaluations and the white variety from the Philippines referred to in SoL as P07. The cross labeled P07Har12 performed well compared with the local but was not quite as high yielding as Sele nor P07 (Table 107). This cross and P07 will continue to be evaluated on-farm during 2012.

Table 105. Select maize yields and yield advantages, research stations, 2001-2011

	Yield (t/ha)						*Yield advantage (%)*				
Year	*Suwan 5*	*Sele*	*Har12*	*Har05*	*P07*	*Local*	*Suwan 5*	*Sele*	*Har12*	*Har05*	*P07*
2001-2005	3.5	3.1	na	na	na	1.7	106	82	na	na	na
2006 (Four sites)	1.6	1.5	na	na	na	1.1	41	39	na	na	na
2007 (Six sites)	1.9	2.6	2.7	2.0	2.6	1.5	27	73	80	33	73
2008 (Four sites)	1.5	1.5	1.3	1.2	1.3	1.0	53	53	33	22	33
2009 (Five sites)	1.9	1.8	1.6	1.6	1.6	1.0	87	81	53	58	58
2010 (Four sites)	1.9	1.7	1.4	1.1	2.1	1.2	58	42	17	-8	75
2011 (Four sites)	2.0	2.2	1.5	na	2.3	1.5	33	47	40	na	53
Mean (2006-2010)	1.8	1.9	1.7	1.5	2.0	1.2	48	55	40	21	63

Table 106. Select maize yields and yield advantages, OFDTs, 2006-2010

	Yield (t/ha)						*Yield advantage (%)*				
Year	*Suwan 5*	*Sele*	*Har12*	*Har05*	*P07*	*Local*	*Suwan 5*	*Sele*	*Har12*	*Har05*	*P07*
2006 (170 sites)	2.6	2.3	na	na	na	1.7	53	35	na	na	na
2007 (278 sites)	2.5	2.4	na	na	na	1.7	47	41	na	na	na
2008 (220 sites)	na	2.4	1.8	na	na	1.6	na	50	13	na	na
2009 (235 sites)	na	2.2	1.9	1.6	1.7	1.4	na	57	36	14	21
2010 (188 sites)	na	2.7	2.1	na	2.5	1.8	na	51	17	na	40
Mean (2006-2010)	2.6	2.4	1.9	1.6	2.1	1.6	50	47	21	14	31

Table 107. Select maize yields and yield advantages, OFDTs, 2011

	Yield (t/ha)				*Yield advantage (%)*		
Year	*Sele*	*Har12/P07*	*P07*	*Local*	*Sele*	*Har12/P07*	*P07*
2011 (86 sites)	2..05	1.77	1.85	1.53	34	16	21

Variety release of Maize: “P07” CMU Var 12

Variety Information-

Botanical Name:	*Zea mays*
Suitable Environment:	Well drained areas in the uplands or lowlands
Evaluation Name:	Code P07
International name:	CMU Var12
Breeder:	Central Mindanao University (CMU), Philippines

Background:

Maize is the main food crop and staple for more than 80% farmers in Timor-Leste. It grows on a range of soils and slopes both as a mono-crop and inter-cropped (or mixed cropped) with cassava, pumpkins, sweet potato and vegetables. Maize crops are generally cultivated with little or no fertilizer in the uplands and yields of traditional varieties are low. Higher yielding open pollinated varieties introduced by CIMMYT early in the 2000’s have consistently returned yield advantages approximately 50%.

After the initial release of two maize varieties in 2007, a series of white maize varieties were sourced from Africa and southern Philippines for testing. As a result of the extensive testing on research stations and on farmer’s fields CMU Var 12 (P07) was recommended to and released by the VRC in November, 2011.

Although the yield performance of P07 is slightly less than that of the recommended variety Sele, it has large white seeds. This allows farmers access to a high-yielding maize with the preferred (white) seed colour. P07 is the first white maize to be released in Timor-Leste.

