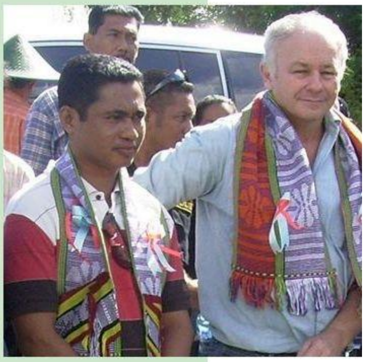
# 2008




# Seeds of Life | Fini ba Moris

## Annual Research Report

# Annual Research Report
# **2008**

# Seeds of Life
# Fini ba Moris

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

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# Foreword

This year's Annual Research Report is the third in a series prepared by the Seeds of Life (SoL) Program in Timor-Leste. It covers the period including the dry season of 2007 and wet season of 2007/2008. SoL is a program within the Ministry of Agriculture and Fisheries (MAF) of the Democratic Republic of Timor-Leste designed to evaluate, recommend and distribute superior crop varieties with the aim of improving the nation's food security.

SoL expanded its activities during the year with an increased budget provided by MAF and the Australian Government. Research and seed multiplication were conducted in the Districts of Alieu, Baucau, Manufahi, Liquica, Manatutu and Ainaro with establishment of some trials in Bobonaro. On-farm demonstration trials were established in 17 Sub Districts during the 2007-2008 wet season (Nov-April). These included test varieties of maize, rice, sweet potato, cassava and peanuts. Testing across these Sub Districts allows improved crop technologies to be evaluated over the full range of agro-ecological zones existing in Timor-Leste. Farmers receiving the test material were able to examine the crops under their own conditions and management practices and if acceptable, keep seed for multiplication.

The results of this year's agronomic research indicate a number of new breeding lines are capable of raising current crop yields. The new lines also possess other desirable characters and will be considered for release by the MAF to expand the choice available to farmers in Timor Leste. Seed multiplication of these and already released varieties will be undertaken by the MAF in the Districts of Alieu, Manufahi, Bobonaro, Viqueque, Baucau and Liquica and distributed to farmers across the nation. We expect that crop yields will increase significantly in the long term as a result of this.

The SoL component of MAF has been very active this past year building the capacity of researchers to design, manage and analyze research trials. Training was in the form of practical exercises, trial implementation and a series of short term courses. Included were courses in statistics, agronomy, seed production and English language to allow researchers read international journals and participate in training courses outside of Timor Leste. An evaluation system to guide future training was also completed. In addition to human capacity building, funding was provided to improve Government research facilities. Buildings at Betano were completed and inaugurated and plans are well advanced to rehabilitate an old station at Loes in Liquica and the new station in Darasula in Baucau.

The activities described in this report were mainly conducted or supervised by MAF personnel. In addition, a number of NGOs distributed or multiplied seed. Assistance was also forthcoming from the Consultative Group on International Agricultural Research, Australian Centre for International Agricultural Research, Centre for Legumes in Mediterranean Agriculture at the University of Western Australia, Australian National University and personnel plus students from the University of Timor Lorosae.

We thank the Australian Government 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 May, 2009

# Abbreviations and Acronyms

| | |
|---|---|
| ACIAR | Australian Centre for International Agriculture Research |
| AEZ | Agro-Ecological Zone |
| ALGIS | Agricultural Land Geographic Information System |
| ANOVA | Analysis of Variance |
| ANU | Australian National University |
| APC | Australian Program Coordinator |
| ARP | Agriculture Rehabilitation Program |
| 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 |
| FPR | Farmer Participatory Research |
| g | gram |
| GPS | Global Positioning System |
| GTZ | Gesellschaft fur Technisch Zusammenarbeit (German Agency for Technical Cooperation) |
| ICRISAT | International Crops Research Institute for the Semi-Arid Tropics |
| ICM | Integrated Crop Management |
| IRRI | International Rice Research Institute |
| LYDMR | Late Yielding Downey Mildew Resistant (Released as Sele) |
| M&E | Monitoring and Evaluation |
| MAF | Ministry of Agriculture and Fisheries |
| MTR | Mid Term Review |
| NGOs | Non-Governmental Organizations |
| OCAP | Oecussi Ambeno Community Activation Programme |
| OFDTs | On-Farm Demonstrations and Trials |
| PSC | Program Steering Committee |
| RA | Research Assistant |
| R/EA | Research and Extension Advisor |
| RDUs | Research and Demonstration Units |
| SoL1 | Seeds of Life 1 |
| SoL | Seeds of Life 2 |
| SOSEK | Social Science and Economics |
| SRI | System of Rice Intensification |
| t/ha | Metric ton per hectare |
| TAG | Technical Advisory Group |
| TL | Timor Leste |
| UN | United Nations |
| UNTL | University of Timor Lorosae |
| UWA | University of Western Australia |
| VIDA | Volunteering for International Development from Australia |
| VRC | Varietal Release Committee |

# Personnel

### Ministry of Agriculture and Fisheries

| | |
|---|---|
| H.E Mariano ASSANAMI Sabino | Minister, Ministry of Agriculture and Fisheries (From August, 2007) |
| Mr. Marcos da Cruz | Secretary of State for Agriculture & Forestry (From August, 2007) |
| Mr. Eduardo de Carvalho | Secretary of State for Fisheries (From August, 2007) |
| Mr. Valentino da Costa Varila | Secretary of State for Livestock (From August, 2007) |
| Mr. Lourenço Borges Fontes | Director General |
| Mr. Deolindo Da Silva | National Director, Agriculture and Livestock and Director for Food Crops and SoL Co-Leader |
| Mr Mr Adalfredo do Rosario Ferreira | Director of Research and SoL Co-Leader |
| Mr. Donato Salsinha | Regional Director, Same |
| Mr. Justino dos Santos Silva | Regional Director, Baucau |
| Mr. Jose Orlando | Regional Director , Maliana |
| Mr. Joao Rodriguez | District Crops Officer, Aileu |
| Mr. Alcino da Costa Sarmento | District Crops Officer, Same |
| Mr. Antonio Lopes | District Crops Officer, Baucau |
| Mr. Apolinario Bere | District Crops Officer, Ermera |
| Mr. Raul Borges | District Crops Officer, Maliana |
| Mr. Moises Lobato | Research Officer, Fatumaca |
| Mr. Abril Fatima Soares | Research Officer, Aileu |
| Mrs. Maria Fernandes | Research Officer, Betano |
| Mr. Telesforo Moniz | Research Officer, Maliana |

**Seeds of Life through Ministry of Agriculture and Fisheries**

| *Name* | *District* | *SubDistrict* |
|---|---|---|
| Mr. Luis Almeida | Dili | |
| Mr. Jose Maria Alves Ornai | Dili | |
| Ms. Armandina Marcal | Dili | |
| Ms. Anita Ximenes | Dili | |
| Mr. Modesto Lopes | Dili | |
| Ms. Dorilanda da Costa Lopes | Maliana | Maliana Villa |
| Ms. Deonisia Raquela Soares Brito | Aileu | Aileu Villa |
| Mr. Cipriano Martins | Aileu | Aileu Villa |
| Mr. Salvador de Jesus | Aileu | Remexio and Liquidoe |
| Ms. Odete Ximenes | Baucau | Baucau Villa |
| Mrs. Juliana de Jesus Maia | Manufahi | Betano |
| Ms. Ermelinda Hornai | Maliana | Maliana Villa |
| Mr. Simao Margono Belo | Baucau | Laga |
| Mr. Antonio Pereira do Rego | Baucau | Venilale |
| Mr. Rojino da Cunha | Baucau | Vemasse |
| 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 Renal Freygen | Liquica | Loes |
| Mr. Jorge Amaral | Manufahi | Alas |
| Mr. Armindo Moises | Manufahi | Turiscai |
| Mr. Leandro Pereira | Liquiça | Loes |
| Mr. Mario Tavares Goncalves | Liquiça | Liquiça Villa |
| Mr. Luis da Costa Patrocinio | Maliana | Cailaco |
| Mr. Luis Pereira | Ainaro | Maubisse |
| Paulo Soares | Liquiça | Liquiça Villa |
| Mario da Costa | Viqueque | Viqueque |
| Maria Martins | Aileu | Aileu |
| Isabel Soares | Baucau | Baucau Villa |
| Julieta Lidia | Baucau | Baucau Villa |
| Luis Fernandes | Manufahi | Same Villa |
| Amandio da Costa | Viqueque | Ossu |
| Inacio Savio | Viqueque | Uatulari |
| Tobias Monis Vicente | Liquiça | Liquiça Villa |
| Joao Paulo | Dili | |

**National University of Timor Lorosae**

| | |
|---|---|
| Mr. Antonio da Costa | Head of Agronomy Department |
| Mr. Marcal Ximenes | Agronomy Lecturer |
| Mr. Hendriche da Costa | Agronomy Lecturer |
| Mr. Adao Berbosa | Agronomy Lecturer |
| Mr. Apolinoario Ximenes | Agronomy Student |
| Mr. Juliao Gusmao | Agronomy Student |
| Mr. Agus Paxcoal | Agronomy Student |

**University of Western Australia**

| |
|---|
| Dr Harry Nesbitt |
| Dr William Erskine |

**Australian National University**

| |
|---|
| Dr. Diana Glazebrook |
| Dr. Andrew McWilliam |

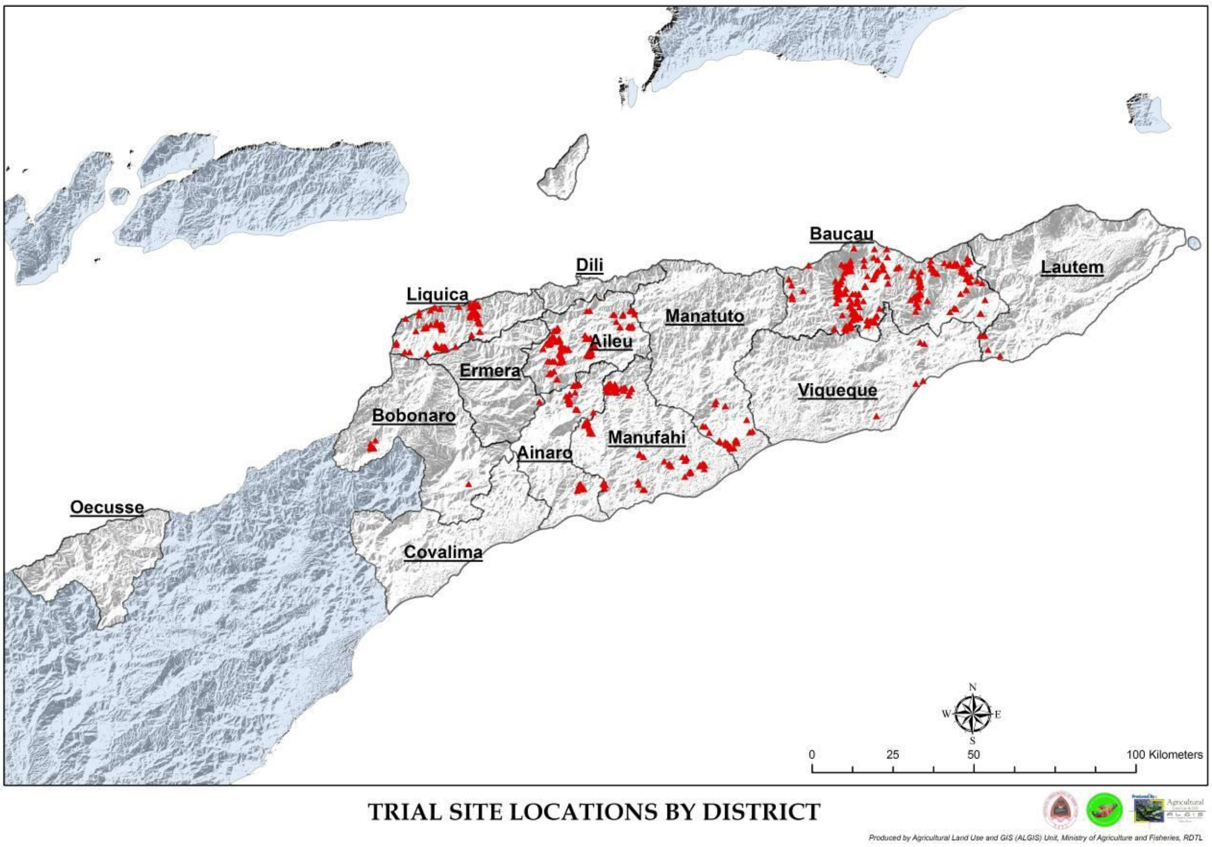
**Seeds of Life Office in MAF, Timor-Leste**

| | |
|---|---|
| Mr. Robert Williams | Seeds of Life Team Leader |
| Mr. Brian Monaghan | Research/Extension Advisor: Manufahi, Aileu |
| Mr. Alex Dalley | Research/Extension Advisor: Baucau, Liquiça (August 2005 – November 2007) |
| Ms. Rebecca Andersen | R/E Adviser for Baucau, Liquiça &Maliana (From November 2007) |
| Ms. Sarah Winnan | Office Manager (until March, 2008) |
| Mr Mark Vaughan | Office Manager (From March 08) |
| Ms. Emilia Ningum Rumsari | Finance Officer (March 2006 – November 2007) |
| Mr. Joaquim J.M.R da Cruz | Finance Officer (From November 2007) |
| Mr. Marcelino da Costa | Date Entry Specialist |
| Mr. Aquilles Barros | Translator / Interpreter |
| Ms. Leny Sarmento | Administrative Assistant (November 06 – September 08) |
| Ms. Miguelina Ribeiro Garcia | Administrative Assistant (From September 08) |

**Collaborating Organizations**

| *National / Local NGOs* | *Contact Person* | *Position* |
|---|---|---|
| Caritas Baucau | | |
| OISCA | Mirandolino A. Guterres | General Coordinator |
| | João da Silva Sarmento | Program Coordinator |
| Fundasaun Halarae | Angelino Lemos | Field staff |
| | Manuel Ati | Field staff |
| Santalum | Helio Jose Antonio da C. | Secretary |
| Loda | Ancelmos Mau | Field staff |
| *International NGOs* | *Contact Person* | *Position* |
| Care International | Buddhi Kunwar | Project Manager LIFT |
| OXFAM Hongkong | Maria dos Reis | Program Officer for Timor-Leste |
| UNOPS (OCAP – Oecusse) | Koen W. Toonen | International Program Coordinator (Ocap –Oecusse) |
| World Vision | Mr. Jim Hooper | Livelihoods Security Manager |
| CCF | Carlos S. Basilio | Team Leader |
| Austcare | Maria Julietta Ribeiro Mota | |
| | Tomas Barros | Field Coordinator for Bobonaro District |
| GTZ | Benjamin Guterres | Farming System Coordinator |
| Concern | Bonifase | Field staff |
| PADRTL | Mario Assis Tavares | Ermera Component Coordinator |
| | Pedro Laranjeira | Component 3 Coordinator |

**Figure 1. Map of Timor-Leste showing OFDT sites (▲)**



# 1. Overview of the Seeds of Life Program

## 1.1 Introduction

"Seeds of Life" (SoL) is a program within the Ministry of Agriculture and Fisheries which addresses food security issues in Timor-Leste. It was established in September, 2005 with funding from the Governments of Australia and Timor-Leste. Australian Government funding is from the Australian Agency for International Development (AusAID) and the Australian Centre for International Agricultural Research (ACIAR) while that from the Government of East Timor is directed by the Ministry of Agriculture and Fisheries (MAF). ACIAR manages the Australian funding through an executing agency, the Centre for Legumes in Mediterranean Agriculture (CLIMA) at The University of Western Australia (UWA).

SoL has a goal of improving food security in Timor-Leste through the introduction of improved crop varieties and associated technologies which will result in increased food production. The main crops under investigation are maize, sweet potato, cassava, peanuts and rice. Much of the improved breeding material and expertise for these crops are sourced from crop centres belonging to the Consultative Group on International Agricultural Research (CGIAR) including the International Rice Research Institute (IRRI) for rice, the International Maize and Wheat Improvement Centre (CIMMYT) for maize, the International Centre for Tropical Agriculture (CIAT) for cassava and beans, the International Potato Centre (CIP) for sweet potato and the International Centre for Research in the Semi-Arid Tropics (ICRISAT) for groundnuts (peanuts). In 2007 and 2008 material was also sourced from national breeding programs in Asia, Australia and Africa.

SoL personnel and plant breeders from each of the collaborating centres select breeding lines considered to be suitable for Timor Leste conditions and compare them with locally available varieties on research stations and other sites. The best of these are then evaluated on farmers' fields in unreplicated "on-farm demonstration trials" (OFDTs). More than 700 OFDTs were established in 2007-2008 allowing a large number of farmers to observe plant growth, measure yield and taste the resulting material. Researchers were also able to compare the test entries over a range of ecosystems and management practices.

In addition to varietal evaluations, a small amount of applied research was conducted on food crop agronomy and other farming practices that address constraints directly related to the successful introduction of the new varieties. Identified constraints include seed storage, weed control and low soil fertility. Studies on these constraints during the past year include seed storage research and the use of green manures to both shade out weeds and improve soil quality through soil mulching. Trials on soil fertility constraints were also initiated. Research and Development Units (RDUs), which include representatives from MAF, Non-Governmental Organizations (NGOs), lead farmers and other members of the community who wish to be involved have been established in each District to advise the researchers. Although most of the research activities were conducted by MAF personnel or staff contracted to MAF, seed was distributed to NGOs, farmers groups and local organizations for multiplication purposes. Research personnel from the Australian National University (ANU) and staff and students from the University of Timor Lorosae (UNTL) were also involved.

The SoL office is located in the MAF compound at Comoro but a major proportion of its activities are located in 15 Sub Districts of Manufahi, Aileu, Liquiça, Baucau, Manatutu and Ainaro (Figure 1). A short summary of program activities during 2007-2008 are presented below.

## 1.2 Program Summary, 2007-2008

SoL was designed with four components possessing the objectives of a) Seed production and storage plus its distribution, b) Evaluation of new germplasm and associated technologies, c) On-farm demonstrations and trials and d) Program management and coordination.

**Component 1: Seed Production and Storage and Distribution**

Activities in this component include:

- Rehabilitation of Betano and two other research stations
- Utilization of the Aileu research site
- Seed production and storage at MAF stations and Districts
- Training in seed production and storage
- Testing and formulation of a seed certification, seed import and variety release policy

Rehabilitation of the main buildings at Betano Research Station were completed and handed over to the MAF by the building contractors during the first half of 2007/08. Station surrounds were improved over the ensuing months. This included the painting of storage sheds, installation of culverts, construction of storage shelves in the seed store, construction of gates and the commissioning of an irrigation system. In addition, the station was equipped with 1 tractor, 1 utility vehicle, a seed cleaner, laboratory and office equipment. The station was inaugurated by the Minister of Agriculture and Fisheries, HE Mariano Assanami Sabino on 29 November, 2007.

The MAF was successful in accessing a former research station site a Loes, Liquica District and land in Darasula, Baucau District for rehabilitation and development respectively. The MAF have provided funds for fencing at Darasula and Loes and the formulation of a rehabilitation plan for Loes was underway during the second quarter of 2008. Construction will start at both stations during the coming year.

Research sites at Alieu, Maliana, Betano and Fatumaca were well managed during the period. Replicated trials planted at the sites included maize, cassava, sweet potato and peanuts. A field day was held in Alieu on 7 November, 2007 and at Maliana later in the month associated with the harvesting of the cassava varieties. These were supplemented with small field days held by each RA in his/her Sub District for each crop to introduce the new tested varieties to local farmers.

Seed production and storage training was provided to SoL and MAF personnel in an on-going basis by the R/EAs and the newly appointed Seed Production Advisor (SPA). CIAT in collaboration with SoL also presented training on cassava production at field days in Alieu and Maliana in November, 2007 and a maize seed storage training course was arranged through the University of the Philippines in March, 2008.

SoL coordinated with the Agriculture Rehabilitation Program (ARPIII) to assist the MAF formulate a draft Seed Law in January, 2008. The Seed Law draft contains the elements of a policy for the release, quality guidelines, labeling, certification and importation of seed. Some of these elements were already in place with the development of a Variety Release Committee to enable the release of SoL varieties in March, 2007. At the end of May, 2008, the draft Seed Law was being considered by the Council of Ministers.

Six seed production officers were selected for placement in six Districts to improve the quality and quantity of seed production. Plans are afoot to produce at least 5 ha of high quality SoL released rice, maize and peanut seed plus a half ha of sweet potato cuttings in each District during the wet season of 2008-2009. Prior to harvest, seed cleaners and other seed production equipment will be procured for the program. In the meantime, sufficient seed for research purposes has been multiplied on research stations.

**Component 2: Evaluation of new germplasm and associated technologies**

Activities in component 2 include:

- Introduction, evaluation and maintenance of new varieties
- Development of an inventory of local varieties
- Training of staff
- Collection of locally cultivated varieties

New varieties of food crops commonly cultivated in TL were introduced for evaluation in replicated trials. Included were 20 maize (mainly from CIMMYT), 11 peanut (mainly from ICRISAT), 11 varieties of sweet potato (mainly from CIP) and 24 cassava clones (mainly from CIAT). Within each trial were at least two local varieties. Two irrigated rice evaluation trials were conducted at Aileu and Betano. Introduced germplasm was cultivated during the season at Corluli (Bobonaro), Betano (Manufahi), Kintal Portugal (Aileu), Fatumaca (Baucau) plus at UNTL, Hera. A total of eighteen replicated trials were installed and evaluated. Included were four trials each of maize, cassava, sweet potato and peanuts. Two trials on rice were also established. In addition, the effect of velvet bean control of weeds in maize was studied at three sites. The timing of planting peanuts was also studied at three sites in an effort to improve productivity.

Conservation of new germplasm is a constant challenge. Seed was conserved on research stations throughout the year. This was particularly difficult with cross pollinated maize varieties. The SPA has developed a plan to improve conservation procedures. This will be implemented over the next two years with an initial collection of 15 peanut and 15 varieties from each Sub District.

Training of members of research and development units (RDUs) involved with the program remains a priority for SoL. Last year, members of the RDUs, MAF staff members from Dili and the Districts plus representatives from NGOs and international organizations were included in training programs on agronomy, seed production, statistics and English language. A total of 875 days of training were provided over the year. Most of this was English language training (579 days) to assist team members with computer work, reading scientific papers and attending training courses abroad. Of the other 296 days, 23% was on agronomy, 18% on seed production and 59% on statistics. Eighty five (85) of these training days were taken abroad during trips to the Philippines and Indonesia for seed production training. Seven MAF/SoL staff members also joined a study tour to Australia to examine peanut research and production techniques. One other person joined a course on English language training in Australia prior to gaining research experience at CLIMA in The University of Western Australia. In addition, the R/EAs and visiting scientists provided constant on the job training in soils, the use of Excel, GPS, soil pH testing equipment etc. This level of local training will continue into 2009. It is also hoped that an increased number of team members will pursue short term training courses abroad, hopefully with one person commencing a Masters degree course in Australia.

The collection of cassava varieties existing in East Timor prior to the commencement of SoL were being maintained in Corluli, Maliana. During the second quarter of 2008, the SPA also held a short course on methods to describe germplasm indicators.

**Component 3: On-farm demonstrations and trials**

Component 3 is comprised of:

- Implementation of OFDTs
- Social research (SOSEK team)
- RDU training
- Development of improved crop production packages

Seven hundred and fourteen (714) maize, peanut, cassava, sweet potato and rice on farm demonstrations and trials (OFDTs) were established in 17 Sub Districts during the 2007-2008 wet season (Nov-April). Included were 259 maize, 147 sweet potato, 13 cassava, 204 peanut and 91 rice trials. By District, the number equaled 121 in Alieu, 298 in Baucau, 99 in Manufahi, 88 in Liquica, 8 in Manatutu and 49 in Ainairo. Of the established trials 586 trials were successfully harvested. The 13 cassava trials were not ready for harvest at the end of 2008.

Agro-ecological zone maps of East Timor were refined by the ALGIS laboratory and distributed to the RAs to assist in site selection for OFDTs. An effort was made to spread the OFDTs across a range of AEZs to evaluate the new varieties under different conditions. GPS manuals were also distributed to the RAs to assist in locating sites on maps. These activities are on-going.

Household data were collected over the year by the SOSEK team. Two East Timorese social scientists were assisted by an ANU research advisor and, for a short period, by an ANU student. While this was being done, reports of the program's impact at a household level were recorded. Included were farmers' reports of harvested surplus cassava, sweet potato and peanuts on sale where previously they were barely self sufficient. This program will be expanded with the re-appointment of an ANU advisor. Evaluation of adoption rates of SoL varieties and farm house hold food security strategies will also be included.

Each RA developed plans to conduct four mini field days at an OFDT site, one for each species. The field days commenced as the crops matured. The crops were harvested during the field day, weighed and results discussed. Feedback on the crop's characteristics was then solicited from the visiting farmers and members of the RDUs.

Calendars of farming activities performed by East Timorese farmers living in different AEZs developed by the SOSEK team over the previous 12 months were completed and printed in September, 2007. These calendars were distributed to each of the Districts to assist the RAs and District agricultural officers develop their work plans.

Research to develop "packages of technology" included experiments on improving the spacing of peanuts, Velvet beans (*Mucuna pruriens*) to control weeds in maize and soil problem identification. Effort was also placed on completing a manual of weeds in Timor Leste and on insect pests in the main food crops.

**Component 4: Program management and coordination and institutionalization of crop research and extension in MAF**

Component 4 includes:

- Office staffing
- Coordination of activities
- Development of a national extension strategy
- Progress reviews and planning
- Reporting
- M&E framework

Personnel are listed on Pages xi to xiii. During the year there were several changes in staffing. Mr Alex Dalley completed his two year contract at the end of August, 2007. Ms Rebecca Andersen, who had gained experience with SoL as a volunteer at UNTL, applied for the position and commenced work with SoL on 01 September, 2007.

The SoL Office Manager, Ms Sarah Winnan also completed her contract and was replaced by Mr Mark Vaughan who commenced work on 03 March, 2008. He will be assisted by a new finance officer, who commenced work in October, 2007.

Two OFDT coordinators were hired at the beginning of Year 3 to help train the RAs and coordinate the installation and monitoring of OFDTs. Seven new research assistants were also employed to manage the research program in two new Districts and fill RA positions vacated to accept OFDT coordinator positions.

As a result of the Mid Term Review, the position of Seed Production Advisor was also created and filled by Dr Asep Setiawan who commenced work with SoL on 03 March, 2008. Dr Setiawan had previously worked with SoL as the CIP representative and resident sweet potato expert. In addition, a farm manager was employed to manage Betano Research Station. This assignment will relieve one of the RE/As of much of this responsibility.

For most of the year, SoL activities were administered from the office at Fomento, Dili, although most team members were based in the Districts. On Friday, 13 May, the office was shifted to a renovated building at the MAF compound in Comoro, Dili.

Weekly meetings were held on Monday mornings to coordinate activities. Minutes were taken and circulated amongst the staff.

A personnel evaluation system was established to help guide staff improvement. Competency-based assessments commenced in January, 2008. These will be included in the Annual Personnel Evaluation due later in the year.

SoL personnel kept in close contact with Regional Directors and District personnel, AusAID, ACIAR, and CGIAR centres during the past year. Also with other agricultural based programs through the RDUs and regular meetings (for example the monthly MAF/Donor "Harmonization meetings" and the monthly Sustainable livelihoods meetings) and with the involvement of NGOs in conducting OFDTs. Activities were effectively coordinated between the major stakeholders. Maize, peanuts and rice seed was provided to the Gesellschaft fur Technisch Zusammenarbeit (German Agency for Technical Cooperation) (GTZ), World Vision, Oecussi Ambeno Community Activation Programme (OCAP), AusCARE, CARE, Oxfam, and Friends of Luro for extension purposes. This close liaison will continue to generate a synergy of results from all concerned.

An agreement was reached between MAF, SoL, ARPIII and GTZ for SoL to field a consultant to assist MAF elucidate and document current directions of an extension philosophy within MAF and outline a policy for agricultural extension for discussion. This input was completed during June, 2008 and GTZ has accepted responsibility to assist MAF finalize the policy.

## 1.3 Publications and Communications

A number of reports were written over the year to detail SoL activities. These are presented in Section 9 of this report. In addition, program activities were presented on the SoL Website hosted by the University of Western Australia. The web address is http://sponsored.uwa.edu.au/sol

Program work was highlighted both nationally and internationally. International publications were primarily through the Australian media and publications in relevant organizations. A list of these is presented in Section 6 of this report.

## 1.4 Rainfall

Farmers in Timor Leste rely on good seasonal rains for crop production. In the north of the country, the main growing season is from Oct/Nov to March/April. This trend is demonstrated in Table 1 where the presented data indicates that most of the rainfall for stations at Kintal Portugal, Alieu; Corluli, Maliana; and Fatumaka, Baucau falls during this period. Seasonal rainfall was above average in the east of the country (Baucau) despite the period from May through to August being extremely dry. The dry season in the west of the country (Maliana and Aileu) was also rainless for this period and because of that, the total rainfall for the year was below average at these sites.

To the south of the country, for example in Betano, the wet season is spread over a longer period and is bimodal in distribution. It is possible to grow two crops a year in these environments. There were good rains during the main cropping season but, like the remainder of the country, it was quite dry in the south of the island from February through to August, 2008 and "second season crops" were very low yielding.

**Table 1. Monthly rainfall at SoL research stations. Sept 2007- Aug 2008**

| *Month* | *Year* | *Kintal Portugal, Aileu* | | *Betano Research Station* | | *Corluli, Maliana* | | *Fatumaka, Baucau* | |
|---|---|---|---|---|---|---|---|---|---|
| | | Rain (mm) | LTA* (mm) | Rain (mm) | LTA* (mm) | Rain (mm) | LTA* (mm) | Rain (mm) | LTA* (mm) |
| *September* | 2007 | 0 | 24.3 | 9 | 26.2 | 2 | 12.6 | 0 | 10.7 |
| *October* | 2007 | 16 | 107.0 | 0 | 29.0 | 117 | 64.3 | 0 | 54.1 |
| *November* | 2007 | 64 | 238.3 | 22 | 68.3 | 231 | 216.0 | 342 | 147.4 |
| *December* | 2007 | 238 | 395.3 | 168 | 159.3 | 418 | 332.4 | 571 | 143.2 |
| *January* | 2008 | 310 | 305.0 | 103 | 179.5 | 238 | 437.5 | 205 | 160.0 |
| *February* | 2008 | 171 | 239.6 | 25 | 143.7 | 484 | 372.5 | 426 | 162.0 |
| *March* | 2008 | 449 | 203.2 | 30 | 127.2 | 323 | 296.0 | 353 | 115.4 |
| *April* | 2008 | 24 | 97.2 | 7 | 101.5 | 79 | 140.8 | 129 | 97.9 |
| *May* | 2008 | 3 | 73.2 | 83 | 210.6 | 0 | 91.9 | 0 | 57.9 |
| *June* | 2008 | 0 | 26.6 | 127 | 147.3 | 0 | 49.7 | 0 | 28.3 |
| *July* | 2008 | 0 | 18.4 | 31 | 112.2 | 0 | 23.1 | 0 | 10.9 |
| *August* | 2008 | 0 | 16.9 | 12 | 24.4 | 0 | 16.3 | 0 | 7.0 |
| | | 1274 | 1745 | 617 | 1329 | 1892 | 2053 | 2026 | 995 |

*Legend. * Long Term Averages (LTA) for monthly rainfall were calculated from data collated by the Indonesia-Australia Development Cooperation Agricultural Regional Assistance Program East Timor (ARPAPET, 1996) presented in Fox, J, 2003. Means calculated over 11, 12, 22 and 34 years for Aileu, Betano, Maliana and Baucau respectively.*

# 2. Evaluation of new germplasm

## 2.1 Maize

### 2.1.1 Replicated maize trials, 2007-2008

Maize (*Zea mays*) varieties with potential for improving yields were tested in replicated trials at different agro-ecological zones across East Timor during 2007-2008. The varieties were sourced from Zimbabwe, Thailand, Indonesia, India and the Philippines. These introduced maize populations were tested in order to identify suitable germplasm for further evaluation in farmers' fields and may have been included in similar trials in earlier years. Five local varieties were also included in the trials. Four trials were implemented during the wet season of 2007-2008 (no dry season trials were conducted following the 2006 wet season).

#### *Materials and methods*

Replicated maize trials were conducted at four locations in 2007/08. Each trial was a randomized block design with at least three full replicates (four replicates were planted at Corluli where land space permitted). Crops were planted starting in late September 2007 in Maliana until January 2008 at Betano (depending in rainfall), and harvested during March and April 2008. A summary of the sites and planting dates is presented in Table 2.

**Table 2. Planting and harvest details at maize trial locations, 2007/08**

| *Location* | *Season* | *Number of entries* | *Planting Date* | *Harvest Date* | *Mean Yield (t/ha) ** |
|---|---|---|---|---|---|
| Baucau (Fatumaka) | Wet | 20 | 23-24 Nov 07 | 14 Mar 08 | 1.4 |
| Maliana (Corluli) | Wet | 21 | 27 Sept 07 | 23 Mar 08 | 1.0 |
| Betano (Manufahi) | Wet | 20 | 05 Jan 08 | 25 Apr 08 | 1.0 |
| Aileu (Kintal Port) | Wet | 20 | 23 Nov 07 | 16 Apr 08 | 1.5 |

*Averages of adjusted yields predicted by REML data analysis (explained below)

Plot dimensions were 5m by 5m at Fatumaka, Aileu and Corluli, and 6m by 5m at Betano, with a 50-60cm walkway between each plot. Six or seven rows were planted per plot with 75cm between-row spacing and 25cm between hills. Two seeds were planted per hill (excluding Corluli where only one seed was planted) and later thinned to one plant per hill.

At harvest, cobs were removed from the central four or five rows to exclude the two outer rows (however entire plots were harvested at Corluli). Cobs were threshed, dried and weighed to determine grain yield. At Betano, Aileu and Fatumaka, cobs from the outer two rows were harvested and dried in their sheaths and stored in woven sacks for weevil tolerance evaluation.

At harvest time in Aileu, a farmer field day was held to assess farmer preferences of maize varieties and to determine the traits that farmers use to value the varieties under test. During the field day, farmers participated in the harvest and weighing of cobs.

A selection of 22 open pollinated maize varieties were evaluated during the wet season, with at least 20 varieties tested at any individual research station. A description of the entries is presented in Table 3. Eight of the varieties were sourced from the Philippines including four varieties tested in the previous year and four new Philippine varieties under their first evaluation. All Philippine test varieties were white in colour and downy mildew resistant. Standard varieties in the evaluation were the high yielding recently released yellow varieties Suwan 5 and Sele plus one of the Indonesian varieties Arjuna or Kalinga. Four local varieties from Liquica, Manatuto, Maliana, and Baucau were planted as local controls. An extra local variety from Suai was included in the Betano trials.

No fertilizer was applied to any of the trials conducted in the wet season.

**Table 3. Population details of maize trials, wet season 2007/08**

| *Code* | *Name* | *Source* | *Colour* | *Testing location* |
|---|---|---|---|---|
| HAR05 | DMRSSyn024/DMRSSyn021 | Zimbabwe CIMMYT | White | Baucau, Maliana, Betano, Aileu |
| HAR06 | DMRSSyn024/DMRSSyn022 | Zimbabwe CIMMYT | White | Baucau, Maliana, Betano, Aileu |
| HAR12 | V036=PopDMRSRE(MOZ)F2 | Zimbabwe CIMMYT | White | Baucau, Maliana, Betano, Aileu |
| **M02** | **Suwan 5** | **Thailand** | **Yellow** | **Baucau, Maliana, Betano, Aileu** |
| **M03** | **Sele (LYDMR)** | **India** | **Yellow** | **Baucau, Maliana, Betano, Aileu** |
| M24 | Arjuna | Indonesia | Yellow | Baucau, Betano, Aileu |
| M39 | Kalinga | Indonesia | Yellow | Maliana. |
| *M44* | *Local Maubara Batar Boot* | *Liquica (Timor)* | *Mixed* | *Baucau, Maliana, Betano, Aileu* |
| *M45* | *Local Fatulurik* | *Manatuto (Timor)* | *Mixed* | *Baucau, Maliana, Betano, Aileu* |
| *M47* | *Local Kakatua* | *Maliana (Timor)* | *White* | *Baucau, Maliana, Betano, Aileu* |
| *M48* | *Local Fatumaka Mutin, Angola* | *Baucau (Timor)* | *White* | *Baucau, Maliana, Betano, Aileu* |
| M 50 | AMCAP | Natabora (Philippines) | White | Baucau, Maliana, Betano, Aileu |
| M 51 | Nai | Suwan 5 and Arjuna cross | Yellow | Baucau, Maliana, Betano, Aileu |
| P01 | IPB Var 4 | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P03 | USM Var 10 | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P07 | CMU Var 12 | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P08 | IES 8906 | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P09 | Tupi White | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P 10 | Syn White | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P 11 | CMU Var10 | Philippines | White | Baucau, Maliana, Betano, Aileu |
| P 12 | Takro | Philippines | White | Baucau, Maliana, Betano, Aileu |
| *Local* | *Lokal mutin Suai* | *Suai, (Timor)* | *White* | *Betano* |

## *Results*

### Baucau

The initial analysis of the Fatumaka replicated maize data indicated that there was significant variation between data collected from different rows and columns within the blocks at the site. Figure 2 shows the trend in the unadjusted means of yields in each row to demonstrate the affect observed at the site which is attributable to site environmental conditions as opposed to varietal differences. It is suspected the row affect at Fatumaka is due to heavy rain damage and soil erosion starting at the top of the site where row 1 begins, reducing the yields. The row variation affected the results for plants/m$^2$, cobs/plant and yield (t/ha). There was also variation between the columns within the plots, which affected the plants/m$^2$ data and yield data (t/ha).

Due to these row and column effects at the site, REML (Restricted/Residual Maximum Likelihood) analysis of column effects was used to analyze the data, using a regular grid spatial model in GenStat Discovery Edition 2 (AR1). The REML analysis adjusts the data accordingly to negate these row and column affects, and the results are displayed in Table 4.

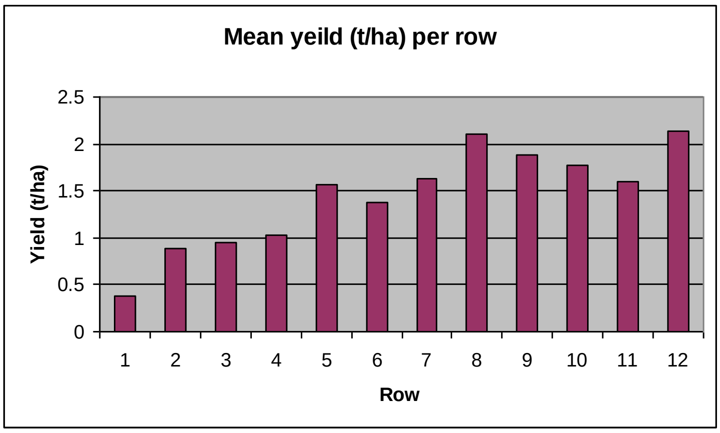



**Figure 2. Row affect on maize yields at Fatumaka 2007-2008.**

**Table 4. Yield and yield components of wet season maize trial, Baucau, 2007/08***

| *Population* | *Plants/m²* | *Cobs/ Plant* | *Cob weight (g)* | *Yield (t/ha)* | *Seed Weight (g/100)* | *Plant height (cm)* |
|---|---|---|---|---|---|---|
| HAR 05 | 4.1 | 0.7 | 27 | 0.6 | 21 | 172.2 |
| HAR 06 | 3.9 | 0.8 | 43 | 1.4 | 29 | 196.3 |
| HAR 12 | 4.7 | 0.8 | 45 | 1.6 | 23 | 178.9 |
| **M 02 (Suwan 5)** | **4.1** | **0.7** | **40** | **1.2** | **25** | **162.7** |
| **M 03 (Sele)** | **4.2** | **0.9** | **54** | **2.0** | **27** | **170.4** |
| M 24 (Arjuna) | 3.6 | 0.5 | 19 | 0.3 | 25 | 215.8 |
| M 39 (Kalinga) | - | - | - | - | - | - |
| *M 44 (Batar Bo'ot)* | *4.0* | *0.9* | *49* | *1.7* | *29* | *191.1* |
| *M 45 (Fatulurik)* | *3.5* | *1.0* | *48* | *1.7* | *29* | *150.3* |
| *M 47 (Kakatua)* | *3.9* | *0.8* | *41* | *1.2* | *31* | *191.8* |
| *M 48 (Angola)* | *2.9* | *0.8* | *52* | *1.1* | *30* | *202.8* |
| M 50 | 4.8 | 0.7 | 46 | 1.7 | 28 | 195.2 |
| M 51 | 4.6 | 0.7 | 35 | 1.1 | 27 | 197.2 |
| P 01 | 4.1 | 0.8 | 40 | 1.6 | 24 | 196.4 |
| P 03 | 4.6 | 0.9 | 41 | 1.7 | 28 | 151.4 |
| P 07 | 4.1 | 0.6 | 41 | 1.4 | 26 | 163.5 |
| P 08 | 3.7 | 0.8 | 46 | 1.1 | 24 | 197.0 |
| P 09 | 4.6 | 0.8 | 51 | 1.8 | 24 | 177.9 |
| P 10 | 4.1 | 0.8 | 45 | 1.7 | 24 | 162.0 |
| P 11 | 4.9 | 0.8 | 41 | 1.4 | 27 | 199.5 |
| P 12 | 2.7 | 0.7 | 48 | 0.9 | 24 | 205.2 |
| *Chi-sq prob kode* | *<0.001* | *0.384* | *0.030* | *<0.001* | *<0.001* | *0.102* |
| *LSD* | *0.84* | *ns* | *17.61* | *0.80* | *3.09* | *ns* |

*(*after correction adjustments with REML analysis)*

Regressions between the various yield components and the total yield in t/ha, measured at Fatumaka are plotted in Figure 3. The strongest correlation with yield was observed between cob weight ($R^2$ 0.55) and cobs per plant ($R^2$ 0.50).

The results at Fatumaka indicated significant differences between varieties for grain yield (t/ha) plant density, and cob size (grain weight per cob), however plant height and cobs per plant were not significantly different between varieties. The average plant stand at Baucau was 4.1 plants/m$^2$ with Angola (M48) and P12 having significantly less dense plant stands. Grain yield ranged from 0.3 t/ha (Arjuna) to 2.0 t/ha (Sele), with an average of 1.4 t/ha. Two local varieties

Kakatua and Angola (M47 and M48) yielded significantly lower than the average, however two local varieties Batar Bo'ot and Fatulurik (M44 and M45) also yielded above the average yield each with 1.7 t/ha. The Arjuna (M24) variety had grain yields significantly lower than all other varieties excluding P12 and Har05.

Of the Zimbabwe maize varieties tested at Baucau, Har06 was equal to the average yield of 1.4 t/ha, and Har12 yielded above the average (1.6 t/ha). However, the other Zimbabwe variety Har05 yielded significantly less than the others (0.6 t/ha), despite having a similar plant stand (due to the small seed weight of Har05 which was only 21g/100).

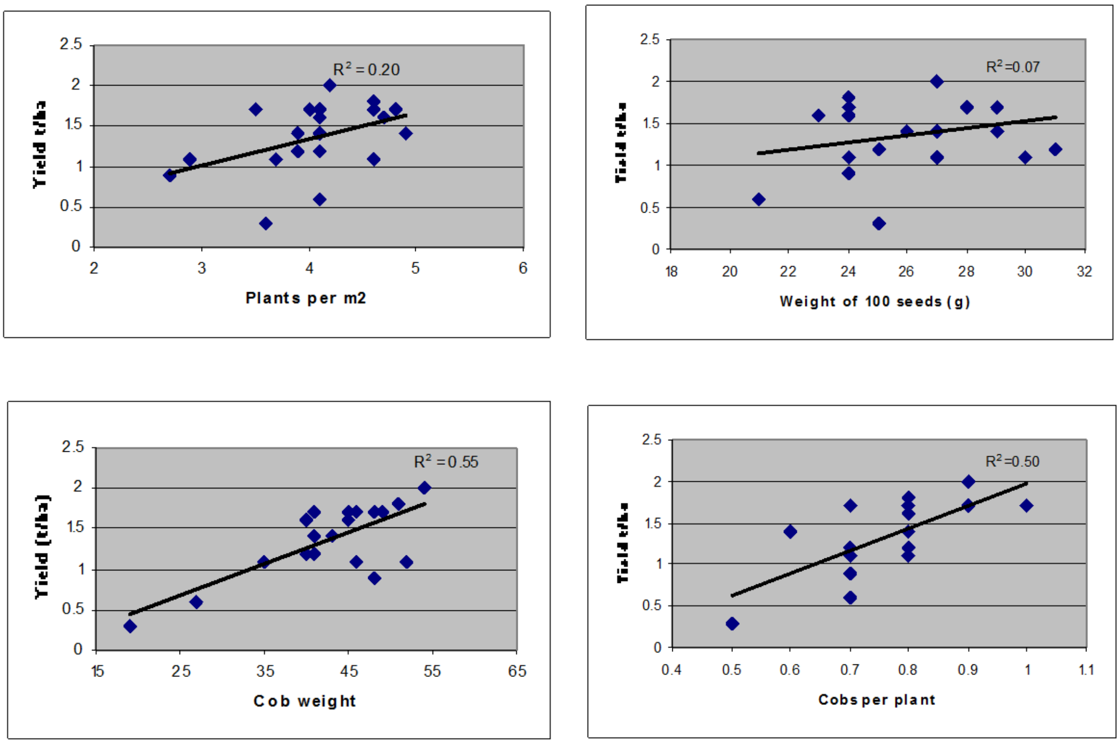



**Figure 3. Maize yield component graphs, Fatumaka**

The average yield from the Philippine maize varieties tested at Baucau was 1.5t/ha with all Philippine varieties above the site's average yield excluding P08 (1.1t/ha) and P12 (0.9t/ha). The highest yielding of the Philippine varieties was P03 which had a significantly heavier seed weight (28g) than many other Philippine varieties.

In regard to the average seed weight of the varieties tested, the local variety Kakatua (M47) had the heaviest seed which was recorded as 31g/100 seeds. This was significantly higher than the seed weights of both Sele and Suwan 5. Har06 had a heavier seed weight than other Zimbabwe varieties (29g/100 seeds). None of the Philippine maize varieties had significantly different seed weights to that of Sele (M03).

Although the cob weight was not highly significant, Sele had the heaviest cob weight (54g) followed by the Angola variety (52g). Arjuna had a significantly lower cob weight than all other varieties (19g) excluding M51 and Har05 which both also had smaller cob sizes.

### Betano

At Betano, data analysis indicated significant variation within the plots at the site, differing both between rows and columns. The in-row variation impacted the results for yield (t/ha) and cob height. The variation between columns impacted the measurements for plants/m$^2$ and plant height. Due to these affects, the maize data from Betano was analyzed with REML regular grid special model (AR1), in order to adjust for these affects and achieve more accurate predicted means. The results of the REML analysis are shown in Table 5. Yield correlations to the various yield components are following in Figure 4.

**Table 5. Yield and yield components of wet season maize trial, Betano, 2007/08***

| *Population* | *Plants/m$^2$* | *Cobs/ plant* | *Cob weight (g)* | *Yield (t/ha)* | *Seed weight (g/100)* | *Cob height (cm)* | *Plant height (cm)* |
|---|---|---|---|---|---|---|---|
| HAR 05 | 4.1 | 1.0 | 35.9 | 1.2 | 23.1 | 64.8 | 137.1 |
| HAR 06 | 4.5 | 0.7 | 49.7 | 1.6 | 29.6 | 68.1 | 162.9 |
| HAR 12 | 3.3 | 0.7 | 30.2 | 0.6 | 21.5 | 51.1 | 107.8 |
| **M 02 (Suwan 5)** | **4.3** | **0.7** | **33.3** | **1.6** | **25.7** | **72.2** | **177.1** |
| **M 03 (Sele)** | **3.8** | **0.9** | **30.1** | **0.7** | **25.5** | **63.0** | **140.0** |
| M 24 (Arjuna) | 3.8 | 0.8 | 30.6 | 1.0 | 28.9 | 61.7 | 127.5 |
| M 39 (Kalinga) | - | - | - | - | - | - | - |
| *M 44* | *1.6* | *0.5* | *20.1* | *0.4* | *27.4* | *95.0* | *188.3* |
| *M 45* | *3.6* | *0.3* | *29.0* | *1.3* | *28.3* | *70.3* | *134.3* |
| *M 47* | *3.4* | *0.9* | *27.6* | *0.6* | *20.8* | *62.3* | *138.3* |
| *M 48* | - | - | - | - | - | - | - |
| M 50 | 4.2 | 1.3 | 44.0 | 0.7 | 26.5 | 74.6 | 153.0 |
| M 51 | 4.1 | 0.9 | 40.3 | 1.5 | 26.5 | 88.9 | 129.7 |
| P 01 | 3.7 | 0.5 | 30.0 | 0.8 | 27.4 | 62.0 | 151.4 |
| P 03 | 3.8 | 0.7 | 28.7 | 1.4 | 28.9 | 65.5 | 136.8 |
| P 07 | 3.8 | 0.4 | 31.7 | 1.2 | 27.7 | 63.8 | 139.7 |
| P 08 | 3.9 | 0.4 | 28.0 | 0.9 | 25.3 | 60.9 | 150.8 |
| P 09 | 3.9 | 0.7 | 30.2 | 1.0 | 24.6 | 71.4 | 148.1 |
| P 10 | 3.5 | 0.6 | 31.4 | 0.8 | 21.1 | 51.2 | 103.1 |
| P 11 | 4.1 | 0.8 | 45.3 | 1.3 | 26.9 | 73.5 | 163.5 |
| P 12 | 1.0 | 0.6 | 23.8 | 0.2 | 26.3 | 62.6 | 151.9 |
| LC Mutin Suai | 2.5 | 0.9 | 37.8 | 0.96 | 30 | 95.3 | 168.8 |
| *Chi-sq prob* | *<0.001* | *0.009* | *0.694* | *0.006* | *<0.001* | *<0.001* | *0.015* |
| ***LSD*** | *0.63* | *0.37* | *ns* | *0.78* | *3.51* | *17.19* | *0.63* |

**(after correction adjustments with REML analysis)*

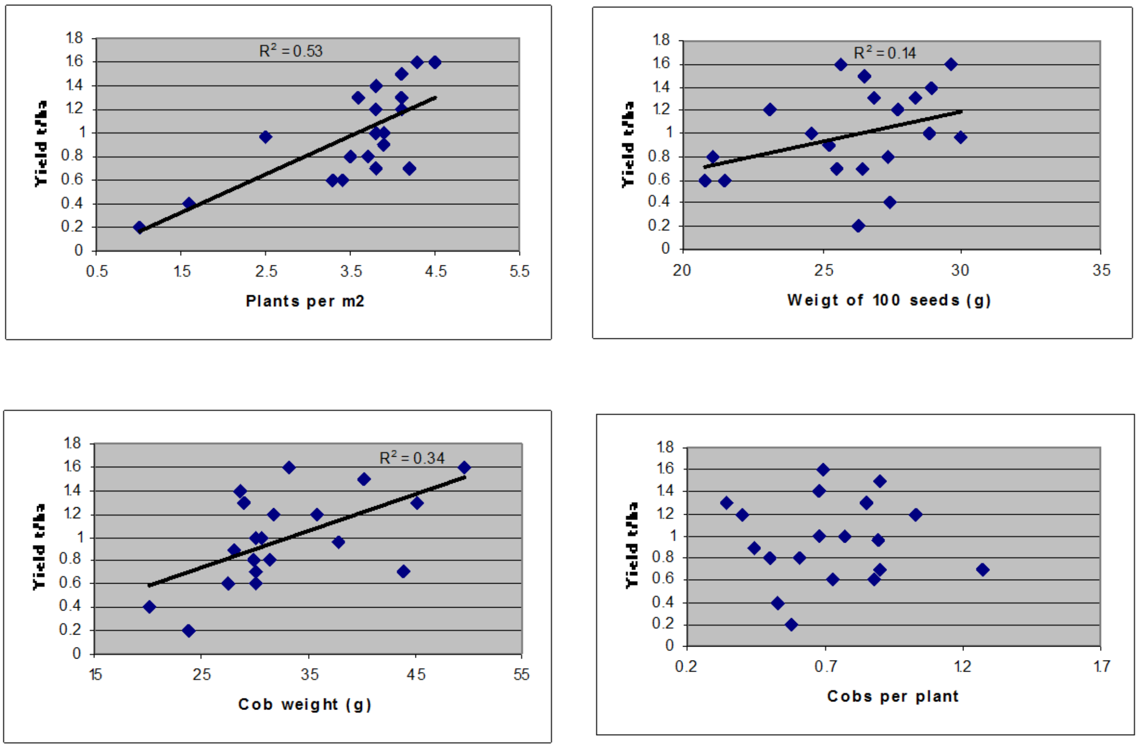



**Figure 4. Maize yield component graphs, Betano**

The yield component graphs from Betano data show different results to those observed at Fatumaka. At Betano, it was plant density which was the most strongly correlating factor to the yield ($R^2$ 0.53), followed by cob weight with a less strong correlation ($R^2$ 0.34). Cobs per plant data showed no correlation to the yield at all.

Yields at Betano were significantly different amongst the varieties tested with an average yield of 1.0 t/ha, lower than the Fatumaka trial average. The highest yielding populations included the Zimbabwe variety Harare 06 (1.6 t/ha), the released variety Suwan 5 (M02) also yielding 1.6t/ha, and Nai (M51) yielding 1.5t/ha.

As in the 2006/2007 trials, few varieties had more than one cob per plant. The only two varieties with greater than one cob per plant were Harare 05 and AMCAP (M50). Cob weights were not significantly different from each other with an average cob weight of 34.3g.

Cob height and plant height were both significantly different amongst the varieties tested. The average plant height at the site was 145.5cm.

### Aileu

Data measurements from Aileu research station showed differences of in-row and column impacts within the replications. The differences between row conditions at the site affected data measurements for seed weight and plant height, while the different column conditions affected the data for cobs per plant. Therefore the analysis of the Aileu maize data was done using a REML regular grid spatial model (AR1) as at the other sites to adjust for these errors. The REML adjusted data is displayed in Table 6 below.

**Table 6. Yield and yield components of maize trial, Aileu, 2007/08***

| *Population* | *Plants/m²* | *Cobs/ Plant* | *Cob weight (g)* | *Seed weight (g/100)* | *Yield (t/ha)* | *Plant height (cm)* |
|---|---|---|---|---|---|---|
| HAR 05 | 4.2 | 0.6 | 37.6 | 24 | 1.6 | 168.1 |
| HAR 06 | 4.2 | 0.7 | 37.6 | 29 | 1.4 | 190.0 |
| HAR 12 | 4.6 | 0.7 | 48.8 | 25 | 1.8 | 192.9 |
| **M 02 (Suwan 5)** | **3.9** | **0.7** | **30.3** | **24** | **1.5** | **179.4** |
| **M 03 (Sele)** | **4.4** | **0.7** | **37.0** | **26** | **1.8** | **184.9** |
| M 24 (Arjuna) | 3.6 | 0.6 | 69.9 | 27 | 1.2 | 172.9 |
| M 39 (Kalinga) | - | - | - | - | - | - |
| *M 44* | *4.2* | *0.7* | *43.9* | *28* | *1.2* | *237.7* |
| *M 45* | *3.7* | *0.7* | *61.1* | *29* | *1.9* | *186.8* |
| *M 47* | *3.9* | *0.5* | *52.9* | *27* | *0.7* | *158.3* |
| *M 48* | *2.8* | *0.5* | *62.8* | *33* | *1.2* | *219.0* |
| M 50 | 4.9 | 0.7 | 39.6 | 26 | 1.9 | 194.4 |
| M 51 | 4.8 | 0.7 | 37.6 | 25 | 1.5 | 198.0 |
| P 01 | 3.9 | 0.7 | 43.8 | 28 | 1.7 | 166.1 |
| P 03 | 4.2 | 0.8 | 39.9 | 27 | 1.8 | 192.6 |
| P 07 | 4.2 | 0.7 | 48.9 | 31 | 1.6 | 189.3 |
| P 08 | 3.8 | 0.6 | 39.7 | 24 | 1.3 | 187.2 |
| P 09 | 4.3 | 0.6 | 57.3 | 25 | 1.5 | 189.5 |
| P 10 | 4.3 | 0.8 | 43.1 | 26 | 1.7 | 149.9 |
| P 11 | 4.8 | 0.7 | 38.9 | 23 | 1.2 | 162.9 |
| P 12 | 2.5 | 0.6 | 45.6 | 27 | 1.1 | 162.6 |
| *Chi-sq prob* | *0.059* | *0.243* | *<0.001* | *0.002* | *0.028* | *<0.001* |
| *LSD* | *1.06* | *ns* | *13.57* | *3.70* | *0.66* | *27.21* |

**(after correction adjustments with REML analysis)*

The yield component graphs for the Aileu maize data demonstrate that the number of cobs per plant had the strongest correlation to yield ($R^2$ 0.50) whereas other components did not show a strong correlation (Figure 5).

The Aileu research site had an average yield of 1.5t/ha, significantly lower than in the 2006-2007 replicated trials (3.5 t/ha). Plants/$m^2$ and cobs/plant showed no significant differences between varieties after adjustment with the REML analysis, however varieties tested had significantly different cob weights and yields. Plant height and cob weight were highly significant.

The highest yielding varieties of 1.8-1.9t/ha included local variety M45 (Local Fatolulik) which also yielded higher than average at Baucau and Betano, M03 (Sele), P03 (USM Var 10) and M50 (AMCAP). The high yield of the Local Fatululik (M45) variety is attributed to its large cob size, with a weight of 70g (24g above the average cob weight at Aileu). The other local variety Kakatua (M47) was the lowest yielding variety in the Aileu trial with a yield of 0.7t/ha. The average yield of the Philippine varieties was 1.5t/ha.

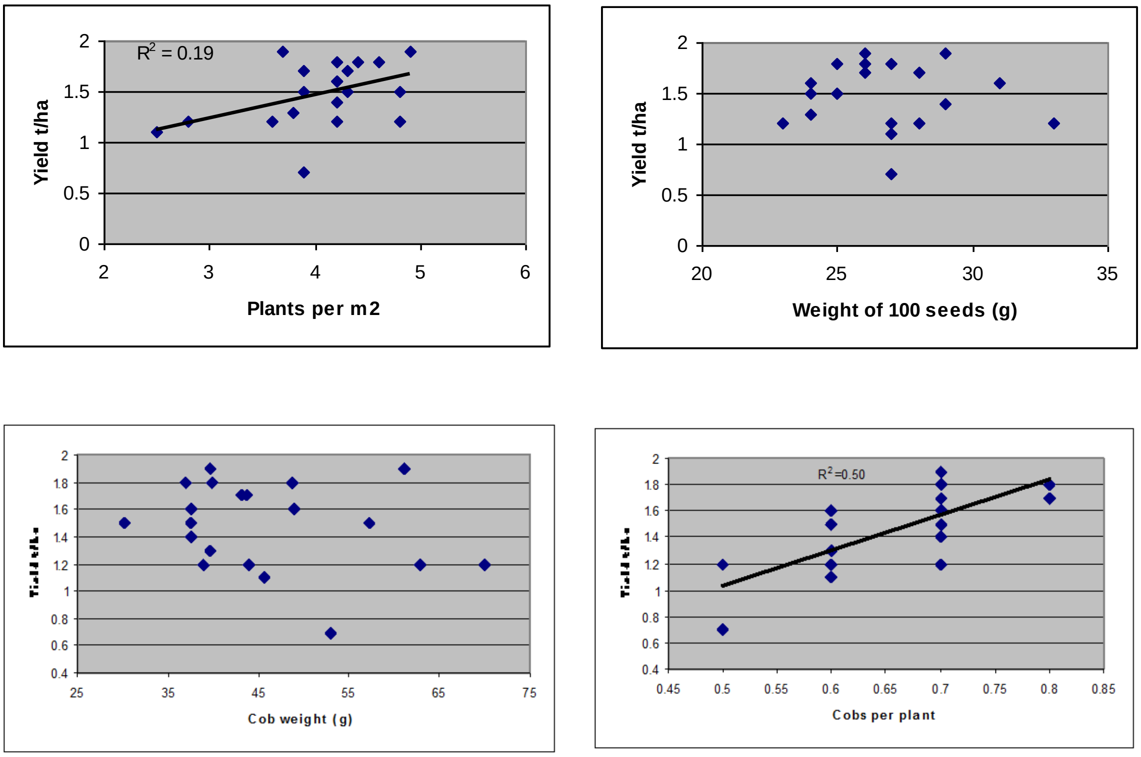



**Figure 5. Maize yield component graphs, Aileu**

### Maliana

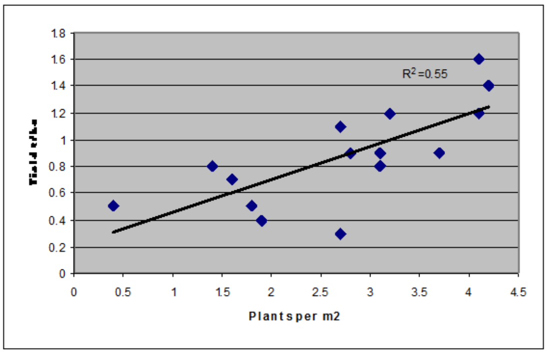
Maize data from the Corluli research site in Maliana indicated that there were significant variations between rows at the site. The yield data was impacted by the variation within rows, and the data for plants per m$^2$ was also affected by the variation within columns. As at the other research stations, REML analysis was used to correct and adjust these errors. Maize yields at the trial site in Maliana averaged 1.0 t/ha (Table 7). Not all yield component data were recorded, however available data is graphed in Figure 6 below. A strong correlation between plants per m$^2$ and yield was observed ($R^2$ 0.55). Average seed weight had no correlation to yield.

The data analysis showed that plant stands were significantly different amongst varieties tested, with Kalinga (M39) having a very poor plant density of 0.4 plants/m$^2$. The three varieties Suwan 5 (M02), Sele (M03) and Har 12 had plant stands of over 4 plants/m$^2$ and also all had yields above the average yield. The local variety Kakatua (M47) also had above average yields at Maliana (1.4t/ha), however at this site, Fatulurik (M45) did not perform as at other research stations yielding only 0.8t/ha.

| Population | Plants/m$^2$ | Yield (t/ha) | Seed weight (g/100) | Cob height (cm) | Plant height (cm) |
|---|---|---|---|---|---|
| HAR 05 | 3.7 | 1.4 | 186.6 | 88.0 | 168.9 |
| HAR 06 | 3.0 | 1.5 | 241.8 | 84.9 | 166.6 |
| HAR 12 | 4.3 | 1.2 | 192.7 | 88.5 | 191.6 |
| M 02 (Suwan 5) | 4.1 | 1.6 | 249.0 | 83.1 | 163.8 |
| M 03 (Sele) | 4.5 | 1.5 | 268.6 | 87.1 | 143.7 |
| M 24 (Arjuna) | - | - | - | - | - |
| M 39 (Kalinga) | 0.4 | 0.5 | 111.6 | 36.9 | 80.2 |
| *M 44* | *1.9* | *0.4* | *302.6* | *90.1* | *177.9* |
| *M 45* | *1.4* | *0.8* | *249.6* | *87.8* | *188.7* |
| *M 47* | *4.2* | *1.4* | *216.0* | *76.6* | *153.0* |
| *M 48* | *1.8* | *0.5* | *162.7* | *82.1* | *163.5* |
| M 50 | 4.1 | 1.2 | 221.9 | 86.7 | 189.7 |
| M 51 | 4.1 | 1.6 | 284.8 | 62.1 | 128.3 |
| P 01 | 2.7 | 0.3 | 294.7 | 80.7 | 168.5 |
| P 03 | 3.1 | 0.9 | 312.7 | 84.2 | 170.6 |
| P 07 | 3.1 | 0.8 | 292.0 | 96.8 | 183.7 |
| P 08 | 3.7 | 0.9 | 221.7 | 92.5 | 176.2 |
| P 09 | 2.7 | 1.1 | 259.1 | 90.0 | 178.2 |
| P 10 | 2.8 | 0.9 | 186.1 | 64.9 | 127.9 |
| P 11 | 3.2 | 1.2 | 229.1 | 80.6 | 154.0 |
| P 12 | 1.6 | 0.7 | 186.9 | 60.5 | 127.1 |
| *Chi-sq prob* | *<0.001* | *<0.001* | *0.372* | *0.003* | *0.006* |
| ***LSD*** | *0.71* | *0.50* | *ns* | *21.53* | *43.38* |

**Table 7. Yield and yield components of maize populations, Maliana 2007/08***

**(after correction adjustments with REML analysis)*



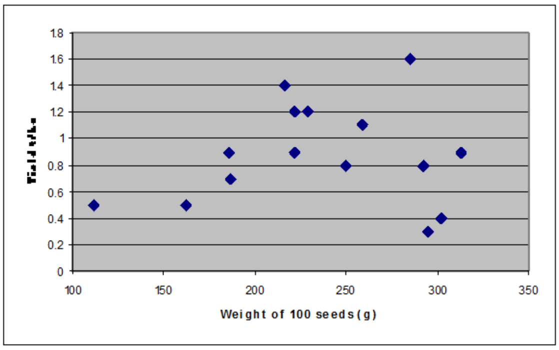




**Figure 6. Maize yield component graphs, Maliana**

Cob height and plant height were measured at Maliana, and significant differences were noted between varieties. The average plant height at the site was 160cm, with Har12 the tallest variety recorded (191.6cm). Har12 was measured to be statistically similar in height to Suwan 5 (163.8cm); however Sele was significantly shorter than these two varieties (143.7cm). The average height of the Philippine varieties was 160.8cm. The Indonesian variety Kalinga was significantly shorter than all other varieties, which is likely due to its poor performance at the site.

Height of the cobs was also found to be significantly different among the varieties tested. The average cob height was 80.2cm, with Sele, Suwan 5 and Har12 statistically similar in height.

**Yield means of wet season trials in 2007 -2008**

To evaluate the populations across the four wet season trial locations, the mean yields at each site were compared and average yield advantages over local varieties (see Table 8 below). The five maize varieties with the highest average yield advantage over local varieties were:

1. Suwan 5 (M02) with 53.4% yield advantage;
2. Har06 with 52.8%;
3. Nai (M51) with 50.4%;
4. Sele (M03) with 43.6%; and
5. P03 with 40.9% yield above local varieties.

It is also worth noting that one of the local varieties Fatulurik from Manatuto (M45) also performed well, with 35.1% greater yields than the average of the local varieties tested.

**Table 8. Mean maize grain yields and yield advantages at 4 sites, 2007/08**

| *Population* | *Yields (t/ha), wet-Season 2007/2008* | | | | | *Yield advantage above local (%)* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *Aileu* | *Maliana* | *Betano* | *Baucau* | *Mean* | *Aileu* | *Maliana* | *Betano* | *Baucau* | *Mean yield advantage %* |
| HAR 05 | 1.6 | 1.4 | 1.2 | 0.6 | 1.2 | 28.0 | 79.4 | 54.6 | -57.9 | 26.0 |
| HAR 06 | 1.4 | 1.5 | 1.6 | 1.4 | 1.5 | 12.0 | 92.2 | 108.8 | -1.8 | 52.8 |
| HAR 12 | 1.8 | 1.2 | 0.6 | 1.6 | 1.3 | 44.0 | 53.8 | -19.4 | 12.3 | 22.7 |
| M 02 (Suwan 5) | 1.5 | 1.6 | 1.6 | 1.2 | 1.5 | 20.0 | 103.3 | 106.2 | -15.8 | 53.4 |
| M 03 (Sele) | 1.8 | 1.5 | 0.7 | 2.0 | 1.5 | 44.0 | 92.4 | -2.2 | 40.4 | 43.6 |
| M 24 (Arjuna) | 1.2 | - | 1.0 | 0.3 | 0.8 | -4.0 | - | 33.5 | -78.9 | -16.5 |
| M 39 (Kalinga) | - | 0.5 | - | - | - | - | -35.9 | - | - | - |
| *M 44* | *1.2* | *0.4* | *0.4* | *1.7* | *0.9* | *-4.0* | *-50.8* | *-44.5* | *19.3* | *-20.0* |
| *M 45* | *1.9* | *0.8* | *1.3* | *1.7* | *1.4* | *52.0* | *4.1* | *65.2* | *19.3* | *35.1* |
| *M 47* | *0.7* | *1.4* | *0.6* | *1.2* | *1.0* | *-44.0* | *79.4* | *-20.7* | *-15.8* | *-0.3* |
| *M 48* | *1.2* | *0.5* | - | *1.1* | *0.9* | *-4.0* | *-32.7* | - | *-22.8* | *-19.8* |
| M 50 | 1.9 | 1.2 | 0.7 | 1.7 | 1.4 | 52.0 | 53.8 | -10.1 | 19.3 | 28.7 |
| M 51 | 1.5 | 1.6 | 1.5 | 1.1 | 1.4 | 20.0 | 101.0 | 103.5 | -22.8 | 50.4 |
| P 01 | 1.7 | 0.3 | 0.8 | 1.6 | 1.1 | 36.0 | -61.6 | 3.1 | 12.3 | -2.5 |
| P 03 | 1.8 | 0.9 | 1.4 | 1.7 | 1.5 | 44.0 | 15.3 | 85.0 | 19.3 | 40.9 |
| P 07 | 1.6 | 0.8 | 1.2 | 1.4 | 1.3 | 28.0 | 2.5 | 63.9 | -1.8 | 23.2 |
| P 08 | 1.3 | 0.9 | 0.9 | 1.1 | 1.1 | 4.0 | 15.3 | 20.3 | -22.8 | 4.2 |
| P 09 | 1.5 | 1.1 | 1.0 | 1.8 | 1.4 | 20.0 | 41.0 | 36.1 | 26.3 | 30.9 |
| P 10 | 1.7 | 0.9 | 0.8 | 1.7 | 1.3 | 36.0 | 15.6 | 9.7 | 19.3 | 20.1 |
| P 11 | 1.2 | 1.2 | 1.3 | 1.4 | 1.3 | -4.0 | 58.4 | 74.4 | -1.8 | 31.8 |
| P 12 | 1.1 | 0.7 | 0.2 | 0.9 | 0.7 | -12.0 | -10.3 | -76.2 | -36.8 | -33.8 |
| *Mean site yield/advantage* | *1.5* | *1.0* | *1.0* | *1.4* | *1.2* | *18.4* | *30.8* | *31.1* | *-4.6* | |

# BiPlot analysis

### Methodology

In order to assess the consistency of maize variety performance over the past two years, and to assess the consistency of the research station environments, a BiPlot analysis was performed using the program GGE BiPlot. Mean yield data from each year/site (each tester) was collated into an Excel graph and then the Principal Component Analysis (PCA) performed by GGEBiPlot.

The program presents results from a PCA in a scatter plot which displays the first 2 principal components of varieties and location/year combinations. The output BiPlot is then used to seek trends in the testers and entries by their proximity on the graph.

**Results**

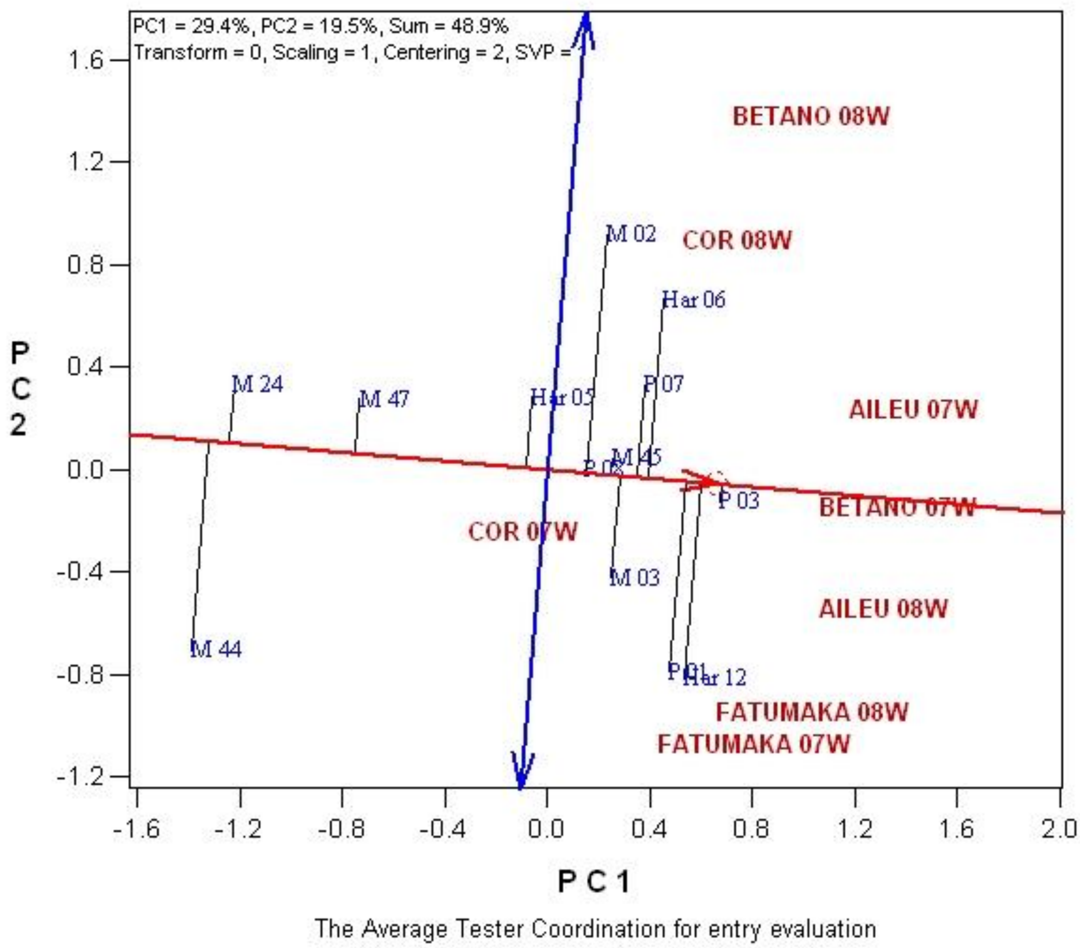



**Figure 7. BiPlot of all replicated maize variety trials, 2007-2008.**

Figure 7 is a BiPlot showing the values of Principal Component 1 (PC1) and Principal Component 2 (PC2) of the environments (location/year) and common varieties, from replicated maize trial data conducted over 2007-2008. The biplot only accounts for 48.9% of the variation in the data related to genotype and environment; however some trends are indicated in the plot.

The biplot shows there is consistent variety performance in Fatumaka across the 2 years (07 and 08). This consistency is shown by the fact that the locations for both years are placed close to each other in Figure 7. Variety performance at Aileu is also fairly consistent, shown by the close proximity of one year to the other. This is encouraging that the screening of varieties over 2 years at these 2 locations is giving generally consistent results.

The Corluli data from the two different years are negatively correlated with each other, the locations being far from each other. This is indicated by the opposite direction of the two testers (environment/year combinations) from each other on the graph, relative to the centre (0,0 point). This may be due to the inconsistency of rainfall across the two years at this research station. 2007 was a very dry year and average yields were only 0.8 t/ha.  Yield at this year was affected by plants per cob, with many varieties having a low yield due to a high percentage of barren plants.

The biplot shows that the variety P03 is the best performing variety if selecting a variety that performs best at all locations. It has very consistent results, as shown by its close proximity to the mean red line. Har12 is the next best performing variety; however it has a large amount of variation in its performance across environments (shown by the length of the black line from the mean line).

The released varieties Suwan 5 (coded as M02) and Sele (coded as M03) are also shown to be above average in performance at all research stations over the two years, with Suwan 5 showing a large amount of variation in its performance. Sele is more consistent in yield.

## 2.1.2 Maize On-farm Demonstration Trials 2007-2008

A total of 259 On Farm Demonstration Trials (OFDTs) were established in 17 Sub Districts of Timor Leste to see how elite populations identified on research stations compared with local varieties when cultivated in farmer's fields using local agronomy practices.

Varieties tested in the 2007-2008 wet season included a) Sele (M03), the yellow open pollinated maize variety originally from India and released by the MAF in 2007, and b) Harare 12, which is a white open pollinated maize variety from CIMMYT, Zimbabwe which showed potential in research station replicated trials. The two test maize varieties had produced yields above local maize populations in trials on research stations at four locations in earlier years. Research station trials were fertilized whereas the OFTD were conducted on farmers' fields with no extra inputs or change in agronomy.

### *Materials and methods*

OFDTs were established by SoL in 17 Sub-Districts in the Districts of Aileu, Ainaro, Baucau, Liquica, Manatuto and Manufahi. One or two RAs worked in each Sub-District and their target was to establish 15 maize OFDTs within each Sub-District. The target number of OFDTs was reduced from 20 the previous year, to enable the RAs to achieve a higher level of accuracy of data collection from a smaller number of sites.

Farmers were chosen on the recommendation of MAF Crops and Research staff, following consultations with the Chefe de Suco in each suco where OFDTs were carried out, through the Research and Demonstration Units (RDU) and with the local networks of the RAs. Farmers were introduced to the objectives and methods of the program by the field based research staff. The staff explained that the program will not be giving away seed or fertilizer, but aims only to trial the new varieties. The RAs were careful to explain that they were not sure how these varieties would perform, which is why they were only providing small amounts of seed to farmers in order to carry out the trials.

The RAs gave 200g seed packets of Sele and Har12 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 RAs so that each variety was planted in a 5m x 5m 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 RAs 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 RA was responsible, but for the majority of sites it was realized.

After planting, RAs re-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 ($25m^2$). 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 was converted to tons per hectare.

### Site characterization

All sites were located (latitude, longitude and elevation) with a Garmin ETrex. The ETrex is a 12 channel GPS receiver, which allows accuracy of measurement of plus or minus 6m. In addition, the slope of the land was defined at each site as was the aspect 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 lowland of the north coast to 6 in for the lowlands of the south coast (Table 9).

**Table 9. Definition of the 6 agro-ecological zones in East Timor (ARPAPET, 1996).**

| *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 2007/08 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. Sieving removes 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 colour with a standard colour sheet.

Soil texture (Table 10) was estimated using a field based ribbon test method. Prior to testing, a handful of surface soil (below 10cm) 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 10. Determining soil texture characteristics.**

| *Texture* | *Description A* | *Length of soil ribbon B* |
|---|---|---|
| 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 were entered into an MS Excel spreadsheet database before being transferred to GenStat. Data entry occurred twice throughout the growing season, once just after the OFDTs were established and once at the end of the season when all of the harvest data was complete. Yield data were analyzed by ANOVA (Unbalanced Model) in a range of methods. Firstly, main effects and interactions between variety and District, Sub-District, AEZ were tested.

Further to this main analysis, the influence of a wide range of factors on maize yield was tested using an unbalanced ANOVA design. 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*

### Testing environments

Maize OFDTs were conducted on a wide range of soil textures, pH, slope and elevation. Elevation of OFDT sites ranged from almost sea level to over 1,748m in Maubisse. Compared to previous years, in 2007-2008 there were a greater proportion of sites at higher elevations. This is because of the addition of the high elevation Sub Districts of Maubisse and Turiscai. All maize sites in Maubisse Sub District were planted at an elevation of more than 1300m. Thirty percent of the sites were planted above 950m, compared to 17 percent in the previous year (Table 11).

**Table 11. Distribution of maize OFDT sites by elevation, 2007/08.**

| Elevation (masl) | Locations 2006/07 (%) | Locations 2007/08 (%) |
|---|---|---|
| 0-150 | 20 | 16 |
| 150-350 | 13 | 7 |
| 350-550 | 20 | 20 |
| 550-750 | 15 | 14 |
| 750-950 | 14 | 13 |
| 950-1150 | 9 | 14 |
| 1150-1350 | 6 | 8 |
| 1350-1550 | 2 | 5 |
| >1550 | 0 | 3 |

### Soil pH, elevation and texture

The average soil pH across the OFDT test sites was 6.9, ranging from 4.0 to 9.0. Approximately 14% of sites can be defined as acid soils (pH 5. 5 or less) and approximately 29% of the sites described as alkaline soils (ph 8.0 or above). The remainder of the sites had soil pH values between 6.0 to 7.5 inclusive (Table 12).

**Table 12. Distribution of soil pH across maize OFDT sites 2007/2008.**

| *Soil pH* | *% locations* |
|---|---|
| 4 | 0.5 |
| 4.5 | 2.1 |
| 5 | 2.7 |
| 5.5 | 8.5 |
| 6 | 10.8 |
| 6.5 | 13.3 |
| 7 | 23.7 |
| 7.5 | 9.4 |
| 8 | 14.7 |
| 8.5 | 11.8 |
| 9 | 2.7 |

Soil pH differed statistically (LSD 0.46) between District and Sub-District, as in 2006-07 (Table 13).

**Table 13. Soil pH and elevation of maize OFDT locations, 2006, 2007 and 2007/08**

| *District* | *Sub-District* | *#locations 2006-07* | *#locations 2007-08* | *Elev 2006-07* | *Elev 2007-08* | *Soil pH 2006-07* | *Soil pH 2007-08* |
|---|---|---|---|---|---|---|---|
| Aileu | Aileu | 56 | 11 | 1055 | 1048 | 6.3 | 6.2 |
| Aileu | Liquidoe | 17 | 5 | 1007 | 1169 | 6.5 | 6.3 |
| Aileu | Remexio | 3 | 8 | 1017 | 993 | 5.8 | 6.0 |
| Ainaro | Hatudo | - | 4 | - | 246 | - | 7.6 |
| Ainaro | Maubisse | - | 14 | - | 1523 | - | 7.0 |
| Baucau | Baucau | 52 | 29 | 369 | 483 | 7.5 | 7.6 |
| Baucau | Laga | 21 | 10 | 290 | 394 | 8.1 | 7.8 |
| Baucau | Quilicai | 21 | 14 | 625 | 570 | 7.9 | 7.4 |
| Baucau | Vemasse | 31 | 13 | 511 | 505 | 7.0 | 7.1 |
| Baucau | Venilale | 23 | 19 | 626 | 630 | 6.4 | 7.3 |
| Liquica | Liquica | 20 | 10 | 643 | 471 | 5.9 | 6.9 |
| Liquica | Maubara | 22 | 14 | 261 | 474 | 7.0 | 6.4 |
| Manufahi | Alas | 30 | 7 | 202 | 125 | 8.2 | 7.7 |
| Manufahi | Fatuberliu | - | 3 | - | 42 | - | 7.5 |
| Manufahi | Same | 41 | 4 | 405 | 928 | 7.1 | 6.2 |
| Manufahi | Turiscai | - | 15 | - | 1197 | - | 6.5 |
| Manatuto | Natarbora | - | 11 | - | 142 | - | 7.2 |
| **LSD (P<0.05)** | | | | | | 0.31 | 0.46 |

Just under half (46%) of the variation in Sub-District soil pH measured at the OFDT sites was accounted for by mean elevation of the sites. The regression (Figure 8) suggests that the higher the elevation, the lower the pH. The rate of the decline in pH was approximately 1 unit of pH per 1000m of elevation compared with twice that rate in 2006-2007 (SoL, 2007). This smaller reduction in pH was most likely due to the inclusion of a number of sites in Maubisse. Of all Sub-Districts, Maubisse was the most distant from the regression line. It has the highest elevation of any Sub District, but possesses neutral soil pH (pH 7.0). This soil pH was higher than expected based on elevation. The more neutral pH in Maubisse is probably due to the large number of limestone outcrops in that area, reducing the acidifying effect of high rainfall. Omission of Maubisse from the regression results in mean elevation of each Sub District explains 66% of the variation in soil pH.

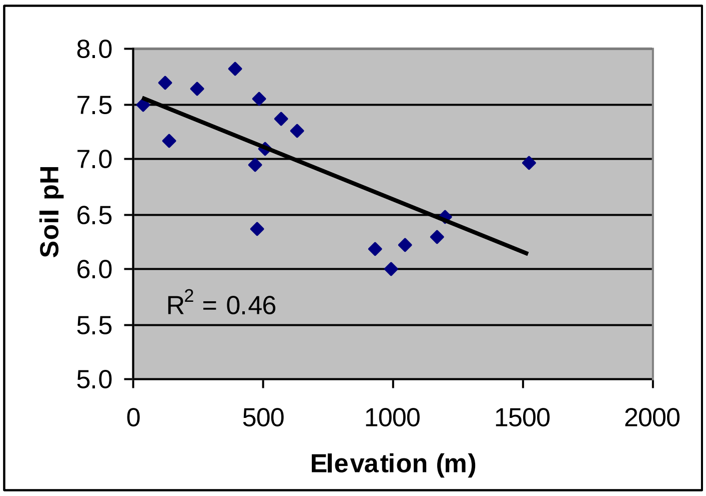



**Figure 8. Effect of elevation on soil pH for maize OFDT sites, 2007/08.**

The majority of test locations (approximately 67%) were clay loams or heavier soils. Sandy soils were rare, accounting for only 6% of the sites (Table 14).

**Table 14. Distribution of soil texture of maize OFDT, 2006/2007 and 2007/2008**

| *Soil texture* | *Location 2006/07 (%)* | *Location 2007/08 (%)* |
|---|---|---|
| Sandy | 6 | 6 |
| Sandy Loam | 10 | 8 |
| Loam | 10 | 20 |
| Clay Loam | 17 | 20 |
| Fine Clay | 29 | 33 |
| Heavy Clay | 29 | 14 |

**Trial losses**

OFDT trial losses (11%) in 2007/2008 were less than the previous two cropping seasons (18% in 2006/2007 and 25% in 2005/2006). This improvement in data quality vindicates the reduction in the number of target trials for each RA from 20 to 15 and relates to the greater experience of the research staff. Table 15 gives a breakdown of the reasons for the trials not being completed. Animal predation on crops was the reason for most crop losses and rats were the most significant single factor.

**Table 15. Maize OFDTs planted and reasons for non-harvest, 2007/08.**

| *Trials* | *Trial number* |
|---|---|
| Total OFDT | 259 |
| Trials harvested | 220 |
| *Trial losses by reason* | |
| Animals (Goats) | 1 |
| Animals (Cows) | 2 |
| Animals (unspecified) | 3 |
| Animals (Monkeys) | 1 |
| No yield (unspecified) | 17 |
| Rats | 5 |
| Mixed at planting | 2 |
| Mixed at harvest | 2 |
| Wind | 2 |
| Farmer lost interest | 1 |
| Grubs ate all | 1 |
| No germination | 1 |
| Road cut | 1 |
| Total losses | 39 |

## Variety

Grain yield of Sele was significantly higher than local maize populations averaged over all Districts (Table 16). Har 12 yielded more than the local but not significantly greater ($p \leq 0.05$). This data is clear evidence that if farmers change from growing their current traditional maize populations to modern varieties such as Sele, there would be a dramatic increase in food production. There was no need for added inputs of fertilizer, pesticides etc to produce such dramatic increases.

The white variety from CIMMYT Zimbabwe, (Har12), did not produce a significantly higher ($p \leq 0.05$) yield overall than the local maize populations despite having significantly heavier cobs. The lack of yield advantage of Har12 over the local could be due to the lower population density of Har12 across all Districts.

**Table 16. Yield components for OFDT maize varieties over all OFDTs, 2007/08**

| *Variety* | *Mean Yield (t/ha)* | *Density (Plants/m$^2$)* | *Cobs/plant* | *Cob weight (g)* | *Seed size (g/100)* |
|---|---|---|---|---|---|
| Local | 1.6 | 4.2 | 0.84 | 44 | 25.7 |
| Har12 | 1.8 | 3.9 | 0.84 | 52 | 25.0 |
| Sele | 2.4 | 4.6 | 0.89 | 61 | 28 |
| ***LSD ($P \leq 0.05$)*** | *0.27* | *0.33* | *ns* | *6.1* | *1.0* |

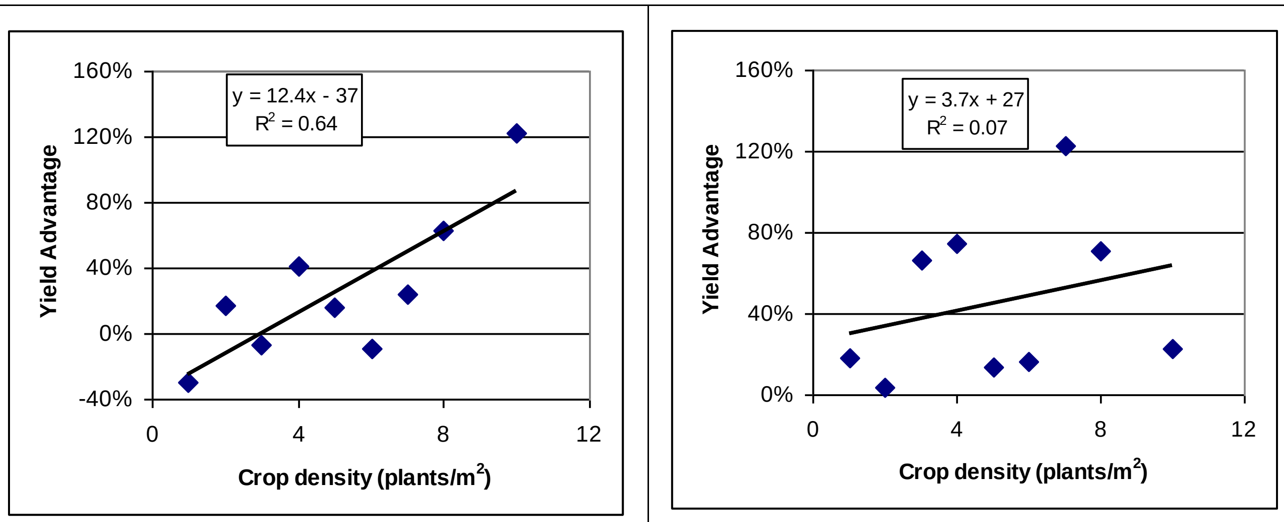
The higher yield of Sele compared with the local populations and Har12 was due to a higher plant density, larger (heavier) cobs and larger seeds. There were no differences between the three populations for the number of cobs per plant (Table 16).

Further analysis was conducted to determine whether the yield advantage of Sele was due to higher overall plant density for that variety. The average yield for each variety was compared with the plant populations in each plot. A comparison was then made between Sele and local maize varieties at the same plant density. For all varieties, yield increased as plant density increased from 1 to 5 plants/m$^2$ (Table 17). Above 6 plants/m$^2$, the yield of the local maize generally declined, whereas the yields of Sele and Har 12 leveled off. In fact the optimum density for Sele was 7 plants/m$^2$.

**Table 17. Effect of crop density on yield for OFDT maize varieties, 2007/08**

| *Plant density (plants /m²)* | *Percent of crops* | *Variety* | | | *Yield advantage above local (%)* | |
|---|---|---|---|---|---|---|
| | | Local | Har12 | Sele | Har12 | Sele |
| 1 | 5 | 0.7 | 0.5 | 0.8 | -30 | 18 |
| 2 | 12 | 1.1 | 1.3 | 1.2 | 17 | 4 |
| 3 | 22 | 1.5 | 1.4 | 2.6 | -7 | 66 |
| 4 | 21 | 1.3 | 1.9 | 2.3 | 41 | 75 |
| 5 | 17 | 2.1 | 2.4 | 2.4 | 16 | 14 |
| 6 | 13 | 2.5 | 2.3 | 2.9 | -9 | 17 |
| 7 | 5 | 1.7 | 2.1 | 3.7 | 24 | 123 |
| 8 | 4 | 1.9 | 3.1 | 3.2 | 63 | 71 |
| 9 | 2 | 0.2 | 1.1 | 3.1 | na | na |
| 10 | 1 | 2.2 | 4.9 | 2.7 | 123 | 23 |

The yield advantage of Sele above the local population was not correlated with plant density, whereas Har12 showed a greater yield advantage at higher plant densities (Figure 9).




a) Har12 | b) Sele

**Figure 9. Effect of plant density on yield advantage Har12 (a) and Sele (b) across OFDTs**

The poor performance of Har12 in farmers' fields is difficult to explain, given its high consistent yield advantage (50%) over local populations on research stations. In the previous year's research station testing, Har12 was tested at a range of plant densities from 2.5 to 4.4 plants/m$^2$. In this data there was no suggestion that the Har12 produced a higher yield advantage at higher plant densities. It would be worth considering Har 12 as a test population next year for on-farm trials to determine the effect of plant density on yield performance, or other factors yet unknown that affect yield.

## Districts

Yields of all varieties trialed in OFDTs were highest in Baucau Sub District and lowest in Liquidoe Sub District (Table 18). There was no significant interaction between variety and Sub-District. This suggests that the higher yield of Sele is consistent across Sub-Districts and there is no reason to recommend different varieties for different Sub-Districts.

**Table 18. Maize OFDT grain yield (t/ha) by Sub-District 2007/08**

| *District* | *Sub District* | *# locations* | *Local* | *Har12* | *Sele* |
|---|---|---|---|---|---|
| Aileu | Aileu | 28 | 0.9 | 1.1 | 1.9 |
| | Liquidoe | 4 | 0.6 | 1.0 | 1.1 |
| | Remexio | 8 | 1.2 | 1.2 | 2.1 |
| Ainaro | Hatudo | 6 | 1.5 | 1.3 | 1.3 |
| | Maubisse | 14 | 1.0 | 0.9 | 2.0 |
| Baucau | Baucau | 28 | 2.2 | 2.2 | 2.9 |
| | Laga | 13 | 1.4 | 1.4 | 1.4 |
| | Quilicai | 14 | 1.7 | 2.0 | 2.4 |
| | Vemasse | 13 | 1.9 | 2.7 | 3.7 |
| Baucau | Venilale | 19 | 1.9 | 1.9 | 2.8 |
| Liquica | Liquica | 15 | 1.1 | 1.5 | 2.0 |
| | Maubara | 14 | 1.2 | 1.2 | 1.9 |
| Manatuto | Natarbora | 11 | 0.9 | 1.5 | 1.8 |
| Manufahi | Alas | 7 | 1.3 | 1.3 | 1.6 |
| | Fatuberliu | 3 | 1.9 | 2.2 | 2.4 |
| | Same | 8 | 1.2 | 0.9 | 1.2 |
| | Turiscai | 15 | 1.1 | 1.1 | 1.9 |
| ***Average*** | | *(Total 220)* | *1.6* | *1.8* | *2.4* |

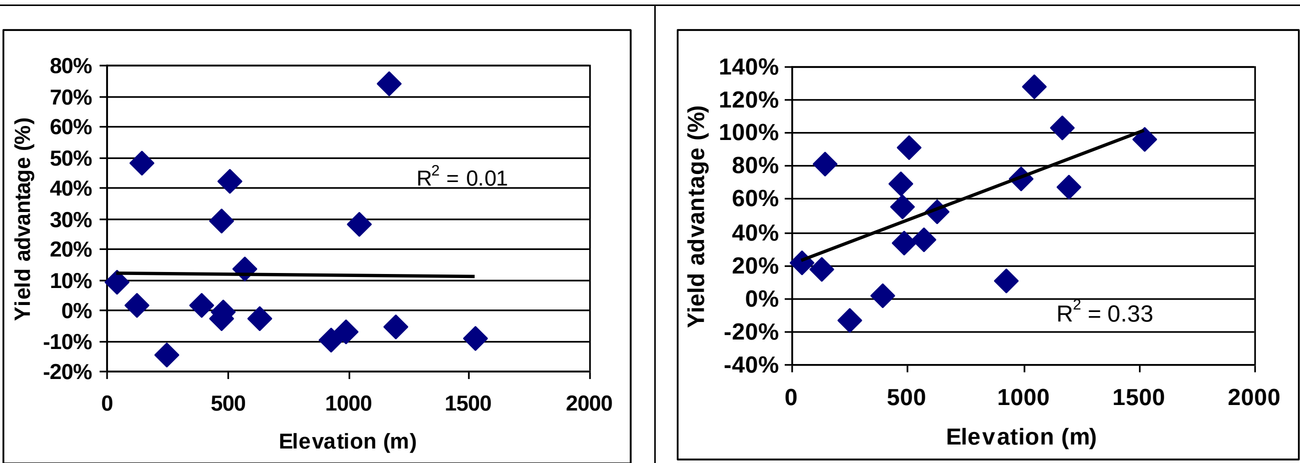
Sele clearly showed a significant yield increase above local maize populations in all Sub Districts tested excluding Hatudo, and yielded the same as the local varieties in Laga and Same Sub Districts (Table 19). This confirms the yield advantage of Sele above the local populations measured in the previous 2 years of on-farm testing. The yield advantage of Sele in 2008 (44%) was slightly higher than that recorded in previous years (2006 40%, 2007 36%). This may be a random fluctuation, or could be a result of the higher quality seed now being produced by the Seeds of Life program.

Har12 had a slightly higher yield than the local populations, but the difference was not significant. Further investigation is required as to why Har12 has performed well on research stations, but not so well on farmers' fields.

**Table 19. Yield advantage of SoL varieties by Sub-District, 2007/08**

| *District* | *Sub District* | *Elevation (m)* | *Locations* | *Har12 (%)* | *Sele (%)* |
|---|---|---|---|---|---|
| Aileu | Aileu | 1048 | 28 | 28 | 128 |
| Aileu | Liquidoe | 1169 | 4 | 74 | 104 |
| Aileu | Remexio | 993 | 8 | -7 | 73 |
| Ainaro | Hatudo | 246 | 6 | -15 | -13 |
| Ainaro | Maubisse | 1523 | 14 | -9 | 97 |
| Baucau | Baucau | 483 | 28 | -1 | 34 |
| Baucau | Laga | 394 | 13 | 2 | 2 |
| Baucau | Quilicai | 569 | 14 | 14 | 35 |
| Baucau | Vemasse | 505 | 13 | 41 | 91 |
| Baucau | Venilale | 630 | 19 | 1 | 52 |
| Liquica | Liquica | 471 | 15 | 27 | 73 |
| Liquica | Maubara | 474 | 14 | -4 | 53 |
| Manatuto | Natarbora | 142 | 11 | 56 | 92 |
| Manufahi | Alas | 125 | 7 | 1 | 18 |
| Manufahi | Fatuberliu | 42 | 3 | 16 | 24 |
| Manufahi | Same | 928 | 8 | -19 | 2 |
| Manufahi | Turiscai | 1197 | 15 | -5 | 68 |
| ***Mean*** | | | | *13* | *50* |

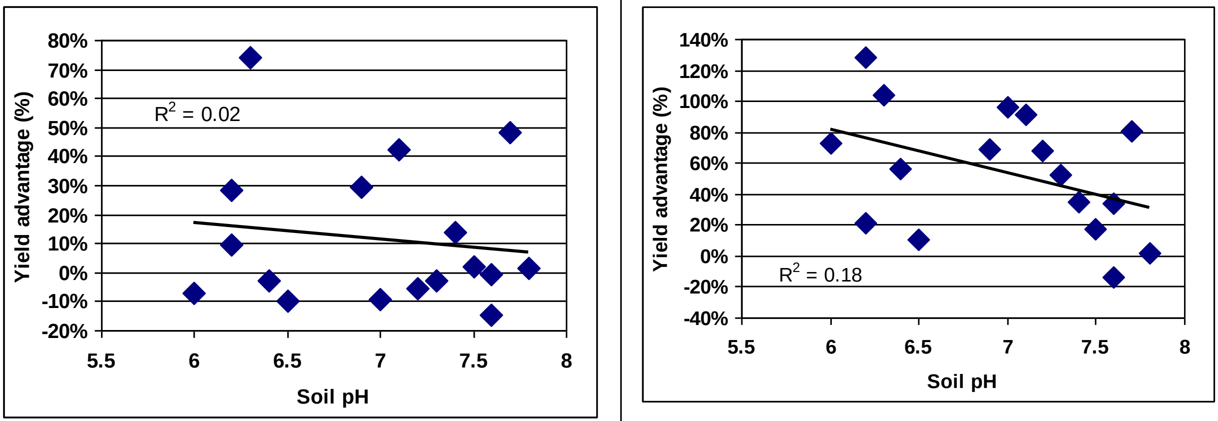
Although Sele had a general yield advantage over the local maize populations across the majority of Sub Districts, the yield advantage of Sele is greater at higher elevations (Figure 10). As the elevation increased from 0 to 1500m, the yield advantage of Sele increases from 20 to 100% above the local maize populations. Har 12, however did not show the same response.




a) Har12 b) Sele

**Figure 10. Influence of elevation on yield of a) Sele and b) Har12 by Sub-District.**

Changes in elevation are often correlated with changes in soil pH (see Figure 8). To test whether the Sele's increased yield advantage at higher altitudes was due to soil pH, the correlation between yield advantage of the new varieties and soil pH was explored. For both Sele and Har 12 there was no significant correlation between soil pH and yield advantage (Figure 11).




a) Har12 b) Sele

**Figure 11. Influence of soil pH on yield advantage of Sele and Har12 by Sub-District.**

**Elevation**

Further analysis was conducted to investigate the interaction between variety and elevation for yield. There was a significant interaction between variety and elevation for grain yield. This is illustrated in Figure 12.

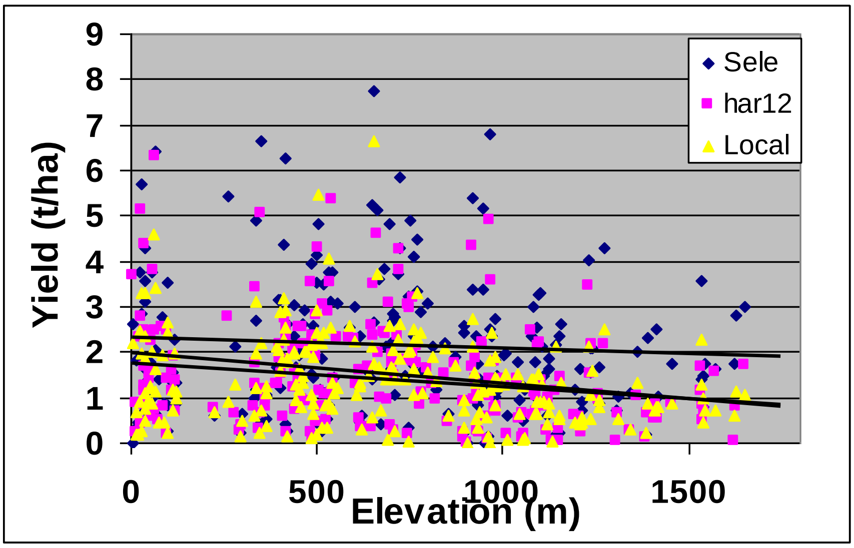



**Figure 12. Effect of elevation on three maize yields, 2007/2008**

As elevation increased from 0 to 1500m the yield of both Har12 and the local maize declined significantly, whereas the yield of Sele reduced only slightly. As maize is a tropical plant, one would expect that higher yield would be achieved at higher temperatures and light levels. In fact farmers at elevations above 1200-1400m have reported that their maize yield are so low, they prefer to grow other crops such as European potatoes and wheat. Sele does resist the trend having a very slight (non-significant) decline in yield with elevation. The consistent high yield of Sele at all elevations was the reason that Sele had a greater yield advantage than the local at high elevations.

Increasing elevation also extended the maturation time for all varieties ( Figure 13) the most noticeable being from 250m elevation to 1500m. Over this range, crop duration from planting to harvest increased from 120 to 140 days. The sharp increase in crop duration above 1300 m elevation shown in the graph suggests that the crops at these high elevations are stressed.

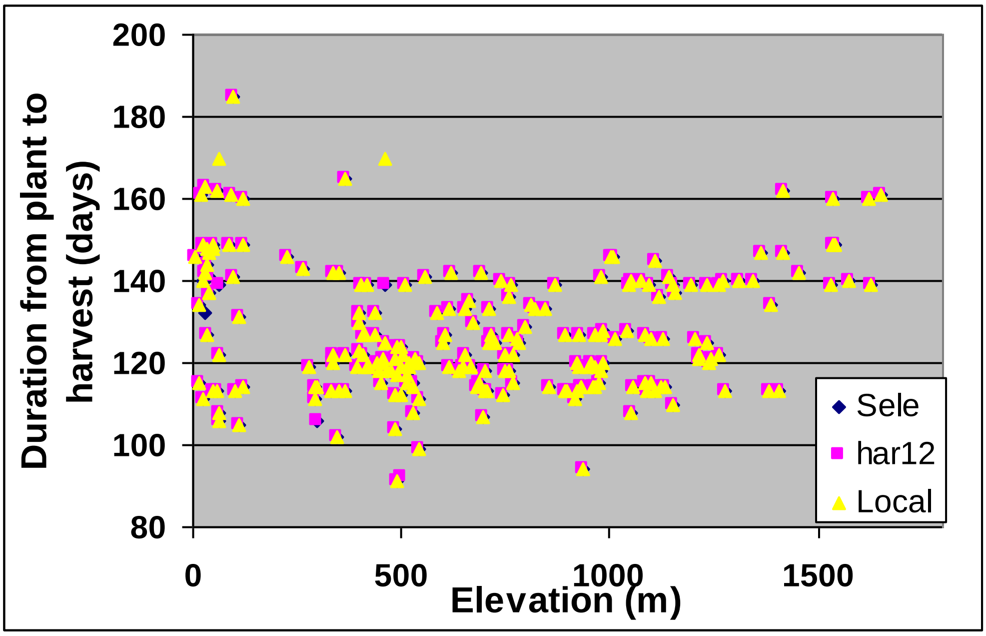



**Figure 13. Effect of elevation on maize crop duration, 2007/2008.**

### Farmer preferences

At the harvest of the OFDT, farmers were asked if they intended to replant any of the test varieties. Table 20 shows that more than 70% of farmers who harvested their OFDTs reported an intention to replant one or more of the varieties. Although Har12 (white seeded) did not yield significantly greater than the local populations, is was equally preferred as the higher yielding Sele variety (yellow seeded). This result indicates that some farmers have a great preference for white maize, and perhaps they also value diversity amongst their maize varieties. Every farmer who achieved a harvest of the OFDT intented to replant at least one of the new varieties.