Variety description:

Seed Color	White
Seed Quality	Semi-flint
Plant height (at harvest)	1.9m
Time to flowering[1]	65-75 days
Time to harvest[1]	105-115 days
Yield (t/ha) [2]	
Yield advantage over local (%)[2]	45
Weevil resistance	Medium resistance

1 Longer at higher altitudes

Yield and grain quality

P07 is an open pollinated maize variety (OPV) with white grain and considered to be very suitable by consumers in Timor-Leste. P07 has been tested on 23 replicated trials over 6 years and extensively tested on farmer’s fields over 3 years.

On replicated trials from 2006 to 2011, P07 yield 46% more than the local check populations. On the 23 replicated trials from 2006 – 2011, P07 produced an average yield of 1.6 t/ha. While this is a little lower than the released variety Sele (1.8t/ha, 54% increase) it is significantly greater (46% increase) than the local test populations (1.1 t/ha).

Although there was considerable testing across years and locations, there is no interaction between variety and location, suggesting that P07 can be recommended for all test districts.

Table 108. Mean yield advantage of P07 & Sele, replicated trials, 2006-2011

Variety	*P07*	*Sele*	*Local*
No. Trials	23	22	23
Average yield (t/ha)	1.6	1.8	1.1
Yield advantage above local (%)	46%	59%	

Farmers' comments at research stations

Farmers also seem to prefer P07. In the 2010 variety testing at Loes and Betano farmers were presented 13 maize variety options and asked to choose which variety they would like to plant. The maize had been boiled so farmers could compare the taste and other traits of the 13 varieties. The majority (63%) of farmers indicated they would like to plant P07 because it was soft to eat, fragrant, easy to pound and thresh, and gave a good milling recovery.

On farm testing

P07 had a consistent good performance when tested with farmers under normal agronomic conditions over 3 years and 389 sites. These sites represent all the maize cropping areas of Timor-Leste, from sea level to over 1550m elevation. Average yield of P07 on farms was 2.1 t/ha, 40% above the local check variety. This yield advantage is less than Sele (60%).

Table 109. Mean yield of P07, Sele, and local in OFDTs, 2009-2011.

Year	*Sites*	*Local yield (t/ha)*	*P07 yield (t/ha)*	*Sele yield (t/ha)*	*Yield advantage of P07*
2009	99	1.4	1.7	2.2	21%
2010	188	1.8	2.5	2.7	39%
2011*	102	1.3	1.9	2.1	46%
All years	389	1.5	2.1	2.4	40%

*Data from 2010/11 season, excluding sites where Sele was the local

At field days conducted at the OFDT locations, farmers commented on P07. Many farmers reported that when they saw the seed colour was white they did not expect much production, so they were very surprised when it produced such large cobs and good yield. Their comments included that P07 had very nice colour (it has a shiny white-coloured seed). The cobs of P07are large and well filled with large sized seed. P07 is seen to be resistant to dry conditions and does not wilt as readily as other varieties. It is resistant to strong winds at harvest time.

Farmers agreed that if/when they sell P07 cobs at the market they sell very quickly due to the attractive colour and size of the seeds and the large size of the cobs.

Processing: P07 is regarded as having a high milling percent and easy to pound. To Cooking: P07 was reported to cook quickly and have a soft texture when cooked. It is also reported to have a good taste, a little sweet.

Agronomic adaptability

P07 is a new maize variety that is well adapted for cultivation in Timor-Leste. This has been proven by the high yield obtained from this variety when grown under local conditions. The seeds are planted in either rows or randomly spaced 75cm to 1m apart with 2-5 seeds per hill. Under local conditions, with no fertilizer, P07 provides a higher yield than the local check varieties.

Similar to Sele and local maize varieties, yield of P07 increases as plant density increases from 0-5plants/m2, and then reaches a plateau. Grain yields of P07 are reduced by very high and very low pH, as for all other maize varieties under test.

Storage

Weevil tolerance of all test maize varieties including P07 was tested on the 4 research locations from the 2009 harvest. At harvest, 20 cobs of each variety were stored in white sacks for 8 months at the research locations in a location protected from rats. After 8 months the weevil damage of each plot was measured.

P07 is a more weevil tolerant that the Indonesian variety Arjuna, but a little more susceptible than the local maize populations (Table 110). Of the three populations that are local test varieties, one has a similar weevil tolerance as P07.

Table 110. Weevil damage in select maize populations, 2009/2010.

Variety	P07	Sele	Local*	Arjuna
No. Trials	4	4	4	4
Average weevil damage (%)	42	48	29[*1]	55
Lsd (p<0.05	15			

*1 A combination of 3 local maize populations. Maximum damage on local populations was 35%.

Disease and Insect Pest Reaction

P07 is resistant to the major maize disease Downy Mildew. Under all test situations, there was no occasion when P07 was observed to be more susceptible to other pests and diseases present in Timor-Leste.

Herbicide Reaction

Herbicides are not used on maize in Timor-Leste, so the reaction is unknown.

Impacts:

Economic benefits

P07 has the potential to have a significant positive impact on farming households. The increase production of grain by P07 will allow all farmers to produce more food for their families. In the case where there is insufficient food produced now, the use of P07 will allow some families to produce sufficient cereal to feed their family.

The only technology required to produce the additional 40% of grain is the seed itself. There is no need to add further inputs to P07 to obtain significantly higher yields. As such, the technology will reproduce itself each year without extra cost.

Social benefits

Cultivation of P07 will provide an alternative planting option for subsistence maize growers in Timor-Leste. Its higher yields and good eating qualities should help it contribute to greater food security.

Environmental impacts

P07 is an open pollinated variety (OPV). P07 originated from the Central Mindanao University breeding program based on improved populations developed by CIMMYT breeding program using conventional breeding techniques. It is not a genetically modified organism (GMO) bred using recombinant DNA technology and thus will not introduce any possible undesirable traits to the environment. P07 will increase the diversity of the current genetic pool in Timor-Leste.

Gender impacts

The release of P07 will assist rural families to feed themselves. The higher yield (40%) with no extra inputs means there is no extra burden for men or women in producing food from P07.

As women do most of the cooking and food preparation in Timorese households, P07 was evaluated for ease of processing (pounding and cleaning) and length of cooking. In testing with farmers P07 is one of the most preferred introduced maize varieties based on it's taste, and cooking qualities. As P07 takes no longer to process or cook, and is no more difficult to pound than local maize varieties it is not considered to have a negative impact on women's lives. P07 will benefit all members of the households that have access to the seed.

Seed production:

The Seeds of Life program started a pure seed scheme for P07 in 2011. At the end of that year there was 210kg of foundation seed produced in Betano and 810 kg stock produced in Manufahi. Larger quantities of seed will be produced after release.

9.1.2 Peanuts

Utamua

The released peanut variety, Utamua, continued to show a high level of adaptation in all agro-ecosystems in Timor-Leste. When successfully included in replicated trials, it was high yielding (Table 111). No peanut on-farm trials were conducted during the 2010-2011 wet season but in previous years performed well against the test entries in OFDTs (Table 112).

Table 111. Utamua peanut yields and yield advantages, research stations, 2001-2010

	Yield (t/ha)					*Yield advantage (%)*			
Year	*Utamua*	*Pt14*	*Pt15*	*Pt16*	*Local*	*Utamua*	*Pt14*	*Pt15*	Pt16
2001-2005	2.1	na	na		2.0	7	na	na	
2006 (Two sites)	1.1	1.8	1.3	1.6	1.2	-9	50	8	33
2007 (Five sites)	2.0	2.4	2.3	1.8	1.7	17	40	34	6
2008 (Four sites)	1.3	1.1	1.1	0.7	0.9	43	26	23	-22
2009 (Six sites)	1.5	1.2	1.5	1.8	1.1	32	5	32	58
2010 (Four sites)*	1.2	0.7	0.8	0.9	0.8	71	-1	10	14
2011 (Four sites)	1.1				Mean	86			
Mean (2006-2011)	1.4	1.6	1.5		1.2	31	24	21	18

* Only two sites for Utamua and only respective controls considered for this evaluation