**Table 20. Farmer preferences for replanting maize varieties after OFDT, 2007/08**

| *Variety* | *Sele (%)* | *Har 12 (%)* | *Local (%)* |
|---|---|---|---|
| Intend to replant | 70 | 85 | 68 |
| Do not intend to replant | 0 | 4 | 2 |
| **No response** | 30 | 11 | 29 |

### Agro Ecological Zones (AEZ) and elevation

Yield results for each variety in each AEZ are shown in Table 21. Yields for Sele were higher in AEZs 1, 2 and 3 (North coast) than in the south coast. There was no statistically significant interaction between variety and AEZ, meaning that yield was affected by AEZ similarly for all varieties.

**Table 21. Maize OFDT mean yield by AEZ, 2007/08**

| *AEZ* | *Number of test locations* | *Local (t/ha)* | *Sele (t/ha)* | *Har12 (t/ha)* | *Average of three (t/ha)* |
|---|---|---|---|---|---|
| 1 Northern coast (0-100m altitude) | 12 | 1.6 | 2.6 | 2.2 | 2.1 |
| 2 Northern slopes (100-500m altitude) | 41 | 1.5 | 2.3 | 1.6 | 1.8 |
| 3 Northern uplands (>500m altitude) | 104 | 1.5 | 2.4 | 1.6 | 1.8 |
| 4 Southern upland (>500m altitude) | 38 | 1.1 | 1.8 | 1.0 | 1.3 |
| 5 Southern slopes (100-500m altitude) | 8 | 1.1 | 1.3 | 1.2 | 1.2 |
| 6 Southern coast (<100m altitude) | 19 | 1.4 | 1.9 | 1.6 | 1.6 |
| *Total* | *220* | | | | |
| *LSD (P<0.05)* | | *Interaction* | *0.72* | | *0.42* |

As with the analysis of elevation and yield advantage of new varieties over local varieties, Sele had a consistent yield advantage above the local across all AEZs (Table 22), confirming the results from the 2006/2007 season (SoL, 2007). Har12 had an erratic yield advantage over the local population that does not seem to be related to elevation.

**Table 22. Yield advantage of SoL improved varieties by AEZ 2007/08**

| *AEZ* | *Yield advantage of Sele (%)* | *Yield advantage of Har12 (%)* |
|---|---|---|
| 1 Northern coast (0-100m altitude) | 40 | 20 |
| 2 Northern slopes (100-500m altitude) | 48 | 4 |
| 3 Northern uplands (>500m altitude) | 62 | 12 |
| 4 Southern upland (>500m altitude) | 66 | -8 |
| 5 Southern slopes (100-500m altitude) | 13 | 8 |
| 6 Southern coast (<100m altitude) | 34 | 16 |

## Agronomic factors affecting yield

Although the overarching purpose of the OFDT system is to test possible candidates for variety release for use on farmers' fields, the process of measuring and comparing yields also provides an opportunity to collect data on agronomic factors and analyze the effect of these factors on yield. This analysis is described in the Materials and methods section above.

A wide range of measured agronomic characters were tested for having an influence on maize yield. The final model included the following factors: variety, AEZ, soil pH, number of seeds per hill and slope of the land. Plant density at harvest and elevation were included as covariates. The final model described above, accounted for 21% of the total variation in grain yield across all plots (Table 23). A range of other factors were also tested for influence on maize yield and were found to be uncorrelated. These included planting in lines or randomly, monoculture or mixed planting, the gender of the farmer, and the reported maize sufficiency of the farming family. As such there seems to be limited gains in promoting activities such as planting in lines, and planting in monoculture/multicropping to increase maize yield on Timor farms.

**Table 23. Significance of management factors affecting maize yield**

| *Factor* | *Significance P<0.05 2007/2008* | *Significance P<0.05 2006/2007* |
|---|---|---|
| Variety | ✓ | ✓ |
| Sub-District | ✓ | ✓ |
| AEZ | ✓ | ✓ |
| Soil pH | ✓ | ✓ |
| Soil colour | ✓ | - |
| Number of staff visits | ✓ | ✓ |
| Plant density at harvest | ✓ | ✓ |
| Elevation | ✓ | - |
| Roofing material (wealth indicator) | ✓ | ✓ |
| Number of weeding times | ns | ✓ |
| Slope of land | ns | ✓ |
| Number of seeds per hill | ns | ✓ |
| Random or line planting | ns | ns |
| Mixed planting or monoculture | ns | ns |
| Gender of the head of the household | ns | ns |
| Rice farmer also | ns | ns |
| Maize result from 2006/07 | ns | ns |
| Soil texture | ns | ns |

## Seeds per hill

The average yield of all varieties was equally affected by the number of seeds planted per hill. This result is different from that of 2006/2007 (Table 23). Although non significant, the data show that there was a reduction in yield in 2007/2008 when 1 or 4 seeds were planted per hill (Table 24). Planting recommendation should remain at 2-3 seeds per hill.

**Table 24. Influence of seeds per hill on OFDT maize yields, 2007/08.**

| *Seeds per hill at planting* | *Average yield of four tested varieties (t/ha)* |
|---|---|
| 1 | 1.1 |
| 2 | 1.8 |
| 3 | 1.6 |
| 4 | 0.8 |
| ***LSD (P<0.05)*** | *0.8* |

## Soil pH

Soil pH significantly reduced maize yield in 2007/2008 as in 2006/2007 (Table 25). The data suggests a lower yield in acid soil (pH <5.5) but no yield reduction in basic soils.

**Table 25. OFDT yield by soil pH for all maize varieties, 2006/07**

| Soil pH | 4.5 | 5.0 | 5.5 | 6.0 | 6.5 | 7.0 | 7.5 | 8.0 | 8.5 | 9.0 |
|---|---|---|---|---|---|---|---|---|---|---|
| % of OFDTs | 2 | 2 | 9 | 11 | 15 | 23 | 8 | 14 | 12 | 2 |
| Mean yield (t/ha) | 1.4 | 1.5 | 1.5 | 1.7 | 1.4 | 1.7 | 1.9 | 1.8 | 1.9 | 2.1 |
| LSD P<0.05= 0.7 | | | | | | | | | | |

## Soil Colour

Sol colour had a significant effect on maize yield across the test sites. In general as the soil became darker in colour, the yield increased (Table 26). It is not surprising therefore that when farmers talk about fertilizing soil; they talk about “making the soil black”.

**Table 26. Effect of soil colour of maize yield 2007/08**

| *Soil colour* | *Yield (t/ha)* |
|---|---|
| Yellow | 0.7 |
| White | 1.3 |
| Red | 1.7 |
| Light brown | 1.5 |
| Dark brown | 1.9 |
| Black | 2.1 |
| ***LSD (P<0.05)*** | *0.5* |

Although many farmers mentioned that black soil gave them a higher yield, some of the OFDT sites were chosen with yellow and white soil colours. White soils include sandy soils at low elevation, and some alluvial soils at higher elevations. The yellow soils are generally associated with poorly drained soils at a range of elevations.

### Soil texture

In general, maize yield increased with heavier soil texture (Table 27). Crops grown on sandy and silty loam soils had significantly lower yields than crops grown on sand and silty loam soils.

**Table 27. Impact of soil texture on maize yield 2007/2008**

| *Soil texture* | *Yield (t/ha)* | *Percent of crops (%)* |
|---|---|---|
| Sandy Loam | 1.0 | 7 |
| Silty loam | 1.1 | 9 |
| Loam (Lempung) | 1.6 | 19 |
| Clay loam | 1.6 | 19 |
| Fine clay | 1.8 | 34 |
| Heavy clay | 1.7 | 13 |
| ***LSD (P<0.001)*** | *0.22* | |

### Staff visits

The number of visits from a researcher to each OFTD farmer ranged from 2 to 17, averaging 6.7 (Table 28). Two percent of the sites were visited 10 or more times. All of these sites were in one Sub-District visited by one staff member. There is a tight correlation ($r^2$=0.86) between the number of visits and maize yield. The regression suggests that yield increased by 0.15 t/ha per staff visit.

**Table 28. Effect of number of staff visits on farm maize yield, 2007/08.**

| *Number of visits* | *Average yield (t/ha)* | *Percent of crops* |
|---|---|---|
| 2 | 0.8 | 1 |
| 3 | 1.0 | 2 |
| 4 | 1.6 | 3 |
| 5 | 1.5 | 16 |
| 6 | 1.7 | 23 |
| 7 | 1.7 | 27 |
| 8 | 1.7 | 18 |
| 9 | 2.1 | 8 |
| >9 | 2.2 | 2 |

**Use of fertilizer**

No farmers included in the maize OFDTs in 2007/08 reported the use of fertilizer, either organic or non-organic.

**Weeds**

Over 90% of farmers involved in the maize OFDTs reported weeds as a problem in their fields. RAs recorded 99 different weed names across all OFDTs.

The weeds representing over 30% of all occurrences are listed below (Table 29). The four most prevalent weeds were Funan mutin (*Chromolaena odorata*), Haeme (*Melinis repens*) Fahi Fulun (*Cyperus brevifolius*) and Manulain (*Imperata cylindrica*). C. odorata was not picked up as a problem weed in 2006/2007 and appears to be a growing problem. The other three weed species were key types seen in 2006/2007 (SoL, 2007).

**Table 29. Weed type in maize OFDT, 2007/08**

| *Weed name (local name)* | *Weed species (Latin)* | *% of Sites* |
|---|---|---|
| Funan mutin | *Chromalaena odorata* | 9.0 |
| Haeme | *Melinis repens* | 8.5 |
| Manulai | *Imperata cylindrica* | 6.3 |
| Fahi fulun | *Cyperus brevifolius* | 8.0 |

**Wealth indicator: housing type**

Housing quality in Timor-Leste is an indicator of household wealth. The type of house defined using the SoL SOSEK team 'Buka Data Los' divides households into 3 categories. The categories are based on the material of the roof, walls and floor. The housing descriptors include 2 types of roof (iron or local material) and 5 types of walls (galvanized iron, local material, half-block, full-block and 3-ply).

Farmers with iron roofed houses (richer households) had a lower maize yield than those with a grass roof (poorer households) (Table 30). This is in contrast to the previous year where farmers with a block house had a significantly higher yield than those with local material houses.

**Table 30. Farm house material relationship to yield, 2007/08.**

| *Roof type* | *Maize yield (t/ha)* | *Percent of crops* |
|---|---|---|
| Grass or palm leaf (local material | 2.2 | 28 |
| Galvanized iron | 1.8 | 72 |
| *LSD (P<0.05)* | *0.25* | |

**Farmer field days at OFDT sites**

Field days were held at OFDT sites during the year and farmers were interviewed regarding the maize varieties under evaluation. They were asked to provide information on what characteristics were found in the local and test varieties that would encourage them to re-plant. Farmers preferred to grow each of the test varieties for different reasons (Table 31). From all the OFDT, more than 170 farmers gave reasons why they would chose to re-plant each variety another year. Those who wanted to grow Sele a second time preferred it because of the high yield (large cobs), taste and wind tolerance. Of the positive comments about Har12, it was preferred because of its good taste, high yield and white colour. This is consistent in other surveys etc, that white maize is generally preferred above yellow maize. Local maize was preferred because it was the maize variety that they knew best.

**Table 31. Reasons farmers (%) gave for planting test maize varieties, 2007-2008.**

| *Characteristic* | *Sele* | *Har12* | *Local* |
|---|---|---|---|
| High yield/Large cobs | 59% | 26% | 2% |
| Tastes well | 19% | 31% | 13% |
| Colour | 1% | 19% | 1% |
| Wind tolerant | 10% | 6% | 2% |
| Short plants | 7% | 8% | 0% |
| Weevil tolerant | 0% | 0% | 6% |
| Local | 0% | 0% | 61% |
| Cobs can be tied together | 0% | 1% | 5% |
| *Total respondents* | *176* | *175* | *183* |

Only a small number of respondents ascribed negative attributes to the three maize populations under test (Table 32). There were more negative comments (tall and low yield) for the local maize than for the other 2 populations.

**Table 32. Reasons farmers (number) gave for not planting test maize varieties.**

| *Characteristic* | *Sele* | *Har12* | *Local* |
|---|---|---|---|
| Small cobs | 0 | 2 | 0 |
| Plants too tall | 0 | 0 | 6 |
| Long time to flower | 0 | 0 | 1 |
| Long time to dry down | 1 | 0 | 0 |
| Poor yield | 1 | 0 | 1 |
| Total respondents | 2 | 2 | 8 |

## Conclusions

On going on-farm testing of new maize varieties has again indicated the suitability of the new maize variety Sele in increasing yield on-farm without alteration of the farming technology (i.e. without additional inputs). This testing has shown that the wide adaptation to all elevations and the yield increase of Sele is well maintained even at high elevations. Farmers like the variety for its high yield and large cobs.

# 2.2 Sweet potato

## 2.2.1 Sweet Potato Replicated trials, 2007 -2008

All sweet potato (*Ipomoea batatas (L.) Lam.*) clones tested by SoL have been introduced from CIP in Indonesia, as part of the previous phase SoL1. A number of these clones have been extensively tested for many years. Stems for planting the trials this year were initially grown on irrigated plots in Aileu.

### *Materials and methods*

Sweet potato variety trials have been conducted for a number of years with varying success. In the 2006-2007 wet season, trials were established at Aileu, Baucau, Maliana and Betano. However the complete set of 12 clones (including two locals) was only planted at Betano and Aileu. The trial at Betano was once again conducted on-station whereas in 2007 it had been planted in a nearby farmer's field because of the build-up of viral diseases affecting previous on-station trials in 2005. In order to minimize this problem, no sweet potato was planted anywhere on the Betano research station during the 18 months preceding this 2008 trial. Trials consisted of 2 or 3 replicates depending on available space. Each plot was 5m by 5m in size. All plots were fertilized with a low rate of 15 kg N/ha and 15 kg P/ha 3-4 weeks after planting. Trials were planted after the start of the wet season, and harvested after the end of the wet season (Table 33). All introduced sweet potato clones produced a harvestable yield much quicker than local sweet potato clones. To adjust for the difference in the length of season, in Aileu, all introduced varieties were harvested on one day (03/07/08), and the local sweet potato clones were harvested almost 2 months later (28/08/08). However, at Betano, the general consensus of research station workers (all local farmers) that by 6 months tuber yields of local varieties should be near their maximum, so all varieties were harvested at this time, even though many of the introduced varieties could have been harvested sooner. At Maliana and Baucau, no local varieties were planted

### *Results*

The average yield achieved at Aileu (20.8t/ha) was again the highest of all locations and very similar to that produced at this higher elevation site in 2007. Yields at the other three sites were much improved on the previous year (Table 33), due largely to more timely planting and higher rainfall during the growing season. The imposition of an 18 month sweet potato-free quarantine period, and the use of healthy planting material obtained from Aileu, helped reduce remarkably the impact of 'small-leaf' disease at Betano in this 2008 trial. It appeared only in a few isolated plants and did not affect unduly the yields of any variety (even the low yielding ones).

**Table 33. Dates of cultivation and mean sweet potato yield by location in 2008.**

| *Location* | *Date of planting* | *Date of harvest* | *Mean yield (t/ha)* |
|---|---|---|---|
| Aileu | 30 November, 2007 | 3 July, 2008[a] | 20.7 |
| Maliana | 18 February, 2008 | 4 June, 2008 | 8.7 |
| Baucau | 11 January, 2008 | 10 May, 2008 | 5.3 |
| Betano | 16 January, 2008 | 4 July, 2008 | 8.7 |

a) This is date of harvest for the introduced clones. Local check varieties were harvested 2 months later.

Unfortunately CIP 8 and 15 were only planted at Aileu and Betano but yielded relatively well at both sites (Table 34). Of the varieties which were planted at all four sites, Hohrae 1, 2 and 3 again proved their superior yield potential. Also, as it did in 2007, CIP 4 again produced very high yields in Aileu. It also performed relatively well in 2008 at the other three locations. And, although it yielded reasonably well at Maliana, Baucau and Betano, CIP 2 again produced a poor yield in Aileu. This suggests it may not be adapted to the cooler, higher elevation of that site. On the other hand, CIP 17 appears to best suited to such cooler growing conditions given its very poor result at both Maliana and Betano. However, this is the first time CIP 17 has been properly tested at these low elevation sites, so further evaluation needs to be made before such conclusions can be drawn.

CIP 5 has again generally produced below average yields at all locations and given that that it also never rated well in taste tests, should be dropped from varietal trials.

**Table 34. Sweet potato yields (t/ha) all locations 2007/08.**

| *Variety* | *Aileu* | *Maliana* | *Baucau* | *Betano* | *Average* |
|---|---|---|---|---|---|
| CIP 08 | 26.0 | * | * | 17.0 | 21.5 |
| CIP 15 | 28.5 | * | * | 11.0 | 19.8 |
| Hohrae 3 | 20.5 | 12.8 | 6.8 | 23.3 | 15.8 |
| Hohrae 1 | 30.1 | 8.3 | 5.8 | 14.2 | 14.6 |
| CIP 04 | 28.4 | 10.4 | 6.9 | 11.4 | 14.3 |
| Hohrae 2 | 23.7 | 9.8 | 5.7 | 8.1 | 11.8 |
| CIP 02 | 6.2 | * | * | 9.5 | 7.9 |
| CIP 17 | 17.9 | * | 2.9 | 0.5 | 7.1 |
| CIP 03 | 9.7 | 9.9 | 3.5 | 2.6 | 6.4 |
| CIP 05 | 15.6 | 0.8 | * | 0.2 | 5.5 |
| *Local mutin* | *25.3* | * | * | *1.9* | |
| *Local mean* | *16.1* | * | * | *1.7* | |
| *LSD (P<0.05)* | *10.3* | *1.8* | *ns* | *ns* | *12.4* |

As in 2007, taste tests on cooked tubers were again conducted at the time of harvest at both Aileu and Betano. A total of 20 respondents were involved at Betano and 34 at Aileu. Overall, 66% of the participating farmers were male and 34% female. The questionnaire used at Betano was expanded to include eating characteristics other than just sweetness. Tubers were rated on texture ('crumbly' generally considered desirable), water content ('watery' generally considered undesirable) as well as overall eating quality. The results in Table 35 indicate that at Betano, Hohrae 1 and 2 were rated as the best varieties to eat. CIP 2 and the local mutin variety also scored well. The least favoured varieties were CIP 4, 5 and CIP 15. This appears largely due to their more watery or mushy, eating quality. CIP 3 scored reasonably well in eating quality (55%) despite it having the lowest sweetness score. It seems that its drier, crumblier texture compensated for a perceived lack of sweetness. In terms of which varieties farmers said they would like to grow in their fields, Hohrae1, CIP 2 and Hohrae 2 were the most preferred. There was some correlation between farmers' preference and varietal sweetness rating as shown in Figure 14. However the correlation between farmer selection and overall eating quality was much stronger ( Figure 15). There was no correlation at all between farmer preferences and yield result from the 2008 Betano harvest. Even with a relatively good yield result (11.4t/ha), no farmer was inclined to plant CIP 4. However up to 10% were ready to try CIP 17, despite its very poor yield performance at Betano. This can only be due to its good eating quality as perceived by those particular farmers.

**Table 35. Farmer field day details for sweet potato harvest at Betano, 2008.**

| *Variety* | *Yield (t/ha)* | *% say 'sweet'* | *% say has 'crumbly' texture* | *% say is 'watery'* | *% say is 'good to eat'* | *% say would plant* |
|---|---|---|---|---|---|---|
| **Hohrae 1** | 14.2 | 90 | 60 | 40 | 95 | 45 |
| CIP 02 | 9.5 | 85 | 85 | 15 | 80 | 40 |
| CIP 03 | 2.6 | 35 | 95 | 5 | 55 | 20 |
| CIP 04 | 11.4 | 65 | 0 | 100 | 0 | 0 |
| CIP 05 | 0.2 | 50 | 10 | 90 | 30 | 0 |
| **Hohrae 2** | 8.1 | 50 | 70 | 30 | 95 | 30 |
| **Hohrae 3** | 23.3 | 70 | 5 | 95 | 60 | 15 |
| CIP 08 | 17.0 | 55 | 15 | 85 | 35 | 5 |
| CIP 15 | 11.0 | 65 | 10 | 90 | 15 | 5 |
| CIP 17 | 0.5 | 80 | 15 | 85 | 40 | 10 |
| L. mutin | 1.9 | 55 | 55 | 45 | 75 | 5 |
| L. mean | 1.7 | 65 | 45 | 55 | 50 | 0 |

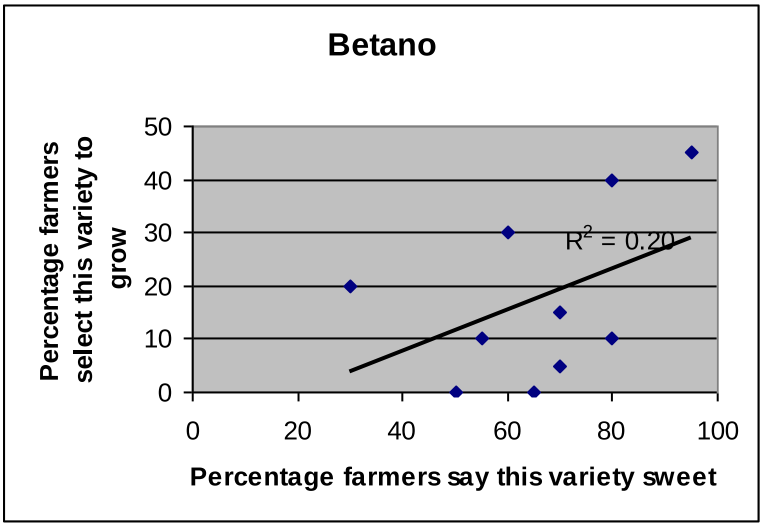



**Figure 14. Correlation between farmers' preference and potato sweetness, Betano.**

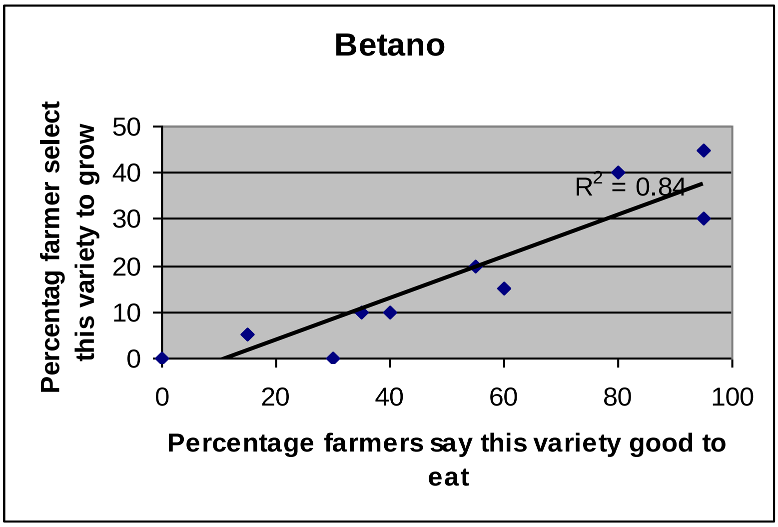



**Figure 15. Correlation between farmers' preference and overall taste, Betano.**

At Aileu, Hohrae 1 was again the sweet potato variety most farmers indicated they would prefer to plant. The data from 2007 and 2008 suggest that this variety is a consistently high yielding and good eating sweet potato. CIP 8 and 15 also rated well. However, as at Betano, CIP 5 was the least preferred variety. In general at Aileu, varieties scoring for sweetness corresponded well with rating of overall eating quality. Future surveys which include the other eating qualities such as texture may provide more detail on just what constitutes good eating quality. The positive correlation between overall eating quality and farmer preference at Aileu in 2008 is presented in Figure 16. In contrast to Betano, there was in fact also some link between yield and farmer's selection of varieties at Aileu, and this is presented Figure 17. There were differences between farmers in Aileu and Betano in terms of which varieties they perceived as sweet and of good eating quality. For example in Aileu, CIP 4 was considered sweet and up to 26% said they would like to grow this variety while at Betano there was not a single positive response. At Betano CIP 2 rated relatively well in terms of taste and 20% wanted to plant but at Aileu very few selected this variety. This may, however, have been influenced by the relatively low yields produced by CIP 2 at Aileu. Also in Aileu in 2008, there was not the clear-cut preference for CIP 17 and CIP 15 (because of their perceived sweetness) that there was in 2007. There will always be a great deal of variation between different individuals, different groups of people and from year to year in perceived eating quality of sweet potato. However the results from the 2008 farmer field days do confirm that perceived eating quality, as variable as it might be, is still of as great (or greater) importance than yield in influencing farmers' decisions on whether to plant new sweet potato varieties or not and such taste tests need to continue to be an integral part of any varietal testing program.

**Table 36. Farmer field day details for sweet potato harvest at Aileu, 2008.**

| *Variety* | *Yield (t/ha)* | *% say' sweet'* | *% say is 'good to eat'* | *% say would plant* |
|---|---|---|---|---|
| **Hohrae 1** | 30.1 | 93 | 90 | 59 |
| CIP 02 | 6.2 | 58 | 57 | 7 |
| CIP 03 | 9.7 | 71 | 67 | 11 |
| CIP 04 | 28.4 | 83 | 79 | 26 |
| CIP 05 | 15.6 | 41 | 42 | 0 |
| **Hohrae 2** | 23.7 | 74 | 57 | 7 |
| **Hohrae 3** | 20.5 | 73 | 63 | 19 |
| CIP 08 | *26.0* | 86 | 89 | 22 |
| CIP 15 | 28.5 | 95 | 91 | 30 |
| CIP 17 | 17.9 | 83 | 61 | 11 |

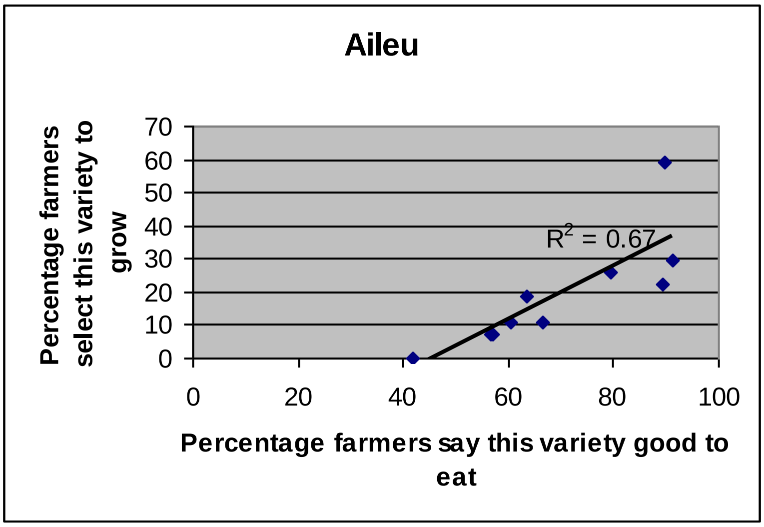



**Figure 16. Correlation between farmers' preference and overall taste, Aileu.**

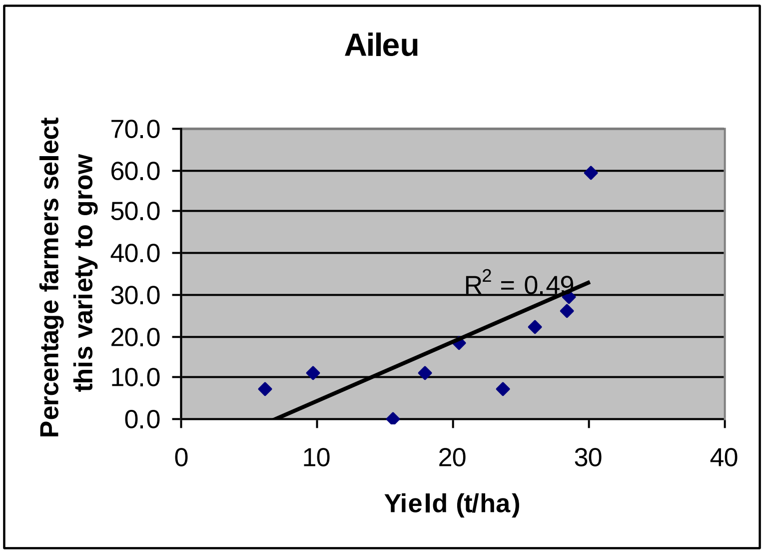



**Figure 17. Correlation between yield and farmer preference at Aileu, 2008**

### *Conclusions*

This seasons testing confirm that the released variety Hohrae 1 is a well-adapted, consistently high yielding sweet potato preferred by a majority of farmers that participate in field days. The other two released varieties, Hohrae 2 and 3, also continue to yield consistently and well. However, farmer preference for these latter varieties appears to be more variable.

Of the remainder of varieties being tested in replicated trials, CIP 8 and CIP 15 yielded well in 2008, but need to be again tested at all sites in the coming 2008/09 season in order to determine their true consistency and adaptability. CIP 4 yielded relatively well at all sites, but was not favourably received by farmers at the field day at Betano, so it to requires further evaluation of its eating quality. CIP 17 appears to have very good eating characteristics, but may not be well adapted to the hotter, coastal areas of Timor Leste. All of these above-mentioned varieties should continue to be tested in replicated on-station trials in 2008/09, but also need to be tested in on-farm demonstration trials, in as many different AEZs as possible to determine more fully their yield performance (and eating quality) across environments.

CIP 5 should not continue to be included in future variety trials. CIP 2 and 3 could also be removed from further trials, if and when, new clones become available for testing.

## 2.2.2 Sweet Potato On-farm Demonstration Trials (OFDTs) 2007-2008

As in 2007, there has been no change in the processes by which sweet potato OFDT are established and they continue to be identical to those described in the maize OFDT section. However the harvest method used in 2007 in an effort to improve the successful collection of analyzable data was further modified in 2008. In 2007, smaller sample areas within each 25m2 were identified by research staff in collaboration with the farmers and farmers agreed not to harvest these smaller areas for their own consumption. However the size of these sample areas varied depending on what size area farmers were willing to 'give up'. Analysis of the yield data then suggested that yield estimates from these sample areas were correlated with the size of the area. Consequently, it was decided to further refine the harvest method and harvest just 5 plants selected at random from each plot. Yield was then estimated by multiplying the average plant production by the number of plants per 25m$^2$ plot. It was hoped that this would provide consistent data with which to compare the relative performance of sweet potato varieties in farmers' fields without imposing too many demands on the participating farmers.

### *Materials and methods*

OFDTs were established in the same way as in 2007. The varieties Hohrae 1, 2 and 3 were again tested against the local in side-by-side, 5m x 5m, plots set out in farmers' fields and managed according to the farmers' usual practices. A new clone CIP 17 which had rated very favourably in farmer taste tests was included in just a few OFDT sites because of a limited supply of cuttings. Observations and data collection was the same as for the previous year and data again entered into MS Excel and then GenStat Discovery Edition 7.2 for ANOVA (Unbalanced Model) analysis.

### *Results and discussion*

A total of 151 sites were identified and measured by SoL staff in co-operation with the participating farmers, however only 147 were actually planted and of these production data from the 5 sample plants was successfully obtained from 115 trials (i.e. 78%). Of these 115 trials, additional total plot harvest data was collected from just 43 (29%). This was a far better result in terms of data collection for analysis than the previous year and appears to justify the harvest method tested. Because of the method used (i.e. average per plant yield times the plot plant density), the estimated yield in t/ha is obviously dependent on the number of plants which are established in each plot. However, analysis of both average yield from single plants, and total plot yields (where successfully harvested), revealed similar trends in yield differences across Sub-Districts and between varieties as the estimated mean yields presented in the tables below.

The major reason for trial loss was damage by animals. In comparison with 2007, there was far less loss due to environmental stress (i.e. drought). In general, 2008 had much better growing conditions than 2007.

**Table 37. Reasons for incomplete sweet potato OFDT 2007/2008**

| *Losses by reason* | *Percent of lost crops (%)* |
|---|---|
| Animals destroyed the trial | 48 |
| Drought or plants died | 21 |
| No tubers | 10 |
| Harvested without the RA | 7 |
| Weeds smothered the site | 7 |
| Flooded or rotted prior to harvest | 7 |

Sweet potato crops were likely to be planted as a mixture with other crops. Of the 147 trials established, 94 (64%) of the OFDT sites were grown as a mixture. This was exactly the same percentage of mixed cropping of sweet potato as was observed in the 2007 trials. As is the practice in East Timor, sweet potato is most usually intercropped with either maize or cassava and as Table 38 shows, the companion crop is generally planted before the sweet potato.

**Table 38. Sweet potato OFDT locations as monocultures or mixed crops**

| *Other crop* | *Total no sites this crop planted* | *No sites planted before* | *No sites planted after* |
|---|---|---|---|
| Maize | 44 | 32 | 12 |
| Cassava | 13 | 8 | 5 |
| Pumpkin | 2 | 1 | 1 |
| Snake bean | 2 | 1 | 1 |
| Talas | 7 | 0 | 0 |
| Pigeon pea | 2 | 1 | 0 |
| Beans | 3 | 3 | 0 |
| Yam | 1 | 0 | 1 |
| Taro | 1 | 1 | 0 |
| Others | 4 | | |

## Yield

As was observed in 2007, sweet potato tuber yield varied significantly between Sub Districts across Timor (Table 39). Once again the lowest yields were observed in Liquica Sub-District (1.1t/ha). The highest yield was found in Faterberliu (12.5t/ha); however this result was from a single site in this Sub-District. Sub-Districts with high mean yields were Alas, Same, Hatudo and Vemasse where average elevations ranged from 50 to 800m. In contrast to 2007, Aileu sub-District had relatively low yields (4.1 t/ha). Turiscai also had quite low yields (2.5t/ha), while the other high altitude Sub-District, Liquidoe, had reasonable yield average (6.2 t/ha). However, in general, the lower altitude AEZs produced higher yields than the higher altitudes. Regression analysis did in fact reveal a very strong negative correlation ($R^2$=-0.87) between elevation and yield. This contradicts the generally held belief that sweet potato grows better at higher altitudes. Also, as shown below, sites from the southern slopes and coast had higher yields than sites on the northern coast. The reasons for these results are not clear. For example, there was no statistically significant correlation between yield and either, pH, slope or topography.

**Table 39. Average sweet potato yields by variety and Sub District for 2007/08.**

| *Sub District* | *Number of sites* | *Hohrae 1 (t/ha)* | *Hohrae 2 (t/ha)* | *Hohrae 3 (t/ha)* | *Local (t/ha)* | *Mean yield (t/ha)* | *Mean elevation of test locations (m)* |
|---|---|---|---|---|---|---|---|
| Aileu | 19 | 5.1 | 3.7 | 4.6 | 2.9 | 4.1 | 1008 |
| Alas | 4 | 8.0 | 10.3 | 14.5 | 6.4 | 9.8 | 70 |
| Baucau | 13 | 6.0 | 5.3 | 5.1 | 2.2 | 4.7 | 470 |
| Faterberliu | 1 | 9.9 | 17.7 | 17.9 | 4.4 | 12.5 | 50 |
| Hatudo | 9 | 9.7 | 9.2 | 9.9 | 4.9 | 8.4 | 295 |
| Laga | 7 | 6.6 | 8.3 | 6.8 | 1.4 | 5.8 | 450 |
| Liquica | 4 | 0.9 | 1.5 | 1.4 | 0.6 | 1.1 | 325 |
| Liquidoe | 4 | 7.0 | 5.6 | 8.6 | 3.4 | 6.2 | 1050 |
| Maubara | 3 | 9.8 | 7.2 | 7.0 | 3.4 | 6.9 | 470 |
| Natabora | 6 | 6.7 | 8.5 | 6.8 | 3.2 | 6.3 | 100 |
| Quilicai | 9 | 4.1 | 3.1 | 4.5 | 4.7 | 4.1 | 490 |
| Remexio | 4 | 6.3 | 7.2 | 8.6 | 1.8 | 6.0 | 990 |
| Same | 6 | 7.4 | 11.7 | 13.3 | 4.8 | 9.3 | 800 |
| Turiscai | 5 | 2.7 | 2.7 | 1.7 | 3.0 | 2.5 | 1200 |
| Vemasse | 7 | 11.3 | 10.9 | 8.4 | 1.5 | 8.0 | 780 |
| Venilale | 8 | 5.2 | 5.9 | 5.8 | 2.3 | 4.8 | 740 |
| ***Average*** | | *6.1* | 6.3 | 6.5 | *3.0* | *5.5* | |

However soil texture apparently had some effect on yields. Soils classified as either sandy loam or silty loam had significantly lower yields than those with higher clay contents (Table 40).

**Table 40. Effect of soil texture on sweet potato yields, 2007/08.**

| *Soil Texture* | *Mean yield (t/ha)* |
|---|---|
| Heavy clay | 6.5 |
| Fine clay | 6.6 |
| Clay loam | 4.7 |
| Loam | 5.5 |
| Sandy loam | 3.8 |
| Silty loam | 3.4 |
| *LSD (P<0.05)* | *1.5* |

Silty soils do appear to be more prevalent on the northern coast (Table 41), but this was not sufficient to explain the differences in yield. Certainly in Liquica Sub-District, which had very poor sweet potato yields in both 2007 and 2008, 100% of the sites had soils of this texture. However, in Natabora, where 90% of soils were also either sandy or silty loams, yields were quite high

**Table 41. Site characteristics and yield result across AEZ**

| *AEZ* | *Yield (t/ha)* | *Mean no. of days to harvest* | *% sites with wider plant spacing* | *% sites with sandy or silt soils* |
|---|---|---|---|---|
| 1 | 3.6 | 136 | 63 | 50 |
| 2 | 3.7 | 146 | 52 | 43 |
| 3 | 5.0 | 147 | 63 | 20 |
| 4 | 9.1 | 210 | 78 | 11 |
| 5 | 9.3 | 187 | 100 | 0 |
| 6 | 7.7 | 188 | 87 | 62 |
| *LSD (P<0.05)* | *1.8* | *14* | | |

Harvest times were significantly longer on the southern AEZs than those in the north. It is not known whether this result was due to cultural and/or management differences or simply a coincidence that all the researchers working in these southern Sub-Districts took longer to harvest the sites. Although it can be considered that sweet potato tubers left longer in the ground should lead to higher yields, a regression analysis did not indicate a significant correlation between days to harvest and yield. However the very high mean yield (12.5t/ha) recorded for a single site in Faterberliu was most likely to be due to the fact that it was not harvested until 262 days after planting.

The data in Table 41 indicate planting distances were wider in the southern AEZs. There was a significant difference in the effect of plant spacing on yields. Planting distances were recorded simply as 'wide' or 'close' and subsequent mean yields estimates were 5.9t/ha and 5.0t/ha respectively with a LSD (0.05) of 0.8t/ha.

It is likely that a combination of the three factors mentioned in Table 41- crop duration, plant spacing and soil type (and other unknown factors) may have resulted in the higher yields observed in the southern sites, however the reason for very poor yields in Liquica remains unclear.

Irrespective of the 'difficult to explain' differences in mean yields between Sub-Districts and AEZs, it is clear that, once again, the newly released varieties Hohrae 1, 2 and 3 produced significantly higher yields than the local varieties. In only two Sub-Districts, Quilicai and Turescai, was there no clear yield advantage. In other Sub-Districts, the yield advantage ranged from 25% to a high 700% in Vemasse. There did not appear to be any significant G x E interaction, thereby confirming the wide adaptation of these new varieties.

Because it was only included in 4 sites (3 in Maubara and 1 in Liquica), the yield data for CIP 17 was not included in Table 39, however its average yield in those trials was 4.3t/ha and average yield advantage over the local was 120%. As with the Hohrae varieties, the observed yield advantage of CIP varieties over the local varieties was largely due to the fact that they produced harvestable tubers in a shorter period of time.

### Effect of farmer management on yield

Although failure to weed by farmers was cited as the reason for at least 7% (Table 37) of planted trials not being harvested at all, the lack of weeding or, number of times plots were weeded, apparently had no statistically significant effect on estimated yield of sweet potato. Also whether or not the sweet potato was planted as a monoculture or as a mixture did not affect final yield. Where maize was the primary companion crop, planting sweet potato before or after the maize also made no difference to yield. However as mentioned above, planting sweet potato at ‘wide’ spacing as opposed to ‘close’ appeared to result in higher yields. Also, yields from sites where a male was listed as the participating farmer (66%) were statistically higher than those where the farmer was female (6.2 vs. 4.4 t/ha).

### Farmers’ responses to new varieties

After the harvest of sweet potato trials, farmers were asked for their opinion on each of the varieties. The results are summarized in Table 42. In general, 65-70% of all farmers participating in the OFDTs gave positive comments about the new varieties. This favourable impression was mainly due to the large size of the tubers and good eating quality but their more rapid production of edible tubers in comparison to the local also had a positive impact on farmers. The local variety did compare well with the new varieties in terms of eating quality, but overall the total number of positive responses (29.3) was significantly lower than that for the newly released sweet potato varieties. Farmers generally (33.3 %) made the comment ‘it is our local’ or ‘it is adapted to our land’ as the reason for continuing to grow their local varieties

**Table 42. Farmers’ opinions (%) of new sweet potato varieties**

| *Reason for liking this variety* | *Hohrae 1* | *Hohrae 2* | *Hohrae 3* | *Local* |
|---|---|---|---|---|
| Big Tubers | 26.5 | 31.6 | 29.2 | 0 |
| Good to eat | 21.1 | 18.4 | 17.7 | 22.4 |
| Fast growing | 12.2 | 10.9 | 12.2 | 0 |
| Total % respondents giving positive comment | 66 | 65.3 | 70.7 | 29.3 |

## *Conclusions*

As in 2007, the newly recommended sweet potato varieties (Hohrae 1, 2 and 3) significantly out-yielded the local varieties in almost all OFDT trials in 2008. There were significant differences in mean sweet potato yields between AEZs and Sub-Districts, the reasons for which are not clear and need further investigation. In particular, the reasons for the continuing poor yields in Liquica need to be identified. The yield performance of CIP 17 in the few trials in which it was included was sufficient high enough to justify its wider inclusion in OFDTs in 2009.

# 2.3 Cassava

Cassava (*Manihot esculenta Crantz*) is grown in East Timor mainly as a source of food. Cassava roots are eaten fresh after boiling or steaming and sometimes processed into dry chips. Cassava leaves are also boiled and eaten as a vegetable. Most farm households have a small number of plants intercropped with other species, although large (200m$^2$ or more) monoculture crops are found in some Districts. Farmers dig roots and harvest leaves from the plant on a needs basis after approximately one year of growth.

## 2.3.1 Replicated cassava trials

New cassava clones were sourced from similar environments in Indonesia and Thailand for evaluation in East Timor. These were tested in replicated trials across four centres in order to identify suitable material for evaluation on farmers' fields. Four trials were implemented during the 2006-2007 season. Harvest was after 9 to 12 months. The results arrived too late to be included in the 2007 Annual Research Report and are presented here.

### *Materials and methods*

Replicated cassava trials were conducted during 2006/2007 at stations in Maliana, Baucau, Alieu and Betano. Each trial was a randomized block design with two replicates except at Betano where three replicates were possible. The trials were planted in December, 2006 or January, 2007 (Table 43) and harvested during September in Baucau or November and December in the other three sites.

**Table 43. Cassava planting and harvest details, 2006/07**

| *Location* | *Number of entries* | *Planting date* | *Harvest date* | *Mean yield (t/ha)* |
|---|---|---|---|---|
| Maliana | 18 | 21/12/2006 | 17/12/2007 | 35.0 |
| Baucau | 25 | 29/12/2006 | 5/09/2007 | 14.8 |
| Aileu | 25 | 26/12/2006 | 12/11/2007 | 9.7 |
| Betano | 36 | 17/01/2007 | 13/12/2007 | 27.3 |

The same set of (to a maximum of 25) accessions were planted at each location. The set included, for the first time, nine new clones from Thailand and as a result, a number of poor-performing or poor-tasting lines tested in the previous year were dropped. The trial included the same two local varieties, Mantega and Merah as in earlier years. A new local from Maliana (Etu Hare) was also included.

Plot dimensions were 5m by 5m with a 30cm walkway between each plot. Plant spacing was 1m by 1m square, resulting in 25 plants per plot. At harvest, roots of 20 plants were dug for yield determination. The remaining 5 plants were left for field day observations and for fresh stem production.

### *Results*

#### Aileu

The trial at Alieu contained 23 accessions, 12 of which had also been tested the previous year. Included was Ca 007 which served as a high yielding but relatively bitter control. The nine introductions from Thailand made up the remainder of the lines tested at Aileu. The results of the trial are presented in Table 44. Root yields were much lower than in previous years. The reason for this is unclear. Total rainfall in 2007 was less than in 2006 but not substantially so. The trial was, however, planted two months later and roots harvested after only an 11 month growing period in comparison to the 13 month growing period in 2005/06. The average yields of the three local varieties were 4.9 t/ha compared to 9.7 t/ha for the new Thai introductions and 10.1 t/ha for all the other accessions carried over from previous years. The highest yielding varieties in Aileu were Ca 13, Rayong 3 and Ca 42. Rayong 3 also had the highest starch content while Ca 13 had the lowest percentage starch content. Ca 42 had a mid-range starch percentage which resulted in a total potential starch yield of 3.4 t/ha. Two varieties which have been tested in OFDTs, Ca 15 and Ca 36 also produced similar potential starch yields.

**Table 44. Cassava variety evaluation trial results, Aileu, 2006/07.**

| *Code* | *Variety name* | *Root yield (t/ha)* | *Yield advantage over average of locals (%)* | *Starch content (%)* | *Starch yield (t/ha)* |
|---|---|---|---|---|---|
| Ca 007 | CMM 96-36-224 | 8.6 | 74 | 26.1 | 2.2 |
| Ca 009 | CMM 96-36-269 | * | * | * | * |
| Ca 010 | OMM 96-01-69 | * | * | * | * |
| Ca 013 | CMM 96-25-25 | 17.0 | 245 | 17.9 | 3.2 |
| Ca 014 | OMM 96-01-93 | 6.0 | 22 | 20.6 | 1.3 |
| Ca 015 | OMM 90-03-100 | 14.1 | 186 | 22.7 | 3.2 |
| *Ca 016* | *Mantega-Aileu* | *4.8* | *-3* | *20.3* | *1* |
| *Ca 017* | *Merah-Aileu* | *5.9* | *20* | *20.3* | *1.2* |
| Ca 021 | Bogor 1 | 5.9 | 20 | 19.2 | 1.1 |
| Ca 025 | Gempol | 13.8 | 180 | 21.4 | 1.8 |
| Ca 026 | Gading | 7.9 | 60 | 21.5 | 1.6 |
| Ca 032 | CMM 97-01-158 | 7.4 | 50 | 21.4 | 2.8 |
| Ca 036 | CMM 97-02-36 | 13.4 | 172 | 25.9 | 3.3 |
| Ca 040 | CMM 97-07-145 | 11.0 | 123 | 20.7 | 2.1 |
| Ca 042 | CMM 97-02-181 | 16.1 | 226 | 23.4 | 3.4 |
| *Ca 060* | *Local Etuhare* | *4.1* | *-17* | *23.4* | *1* |
| Ca 101 | Hanatee | 5.1 | 3 | 22.6 | 1.2 |
| Ca 102 | Rayong 1 | 9.8 | 99 | 22.8 | 2.2 |
| Ca 103 | Rayong 2 | 7.4 | 50 | 22.6 | 1.7 |
| Ca 104 | Rayong 3 | 16.7 | 239 | 28.5 | 5 |
| Ca 105 | Rayong 5 | 14.6 | 196 | 23.7 | 3.2 |
| Ca 106 | Rayong 60 | 3.8 | -23 | 17.9 | 0.7 |
| Ca 107 | Rayong 72 | 10.8 | 119 | 24.4 | 2.6 |
| Ca 108 | Rayong 90 | 7.3 | 48 | 28.6 | 2.1 |
| Ca 109 | KU 50 | 12.2 | 147 | 23.1 | 2.6 |
| *Site average* | | *9.7* | | *22.6* | *2.2* |
| *Fprob* | | *ns* | | *0.004* | *ns* |
| *LSD(P<0.05)* | | | | *5* | |
| *CV%* | | | | *10.9* | *52.9* |

* Not included at this site

### Maliana

A similar set of 23 clones planted at Alieu were also planted at Maliana. However average root yields and starch contents in Maliana were considerably higher than those observed at Aileu and also much higher than those measured in Maliana in 2006. This was most likely due to the fact that the cassava trial was harvested much later and the total growing period was 12 months in 2006/07 in comparison with 10 months in 2005/06.

Average root yields were 35 t/ha and average starch content was 33.4% producing an average starch yield of 11.9 t/ha (Table 45). Breeding lines Ca 107, Ca 102 and Ca 15 had the highest yields and all were significantly higher than local Mantega, the best yielding local. The local Merah performed particularly badly at Maliana in 2007, producing a yield of only 5.7 t/ha.

Ca 107 and Ca 25 had the highest percentage starch of all varieties while, as in Aileu, Ca 106 again had the lowest. However this difference in percentage starch was not significant. The high percentage starch content measured in Ca 107, combined with its high yield, produced a potential starch yield from this particular clone of a high 21 t/ha.

**Table 45. Cassava variety evaluation trial results, Maliana, 2006/07.**

| *Code* | *Variety name* | *Root yield (t/ha)* | *Yield advantage over average of locals (%)* | *Starch content (%)* | *Starch yield (t/ha)* |
|---|---|---|---|---|---|
| Ca 007 | CMM 96-36-224 | 35 | 68 | 29.4 | 10.5 |
| Ca 009 | CMM 96-36-269 | * | * | * | * |
| Ca 010 | OMM 96-01-69 | * | * | * | * |
| Ca 013 | CMM 96-25-25 | 39.6 | 90 | 30.4 | 12.1 |
| Ca 014 | OMM 96-01-93 | 43.9 | 110 | 30.1 | 13.5 |
| Ca 015 | OMM 90-03-100 | 47.1 | 126 | 31.5 | 14.9 |
| *Ca 016* | *Mantega-Aileu* | *28.1* | *35* | *35.1* | *9.9* |
| *Ca 017* | *Merah-Aileu* | *5.7* | *-73* | *33.9* | *2.0* |
| Ca 021 | Bogor 1 | 25.8 | 24 | 37.0 | 9.6 |
| Ca 025 | Gempol | 27.2 | 30 | 40.6 | 11.1 |
| Ca 026 | Gading | 33.4 | 60 | 32.8 | 10.9 |
| Ca 032 | CMM 97-01-158 | 31.8 | 52 | 33.6 | 10.8 |
| Ca 036 | CMM 97-02-36 | 24.9 | 19 | 35.1 | 9.3 |
| Ca 040 | CMM 97-07-145 | 42.0 | 101 | 34.5 | 14.5 |
| Ca 042 | CMM 97-02-181 | 32.0 | 53 | 32.2 | 10.3 |
| *Ca 060* | *Local Etuhare* | *28.8* | *38* | *35.9* | *10.3* |
| Ca 101 | Hanatee | 37.5 | 80 | 34.5 | 13.0 |
| Ca 102 | Rayong 1 | 47.1 | 126 | 34.9 | 16.4 |
| Ca 103 | Rayong 2 | 32.2 | 54 | 30.5 | 9.9 |
| Ca 104 | Rayong 3 | 32.7 | 57 | 37.5 | 12.3 |
| Ca 105 | Rayong 5 | 39.4 | 89 | 31.0 | 12.3 |
| Ca 106 | Rayong 60 | 45.5 | 118 | 28.7 | 13.1 |
| Ca 107 | Rayong 72 | 51.7 | 148 | 40.7 | 21 |
| Ca 108 | Rayong 90 | 29.8 | 43 | 35.1 | 10.5 |
| Ca 109 | KU 50 | 44.1 | 111 | 34 | 15.1 |
| *Site average* | | *35.0* | | *33.9* | *11.9* |
| *Fprob* | | *0.007* | | *ns* | *0.05* |
| *LSD(P<0.05)* | | *17.1* | | | *7.2* |
| *CV%* | | *23.5* | | *11.2* | *29.1* |

* Not included at this site

### Baucau

With only minimum termite damage occurring in 2007, the trial at Baucau yielded much better than in 2006 and the average yield of 14.8t/ha was higher than that achieved at Aileu (Table 46). Only 21 clones were tested at this site in 2006/07. The two standard locals Mantega and Merah were not included. However the new local Etuhare was tested and this local performed relatively well, producing a tuber yield similar to the site average at 14.8 t/ha. With the exception of KU 50, the clones from Thailand all performed very poorly at Baucau. The highest yielding varieties were Ca 13, Ca 09 and Gading (Ca 26). The highest percentage starch contents were observed in Ca 36, Ca 105 and Ca 106. At Baucau, the lowest starch content was found in Ca 25 (15.9 %), a clone which at Maliana had the highest starch percentage (40.6).