Table 112. Utamua peanut yields and yield advantages, OFDTs, 2006-2010

Year	*Yield (t/ha)*					*Yield advantage (%)*			
	Utamua	*Pt14*	*Pt15*	*Pt16*	*Local*	*Utamua*	*Pt14*	*Pt15*	Pt16
2006 (168 sites)	1.8	na	na	na	1.2	50	na	na	na
2007 (138 sites)	2.0	na	na	na	1.6	24	na	na	na
2008 (175 sites)	2.0	na	na	na	1.5	33	na	na	na
2009 (166 sites)	2.0	1.1	1.4	na	1.1	82	0	27	na
2010 (132 sites)	3.5	na	2.3	2.3	2.4	43	na	-6	-7
Mean (2006-2010)	2.3	1.1	1.9	2.3	1.6	47	0	3	-7

9.1.3 Sweet potato

Hohrae 1, Hohrae 2 and Hohrae 3

The three released varieties, Hohrae 1-3 (Table 113) continued to perform well in replicated trials during 2011. All three varieties are highly popular with the farmers, particularly Hohrae 3 which is an orange coloured flesh variety bringing extra vitamin D into the diet of consumers. Biplot analysis presented in Section 2.2 of this report indicate that CIP 83 and Hohrae 3 had very similar performances across environments although CIP 72 performed best overall. The yield results of these entries from replicated trials are presented in Table 114. Hohrae continued to be included in OFDTs during 2011 as the best performer to date for comparison purposes.

Table 113. Sweet potato yields and yield advantages, research stations, 2001-2010

Year	*Yield (t/ha)*				*Yield advantage (%)*		
	Hohrae 1	*Hohrae 2*	*Hohrae 3*	*Local*	*Hohrae 1*	*Hohrae 2*	*Hohrae 3*
2001-2005	12.7	13.2	13.3	5.6	128	137	138
2006 (One site)	2.8	4.8	1.3	0.6	367	700	117
2007 (One site)	29.6	23.9	26.5	9.8	202	144	170
2008 (Two sites)	22.2	15.9	21.9	8.9	149	79	146
2009 (Five sites)	9.2	13.8	19.6	8.9	3	55	121
2010 (4 sites)	5.0	6.6	9.5	5.9	-15	12	61
Mean (2006-2010)	13.8	13.0	15.8	6.8	102	91	131

Table 114. Select sweet potato yields and yield advantages, research stations, 2011

Year	*Yield (t/ha)*				*Yield advantage (%)*		
	Hohrae 3	*CIP83*	*CIP72*	*Local*	*Hohrae 3*	*CIP83*	*CIP72*
2011 (4 sites)	10.2	9.1	14.8	4.2	145	118	254

OFDTs conducted between 2007 and 2010 demonstrated the capacity of the Hohrae varieties to perform on-farm under a range of conditions (Table 115). Hohrae 3 was included in 44 OFDTs in 2011 and continued to be the best performer. However, farmers also liked CIP83 and CIP 72 and these will be included in OFDTs in 2012.

Table 115. Sweet potato yields and yield advantages, OFDTs, 2007-2010

Year	*Yield (t/ha)*				*Yield advantage (%)*		
	Hohrae 1	*Hohrae 2*	*Hohrae 3*	*Local*	*Hohrae 1*	*Hohrae 2*	*Hohrae 3*
2001-2005	na	na	na		na	na	na
2006 (None harvested)	na	na	na		na	na	na
2007 (83 sites)	4.0	4.7	4.5	3.1	29	52	45
2008 (115 sites)	6.1	6.3	6.5	3.0	103	110	117
2009 (76 sites)	na	na	15.6	3.8	na	na	311
2010 (109 sites)	na	na	15.8	6.5	na	na	143
Mean (2006-2010)	5.1	5.5	10.6	4.1	66	80	159

Table 116. Select sweet potato yields and yield advantages, OFDTs, 2011

Year	*Yield (t/ha)*				*Yield advantage (%)*		
	Hohrae 3	*CIP83*	*CIP72*	*Local*	*Hohrae 3*	*CIP83*	*CIP72*
2011 (44 sites)	13.4	9.3	4.0	4.0	235	127	0

9.1.4 Rice

Nakroma

Nakroma, the SoL/MAF variety released in 2007 did not perform well compared with other varieties in replicated trials during 2009-2010 (Table 117). It did however, perform well in the OFDTs averaging 31% more yield on 51 sites (Table 118). This variety was selected by MAF personnel and farmers in trials conducted in 2005 for targeting to release in Timor-Leste. It remains a popular variety amongst the rice farming population and is spreading rapidly in the rice growing areas. PSB RC 80 is another variety which has also performed extremely well in some rice areas and is favourably received by farmers. This variety and PSB RC 82, Matatag 2 and Angelica were included in OFDTs during 2011 (Table 119). Their performance on a site by site comparison basis was encouraging and these three varieties will be included in OFDTs in 2012.

Table 117. Rice yields and yield advantages, research stations, 2008-2010

	Yield (t/ha)			*Yield advantage (%)*	
Year	*Nakroma*	*PSB RC80*	*Local*	*Nakroma*	*PSB RC80*
2008 (Three sites)	1.8	1.9	1.7	5	13
2009 (One site)	1.2	1.7	1.0	12	64
2010 (1 site)	5.5	6.3	6.2	-11	2
Mean (2008-2009)	2.1	2.5	2.2	-4.5	11.2

*significant for a pairwise comparison between mean yields of Nakroma and local only

Table 118. Rice yields of OFDT, all districts, 2005 to 2010

Variety	*Mean yield (t/ha)*			*Yield advantage (%)*		*LSD*
	Local	Nakroma	PSBRC 80	Nakroma	PSBRC 80	*(p=0.05)*
2005/06 (47 sites)	2.9	3.3	na	17	na	
2006/07 (52 sites)	3.0	3.7	na	20	na	0.5
2007/08 (76 sites)	3.6	4.8	na	30	na	0.6
2008/09 (71 sites)	3.2	3.8	3.3	18	4	0.5*
2009/10 (51 sites)	2.9	3.8	3.5	31	21	0.7
Total (297 sites)	3.1	3.9	3.4	24	11	

Table 119. Rice yields of OFDT varieties 2010/11

	Mean predicted yield (t/ha)					
Variety (17 sites)	Local	Nakroma	PSBRC 80	PSBRC 82	Matatag 2	Angelica
ns ($P < 0.05$)	2.4	3.3	3.0	2.5	4.2	2.1

9.1.5 Cassava

Ai-luka 2 and Ai-luka 4 continue to be the varieties most preferred by farmers when evaluated at field days (See Section 2.3). No other varieties are yet ready for release.

9.2 Farming systems recommendations

Maize

Agro-ecological zone (AEZ). Research conducted during the year did not reveal a variety by AEZ interaction. This indicates that Sele and P07 are well adapted over all testing regions. There is no indication that Sele or P07 should be recommended in some areas and not others. However Sele is often reported by farmers to show significant drought resistance.

Soil pH. The growth of all maize varieties was reduced when grown in either acidic or basic soils. Of all maize production sites, 18% had a soil pH acidic enough to reduce maize yield. Future research could evaluate different varieties to see if it is possible to expand the pH tolerance of maize varieties, or ameliorate the soils to increase grain yields. There may also be a role for extension staff to work with farmers to identify acid soils. Once identified, farmers could avoid the acid soil sites, and produce higher yields at other locations.

Seeds per hole. Research results indicate that the optimum number of seeds per hole is three or less and that farmers who plant more than this suffer significant yield reductions. Farmers will be encouraged to maintain their hill seeding density at below 4 for local and new varieties.

Plant density. Grain yields are not influenced by whether the maize is planted in rows or randomly. Although there is no yield advantage in plant densities exceeding four plants per square metre, there is a yield reduction when plants/m^2 drops below four. Maize crops should be managed to achieve at least four plants/m^2 at harvest time.

Weeding. Two weedings, preferably early in the season are recommended for maize. More than three weedings do not increase yields. The first weeding, within 4 weeks after planting, is critical in achieving high yields.

Fertilizer. Farmers in Timor-Leste currently do not use fertilizers, either organic or chemical, on maize, although soil improvement could significantly increase yields.

Insect pests and diseases. Maize crops were not significantly affected by insect pests and diseases during the year. However downy mildew can sometimes devastate susceptible crops, so varieties that are resistant to downy mildew are essential.