**Table 46. Cassava variety evaluation trial results, Baucau, 2006/07**

| *Code* | *Variety name* | *Root yield (t/ha)* | *Yield advantage over average of locals (%)* | *Starch content (%)* | *Starch yield (t/ha)* |
|---|---|---|---|---|---|
| Ca 007 | CMM 96-36-224 | 23.8 | 60.3 | 17.5 | 4.2 |
| Ca 009 | CMM 96-36-269 | 27.7 | 86.5 | 20.8 | 5.8 |
| Ca 010 | OMM 96-01-69 | * | * | * | * |
| Ca 013 | CMM 96-25-25 | 28.8 | 93.8 | 21.6 | 6.4 |
| Ca 014 | OMM 96-01-93 | 9.2 | -38.0 | 17.1 | 1.6 |
| Ca 015 | OMM 90-03-100 | 17.5 | 17.8 | 17.8 | 2.6 |
| Ca 016 | Mantega-Aileu | * | * | * | * |
| Ca 017 | Merah-Aileu | * | * | * | * |
| Ca 021 | Bogor 1 | * | * | * | * |
| Ca 025 | Gempol | 20.5 | 38.0 | 15.9 | 2.9 |
| Ca 026 | Gading | 27.6 | 85.7 | 24.0 | 5.0 |
| Ca 032 | CMM 97-01-158 | * | * | * | * |
| Ca 036 | CMM 97-02-36 | 21.2 | 43.1 | 28.2 | 5.9 |
| Ca 040 | CMM 97-07-145 | 25.1 | 69.4 | 25.6 | 6.5 |
| Ca 042 | CMM 97-02-181 | 14.7 | -0.7 | 21.4 | 3.2 |
| Ca 060 | Local Etuhare | 14.8 | * | 21.8 | * |
| Ca 101 | Hanatee | 5.3 | -64.0 | 24.8 | 1.4 |
| Ca 102 | Rayong 1 | 9.3 | -37.0 | 23.9 | 2.2 |
| Ca 103 | Rayong 2 | 2.6 | -82.2 | 24.8 | 0.7 |
| Ca 104 | Rayong 3 | 3.5 | -76.1 | 17.2 | 0.6 |
| Ca 105 | Rayong 5 | 7.5 | -49.5 | 26.8 | 2.0 |
| Ca 106 | Rayong 60 | 3.8 | -74.4 | 26.2 | 1.2 |
| Ca 107 | Rayong 72 | 12.0 | -19.3 | 21.5 | 2.6 |
| Ca 108 | Rayong 90 | 1.8 | -87.5 | 18.9 | 0.4 |
| Ca 109 | KU 50 | 19.9 | 34.0 | 21 | 4.0 |
| Site average | | 14.8 | | 21.8 | 3.1 |
| Fprob | | 0.001 | | ns | <0.001 |
| LSD(P<0.05) | | 12.4 | | | 2.2 |
| CV% | | 41.3 | | 18.2 | |

* Not included at this site

**Betano**

The full set of 25 clones was planted at Betano, but most of the cuttings of Ca 60, Ca 40 and Ca 21 either died after germination or remained stunted and yellow. This occurred again to cuttings which were replanted. At the time of harvest only one or two plants of these varieties remained in each plot and consequently were not included in the analysis.

Although the site average was lower than at Maliana, the highest individual tuber yield at any site in 2006/07 (59.1 t/ha) was produced at Betano by the variety Ca 107 (Table 47). As in Maliana, this variety also had the highest starch content measured at Betano and its potential starch yield was calculated at 17.6 t/ha. Other varieties producing high tuber yields at Betano were Ca 42 (48.7 t/ha), Ca 26 (44.2 t/ha) and Ca 13 (43.9 t/ha), all of which were significantly higher than the best of the local varieties (Mantega, at 24.5 t/ha). The lowest yield (and starch content) at Betano was produced by Ca 103. Surprisingly Ca 10, which has consistently been a relatively high yielding variety at Betano (but not elsewhere), yielded very poorly at Betano in 2006/2007. Yields ranged from 8.5 to 48.4 t/ha and averaged 27.3t/ha compared with 35t/ha in Maliana and 9.7tha in Aileu. Starch contents were quite high ranging from 13.4% to 36%. As a result, starch yields on an area basis were also high.

The best tuber yields were from Ca15 (48.4t/ha), Ca7 (40.6t/ha), Ca13 (39t/ha) and Ca40 (38.1t/ha). These yields are all well above those from local controls (8.5-34.4t/ha)

**Table 47. Cassava variety evaluation trial results, Betano, 2006/07.**

| *Code* | *Variety name* | *Root yield (t/ha)* | *Yield advantage over average of locals (%)* | *Starch content (%)* | *Starch yield (t/ha)* |
|---|---|---|---|---|---|
| Ca 007 | CMM 96-36-224 | 41.1 | 130 | 16.8 | 6.9 |
| Ca 009 | CMM 96-36-269 | 36.7 | 105 | 20.8 | 7.8 |
| Ca 010 | OMM 96-01-69 | 9.3 | -48 | 25.1 | 2.3 |
| Ca 013 | CMM 96-25-25 | 43.9 | 145 | 21.4 | 9.4 |
| Ca 014 | OMM 96-01-93 | 10.3 | -42 | 17.6 | 1.8 |
| Ca 015 | OMM 90-03-100 | 27.3 | 53 | 23.3 | 6.5 |
| Ca 016 | Mantega-Aileu | 24.5 | 37 | 24.8 | 6.0 |
| Ca 017 | Merah-Aileu | 11.3 | -37 | 25.6 | 3.0 |
| Ca 021 | Bogor 1 | nh | nh | * | * |
| Ca 025 | Gempol | 26.4 | 47 | 21.5 | 5.5 |
| Ca 026 | Gading | 44.2 | 147 | 20.8 | 9.2 |
| Ca 032 | CMM 97-01-158 | 13.6 | -24 | 21.2 | 2.7 |
| Ca 036 | CMM 97-02-36 | 20.9 | 17 | 24.6 | 4.9 |
| Ca 040 | CMM 97-07-145 | nh | nh | * | * |
| Ca 042 | CMM 97-02-181 | 48.7 | 172 | 24.9 | 11.9 |
| Ca 060 | Local Etuhare | nh | nh | * | * |
| Ca 101 | Hanatee | 16.4 | -8 | 24.1 | 4.0 |
| Ca 102 | Rayong 1 | 36.5 | 104 | 20 | 7.0 |
| Ca 103 | Rayong 2 | 6.4 | -64 | 14.3 | 1.1 |
| Ca 104 | Rayong 3 | 32.4 | 81 | 28.7 | 9.4 |
| Ca 105 | Rayong 5 | 13.5 | -25 | 26.9 | 3.8 |
| Ca 106 | Rayong 60 | 33.9 | 89 | 21.2 | 7.2 |
| Ca 107 | Rayong 72 | 59.1 | 230 | 29.8 | 17.6 |
| Ca 108 | Rayong 90 | 15.6 | -13 | 26.1 | 4.0 |
| Ca 109 | KU 50 | 29.1 | 63 | 18.6 | 5.6 |
| *Site average* | | *27.3* | | *22.6* | *6.2* |
| *Fprob* | | *<0.001* | | *0.001* | *0.001* |
| *LSD(P<0.05)* | | *15.4* | | *6.2* | *3.6* |
| *CV%* | | *34.2* | | *16.5* | *35.3* |

* Not included at this site, nh Not harvested

### Cassava selections across years

Cassava clones which performed well during 2007 consistently out yielded local varieties over a seven year period (Table 48). The variety with the highest yield advantage across all sites in 2007 was Ca 13. This variety performed relatively consistently over the years with a yield advantage of 49.1% above the mean at 17 sites. Other consistently high yielding varieties such as Ca 15, Ca 42 and Ca 40 again yielded relatively well across all sites in 2007. Varieties Ca 25 (Gempol) and Ca 26 (Gading), which always rated well in previous taste tests and also possessed a consistent yield advantage over 13 trials during 2001-2007, again demonstrated considerable yield advantage over local varieties in 2007. However Ca 14 which over 12 previous trials had an average yield advantage of 34.4%, yielded relatively poorly in 2006/07. Of the new Thai varieties tested for the first time, Ca 107 had the second highest yield advantage in these 2006/2007 trials, largely due to its very high yields in both Maliana and Betano.

SoL's mandate is to release varieties that have proven to be consistently high yielding and highly acceptable to farmers as a food crop. By mid 2008, some clones had been evaluated in 10-15 sites and measured for sweetness by farmers on different occasions. Sixty four (64) clones, some of which were released varieties in other countries, were evaluated in one or more trials over a 7 year period. Those that were tested in four or more sites are presented in Table 48. Only four local varieties consistently used in trials over the period and are included in the table. Most entries originated from Thailand, Indonesia or are local varieties. They are compared by percentage yield above the average. Variation in yield across years is represented as the standard deviation. The highest yielding entries (Ca 107, Ca109, Ca 104, and Ca 102) were included in the trials only in 2007. This was also the case for Ca 105 (seventh highest yielding). None of these clones have been evaluated for taste and will not be considered for release until further testing. A select number of other entries were, however put through the "taste test" at Betano in 2007.

**Table 48. Cassava variety comparisons 2001-2007.**

| *Code* | *Variety* | *Origin* | *Aileu Taste* | *Maliana 05 taste* | *No. sites* | *% yield above mean* | *StDev* |
|---|---|---|---|---|---|---|---|
| Ca 107 | Rayong 72 | Thailand | | | 4 | 119.4 | 1.03 |
| Ca 109 | KU 50 | Thailand KU* | | | 4 | 88.9 | 0.50 |
| Ca 104 | Rayong 3 | Thailand | | | 4 | 74.9 | 1.29 |
| Ca 102 | Rayong 1 | Thailand | | | 4 | 72.7 | 0.74 |
| Ca 42 | CMM 97-02-181 | RILET*, Indonesia | Sweet | | 9 | 71.3 | 0.85 |
| Ca 15 | OMM 90-03-100 | RILET, Indonesia | Sweet | Sweet | 16 | 64.7 | 0.58 |
| Ca 105 | Rayong 5 | Thailand | | | 4 | 52.7 | 1.12 |
| Ca 26 | Gading | CRIFC*, Indonesia | Mixed | Vsweet | 13 | 50.9 | 0.56 |
| Ca 13 | CMM 96-25-25 | RILET, Indonesia | Sweet | Vsweet | 17 | 49.1 | 0.63 |
| Ca 25 | Gembol | CRIFC, Indonesia | Sweet | Vsweet | 13 | 47.4 | 0.73 |
| Ca 36 | CMM 97-02-36 | CRIFC | VSweet | Vsweet | 9 | 45.0 | 0.49 |
| Ca 07 | CMM 96-36-224 | RILET, Indonesia | | Sweet | 10 | 44.7 | 0.44 |
| Ca 40 | CMM 97-07-145 | RILET Indonesia | VSweet | VSweet | | 39.3 | 0.75 |
| Ca 34 | CMM 97-11-155 | RILET Indonesia | Sweet | | 5 | 38.9 | 0.49 |
| Ca 09 | CMM 96-36-269 | RILET, Indonesia | Bitter | Mixed | 10 | 35.0 | 0.39 |
| Ca 19 | local Sulawesi | CRIFC, Indonesia | Mixed | | 7 | 31.1 | 0.51 |
| Ca 14 | OMM 96-01-93 | RILET, Indonesia | VSweet | Vsweet | 16 | 29.0 | 0.68 |
| Ca 106 | Rayong 60 | Thailand | | | 4 | 27.5 | 0.91 |
| Ca 45 | CMM 97-15-255 | RILET Indonesia | VSweet | VSweet | 5 | 27.3 | 0.47 |
| Ca 03 | CMM 96-08-19 | RILET, Indonesia | | Bitter | 6 | 25.5 | 0.30 |
| Ca 21 | Bogor-1 | CRIFC, Indonesia | Sweet | | 8 | 24.3 | 0.33 |
| Ca 05 | CMM 96-36-255 | RILET, Indonesia | Bitter | Sweet | 13 | 16.4 | 0.47 |
| Ca 35 | CMM 97-11-191 | RILET Indonesia | Sweet | | 6 | 15.9 | 0.64 |
| Ca 38 | CMM 97-11-157 | RILET Indonesia | Sweet | | 5 | 14.8 | 0.47 |
| Ca 12 | CMM 95-42-3 | RILET, Indonesia | Bitter | Bitter | 13 | 13.5 | 0.72 |
| Ca 33 | CMM 97-02-183 | RILET Indonesia | Vsweet | VSweet | 5 | 12.3 | 0.64 |
| Ca 04 | CMM 96-08-44 | RILET, Indonesia | | Mixed | 7 | 9.2 | 0.22 |
| Ca 32 | CMM 97-01-158 | RILET Indonesia | VSweet | VSweet | 8 | 7.3 | 0.44 |
| Ca 101 | Hanatee | Thailand | | | 4 | 2.6 | 0.59 |
| Ca 08 | OMM 96-02-113 | RILET, Indonesia | | Bitter | 6 | 2.0 | 0.17 |
| Ca 18 | local Putih | East Timor | VSweet | VSweet | 9 | 1.4 | 0.68 |
| Ca 11 | CMM 95-14-13 | RILET, Indonesia | | Bitter | 6 | -0.4 | 0.28 |
| Ca 108 | Rayong 90 | Thailand | | | 4 | -2.4 | 0.63 |
| Ca 01 | CMM 96-27-76 | RILET, Indonesia | | Bitter | 6 | -6.3 | 0.32 |
| Ca 16 | local Mentega | East Timor | Sweet | Sweet | 16 | -10.5 | 0.42 |
| Ca 103 | Rayong 2 | Thailand | | | 4 | -10.5 | 0.72 |
| Ca 10 | OMM 96-01-69 | RILET, Indonesia | | | 7 | -18.3 | 0.37 |
| Ca 060 | Local Etuhare | East Timor | | | 4 | -19.7 | 0.58 |
| Ca 31 | CMM 94-04-87 | RILET Indonesia | Sweet | | 5 | -23.5 | 0.40 |
| Ca 23 | Enak | CRIFC, Indonesia | Mixed | Sweet | 9 | -24.3 | 0.27 |
| Ca 43 | CMM 97-14-54 | RILET Indonesia | Sweet | | 4 | -25.7 | 0.40 |
| Ca 39 | CMM 97-15-241 | RILET Indonesia | Sweet | | 5 | -26.1 | 0.39 |
| Ca 06 | CMM 96-37-275 | RILET, Indonesia | | Sweet | 7 | -29.6 | 0.25 |
| Ca 17 | local Merah | East Timor | Sweet | | 11 | -29.9 | 0.59 |

*RILET=Research Institute of Legumes and Tuber Crops (Indonesia)
*CRIFC=Center Research Institute of Food Crop (Indonesia)
*KU =Kasetsart University, Thailand

The taste test evaluation at Betano was for select high yielding and better eating, cassava varieties (Ca 07 was included as a bitter control variety). The evaluation was carried out after the harvest at Betano Research Station in December 2007. A group of 22 local farmers were asked to taste boiled tubers (each variety cooked in a separate pot) and rate them accordingly as "bitter" or "sweet". They were requested to select which variety they considered as having the best eating quality, which variety had the worst taste and whether they would consider growing the varieties on their farms. The results of the evaluation are presented in Table 49, along with yield advantages over a seven year period. The HCN score was obtained from each of the selected varieties in the 2006/07 trial at Betano. As expected, almost all respondents rated Ca 07 as bitter and the worst eating of the tested tubers. However a few people did rate Ca 07 as sweet!! In contrast, 100% of the farmers considered Ca 15, Ca 25, Ca 26 and Ca 107 to be sweet. Ca 14 induced a conflicting response, half the respondents rating it as sweet and the other half as bitter. The majority considered both Ca 36 and Ca 42 to be sweet, but a significant percentage said they were at least slightly bitter.

With a score of 52.2%, Ca 26 was rated as having the best eating quality of all varieties, followed by Ca 15 and Ca 25. Even though 100% said Ca 107 was sweet tasting, no-one selected it as being the best to eat. Other factors such as texture affect the eating quality of cassava tubers. Although not stated in Table 49, 87% of respondents considered Ca 107 to be 'powdery or crumbly' consistency. When it came to selecting which varieties to grow, Ca 26 was picked by 73.9% of farmers, followed by Ca 15 with 39.1%. Obviously taste was a major factor in this result, however the fact that a sizable percentage also selected Ca 107 and Ca 42, even though not considered the best eating but having produced very high yields at Betano (which the respondents had observed first-hand at the time of harvest), suggest that this was also a factor in their choice. Despite its relatively high yield, no farmer selected Ca 07 because of its bitterness and no-one selected Ca 36 possibly because its relatively low yield was combined with a variable or intermediate eating quality.

The HCN contents presented in Table 50 demonstrate that the quite bitter taste of Ca 07 corresponds with a high HCN content. However, all other varieties tested have similar and relatively low HCN contents irrespective of whether they were scored as sweet by 100% of farmers or had a mixed bitter/sweet response. HCN contents were measured on all varieties tested in 2006/07. A simple taste test of uncooked tubers at the same time as HCN was tested was carried out at three sites (not at Betano). Slices of tubers sampled from each plot were tasted and then scored according to a scale of; 1 = very bitter; 2 = bitter; 3 = bitter/sweet; 4 = sweet and 5 = very sweet. The results as presented in Table 50 indicate there are significant differences between varieties and sites. However the CV% at all sites was extremely high making the statistical differences debatable. A renowned bitter variety, Ca 07 from tubers sampled from Aileu, was actually scored as sweet. But it did at least have a correspondingly low HCN content at that site. A regression analysis between HCN content and (numerical) sweetness score indicated a significant negative correlation between HCN and sweetness score.

**Table 49. Farmer preferences for cassava clones across test locations 2001-2007**

| *Variety code* | *% of farmers rating this variety as the best taste* | *% of farmers rating this variety as the worst taste* | *% farmers saying this variety bitter* | *% farmers saying this variety sweet* | *HCN content (ppm)* | *Yield advantage above mean 2001-2007* | *% farmers wanting to grow this variety* |
|---|---|---|---|---|---|---|---|
| Ca 07 | 0 | 87.0 | 95.7 | 4.3 | 225 | 44.7 | 0 |
| Ca 14 | 4.3 | 4.3 | 56.5 | 43.5 | 23 | 29.0 | 4.3 |
| Ca 15 | 30.4 | 0 | 0 | 100 | 33 | 64.7 | 39.1 |
| Ca 25 | 13.0 | 0 | 0 | 100 | 9 | 47.4 | 21.7 |
| Ca 26 | 52.2 | 0 | 0 | 100 | 30 | 50.9 | 73.9 |
| Ca 36 | 0 | 4.3 | 26.1 | 73.9 | 45 | 45.0 | 0 |
| Ca 42 | 0 | 4.3 | 30.4 | 69.6 | 44 | 71.3 | 13.0 |
| Ca 107 | 0 | 0 | 0 | 100 | 30 | 119.4 | 26.1 |

**Table 50. HCN content and uncooked taste of all cassava varieties tested in 2007**

| *Variety code* | *Aileu* | | *Maliana* | | *Baucau* | | *Betano*[1] |
|---|---|---|---|---|---|---|---|
| | *HCN* | *Raw Taste* | *HCN* | *Raw Taste* | *HCN* | *Raw Taste* | *HCN* |
| Ca 007 | 77 | Sweet | 125 | Bitter | 370 | Bitter | 225 |
| Ca 009 | * | * | * | * | * | * | 113 |
| Ca 010 | * | * | * | * | * | * | 33 |
| Ca 013 | 27 | Sweet | 25 | Sweet | 240 | Bitter | 23 |
| Ca 014 | 31 | Bitter | 62 | Bitter | 169 | Very bitter | 23 |
| Ca 015 | 43 | Sweet | 48 | Sweet | 222 | Bitter/sweet | 33 |
| Ca 016 | 25 | Sweet | 37 | Sweet | * | * | 22 |
| Ca 017 | 43 | Sweet | 25 | Sweet | * | * | 139 |
| Ca 021 | 14 | Sweet | 40 | Sweet | * | * | * |
| Ca 025 | 24 | Sweet | 28 | Sweet | 420 | Bitter/sweet | 9 |
| Ca 026 | 18 | Sweet | 37 | Sweet | 69 | Very sweet | 30 |
| Ca 032 | 18 | Sweet | 43 | Sweet | * | * | 39 |
| Ca 034 | 133 | Bitter | * | * | * | * | * |
| Ca 036 | 183 | Bitter | 92 | Sweet | 333 | Bitter | 45 |
| Ca 040 | 92 | Sweet | 60 | Sweet | 192 | Bitter | * |
| Ca 042 | 29 | Sweet | 85 | Sweet | 155 | Sweet | 44 |
| Ca 060 | 16 | Sweet | 33 | Sweet | 47 | Sweet | * |
| Ca 101 | 20 | Sweet | 35 | Sweet | 178 | Bitter/sweet | 40 |
| Ca 102 | 52 | Sweet | 62 | Bitter | 250 | Very bitter | 38 |
| Ca 103 | 35 | Sweet | 46 | Sweet | 53 | Sweet | 30 |
| Ca 104 | 26 | Bitter | 111 | Sweet | 80 | Sweet | 20 |
| Ca 105 | 60 | Sweet | 115 | Sweet | 225 | Bitter | 28 |
| Ca 106 | 133 | Bitter | 29 | Sweet | 378 | Very bitter | 50 |
| Ca 107 | 68 | Sweet | 120 | Sweet | 489 | Bitter/sweet | 30 |
| Ca 108 | 30 | Sweet | 87 | Sweet | 139 | Very bitter | 34 |
| Ca 109 | 250 | Bitter | 195 | Bitter | 309 | Bitter/sweet | 63 |
| *Site Average* | *60* | | *67* | | *227* | | *51* |
| *Fprob* | *<0.001* | | *<0.001* | | *<0.001* | | *<0.001* |
| *LSD(P<0.05)* | *45* | | *45* | | *249* | | *44* |
| *CV%* | *64* | | *68* | | *73* | | *51* |

[1]No raw taste test carried out on varieties at Betano but cooked tubers in taste test (see Table 48). * Not included at this site.

**Conclusions**

A total of 64 cassava clones were evaluated for release in East Timor over the period between 2001 and 2007. Some of these failed to yield well and others were more suited to industrial purposes than for consumption as fresh roots. Only 34 were evaluated in 4 or more trials, the results of which are presented in Table 48. The MAF has a desire to release consistently higher yielding varieties which are preferred by the consumer over currently available material. New material with the notation Ca 107, Ca 109, Ca 104, Ca 105 and Ca 102 were extremely good performers during the 2006-2007 year but were evaluated in only 4 sites and do not have a record of high yields. They were therefore not included in consideration for release. Ca 42 also performed well in 9 trials to the end of 2007, but the results are variable (Standard Deviation of 0.85 over 9 trials) and farmers at an evaluation at Betano during 2007 did not rate this clone highly as a variety to cultivate on their farms (Table 49). Farmers did, however, rate Ca 15, Ca 25 and Ca 26 as having the best eating taste and a high percentage of farmers desired to plant the variety (Table 49). These varieties have very high yield advantages over local varieties and the mean of test entries. Planting material of these three varieties are available for distribution and the MAF will provided with all available research results for consideration to release them to farmers in 2008.

# 2.4 Rice

## 2.4.1 Rice Replicated trials, 2007-2008

Two replicated rice (*Oryza sativa*) trials were conducted during the 2007-2008 reporting year. They were located in Betano and Aileu.

### *Materials and methods*

The trials were installed as a randomized block design with three replicates in Aileu and 4 replicates at Betano research station. The crop was planted in early April and October respectively and harvested 4-5 months later (Table 51)

**Table 51. Planting and harvest details of rice replicated trial, Maliana, 2007**

| *Location* | *Number of entries* | *Transplanting Date* | *Harvest Date* | *Mean Yield (t/ha)* |
|---|---|---|---|---|
| Aileu | 20 | 3 April 2007 | 6 August 2008 | 3.0 |
| Betano research station | 21 | 26 October 2007 | 25 Jan 2008 | 1.3 |

Rice varieties were sourced from the IRRI irrigated rice nursery, with the addition of Nakroma and one or more local rice varieties. Plants were established in a nursery and transplanted into the plots 20-30 days afterwards. Plot dimensions in Aileu were 2.6m by 1.5m with a 30cm clearance between the plots. At transplanting, 7 rows were planted per plot (20 cm between row spacing) with 15cm between plants in the row. In Betano, plot size was 3m by 2m. Plant spacing in the plot was 25cm by 25 cm, with 2 or 3 plants planted per hill. In Aileu, urea at the rate of 15 kg N/ha was applied to all plots, and no fertilizer was applied in Betano. .

At harvest, the whole plot was harvested and threshed. The grain was sun-dried to an approximate 12% moisture content before being weighed for yield determination.

### *Results*

Aileu

There were significant differences for grain yield at Aileu between rice varieties. The highest yielding variety was not significantly greater than the local variety “Meloban” (Table 52). The MAF recommended variety Nakroma yield lower than the lead varieties, and less than the local rice variety. The range in yield were independent of plant density, plant height and panicle length.

**Table 52. Yield of rice varieties tested, Aileu, 2008**

| *Variety* | *Yield (t/ha)* | *Tillers per plant* | *Height to base of panicle (cm)* | *Panicle length (cm)* | *1000 seed weight (g)* | *Plant density (plants/m$^2$)* |
|---|---|---|---|---|---|---|
| IR69726-29-1-2-2-2(MATATAG 2) | 4.3 | 8.7 | 43.7 | 19.0 | 24.1 | 22.4 |
| IR77298-5-6(IR014108) | 3.9 | 9.0 | 34.7 | 19.7 | 24.0 | 19.7 |
| IR54742-31-9-26-15-2 | 3.7 | 7.0 | 40.3 | 19.0 | 25.3 | 22.0 |
| IR59552-21-3-2-2(PSB RC 64) | 3.5 | 7.3 | 37.7 | 19.7 | 27.0 | 22.7 |
| *LOCAL (MELOBAN)* | *3.5* | *9.3* | *35.7* | *17.7* | *24.6* | *21.6* |
| IR62141-114-3-2-2-2(PSB RC 80) | 3.4 | 8.7 | 38.3 | 18.7 | 25.5 | 22.5 |
| IR72102-4-159-1-3-3-3(NSIC 112) | 3.4 | 8.3 | 34.0 | 17.7 | 26.4 | 21.6 |
| IR61979-138-1-2-3(ANGELICA) | 3.4 | 11.3 | 36.0 | 19.0 | 25.8 | 21.6 |
| IR73885-1-4-3-2-1-6(MATATAG 9) | 3.2 | 8.0 | 36.0 | 19.7 | 24.0 | 20.5 |
| IR64683-87-2-2-3-3(PSB RC 82) | 3.2 | 10.7 | 42.7 | 18.0 | 25.4 | 21.9 |
| RHS 334-28CX-2CX-5CX-OZA | 3.1 | 8.3 | 36.7 | 19.3 | 26.3 | 22.4 |
| IR68333-R-R-B-22(MS 11) | 2.8 | 8.0 | 41.3 | 20.0 | 27.2 | 19.7 |
| IR68305-18-1-1(NSIC 118) | 2.8 | 11.3 | 37.7 | 19.0 | 23.0 | 22.3 |
| IR71606-1-1-4-2-3-1-2(NSIC 110) | 2.7 | 8.3 | 28.3 | 16.7 | 25.3 | 21.6 |
| IR58088-16-2-2 | 2.6 | 8.0 | 38.3 | 18.3 | 31.7 | 18.5 |
| IR52952-B-B-3-3-2 | 2.6 | 10.7 | 34.7 | 18.3 | 24.2 | 22.0 |
| Nakroma (PSB RC54) | 2.6 | 8.7 | 41.7 | 21.0 | 25.3 | 22.8 |
| IR39357-71-11-2-2 | 2.3 | 7.7 | 31.0 | 15.0 | 25.2 | 19.2 |
| IR68144-2B-2-2-3 (MS 13) | 1.8 | 10.0 | 22.7 | 14.0 | 21.7 | 22.7 |
| IR69726-116-1-3-(MATATAG 1) | 1.1 | 10.0 | 42.7 | 18.0 | 26.1 | 21.2 |
| ***LSD (P<0.05)*** | *1.0* | *2.2* | *6.5* | *1.9* | *2.6* | *ns* |

**Betano**

Average yields in Betano were very low, mainly due to limited water supply. Water for the rice bays was supplied at the end of an irrigation channel, which only flowed intermittently. There was considerable within-bay variation between plots, depending on whether the plots were located on the low side or the high side of the bay. There was significant differences between varieties for grain yield at the site (Table 53). Nakroma was one of the highest yielding rice varieties. Nakroma yielded significantly greater than one of the local varieties Membrano, but not significantly higher than the local rice variety President. Grain yield was not correlated to seed size, panicle length or tillers per plant.

**Table 53. Yield of a range of rice varieties tested at Betano 2008.**

| *Variety* | *Yield (t/ha)* | *Panicle length (cm)* | *1000 seed wt (g)* | *Tillers per plant* |
|---|---|---|---|---|
| IR.64683.87.2.2.3.3(PSBRC 82) | 1.8 | 21 | 18.7 | 8.8 |
| Nakroma | 1.8 | 20 | 19.0 | 9.3 |
| IR.61979.138.1.3.2.3(Angelica) | 1.8 | 22 | 17.9 | 11.5 |
| IR.52952 B.3.3.2 | 1.8 | 18 | 19.0 | 10.3 |
| IR.62141.114.3.2.2.2.(PSBRC 80) | 1.7 | 20 | 19.0 | 8.0 |
| IR.54742.31.9.26.15.2 | 1.7 | 23 | 22.9 | 7.0 |
| IR.59552.21.3.2.2.(PSBRC 64) | 1.7 | 21 | 21.8 | 6.0 |
| IR.69726.29.1.2.2.2(MATATAG 2) | 1.7 | 21 | 20.8 | 11.5 |
| *Local, President* | *1.6* | *22* | *16.6* | *5.8* |
| IR.73885. 1.4.3.2.1.G(MATATAG 9) | 1.6 | 23 | 14.1 | 10.0 |
| IR.71606.1.1.4.2.3.1.2(NSICRC110) | 1.5 | 18 | 17.9 | 13.0 |
| IR.68144.2B.2.2.3(MS 13) | 1.4 | 18 | 14.8 | 11.3 |
| IR.58088.16.2.2 | 1.2 | 25 | 21.2 | 10.0 |
| *Local Membramo* | *1.0* | *19* | *17.8* | *8.0* |
| RHS.334.28CX.5CX.OZA | 0.9 | 20 | 18.0 | 8.5 |
| IR.01A108(IR.77298.5.6) | 0.9 | 21 | 18.4 | 9.3 |
| IR.72102.4.159.1.3.3.3(NSICRC 112 | 0.8 | 22 | 21.8 | 13.3 |
| IR.69726.116.1.3(MATATAG 1) | 0.7 | 26 | 15.7 | 10.0 |
| IR.68305.18.11(NSICRC 118) | 0.5 | 20 | 15.9 | 9.8 |
| IR.39357.71.1.2.2 | 0.4 | 18 | 14.1 | 9.5 |
| IR.68333.R.R.B.22(MS 11) | 0.3 | 22 | 17.0 | 14.5 |
| **LSD (P<0.05)** | 0.71 | ns | 4.8 | 4.2 |

2008 was the second year that this set of genotypes was compared in Timor Leste. Table 54 shows the yield advantage for each variety at these two sites, compared with a rice trial conducted in Maliana the previous year. For each site and each variety, the yield advantage of that variety was calculated based on its yield and the yield of the local varieties in that trial. Over the three sites, three varieties show consistently higher yields over the local rice varieties. These varieties are MATAG 2, IR.54742.31.9.26.15.2 and PSB RC 80. In taste testing in the previous year, PSB RC 80 was defined as soft to eat, oily and fragrant.

**Table 54. Yield advantage above a local check of introduced rice varieties (3 sites).**

| *Variety* | *Aileu (%)* | *Betano (%)* | *Maliana (%)* | *Mean yield advantage (%)* |
|---|---|---|---|---|
| IR.69726.29.1.2.2.2(MATATAG 2) | 26 | 23 | 9 | 19 |
| IR.54742.31.9.26.15.2 | 28 | 6 | 11 | 15 |
| IR.62141.114.3.2.2.2.(PSBRC 80) | 29 | -2 | 13 | 13 |
| Nakroma | 35 | -26 | | 5 |
| IR.64683.87.2.2.3.3(PSBRC 82) | 36 | -10 | -15 | 4 |
| IR.59552.21.3.2.2.(PSBRC 64) | 26 | 1 | -17 | 3 |
| IR.73885. 1.4.3.2.1.G(MATATAG 9) | 21 | -9 | -4 | 3 |
| IR.52952 B.3.3.2 | 32 | -25 | -2 | 2 |
| IR.61979.138.1.3.2.3(Angelica) | 33 | -4 | -28 | 0 |
| IR.01A108(IR.77298.5.6) | -31 | 12 | 9 | -3 |
| IR.71606.1.1.4.2.3.1.2(NSICRC110) | 16 | -22 | -6 | -4 |
| IR.72102.4.159.1.3.3.3(NSICRC 112 | -35 | -3 | 13 | -9 |
| IR.68144.2B.2.2.3(MS 13) | 6 | -49 | 11 | -11 |
| IR.58088.16.2.2 | -11 | -25 | -15 | -17 |
| RHS.334.28CX.5CX.OZA | -28 | -11 | -53 | -31 |
| IR.39357.71.1.2.2 | -64 | -33 | -9 | -35 |
| IR.68305.18.11(NSICRC 118) | -61 | -21 | | -41 |
| IR.69726.116.1.3(MATATAG 1) | -46 | -69 | -15 | -43 |
| IR.68333.R.R.B.22(MS 11) | -77 | -19 | -45 | -47 |

### *Conclusion*

Three rice varieties have been identified to have a consistently higher yield than local test varieties. Of these varieties, PSB RC 80 is considered to be good tasting. This variety should now be incorporated in the on-farm testing program.

## 2.4.2 Rice On-Farm Demonstration Trials (OFDTs)

Data from two years of OFDT research are included in this section. Trials from 2006-2007 were harvested too late to be included in the 2007 Annual Research Report and are included here in addition to the trials established in 2007/08.

### *Materials and methods*

Much of the process for establishing rice OFDTs is similar to that used in other crops and the methods used to obtain the data presented in this report are as described in full in previous SoL Annual Research Reports (SoL, 2006; SoL, 2007).

Farmers were chosen using similar processes as for other crops. All farmers received 5kg bags of Nakroma seed but plot size varied according to each farmers' bunded paddy area. Half of each bay was planted to the new variety Nakroma, and half was planted to the local variety. Where possible, a 5m x 5m area was used for yield measurements, however at some sites smaller sample sizes were taken.

After harvest, the RAs measured the weight of wet threshed grain. This grain was then dried and weighed again. All of the weights quoted in the Results and Discussion section are for paddy rice (dry threshed un-milled weights). Data was entered into MS Excel and then GenStat Discovery Edition 4.2 for ANOVA (Unbalanced Model) analysis. All data included in this analysis was collected, entered and analyzed by SoL staff.

### *Results and discussion*

A total of 62 OFDT trials were installed for evaluation during the 2006-2007 season and 91 during the 2007-08 season. As mentioned in previous reports, the rice cropping areas were not distributed uniformly across Sub-Districts in which SoL works so the number of OFDT for rice was less than that for maize or peanuts. Although there were more females recorded as the primary rice farmer than in the 2007 report, OFDT irrigated rice farmers were still predominantly male (87% of all OFDTs). Reasons behind unsuccessful trials are set out in Table 55 Insufficient water and damage by animals remains the primary reasons for failure. Unfortunately in Aileu Sub-Districts, no yield data was obtained from any of the 7 established OFDTs.

**Table 55. Rice OFDTs established and lost, 2006/07 and 2007/08**

| *Trial* | *No. planted* | |
|---|---|---|
| | *2006/07* | *2007/08* |
| *Trials established* | *62* | *91* |
| *Losses by reason:* | | |
| • Drought | 4 | 3 |
| • Unsecured animals causing damage | 3 | 1 |
| • Weed competition | 1 | 0 |
| • Farmer did not wait for assistance with data measurement | 1 | 7 |
| • Destroyed by flood | 1 | 0 |
| • Farmer mixed seed at planting | 0 | 4 |
| *Trials lost* | *10* | *15* |
| ***Trials harvested*** | *52* | *76* |

### Yield

The yield advantage (when averaged over all Sub-Districts) in 2006-07 was 20% and in 2007-08, Nakroma out yielded the local by 30% (Table 56). This difference in yield varied somewhat between Sub-Districts (Table 57). As in 2005-06, the greatest yield advantage in both 2006-07 and 2007-08, was observed in the Baucau region. Overall rice yields were significantly higher in Baucau than in either Aileu or Liquica in 2006-07, but in 2007-08, yields were lower in Baucau than in Maliana or Same but this difference was not statistically significant.

**Table 56. Rice yields of OFDT, all Districts, 2006/07 and 2007/08**

| *Variety* | *Mean yield (t/ha)* | | *Yield advantage over local (%)* | |
|---|---|---|---|---|
| | 2006/07 | 2007/08 | 2006/07 | 2007/08 |
| Local | 3.0 | 3.7 | - | - |
| Nakroma | 3.6 | 4.8 | 20 | 30 |
| LSD (p=0.05) | 0.5 | 0.6 | | |

**Table 57. Yield of rice OFDT in SoL Sub-Districts, 2006/07 and 2007/08**

| *District* | *Sub District* | *2006/07* *No. sites* | *2006/07* *Yield of local, (t/ha)* | *2006/07* *Yield of Nakroma, (t/ha)* | *2007/08* *No. sites* | *2007/08* *Yield of local, (t/ha)* | *2007/08* *Yield of Nakroma, (t/ha)* |
|---|---|---|---|---|---|---|---|
| Aileu | Aileu Vila | 27 | 2.3 | 2.4 | | | |
| Baucau | Baucau Kota | | | | 17 | 2.7 | 5.0 |
| | Laga | | | | 6 | 5.0 | 5.1 |
| | Quilicai | | | | 8 | 3.8 | 4.9 |
| | Vemasse | 7 | 3.9 | 5.2 | 15 | 3.8 | 4.8 |
| | Venilale | 16 | 3.7 | 4.9 | 13 | 2.7 | 4.6 |
| Liquica | Maubara | 1 | 3.6 | 3.0 | | | |
| | Liquica | 1 | 3.8 | 4.2 | | | |
| Maliana | Atabae | | | | 3 | 6.1 | 6.4 |
| | Balibo | | | | 3 | 4.9 | 4.6 |
| Same | Alas | | | | 8 | 4.6 | 4.4 |
| Same | Faterberliu | | | | 3 | 5.1 | 4.6 |
| **LSD (.05)** | | | 2.3 | 2.3 | | 2.1 | 2.1 |

### Agronomic factors affecting yield

The various factors affecting yield of rice during 2006/2007 and 2007/2008 are presented in Table 58. In both seasons, the introduced variety, Nakroma (PSBRC54) produced significantly higher yields than the local varieties.

**Table 58. Significance of factors affecting rice yield, OFDTs 2006/07 and 2007/08**

| *Factor* | *Significance* 2006/07 | *Significance* 2007/08 |
|---|---|---|
| Variety | ✓ | ✓ |
| Sub-District | ✓ | ✗ |
| AEZ | ✓ | ✗ |
| Elevation | ✓ | ✓ |
| pH | ✗ | ✗ |
| Soil texture | ✗ | ✗ |
| Soil colour | ✗ | ✗ |

### AEZ

AEZ also had a significant effect on rice yield in 2006-07 but not in 2007-08. But in contrast to the results presented in the 2007 Annual Report (SoL, 2007), using data from 2005-06 season, rice yields were higher in the lower altitude AEZs below 500m than in AEZ 3. As explained in SoL (2007), high average yields in AEZ 3 in the 2005-06 season were largely due to some very high yields being recorded in Aileu Sub-District. However as Table 59 shows, yields in Aileu in the following 2006-07 season were significantly lower in comparison to other Sub-Districts. As mentioned above, no yield data was obtained from Aileu in 2007-08, which may have been able confirm which of these conflicting yield results at the high altitude sites in Aileu is more 'normal'. It is likely that there will be significant year to year variations in yield between Sub-Districts and AEZs, but one would expect that warmer, lower altitudes would produce higher rice yields than higher altitudes. A regression analysis of the effect of elevation on yield did produce a strongly significant negative correlation in both the 2006-07 ($R^2$ = -0.93) and 2007-08 ($R^2$ = -0.81) seasons. Both the local varieties and Nakroma had higher yields at lower altitudes but the yield advantage of Nakroma (particularly in 2007-08) appears to be greater at higher elevations (Table 59). There was no effect of soil pH, texture or soil colour on yield in either year.

**Table 59. Yield of rice OFDT by Agro-Ecological Zone, 2006/07 and 2007/08**

| *AEZ* | *Number of successful OFDTs* | | *Average yield local varieties (t/ha)* | | *Average yield Nakroma (t/ha)* | | *Yield advantage of Nakroma (%)* | |
|---|---|---|---|---|---|---|---|---|
| | *2006/07* | *2007/08* | *2006/07* | *2007/08* | *2006/07* | *2007/08* | *2006/07* | *2007/08* |
| 1 Northern coast (0-100m altitude) | 4 | 17 | 4.5 | 4.3 | 5.7 | 4.9 | 27 | 14 |
| 2 Northern slopes (100-500m altitude) | 4 | 9 | 4.4 | 4.7 | 5.1 | 4.9 | 16 | 4 |
| 3 Northern uplands (>500m altitude) | 44 | 39 | 2.7 | 3.0 | 3.3 | 4.8 | 22 | 60 |
| 4 Southern upland (>500m altitude) | - | - | - | - | | - | - | - |
| 5 Southern slopes (100-500m altitude) | - | 1 | - | 6.0 | | 6.1 | - | 2 |
| 6 Southern coast (<100m altitude) | - | 10 | - | 4.6 | | 4.3 | - | -7 |
| LSD (0.05) | | | 1.7 | 2.3 | 1.7 | 2.3 | | |

## Local rice varieties

The names of local rice varieties used as the local check in the rice OFDT were recorded for 42 of the 76 OFDT for which there was complete yield data in 2006-2007 (Table 60). Of the 16 kinds of local varieties used the most common 'local' varieties were Membramo an Indonesian variety released many years ago, IR 64 and 'Siaong' which was recorded in 5 sites in the Baucau region.

**Table 60. Local rice varieties included in OFDT 2007/08**

| *Local rice variety name* | *Number of OFDTs* | *Average plant height at these sites (cm)* | | *Average yields at these sites (t/ha)* | | *Yield advantage of Nakroma (%)* |
|---|---|---|---|---|---|---|
| | | Local | Nakroma | Local | Nakroma | |
| Membramo | 11 | 74 | 71 | 4.0 | 4.9 | 22 |
| IR 64 | 6 | 79 | 82 | 4.9 | 5.6 | 15 |
| Siaong | 5 | 121 | 75 | 4.2 | 6.0 | 44 |
| IR 5 | 4 | 67 | 68 | 4.5 | 5.2 | 15 |
| Nona Manis | 3 | 87 | 72 | 4.5 | 4.4 | 0 |
| Sisadare | 3 | 77 | 66 | 5.1 | 4.2 | -18 |
| Dinas | 1 | 83 | 89 | 6.2 | 6.7 | 7 |
| IR 8 | 1 | 54 | 52 | 2.0 | 4.2 | 103 |
| Kailaku | 1 | 80 | 56 | 3.5 | 3.2 | -9 |
| Kelemeak | 1 | 78 | 77 | 6.0 | 6.1 | 3 |
| PB30 | 1 | 75 | 82 | 1.1 | 3.3 | 188 |
| President | 1 | 69 | 72 | 1.5 | 3.1 | 105 |
| Riabu | 1 | 73 | 79 | 3.4 | 3.6 | 7 |
| Sele bete ana | 1 | 58 | 61 | 3.2 | 5.2 | 65 |
| Selhaima | 1 | 70 | 70 | 3.2 | 3.4 | 8 |
| Similate | 1 | 82 | 69 | 2.8 | 4.3 | 53 |
| Unrecorded local | 34 | 77 | 75 | 3.3 | 4.7 | 44 |

As indicated by the plant height measurements in Table 60, ‘Siaong’ is a particularly tall rice variety. ‘Nono manis’, ‘Sisadare’ ‘Kailaku’ and ‘Similate’ are also relatively tall but all other locals as well as Membramo, IR 64 and President are all of similar height to Nakroma. Nakroma had a yield advantage over all other varieties with the exception of ‘Sisadare’ (3 sites) and ‘Kailaku’(1 site)

**Effect of farmer management on yield**

The effect of farmer management on rice yield is presented in Table 61. In both seasons, the majority of farmers (> 50%) cultivated their paddies before planting using buffalo. In 2007-08, there was an increase in the number of farmers who used tractors. This is due to the increased availability of hand tractors as result of the MAF agricultural mechanization program. Using tractors apparently increased yields in 2006-07 but this effect was not repeated in 2007-08.

Almost all rice farmers, presoak seed before either broadcast seedling or planting nurseries. However not presoaking seed does not have a detrimental effect on subsequent yield.

There was a significant yield increase (6.8t/ha vs. 4.2) in 2007-008 where farmers broadcast seed rather than transplant seedlings. However this is likely to be a spurious result and due to other unknown factors specific to the few sites (5%) where farmers actually practice broadcast sowing.

In both years, transplanting seedlings early seems to result in higher yields. However this was only statistically significant in 2006-07. It is generally accepted that 21 days or less after sowing is the best transplanting time for modern varieties. Later transplanted seedlings suffer greater transplant trauma and mortality, however if seedlings are transplanted earlier than 3 weeks, water control and management also has to very good to ensure seedling survival. If this was the case, such as where System of Rice Intensification/Integrated Crop Management (SRI/ICM) methods are practiced, yields can be increased by early transplanting. Certainly early transplanting is far more desirable than the very late transplanting (> 4 weeks) practiced by a significant percentage (35-44%) of farmers participating in these OFDTs.

In 2006-07, the vast majority of farmers (81%) planted randomly, but more farmers began planting in lines the following year. Planting in lines resulted in significantly higher yields in 2006-07 but only slightly higher yields in 2007-08. All farmers appeared to plant at closer plant spacing in 2006-07, but in 2007-08 a few decided to plant at wider spacing with a significant yield penalty. Usually extra tillering compensates for lower plant density with little difference in subsequent rice yield. However this can depend on variety and other management factors.

There were very few participating farmers who applied fertilizer. Those 6 % that did in 2006-07 appeared to produce significantly higher yields, but there was no similar effect in 2007-08.

Surprisingly, the number of farmers who did not weed increased from 2006-07 to 2007-08 but this did not have any effect on yield

The average length of time from planting to harvest was 113 days for the local varieties and 111 for Nakroma and did not have any effect on rice yields.

**Table 61. Significance of management factors affecting OFDTs 2006/07 and 2007/08**

| Factor | | 2006/07 | | | 2007/08 | | |
|---|---|---|---|---|---|---|---|
| | | % farmers using | Yield (t/ha) | LSD (0.05) | % farmers using | Yield (t/ha) | LSD (0.05) |
| 1. | Cultivate with buffalo | 58 | 2.8 | | 54 | 4.5 | |
| | Cultivate with horse | 21 | 4.3 | 0.9 | 11 | 3.5 | Ns |
| | Cultivate with tractor | 21 | 4.8 | | 34 | 3.5 | |
| 2. | Pre-germinate seeds | 96 | 3.3 | | 97 | 4.3 | |
| | No pre-germination | 4 | 4.3 | Ns | 3 | 5.0 | Ns |
| 3. | Broadcast seeds | 6 | 3.0 | | 4 | 6.8 | |
| | Transplant seedlings | 94 | 3.3 | Ns | 96 | 4.2 | 1.6 |
| 4. | Transplant less than 2 weeks | 17 | 3.9 | | 6 | 5.3 | |
| | Transplant 2-4 weeks | 39 | 2.1 | 0.9 | 58 | 4.3 | Ns |
| | Transplant more than 4 weeks | 44 | 3.3 | | 35 | 4.0 | |
| 5. | Plant in lines | 19 | 4.3 | | 47 | 4,4 | |
| | Plant random | 81 | 3.1 | 0.8 | 53 | 4,2 | Ns |
| 6. | Wide planting distance | 0 | * | | 15 | 3.1 | |
| | Close planting spacing | 100 | * | | 85 | 4.5 | 0.9 |
| 7. | Applied fertilizer | 6 | 5.0 | | 3 | 4.4 | |
| | No fertilizer used | 94 | 3.2 | 1.24 | 97 | 4.3 | Ns |
| 8.. | No weeding | 25 | 3.6 | | 36 | 4.2 | |
| | Weeded once | 72 | 3.3 | Ns | 43 | 4.3 | Ns |
| | Weeded more than once | 3 | 2.4 | | 22 | 4.7 | |

As in previous years, farmers were asked about the disadvantages and advantages of Nakroma and the local variety they grew and the responses were the same. In general, farmers liked their local varieties as they were adapted to their climate and way of farming. The disadvantages of the local rice varieties were that they were tall and prone to lodging. Nakroma was desired by farmers as it is high yield; good taste (a little fragrant), white clean rice, short stem that is resistant to wind damage and produces an early harvest. Once again, there were no negative characteristics recorded for Nakroma.

## *Conclusion*

The test rice variety, Nakroma, continued to show significant increases in yield over locally available varieties across most Sub-Districts and AEZs in Timor Leste. And it continually appeared to produce a favourable response from farmers who were growing it for the first time.

# 2.5 Peanuts

## 2.5.1 Replicated trials, 2007-2008

Replicated trials to evaluate peanut varieties during 2007-2008 were conducted at Aileu, Baucau, Betano, and Maliana. Characteristics of the varieties used in the trials are as presented in Table 62. Varieties were initially sourced from ICRISAT and the local variety (Pt10) was sourced from Darasula, Baucau District.

**Table 62. Varietal characteristics, peanuts in replicated peanut trials 2007-2008.**

| *Code* | *Name* | *Botanical type* | *Seed colour* |
|---|---|---|---|
| Pt05 (Utamua) | ICGV 88438 | Spanish bunch | Brown |
| *Pt10 (Local)* | *Local Darasula* | *Timorese local* | *Brown* |
| Pt11 | ICGV 95058 | Spanish bunch | Brown |
| Pt12 | ICGV 96172 | Spanish bunch | Brown |
| Pt13 | ICGV 95069 | Spanish bunch | Brown |
| Pt14 | ICGV 96165 | Virginia | Red |
| Pt15 | ICGV 97128 | Virginia | Brown |
| Pt16 | ICGV 98378 | Spanish bunch | Brown |
| Pt17 | ICGV 98379 | Spanish bunch | Brown |
| Pt18 | ICGV 98381 | Spanish bunch | Brown |
| Pt19 | ICGV 98375 | Spanish bunch | Brown |
| Pt20 | ICGV 99017 | Spanish bunch | Brown |
| GN11 | ICGV 95278 | Spanish bunch | |
| *Lokal Boot (Betano)* | *Local Betano* | *Timorese local* | *Brown* |
| *Lokal Mean (Betano)* | *Local Betano* | *Timorese local* | *Red* |

### *Methodology*

One trial was held in each of Maliana, Baucau, Aileu and Betano in the wet season of 2007-2008. Maliana and Betano plots were 4m x 5m, while Fatumaka and Aileu plots were 5m x 5m. Planting distances were either 25 x 50cm or 30 x 50cm. The trials were planted in a randomized block design with four replications (excluding Aileu which had only 3 replications due to land limitations on the research station).

Planting and harvest dates and the mean yields are presented in Table 63. Pod yields differed between sites.

**Table 63. Trial site details peanut variety trials, 2007-2008.**

| *Location* | *Season* | *Number of entries* | *Planting date* | *Harvest date* | *Mean yield (t/ha)* |
|---|---|---|---|---|---|
| Baucau (Fatumaka) | Wet | 12 | 29-30 Nov 07 | 23 Apr 08 | 1.0 |
| Aileu (Kintal Port) | Wet | 12 | 29 Nov 07 | 21 Apr 08 | 1.1 |
| Maliana (Corluli) | Wet | 12 | 9 Jan 08 | 5 May 08 | 0.9 |
| Betano (Manufahi) | Wet | 15 | 9 Jan 08 | 10-14 May 08 | 0.4 |

### *Results*

Poor rainfall conditions in Betano in 2007-2008 severely influenced the crop whose yields dropped from an average of 1.86t/ha in the 2006-2007 wet season down to 0.4t/ha in 2007-2008. The average yields at Maliana also dropped from the previous year (1.48t/ha average), as did yields in Baucau and Aileu (2.19 t/ha and 2.23 t/ha respectively in 2007). However, some varieties performed consistently well across the research stations when compared to previous year’s data. Results from each research station for 2007-2008 are presented below.