Rice

Plant density. Grain yields are not influenced by planting either in rows or randomly in the OFDT data set. However for ease of weeding, especially with mechanical weeders, planting should be at approximately 20-25cm intervals in lines.

Weeding. A second weeding was shown to be very beneficial to rice yield. At least two weedings – preferably early in the season are recommended for rice.

Peanuts

Seeds per hill. Planting two seeds per hill increases yields in both Utamua and local varieties.

Replanting. Replanting poorly germinated hills will increase plant population and subsequent yields.

Weeding. Research in 2007 indicated that pod yields are higher with an increased number of weedings. Peanuts may need to be weeded up to four times to maximize yields.

General

Grain storage Weevils are a renowned problem in stored grain in Timor-Leste. Techniques for improving storage life of maize includes storing grain in air tight containers (plastic containers and bags) or selecting varieties with known weevil resistance. The trials conducted during the year confirm that weevil tolerance is partially due to sheath characteristics but also on characteristics of the grain itself. Further research will focus on investigating both improved storage techniques and releasing varieties with better resistance.

Velvet bean The use of velvet bean (*Mucuna pruriens*) to both suppress weeds and improve soil nutrition through mulching is well known in other parts of the world. This technology was used by Timor-Leste farmers in the past and can be extended to farmers during future on-farm evaluation. Research conducted between 2006 and 2011 indicated that velvet bean will need to be planted after maize to avoid smothering the crop during the wet season. Planting velvet bean the same time as the maize crop leads to velvet bean dominating the maize crop, reducing maize yield. It is recommended that Velvet bean be used as a technology to increase maize yield and reduce the weed burden of farmers.

On the south coast where farmers plant 2 crops a year, velvet bean grown in the main wet season has been shown to significantly increase maize yields in the second season crop (planted May-June).

10. References

Agricultural Compendium for Rural Development in the Tropics and Sub Tropics. (1989). Elsevier Science Publishers, Netherlands. 740p

ARPAPET, (1996). Agroclimatic zones of East Timor, (Lindsay Evans, April, 1996)

Claydon A (1983) Potential of Winged Bean Pods and Their Products in Papua New Guinea. Plant Foods for Human Nutrition 32(2): 167-177.

Hymowitz T & Boyd J (1977) Origin, Ethnobotany and Agricultural Potential of the Winged Bean- Psophocarpus tetragonolobus. Economic Botany 31: 180-188.

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J., and Hopkins, M.S. (1990). Australian Soil and Land Survey – Field Handbook. 2nd Edition. Inkata Press, Melbourne, Australia

Ministry of Agriculture and Fisheries, (2008). National Directorate of Agriculture and Horticulture Statistics, 2008. Agricultural Statistics

Ministry of Agriculture and Fisheries (2009). Strategic plan.

Mnembuka B & Eggum B (1995) Comparative Nutritive Value of Winged Bean (Psophocarpus tetragonolobus (L) DC) and Other Legumes Grown in Tanzania. Plant Foods for Human Nutrition 47: 333-339.

Molyneux N, 2011. Seeds of Life: Adapting for food security. Issues, Vol 94. March, 2011

Nicholas Molyneux, Gil Rangel da Cruz, Robert L. Williams, Rebecca Andersen and Neil C. Turner. Climate change and population growth in Timor-Leste: Implications for food security. 30pp Accepted for publication by Ambio, January, 2012

Seeds of Life, 2011 Agricultural Interventions for improving food and nutritional security in Timor-Leste; with reference to Contemporary Predictions of Climate Change and Population Pressure. A policy and planning paper for the Ministry of Agriculture. 57p

Soil and Land Survey – Field Handbook. 2nd Edition. Inkata Press, Melbourne, Australia

SoL, 2006 Annual Research Report, 2006, Seeds of Life, January, 2007, 58p

SoL, 2007 Annual Research Report, 2007, Seeds of Life, August, 2008, 136p

SoL, 2008 Annual Research Report, 2008, Seeds of Life, August, 2009, 146p

SoL, 2009 Annual Research Report, 2009, Seeds of Life, June, 2010

Website http://www.seedsoflifetimor.org/