**Fatumaka (wet season)**

Analysis of the Fatumaka peanut data indicated that there was significant variation between data collected from different columns within the blocks at the site (F prob 0.005). Figure 18 shows the trend in the unadjusted means of yields in each column, to demonstrate the affect observed at the site which is attributable to site environmental conditions as opposed to varietal differences

Due to the column effects at the site, REML analysis was used to analyze the data, using a regular grid spatial model in GenStat Discovery Edition 2 (AR1). The REML analysis adjusts the data accordingly to negate the column affects, and the results are displayed in Table 64 below.

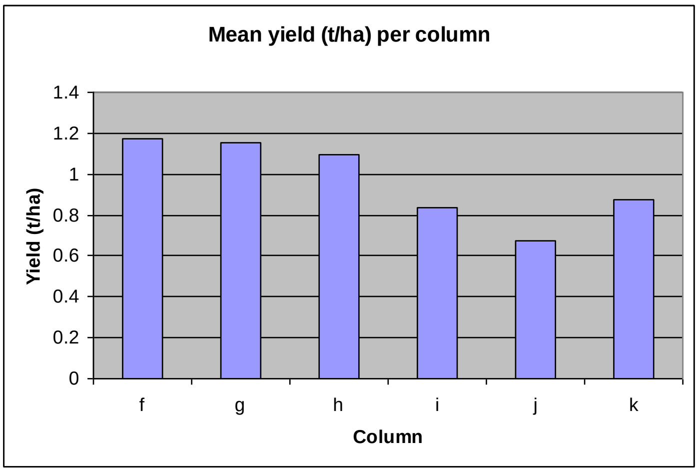



**Figure 18. Row effect on peanut yields at Fatumaka, 2007-2008.**

The peanut trial at Fatumaka had an average yield of 1.0 t/ha (Table 64). Plants per $m^2$, yield and seed weight were all significantly different amongst the varieties tested. Higher density plant stands did not correlate with higher production. The average plant density at Fatumaka was 5.3 plants/$m^2$. Individual seed size contributed to the higher yields. The local Darasula peanut variety (Pt10) and the ICGB variety Pt16 were the lowest yielding varieties (0.7 t/ha) and the highest was Utamua (1.3 t/ha).

**Table 64. Results of replicated peanut trial, Fatumaka 2007-2008 wet season**

| *Population* | *Plants per $m^2$* | *Yield (t/ha)* | *Seed weight (g/100)* |
|---|---|---|---|
| Pt05 (Utamua) | 3.8 | 1.3 | 85.7 |
| *Pt10 (Local Darasula)* | *5.0* | *0.7* | *54.7* |
| Pt11 | 5.7 | 1.2 | 61.0 |
| Pt12 | 5.6 | 1.0 | 47.2 |
| Pt13 | 5.9 | 1.0 | 47.7 |
| Pt14 | 5.7 | 1.0 | 60.6 |
| Pt15 | 5.5 | 1.0 | 68.0 |
| Pt16 | 5.4 | 0.7 | 40.2 |
| Pt17 | 4.8 | 0.8 | 62.5 |
| Pt18 | 5.8 | 0.9 | 64.2 |
| Pt19 | 5.3 | 1.1 | 59.0 |
| Pt20 | 5.1 | 1.0 | 63.1 |
| *Chi-sq prob* | *<0.001* | *0.004* | *<0.001* |
| *LSD* | *0.56* | *0.32* | *5.6* |
| *Mean* | *5.3* | *1.0* | *59.5* |

Utamua had significantly lower plant density recorded at harvest (3.8 plants/$m^2$) however was found to have the highest seed size (85.7 g/100 seeds), significantly higher than all other varieties in the test (LSD 5.6). This was due to the large seed weight of this variety.

**Aileu (wet season)**

Data analysis of the peanut data from Aileu showed that there were neither significant difference between rows nor columns at the site, therefore the analysis was done with a general balanced model.

The trial at Kintal Portugal, Alieu had an average yield of 1.1 t/ha. Plant stand, shelling ratio, yield and seed weights were all tested and compared and the results all showed significant differences among the varieties (Table 65). The highest yielding varieties at Aileu included Pt18 (1.5t/ha), Pt12 and Pt 17 (both 1.4t/ha).

Utamua had a significantly lower shelling ratio (60.2%) than all other varieties of peanuts tested at Aileu, but a significantly larger seed weight than all other varieties (111.8g/100 seeds).

Utamua yielded 0.8t/ha and was significantly lower than the Local Darasula variety (Pt10) which yielded 1.2t/ha (LSD 0.34). This may be due to the significantly lower number of pods per plant produced by Utamua (4.4) compared to the Darsula variety (9.5).

The plant stands at Aileu were much greater than at Fatumaka. Aileu had an average plant density of 8.4 plants/$m^2$ with all variety plant stands greater than the Fatumaka average.

**Table 65. Results of replicated peanut trial, Aileu 2007-2008 wet season**

| *Population* | *Plants per $m^2$* | *Shelling %* | *Yield (t/ha)* | *Seed weight (g/100)* | *Pods per plant* |
|---|---|---|---|---|---|
| Pt05 (Utamua) | 8.1 | 60.2 | 0.8 | 111.8 | 4.4 |
| *Pt10 (Local Darsula)* | *7.7* | *66.1* | *1.2* | *55.3* | *9.5* |
| Pt11 | 5.9 | 73.0 | 1.0 | 66.0 | 11.2 |
| Pt12 | 8.1 | 74.9 | 1.4 | 81.4 | 10.2 |
| Pt13 | 7.9 | 70.7 | 1.2 | 72.2 | 9.0 |
| Pt14 | 7.5 | 67.0 | 1.2 | 62.8 | 11.8 |
| Pt15 | 9.8 | 74.3 | 1.3 | 81.4 | 8.1 |
| Pt16 | 9.5 | 67.8 | 1.1 | 51.2 | 8.4 |
| Pt17 | 9.3 | 72.2 | 1.4 | 72.0 | 9.0 |
| Pt18 | 9.1 | 68.8 | 1.5 | 68.7 | 10.2 |
| Pt19 | 8.7 | 74.5 | 0.8 | 59.6 | 6.7 |
| Pt20 | 8.6 | 73.8 | 0.9 | 56.5 | 8.7 |
| *CV* | *9.8* | *4.8* | *11.9* | *12.7* | *21.7* |
| *F prob* | *0.011* | *<0.001* | *0.003* | *<.001* | *0.011* |
| *LSD* | *1.78* | *5.75* | *0.34* | *15.02* | *3.29* |
| *Mean* | *8.3* | *70.3* | *1.1* | *67.0* | *8.9* |

**Corluli (wet season)**

Initial analysis of the Corluli data indicated there were no significant locational effects between rows or columns at the Corluli site. Due to the plot layout being non-orthogonal, the data was analyzed using an unbalanced general model.

The average plant stand at the site was 3.2 plants/$m^2$, lower than Aileu and Fatumaka sites, but above the Betano site average. There was no statistically significant variation between the varieties at Maliana for plant stand. However Utamua (Pt5), the local Darsula variety (Pt10), and Pt15 each had plants stands of 4 plants/$m^2$ or above (Table 66).

There were significant differences between the yields of the varieties tested. Utamua (Pt5) was the highest yielding variety at the Maliana site with a yield of 1.9 t/ha, higher than 60% of the other varieties. Pt11, Pt14, Pt17 and Pt 19 also yielded above the site average with the poorest yielding variety being Pt20, due to its poor plant stand (1.3 plants/m$^2$).

**Table 66. Yield and yield components of peanut trial, Corluli 2007-08 wet season**

| *Population* | *Plants per m$^2$* | *Yield (t/ha)* |
|---|---|---|
| Pt05 (Utamua) | 4.2 | 1.9 |
| *Pt10 (Local)* | *4.6* | *0.9* |
| Pt11 | 3.8 | 1.0 |
| Pt12 | 2.0 | 0.5 |
| Pt13 | 3.5 | 0.5 |
| Pt14 | 2.2 | 1.2 |
| Pt15 | 4.0 | 0.8 |
| Pt16 | 4.3 | 0.7 |
| Pt17 | 3.6 | 1.5 |
| Pt18 | 2.4 | 0.7 |
| Pt19 | 3.0 | 1.1 |
| Pt20 | 1.3 | 0.1 |
| *F Prob* | *0.053* | *0.036* |
| *LSD* | *ns* | *0.92* |
| *CV%* | *ns* | *70.2* |
| *Mean* | *3.2* | *0.9* |

**Betano (wet season)**

There were no column or row affects observed in the initial data analysis of the Betano peanut data, therefore the analysis was done as a General Balanced ANOVA.

Three additional peanut varieties were tested in the Betano peanut trials that were not tested at the other research stations; two local varieties and GN11 (Local boot, Local mean). The trial at Betano had very poor yields for all tested varieties. This was due to the low rainfall and to some damage to the plots by dogs. The germination rates and plant stands at the site were poor, with 80% of the varieties tested being below 4 plants/m$^2$ at harvest time.

Pod yields amongst the varieties tested were significantly different from each other. However the average yield was low at only 0.4t/ha. Utamua was at average yield, and the highest yielding variety was the variety Lokal Mean, the red local peanut from Betano (0.9t/ha) which was significantly higher than all other varieties in the trial (LSD 0.27 t/ha). The seed weight for this variety was also significantly heavier than the majority (63%) of the other varieties. Utamua had a heavier than average seed weight (89g/100 seeds). This was only statistically higher than 50% of the varieties tested.

Lowest yielding varieties were GN11 (0.3 t/ha) and Pt16 (0.1t/ha). It is noted the poor yield of these two varieties was a result of poor germination rates and consequent poor plant stands. Of the ICGV varieties tested, Pt16 performed significantly poorer than the other varieties except Pt 14 and Pt19 which were both also less than the average yield at the site.

**Table 67. Yield and yield components of peanut trial, Betano 2007 wet season**

| *Population* | *Plants per m$^2$* | *Yield (t/ha)* | *Seeds weight (g/100)* |
|---|---|---|---|
| Pt05 (Utamua) | 4.3 | 0.4 | 89 |
| *Pt10 (Local)* | *3.7* | *0.5* | *71* |
| Pt11 | 3.3 | 0.4 | 62 |
| Pt12 | 3.6 | 0.6 | 74 |
| Pt13 | 4.6 | 0.6 | 59 |
| Pt14 | 3.6 | 0.3 | 67 |
| Pt15 | 3.8 | 0.5 | 61 |
| Pt16 | 0.2 | 0.1 | * |
| Pt17 | 4.2 | 0.5 | 91 |
| Pt18 | 3.3 | 0.4 | 75 |
| Pt19 | 1.4 | 0.2 | 59 |
| Pt20 | 3.8 | 0.4 | 73 |
| GN11 | 1.4 | 0.3 | 62 |
| *Local Boot* | *0.9* | *0.4* | *75* |
| *Local Mean* | *2.1* | *0.9* | *94* |
| *F prob* | *<.001* | *<.001* | *<.001* |
| *LSD* | *1.07* | *0.27* | *19.2* |
| *CV %* | *25.6* | *44.2* | *20.0* |
| *Mean* | *2.9* | *0.4* | *72.1* |

*Insufficient seed harvested from the plot to weigh 100 seeds

When all entries were compared across all research sites and three years of data, the varieties with the highest mean yield advantage over local varieties were Pt14 (35%), Pt15 (25%) and Utamua (21%) (Table 68). This indicates the requirement to further test Pt14 and Pt15 in OFDTs.

**Table 68. Mean peanut yield advantages (%) across seven sites 2005-2008.**

| | *Dry-Season 2006* | *Wet-Season 2005-2006* | *Wet-Season 2006/2007* | | | | *Wet-Season 2007/2008* | | | | *Mean Yield Adv 2005-2008* | *St. Dev* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Population* | *Btno* | *Btno* | *Cor* | *Ail* | *Btno* | *Bcu* | *Ail* | *Cor* | *Btno* | *Bcu* | | |
| Pt05 (Utamua) | 43 | -8 | -7 | -23 | 0 | 77 | -33 | 111 | -33 | 86 | 21 | 0.54 |
| *Pt10 (Local)* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *-17* | *0* | *-2* | *0.05* |
| Pt11 | 29 | -8 | -47 | 18 | 61 | 73 | -17 | 11 | -33 | 71 | 16 | 0.43 |
| Pt12 | 0 | 50 | -20 | 27 | 17 | -14 | 17 | -44 | 0 | 43 | 8 | 0.29 |
| Pt13 | 57 | 75 | -20 | -45 | 39 | 41 | 0 | -44 | 0 | 43 | 14 | 0.42 |
| Pt14 | 129 | 58 | 27 | 9 | 33 | 64 | 0 | 33 | -50 | 43 | 35 | 0.46 |
| Pt15 | 114 | 0 | 20 | 5 | 56 | 36 | 8 | -11 | -17 | 43 | 25 | 0.39 |
| Pt16 | 57 | 58 | -33 | -5 | 39 | 14 | -8 | -22 | -83 | 0 | 2 | 0.43 |
| Pt17 | 71 | 0 | -20 | 18 | 17 | 32 | 17 | 67 | -17 | 14 | 20 | 0.30 |
| Pt18 | 29 | 17 | 7 | -5 | 50 | 50 | 25 | -22 | -33 | 29 | 15 | 0.28 |
| Pt19 | 29 | 42 | 13 | -5 | 17 | 36 | -33 | 22 | -67 | 57 | 11 | 0.37 |
| Pt20 | 143 | 42 | -40 | 27 | -28 | 55 | -25 | -89 | -33 | 43 | 9 | 0.66 |

### Farmer Preferences

At the Kintal Portugal Research Station, Alieu, a farmer field day was held to assess farmers' preferences of the tested peanut varieties. Farmers were given the opportunity to judge peanuts based on various traits, and then to select two varieties that they would like to plant in their own fields, based upon their own individual preferred peanut traits. Also, each farmer was asked to assess the thickness of the shell, ease of shelling, oiliness and sweetness of the several varieties of peanuts when eaten.

Initially, farmers were presented with yield results for all the varieties tested at the Aileu research station. Then farmers were asked to test opening a few peanuts of each variety to allow them to comment on whether they thought the variety had a hard or soft shell, and whether they thought the shells were thick or thin (this relates to the seed weight ratio and also the ease of opening the shell). Generally the farmers considered the local variety to have a thinner and softer shell than the new varieties (Table 69). Utamua was given the highest percentage of votes (70%) for having a thick and hard shell (60%).

**Table 69. Farmers' characterisation of peanut shells (%).**

| *Variety* | *% farmers' characterization* | | | |
|---|---|---|---|---|
| | *Thick shell* | *Thin shell* | *Hard shell* | *Soft shell* |
| Pt05 (Utamua) | 70 | 30 | 60 | 40 |
| *Pt10 (Local)* | *33* | *67* | *31* | *69* |
| Pt11 | 24 | 76 | 39 | 61 |
| Pt12 | 55 | 45 | 41 | 59 |
| Pt13 | 52 | 48 | 57 | 43 |
| Pt14 | 55 | 45 | 60 | 40 |
| Pt15 | 29 | 71 | 15 | 85 |
| Pt16 | 57 | 43 | 55 | 45 |
| Pt17 | 49 | 51 | 37 | 63 |
| Pt18 | 29 | 71 | 28 | 72 |
| Pt19 | 23 | 77 | 39 | 61 |
| Pt20 | 53 | 47 | 53 | 47 |

Farmers were also presented with all varieties of the test so they could conduct a taste test on them. Firstly, they were asked to comment on whether they thought the peanut variety was oily or not, then whether the peanut was sweet, bland or bitter (Table 70).

**Table 70. Farmers' characterization of peanut taste (%).**

| *Variety* | *% farmers' characterization* | | | | |
|---|---|---|---|---|---|
| | Oily | Not oily | Sweet | Bland | Bitter |
| Pt05 (Utamua) | 64 | 36 | 72 | 28 | 0 |
| *Pt10 (Local)* | *76* | *24* | *68* | *18* | *15* |
| Pt11 | 65 | 35 | 62 | 24 | 15 |
| Pt12 | 71 | 29 | 56 | 17 | 28 |
| Pt13 | 58 | 42 | 68 | 22 | 10 |
| Pt14 | 67 | 33 | 68 | 27 | 5 |
| Pt15 | 53 | 47 | 64 | 25 | 11 |
| Pt16 | 57 | 43 | 45 | 35 | 20 |
| Pt17 | 77 | 23 | 74 | 7 | 19 |
| Pt18 | 83 | 17 | 59 | 23 | 18 |
| Pt19 | 44 | 56 | 76 | 14 | 11 |
| Pt20 | 50 | 50 | 50 | 31 | 19 |

Farmers did not appear to have consistent perceptions of oiliness as the data was variable. Sweetness of the peanuts was more precise, with 72% of farmers considering Utamua as Sweet and the remaining farmers saying it had no taste (bland). Pt19 and Pt17 were the two other varieties given a large percentage of votes for being sweet. It was also observed that the varieties Utamua and Pt14 had the lowest votes for bitterness.

The most popularly selected variety by farmers was Utamua with 24% of farmer selection, followed by Pt14 with 22%. Pt17 and Pt18 were also popular.

**Table 71. Farmers' selection of test variety for planting.**

| *Variety* | *% farmers choice* |
|---|---|
| Pt05 (Utamua) | 24 |
| *Pt10 (Local)* | *4* |
| Pt11 | 0 |
| Pt12 | 9 |
| Pt13 | 0 |
| Pt14 | 22 |
| Pt15 | 7 |
| Pt16 | 2 |
| Pt17 | 17 |
| Pt18 | 11 |
| Pt19 | 0 |
| Pt20 | 4 |

Correlation analysis was performed on all data from the Farmer Field Day however no factors (yield, taste, oiliness etc) were found to have a significant correlation with farmer's preferred choice of variety. Trends were seen however between farmer's choice of variety and bitterness of the variety, bitterness being a negative selection value (Figure 19). The two varieties with the lowest bitterness scores were the most popular varieties amongst the farmers. There was no correlation between the yield of the varieties at Aileu and the farmers' variety selection.

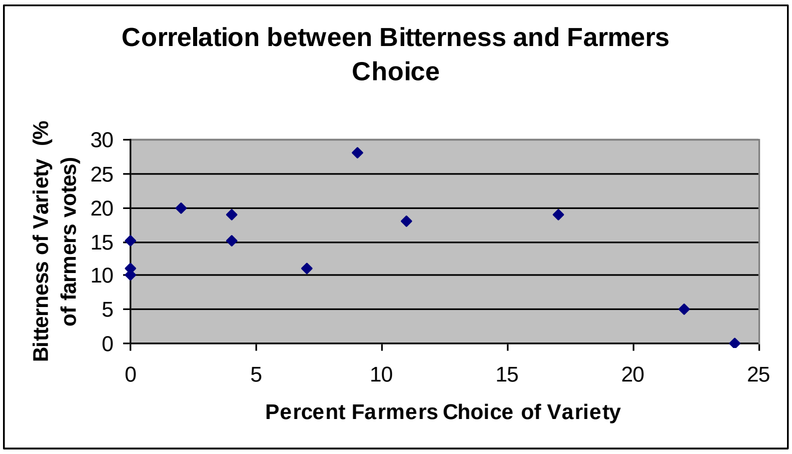



**Figure 19. Trend between farmers' selection of peanut variety (%) and bitterness.**

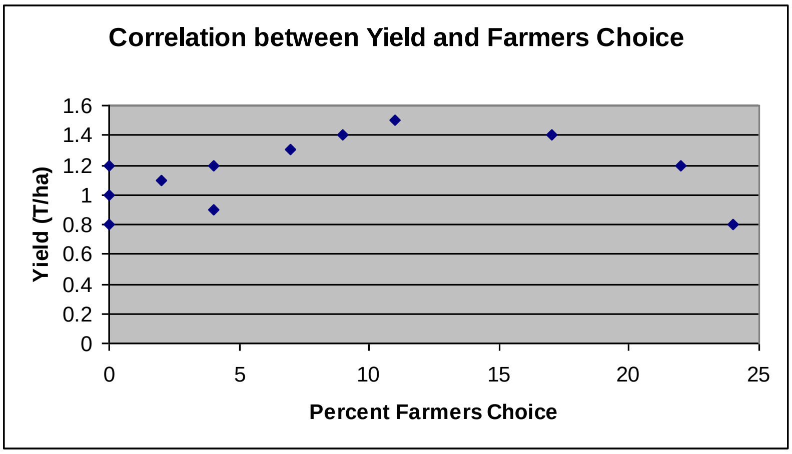



**Figure 20. Trend between farmers' selection of varieties (%) and yield (t/ha).**

**Gender**

Of the farmers attending the farmer field day, 8 out of the 36 were women. There was a significant affect of the gender of farmers on their choices of sweetness in the peanut varieties (F prob 0.023). Generally, female farmers tended to give more votes to sweetness than males. However there was no significant interaction between the variety and gender data. Gender was also found to give an impact to the characterization of the shell thickness (F prob 0.042). However there were no trends in the data to indicate patterns in the selection. The interaction of shell thickness selection and gender was not significant. The characterization of farmers to oiliness and shell hardness was similar in both men and women's votes.

There was inconsistency of the farmer's individual classification of desirable traits between peanut varieties.

## *Conclusions*

This is the second testing of the peanut varieties from ICRISAT (Pt11-Pt20) at the research stations. The released peanut variety Utamua was the most preferred peanut for various reasons, with Pt14 being the next most preferred variety.

Pt14, aside from having the highest yield advantage over the local varieties (35% above local) was also selected by farmers as one of the most preferred varieties for them to plant in their own fields. Although the data was inconsistent in regards to the shell traits, the majority of farmers considered the variety to be sweet and oily.

### 2.5.2 Peanut On-Farm Demonstration Trials (OFDTs) 2007-2008

Peanut OFDTs were established and monitored in a similar fashion to maize OFDTs, as described in the maize chapter above. The objective of the OFDTs was to test whether the new variety Utamua (code name Pt05) performed better than local peanut varieties when cultivated in farmers' fields at different locations, using local agronomy. Utamua is a large seeded peanut variety from India, released by MAF for use by subsistence farmers. The establishment of peanut OFDTs is also a way of distributing small quantities of Utamua seed (released and recommended by MAF) to farmers, for their consideration and potential adoption as a food or cash crop.

#### *Materials and methods*

Peanut OFDTs were established in a similar way as described in the 2007 Annual Research Report. The Research Assistants requested farmers to use their traditional planting system with the only exception being advice that pre-soaking of the Utamua seed prior to planting assists in achieving good plant stands.

204 peanut OFDTs were established in 16 Sub-Districts across East Timor, in 6 Districts (Aileu, Ainaro, Baucau, Liquica, Manatuto and Manufahi). The new Sub-Districts entered into include Hatuudo in Ainaro District, Natarbora in Manatuto District, and Fatuberliu and Turiscai in Manufahi. One Research Assistant was present in each Sub-District, with two in Baucau villa. 175 OFDTs were harvested with yield data collected.

Soil pH and texture were measured using the methodology described in the maize OFDT chapter.

Data was entered first into MS Excel and then GenStat Discovery Edition 3 for ANOVA (Unbalanced Model) analysis. Peanut yield data (dry weight in pods, t/ha) were analyzed by ANOVA (Unbalanced Linear Model) with variety and AEZ as constant factors in the model. The ANOVA output was used to test for significant effect of Sub District, variety and significant interactions between variety and AEZ. The influence of a wide range of factors on peanut yields was tested using an unbalanced ANOVA design. In turn a range of factors were added to the model, one at a time. Once a significant factor was identified, the interaction of that factor and variety was also tested for significance at the 0.05 level.

#### *Planting and harvesting times*

In the Districts tested, the peanut planting season generally started in mid-October, and harvesting was completed by the end of the first week of May 2008. Table 72 shows that over 91% of the OFDT sites were planted in November and December 2007, and the majority of OFDT sites were harvested in April.

**Table 72. Peanut OFDT planting and harvesting times, 2007-2008.**

| *Month* | *OFDTs planted (%)* | *OFDTs harvested (%)* |
|---|---|---|
| October 2007 | 2 | 0 |
| November 2007 | 39 | 0 |
| December 2007 | 52 | 0 |
| January 2008 | 6 | 0 |
| February 2008 | 1 | 1 |
| March 2008 | 0 | 26 |
| April 2008 | 0 | 58 |
| May 2008 | 0 | 15 |

Of the varieties tested in the trials, Utamua had an average growth duration of 129 days, and the local varieties had an average growth duration of 125 days.

## *Site Characteristics*

Peanut OFDTs were conducted on a wide range of elevations, soil pH, textures and slope across the 16 Sub-Districts.

### Elevation

The range of elevation of OFDT sites in 2007-2008 expanded from the previous year and ranged from sea-level in Vemasse Sub-District of Baucau, to over 1350 metres above sea level (masl). The average elevation was 578 masl, with the highest sites being measured at Suco Liurai in Aileu Sub-District (1353 masl).

**Table 73. Distribution of peanut OFDT sites by elevation (masl), 2006-2008**

| *Elevation (m)* | *Locations 2006-07 (%)* | *Locations 2007-08 (%)* |
|---|---|---|
| 0-150 | 21 | 22.7 |
| 150-350 | 13 | 9.4 |
| 350-550 | 13 | 16.3 |
| 550-750 | 21 | 14.3 |
| 750-950 | 11 | 19.2 |
| 950-1150 | 17 | 9.9 |
| 1150-1350 | 4 | 6.9 |
| >1350 | 0 | 1.5 |

### Soil pH

The average soil pH across all OFDT peanut test sites was 6.8, ranging from 4.5 to 9.0. This was slightly lower than the previous year (7.1). Less alkaline soils (those with pH 8.0 or above) were selected in 2007-2008 than in the previous year's trials. Approximately 17% of the sites are described as alkaline soils and 17% of the sites are also acidic (pH 5. 5 or less). 66% of the sites had soil pH values between 6.0 to 7.5 inclusive (Table 74).

**Table 74. Distribution of soil pH across peanut OFDT sites, 2006-2008**

| *Soil pH* | *Locations 2006-07 (%)* | *Locations 2007-08 (%)* |
|---|---|---|
| 4.5 | 2 | 3 |
| 5 | 3 | 3 |
| 5.5 | 10 | 11 |
| 6 | 12 | 15 |
| 6.5 | 12 | 18 |
| 7 | 10 | 20 |
| 7.5 | 16 | 13 |
| 8 | 17 | 13 |
| 8.5 | 14 | 3 |
| 9 | 4 | 1 |

Excluding Remexio, all Sub-Districts had an average soil pH which was neutral (Table 75). There was also a trend in the correlation between soil pH and soil elevation ($R^2$=0.57), with soil pH becoming more acidic as elevation increased (Figure 21). This result confirms the trends of decreasing pH with higher altitudes described in the maize OFDT data presented in Figure 8).

**Table 75. Average soil pH and elevation of peanut OFDTs, 2007-2008**

| *District* | *Sub District* | *Locations* | *Elevation* | *Soil pH* |
|---|---|---|---|---|
| Aileu | Aileu | 26 | 1026 | 6.5 |
| Aileu | Liquidoe | 7 | 1146 | 5.9 |
| Aileu | Remexio | 7 | 932 | 5.4 |
| Baucau | Baucau | 22 | 437 | 7.5 |
| Baucau | Laga | 6 | 431 | 7.4 |
| Baucau | Quilicai | 17 | 467 | 7.2 |
| Baucau | Vemasse | 17 | 539 | 6.9 |
| Baucau | Venilale | 18 | 868 | 6.3 |
| Liquica | Liquica | 14 | 328 | 7.3 |
| Liquica | Maubara | 15 | 251 | 6.5 |
| Manatuto | Natarbora | 13 | 196 | 6.9 |
| Manufahi | Alas | 11 | 121 | 7.4 |
| Manufahi | Fatuberliu | 4 | 40 | 7.1 |
| Manufahi | Hatuudo | 7 | 246 | 7.2 |
| Manufahi | Turiscai | 11 | 1189 | 6.1 |
| Manufahi | Same | 9 | 926 | 6.5 |
| **LSD (P<0.05)** | | | | 0.55 |

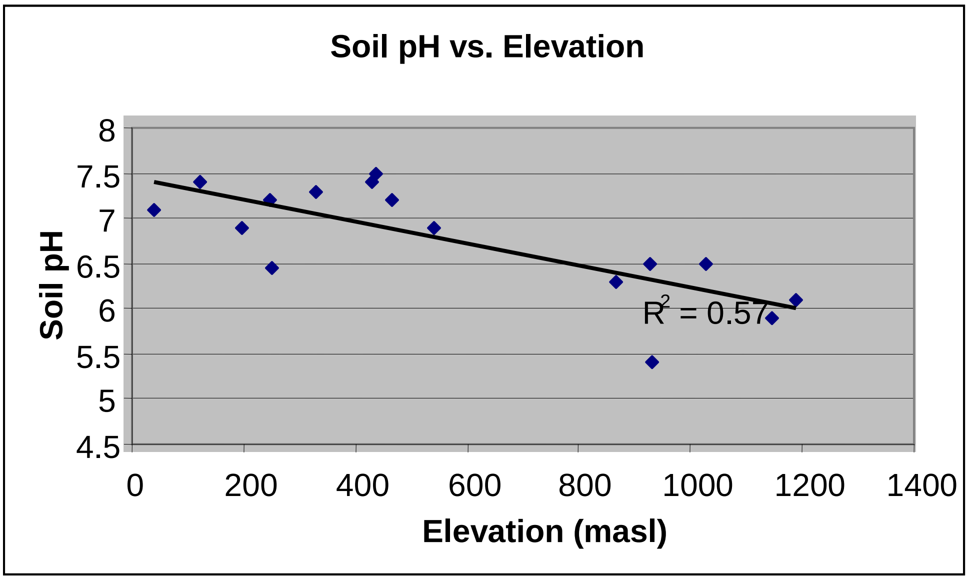



**Figure 21. Soil pH Vs elevation of peanut OFDTs, 2007-2008**

## Soil Texture

Of the OFDT soils tested, 65% were clay soils with the rest being loamy soils (Table 76). No peanut OFDT sites were planted in sandy soils.

**Table 76. Distribution of soil texture in peanut OFDTs, 2007-2008**

| *Soil texture* | *Locations (%)* |
|---|---|
| Silty Loam | 10 |
| Sandy Loam | 13 |
| Loam | 14 |
| Clay Loam | 21 |
| Fine Clay | 28 |
| Heavy Clay | 16 |

## *Results and discussion*

A total of 204 peanut OFDTs were established and 175 locations were harvested with results recorded.

Trial losses were largely due to lack of fencing and consequent damage by animals, and uncontrollable environmental factors such as drought and landslides (Table 77). Of the total plots not harvested, 31% were due to animal damage, 38% due to environmental conditions and the remainder being an impact of the farmers misunderstanding about the OFDT or lack of interest in data collection.

**Table 77. Reasons for incomplete peanut OFDT data 2007-2008**

| *Trial*<br>*Trials Established*<br>*Losses by reason:* | | *No of OFDTs*<br>*204* | *%* |
|---|---|---|---|
| Animal damage | Eaten by goats | 1 | 31 |
| | Eaten by pigs | 3 | |
| | Eaten by cows | 2 | |
| | Eaten by horses | 2 | |
| | Eaten by rats | 1 | |
| Environmental conditions | All plants died | 1 | 38 |
| | Chlorotic leaves | 1 | |
| | No pods developed | 1 | |
| | Plot washed away by the river | 4 | |
| | Drought | 2 | |
| | Landslide/erosion | 2 | |
| Farmer misunderstanding | Farmers harvested the plots prior to RA presence | 1 | 28 |
| | Farmers didn't follow planting instructions | 3 | |
| | Too many weeds in plot | 2 | |
| | Eaten by adults before harvest | 1 | |
| | Eaten by children before harvest | 1 | |
| Unclear | Unclear | 1 | 3 |
| Trials Lost | | 29 | |
| **Trials Harvested** | | 175 | |

### Yield

Initial analysis of the peanut OFDT data indicated significant differences in yields of Utamua and the local peanut varieties across OFDTs in all Sub Districts in the 2007-2008 cropping season.

As in the 2006-2007 OFDTs, plant density significantly impacted on the peanut yields. The average plant density for Utamua was 7.4 plants/$m^2$ and for local varieties 9.2 plants/$m^2$. The increase in the density of the Utamua plant stands as seen from the 2006-2007 data is possibly due to the recommendation by research assistants that farmers soak seed prior to planting. Pre-soaking Utamua gives the seed better access to moisture so it is not inhibited by limited soil moisture at time of planting due to its large seed size compared to local varieties. 32% of farmers pre-soaked seed in accordance with advice from the research assistants.

### Yield components

**Table 78. Yield components of local peanut and Utumua across all on-farm trials, 2007/08**

| *Variety* | *Yield (t/ha)* | *Plant density (plants/$m^2$)* | *Seed size (g/100 seeds)* | *Yield per plant (g/plant)* |
|---|---|---|---|---|
| Local | 1.5 | 9.2 | 7.2 | 16 |
| Utumua | 2.0 | 7.4 | 9.2 | 27 |
| **LSD (P<0.05)** | 0.21 | 1.1 | 0.07 | 4 |

Analysis of the yield components in Table 78 above shows that although Utamua has a mean plant density which is significantly lower than the Local varieties, it has however a much higher seed weight per plant, and seed weight (g/100 seeds) which correlates with the higher yields observed.

### Location

The differences in yield at the Sub District level are shown in Table 79. Yields of Utamua were highest in Quelicai Sub District of Baucau (3.7t/ha, significantly higher than all other Sub-Districts). The newly added Sub District Natarbora in Manatuto also yielded well (2.4t/ha).

An interaction between Sub District and variety was found to be significant in the peanut OFDT data (F prob 0.016). This indicates an inconsistent yield difference between Utamua and the local peanuts in different Sub Districts. For example Sub District Quelicai, Natarbora, Venilale, Vemasse, Baucau and Hatuudo, Utamua yielded significantly higher than local varieties.

**Table 79. Peanut OFDT mean yields (air-dried nut in shell) by Districts, 2007-2008**

| *District* | *Sub District* | *No of OFDTs* | *Mean yield local* | *Mean yield of Utamua (t/ha)* | *Yield advantage of Utamua 2007-08 (%)* | *Yield advantage of Utamua 2006-07* |
|---|---|---|---|---|---|---|
| Ainaro | Hatuudo | 7 | 1.2 | 2.1 | 68 | - |
| Aileu | Aileu | 26 | 0.8 | 1.1 | 25 | 0 |
| | Liquidoe | 7 | 2.4 | 2.2 | -8 | 20 |
| | Remexio | 7 | 1.9 | 2.2 | 14 | 116 |
| Baucau | Baucau | 22 | 1.5 | 2.3 | 56 | 57 |
| | Laga | 6 | 1.3 | 0.9 | -28 | 1 |
| | Vemasse | 17 | 1.2 | 2.1 | 80 | 11 |
| | Venilale | 18 | 1.2 | 2.2 | 79 | 0 |
| | Quilicai | 17 | 2.4 | 3.7 | 53 | 650 |
| Manatuto | Fatuberliu | 4 | 1.5 | 1.6 | 2 | - |
| | Natarbora | 13 | 1.3 | 2.4 | 90 | - |
| Liquica | Liquica | 14 | 1.3 | 1.6 | 27 | -18 |
| | Maubara | 15 | 1.5 | 1.8 | 22 | 7 |
| Same | Alas | 11 | 1.5 | 1.5 | 0 | 0 |
| | Same | 9 | 2.0 | 2.3 | 14 | 37 |
| | Turiscai | 11 | 1.2 | 0.7 | -40 | |
| *Total* | | *204* | | | | |
| *Mean* | | | *1.5* | *2.0* | *30.0* | |
| *LSD (P<0.05)* | | | | *0.828* | | |

The results presented in Table 79 indicate that in 12 of the 16 Sub-Districts, Utamua had a positive yield advantage. After the first year of testing in Natarbora, the yield advantage of Utamua was 90.8%. Local varieties performed better than Utamua in Turiscai, Laga and in Liquidoe. In Fatuberliu there was no significant difference between the yield of local varieties and Utamua.

There were large differences between the results from this year and the previous year, indicating the need for defining of the factors that give differing results of Utamua at different Sub Districts in OFDTs.

Plant density had a significant impact on yields, and may have been responsible for yield interacting between varieties and Sub Districts. In Turiscai, plant density was an average of 17.5 plants/m$^2$ for local varieties. However for Utamua, the plant density was only 8.2 plants/m$^2$. This may be the reason for the significantly lower yields of Utamua in this Sub-District. This is similar in Liquidoe where local plant density was 25.9 plants/m$^2$ for local varieties and only 16.6 plants/m$^2$ for Utamua. Plant densities in Laga and Fatuberliu were similar for both varieties of peanut.

There was a significant interaction between plant density and variety for crop yield (Figure 22). At high plant density, Utamua produced a much higher yield than local peanuts; however there is less difference between varieties at low densities (less than 5 plants/m$^2$). The interaction between variety and crop density explains 24.8% of the variation in yield across all sites and both varieties.

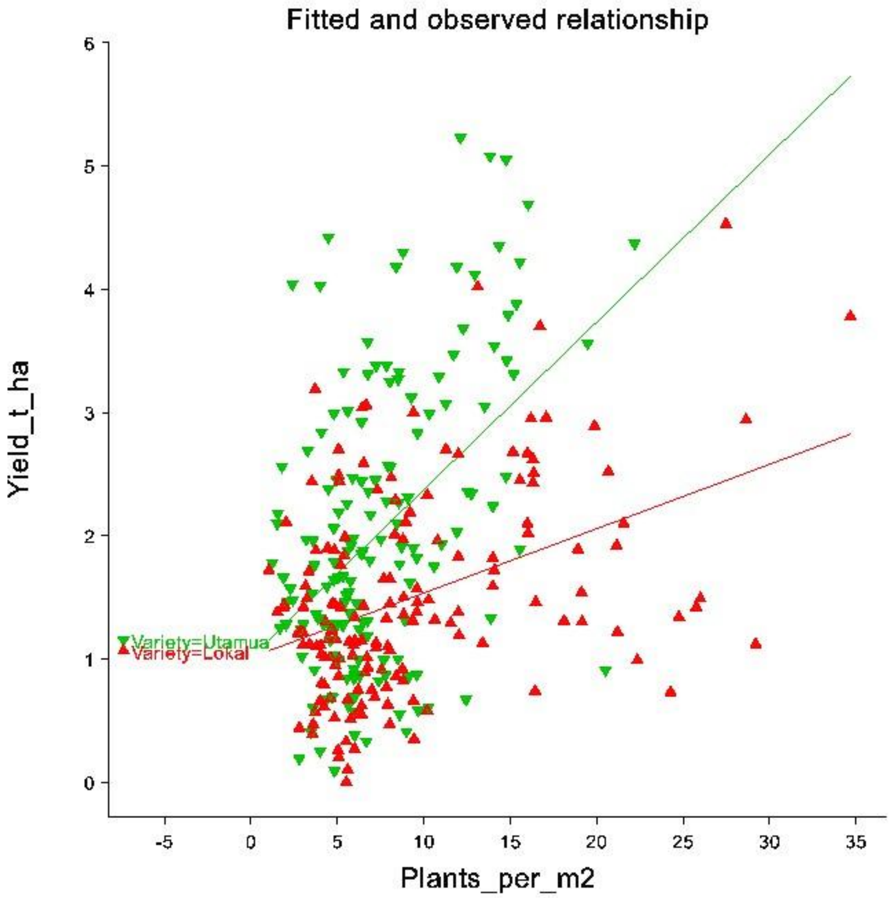



**Figure 22. Interaction between variety and plant density for yield, 2007-2008**

Due to the interaction, it is expected that yield figures in many Sub-Districts would be higher given a higher planting density of Utamua. As a result, although Utamua had a yield advantage over the local varieties in the Sub District of Remexio, it is expected this would be higher if planting densities were the same for local and Utamua. Local peanuts were planted at an average of 19.6 plants/$m^2$, however Utamua only 10.8 plants/$m^2$.

### AEZ

Mean peanut yields were significantly influenced by AEZ. As in 2006-2007, there was no significant interaction between the effect of variety and AEZ, as varieties generally performed similarly in all AEZs. Utamua had higher average yields than local varieties in all zones (Table 80).

**Table 80. Peanut OFDT mean yields and yield advantage by AEZ, 2007-2008**

| *AEZ* | *Percentage of sites* | *Yield of local (t/ha)* | *Yield of Utamua (t/ha)* | *Yield advantage of Utamua (%)* |
|---|---|---|---|---|
| 1- Northern coast (0-100m) | 8 | 1.3 | 1.7 | 36.0 |
| 2- Northern slopes (100-500 | 19 | 1.7 | 2.6 | 47.4 |
| 3- Northern uplands >500m | 46 | 1.4 | 1.9 | 33.7 |
| 4- Southern upland >500m | 11 | 1.4 | 1.6 | 9.7 |
| 5- Southern slopes (100-500 | 6 | 1.3 | 2.1 | 66.8 |
| 6 Southern coast (<100m) | 10 | 1.5 | 1.9 | 27.7 |
| Mean (175 sites) | | 1.5 | 2.0 | |
| LSD (P<0.05) [1] | | 0.47 | | |

[1] LSD for main effect of AEZ

The interaction of elevation and plant density/m$^2$ was highly significant to yield as was the interaction of variety and plants/m$^2$. A Linear Regression (<0.001), using these fitted terms of plant density and variety, against elevation, shows that the affect of elevation also had a significant affect on yield (Figure 23). The variety, plant density and elevation factors used in the regression model account for 31.4% of the variance of the data set.

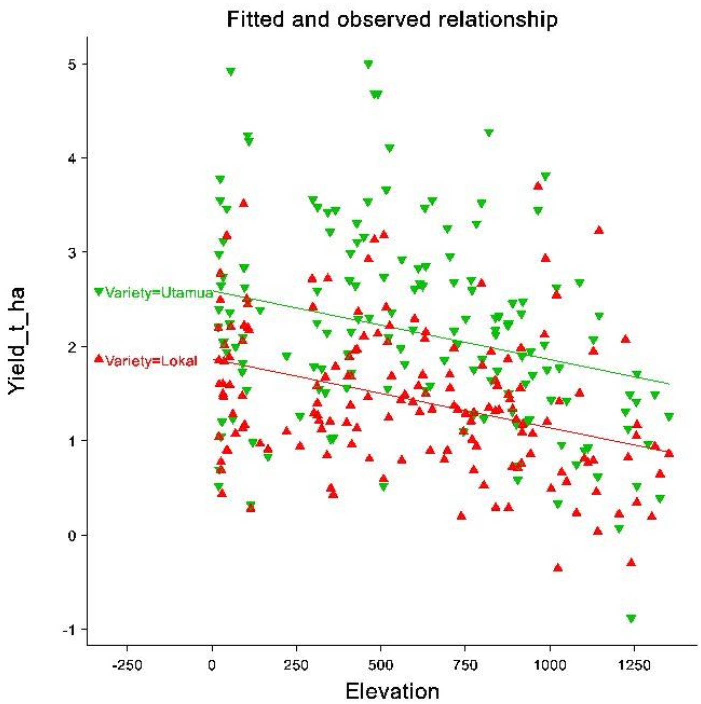



**Figure 23. Interaction between elevation and peanut yield, 2007-2008**

### Agronomic Factors

Using an Unbalanced ANOVA model with Variety and AEZ as permanent factors and plant density as a covariate, it was found that many other factors also had a significant effect on yield (Table 81).

**Table 81. Various factors affecting peanut OFDT yields, 2007-2008**

| *Factor* | *F pr.* | *Significant 2007-2008* | *2006-07* |
|---|---|---|---|
| AEZ | <0.01 | ✓ | ✓ |
| Variety | <0.01 | ✓ | ✓ |
| Sub-District | <0.01 | ✓ | ✓ |
| Planting distance | <0.01 | ✓ | × |
| Tools used for land preparation | <0.01 | ✓ | × |
| Soil pH | 0.002 | ✓ | × |
| Slope class | 0.003 | ✓ | × |
| Number of staff visits | <.001 | ✓ | × |
| Soil texture | 0.05 | ✓ | ✓ |
| Random or line planting | - | × | × |
| Number of growing days | - | × | × |
| Number of seeds per hole | - | × | × |
| Number of weeding events | - | × | ✓ |
| Soil colour | - | × | × |
| Maize result from 2005-2006 year | - | × | × |
| Mixed planting of monoculture | - | × | × |
| Gender | - | × | × |
| Seed soaked before planting | - | × | × |

### Soil texture

Soil texture had a significant effect on peanut yield in 2007-2008 as it did in the previous year. Clay loam soils and fine clay soils had higher average yields. Silty loam soils had a significantly lower average yield than most other soil textures (Table 82).

**Table 82. Effect of soil texture on peanut OFDTs, 2007-2008**

| *Soil texture* | *Yield t/ha* | *Locations (%)* |
|---|---|---|
| Silty loam | 1.3 | 10 |
| Sandy loam | 1.6 | 13 |
| Loam | 1.7 | 13 |
| Clay loam | 1.8 | 21 |
| Fine clay | 1.9 | 28 |
| Heavy clay | 1.6 | 15 |
| **LSD (P<0.05)** | 0.4 | |

### Number of weeding events

As in the previous year, the number of times farmers weeded their fields had an effect on peanut yield although it was not significant. There was also no significant interaction between the number of weeding times and the variety of peanut indicating the same affect of weed burden for Utamua as for local varieties.

Sixty three percent of farmers only recorded weeding one time after the planting of the peanut crops, with 25% weeding twice and the remainder three or four times (Table 83).

**Table 83. Effect of weeding on peanut yields in OFDTs, 2007-2008**

| *Number of Weeding Events* | *Percent of crops* |
|---|---|
| 1 | 63 |
| 2 | 25 |
| 3 | 9 |
| 4 | 4 |

## Tools used for land preparation

Various tools are used by farmers for land preparation. Commonly, a single metal rod (aisuak) is used by farmers. However some have access to plows pulled by buffalo. Table 84 shows that use of a buffalo-pulled plow gives the highest yields, significantly higher than all other methods used, but occurs at very low frequency.

The OFDT data reported that 22% of farmers were able to access tractors (two and four wheel tractors) for land preparation during the cropping season.

**Table 84. Effect of land preparation tools on peanut OFDTs, 2007-2008**

| *Tools used for land preparation* | *Percentage of OFDTs* | *Yield (t/ha)* |
|---|---|---|
| Single metal bar | 22 | 1.9 |
| Hoe | 45 | 1.6 |
| Pick | 9 | 1.5 |
| Animal pulled plough | 2 | 3.1 |
| Tractor | 22 | 1.8 |
| LSD (P<0.05) | | 0.6 |

### Soil pH

Table 85 shows that the majority of sites selected for peanuts in 2007-2008 were planted in a soil with pH ranging between 5.5 and 8. The highest yields were achieved in a neutral soil pH of 7, which gave significantly higher yields than the extreme acid and alkaline soil types (Table 85). The effect of soil pH on yield was not significant in 2006-2007.

**Table 85. Effect of soil pH on peanut OFDTs, 2007-2008**

| *Soil pH* | Locations 2007-08 (%) | *Yield (t/ha)* |
|---|---|---|
| 4.5 | 3 | 1.2 |
| 5 | 3 | 0.8 |
| 5.5 | 11 | 1.6 |
| 6 | 15 | 1.6 |
| 6.5 | 18 | 1.7 |
| 7 | 20 | 2.1 |
| 7.5 | 13 | 1.7 |
| 8 | 13 | 1.8 |
| 8.5 | 3 | 2.0 |
| 9 | 1 | 0.9 |
| LSD (p<0.05) | | 0.6 |

## Slope class

Slope class was found to have a significant affect on the production of peanut varieties in the 2007-2008 trials. Sites with greater slope than 30% yielded significantly lower than other less sloping sites (Table 86). No such effect was found in the preceding season.

Table 86. Effect of slope class on peanut OFDTs, 2007-2008

| *Slope Class* | *Yield (t/ha)* |
|---|---|
| 0-2% | 1.7 |
| 2-5% | 2.0 |
| 5-8% | 2.0 |
| 8-10% | 1.6 |
| 16-30% | 2.0 |
| >30% | 0.9 |
| LSD (P<0.05) | 0.5 |

## Number of staff visits

In contrast to the previous year, the number of times the RAs visited the farmers had an affect on the peanut yields. Figure 24 shows the trend in increasing yield due to increasing number of visits. Yields increase as staff visits increase from 4 to 6, and then do not increase further.

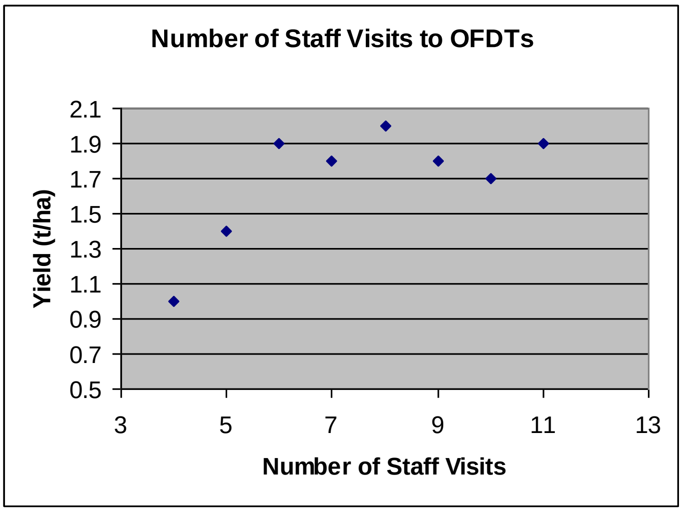



**Figure 24. Relationship between staff visits and peanut yields, 2007-2008**

## Farmer preferences

Farmers choice of peanut variety varies. After the farmers harvested their OFDTs, the research assistants provided them the opportunity to comment on whether or not they would plant the varieties again, and why.

**Table 87. Farmers' reasons for replanting peanut varieties after OFDT.**

| *Reason for replanting* | *Local (%)* | *Utamua (%)* |
|---|---|---|
| Large nuts | 0 | 80 |
| Easy to harvest / pull | 1 | 4 |
| Tastes good | 11 | 4 |
| New variety | 0 | 4 |
| Many seeds per pod | 10 | 3 |
| Many pods | 5 | 2 |
| Good price | 0 | 1 |
| Shell easy to open | 0 | 1 |
| All branches yield pods | 0 | 1 |
| Wide leaves | 0 | 1 |
| Adapted to the climate | 5 | 0 |
| Can make money | 1 | 0 |
| Only three month duration | 2 | 0 |
| New variety not yet common | 4 | 0 |
| The variety belongs to the land | 42 | 0 |
| Three nuts per pod | 5 | 0 |
| Large pods | 1 | 0 |
| Fast yielding | 12 | 0 |
| Good germination rate | 1 | 0 |
| Shell soft to open | 1 | 0 |

Most (80%) farmers who wanted to replant Utamua chose to do so due to its large seed size. Other reasons included the ease of harvesting the plants, and the fact that it is simply a new variety to grow.

Of the farmers commenting on their local varieties, 42% said the reason to replant was that the variety was 'rai nain', or that it is the area's own variety. Other common comments were that the local varieties are fast yielding, have many nuts per pod and are adapted to the local climate.

Only one farmer commented on the disinterest of replanting his local peanut variety. The reason was that the local variety was difficult to harvest, in that the majority of the pods remain in the ground when you pull up the plant. No farmers reported a reason to not want to plant Utamua again.

### *Conclusion*

In the third year of OFDT testing Utamua consistently showed a yield advantage over the local varieties in the majority of Sub-Districts. A significant affect of plant density must be considered in further research and in order to make specific technological recommendations for maximizing farmers' Utamua yields.

# 2.6 Mungbean

Beans are an important source of protein in the maize – rice based diet of East Timor. Mungbean (*Vigna radiata*) possessing 22-28% protein, is grown in small plots on farms spread across the country and consumed on-farm or sold in local markets. The grain is harvested after drying on the plant and boiled for consumption.

## 2.6.1 Replicated trial

Eight mungbean varieties which were successfully grown in East Timor by other organizations during 2006-2007 were selected for further evaluation by the Seeds of Life program in 2007-2008. Three of these varieties were recently sourced from Indonesia and one from Cambodia. Three other varieties have been cultivated in Timor Leste for a number of years. A replicated trial (three replicates) was designed and established at Betano Research Station on 29 May, 2008. It was installed as a randomized complete block with plot sizes of 5m x 3m. Twelve rows were planted spaced 25 cm between rows and 15 cm between hills. More than one seed was planted at each hill to bring the plant population to over 27 plants each square metre. The mean population density was approximately 35 plants/m$^2$ (Table 88). Some test varieties possessed modern breeding traits, maturing quickly with the first and major harvest being as early as 60 days after planting. Three of the varieties were indeterminate and took three months (90 days) to mature (Besicama and Suai in Table 88).

The ten middle rows were harvested, using the outer two as guard rows. Grain yields of the two highest yielding varieties, Sriti and Murai exceeded 1.5 t/ha, a yield high enough to be commercially viable if grown on a larger area. These yields may be higher in future trials when plant populations are lifted to 50 plants per square metre. The good yields also indicate that Betano is a suitable site for such trials to be conducted. Three new varieties from Australia will be added to this trial for evaluation later in the year.

**Table 88. Mungbean variety trial, Betano, 2008**

| *Variety* | *Country of origin* | *Production (t/ha)* | *No. plants/m$^2$* | *Days to first harvest* |
|---|---|---|---|---|
| Sriti | Indonesia | 1.73 | 33.5 | 60 |
| Murai | Indonesia | 1.54 | 36.3 | 60 |
| Metan | East Timor | 1.39 | 37.1 | 70 |
| Merpati | Indonesia | 1.38 | 37.4 | 60 |
| Besicama | East Timor | 1.01 | 35.8 | 90 |
| Suai | Cambodia | 1.00 | 36.8 | 90 |
| Amo Pedro | East Timor | 0.83 | 35.1 | 60 |
| Balibo | East Timor | 0.82 | 35.3 | 90 |
| LSD ($P<0.05$) | | 0.41 | ns | na |

## 2.7 Temperate cereals

### 2.7.1 Temperate cereal observational trials, 2007-2008

One observation plot of temperate cereals was conducted in Maubisse during the second wet season for that area. Wheat and barley (both referred to locally as trigu) are commonly grown in areas above 2000m in East Timor. The varieties are tall (non- semi dwarf) and are probably descendants of Portuguese wheat varieties. It is unknown when the most recent wheat or barley introductions were made.

Although wheat from Maubisse has been used to make wheat flour for baking in the past, wheat and barley are now eaten in a similar manner to maize at lower altitudes. The grain is pounded to rice-size grit pieces and then boiled with green leafy vegetables and beans to be eaten as a thick porridge.

#### *Materials and methods*

The introduced wheat and barley varieties are commercial Australian varieties and were sourced from CSIRO Canberra. A winter and a spring wheat were selected to see if winter or spring varieties would be most suitable.

The observation plots were grown in a farmer's field as a single replication. All plots were planted on 28 April, 2008 and harvested from 2 to 9 October, 2008 (Plots were 2 rows, 15cm apart and 5m in length). Within each row, hills were spaced 15cm apart, planted with 4 seed per hole.

**Table 89. Wheat and barley varieties planted in Maubisse, 2008**

| *Species* | *Variety* | *Planted* | *Harvested* |
|---|---|---|---|
| Spring wheat | Silverstar | 28/04/2008 | 7/10/2008 |
| Spring wheat | Lokal Titboa | 28/04/2008 | 2/10/2008 |
| Winter wheat | Merimba | 28/4/2008 | Did not flower |
| Barley | Proctor | 28/04/2008 | 7/10/2008 |
| Barley | Naked barley | 28/04/2008 | 9/10/2008 |
| Barley | Local Aisnata | 28/04/2008 | 9/10/2008 |

At harvest, the whole plot was reaped and threshed. The grain was sun dried to an approximate 12% moisture content before being weighed for yield determination. Subsets of 5 hills were randomly selected from the plots to measure tillers per plant, plant height, and head length. The seed numbers per head were measured from 5 plants.

## *Results*

### Growth habit

All wheat and barley varieties grown in the trial established well, flowered and set grain, with the exception of Merimba, a winter wheat. Merimba did not flower and remained vegetative throughout the testing period. It was concluded therefore that spring wheat only should be tested for introduction and testing in Timor.

### Disease and pest reaction

On 3 September (mid grain filling) the trial was inspected for disease and pest problems. All varieties under test with the exception of the winter wheat showed low levels of degenerated heads. Some heads were dried and withered, whereas others seem to have black fungal mass growing in the seed bracts. Often the degenerated heads were associated with stem damage below the developing head. No identification of stem borer species was made and the damage level was less than 1% across all varieties. There was no obvious difference in damage between the varieties.

A form of rust disease was very evident on the local wheat variety. More than 90% of the leaves below the flag leaf had approximately 50% coverage by rust lesions. There was no rust evident on the introduced wheat varieties or on any of the barley.

The varieties did not establish equally well. Although 4 seeds were planted per hill, not all plants established, reducing the plant populations. The naked barley had the lowest density of established hills, followed by the local barley (Table 90).

The highest yield of the observation plots was for the wheat variety Silverstar, 40% above the local wheat variety. The introduced barley varieties also yielded more than the local barley, with the variety Proctor yielding more than the naked barley.

**Table 90. Yield of temperate cereals tested in Maubisse, 2008**

| *Species* | *Variety* | *Hill density (hills/m$^2$)* | *Height (cm)* | *No. tillers per plant* | *Head length (cm)* | *Yield (t/ha)* |
|---|---|---|---|---|---|---|
| Wheat | Silverstar | 74 | 69 | 1.3 | 6.6 | 6.6 |
| Wheat | Lokal Titboa | 80 | 111 | 2.2 | 7.3 | 4.6 |
| Barley | Proctor | 79 | 86 | 2.8 | 8.0 | 3.7 |
| Barley | Naked barley | 31 | 99 | 3.0 | 8.7 | 3.5 |
| Barley | Local Aisnata | 51 | 114 | 2.5 | 7.8 | 3.0 |

Grain yield across the test varieties was correlated with the density of established hills and with the higher number of hills giving a higher grain yield (Figure 25).

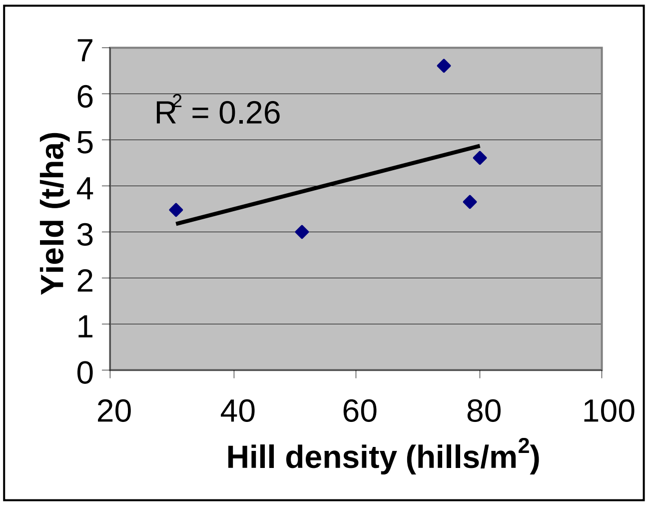



**Figure 25. Correlation between grain yield and hill density for wheat and barley.**

Discussions with farmers during the trial suggest they were open to the idea of new varieties being tested and sown in the area. Some preference of awned varieties was suggested, as this may lead to less bird damage (mainly finches at late grain fill) and could be planted further from the house.

Until now there has been no suggestion of eating preference between the 2 species (wheat and barley) and between different varieties. This needs to be evaluated over the next few years.

### *Conclusion*

These initial observation plots show there was good potential for introduced wheat and barley varieties to increase the yield of temperate cereals in the highlands of East Timor. Wheat rust does seem to be a limiting factor on local variety yields.

# 3. Farming systems

## 3.1 Maize and velvet bean at Fatumaka

Research conducted in 2006-2007 using velvet bean (*Mucuna pruriens*) as a weed suppressant presented encouraging results. A trial to further evaluate this effect was implemented at the Fatumaka Research Station in 2007-2008. The trial investigated the impact of number of weeding times and intercropping of maize and velvet bean, on maize yields of two different varieties (Harare 05 and Sele).

The trial was initiated on 22 November 2007 when maize was planted. The treatments were Variety (Har05 and Sele) x Crop mixture (Maize only and maize and velvet bean) x Weeding number (one weeding, two weedings and three weedings). Plot sizes were 5m by 5m. Maize was sown at distances of 75cm between rows and 25cm within rows and velvet bean was planted a month later at a 75 cm x 75 cm spacing between the maize rows. All plots were weeded at the time of velvet bean sowing (1 month after maize planted) and then again at monthly intervals according to the treatment. Treatments incorporating velvet bean were all planted one month after maize (there was no differentiation of the timing of velvet bean seed planting). Plots were harvested on the 24 Mar 08. The two outside maize rows from each plot were discarded and not included in the analysis of yield.

The trial was set up as a completely randomized block design with three replications. Weeding was done one, two or three times during the maize crop.

### *Results and discussion*

No individual factors or interactions between factors were found to have significant impact on the yields (t/ha) of the two maize test varieties. The average yields of both varieties was 0.9t/ha (Table 91).

**Table 91. Grain yield in velvet bean trial, Fatumaka, 2008**

| | *Number of weeding times* | *1* | *2* | *3* |
|---|---|---|---|---|
| *Variety* | | | *Maize yield t/ha* | |
| Har05 | Maize only | 0.6 | 1.3 | 0.5 |
| | Maize and velvet bean | 1.3 | 1.0 | 0.9 |
| Sele | Maize only | 0.9 | 1.2 | 0.8 |
| | Maize and velvet bean | 1.0 | 0.6 | 0.8 |
| *CV %* | *74.1* | | | |

Plant height was significantly different between the two varieties (F prob 0.025) with Har 05 having an average height of 176 cm and Sele 187 cm. This was a varietal trait, not related to treatment. Yield variability was high (CV of 74.1%) and no yield differences were significant.

### *Conclusion*

This was the first planting of intercropped maize and velvet bean at Fatumaka research station. Another season of intercropping will enable further understanding of the impact of velvet bean on maize yields. It was also suggested that any further trials at Fatumaka include measurements of the dry weights of both weed component and velvet bean above-ground vegetative growth from each plot.

## 3.2 Maize and velvet bean at Corluli

This trial describes the use of velvet bean as a weed suppressant. The trial was conducted at Corluli in the District of Bobonoro and evaluated the time of planting of velvet bean and number of weedings on the impact of weed density and maize yields.

### *Methodology*

Maize in the trial was planted on the 23 November 2007. The variety used was 'Lokal Kakatua', a white maize variety sourced from within Maliana Sub-District of Bobonaro. There were three times of sowing the velvet bean intercrop, one concurrent with maize, one two weeks after sowing maize and one four weeks after sowing maize. To investigate the impact of number of weeding times on intercropped maize and velvet bean, weeding was done either once or twice during the maize crop. The velvet bean 'abundance' or growth success was also scored on a scale of 1 to 5, with 1 being poor growth and 5 being abundant vegetative growth of the bean.

The trial was set up as a completely randomized block design with three replications. Plot size was 5m by 5m. Maize was sown at a 40cm (between rows) by 40cm (within rows) spacing and velvet bean was planted at 100cm x 100cm distances between the maize.

Plots were harvested on the 28$^{th}$ March 08. The entire plot was harvested. Above ground weed matter was also harvested from a 4m$^2$ area on each plot at harvest time. Weed weights were recorded.

### *Results and discussion*

Initial analysis of the data showed that there were both row and column affects at the site (Row F Prob 0.02 and Column F Prob 0.004). Figure 26 shows the average grain weights of plots in each row at the site.

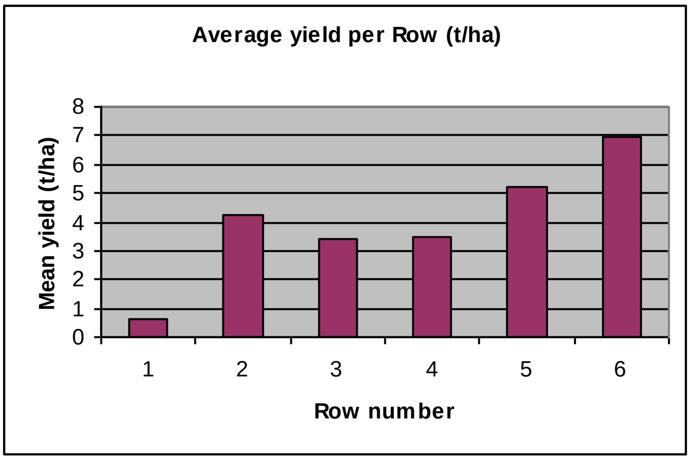



**Figure 26. Maize grain yield (t/ha) per row, maize and velvet bean trial, 2008**

Due to the row and column effects at the site, REML analysis was used to analyze the data, using a regular grid spatial model in GenStat Discovery Edition 2 (AR1). The REML analysis adjusted the data accordingly to negate these affects. Variates such as maize yields, weed weights and the 'abundance' score of the velvet bean were used to assess which factors gave significant impact to these. Results are shown in Table 92.

**Table 92. Significant factors**

| *Factor* | *Significant* | *Chi-sq prob* |
|---|---|---|
| Number of weeding times to maize yield | ns | - |
| Number of weeding times to weed vegetative matter | ns | - |
| Number of weeding times to poor quality cobs | ns | - |
| Number of weeding times to velvet bean growth score | ns | - |
| Number of weeding times to seed weight | ns | - |
| Time of planting velvet bean to maize yield | Significant | <0.001 |
| Time of planting velvet bean to weed vegetative matter | ns | - |
| Time of planting velvet bean to velvet bean growth score | ns | - |
| Time of planting velvet bean to poor quality cobs | ns | - |

When analysis of the dry weight of threshed maize seed was calculated it was found that the timing of planting the velvet bean had a significant impact on the maize yield. This was the only significant factor in the trial. There was no significant impact of the number of weeding times on any variates tested in this trial.

The interaction of timing of planting velvet bean and number of weeding times also did not statistically influence the maize yields in the first year tested. The timing of sowing of the velvet bean influenced the dry grain yield (t/ha), however gave no impact to the plant stands ($m^2$) or seed weights of the maize. Table 93 shows that planting the velvet bean at the same time as the maize seed significantly reduced the yield of the maize crop. Planting the velvet bean at both 2 and 4 weeks after the maize resulted in statistically similar higher maize yields.

**Table 93. Effect of time of planting of velvet bean on maize yield.**

| *Time of planting velvet bean* | *Mean predicted maize yields (t/ha)** |
|---|---|
| 0 (same time as planting maize) | 1.5 |
| 2 weeks after planting maize | 4.6 |
| 4 weeks after planting maize | 3.5 |
| Chi-sq prob | <0.001 |
| **LSD (P<0.05)** | 2.1 |

*These are the mean predicted yields after adjustment by REML analysis to counter the row and column affects in the raw data.

## *Conclusion*

This was the first planting of intercropped maize and velvet bean at the Corluli research station. Another season of intercropping would enable further understanding of the impact of velvet bean on maize yields. The trial will be continued in the same plots in 2008-2009 to see the continued effects of the velvet bean on subsequent maize crop yields, and to further assess the timing of planting and number of weeding times on the weed vegetative matter. A scoring of percentage cover of weeds will also be tested.

## 3.3 Planting system/plant density on maize yield

Maize in East Timor is traditionally planted randomly with a wide spacing (0.7 to 1m) between planting hills but usually with 2-4 seeds planted per hill. Timorese farmers rarely, if ever, then thin maize back to 1 or 2 plants per hill. The consequence is that, where germination is good, 3, 4 or even 5 plants can occupy the one planting hole, resulting in intense competition for soil nutrients and moisture. It is hypothesized that planting maize at a similar total plant density as the traditional system, but at closer spacing and only one seed per hill would result in less competition between individual plants and therefore produce higher total yields. This series of trials was established to explore this hypothesis.

### *Methods*

The first trial was planted at the Betano Research Station on 09/01/2007 and harvested on 14/04/2007. It followed a split-split plot design with 5 different planting system treatments as the main factor with 2 fertilizer treatments (either with the equivalent of 50:50 kg/ha of N: P or without any fertilizer) as a split-plot factor and three different maize varieties (two introduced and one local) as the sub factor. The different treatments are detailed in Table 94. For planting distance treatments, extra seeds were sown into each hole and then thinned back as required. Fertilizer was applied at approximately 5 weeks after planting. Plots were 5m wide by 5m long. The outside 2 rows of each plot were not harvested. At harvest, a final plant count was made and total no of cobs counted. The weight of un-husked cobs was measured immediately after harvest and then again after drying. The weight of the cobs after removal from sheaths was recorded, as well as seed weight after shelling. Finally, the weight of 100 seeds was measured.

The second trial was planted on 07/06/2007 and harvested on 04/10/2007 and had the same experimental design, treatment structure and methods as the preceding trial.

**Table 94. Trial treatments in 2007**

| *Factor* | *Treatment level* | *Planting Distance* | Seeds per hole | *Plants/ha* |
|---|---|---|---|---|
| Planting system (Main Factor) | 1 | 75 x 70cm | 1 | 20,000 |
| | 2 | 75 x 70cm | 2 | 40,000 |
| | 3 | 75 x 70cm | 3 | 60,000 |
| | 4 | 50 x 50cm | 1 | 40,000 |
| | 5 | 40 x 40cm | 1 | 60,000 |
| Fertilizer (Split-factor) | 1 | 50kg N:50kg P/ha | | |
| | 2 | None | | |
| Variety (Sub-factor) | 1 | Suwan 5 | | |
| | 2 | Local White | | |

The third trial was established in the main wet season of 2007/2008. It was planted on 17/01/2008 and harvested on 20/04/2008. Based on observations from the previous two trials, it was decided to modify the applied treatments. Firstly, because of no apparent fertilizer effect in the first set of trials, the fertilizer factor was eliminated. Also the varietal factor was reduced to only two levels; an introduced variety, Suwan 5, vs. the local white maize. Rather than a split plot, the new trial design layout became a completely randomized block. The planting treatments were modified to include two levels where total plant density was very high (100,000 plants/ha), so that some yield reduction might be expected to occur. A further variation on the 60,000 plants /ha at one seed per hole treatment (Treatment 4 in the 2007 trials) was also added. Instead of planting at a uniform spacing to achieve such a plant density, the between row spacing was maintained at 70cm, but within row spacing was reduced to 25cm (in comparison with the 40cm x 40cm used in the 2007 trials). It was decided to include this modification because a wider row spacing such as this allows for the possibility of mechanical weeding and is in fact the planting system used in the maize variety trials. It was also hypothesized that the different plant arrangement (at the same plant density) may have an impact on the level of competition, not only between individual maize plants, but from weeds due to different levels of light interception that the different planting arrangements would produce.

The planting system treatments applied in the 2008 trial are presented in Table 95

**Table 95. Trial treatments in 2008**

| *Factor* | *Treatment level* | *Planting Distance* | Seeds per hole | *Plants/ha* |
|---|---|---|---|---|
| Planting System (Main Factor) | 1 | 75 x 70cm | 1 | 20,000 |
| | 2 | 75 x 70cm | 3 | 60,000 |
| | 3 | 75 x 70cm | 5 | 100,000 |
| | 4 | 70 x 25cm | 1 | 60,000 |
| | 5 | 40 x 40cm | 1 | 60,000 |
| | 6 | 30 x 30cm | 1 | 100,000 |
| | | Variety | | |
| Variety (Sub-factor) | 1 | Suwan 5 | | |
| | 2 | Local White | | |

## *Results and discussion*

Data analyzed from the two 2007 trials which had the same treatment levels and split-plot design are presented in Table 96. Both trials showed the same trends; when the traditional planting distance of 75 x 70 cm was used, increasing the number of seeds planted per hole, increased the final yield. At the same planting density of 4 plants/m$^2$, using a closer plant spacing of 50 x 50 but with only 1 seed per hole had no effect on yield are compared to 2 seeds per hole at the traditional wide spacing. However at the higher plant density of 6 plants/ m$^2$, planting a single seed at a spacing of 40cm x 40cm did result in a yield increase compared to planting 3 seeds at the traditional spacing. This difference became statistically significant when the two trials were analyzed as a combined data set.

**Table 96. Impact of plant density on 2007 trials (from 2 planting seasons)**

| *Planting System* | *Intended plant density/m$^2$* | *Actual plant density/m$^2$* | | *Seed yield (t/ha)* | | |
|---|---|---|---|---|---|---|
| | | *Trial 1* | *Trial 2* | *Trial 1* | *Trial 2* | *Average* |
| 75cm x 70cm - 1 seed | *2* | *1.3* | 1.1 | 0.76 | 0.67 | 0.72 |
| 75cm x 70cm - 2 seeds | *4* | *2.8* | 2.1 | 1.12 | 0.90 | 1.00 |
| 75cm x 70cm - 3 seeds | 6 | 3.7 | 2.7 | 1.25 | 0.97 | 1.11 |
| 50cm x 50cm - 1 seed | 4 | 2.7 | 2.4 | 1.04 | 1.13 | 1.09 |
| 40cm x 40cm - 1 seed | 6 | 4.1 | 3.3 | 1.40 | 1.23 | 1.31 |
| *LSD (P<0.05)* | | *0.5* | *0.3* | *0.32* | *0.31* | *0.18* |

As mentioned above, the following 2008 trial was modified in order to determine whether increasing the number of seeds planted per hole to 5 at the traditional spacing incurred a yield penalty or not. For purpose of comparison, the equivalent planting density, but with a single seed per hole at 30 cm x 30 cm spacing, was also included as a treatment. The results are presented in Table 97.

At the traditional wider plant spacing, increasing the number of seeds planted up to 5 did not have a negative impact on yield. In fact, yield with 5 seeds was slightly higher than when 3 seeds were planted and significantly higher than when only a single seed was planted per hill. When 5 seeds per hill were planted, cob size and seed size were significantly decreased, but %

lodging was significantly increased compared to when only 1 seed was planted at the traditional spacing. In the comparison between the traditional wide spacing and closer plant spacing, the 2008 trial followed the trend observed in the preceding 2007 trials, at the same total plant density of 6 plants/$m^2$ planting single seeds at 40cm x 40cm produced higher yields than 3 seeds planted at the wider spacing. Increasing plant density again to 11 plants/$m^2$ by planting single seeds at 30cm x 30cm spacing had a negative impact on yield however this was not statistically significant. Also the difference between the two high plant density (i.e. 10-11 plants/$m^2$) treatments but with different plant spacing was also not significant. At these higher plant densities, cob size and seed weight were reduced but also not significantly. There was also a trend for weed dry weight to decrease with increasing plant density of maize. At the same total plant density of 6 plants/$m^2$, treatments 2 and 4 had a similar weed burden. However, treatment 5 which had the same number of seeds per hill as treatment 4 but with a more equidistant planting structure appeared to have a reduced weed burden. Increasing the plant density even higher, as in treatment 6, further reduced weed dry weight, but this difference was still not significant. Only treatment 1 with only 1 seed per hole at the wider spacing had a significantly higher weed dry weight than all other planting system treatments.

**Table 97. Effect of planting system on yield and yield components in 2008 trial**

| *Treatment No.* | *Planting System* | *Intended plant density/$m^2$* | *Actual plant density/$m^2$ at harvest* | *Yield (t/ha)* | *Cob size (g)* | *% lodging* | *100 seed wt (g)* | *Weed DW (g/plot)* |
|---|---|---|---|---|---|---|---|---|
| 1 | 75cm x 70cm - 1 seed | 2 | 2.1 | 1.43 | 71.1 | 1.9 | 27.0 | 104.2 |
| 2 | 75cm x 70cm - 3 seed | 6 | 5.9 | 1.98 | 48.6 | 4.3 | 24.6 | 59.1 |
| 3 | 75cm x 70cm - 5 seed | 10 | 8.1 | 2.15 | 37.4 | 13.8 | 22.2 | 36.3 |
| 4 | 70cm x 25cm - 1 seed | 6 | 5.9 | 2.22 | 48.7 | 9.1 | 24.0 | 62.1 |
| 5 | 40cm x 40cm - 1 seed | 6 | 6.5 | 2.77 | 59.0 | 5.9 | 24.0 | 35.0 |
| 6 | 30cm x 30cm - 1 seed | 11 | 11.6 | 2.32 | 32.8 | 8.5 | 22.6 | 25.6 |
| | *LSD (0.05)* | | *0.95* | *0.75* | *17.5* | *11.6* | *2.9* | *45.1* |

When the data from planting system treatments common to all three trials were analyzed together, the average yield results as presented in Table 98 support the hypothesis that planting single seeds at a closer plant spacing will produce higher yields than planting 3 seeds at the traditional wider spacing. However this significant difference is largely due to the big differences observed in the 2008 trial 3. In addition this difference in yield is not reflected in any of the yield components as recorded in Table 99. Using data from all three trials, there was no significant difference in either cob size, seed size, % shelling or number of cobs per plant between the two treatments. It was only where a single seed was planted at the wide spacing that cob size, seed weight and number of cobs were significantly different than the two higher planting density treatments. Increasing the plant density (irrespective of planting distance) apparently resulted in cobs being produced higher up on the plant (i.e. higher cob/plant height ratio) but this did not have any effect on the amount of lodging observed.

**Table 98. Planting distance treatments common to all 3 trials. Impact on yield (t/ha)**

| *Planting system* | *Plants/$m^2$* | *Trial 1* | *Trial 2* | *Trial 3* | *Average* |
|---|---|---|---|---|---|
| 75cm x 70cm - 1 seed | 2 | 0.66 | 0.64 | 1.44 | 0.83 |
| 75cm x 70cm - 3 seeds | 6 | 1.25 | 0.94 | 2.01 | 1.28 |
| 40cm x 40cm - 1 seed | 6 | 1.35 | 1.12 | 2.78 | 1.57 |
| ***LSD*** | | *0.46* | *0.46* | *0.46* | *0.25* |

**Table 99. Impact of planting system on maize characteristics (across all 3 trials)**

| *Planting system* | *Plants/m$^2$* | *Cob size (g)* | *100 seed wt (g)* | *Cobs/plant* | *% shelling* | *% lodging* | *Ratio cob/plant height (%)* |
|---|---|---|---|---|---|---|---|
| 75cm x 70cm - 1 seed | 2 | 59.1 | 29.5 | 1.024 | 66.48 | 20.5 | 39.19 |
| 75cm x 70cm - 3 seeds | 6 | 48.8 | 28.66 | 0.799 | 69.5 | 19.9 | 43.6 |
| 40cm x 40cm - 1 seed | 6 | 50.3 | 28.32 | 0.761 | 69.12 | 25.8 | 46.54 |
| ***LSD*** | | *8.1* | *ns* | *0.09* | *ns* | *ns* | *4.53* |

## *Conclusion*

This series of trials suggests that planting single seeds at closer plant spacing may result in higher yields than with multiple seeds at wider spacing. Any such effect is likely to be dependent on seasonal conditions and will vary from year to year. Planting at a closer spacing and planting geometry may also have an effect on weed density. In the 2008 trial, planting maize at a closer and equidistant spacing resulted in a lower weed burden than where the row spacing was 75cm irrespective of the within-row plant spacing.

It is recommended that a further planting distance trial be carried out in 2009 using only treatments 1, 2, 4 and 5 (as tested in the 2008 trial) to confirm the impacts on yield and weed density observed in the trials to date.

# 3.4 Planting distance in peanuts

After performing well in on-station variety trials and also being well received by farmers in on-farm trials (OFDTs) and in taste tests, the peanut breeding line formerly referred to as Pt5 was officially released in 2007 as Utamua, a new variety for widespread cultivation by farmers in East Timor.

It was observed during the OFDTs that some farmers planted Utamua at a wider plant spacing than their local variety, citing the larger seed size of Utamua as the reason for this decision. Consequently it was decided to conduct a simple trial to determine just what plant spacing is appropriate for Utamua.

### *Materials and methods*

The trial was in planted at Betano Research Station in January 2008. Two peanut varieties were used in the trial, a local variety (local boot) and Utamua. These varieties were planted at four different planting densities; 50cm x 50cm spacing (4 plants/$m^2$), 50cm x 25cm (8 plants/$m^2$), 33cm x 25cm (12 plants/$m^2$) and 25cm x 25cm (16 plants/$m^2$). Individual plot sizes were 6m wide by 6m long. A randomized block design with four replicates was used. Two seeds were planted per hill and then thinned back to a single plant after emergence. Any missing spaces were replanted immediately to achieve the desired plant density for each treatment. No fertilizer was used and plots were weeded as necessary. The outside border rows of each plot were not harvested. The fresh weight of both mature and immature pods was recorded at harvest and then the total dry weight of pods from each 36$m^2$ plot used to calculate yield in t/ha. A sub-sample of 100pods was used to determine shelling percentage, number of seeds per pod and seed weight.

### *Results*

The effect of plant density on yield is presented in Table 100. Increasing plant density from 4 to 16 plants/$m^2$ uniformly increased pod yield in both Utamua and the local peanut variety. However the only statistically significant difference was between the mean pod yields of Utamua at the lowest plant density and the highest plant density. This effect was also significant when the actual seed yield was estimated from the measured mean shelling percentages of each variety. Utamua had a significantly lower, shelling percentage and average number of seeds per pod, than the local variety, but possessed a significantly bigger seed size. Increasing plant density had no effect on any of these yield components. It also did not affect the percentage maturity of pods at harvest. There was also no difference in mean yield averaged over all treatments between the two varieties.

**Table 100. Peanut yield (t/ha) of four planting densities**

| *Planting Density (plants/$m^2$)* | *Harvested pod yield* | | *Estimated seed yield* | |
|---|---|---|---|---|
| | *Utamua* | *Local* | *Utamua* | *Local* |
| 4 | 1.8 | 1.7 | 1.0 | 1.1 |
| 8 | 2.3 | 2.4 | 1.4 | 1.5 |
| 12 | 2.6 | 2.5 | 1.5 | 1.6 |
| 16 | 3.1 | 2.6 | 1.8 | 1.6 |
| *LSD ($P<0.05$)* | *1.05* | | *0.69* | |

Because Utamua has such a large seed size, of relevance to the question of the optimum planting density for this new variety is the yield return on the amount of seed planted. As Table 101 indicates, increasing the planting density reduced the amount of seed produced per kg sown for both varieties. However this was statistically significant only for the initial doubling of planting density from 4 to 8 plants/$m^2$. At these lower planting densities, the local variety produced a much greater return on seed planted than Utamua but this difference was reduced as planting density increased.

**Table 101. Seed return on 1 kg seed planted (kg)**

| *Planting density (plants/m²)* | *Kg seed required for planting 1 ha** | | *Kg seed returned* | | *Average* |
|---|---|---|---|---|---|
| | *Utamua* | *Local* | *Utamua* | *Local* | |
| 4 | 28 | 17.8 | 37.5 | 61.4 | 49.4 |
| 8 | 56 | 35.7 | 24.7 | 42.5 | 33.6 |
| 12 | 84 | 53.5 | 18.1 | 29.3 | 23.7 |
| 16 | 112 | 71.4 | 16.5 | 23.2 | 19.8 |
| *LSD (P<0.05)* | | | *13.8* | | *9.8* |

* based on 100 seed weight of 70.1g and 44.6g for Utamua and local, respectively

## *Conclusion*

This trial indicates that agronomically, there is no reason to plant Utamua at the wider 50cm x 50cm plant spacings as practiced by some farmers. Increasing plant density will in fact increase the yields of Utamua. This is is supported by the field (OFDT) data presented in Figure 22). It is not clear from this trial whether 16 plants/m$^2$ was the optimal planting density and a further increase in density would actually have a negative impact on yield. It is true however, that increasing the planting density significantly increased the amount of seed required for planting and results in a reduced return on kg sown. Whether the total amount of pods harvested from higher plant densities compensates for the amount of seed required to plant will depend on seasonal conditions (higher risks of crop failure) and on the availability and costs of seed for planting. It is suggested here that given availability of sufficient seed, planting densities of 8 or 12 plants/m$^2$ might be an appropriate compromise planting density for Utamua under average growing conditions.

# 3.5 The effect of applied phosphorus on peanut yield in Baucau District

### *Introduction*

Baucau is considered to be the center of peanut production in Timor Leste. The District possesses varied soil types, all of which suffer from nitrogen and phosphorus deficiencies to some degree. Peanuts are able to satisfy their nitrogen requirements naturally through nitrogen fixation *via* their leguminous nodules. However, phosphorus may need to be applied to improve peanut yields. This trial was designed to provide guidance for further detailed trials on phosphorus fertilizing as well as assist peanut farmers with practical information about the role of phosphorus in their fields. The trials were conducted during the 2007/2008 wet season in production fields located in the District of Baucau.

### *Methodology*

The trial was conducted on 5 different fields located at Baucau. At each site the trial was laid out in randomized complete block design with 3 replications. The treatments applied in the trial were 0 kg/ha Triple Super Phosphate (TSP) versus 40 kg/ha of TSP. A description of trial sites and planting dates is presented in Table 102. Each plot was 5m by 5m in dimension.

Each trial was located on a farmer's field where seed production of Utamua was in progress at the time but the plots were managed by SoL staff. Phosphorus was applied one time about 1 month after planting at a rate of 100 g of TSP/plot. This is equivalent to 18 kg of elemental P per hectare. Control plots received no fertilizer.

At harvest, all plants in the plot were dug, dried and weighed. In addition, 5 sample plants were harvested separately, and the pods of these plants were used for measuring yield components. Variables observed were: sun dried pod yield, number of pods/plant, number of good seed/100 pods, and weight of good seed/100 pods.

Analysis of variance for each component was by GenStat, with location and fertilizer application as the main effects and reps with location as the blocking structure. This allowed for the testing on the main effect of site and phosphorus application as well the interaction between site and phosphorus application.

**Table 102. Description sites for phosphorus on peanut trial, 2007-2008**

| *Site* | *Farmer's name* | *Sub District* | *Aldea* | *Planting date* | *Elevation (masl)* | *($^o$E)* | *($^o$S)* | *pH* | *Soil colour* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Alberto Caldeira | Triloka | Makadae | 20/12/07 | 640 | 126.3678 | 8.5294 | 5.5 | Red |
| 2 | Carlos D.C. Freitas | Gariuai | Darasula | 23/12/07 | 668 | 126.3582 | 8.5360 | 6.0 | Brown |
| 3 | Joao Da Costa | Gariuai | Darasula | 9/12/07 | 664 | 126.3582 | 8.5360 | 5.5 | Red |
| 4 | Domingas Alves | Gariuai | Waibehana | 19/12/07 | 689 | 126.4069 | 8.5710 | 5.5 | Red |
| 5 | Maria L.D.J. Belo | Gariuai | Gariuai | 5/12/07 | 512 | 126.4069 | 8.5501 | 6.0 | Brown |

### *Results*

In general, all the plants in the plots grew well and no significant infestations of disease or insect pests were observed.

#### Effect of sites on yield

Except for the number of pods/plant, no significant interaction between the sites and fertilizer treatment was found in the trial for the observed variables. The highest yield was achieved at site 1 (2.2 t/ha) followed with site 3 (1.7 t/ha), site 4 (1.5 t/ha), site 5 (1.4 t/ha) and site 2 (1.0 t/ha) respectively (Table 103).

**Table 103. Effect of trial site on yield and yield components.**

| *Site* | *Yield (t/ha)* | *Number of pods/plant* | *Number of seeds/100 pods* | *Weight of seed/100 pods (g)* | *Plant density (plants/m$^2$)* |
|---|---|---|---|---|---|
| 1 | 2.2 | 29.7 | 169.8 | 161.4 | 4.7 |
| 2 | 1.0 | 20.6 | 167.1 | 139.6 | 4.2 |
| 3 | 1.7 | 22.6 | 181.4 | 150.5 | 6.9 |
| 4 | 1.5 | 14.6 | 167.8 | 131.4 | 6.3 |
| 5 | 1.4 | 49.8 | 144.9 | 92.6 | 3.3 |
| **LSD** | 0.51 | 10.03 | 14.61 | 11.14 | |

The number of pods per plant was highest at Site 5 (49.8 pods/plant), however its number of seeds/100 pods and weight of seed/100 plants was lower than that found in the other trial sites. More empty pods and rotten pods were found in site 5 than other sites resulting in a reduced yield.

Although the result clearly indicates that Site-1 can be considered as the most suitable site for peanut production, it is impossible to discern which factors were most influential.

**Interaction effect of sites and phosphorus fertilizer on the number of pods/plant**

Figure 27 illustrates a different pattern of the effect of applied phosphorus at the 5 trial sites. The number of pods/plant increased less at site 2 than at sites 1, 3, and 4. At site 5 there appeared to be a reduction in the number of pods/plant when phosphorus was applied.

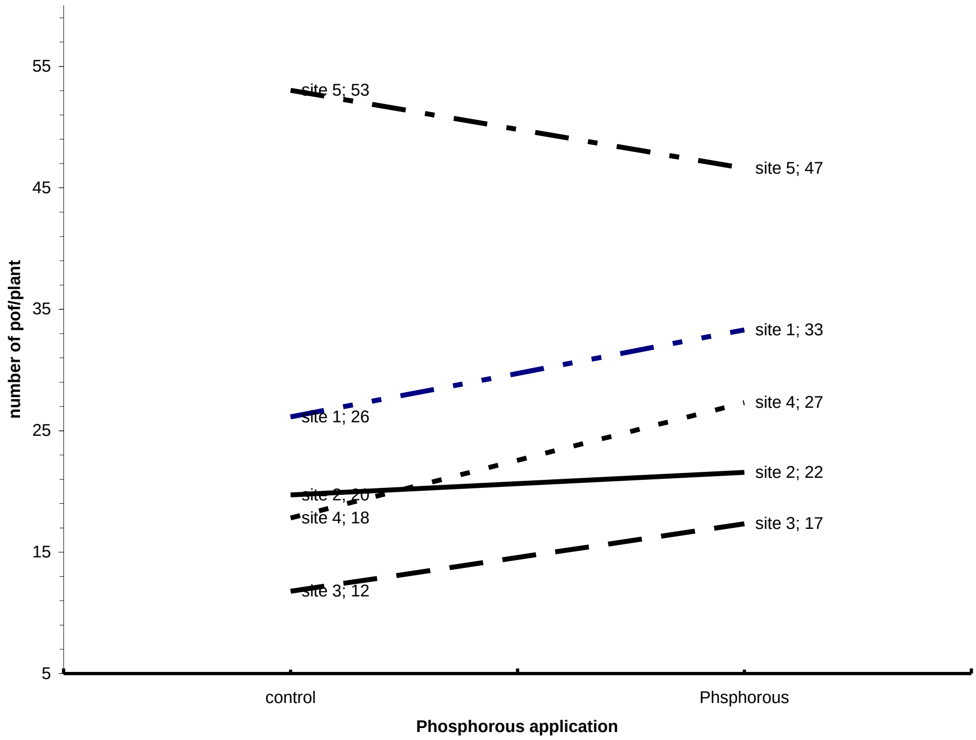



**Figure 27. Effect of applied phosphorus on the number of pods/plant.**

**Effect of fertilizer application on yield**

The number of pods/plant, number of seed/100 pods and weight of seed/100 pods were significantly increased due to phosphorus application (Table 104). This indicates that applying phosphorus can improve yield components and tend to increase the yield. To find out the optimum rate of phosphorus application a further detailed trial is required.

**Table 104. Effect of phosphorus on pod yield and yield components of peanuts**

| *Treatment* | *Yield (t/ha)* | *Number of pods/plant* | *Number of seed/100 pods* | *Weight of seed/100 pods (g)* | *Plant Density (plants/$m^2$)* |
|---|---|---|---|---|---|
| Control | 1.47 | 25.7 | 161.4 | 130.7 | 10.0 |
| Phosphorus | 1.64 | 29.2 | 171.0 | 139.5 | 10.4 |
| **LSD** | 0.18 | 2.8 | 7.44 | 6.67 | |

The application of 40kg TSP/ha had a positive effect on peanut pod yield in 4 of the 5 test sites although statistically not significant (F prob.0.56). The one site that didn't respond to P was the lowest yielding site. Although this site had a similar plant density to other sites, there were other factors that limited the yield response. There is a possibility that as this site was the last to be planted, the late planting may have reduced the yield. As shown in Table 105, application of phosphorus can improve yield about 12 %, e.g. 1.64 t/ha vs. 1.47 t/ha, respectively. On average this is an increase of 174 kg peanut produced per 40 kg of TSP. On a per kilo basis, on average 1 kg of TSP produces 4.3 kg of peanuts.

**Table 105. Effect of TSP application on peanut yield at 5 sites in 2008.**

| *Site* | *Peanut yield with no application (t/ha)* | *Peanut pod yield with 40 kg P applied (t/ha)* | *Yield increase (%)* | *Yield increase (kg/ha)* |
|---|---|---|---|---|
| 1 | 2.03 | 2.36 | 16.7 | 338 |
| 2 | 1.03 | 0.99 | -4.0 | -41 |
| 3 | 1.62 | 1.74 | 7.2 | 117 |
| 4 | 1.31 | 1.62 | 23.6 | 310 |
| 5 | 1.35 | 1.50 | 10.7 | 145 |
| **Average** | 1.47 | 1.64 | 11.8 | 174 |

## *Conclusion*

Yield of peanut was affected by site. Site 1 was the most suitable site for peanut production. There was tendency that phosphorus application with rates of 40 kg TSP/ha can increase peanut yield up to 12 % and also improved the number of pods/plant, number of seed/100 pod, and weight of seed/100 pod as well. For each kg of TSP applied, about 4.3 kg more of harvested peanut was realized.

# 3.6 The effect of applied nitrogen on rice in Seisal, Baucau

### *Introduction*

Applying fertilizer is a recognized method to increase rice production in most parts of the world. However, excessive applications can also cause negative impacts to the environment. Optimal application rates are generally dependent on the soil type, past fertilizer history, water availability, season and the variety being planted. Rates are usually higher in the dry season when there is increased solar radiation and are more effective on HYVs than traditional varieties. This trial was designed to evaluate the effect of increasing rates of urea on the newly released rice variety, Nakroma in a rice field located in Seisal, Baucau.

### *Methods and materials*

This trial was located in a farmer's field in Seisal, Baucau. A nursery of Nakroma rice was established on 10 April, 2008. Three week old rice seedlings were then transplanted into the paddy field with two seedlings/hill at a planting distance of 25 cm x 25 cm. The trial plot size/replication was 5 m x 5 m.

The trial was laid out in randomized complete block design with three replications. Four rates of nitrogen fertilizer were applied as urea. These were 0, 30, 60 and 90 kg N/ha. Urea was applied three times in equal amounts: 1/3 at transplanting, 1/3 at 1 month after transplanting and 1/3, 2 months after transplanting.

Measured variables were the number of tillers (taken at flowering time), number of panicles/hill, weight of panicles/hill, and grain yield at harvest.

### *Results*

No diseases or insect infestations were observed during the field trial. Grain yields increased steadily with higher rates of applied nitrogen (Table 106, Figure 28). This increase was statistically significant at 90 kg/ha of N. At this stage, grain yield had increased by approximately 60%. Increased yield was reflected in a greater number of tillers/hill. Plant height also increased significantly but in this case, no increased lodging was observed. The increase in the number of seeds per panicle was not statistically significant.

**Table 106. The effect of nitrogen rate on several observed variables**

| *Variable* | *Nitrogen rate (kg N/ha)* | | | | |
|---|---|---|---|---|---|
| | *0* | *30* | *60* | *90* | *LSD (P<0.05)* |
| Yield (t//ha) | 1.7 | 2.3 | 2.3 | 2.8 | 0.74 |
| Number of tillers/hill | 9.6 | 14.3 | 16.0 | 17.6 | 6.76 |
| Number of seeds/panicle | 46.7 | 64.0 | 62.4 | 58.8 | ns |
| Plant height (cm) | 66.1 | 89.6 | 93.6 | 96.3 | 31.87 |

ns Not significant at P = 0.05

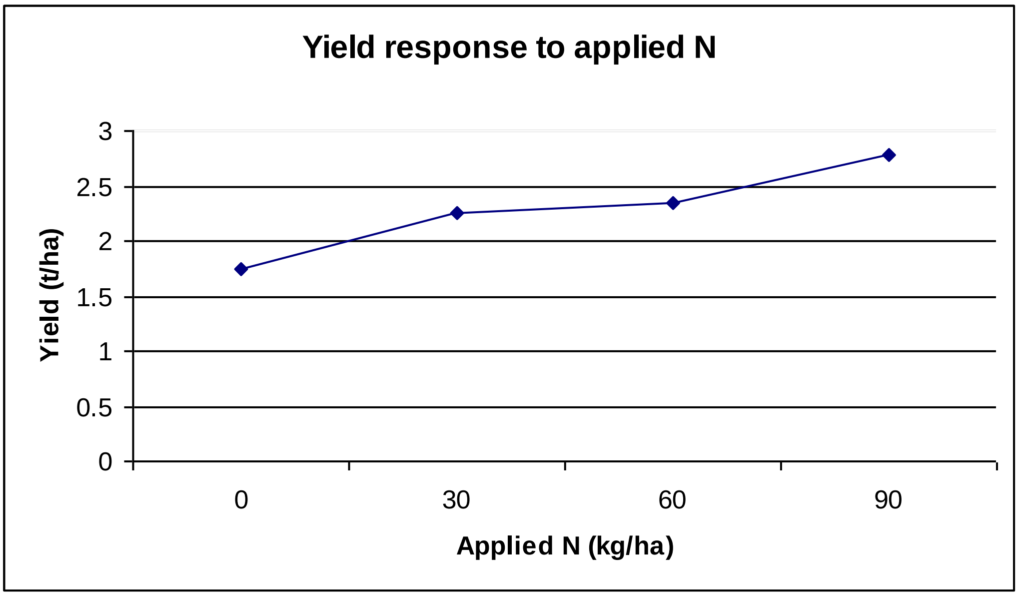



**Figure 28. Response of rice to applied N in Seisal, Baucau**

### *Discussion*

Applications of nitrogen on the trial site rice paddy at Seisal-Baucau significantly improved grain yield. As shown in Figure 28, there was an almost linear response with one Kg of N (2.2kg of urea) increasing production by approximately 11.5 kg of paddy. The economics of applying urea is, therefore, dependent on the price and availability of urea and price received for the unmilled rice. Note also in this trial, the optimum level of fertilizer on this field may not have been reached.

This trial revealed that increasing nitrogen rates significantly increased tillering in Nakroma but did not increase the panicle size. This effect may decrease the propensity for Nakroma to lodging despite higher N rates resulting in a significant increase in plant height.

# 4. Farmer adoption of OFDT test varieties

A structured questionnaire was used to measure the level of adoption/replanting among all farming households involved in OFDTs during the previous 2 cropping seasons, 2005/06 and 2006/07. The questionnaire covered all species of improved varieties of maize, peanuts, rice, and sweet potato used in the SoL research program in the four Districts.

The questionnaire was improved based on comments from the previous year and completed by each of the farming households involved in OFDTs in the previous 2 years. Data on the individualized sheets included location and details of the farmers' planting area and other information. SoL RAs conducted the interviews in February/March 2008 in the Districts of Aileu, Baucau, Liquica and Manufahi.

As in the 2007 Annual Research Report (SoL, 2007), adopters are defined as farming families who harvested seed (or tubers in the case of sweet potato) in an OFDT and then replanted the new varieties on at least one occasion. Adoption rates are calculated on a per variety basis, as well as per species, for one year and 2 years after the initial OFDT. Adoption rate on a species basis is defined as the percent of farmers who planted the seed of one or more varieties from a successful OFDT. Overall adoption rates based on a species basis are therefore higher than those calculated on a variety basis.

The questions included one on which the farmers were asked to state the number of times they planted the new varieties. From this response, and the number of planting opportunities that had passed, it was deduced whether the farmers had adopted the varieties, had never adopted the varieties or had stopped growing (dis-adopted) the varieties. Of those farmers who planted the varieties in the 2007/2008 wet season, the areas of replanting were estimated. This was done by asking the farmer to estimate the number of steps it took to walk down each side of the crop and then converting this into the number of square metres. The effect of gender on adoption was tested by the use of ANOVA procedure in GenStat.

Each farmer was also asked whether he/she distributed seed to family, friends and neighbours. If seed was distributed to others, information was collected on the number of recipients and the areas of the new varieties that the recipient farmers planted to the received seed.

### Overall adoption level

The percentage of farmers in four Districts who stated that they would replant after experiencing an OFDT in 2006 were 92%, 71%, 71% and 95% for maize, peanuts, sweet potato (at Betano only) and rice (2007 only) respectively (see SoL, 2006, SoL, 2007 and this report for details of farmers responses). After being surveyed in 2007 (see Sol, 2007), the numbers of farmers who possessed sufficient seed and did plant was measured and found to be at a lower adoption rate than their initial intention. The percentage of farmers who stated to have adopted the new varieties after conducting an OFDT in 2006 was surveyed in 2007 at 77%, 69%, 48% and 81% for maize, peanuts, sweet potato and rice respectively (Table 107). When the same question was asked two years after the OFDT (2008), the percentage of farmers who stated that they planted OFDT material one year after the 2006 OFDT was 75%, 48%, 29% and 50% for maize, peanuts, sweet potato and rice respectively (Table 107). The stated adoption rates are surprisingly lower than surveyed in 2007. It is difficult to explain why the numbers are so different but may show deficiencies in the survey tool or farmers' memory/willingness to report actual results.

The survey was repeated two years later. When surveyed in 2008, the percentage of farmers who stated that they were still growing released varieties evaluated in 2006 OFDTs dropped from 75% to 58%. The percentage of farmers adopting rice was similar after two years. The results for peanuts and sweet potato were incomplete at the time of reporting (Table 107). During the survey period, some farmers were reluctant to provide information. One thought is that the farmers were worried that they would be requested to return seed. Additionally, Utamua seed remains dormant for three months and cannot be planted soon after harvest. Sweet potato farmers also have a tendency to harvest all of the high yielding Hohrae sweet potatoes and rely on others for planting material. There will be follow up studies to physically measure the areas under production and to determine the reasons for farmers not consistently growing the varieties. There is certainly evidence that an increasing number of farmers are making considerable income from selling adopted varieties (see Chapter 5 for details).

The percentage of farmers growing released varieties from seed harvested from 2007 OFDTs is presented in Table 107. The presented adoption level is again lower than the number of farmers who, in 2007, stated that they would grow the new varieties. The number of farmers who stated they would plant the new varieties after completing an OFDT in 2007 were 87%, 95%, 71% and 95% for maize, peanuts, sweet potato and rice respectively (SoL, 2007 and SoL, 2008) (Table 107). When interviewed, some farmers stated that their lack of adoption was due to the fact that insufficient seed remained at the end of the year to plant. This is very much the case. An average OFDT maize yield of 2.4t/h provides only 6kg of grain from a $25m^2$ plot. After consuming part of this grain for evaluation, little seed would remain to plant a crop following an OFDT. For peanut which requires a very large seeding rate of 100-200kg/ha, the resulting average yield of 4kg from $25m^2$ would provide sufficient seed for only a very small area of replanting. Planting material from sweet potato plots would also diminish rapidly over the season as farmers harvested the crop for consumption. Hohrae varieties are faster maturing than local varieties, are extremely popular and are therefore harvested early in the season making runner storage for the following season difficult.

These results emphasize the need for an effective seed production system to support the introduction of improved, higher yielding varieties.

**Table 107. Adoption rate of one or more tested varieties after the initial OFDT.**

| *Crop* | *Adoption level one year after 2006 OFDT (%) (2007 Survey)*[a] | *Adoption level one year after 2006 OFDT (%) (2008 survey)* | *Adoption level two years after 2006 OFDT (%) (2008 survey)* | *OFDT farmers proposing to re-plant (%)*[c] | *Adoption level one year after 2007OFDT (%)* |
|---|---|---|---|---|---|
| Maize | 77 | 75 | 58 | 87 | 66 |
| Peanuts | 69 | 48 | na[b] | 95 | 59 |
| Sweet potato | 48 | 29 | na | 71 | 52 |
| **Rice** | 81 | 50 | 48[d] | 95 | 67 |

a From SoL, 2007. b Figures not available. c % of farmers stating they would replant OFDT material at harvest of OFDT in 2007

## Adoption by gender

The adoption of the new peanut, sweet potato and rice varieties was not affected by gender, and there was no significant interaction between gender and variety or adoption rate for seed from OFDTs conducted in 2006 or 2007. This suggests that the adoption rate of female and male headed households were similar (Table 108).

For seed from 2007 OFDTs, male headed households were more likely to adopt a new maize variety than a female headed household. Of the male headed households, 79 % adopted Sele compared to 61% of the female headed households. There was no interaction between variety and adoption (Table 108). There was no difference in adoption for farmers growing crops from seed derived from 2006 OFDTs.

**Table 108. Adoption by gender of SoL varieties over four Districts across years**

| *Crop* | *Variety* | *Gender* | *Adoption level one year after 2007 OFDT (%)* | *Adoption level one year after 2006 OFDT (%)* | *Adoption level two years after 2006 OFDT (%)* |
|---|---|---|---|---|---|
| Maize | Sele | Male | 79 | 68 | 55 |
| | | Female | 61 | 65 | 59 |
| | SW5 | Male | 73 | 69 | 55 |
| | | Female | 55 | 65 | 59 |
| Peanuts | Pt5 | Male | 56 | 45 | |
| | | Female | 67 | 48 | |
| Sweet Potato | CIP1 | Male | 39 | 53 | |
| | | Female | 54 | 65 | |
| | CIP6 | Male | 21 | 53 | |
| | | Female | 38 | 64 | |
| | CIP7 | Male | 15 | 44 | |
| | | Female | 23 | 53 | |
| Rice | Nakroma | Male | 69 | 49 | |
| | | Female | 50 | 100 | |

## Maize

The area planted to maize from OFDTs varied significantly between Sub Districts (Table 109). In Baucau District for example, the area planted to crop from seed harvested from OFDTs averaged 780m$^2$ compared with 70m$^2$ in Maubara. The areas planted in Vemasse were very large at 5,100 m$^2$. With the exception of Liquidoe, the area replanted by farmers the following year increased. This is an indication that the farmers were happy with the new varieties. Access to seed may also have been less problematic in Liquidoe. The areas planted to released varieties from OFDT seed in the new Sub Districts were also quite high (Table 110).

**Table 109. Area planted to maize with seed from 2006 OFDTs in sub districts**

| *District* | *Sub District* | *Area planted one year after OFDT (m$^2$)* | *Area planted two years after OFDT (m$^2$)* |
|---|---|---|---|
| Aileu | Aileu | Not measured | 110 |
| Baucau | Baucau | 780 | 1,600 |
| Liquica | Liquica | 248 | 640 |
| Alieu | Liquidoe | 420 | 153 |
| Liquica | Maubara | 70 | 725 |
| Baucau | Vemasse | 5,100 | 5,300 |
| ***Mean*** | | *1,324* | *1684* |

**Table 110. Area planted to maize with seed from 2007 OFDTs in new Sub-Districts.**

| *District* | *Sub District* | *Area planted one year after OFDT (m$^2$)* |
|---|---|---|
| Baucau | Laga | 1,043 |
| Baucau | Quelicai | 110 |
| Manufahi | Same | 2,000 |
| Baucau | Venilale | 416 |
| ***Mean*** | | *892* |

More than 10% of 2006 maize OFDT farmers reported giving seed to family members and friends. The areas planted to this seed were significant, averaging 1891m$^2$ (Table 111).

After performing OFDTs in 2007, 22% of farmers gave seed to friends and family who planted an average of 1480 $m^2$ to the crop. This is equivalent to the area planted by the original OFDT farmers.

**Table 111. Cultivation of maize by friends and family with seed from OFDTs.**

| *Crop* | *Seed movement off farm from successful OFDT in 2006. (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* | *Seed movement off farm for successful OFDT in 2007 (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* |
|---|---|---|---|---|
| Friends | 11.7 | | 20.1 | |
| Family | 0.6 | | 1.5 | |
| Mean | 12.3 | 1,891 | 21.6 | 1,480 |

## Peanuts

The small number of farmers who retained sufficient seed after harvesting their crops following an OFDT in 2006 (two years after completing an OFDT) planted a small area to the crop (Table 112). This was about one third of the area planted one year after conducting an OFDT in 2007. The trend of farmers planting a reduced area for a second crop is a reverse of the maize farmers who tended to plant an increasing area (Table 109). The reason for this trend will be investigated further in 2008-2009.

**Table 112. Cultivation of Utamua by farmer with seed from OFDTs.**

| *Crop* | *Area planted two years after 2006 OFDT ($m^2$)* | *Area of replanting one year after 2007 OFDT ($m^2$)* |
|---|---|---|
| Aileu | 119 | 40 |
| Alas | 76 | 23 |
| Baucau | 344 | 45 |
| Liquica | 435 | |
| Liquidoe | | 44 |
| Maubara | 105 | 120 |
| Quelicai | 24 | |
| Same | 2670 | |
| Vemasse | 1450 | 4,500 |
| Venilale | 190 | |
| **Mean** | 434 | 1,159 |

Those family members who planted Utamua with seed from the 2006 OFDTs planted a reasonably large area at 1860 $m^2$ (Table 113). The area planted with seed from the 2007 OFDTs was smaller at 226 $m^2$. Some OFDT seed was sold at the market. Sales of surplus product is becoming an increasing trend of farmers growing SoL released varieties as discussed in Section 5).

**Table 113. Cultivation of Utamua by family and friends with seed from OFDTs.**

| *Crop* | *Seed movement off farm from successful OFDT in 2006. (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* | *Seed movement off farm for successful OFDT in 2007. (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* |
|---|---|---|---|---|
| Friends | 5.7 | | 8.1 | |
| Family | 0 | | 0.9 | |
| Sold | | | 0.4 | |
| Mean | 5.7 | 1860 | 9.4 | 226 |

### Rice

Significant areas of Nakroma have been planted as a result of OFDT farmers producing seed for distribution. On average OFDT farmers planted 2,700m$^2$ of rice to Nakroma one and two years after an OFDT (Table 114). Some areas were quite large (up to one hectare) indicating some farmers retained all of their seed for replanting. Some rice farmers were also able to grow an irrigated dry season crop, thereby increasing their seed stock. Family and friends of the OFDT farmers also planted large areas of crop (Table 115). These farmers tended to grow an increasing area of rice. The average area of planted rice was 9416 m$^2$ two years after an OFDT in 2006 and 4438m$^2$ one year after conducting an OFDT in 2007.

**Table 114. Area of replanting of Nakroma by successful OFDT farmers.**

| *Crop* | *Area Nakroma planted two years after 2006 OFDT (m$^2$)* | *Area Nakroma planted one year after 2007 OFDT (m$^2$)* |
|---|---|---|
| Aileu | 440 | 573 |
| Baucau | | 4045 |
| Liquica | 620 | |
| Maubara | 66 | |
| Same | | 10000 |
| Vemasse | 7400 | 8670 |
| Venilale | 5100 | |
| **Mean** | 2,700 | 2,780 |

**Table 115. Cultivation of Nakroma by family and friends with seed from OFDTs.**

| *Crop* | *Seed movement off farm from successful OFDT in 2006. (%)* | *Area planted by friends and family of Nakroma (m$^2$/farm)* | *Seed movement off farm for successful OFDT in 2007. (%)* | *Area planted by friends and family of Nakroma (m$^2$/farm)* |
|---|---|---|---|---|
| Friends | 25 | | 21 | |
| Family | | | 1.9 | |
| Mean | 25 | 9416 | 23.1 | 4438 |

### Sweet potato

The newly released Hohrae sweet potato varieties are of shorter duration than the traditionally grown varieties. Because of this, there is a longer period between harvest and the following planting. Therefore the management practices are different for the new varieties compared with the old. New farmers are often unaware of how to manage the new technologies and have little planting material after harvest. Those that do have supplementary water during the dry season or leave part of the crop in the ground have sufficient planting material for the following year. In general, the area planted to Hohrae sweet potato the second year was smaller than that planted immediately after the OFDT was harvested (Table 116).

**Table 116. Area of replanting of new sweet potato varieties by OFDT farmers.**

| *Crop* | *Area planted two years after 2006 OFDT($m^2$)* | *Area of replanting one year after a successful OFDT in 2007 ($m^2$)* |
|---|---|---|
| Aileu | 30 | 20 |
| Baucau | 320 | 1090 |
| Liquica | 21 | 225 |
| Liquidoe | 60 | 180 |
| Maubara | 30 | 13 |
| Same | 32 | 2,350 |
| Vemasse | 874 | 437 |
| Venilale | | 142 |
| **Mean** | 195 | 557 |

A small number of farmers shared their Hohrae sweet potato cuttings with their friends and family (Table 117). The amount of planting material they provided was small and the friends and family were only able to plant small areas.

**Table 117. Cultivation of Hohrae by family and friends with cuttings from OFDTs.**

| *Crop* | *Seed movement off farm from successful OFDT' in 2006. (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* | *Seed movement off farm for successful OFDT' in 2007. (%)* | *Area planted by friends and family of elite varieties ($m^2$/farm)* |
|---|---|---|---|---|
| Friends | 1.5 | | 17 | 253 |
| Family | | | 1 | 400 |
| Mean | 1.5 | *[a] | 18 | 263 |

a No estimates of the area planted was possible.

## Discussion

Farmers planting OFDTs each year receive only a small amount of planting material for the trials. As a result, there is little opportunity for widespread expansion in the following crop area, especially in the case of peanuts and sweet potato which have low multiplication ratios. Utamua peanuts also possesses a long dormancy where the seed does not germinate within three months. It therefore cannot be planted into the following mini wet season for seed production. In addition, planting material of the early maturing Hohrae sweet potato varieties needs to be conserved for longer periods than the local varieties. This is difficult if all the plants are harvested as often happens, leaving the planting material exposed to the elements. Farmers will slowly adapt to the different management practices required for these varieties.

Despite the small amount of available seed, more than half of the OFDT farmers from 2006 used maize and rice seed harvested from their plots to grow crops for consumption the following season. A slightly smaller percentage were still growing these crops two years later but on larger areas. Because the OFDT plots are only 25m$^2$ in area, the harvest is small and farmers needed to grow a high proportion of the harvested seed to expand their crops in such a manner.

Further expansion in the area of all released varieties will require a dedicated seed production program. Seed production of all SoL/MAF released varieties will be increased on farmer fields in 2008/2009 to cater for increasing demand.

# 5. Social science program

## 5.1 Baseline data survey (Buka Data Los)

This report provides findings of Buka Data Los (means 'looking for true or reliable data' in Tetun language) (BDL) surveys undertaken during 2008 in the seven project Districts of East Timor (Aileu, Ainaro, Baucau, Liquiça, Bobonaro, Manatuto and Manufahi). Livelihood information covering a total of 612 households is presented. The questionnaire survey was undertaken by SoL agricultural research field staff with clusters of farmer groups as part of their routine monitoring and extension work.

The survey was designed to provide a snapshot or situation report of participating farmers in terms of general indicators of socio-economic status and well-being. The study attempts to address program requirements for disaggregated data, particularly in gender terms; address aspects of food security and economic standing; and form a basis for assessing adoption rates and constraints to improved food production. The findings provide broad indicators and patterns of farmer household conditions and can serve as a guide for targeted or focused research enquiry into more specific aspects of production constraints and opportunities.

**Farmer households and gender participation**

The majority of agricultural livelihoods across East Timor are based around farmer households as production units. All members of Timorese households (with the exception of babies and the infirm) contribute to the production of domestic food requirements. Table 118 illustrates variation in household membership among participating farmers.

**Table 118. Members of households by District**

| *Members/household* | *Aileu (%)* | *Ainaro (%)* | *Baucau (%)* | *Bobonaro (%)* | *Liquica (%)* | *Manatuto (%)* | *Manufahi (%)* | *Average (%)* |
|---|---|---|---|---|---|---|---|---|
| 1 | 15 | 56 | 19 | 38 | 2 | 4 | 26 | *19* |
| 2 | 13 | 9 | 8 | 13 | 8 | 8 | 3 | *8* |
| 3 | 4 | 0 | 14 | 0 | 13 | 8 | 4 | *10* |
| 4 | 13 | 4 | 10 | 0 | 22 | 29 | 8 | *12* |
| 5 | 12 | 7 | 16 | 38 | 23 | 13 | 8 | *14* |
| 6 | 7 | 4 | 14 | 13 | 16 | 13 | 18 | *13* |
| 7 | 9 | 7 | 10 | 0 | 6 | 8 | 4 | *8* |
| 8 | 12 | 7 | 4 | 0 | 7 | 13 | 14 | *7* |
| 9 | 5 | 4 | 5 | 0 | 3 | 4 | 6 | *5* |
| 10 | 2 | 2 | 0 | 0 | 1 | 0 | 8 | *2* |
| 11 | 5 | 0 | 0 | 0 | 0 | 0 | 1 | *1* |
| 12 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | *1* |
| Total | 95 | 46 | 265 | 8 | 88 | 24 | 80 | *595* |

Of interest in Table 118 is the relatively large number of households with four or fewer members (49%). The great majority of households (66%) had six members or less and reflected nucleated households of parents with children. Households with large family membership (greater than 10) accounted for just four percent of the respondent households. One somewhat anomalous result was the large number of farmer respondents in Aileu who reported single membership households (56%). Whether this simply reflects a lack of recorded household membership data or some other social pattern requires confirmation. Overall the results are broadly similar to the 2006-7 BDL survey.

The gender balance of farmer household membership engaged in the on-farm demonstration trials (OFDTs) is presented in Table 119. The sample indicates that 75% of the surveyed heads of households were men and 25% women. The average age of participating farmers was 40 for women and 43.5 for men.

**Table 119. Gender participation in agricultural activities**

| *District* | *Sub District* | *Female* | *%* | *Male* | *%* | *Total* |
|---|---|---|---|---|---|---|
| Aileu | Aileu | 17 | 32 | 36 | 68 | 53 |
| | Liquidoe | 5 | 24 | 16 | 76 | 21 |
| | Remexio | 10 | 48 | 11 | 52 | 21 |
| Ainaro | Hatudo | 0 | 0 | 21 | 100 | 21 |
| | Maubisse | 7 | 28 | 17 | 72 | 24 |
| Baucau | Baucau | 17 | 25 | 50 | 75 | 67 |
| | Laga | 7 | 18 | 31 | 82 | 38 |
| | Quilicai | 20 | 40 | 30 | 60 | 50 |
| | Vemasse | 22 | 39 | 35 | 61 | 57 |
| | Venilale | 22 | 37 | 38 | 63 | 60 |
| Liquica | Liquica | 11 | 22 | 38 | 78 | 49 |
| | Maubara | 8 | 21 | 31 | 79 | 39 |
| Bobonaro | Atabae | 0 | 0 | 5 | 100 | 5 |
| | Balibo | 0 | 0 | 3 | 100 | 3 |
| Manatuto | Natarbora | 3 | 13 | 21 | 88 | 24 |
| Manufahi | Alas | 3 | 17 | 15 | 83 | 18 |
| | Fatuberliu | 2 | 22 | 7 | 78 | 9 |
| | Same | 1 | 5 | 21 | 95 | 22 |
| | Turiscai | 0 | 0 | 33 | 100 | 33 |
| | Total | 153 | 25 | 450 | 75 | 614 |

## Cropping patterns

Table 120 provides collated information on the pattern of food crop production among the participating farmer households, in terms of the variety of crops planted. The data illustrates a number of features about Timorese agriculture that have wider application. There was a strong reliance among the farmers on the production of a small number of key staple foods that have proved reliable in an unreliable monsoon environment. Most commonly reported crops planted by 60% or more of the farmer respondents were cassava, pumpkin, maize and sweet potato. Some 20% of farmers reported planting irrigated rice which is consistent with other surveys in East Timor and reflects the greater emphasis on upland and dryland food cropping among the majority of Timorese farming households.

**Table 120. Food crops planted in house gardens or bush gardens**

| *Crops planted* | *Total* | *% of total respondents* |
|---|---|---|
| Cassava | 413 | 68 |
| Pumpkin | 400 | 66 |
| Long season maize | 395 | 68 |
| Sweet potato | 361 | 60 |
| String bean | 332 | 55 |
| Taro | 312 | 52 |
| Peanut | 300 | 50 |
| Arrowroot | 286 | 47 |
| Short season maize | 266 | 44 |
| Cucumber | 251 | 42 |
| Kumbili (wild yam) | 214 | 35 |
| Sinkumas tuber (yam bean) | 181 | 30 |
| Red bean | 159 | 26 |
| Bitter bean (wild lima bean) | 155 | 26 |
| Maek (elephant foot's yam) | 144 | 24 |
| Irrigated rice | 115 | 19 |
| Sorgham | 79 | 13 |
| Banana | 78 | 13 |
| Papaya | 36 | 6 |
| Green leaf vegetables | 24 | 4 |
| Soybean | 24 | 4 |
| Pigeon pea | 22 | 4 |
| Upland rice | 20 | 3 |
| Potato | 19 | 3 |
| Mung bean | 18 | 3 |
| Coconut | 15 | 2 |
| Mango | 15 | 2 |
| Guava | 12 | 2 |
| Mandarins | 12 | 2 |
| Jackfruit | 7 | 1 |
| Pineapple | 6 | 1 |
| Melon | 5 | 1 |
| Avocado | 4 | 1 |

Of particular interest was the prominence of tuber crops in the key staples planted or produced by the farmer households. This is consistent with the 2006-7 BDL survey results.

**Table 121. Tubers cultivated**

| *Tuber crop* | *%* |
|---|---|
| Cassava | 68 |
| Sweet potato | 60 |
| Taro | 52 |
| Arrowroot | 47 |
| Kumbili (wild yam) | 35 |
| Singkumas (yam bean) | 30 |
| **Maek (elephant foot's yam)** | 24 |

As indicated in the 2006-7 BDL survey analysis, tuber crops have the distinct advantage of being able to be stored in the ground and only harvested when needed. Cassava is exemplary in this respect, while others are harvested and stored for periods of months until consumed. Tubers tend to be supplementary foods to the principal staples of maize and rice, and are also frequently harvested opportunistically as wild products from surrounding forests (see Glazebrook et al 2007:12).

The majority of food crops were planted in designated food crop gardens (to'os) which may be some distance from the settlement and house yard (kintal) of the producers. This is borne out in the BDL 2008 results where an average of 69% of respondents designated the to'os as the site of production, with just 33% electing also to plant their house yards. There was some variation across the SoL Sub-Districts in this regard. In Liquica for example, these figures were reversed with a majority (70%) electing to plant house yard gardens.

### Food Security

The survey sought an estimate from the participant farmers about the adequacy of their food production harvest for domestic consumption requirements (Table 122). This is clearly a gross measure of production yields and is dependent to some extent on the availability of supplementary or alternative food supplies by particular households, but the data reflects the perceptions of farmer households based on their immediate experience.

**Table 122. Respondent measures of food sufficiency (maize)**

| *District* | *Insufficient* | *%* | *Surplus* | *%* | *Sufficient* | *%* | *Total* |
|---|---|---|---|---|---|---|---|
| Aileu | 34 | 44 | 16 | 21 | 27 | 35 | 77 |
| Ainaro | 13 | 52 | 6 | 24 | 6 | 24 | 25 |
| Baucau | 78 | 33 | 19 | 8 | 139 | 59 | 236 |
| Bobonaro | 4 | 80 | 0 | 0 | 1 | 20 | 5 |
| Liquica | 28 | 33 | 21 | 24 | 37 | 43 | 86 |
| Manatuto | 5 | 25 | 7 | 35 | 8 | 40 | 20 |
| Manufahi | 32 | 60 | 6 | 11 | 15 | 28 | 53 |
| Total | 194 | 38 | 75 | 15 | 233 | 47 | 502 |

The results of 2008 OFDT farmers are consistent with those reported in the 2006-7 BDL survey. A significant number of respondents reported insufficient stores of maize to meet their domestic requirements (38%). Conversely, some 47% of the respondents reported sufficient stocks with a minority (15%) enjoying surplus production. The results highlight the importance of producing a diversity of food crops such as tubers to allow for annual variations in maize crop production. These figures, however, are averages, and the results also highlight a significant variation across the Districts, which is a common pattern of agricultural production in East Timor. For instance, fully 60% of farmer households in Manufahi reported insufficient quantities of maize. This is despite the fact that Manufahi generally receives a more favourable and extended rainy season for additional cropping.

Table 123 presents another perspective on food security and sufficiency. The table presents the point during the calendar year when the stored maize harvest is exhausted in a household. The data are consistent with previous surveys which highlight the fact that few farmer households are able to maintain stores of maize through the entire year to the next harvest. Over half of the respondents (56%) reported maize stores to be fully consumed by August, which is little more than three or four months following harvest. Three quarters of households had exhausted their maize stocks by September and 90% reported no supplies by November, three to four months before the new maize harvest can be secured.

**Table 123. Month when harvest maize stores are exhausted**

| *Month of exhausted maize supplies* | *Total* | *Percentage* | *Cumulative* |
|---|---|---|---|
| April | 3 | | 1 |
| May | 11 | 5 | 7 |
| June | 26 | 13 | 20 |
| July | 26 | 13 | 33 |
| August | 45 | 23 | 56 |
| September | 38 | 19 | 75 |
| October | 15 | 8 | 83 |
| November | 13 | 7 | 90 |
| December | 13 | 7 | 97 |
| January | 1 | 1 | 98 |
| February | 3 | 2 | 100 |
| Total | 194 | 100 | |

For those farmers who reported diminished or insufficient food crop harvests, a follow-up question was asked seeking the main reasons for the lowered yields. These are listed in Table 124 and reflect something of the scope of impact by different factors. The key causes of crop failure or damage include variable monsoon rainfall that impedes plant growth; strong winds that may flatten crops, especially maize; and the deleterious impact of rats and vermin. Factors that encourage drought tolerance in plants, reduced vegetative stem growth in maize, and control of pests, can significantly ameliorate these environmental threats to crop production. These factors are all being addressed by the SoL variety testing.

**Table 124. Farmers perceptions of factors reducing harvest yields by district**

| *District* | *Lack of rain (%)* | *Weed effects (%)* | *Damage by livestock (%)* | *Pests (%)* | *Rats (%)* | *Strong winds (%)* | *Other (%)* |
|---|---|---|---|---|---|---|---|
| Aileu | 21 | 2 | 0 | 2 | 25 | 44 | 6 |
| Ainaro | 25 | 0 | 0 | 0 | 0 | 50 | 25 |
| Baucau | 74 | 0 | 3 | 5 | 11 | 5 | 3 |
| Bobonaro | 50 | 0 | 50 | 0 | 0 | 0 | 0 |
| Liquica | 53 | 4 | 2 | 6 | 4 | 27 | 4 |
| Manatuto | 0 | 0 | 0 | 0 | 100 | 0 | 0 |
| Manufahi | 44 | 0 | 6 | 0 | 11 | 39 | 0 |

Table 125 presents the most common practices of storage for maize and other crops. Of particular significance here are the two principal methods of storing maize: by tying the sheathed cobs into large bundles and storing them in an elevated position either in nearby trees (28% of respondents) or in the rafters and attics of thatched kitchens where heat and smoke from hearth fires helps dry the maize and deter weevils and fungal infestation (48%). Just three percent of farmers stated that they recycled a rice sack to store corn and other crops. Given that post-harvest storage losses are a significant cause of reduced food stocks for farmer households, the results highlight the need for improved storage techniques such as sealed drums or other forms of economical sealed containers.

**Table 125. Storage methods for maize (and other crops)**

| *Method* | *Aileu* % | *Ainaro* % | *Baucau* % | *Bobonaro* % | *Liquica* % | *Manatuto* % | *Manufahi* % | *Average* % |
|---|---|---|---|---|---|---|---|---|
| Above the fireplace | 65 | 17 | 31 | 100 | 78 | 61 | 70 | 49 |
| In a branch of a tree | 27 | 22 | 45 | 0 | 3 | 11 | 11 | 29 |
| Drum | 3 | 57 | 2 | 0 | 0 | 6 | 16 | 6 |
| Above the hearth | 1 | 0 | 7 | 0 | 14 | 0 | 4 | 6 |
| Bottle | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Small basket | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| One gallon container | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bamboo platform | 0 | 0 | 2 | 0 | 0 | 11 | 0 | 1 |
| Big basket | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 1 |
| Sack | 0 | 0 | 8 | 0 | 0 | 6 | 0 | 4 |
| Jerry can | 4 | 0 | 3 | 0 | 3 | 6 | 0 | 3 |
| Silo | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| *Total no. respondents* | *77* | *23* | *236* | *5* | *87* | *18* | *56* | *512* |

## Economic status and strategies

One of the objectives of the survey was to assess the socio-economic standing of the participating households, to ensure that an appropriate range of farmer families was able to participate in the OFDT activities. Farmer participants were self-selected but there was an effort to ensure that their profiles were consistent with the general economic standing of the Timorese farming communities. Two measures of relative wealth were developed and illustrated in the following tables.

Table 126 shows the standard of residential housing reported among the participating farmers. House style and quality are a widely used proxy for relative economic standing and tend to correlate well with household financial capacity. Basic housing was widely reported across the Districts. An average of 57% of houses used sago palm (bebak) for walls and 66% had dirt floors. The western District of Bobonaro registered the highest average of this basic housing, reflecting the distance from Dili and general level of livelihood insecurity in the region.

**Table 126. House types across the seven Districts**

| Description | Aileu % | Ainaro % | Baucau % | Bobonaro % | Liquica % | Manatuto % | Manufahi % | Average % |
|---|---|---|---|---|---|---|---|---|
| Basic thatch roof | 8 | 33 | 43 | 60 | 9 | 17 | 31 | 24 |
| Tin/board roof | 92 | 67 | 57 | 40 | 91 | 83 | 69 | 76 |
| Tin walls | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 2 |
| Sago tree walls | 56 | 67 | 64 | 80 | 76 | 26 | 58 | 57 |
| Half wall | 8 | 4 | 19 | 0 | 9 | 65 | 29 | 22 |
| Full wall | 31 | 25 | 17 | 20 | 15 | 9 | 14 | 19 |
| Non-cement floor | 77 | 71 | 83 | 80 | 77 | 35 | 51 | 66 |
| Cement/floor tiles | 23 | 29 | 17 | 20 | 23 | 65 | 42 | 34 |

A second set of wealth indicator questions relates to a range of belongings and technologies that may reflect the relative economic status among the respondent group. Table 127 illustrates responses by farmers about ownership of a vehicle, motorbike, mobile phone and electrical generator.

As a general comment, the data demonstrate that the great majority (79%) of farmer respondents do not own any of the modern items listed. The areas where ownership of these items was reported are correlated to a degree with areas where higher housing standards were reported – namely Manatuto and Baucau. Although these indicators illustrate a general consistency with last year's BDL, a prominent difference with the previous year's BDL is the increased number of farmers with mobile phones (10%). In the 2007 BDL just 2.9% of all participating famers reported that they owned a mobile phone. Given that on other comparable measures the two groups of respondents are similar, the data suggests a real increase in the spread of mobile telephone into rural areas. It highlights the importance people place on communication with others beyond their local areas.

**Table 127. Wealth measures by key commodities**

| *Description* | *Aileu (%)* | *Ainaro (%)* | *Baucau (%)* | *Liquica (%)* | *Manatuto (%)* | *Manufahi (%)* | *Average (%)* |
|---|---|---|---|---|---|---|---|
| Car | 0 | 0 | 3 | 2 | 13 | 0 | 3 |
| Motorbike | 8 | 4 | 12 | 1 | 4 | 0 | 5 |
| Mobile phone | 8 | 8 | 17 | 3 | 13 | 8 | 10 |
| Diesel generator | 0 | 0 | 5 | 1 | 13 | 0 | 3 |

* BDL information on key commodities for Bobonaro was not collected.

A combined wealth indicator including assets and housing conditions suggests the majority (65.5%) of subsistence farmers were considered at a low-social-economic standard. 21.2% were considered to have a medium social-economic standard and 13.3% were considered as having a high social-economic standard which included a house with concrete or tin roof, concrete floor and one or more of the key commodities.

A third economic measure of activity sought in the survey instrument was a review of how the farmer households generated cash incomes to supplement their farming practice over the previous year. Minimally, all rural households in East Timor require a small but regular cash income to afford basic household necessities such as soap, shampoo, kerosene for lamps, seasonings, salt and sugar. Many households also need to generate funds for schooling costs and transport requirements. The survey focused on the source of income rather than any specific attempt to measure the amount of cash generated.

For these farmers the principal source of farm-based cash income came from trade in household domestic livestock (an average of 42%), including chickens, pigs and goats. Regular, smaller amounts of income, such as occasional sales of poultry, are generally more suited to household budgets than the larger cash windfalls derived from buffalo or cattle, particularly in the absence of banking services.

The sale of a range of surplus food crops (an average of 32%) and plantations such as coffee (an average of 21%) were the other major sources of income. Commercial sales of household food crops included a wide range of cultivars. The multiple sources of cash income, most of which will be sold in local market, exemplifies the highly diversified nature of smallholder farm activity in East Timor. The most common sources of cash income through crops and harvested foods include vegetables (modo), usually in the dry season; maize; cassava; rice; coconut; coffee; peanuts; sweet potato; banana; mango; taro; and mandarin. The data highlights the orientation of most near-subsistence farmer households in East Timor to optimise a range of available resources rather than seeking to maximise the returns on a smaller range of products. This can be seen as a risk management strategy designed to guarantee livelihood through diversified farming practice.

In another section of the survey a question was asked about the sources of supplementary income in addition to farming, which provided a number of additional perspectives. These non-farm activities could include food kiosks, teachers, fishermen, and tradesmen, and these accounted for an average of ten percent of income sources. Typically these small home-based shops provide a range of household necessities and frequently sought items sold to neighbours and members of the local community. In providing a service to local households kiosk owners were able to generate small amounts of income through profit margins.

## Conclusion

The BDL surveys are intended to provide a baseline snapshot of all farmer households participating in SoL OFDTs. The present survey was directed principally to maize farmers but included many households who also cultivated improved varieties of peanuts (forerai) and sweet potato (fehuk midar).  The present results are highly consistent with similar surveys and depictions of smallholder farming practice across East Timor (McWilliam, 2006). The findings illustrate both the range of constraints, particularly environmental factors, limiting food production and the multiple strategies that farmer households adopt to sustain rural livelihoods and manage risk.

The plan for the BDL survey instrument is to extend its application into the expanded areas of SoL activity and to include farmer households who are participating in the full range of variety trial activities. Some fine tuning of the questions and additional explanation of the objectives of the questions within the survey would assist the SoL agronomy research officers (pescizador) to obtain consistent data and appreciate the relevance of socio-economic data and analysis to the broader program objectives. The BDL survey instrument is designed to provide general comparative information across the majority of participating farmer households in the SoL program. To this extent its findings are limited but representative and highlight a number of patterns and practices that may be investigated further. The BDL instrument is designed to complement the ongoing and more focused activity-specific surveys and interviews undertaken by the SoL SOSEK team.

# 5.2 Economic benefits some farmers derived from SoL varieties in 2007-2008

This report describes some experiences and economic benefits gained by farmers planting SoL's newly released improved varieties and selling their produce in the market. The study was conducted in four Districts; Aileu, Baucau, Liquiça and Manufahi. Farmers included in this study were, at one stage, collaborators of the On Farm Demonstration Trial (OFDT) program and nominated as being "progressive farmers" by SoL Research Advisors (RAs).

### *Materials and methods*

Data was collected from a sample of 24 farmers planting the new varieties. These farmers were nominated by RAs in the Districts of Aileu, Baucau, Liquica and Manufahi. The questionnaire included questions on the measurements were planting area; yield; amount sold; the amount of money obtained from sales and how the farmers used the income; farmer preferences with varieties plus the perceived differences between the local and new varieties. If the material was shared with neighbours or relatives, the reason it was shared plus the social economic benefits they obtained were also noted. Surveys were conducted between September 2007 and August 2008 as part of a long term study.

The list of farmers who were likely to either sell or share new varieties during the year was provided to the social scientists by the agronomists working in each of the four Districts. The farmers at these sites were visited a number of times during the year and interviewed according to a structured questionnaire. One surveyed farmer in Ostico village, Baucau (Mrs Juvita Da Freitas) harvested sweet potatoes and sold produce three times. Another farmer in Betano, Manufahi grew two crops of rice and sold it in the market. This raised the number of survey points to 27. Of the 24 farmers, 11 grew sweet potatoes, 4 maize, 7 rice and 2 peanuts. Some short stories of the collaborating farmers were also recorded along with their impressions of the new varieties. Planting times for each of the crops are presented in Table 128; close to the beginning of the wet season except in the case of rice which had the potential for being irrigated.

**Table 128. Planting time for each crop (2007/2008)**

| | *Planting time* | | | |
|---|---|---|---|---|
| *Commodity* | *Aileu* | *Baucau* | *Liquica* | *Manufahi* |
| Rice | Dec/Jan | Jan-March | Dec/Jan | Dec-Jan |
| Maize | Oct/Nov | Oct/Nov | Oct/Nov | Oct-Dec |
| Sweet potato | Nov/Dec | Nov-Jan | Dec/Jan | Nov/Dec |
| Peanuts | Nov-Jan | Nov/Dec | Nov-Jan | Nov/Dec |

### *Results*

**Rice**

One rice variety, Nakroma, was released by SoL/MAF during 2007. This variety is suitable for irrigated lowlands and low risk rainfed lowlands. It is considered to be of good eating quality (see Chapter 8 for full description). In 2008, participating farmers have had the opportunity to harvest the new Nakroma varieties over a number of cropping seasons. As the production of Nakroma increases with successive replanting, so to do opportunities for sale or distribution of surplus.

Six of the seven surveyed rice farmers sold Nakroma grain for consumption. One of the farmers was able to grow two crops during the season and sell it on the open market. One collaborator in Buruma village (Mr Ernesto da Costa Freitas) distributed the harvest amongst the farmer group he represented and provided some to his family and neighbours. Three of the interviewees were from Aileu, two from Baucau and two from Manufahi. The area under production varied from $25m^2$ to 1.5 ha (Table 129) being related to whether the farmer was a new OFDT collaborator receiving seed for the first time (area of $25m^2$) or had multiplied seed from earlier OFDTs (1.2ha). The method of sale differed by District and the amount being sold. Some farmers measured the value of their grain by the kg, while farmers with smaller amounts for sale used milk cans, kerosene tins (large) or powdered milk (SGM) cans.

**Table 129. Area sown, harvest and method of sale of rice**

| *Name* | *District* | *Village* | *Area sown (ha)* | *Total harvest (kg)* | *Sold (kg)* | *Selling method ($)* | *Price ($)* |
|---|---|---|---|---|---|---|---|
| Fernando Kolimau | Alieu | Sarin | 0.24 | 720 | 120 | $/large can[1] | 3.50 |
| Antonio Hornai | Manufahi | Betano | 1.2 | 2000 | 50 | $/SGM can[2] | 0.50 |
| Ernesto da Costa Freitas | Baucau | Buruma | 1.0 | 2880 | - | - | - |
| Regina Amaral | Baucau | Uma nai iku | 1.0 | 2500 | 763 | $/kg | 0.50 |
| Antonio Hornai | Manufahi | Betano | 1.2 | 1000 | 60 | $/kg | 0.30 |
| Domingos | Alieu | Sarin | 0.44 | 850 | 25 | $/milk can[3] | 0.10 |
| Augusto Da Silva | Alieu | Sarin | 0.025 | 75 | 34 | $/milk can | 0.10 |
| Maria da Costa | Alieu | Sarin | 0.4 | 500 | 72 | $/large can (12kg) | 3.00 |

1) Large (kerosene) can = 12 kg, 2) Milk (SGM) can = 1 kg, 3) Milk can = 0.3 kg

Farmers who sold their grain generally used the money to buy more food (one farmer purchased rice) while others paid associated schooling costs, bought clothing and equipment or saved for future needs (Table 130). Both times Antonio Hornai sold grain he used part of the proceeds to educate his children.

**Table 130. Use of cash earned from selling Nakroma rice**

| *Name* | *Village* | *Amount of money obtained ($)* | *Household needs covered* |
|---|---|---|---|
| Fernando Kolimau | Sarin | 35.0 | Bought 1 pig and 1 chicken |
| Antonio Hornai | Betano | 25.0 | Paid children school fees, paid labour for planting, harvest and threshing |
| Ernesto da Costa Freitas | Buruma | - | Shared the yields with group member |
| Regina Amaral | Uma nai iku | 305.2 | Bought coconut grater machine |
| Antonio Hornai | Betano | 21.0 | Paid children's school fees |
| Domingos | Sarin | 17.5 | Bought cheaper rice |
| Augusto Da Silva | Sarin | 23.8 | Bought children's clothes |
| Maria da Costa | Sarin | 18.0 | Bought food |

According to the collaborating rice farmers, Nakroma possesses characteristics that attract consumers to buy it. These characteristics include its white, fragrant, oily grain. Its good tillering ability, even crop height and high yields are also criteria for selection (Table 131). Farmers reported that many of their neighbours who were not involved in the program asked for seed to plant in their rice fields.

**Table 131. Farmers' preferences for Nakroma**

| *Name* | *Village* | *Preferences* |
|---|---|---|
| Fernando Kolimau | Sarin | Large, fragrant grain, similar height plants |
| Antonio Hornai | Betano | High yields, fragrant, oily, similar height |
| Ernesto da Costa Freitas | Buruma | Large, fragrant grain, similar height plants |
| Regina Amaral | Uma nai iku | Produce many tillers, high yields |
| Domingos | Sarin | Similar height, fragrant |
| Augusto Da Silva | Sarin | High yields |
| Maria da Costa | Sarin | White colour seed, high yields |

Surveyed farmers were asked whether they had shared their SoL seed with family and neighbours. Mrs. Regina Amaral who has been involved in the SoL program since 2006, had shared Nakroma seed with 34 other rice farmers including 4 family members (Table 132). Both Mr Kolimau and Mr. Domingos reported that they had too little seed to share at the expense of income. Mr Antonio Hornai placed high value on his crop and was quoted a saying the following in July, 2008:

> *The rice called Nakroma, it's like this. For the last three years I have held onto the rice Nakroma because it is good. Other friends have come and bought some rice seed we have sold. Last year, the government themselves wanted to come and buy the rice because they saw the rice was uniform and short. I want to hold onto this rice variety and will always keep some to plant myself.*

**Table 132 Sharing of Nakroma seed by OFDT farmers**

| | | *Total farmer number* | |
|---|---|---|---|
| *Name* | *Village* | *Family* | *Neighbours* |
| Fernando Kolimau | Sarin | - | - |
| Antonio Hornai | Betano | 3 | 7 |
| Ernesto da Costa Freitas | Buruma | 2 | 3 |
| Losconi group | Fatukahi | - | - |
| Regina Amaral | Uma nai iku | 4 | 30 |
| Domingos | Sarin | - | - |
| Augusto Da Silva | Sarin | 2 | 5 |
| Maria da Costa | Sarin | 1 | - |

## Sweet potato

The three released sweet potato varieties, Hohrae 1, Hohrae 2 and Hohrae 3 have been continuously evaluated by researchers and farmers since 2005. All three possess large tuber sizes and have similar high yields compared with local varieties. Farmers who have adopted these varieties regularly replant and sell the produce in the market.

Sweet potatoes are rarely grown as a monocrop, often being planted as inter row crops between maize. The areas are also often small and non-contiguous making measurement difficult. Additionally sweet potato roots are dug as required for consumption by the household and total yields almost impossible to measure. For these reasons, there is considerable missing data in the total yields presented in Table 133.

**Table 133. Yields and saleable amounts of sweet potato**

| *Name* | *District* | *Village* | *Total yields (kg)* | *Total yields sold (kg)* |
|---|---|---|---|---|
| Palmira Eliza Soares | Baucau | Ostico | 1925 | 1470 |
| Juvita Da Costa Freitas | Baucau | Ostico | 210 | 875 |
| Alberto Caldeira da Silva | Liquica | Triloka | 1680 | 455 |
| Zeferino Mirabela | Liquica | Triloka | * | 12.5 |
| Juvita Da Costa Freitas | Baucau | Ostico | 875 | 490 |
| Martinha Boavida | Baucau | Ostico | * | 420 |
| Constancio Da Costa | Baucau | Ostico | * | 175 |
| Juvita Da Costa Freitas | Baucau | Ostico | 700 | 280 |
| Henriqueta | Baucau | Bucoli | * | 6 |
| Carlos da Costa Freitas | Baucau | Gariwai | * | 420 |
| Manuel Caso | Liquica | Varuvou | * | 7 |
| Martina Boavida | Baucau | Ostico | * | 210 |
| Cipriano Martins | Alieu | Malere | 375 | 125 |

Farmers from Baucau District have been particularly active in the cultivation and sale of SoL released varieties. Baucau farmers have also gained the most socio-economic benefit from selling sweet potatoes. The reasons for this occurrence may become clearer as more farmers are given the opportunity to grow the crop. Ten of the thirteen surveyed farmers benefited from selling Hohrae varieties. Among these, Mrs. Juvita da Costa Freitas sold potatoes three times, and Mrs. Martina Boavida 2 times. One farmer (Mrs Palmira Eliza Soares) managed to sell more than a ton of potatoes from one harvest. She also received an excellent price per sack compared with other sellers when the new large, sweet potatoes entered the market for the first time (Table 134). Sweet potatoes were sold by the sack for larger amounts and by the kg or pile for smaller numbers of tubers.

**Table 134. Selling method and money obtained from sweet potatoes**

| *Name* | *District* | *Village* | *Produce sold (kg)* | *Selling method* | *Price ($)* | *Income ($)* |
|---|---|---|---|---|---|---|
| Palmira Eliza Soares | Baucau | Ostico | 1470 | $/Sack | 9.00 | 380.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 875 | $/Sack | 4.00 | 100.0 |
| Alberto Caldeira da Silva | Liquica | Triloka | 455 | $/Sack | 6.00 | 78.0 |
| Zeferino Mirabela | Liquica | Triloka | 12.5 | $/kg | 0.50 | 45.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 490 | $/Sack | 5.00 | 70.0 |
| Martina Boavida | Baucau | Ostico | 420 | $/Sack | 5.00 | 60.0 |
| Constancio Da Costa | Baucau | Ostico | 175 | $/Sack | 5.00 | 35.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 280 | $/Sack | 7.50 | 60.0 |
| Henriqueta | Baucau | Bucoli | 6 | $/kg | 1.00 | 6.0 |
| Carlos da Costa Freitas | Baucau | Gariwai | 420 | $/Sack | 5.00 | 60.0 |
| Manuel Caso | Liquica | Varuvou | 7 | $/kg | 1.00 | 7.0 |
| Martina Boavida | Baucau | Ostico | 210 | $/Sack | 5.00 | 30.0 |
| Cipriano Martins | Alieu | Malere | 125 | $/Sack | 10.00 | 50.0 |

Money obtained from selling these sweet potatoes is often used to fulfil their basic household needs. The high price received for Hohrae varieties support the farmers to pay for children's school fees, purchase building materials, purchase furniture and pay for food, kerosene, clothes and other items (Table 135). The farmers also gained considerable social capital from having these varieties to sell and distribute to family and neighbours which may help secure access to food in the future.

**Table 135. Use of Hohrae sweet potato sales money**

| *Name* | *Village* | *Selling method* | *Price ($)* | *Income* | *Use of income* |
|---|---|---|---|---|---|
| Palmira Eliza Soares | Ostico | $/Sack | 9.0 | 380.0 | Purchased kitchen utensils |
| Juvita Da Costa Freitas | Ostico | $/Sack | 4.0 | 100.0 | Purchased rice, school fees and bought watch |
| Alberto Caldeira da Silva | Triloka | $/Sack | 6.0 | 78.0 | School fees and rice purchase |
| Zeferino Mira Bela | Triloka | $/root | 0.1 | 45.0 | Bought rice |
| Juvita Da Costa Freitas | Ostico | $/Sack | 5.0 | 70.0 | Bought zinc for house |
| Martina Boavida | Ostico | $/Sack | 5.0 | 60.0 | Bought children clothes |
| Constancio Da Costa | Ostico | $/Sack | 5.0 | 35.0 | Bought tape recorder |
| Juvita Da Costa Freitas | Ostico | $/Sack | 7.5 | 60.0 | Bought chairs |
| Henriqueta | Bucoli | $/kg | 1.0 | 6.0 | Bought rice |
| Carlos da Costa Freitas | Gariwai | $/Sack | 5.0 | 60.0 | Paid children school fees |
| Manuel Caso | Varuvou | $/kg | 1.0 | 7.0 | Bought kerosene, salt and rice |
| Martina Boavida | Ostico | $/Sack | 5.0 | 30.0 | Bought clothes |
| Cipriano Martins | Malere | $/Sack | 10.0 | 50.0 | Paid brothers school fees |

Some farmers gained considerable benefit from selling Hohrae varieties over the year. Mrs. Juvita da Costa Frietas, for example, bought a watch from her first harvest. From her second harvest she used the money to buy a sink for her new house and from the third season, the money was used to buy home furniture.

Below is an account from Mrs. Juvita in August, 2008.

*"Before I explain my activities as a farmer, firstly I would like to introduce myself: My name is Juvita Da Costa Freitas from Ostico village, Ostico hamlet, Vemasse Sub-District. The sweet potato that I planted and sold in 2008 provided me with $58.00; I sold it in the market for $7.50/sack. With the money, my husband and I decided to buy a set of plastic chairs that can be considered as souvenir for my hard work in planting sweet potatoes. Sometimes, I also sell sweet potato at home and to school teachers and students. I also share the cuttings with the neighbors who wish to plant them. I also shared some of the crop with my brothers. The experience we had with sweet potato is a story that can be remembered by our children when I pass away. Thank you*

Most of the farmers preferred Hohrae because of their large tubers, their sweetness and their high yield. These characteristics resulted in Hohrae varieties being in high demand in the market compared with the smaller roots of local varieties.

**Table 136. Farmer's preferences for Hohrae sweet potato**

| *Name* | *Village* | *Preference* |
|---|---|---|
| Palmira Eliza Soares | Ostico | Large tuber, sweet, making cake |
| Alberto caldeira da silva | Triloka | High yields |
| Zeferino mira bela | Triloka | Large tuber |
| Constancio Da Costa | Ostico | Large tuber, taste good |
| Juvita Da Costa Freitas | Ostico | Large tuber, sweet, making cake |
| Henriqueta | Bucoli | Large tuber |
| Carlos da Costa Freitas | Gariwai | High yields |
| Manuel Caso | Varuvou | Good and large taste |
| Martinha Boavida | Ostico | Good tuber, large, sweet, taste good |
| Cipriano Martins | Malere | High yields |

Most of the surveyed farmers provided sweet potato cuttings to family and neighbours. The number of non-SoL farmers provided with cuttings is presented in Table 137. Provision of cuttings to such a large number of farmers will ensure a rapid spread of the new varieties and indicates a high degree of acceptance among farmer households.

**Table 137. Transfer of Hohrae sweet potato cuttings off farm**

| | | *Relationship* | |
|---|---|---|---|
| *Name* | *Village* | *Family* | *Neighbour* |
| Palmira Eliza Soares | Ostico | 2 | 4 |
| Juvita Da costa freitas | Ostico | 4 | 15 |
| Alberto caldeira da silva | Triloka | - | 2 |
| Zeferino mira bela | Triloka | 1 | 2 |
| Martina Boavida | Ostico | 2 | 4 |
| Constancio Da Costa | Ostico | 2 | 5 |
| Henriqueta | Bucoli | - | - |
| Carlos da Costa Freitas | Gariwai | 5 | 10 |
| Manuel Caso | Varuvou | 1 | 1 |
| Cipriano Martins | Malere | 2 | 7 |

## Maize

Two maize varieties were released by SoL/MAF during 2007. Both are yellow maize varieties and have much higher yields compared with locals. Of the two, Sele is the most popular and possesses reasonably good weevil tolerance (See Chapter 8 for details).

Four of the surveyed maize producers surveyed sold part of their produce (Table 138). Sele is considered to be sweet to eat, especially as fresh cobs. As a result, part of the crop from the remaining individual farms was eaten as young corn. Mature dry grain was either sold on the cob (at 10 cents per cob) by the kg, kerosene can or by the bunch (Table 138). The small amounts of money received from these sales were used for a range of activities in the home ranging from purchasing food or purchase issue of birth certificates (Table 139). Although the incomes were small, they were appreciated by the near-subsistence farmers. Mr Alfonso Brito was quoted on 21 August, 2008 as saying:

> *This maize I sold, with the money I organized the children's baptism certificate, bought shoes for the kids and paid for their school.... We have planted it twice already, and will plant it in the dry season, but we are waiting until next week to harvest the present crop. From the money we make, we will not waste the money but will use it to help the children, that is all for now.*

**Table 138. Maize sales and selling method**

| *Name* | *District* | *Village* | *Maize sales (kg)* | *Selling method* | *Price ($)* | *Income ($)* |
|---|---|---|---|---|---|---|
| Helder Guterres | Baucau | Triloka | 26 | $/3 cobs | 0.10 | 32.0 |
| Zeronimo Ximenes | Baucau | Fatulia | 17 | $/kg | 0.50 | 8.5 |
| Afonso Brito | Liquica | Guiso | 36 | $/kerosene tin | 5.00 | 40.0 |
| Henriqueta | Baucau | Bucoli | 6 | $/4 bunch | 0.50 | 3.0 |

**Table 139. Use of funds from selling SoL maize**

| *Name* | *Village* | *Income($)* | *Use of funds from Sele sales* |
|---|---|---|---|
| Helder Guterres | Triloka | 32.0 | Paid children's school fees |
| Zeronimo Ximenes | Fatulia | 8.5 | Bought rice |
| Afonso Brito | Guiso | 40.0 | Issued two children's birth certificates and bought rice |
| Henriqueta | Bucoli | 3.0 | Buy kerosene |

Three of the farmers (or farming group) shared their maize varieties with their neighbours or friends (Table 140). Henriqueta had too little seed to give away.

**Table 140. Transfer of SoL maize varieties off farm**

| | | *Relationship* | |
|---|---|---|---|
| *Name* | *Village* | *Family* | *Neighbour* |
| Helder Guteres | Triloka | 2 | - |
| Zeronimo Ximenes | Fatulia | 1 | 2 |
| Afonso Brito | Guiso | 2 | 2 |
| Henriqueta | Bucoli | - | - |

Sele is popular amongst farmers for eating fresh for its sweet soft cobs. The cobs are also considered to be large (Table 141) and yields high. Because Sele is a yellow coloured maize, some farmers were a little unsure of its storing ability. Sele is reasonably susceptible to storage weevils but less so than some local varieties (see Weevil Tolerance in 2007 SoL Annual Research Report).

**Table 141. Farmer's preference for Sele maize**

| *Name* | *Village* | *Farmer's preference* |
|---|---|---|
| Helder Guterres | Triloka | Soft, large cob |
| Zeronimo Ximenes | Fatulia | Soft, big cob |
| Afonso Brito | Guiso | Sweet, large cob |
| Henriqueta | Bucoli | Sweet |

**Peanuts (Utamua)**

One peanut variety, Utamua was released by SoL/MAF in 2007. Research results indicate that some peanut farmers prefer to plant Utamua because of its large seed; high yields and the sweetness and oiliness of the nuts (see Chapter 8). However, seed multiplication has been a problem preventing its spread. This problem is being addressed.

Both of the surveyed farmers sold part of their crop at the market (Table 142).

**Table 142. Amount of peanut sold, selling method and income derived.**

| *Name* | *District* | *Village* | *Peanuts sold (kg)* | *Selling method* | *Price ($)* | *Income ($)* |
|---|---|---|---|---|---|---|
| Domingos Sequera | Baucau | Gariwai | 650 | $/Sack | 12.0 | 600.0 |
| Jorge Concecao | Manufahi | Dotik | 208 | $/Sack | 10.0 | 80.0 |

Mr Domingos used the proceeds of this sale to send his children to Indonesia to study while Mr Concecao used his income to purchase a bicycle and clothes for his children. Both farmers like the variety for its large seed, soft texture of the nut which possesses an oily fragrant smell and the fact that they considered it produced a higher yield than their local variety. Neither farmer transferred significant amounts of seed to their family or neighbours.

### *Discussion*

The results of this short study indicate that the surveyed farmers gained socio-economic benefits from planting the new varieties. This is demonstrated by the fact that they were able to sell surplus to support household activities where no surplus existed before. A premium price was often paid for released varieties (especially for rice and sweet potato) compared with the locals. The new varieties were valued for their large tubers (Hohrae), large seed (Utamua and Nakroma), and large cob (Sele). More importantly their good eating qualities were highly sought after, sometimes to the disadvantage of measuring higher yields for this and other studies. Sele, for example is eaten as fresh cobs and Hohrae consumed on a needs basis from the field.

SoL would like to see the new varieties being evaluated by a higher percentage of the farming community. It is envisaged that the spread of these varieties from farm to farm would facilitate this process. In this study, the transfer of material from one farm to another was more successful for rice and sweet potato than for maize and peanuts. Seed multiplication is one factor restricting the spread of the popular Utamua peanuts, while the yield advantage of growing Sele may require additional time before it too spreads rapidly between farms. This is particularly evident when it is considered that the retention of all released varieties by the implementing farmers is extremely high (see Adoption Survey in Chapter 6 of 2007 SoL Annual Research Report).

# 6. Communication and dissemination

Communication of SoL activities to the farming community and general public during 2007-2008 was primarily through the direct contact of MAF/SoL personnel as they designed and installed OFDTs. A decision of where the OFDTs were placed was often through the RDUs and discussion with MAF personnel, village chiefs and farmers. NGOs and MAF extension personnel also assisted with the distribution of seed and discussion of the attributes of each released variety.

OFDTs were installed in an increasing number of sucos in the Districts currently collaborating in the program. At the end of the 2007-2008 wet season, OFDTs had been installed in 26% of the sucos of Timor Leste. In some Districts the coverage is even greater. For example, the original four Districts (Alieu, Liquica, Manufahi and Baucau) had, at this stage, been exposed to OFDTs in more than 70% of the sucos. NGOs have also had activities in a number of sucos to different degrees of success. Approximately 300 farmers received SoL released variety seed from NGOs in 2007-2008. This number is expected to rise dramatically in 2008-2009 as the SoL/MAF seed production programs expand their activities.

Field days were held in all Sub Districts in which the OFDTs were established. The aim at the beginning of the year was for each RA to hold one field day for each crop in all collaborating Sub Districts. Between 10 and 30 farmers were invited to each field day at harvest time. The plots were discussed and then harvested with the assistance of all farmers. The harvest from each plot was then weighed, cooked and eaten. The attributes of each variety were discussed. SoL team members used this opportunity to disseminate technological information to communities adjacent to the sites.

Research station field days were designed to enable farmers and other consumers to evaluated technologies under examination prior to advancing them to the on-farm stage. These field days also provided the opportunity for farmers to taste test some of the species under investigation. Such evaluations helped the researchers “short list” accessions for further measurement.

Information brochures in Tetun were developed and released during the year. These highlight the attributes of recently released MAF varieties and explained other technologies including the GrainPro Grainbags for seed storage. The manual on the “Principles of Farmer Participatory Research” in Tetun were also distributed as was the “Manual for in-field soil assessment” prepared early in 2007. The latter manual was developed to assist the RAs classify the soils on which OFDTs were installed in an effort to link variety yields with field conditions.

Additional SoL information was included in the MAF Agriboletins, local newspapers on a number of occasions, local radio and on television telecast in Tetun. SoL achievements also received attention internationally with articles on the program appearing in local newspapers, on television and in University of Western Australia newsletters.

A list of these is presented below:

18 September, 07. SoL/MAF international research results meeting aired on local TVTL television.

16-21 October, 07 SoL Activities in MAF expo aired on the national TV station, TVTL

November, 2007 “Seeds of Life” Program in East Timor Successfully reviewed”. SoL feature on the front of CLIMAs *Beanstalk* newsletter Volume 8 no.2.

01 March, 2008. Timor Sun newspaper. Article highlighting the contribution Seeds of Life is making to the increase of food production in East Timor.

27 April, 2008 East Timor attempts to answer the Food Crisis. TV station Al Jazeera The video is available on YouTube at http://www.youtube.com/watch?v=Ho_pVhEatq4

22 April, 2008. TVTL program showing Minister of Agriculture harvesting SoL maize.

11 July, 2008. Newspapers Suara Timor Lorosae (STL) and Diario Tempu story and photographs on activities and impacts of SoL released varieties.

Articles for the scientific community included discussion papers prepared by the SOSEK group. Reports were also prepared monthly, six monthly and annually for the MAF and donor communities.

The Seeds of Life web site http://sponsored.uwa.edu.au/sol/index describes many of the program's activities.

# 7. Capacity building

The long term sustainability of the SoL program is dependent on the MAF personnel being able to design, implement and manage agronomic trials, write up the results and extend the resulting technologies to the farming community. As most of the new SoL team members were fresh graduates from the university, an extensive capacity building program was developed to ensure team members have the capacity to assume responsibility for agronomic research before the SoL program terminates. A training needs assessment conducted by IRRI personnel in 2007 identified the need for a combination of on-the-job training, short-term and long-term courses. On the job training includes the RAs working closely with the R/EAs throughout the year. Support was also provided by visiting scientists and trainers.

Short term courses were provided on a number of occasions throughout the year. Courses were divided into categories of English language, agronomy, seed production and statistics. English is considered to be and an important skill for the RAs to possess to facilitate reading of international scientific material especially research publications, and to open the horizons for international travel to attend short term courses. One person attended a 5 week English language course at the University of Western Australia (UWA) prior to undergoing two weeks of work experience at the Centre for Legumes in Mediterranean Agriculture (CLIMA) at UWA. It is envisaged that the number of RAs and other SoL personnel attending short courses outside of East Timor will increase in the future.

Three persons attended a seed production course in the Philippines and two persons visited Indonesia for seed technology training. Other training in the year included short courses in Dili and in the Districts.

A total of 875 days of training were provided during the year. Included were 579 days of English language training, 49 days of Agronomy training, 85 days of seed production training and 162 days of data management (including statistics) training (Table 143). This is an increase of 264% over the amount provided in 2006-2007 (Sol, 2007). An increasing amount of time and effort will be spent on seed production training in future years.

In addition to formal training courses, workshops held in Dili and the Districts allowed SoL/MAF personnel present the results of their work for discussion. Team members also attended workshops of other organizations.

**Table 143. Total number of training days over years 2005-2008**

| | *2005-2006* | *2006-2007* | *2007-2008* |
|---|---|---|---|
| Agronomy | 90 | 66 | 49 |
| Data management | 30 | 26 | 162 |
| English language | 100 | 192 | 579 |
| Seed production | 0 | 0 | 85 |
| Other | 60 | 47 | 0 |
| **TOTAL** | 280 | 331 | 875 |

# 8. Technology recommendations

## 8.1 Released variety descriptions

The varietal recommendation committee held its first meeting on 8 March 2007 and approved the release of seven new varieties. Two of these varieties were 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 2005-2006 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 2006/2007 plus the dry season of 2007 and the current reporting season of 2007/2008. These trials are described in the Annual Research Report for 2007 (SoL, 2007) and this report (SoL, 2008) respectively. A description of the released varieties is presented below.

### 8.1.1 Maize

Two open pollinated maize varieties introduced by CIMMYT in 2000 and evaluated through the SoL program were released in March 2007. Their released names are Sele and Suwan 5. Both are yellow grained and, for yellow maize, possess characteristics preferred by most of the population. They are both high yielding, possess good pounding characteristics and are sweet to eat. Descriptions of the varieties are presented below.

The primary selection criteria for maize are for higher yield and acceptability, plus other characteristics including storage. Replicated trials over the period 2001-2005 indicated Suwan 5 and Sele returned an average yield advantage of 105% and 82% over local varieties respectively (Table 144). These varieties were continually included in replicated trials possessing approximately 20 entries in 2006, 2007 and 2008. Suwan 5 and Sele returned a yield advantage of 60% and 65% respectively over the eight year period, or 38% and 57% respectively for the period 2006-2008. Both performed better than locals over all six agro-ecosystems and under farmer management conditions.

**Table 144. Select maize yields and yield advantages, research stations, 2001-2008**

| | *Yield (t/ha)* | | | *Yield advantage (%)* | |
|---|---|---|---|---|---|
| *Year* | *Suwan 5* | *Sele* | *Local* | *Suwan 5* | *Sele* |
| 2001-2005 | 3.5 | 3.1 | 1.7 | 106 | 82 |
| 2006 (Four sites) | 1.6 | 1.5 | 1.1 | 41 | 39 |
| 2007 (Six sites) | 1.9 | 2.6 | 1.5 | 27 | 73 |
| 2008 (Four sites) | 1.5 | 1.5 | 1.0 | 53 | 53 |
| *Mean (2006-2008)* | *1.7* | *1.9* | *1.2* | *38* | *57* |
| *Mean (2001-2008)* | *2.1* | *2.2* | *1.3* | *60* | *65* |

Based on this data and a series of farmer evaluations over that period, Suwan 5 and Sele were included in OFDTs for evaluation under farmer conditions (Table 145). Suwan 5 performed particularly well on farmers' fields, improving yields compared with an average of farmers' local varieties by 53% over 448 sites in 2006 and 2007. Sele improved yields by 44% across 668 sites in three years (2006-2008). These results indicate that both varieties perform extremely well compared with local varieties in farmers' fields.

**Table 145. Select maize yields and yield advantages, OFDTs, 2006-2008**

| Year | *Yield (t/ha)* | | | *Yield advantage (%)* | |
|---|---|---|---|---|---|
| | *Suwan 5* | *Sele* | *Local* | *Suwan 5* | *Sele* |
| 2001-2005 | na | na | na | na | na |
| 2006 (170 sites) | 2.6 | 2.3 | 1.7 | 53 | 35 |
| 2007 (278 sites) | 2.5 | 2.4 | 1.7 | 47 | 41 |
| 2008 (220 sites) | na | 2.5 | 1.6 | na | 50 |
| *Mean (2006-2008)* | *2.6* | *2.4* | *1.7* | *53* | *44* |

## Sele

### *Variety information*

Botanical name: *Zea maize*
Suitable environment: Well drained areas in the uplands or lowlands
Evaluation name: LYDMR (Late Yielding Downey Mildew Resistant)
Breeder: CIMMYT
Released name: Sele

### *Description*

| | |
|---|---|
| Seed colour | Yellow |
| Seed quality | Semi-flint |
| Plant height (at harvest) | 2.0m |
| Time to flowering[1] | 65-75 days |
| Time to harvest[1] | 105-115 days |
| Yield (t/ha) [2] | 2.4 |
| Yield advantage over local at: | |
| OFDTs (%)[2] | 44 |
| Research stations (%)[3] | 57 |
| Weevil Resistance | Similar to local varieties |

[1] Faster at lower altitudes
[2] On-farm mean across 668 sites 2006-2008
[3] Based on 14 sites 2006-2008

### *Yield and grain quality*

Sele is an open pollinated variety with yellow grain and is considered to be sweet by consumers in Timor-Leste. It performed extremely well under research station conditions and on farmers' fields (see above), outperforming locals over all 6 agro-ecosystems and under farmers' management. When cooked and sampled by farmers, Sele (5%) compared well with the best local (8%) and the worst local (1%) varieties. During the same year (SoL, 2007), Sele (20.7%) also scored well in taste tests compared with the best local variety, also at 20.7%. Farmers at Alieu also considered Sele to be easier to pound (for cooking) than the other seven test subjects. More that 92% of farmers surveyed in 2007 stated that they would replant Sele the following year (Table 146). A similar number of farmers wanted to plant again in 2007/2008 (Table 147).

**Table 146. Farmer preferences for planting maize varieties after OFDT, 2006/07**

| *Variety* | *SW5 (%)* | *Sele (%)* | *Local (%)* |
|---|---|---|---|
| Intend to replant | 88 | 85 | 85 |
| Do not intend to replant | 1 | 4 | 2 |
| **No response** | 11 | 11 | 13 |

**Table 147. Farmer preferences for replanting maize varieties after OFDT, 2007/08**

| *Variety* | *Sele (%)* | *Local (%)* |
|---|---|---|
| Intend to replant | 70 | 68 |
| Do not intend to replant | 0 | 2 |
| **No response** | 30 | 29 |

When asked what they liked about Sele or Har12 compared with their locals, the farmers from 170 OFDT sites were overwhelmingly enthusiastic about the high yield and large cobs of Sele (Table 148). In general, they would prefer a white variety if its yield was higher than their local. The fact that their local variety has been tried and tested over a long period of time encourages all farmers to include their traditional varieties in the pool of varieties they plant.

In 2008 very few farmers stated that they would not plant the test varieties the following year (Table 149). The main reason farmers gave for not planting their own local variety was that they were tall and thereby susceptible to lodging in high winds.

**Table 148. Reasons farmers gave for planting test maize varieties, 2007-2008.**

| *Characteristic* | *Sele (%)* | *Local (%)* |
|---|---|---|
| High yield/large cobs | 59 | 2 |
| Good flavour | 19 | 13 |
| Colour | 1 | 1 |
| Wind tolerant | 10 | 2 |
| Short plants | 7 | 0 |
| Weevil tolerant | 0 | 6 |
| Local | 0 | 61 |
| Cobs can be tied together | 0 | 5 |
| *Total respondents* | *176* | *183* |

**Table 149. Reasons farmers gave for not planting test maize varieties, 2007-2008.**

| *Characteristic* | *Sele* | *Har12* | *Local* |
|---|---|---|---|
| Small cobs | 0 | 2 | 0 |
| Plants too tall | 0 | 0 | 6 |
| Long time to flower | 0 | 0 | 1 |
| Long time to dry down | 1 | 0 | 0 |
| Poor yield | 1 | 0 | 1 |
| Total No. respondents | 2 | 2 | 8 |

Maize and food preparation times are described in SoL, 2007. In one trial, grain of both Sele and Suwan 5 were pounded, cooked and tasted in four Districts (Aileu, Baucau, Liquica and Manufahi). Two traditional methods of pounding were used. The first method used two rocks. On one flat rock was placed 2-3 seeds and a pounding rock used to crush the seeds. The second method of pounding used a hollowed out log (mortar). A pole was used to pound the grain.

500g of seed was provided to the farmers and the time taken to pound this quantity was recorded. The pounding processes involved grading the maize flour into three grades, two of which were cooked, and the third roughest grade given to animals.

For cooking, the roughest grade of grain was boiled first and the following finer grades added to the pot for cooking several minutes after. The maize varieties were cooked into a porridge of a dry texture called *sasoro* and then tasted by farmers. Farmers were asked to comment on whether the food was *mamar* (soft), *midar* (sweet), *belit* (chewy/sticky), *to'os* (hard), or *morin* (fragrant) or *mina* (oily).

The average time taken to pound and cook maize grain is presented in Table 150. An analysis of variance indicated there were no significant differences between the varieties tested for any of the pounding or cooking traits.

**Table 150. Time taken to pound and cook maize.**

| | *Pounding maize with a stone (minutes)* | *Cooking maize after pounding with stone (minutes)* | *Pounding maize with a mortar (minutes)* | *Cooking maize pounded in mortar (minutes)* |
|---|---|---|---|---|
| *Local Maize* | 73.8 | 52.8 | 13.0 | 98.5 |
| *Sele* | 55.2 | 40.8 | 11.8 | 77.5 |
| *Suwan 5* | 61.5 | 48.0 | 15.0 | 102.0 |
| | ns | ns | ns | ns |

After cooking, the varieties were evaluated for taste and other characteristics (Table 151).

**Table 151. Significance of taste characteristics of maize**

| | *Soft eating* | *Sweet* | *Chewy* | *Hard* | *Fragrant* |
|---|---|---|---|---|---|
| *Maize* | Significant | ns | ns | Significant | ns |

The results in Table 152 indicate that there were significant differences for farmer characterization of seed softness (*mamar*) and seed hardness (*to'os*) in maize seed. Farmer characterization of maize hardness was highly significant with results clearly indicating that 100% of maize farmers tested in all locations considered Sele a 'soft' maize variety, however only 25% of farmers' characterized local maize as soft, and no farmers considered Suwan 5 as a soft seed. Conversely no farmers described Sele as hard while 100% of farmers considered Suwan 5 hard, and 50% of farmers considered local maize as hard. (Table 152).

**Table 152. Number of farmers characterizing maize as soft and hard**

| | *Soft* | *Hard* |
|---|---|---|
| *Local Maize* | 25% | 50% |
| *Sele* | 100% | 0% |
| *Suwan 5* | 0% | 100% |

### *Agronomic adaptability*

Sele is well adapted for cultivation in Timor-Leste. Sele crops can be planted either in rows or randomly spaced 75cm to 1 m apart with five to six seeds per hill as per the traditional methods. No significant yield difference was observed when Sele was planted in rows or randomly (SoL, 2007, 2008). Crops were generally not fertilized.

Sele performed particularly well compared with the local varieties at high elevations (1200 – 1500 masl) in 2007/2008 and displayed a yield advantage to reflect this (Figure 12).

### *Storage*

Evaluations during 2005-2006 illustrated that Sele was more resistant to weevil damage when compared to Suwan 5 and similar to the average of local varieties when stored using traditional methods. In 2007, a larger number of varieties were compared and Sele performed as “average” compared with four local varieties (SoL, 2007). Weevil damage in stored maize continues to be a major problem in Timor Leste and on-farm storage techniques need improving.

### *Disease and insect pest reaction*

Sele derives its evaluation name (LYDMR, Late Yielding Downey Mildew Resistant) from the fact that it is resistant to downy mildew. There is no observed susceptibility to other pests and diseases present in Timor-Leste above those observed for other varieties under cultivation.

### *Herbicide reaction*

Herbicides are not used on maize in Timor Leste.

### *Economic benefits*

Maize is mainly grown for household consumption in Timor-Leste, however small amounts are also sold in local markets. Sele is considered to be sweet to eat, especially as fresh cobs. As a result, part of the crop from the remaining individual farms was eaten as fresh cobs. As described in Section 5.2 above, some mature dry grain was either sold on the cob (at 10 cents per cob) by the kg, kerosene can or by the bunch (Table 138, Table 153). The small amounts of money received from these sales was used for a range of activities in the home ranging from purchasing food or kerosene to the issue of birth certificates (Table 139, Table 154).

**Table 153. Maize sales and selling method**

| *Name* | *District* | *Village* | *Maize sales (kg)* | *Selling method* | *Price ($)* | *Income ($)* |
|---|---|---|---|---|---|---|
| Helder Guterres | Baucau | Triloka | 26 | $/3 cobs | 0.10 | 32.0 |
| Zeronimo Ximenes | Baucau | Fatulia | 17 | $/kg | 0.50 | 8.5 |
| Afonso Brito | Liquica | Guiso | 36 | $/kerosene tin | 5.00 | 40.0 |
| Henriqueta | Baucau | Bucoli | 6 | $/4 bunch | 0.50 | 3.0 |

**Table 154. Use of funds from selling SoL maize**

| *Name* | *Village* | *Income($)* | *Use of funds from Sele sales* |
|---|---|---|---|
| Helder Guterres | Triloka | 32.0 | Paid children’s school fees |
| Zeronimo Ximenes | Fatulia | 8.5 | Bought rice |
| Afonso Brito | Guiso | 40.0 | Issued two children’s birth certificates and bought rice |
| Henriqueta | Bucoli | 3.0 | Bought kerosene |

Sele is popular amongst farmers for eating fresh for its sweet soft cobs. The cobs are also considered to be large (Table 141, Table 155) and yields high. Because Sele is a yellow coloured maize, some farmers were a little unsure of their storing ability. Sele is reasonably susceptible to storage weevils but less so than some local varieties (see Weevil Tolerance in 2007 SoL Annual Research Report).

**Table 155. Farmer’s preference for Sele maize**

| *Name* | *Village* | *Farmer’s preference* |
|---|---|---|
| Helder Guterres | Triloka | Soft, large cob |
| Zeronimo Ximenes | Fatulia | Soft, big cob |
| Afonso Brito | Guiso | Sweet, large cob |
| Henriqueta | Bucoli | Sweet |

***Social benefits***

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

***Environmental impacts***

Sele originated from the 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 undesirable traits to the environment. Sele will increase the diversity of the current genetic pool in Timor-Leste.

***Seed production***

Fifteen tons of Sele seed was ready for distribution at the end of 2008. Included in this amount was sufficient foundation seed for an expanded seed production program in 2009 for the 2009/2010 season.

## Suwan 5

***Variety Information-***
Botanical name: *Zea maize*
Suitable environment: Well drained areas in the uplands or lowlands
Evaluation name: Suwan5
Breeder: CIMMYT (India)
Released name: Suwan5

As with Sele above, Suwan 5 was released by MAF in March, 2007 for use in Timor Leste. Suwan 5 was also bred by CIMMYT (in India) and at the time of selection for evaluation in Timor Leste was already released in Thailand.

***Description of Suwan 5***

| | |
|---|---|
| Seed color | Yellow |
| 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] | 2.6 t/ha |
| Yield advantage over local on: | |
| OFDTs[2] | 53% |
| Research stations[3] | 38% |
| Weevil resistance | Low resistance |

[1] Faster at lower altitudes
[2] On-farm mean across 448 sites 2006-2008
[3] Based on 14 trials 2006-2008

***Yield and grain quality***

Suwan 5 is an open pollinated variety with yellow grain and considered to be sweet by consumers in Timor-Leste. It performed extremely well on research stations and on farmers' fields under farmer management (see above) outperforming local varieties over all 6 agro-ecosystems. When 23 varieties were evaluated for preference by 92 farmers in Alieu and 72 farmers in Betano during 2007 preference for Suwan 5 (7%) was equal to that of the best local (Local 47 at 8%) and other local varieties (2%, 1% and 1% respectively). In the same year, Suwan 5 was not considered to be as tasty (14.8%) as the best local (Local 45 at 20.7%) in Alieu but compared equally as the local variety in Betano (57% compared with 59%). Pounding times were similar to local maize and Sele (see Table 150).

***Agronomic adaptability***

Suwan 5 is a new maize variety that is well adapted for cultivation in Timor-Leste. The seeds are planted in either rows or randomly spaced 75cm to 1m apart with 5-6 seeds per hill. No significant yield difference was observed when Suwan 5 was planted in rows or randomly (SoL, 2007, SoL, 2008). Crops are generally not fertilized

***Disease and insect pest reaction***

Evaluations during 2005-2006 (SoL, 2006) and 2007 (SoL, 2007) illustrated that Suwan 5, although high yielding, is more susceptible to storage weevils compared with local varieties when stored using traditional methods. Suwan 5 is recommended to farmers who possess air proof containers for conservation periods exceeding a couple of months. Suwan 5 is resistant to downy mildew. There is no observed increased susceptibility to other pests and diseases present in Timor Leste.

***Herbicide reaction***

Herbicides are not used on maize in Timor Leste.

***Economic benefits***

Maize is mainly grown for household consumption in Timor-Leste, however small amounts are also sold in local markets. Although not resistant to weevils, Suwan 5 has higher average yields than Sele and so could produce even greater surpluses. It is possible that other varieties with better storage characteristics would be retained by farmers for household consumption and surplus yields from Suwan 5 sold to generate cash.

***Social benefits***

Cultivation of Suwan 5 will provide an alternative planting option for subsistence maize growers in Timor-Leste. Its higher yields and good eating qualities will help contribute to greater food security in the country

***Environmental impacts***

Suwan 5 originated from the 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 undesirable traits to the environment. Suwan 5 will increase the diversity of the current genetic pool of maize in Timor Leste.

***Seed production***

Sufficient Suwan 5 seed was produced by SoL for the 2008/2009 season trials. MAF has undertaken the multiplication of Suwan 5 seed from seed purchased from Thailand. This seed will be distributed to farmers by MAF food production personnel.

## 8.1.2 Peanuts

### Utamua

***Variety information-***
Botanical Name: *Arachis hypogaea L.*
Sub Species: Virginia (subsp. *hypogaea* var. *hypogaea*)
ICRISAT Designation: ICGV 88438
Breeder: International Crops Research Institute for the Semi Arid Tropics (ICRISAT)
Evaluation Name: Pt5
Released Year: Registered with Crop Science by ICRISAT in 1997 and released as Utamua in Timor Leste in March, 2007

Utamua (ICGV 88438 or Pt5) is a large-seeded Virginia type peanut bred at the International Crops Research Institute for the Semi Arid Tropics (ICRISAT). It was registered with Crop Science (Reg no GP 0844) (Accession ID PI596514) on 11 January 1997 without plant variety rights. This cultivar has been included in trials in Timor-Leste since 2000 under the SoL/MAFF program with the designation of Pt5. It was the highest ranking cultivar during this period and was included in replicated and on-farm trials in 2005/2006. Pt5 is a large sized pod and matures slightly later than the smaller seeded varieties. As a consequence the plots were harvested later than other plots.

***Description***

The following observations were recorded at ICRISAT, Patancheru, India

***Plant description***

| | |
|---|---|
| *Growth habit* | *Decumbent-3* |
| Branching pattern | Alternate |
| Pigmentation<br>Stem<br>Peg | <br>Absent<br>Present |
| Number of primary branches | 6 |
| Number of secondary branches | 5 |
| Plant height and breadth | 54 cm, 44 cm |
| Leaf character<br>Size<br>Shape<br>Color | <br>Medium<br>Elliptic<br>Green |
| Flower color<br>a. Standard<br>b. Cresent/fulan sabit<br>c. Cresent marking/<br>d. Wing petal | <br>Yellow<br>Orange<br>Garnet<br>Orange |
| Pod and seed characters<br>a. Pod beak | <br>Slight |

| | |
|---|---|
| b. Pod constriction | Moderate |
| c. Pod reticulation | Slight to moderate |
| d. Ridge | Moderate |
| e. Seeds per pod | 2-1 |
| f. Pod length | 34 mm (Average of 20 two-seeded pods) |
| g. Pod breadth | 16 mm (Average of 20 two-seeded pods) |
| h. Shelling | 71% |
| i. Seed length | 18 mm (Average of 20 seeds) |
| j. Seed breadth | 9 mm (Average of 20 seeds) |
| k. 100-seed weight | 103 g |
| l. Seed color | Tan |

***Yield and grain quality***

Utamua consistently ranked among the top yielding cultivars during replicated trials harvested across the years of 2001-2005. Over the four years, it attained the highest yield average at 2.1t/ha out of 18 introduced and one local varieties. Farmers were also attracted to the large seed size and good eating quality. For this reason it and another variety, GN11, were included in OFDTs in 2005-2006. Research effort was then concentrated on Pt5 which was later released as Utamua. Pod yields for all varieties were inconsistent in replicated research trials, particularly at Betano when the trials were conducted during the wet season. For this reason, the yield advantage expressed by Utamua from replicated trials averaged a low 15% across three years from 2006-2008 (Table 156). Utamua performed much better in soils more suited to peanuts (see Agronomic adaptability below). In on-farm trials, Utamua expressed a yield advantage of over 31% averaged in three years from 2006 to 2008 (Table 157) over 481 trials.

**Table 156. Utamua peanut yields and yield advantages, research stations, 2001-2008**

| | *Yield (t/ha)* | | *Yield advantage* |
|---|---|---|---|
| *Year* | *Utamua* | *Local* | *%* |
| 2001-2005 | 2.1 | 2.0 | 7 |
| 2006 (Two sites) | 1.1 | 1.2 | -9 |
| 2007 (Five sites) | 2.0 | 1.7 | 17 |
| 2008 (Three sites) | 1.3 | 0.9 | 43 |
| *Mean (2006-2008)* | *1.5* | *1.3* | *15* |
| *Mean (2001-2008)* | *1.6* | *1.4* | *12* |

Utamua consistently produces large seeds. The average seed size of 103g/100 seeds is 60-100% greater than most local peanuts.

**Table 157. Utamua peanut yields and yield advantages, OFDTs, 2006-2008**

| | *Yield (t/ha)* | | *Yield advantage* |
|---|---|---|---|
| *Year* | *Utamua* | *Local* | *%* |
| 2001-2005 | na | na | na |
| 2006 (168 sites) | 1.8 | 1.2 | 48 |
| 2007 (138 sites) | 2.0 | 1.6 | 23 |
| 2008 (175 sites) | 2.0 | 1.5 | 33 |
| *Mean (2006-2008)* | *1.9* | *1.5* | *31* |

Peanuts from the replicated trials have undergone extensive evaluation with farmers. Seventy one percent of surveyed farmers in 2006 expressed a desire to replant (SoL, 2006). At farmer field days in Aileu, Manufahi and Maliana, an average of 42% of farmers preferred the Utamua variety compared with the local at 16% (SoL, 2007). At these field days, there was considerable variation for the perception of desirability, between peanut varieties at each of the test sites. There were no differences between the choice and selections of female and male farmers.

In Aileu, farmers' preference was correlated with the taste of the peanuts, and negatively correlated with yield. In Betano and Maliana farmers' preference was significantly correlated with yield as well as oily taste (Table 158).

**Table 158. Correlation (r) between farmers' preference and peanut plant characteristics.**

| *Character* | *Aileu* | *Maliana* | *Betano* |
|---|---|---|---|
| Yield | -.37 | 0.45 | 0.45 |
| Sweetness | 0.46 | -0.13 | 0.21 |
| Oiliness | .28 | 0.30 | 0.53 |
| Ease of shelling | 0.01 | -0.02 | 0.25 |
| Thin shell | -0.59 | 0.11 | 0.10 |

Farmers were also requested to compare 12 varieties in 2008. As presented above and in (Table 70), Utamua (Pt5) compared well with the local variety. It was also observed that the varieties Utamua and Pt14 had the lowest votes for bitterness (Table 159).

**Table 159. Farmers' characterization of peanut taste (%).**

| *Variety* | *% farmers' characterization* | | | | |
|---|---|---|---|---|---|
| | Oily | Not oily | Sweet | Bland | Bitter |
| Utamua | 64 | 36 | 72 | 28 | 0 |
| Local | 76 | 24 | 68 | 18 | 15 |

The most popularly selected variety by farmers was Utamua with 24% of farmer selection compared with 4% for the local (Table 160). Generally, female farmers tended to give more votes to sweetness than males, however there was no significant interaction between the variety and gender data.

**Table 160. Farmers' selection of test variety for planting.**

| *Variety* | *% farmers choice* |
|---|---|
| Utamua | 24 |
| Local | 4 |

### *Agronomic adaptability*

Peanuts grow best in sandy loam type soils which are friable and not cloddy or hard-setting. Fields should receive good rain over the growing period but must be well drained. An ideal soil pH is around 6.0. Being a legume, peanuts do not require applications of nitrogen fertilizer.

Utamua is a longer season variety than most local peanuts. It takes seven extra days to emerge from the soil, two weeks extra to flower and two to three weeks longer to mature than most local populations. The delay in maturity may increase its susceptibility to rat damage if surrounded by local varieties planted at the same time.

Utamua shows seed dormancy and does not germinate in the field if the harvest is delayed due to rain. Due to the seed dormancy, seed should be stored for 2-3 months before planting to ensure seed viability. Seed can be soaked for 12-24 hours prior to planting to enhance seed emergence and good establishment.

### *Disease and insect pest reaction*

As with most peanuts in Asia, Utamua suffers from many abiotic and biotic stresses including drought, rust, late leaf spot, early leaf spot, aflatoxin, collar rot, stem and pod rots (all fungal diseases), bud necrosis and peanut stripe virus diseases, bacterial wilt and Spodoptera, leaf minor, red hairy caterpillar, aphids, thrips, and white grub (all insect pests). Utamua is reported to be tolerant to iron chlorosis which is common in the local varieties grown in Timor Leste. (Nigam *et al*, 2003), (SoL, 2006).

***Economic benefits***

Peanuts are regularly grown as a cash crop in Timor-Leste and although trading is small, they provide a source of income for farmers. As a result, most crops are well tended. The large seed of Utamua is universally liked and there is high potential for export to other Districts or internationally. The study presented in Section 4 of this report presents the results of two farmers who sold peanuts to support their household activities (Table 161).

**Table 161. Amount of peanut sold, selling method and income derived.**

| *Name* | *District* | *Village* | *Peanuts sold (kg)* | *Selling method* | *Price ($)* | *Income ($)* |
|---|---|---|---|---|---|---|
| Domingos Sequera | Baucau | Gariwai | 650 | $/Sack | 12 | 600 |
| Jorge Concecao | Manufahi | Dotik | 208 | $/Sack | 10 | 80 |

Mr Domingos used the proceeds of this sale to send his children to Indonesia to study while Mr Concecao used his income to purchase a bicycle and clothes for his children. Both farmers liked the variety for its large seed, soft texture of the nut which possesses an oily fragrant smell, and the fact that they considered it produced a higher yield than their local variety.

***Social benefits***

Cultivation of Utamua provides one extra cultivar to diversify the selection for Timor-Leste farmers thereby reducing risk. Its higher yielding characteristics and potential for generating cash income may lead to improved food security.

***Environmental impacts***

Utamua originated from the ICRISAT 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 undesirable traits to the environment. Planting Utamua increases the diversity of the current genetic pool in Timor-Leste.

***Seed production***

4.8 tons of Utamua seed was ready at the end of 2008 for use in OFDTs, for further seed production and for distribution to farmers. It is planned that 16 ha of seed will be multiplied over the 2008/2009 growing season producing approximately 32 ton of pods.

### 8.1.3 Sweet potato

Sweet potato is an extremely important crop in Timor-Leste for both food security and nutritional purposes. It grows well in a range of soils where it is generally cultivated with little or no fertilizer. Traditional sweet potato varieties are low yielding. Higher yielding sweet potato varieties have been evaluated by the Seeds of Life program since 2000 with exceptional results. Between 2000 and 2005 trials were designed by the CIP Regional Office for East, South East Asia and the Pacific (ESEAP). The best of the evaluated clones to date are CIP–1 (released as Hohrae 1), CIP-6 (released as Hohrae 2) and CIP-7 (released as Hohrae 3) all of which were released in Timor Leste in March 2007.

**Sweet potato yields**

All 14 varieties from CIP initially imported for evaluation by SoL performed well compared with local varieties over the period from 2001 to 2005. Hohrae 1-3 were the best performing of these. Root yields varied considerably across the trials sites with yields being high at the higher altitude in Alieu compared with Betano. The results of the successful replicated sites are presented for each year in Table 162**.** Yield advantages of Hohrae 1-3 compared with local varieties were very significant in these trials, with more than a doubling of root yield.

**Table 162. Sweet potato yields and yield advantages, research stations, 2001-2008**

| | *Yield (t/ha)* | | | | *Yield advantage (%)* | | |
|---|---|---|---|---|---|---|---|
| *Year* | *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 |
| *Mean (2006-2008)* | 18.2 | 14.9 | 16.6 | 6.4 | 239 | 308 | 144 |
| *Mean (2001-2008)* | 16.8 | 14.5 | 15.7 | 6.2 | 211 | 265 | 143 |

It has proved very difficult to gain meaningful yield data from on-farm trials. The varieties are extremely popular with farmers who tend to harvest the roots on a needs basis and do not wait for the researchers to harvest the whole plot. Many of the OFDTs were grown close to the house and were harvested prior to the agreed harvest date (SoL, 2007). Comparative yields increased significantly in 2008 as the researchers become aware of the problem. In the 2008/2009 season, yields will be compared on a plant basis where five or more plants will be harvested from each plot to reduce the variability in yield data.

The yield advantage of growing Hohrae varieties compared with the local varieties is very significant when the results of OFDTs are compared. The mean yield advantage of Hohrae 1-3 for two years was 66%, 80% and 80% respectively on 198 on-farm trials.

**Table 163. Sweet potato yields and yield advantages, OFDTs, 2001-2008**

| *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 | 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 |
| *Mean (2007-2008)* | 5.1 | 5.5 | 5.5 | 3.1 | 66 | 80 | 80 |

## Description of Hohrae 1, Hohrae 2 and Hohrae 3

### Hohrae 1

Botanical Name: *Ipomoea batatas (L.) Lam.*
Evaluation Name: CIP-1
Breeding Number: B0053-9
Parents: Open pollination of B0053
Breeder: Centro International de la Papa (CIP)
Released Name: Jago in Indonesia and Hohrae 1 in East Timor
Description and root quality. The following description was provided by CIP, Bogor, Indonesia

***Vine description***

| | |
|---|---|
| *Plant type* | *Semi compact* |
| Mature leaf shape | Lobed |
| Immature leaf color | Green |
| Petiole pigmentation | Green with purple at both ends |
| Predominant color of vine | Green |
| Secondary color of vine | Purple nodes |
| Abaxial leaf vine pigmentation | All vines mostly purple |
| Storage root skin color | White |
| Storage root flesh color | Pale yellow |

***Root quality-***

| | |
|---|---|
| *Dry matter* | *33.3%* |
| Vitamin C | 20.6 mg/100g |
| Total sugar | 4.3% |
| Fiber | 1.1% |
| Protein | 1.5% |
| Amylose | 32.9% |
| Amylopectin | 66.1% |

### Hohrae 2

***Variety Information-***
Botanical Name: *Ipomoea batatas (L.) Lam.*
Evaluation Name: CIP-6
Breeding Number: AB96001.2
Parents: Xusha – 18 x I. trifida
Breeder: Centro International de la Papa (CIP)
Released Name: Not known to be released in other parts of the world. Released as Hohrae 2 in Timor Leste in March 2007
Description and root quality. The following description was provided by CIP, Bogor, Indonesia

***Vine description***

| | |
|---|---|
| *Plant type* | *Semi compact* |
| Mature leaf shape | Lobed |
| Immature leaf colour | Purple both surfaces |
| Petiole pigmentation | Green |
| Predominant colour of vine | Green |
| Secondary colour of vine | Absent |
| Abaxial leaf vine pigmentation | Green |
| Storage root skin colour | Cream |
| Storage root flesh colour | Yellow |

***Root quality-***

| | |
|---|---|
| *Dry matter* | *32.2%* |
| Vitamin C | 0.9mg/100g |
| Total sugar | 6.7% |
| Fibre | 3.4% |
| Protein | 5.1% |
| Amylose | 13.4% |
| Amylopectin | 54.8% |

## Hohrae 3

***Variety Information***

Botanical Name: *Ipomoea batatas (L.) Lam.*
Evaluation Name: CIP-7
Breeding Number: BB9702.1
Parents: B0053-9 x AB94004
Breeder: Centro International de la Papa (CIP)
Released Name: Not released commercially in other parts of the world. Released as Hohrae 3 in Timor Leste during March, 2007
Description and root quality. The following description was provided by CIP, Bogor, Indonesia

***Vine description***

| | |
|---|---|
| *Plant type* | *Semi compact* |
| Mature leaf shape | Chordate |
| Immature leaf colour | Green with purple veins on lower surface |
| Petiole pigmentation | Green with purple at both ends |
| Predominant colour of vine | Green with many purple spots |
| Secondary colour of vine | Purple nodes |
| Abaxial leaf vine pigmentation | All vines mostly purple |
| Storage root skin colour | Red |
| Storage root flesh colour | Intermediate orange |

***Yield and root quality-***

| | |
|---|---|
| *Dry matter* | *33%* |
| Vitamin C | 1.3 mg/100g |
| Total sugar | 6.3% |
| Fibre | 6.6% |
| Protein | 7.5% |
| Amylose | 11.0% |
| Amylopectin | 59.5% |

***Agronomic adaptability***

Hohrae 1, 2 and 3 are all suited to upland conditions in Timor-Leste. Hohrae 1 yields lower than the other two Hohrae varieties and is not recommended for cultivation below 500masl. Cuttings of 25-30 cm lengths (five nodes) are generally planted with two to three nodes being buried in the soil. Sweet potatoes grow best on raised beds at 25cm-50cm x 100cm spacing, preferably with irrigation or at the beginning of the wet season. They should be kept free of weeds and it is recommended that they are weeded four and eight weeks after planting. Harvesting should be after three to four months compared with the local varieties at eight to nine months. Irrigation will allow for planting and harvesting all year round.

***Storage***

High yielding sweet potato clones do not store well in the ground. Unlike local varieties, roots of Hohrae 1, 2 and 3 should be harvested at three to four months or when the soil cracks above the tuber. Their large roots often break the soil surface exposing the tubers to weevil damage. Soil cracks allow sweet potato weevils to enter the soil and thereby attack the tuber. Once weevils attack the tuber, the sweet potatoes become very bitter and cannot be eaten, even by pigs. The tubers should be stored in low temperatures with high humidity. Hohrae sweet potatoes can be stored for up to three months.

***Disease and insect pest reaction***

Hohrae 1, 2 and 3 are susceptible to the sweet potato weevil when not completely buried. It is also susceptible to the fungus disease leaf scab and the Mycoplasma causing little leaf. Plants showing little leaf symptoms should be removed from the paddocks and burnt. Leaf scab causes the young leaves to curl upwards standing above the rest of the leaves. It is not known to cause a reduction of yield.

***Herbicide reaction***

Herbicides are not used on sweet potatoes in Timor-Leste

***Farmer acceptability***

Taste, especially sweetness, is more important than yield in the selection of sweet potato clones by many farmers (SoL, 2007). In 2007, Hohrae 1 was reported to be the sweetest and most preferred variety. There was no difference in taste or preference between men and women farmers. In 2008, Hohrae 1 was again the sweet potato variety most farmers indicated they would prefer to plant. The data from 2007 and 2008 suggest that this variety was a consistently high yielding and good eating sweet potato. There was an inconsistency from District to District, with some farmers preferring different flavours. Hohrae 1, 2 and 3 are all considered to be sweet compared with local varieties and were, on average, preferred varieties for planting.

***Economic benefits***

Cuttings of Hohrae 1, 2 and 3 are in high demand because of their good yield and sweet tubers. A premium is currently paid to seed producers for cuttings. The market for sweet potatoes is not fully developed; however there is a competitive advantage to growing sweet varieties with large sized roots. Surveyed farmers in Baucau District make sufficient funds from the sale of Hohrae varieties to purchase items for their house and educate their children (see Section 4 above and (Table 164).

**Table 164. Yields and saleable amounts of sweet potato**

| *Name* | *District* | *Village* | *Roots sold (kg)* | *Income ($)* |
|---|---|---|---|---|
| Palmira Eliza Soares | Baucau | Ostico | 1470 | 380.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 875 | 100.0 |
| Alberto Caldeira da Silva | Liquica | Triloka | 455 | 78.0 |
| Zeferino Mirabela | Liquica | Triloka | 12.5 | 45.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 490 | 70.0 |
| Martinha Boavida | Baucau | Ostico | 420 | 60.0 |
| Constancio Da Costa | Baucau | Ostico | 175 | 35.0 |
| Juvita Da Costa Freitas | Baucau | Ostico | 280 | 60.0 |
| Henriqueta | Baucau | Bucoli | 6 | 6.0 |
| Carlos da Costa Freitas | Baucau | Gariwai | 420 | 60.0 |
| Manuel Caso | Liquica | Varuvou | 7 | 7.0 |
| Martina Boavida | Baucau | Ostico | 210 | 30.0 |
| Cipriano Martins | Aileu | Malere | 125 | 50.0 |

### *Social benefits*

Farmers are already benefitting from the high yielding Hohrae varieties through the sale of surplus production, especially in Baucau. As a result, the education standards of these farmers' children are improving. In addition, the higher Vitamin C levels in Hohrae varieties will improve the health of the farmer and his family. The risk level of growing improved clones is similar to that of growing traditional varieties.

### *Environmental impacts*

The introduction of three new sweet potato varieties will improve the genetic diversity within Timor-Leste. None of the new clones are genetically modified organisms (GMO) using recombinant DNA technology and thus will not introduce any undesirable traits to the environment. Sweet potatoes tend to be environmentally friendly because of the low inputs required, especially nitrogen. They also grow quickly and cover the ground surface thus preventing erosion.

### *Seed production*

Twenty thousand cuttings of Hohrae varieties were distributed in 2008. At least four-fold this number will be available in 2009 for distribution.

### 8.1.4 Rice

**Nakroma**

***Variety Information***

Botanical Name: *Oryzae sativa L.*
Suitable Environment: Irrigated rice areas
IRRI Elite Name: IRRI 116
Designation: IR60819-34-2-1
Parents: IR72/IR48525-100-1-2
Breeder: International Rice Research Institute (IRRI)
Released Name: Released for use in the Philippines in 1997 as PSBRc54. Officially released by the MAF for use in Timor Leste in March, 2007 as Nakroma.

Nakroma is a lowland rice variety bred at the International Rice Research Institute (IRRI) by crossing the released variety IR72 with the breeding line IR48525-100-1-2. It was released in the Philippines by the Philippine Seed Board as PSBRc54 in 1997. The variety was evaluated in replicated trials in Timor-Leste with the designation PSBRc54 during 2000-2004. It showed potential in the trials and farmers appreciated its attributes as a consistent yielding variety suited to the irrigated lowlands. It was also recognized as being a good tasting addition to their current selection of rice varieties. Farmers commenced seed multiplication during the 2003/2004 wet season and in 2005/2006 seven hectares of seed was produced for sale in Baucau District. Nokrama was officially released by the MAF in 2007.

***Description***

The following general characteristics of Nakroma are based on the national testing program of the Philippines.

| | |
|---|---|
| Yield (t/ha) | |
| Dry season | 4.4-4.9 |
| Wet season | 4.6-5.0 |
| Maturity (no. days after sowing) | |
| Dry season | 113 |
| Wet season | 113 |
| Plant height (cm) | |
| Dry season | 86 |
| Wet season | 96 |
| No. productive tillers (no./hill) | |
| Dry season | 15 |
| Wet season | 15 |
| Reactions to: | |
| Blast | Resistant |
| Bacterial blight | Intermediate |
| Sheath blight | Intermediate |
| Tungro | Resistant |
| Stemborer (deadhearts) | Susceptible |
| Stemborer (whiteheads) | Intermediate |
| Green leafhopper | Moderately susceptible |
| Brown planthopper 1 | Intermediate |
| Brown planthopper 2 | Intermediate |
| Brown planthopper 3 | Resistant |
| Grain quality | |
| Brown rice recovery (%) | 78.4 |
| Milling recovery (%) | 69.1 |
| Head rice recovery (%) | 43.1 |
| Amylose content (%) | 22.5 |
| Protein (%) | 7.5 |
| Gel consistency (mm) | 54.6 |

### *Yield and grain quality*

Nakroma was one of the 14 high yielding varieties tested against the local variety Nona Portu and the popular improved variety IR 64 in replicated trials conducted by the SoL program in Timor-Leste between 2001 and 2004. Rice trials were difficult to conduct during this period and later because MAF research stations are not located in the lowlands. Despite being the highest yielding variety, variability was high and significant differences were unattainable. In 2008, an average small difference of 5% was measured (Table 165).

**Table 165. Nakroma yield advantages, research stations, 2001-2008**

| | *Yield (t/ha)* | | *Yield advantage* |
|---|---|---|---|
| *Year* | *Nakroma* | *Local* | *%* |
| 2001-2005 | ns | ns | ns |
| 2006 | na | na | na |
| 2007 | na | na | na |
| 2008 (Two sites) | 2.2 | 2.1 | 5 |
| *Mean (2006-2008)* | 2.2 | 2.1 | 5 |
| *Mean (2001-2008)* | 2.2 | 2.1 | 5 |

In on-farm testing in the 2005/06 season, Nakroma was successfully evaluated in 47 locations. The average yield for Nakroma was 3.3 t/ha compared to 2.9 t/ha for the local rice. Nakroma gave an average yield advantage of 17% above the local rice varieties tested.

As a result, farmers requested its seed for multiplication and cultivation. This variety is considered by farmers to have good eating quality and its grain possesses good milling quality.

In 2007 and 2008, yield advantages over the locally used variety were 20% and 30% respectively. On average over 175 sites spread over three years the yield advantage of Nakroma was 23% (Table 166)

**Table 166. Nakroma yield advantages, OFDTs, 2006-2008**

| *Year* | *Yield (t/ha)* | | *Yield advantage* |
|---|---|---|---|
| | *Nakroma* | *Local* | *%* |
| 2001-2005 | na | na | na |
| 2006 (47 sites) | 3.3 | 2.9 | 17 |
| 2007 (52 sites) | 3.6 | 3.0 | 20 |
| 2008 (76 sites) | 4.8 | 3.7 | 30 |
| *Mean 175 sites (2006-2008)* | 3.9 | 3.2 | 23 |

Farmers grow Nakroma for a number of reasons ranging from grain size to fragrance and yield (see Section 4 and Table 167). According to collaborating rice farmers, Nakroma possesses characteristics that attract consumers to buy it. These characteristics include its white, fragrant, oily grain. Its good tillering ability, even crop height and high yields are also criteria for selection (Table 167). Farmers reported that many of their neighbours who were not involved in the program asked for seed to plant in their rice fields.

**Table 167. Farmer's preferences for Nakroma**

| *Name* | *Village* | *Preferences* |
|---|---|---|
| Fernando Kolimau | Sarin | Large, fragrant grain, similar height plants |
| Antonio Hornai | Betano | High yields, fragrant, oily, similar height |
| Ernesto da Costa Freitas | Buruma | Large, fragrant grain, similar height plants |
| Regina Amaral | Uma nai iku | Produce many tillers, high yields |
| Domingos | Sarin | Similar height, fragrant |
| Augusto Da Silva | Sarin | High yields |
| Maria da Costa | Sarin | White colour seed, high yields |

Rice food preparation times are described in SoL, 2007. In one trial, grain of Nakroma was pounded, cooked and tasted by six farmers from four Districts. Two farmers were from Aileu and Baucau and one each from Liquica and Manufahi. Two traditional methods of pounding were used. The first method used two rocks. On one flat rock was placed two to three seeds which were pounding with a rock to crush them. The second method of pounding used a hollowed out log (mortar). A pole was used to pound the grain.

Five hundred grams of seed was provided to the farmers and the time taken to pound this quantity was recorded. The pounding processes involved grading the rice flour into three grades, two of which were cooked, and the third roughest grade given to animals.

For cooking, the roughest grade of grain was boiled first and the following finer grades added to the pot for cooking several minutes after. The rice was cooked into a porridge of a dry texture called *sasoro* and then tasted by farmers. Farmers were asked to comment on whether the food was *mamar* (soft), *midar* (sweet), *belit* (chewy/sticky), *to'os* (hard), *morin* (fragrant) or *mina* (oily).

The average time taken to pound and cook rice grain are presented in Table 168. An analysis of variance indicated there were no significant differences between the varieties tested for any of the pounding or cooking traits.

**Table 168. Times taken to pound and cook rice varieties.**

| | *Time to pound rice in a mortar (minutes)* | *Cooking rice pounded with in mortar (minutes)* |
|---|---|---|
| *Local rice* | 23.0 | 41.5 |
| *Nakroma* | 18.0 | 30.0 |
| | ns | ns |

After cooking, the rice was evaluated for taste and other characteristics (Table 169).

**Table 169. Significance of taste characteristics of rice varieties**

| | *Soft eating* | *Sweet* | *Chewy* | *Hard* | *Fragrant* | *Oily* |
|---|---|---|---|---|---|---|
| *Rice* | ns | ns | ns | Significant | ns | Significant |

The results in Table 169 indicate that there were significant differences for farmer characterization for seed hardness and seed oiliness ('mina') in rice varieties. Table 170 also indicates highly significant results for taste characteristics 'hardness' and 'oiliness' in rice. While all farmers considered local rice varieties tested to have a 'hard' texture while eating, no farmers considered Nakroma to be hard. Also no farmers described local rice as oily however all farmers considered Nakroma as oily.

**Table 170. Number of farmers characterizing rice as hard and oily**

| | *Hard* | *Oily* |
|---|---|---|
| *Local Rice* | 100% | 0% |
| *Nakroma* | 0% | 100% |

### *Agronomic adaptability*

Nakroma is a high yielding, photoperiod insensitive rice variety suited for irrigated or low risk rainfed lowland areas. Plant density is best at 20 cm, placed between hills and with the transplanting of seedlings at three weeks or younger. Seedlings should be transplanted or directly seeded into well prepared soil that is free of weeds and is flooded during the growing period. In Timor-Leste the crop matures after approximately 115 days. Plant height in Betano during 2002 was 94cm. Nakroma has not been specifically tested for allelopathic traits. Being a high yield ing variety (HYV) of medium height, it is susceptible to weed infestation. It does not shed seed excessively and can be threshed either by hand or machine.

***Disease and insect pest reaction***

Nakroma shows resistance to blast, tungro and several other pests and diseases found in Timor-Leste (see Description table above). It also matures at a similar rate to other high yielding varieties currently cultivated in Timor-Leste thus reducing its susceptibility to rat damage.

***Herbicide reaction***

Nakroma was not selected specifically for herbicide tolerance and is susceptible to grass herbicides.

***Economic benefits***

Nakroma is being cultivated by an increasing number of farmers, many of whom sell their product at a slight premium. Farmers who sold their grain generally used the money to buy more food (one farmer purchased rice) while others paid school fees, bought clothing and equipment or saved for future needs (Table 130, Table 171).

**Table 171. Use of cash earned from selling Nakroma rice**

| *Name* | *Village* | *Amount of money obtained ($)* | *Household needs covered* |
|---|---|---|---|
| Fernando Kolimau | Sarin | 35.0 | Bought 1 pig and 1 chicken |
| Antonio Hornai | Betano | 25.0 | Paid children school fees, paid labour for planting, harvest and threshing |
| Ernesto da Costa Freitas | Buruma | - | Shared the yields with group member |
| Regina Amaral | Uma nai iku | 305.2 | Bought coconut grater machine |
| Antonio Hornai | Betano | 21.0 | Paid children's school fees |
| Domingos | Sarin | 17.5 | Bought cheaper rice |
| Augusto Da Silva | Sarin | 23.8 | Bought children's clothes |
| Maria da Costa | Sarin | 18.0 | Bought food |

***Social benefits***

Cultivation of Nakroma provides one extra variety to diversify the selection for Timorese farmers thereby reducing risk. Risk is also reduced by the introduction of tungro and blast resistance to Timorese farms. Its consistent yielding characteristics may lead to improved food security. Farmers who produce surpluses by growing this HYV also improve the education of their children from the sale proceeds.

***Environmental impact***

Nakroma originated from the IRRI 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 undesirable traits to the environment. Nakroma will increase the diversity of the current genetic pool in Timor-Leste.

***Seed production***

Five tons of good Nakroma seed was produced during 2008 and was ready for distribution at the end of the year. Because of the high demand for this variety approximately 35 hectares of seed will be grown in 2009.

## 8.2 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 Suwan 5 are well adapted over all testing regions. There is no indication that Sele or Suwan 5 should be recommended in some areas and not others. However at the Maliana research site, Sele did demonstrate significant drought resistance at high plant density, by having a low percent of barren plants.

**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 during the 2006/2007 wet season indicated that velvet bean will need to be planted after maize to avoid smothering the crop during the wet season. These results were supported by trials conducted in 2007/2008. 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).

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